SAMOA

STATE OF THE ENVIRONMENT REPORT 2023

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

UN environment programme

SPREP PROE

Sustainable, transformative and resilient for a Blue Pacific

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SAMOA

STATE OF THE ENVIRONMENT REPORT 2023

Honourable Minister
Toeolesulusulu Cedric Posē Salesa Schuster
Minister of Natural Resources and Environment

Foreword

Reviewing and reporting on the state of the environment of Samoa is an important part of the government's mandate for achieving environmentally sound and sustainable development. The Ministry of Natural Resources and Environment (MNRE) is entrusted with the responsibility of coordinating the monitoring and review of the state of Samoa's environment with the cooperation and support of its stakeholders in line Ministries, Non-Governmental Organisations and the wider community.

The last comprehensive Third SOE report for Samoa was completed and published in 2013, providing a holistic understanding of the trends in the natural and built environments given the issues of climate change and disasters, population growth and Samoa first completed and published its comprehensive SOE report in 1993 and the second in 2006. The review conducted provides a holistic understanding of the trends in Samoa's natural and human environments under the influence of economic, social and environmental forces over the reviewed period is fundamental to the determinants of future responses to these changes. The findings outlined in the report also indicates the level of effectiveness of policy and educational measures put in place to cope with the consequent impacts of these changes. It is also designed to improve environmental monitoring, education and training amongst decision makers and the general public

Samoa is among nations with the highest level of vulnerability to natural and anthropogenic changes, particularly the impacts of climate change. The latter being forecasted (IPCC 6) to become more pronounced this century. These requirements are further urged by both the projected long term global climate change impacts, as well as the increasing short to medium term impacts of variable weather patterns affecting the country, such as extended drought periods and frequent occurrence of severe cyclone.

In this Fourth SOE Report, the Ministry adopted the Drivers-Pressures-State-Indicator-Response (DPSIR) Framework to assess the four main Thematic Areas namely the Natural Environment, Built Environment, Atmosphere & Climate Change and Environment Governance. Each theme comprises of several indicators that are assessed accordingly based on the tool used. It is the hope of the Government through the MNRE, that the State of the Environment Report will enhance decision making for environmental protection and sustainable development at all levels of Samoa's economy. It is our hope that this edition of Samoa's SOE will attract attention that is due to the seriousness of environmental issues existing at national and local levels, as well clear doubts that hamper the positive progression of national initiatives in addressing these issues. Moreover, the information herein contained will bring about creative interest from our young generation and the general public to be more involved and take responsibilities for current and future environment management decisions.

Producing the 2023 SOE Report is one of the highlights that showcase the outcomes of management actions over the past years. However, the real highlight is the working collaboratively as a nation with various stakeholders to make the changes for the benefit of the environment and communities. Even the most challenging of environmental issues can be overcome through collective actions and good leadership. The outcomes of the 2023 SOE Report will inform the National Environment Sector Plan 2023-2027

Conserving Samoa's unique environment is our collective responsibility as decision-makers, professionals, teachers, stewards and advocates to ensure that we meet the challenges and bequeath a better future to our children.

Mr. Sefanaia Nawadra
Director General
Secretariat of the Pacific Regional Environment Programme

Message from SPREP

The natural environment has always been part of our Pacific island cultures. It has shaped and influenced our way of life over centuries, providing many resources that have fed, clothed and kept us safe. As our population grew, we began to shape and influence our natural environment. We cut down trees to make way for our expanding families, we tilled more land to grow crops, and we harvested more fish than we can eat, so we can sell them to provide for our families and our nations.

Our economic growth is seen as the solution to lift our countries and people out of poverty. We export and import goods, and we adopt new ways and new technologies, as we embrace globalisation. Our once small carbon footprints are added to those of bigger nations, causing our climate to change. The increasing temperatures, droughts, heavy rainfalls and floods, and severe tropical cyclones are adversely impacting our natural environment. How much more can Mother Nature take from the relentless pressure that we exert on her? How can it sustain us, sustain our communities and our traditions and cultures?

The people of Samoa, and the Government of Samoa recognise this challenge. This state of the environment report is the fourth health check report on Samoa's natural environment. It identifies the drivers behind the changes that are happening to the natural environment. The report focuses on four thematic areas – (i) natural environment, (ii) built environment, (iii) atmosphere, climate and disasters; and (iv) environmental governance, using over 50 indicators.

SPREP is pleased to have partnered with the Ministry of Natural Resources and Environment, in developing this report. The engagement of the many local agencies and stakeholders has improved the quality of the report. I sincerely thank the individuals and all the government ministries and departments for their contributions. It is important that regular assessments of the environment are carried out. I encourage you all to use this report to help track, manage, plan and report on our natural resources and the environment.

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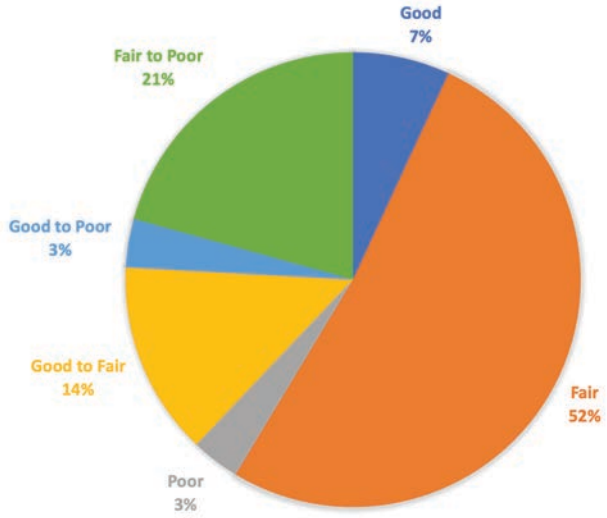
Executive Summary

The State of the Environment Report 2023 provides the most recent health check on the threats, state and impacts on Samoa's environment. The report builds on previous SOE reports (1993, 2006 and 2013). The SOE 2023 uses the DPSIR (Drivers, Pressures, State, Impact and Response) framework. The SOE report assessed four thematic areas and 50 indicators and sub-indicators. Consultations with various government and non-government organisation stakeholders provided the data and information used in the assessment.

Environmental Drivers and Pressures

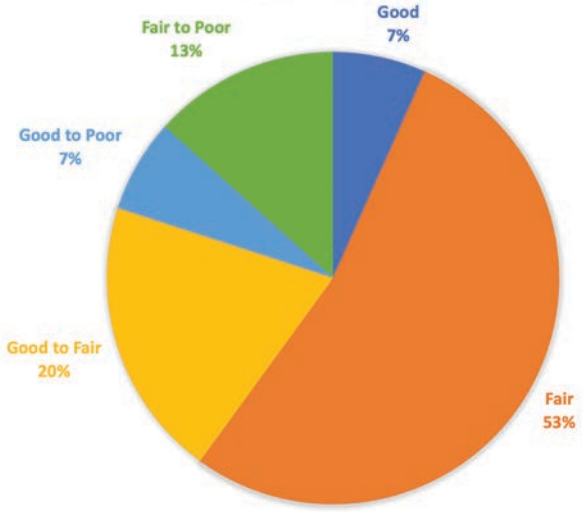
Five key drivers that are causing environment change for Samoa are the increasing population, climate change, economic and technological development, global economics and geographic constraints, and culture values and traditions. These have led to environmental pressures for Samoa, such as land use, climate variability and disasters, resource use, consumption and waste generation, agriculture and rural development, and invasive species.

Samoa's state of environment



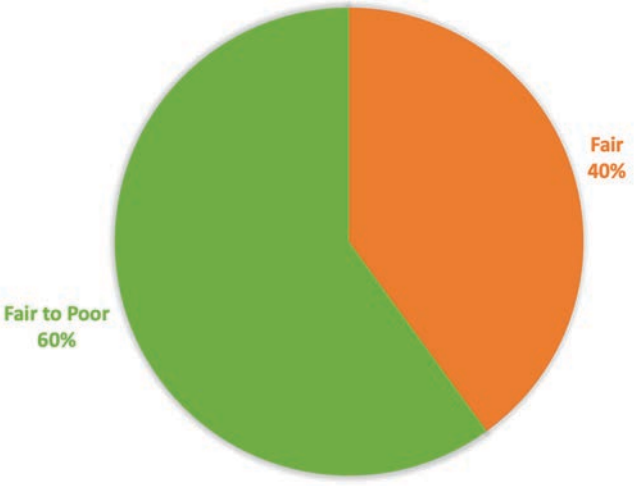
The overall state for Samoa is Fair (52%). Only 7% of the indicators were in Good state. When assessing each of the thematic areas, most were in transition with the exception of the Atmosphere, Climate and Disaster Management, where the state was Poor with one indicator in Good state.

Natural environment



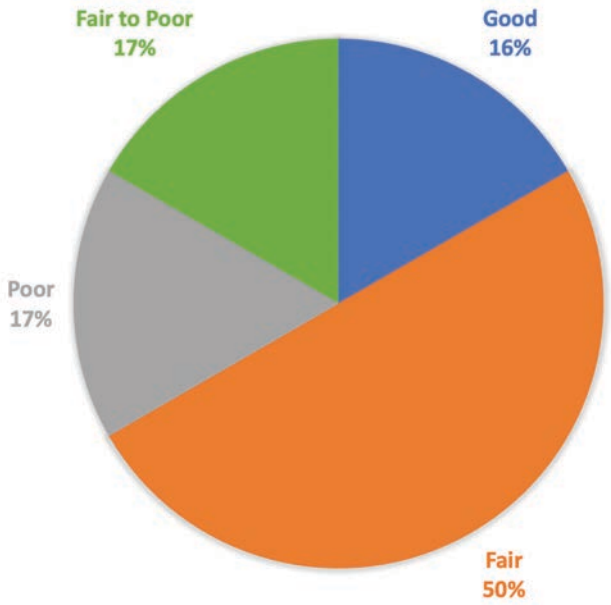
The state of the terrestrial, and the marine and coastal environments are a mixture of good, fair and poor. The trends are mixed, with some improving, others not. The continuous threat to Samoa's biodiversity, especially endemic and native species, is of concern despite efforts to protect them. The confirmation of the extinction of the Samoa woodhen (Gallinula pacifica), and the ongoing threat to the Manumea (Didunculus strigirostris) highlight the need to do better and to do more. Wetlands, coral reefs and forests are important habitats for many of Samoa's species, yet large areas of these habitats have been degraded and lost due to human activities. Conservation and protected areas are established throughout the country, and community engagement and awareness on the importance of these conservation sites are improving. Management plans are available for some of the conservation sites, as well as for a number of threatened species. National policies are also available including the Ocean Strategy. The challenge remains with regards to implementation of the plans, the enforcement of legislation and the monitoring of these sites. Resources and capacity are needed to address some of these challenges.

Built environment



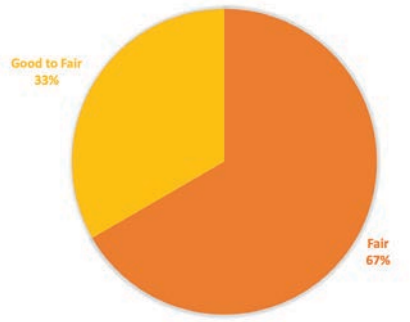
The built environment is mostly in a fair to poor state and urgent actions are needed to arrest further deterioration of this thematic area. The trends for access to potable water and environmental compliance are positive, whereas sanitation and waste management include some areas that are trending positive and others needing interventions. The waste management indicator is a concern, especially with regards to recycling and repurposing some of the waste resources. If all of the wastes are being dumped and not recycled, it will shorten the lifespan of the existing waste management site at Tafaigata to nine years. There continues to be improvement in terms of access to improved sanitation for many households. However, there are still many toilet facilities that are inadequately built or maintained and are causing contamination to the environment. The Apia urban area entices many people living in rural areas to migrate to Upolu. Many settled on the northwest of the island, within easy access to Apia. Unfortunately, the high concentration around Apia and peri-urban areas are placing the environment and resources in severe stress. Awareness on environmental compliance has improved considerably and more people are seeking approvals for their activities, or are lodging complaints regarding non-compliance with existing projects. National policies are in place to manage these issues, however, the challenge of resources and capacity especially in enforcement and monitoring are hindering the effectiveness of these policies.

Atmosphere, climate and disasters



The six indicators under the thematic area covered a broad range of environmental issues. Samoa's Greenhouse Gas emissions remain small and efforts to address the main emission source (energy) are being addressed through the uptake of renewable sources to replace fossil fuel. The most serious of ozone depleting substances (the CFC) has been phased out, and efforts to phase out others (HCFC and HFC) are ongoing. Samoa's main energy source comes from fossil fuel (70%). A national target of 71% renewable sources into the grid by 2031 remains achievable provided the rate of renewables increases by 2-3% per annum. Samoa's physical climate continues to track according to projections and modelling by the Commonwealth of Science, Industrial Research Organisation (CSIRO), the Australian Bureau of Meteorology (BOM) and other climate research institutions. Temperatures will continue to increase bringing more hot days for Samoa. Sea level rise is at 5.2 mm per annum and will continue to increase to 170 mm by 2030. Ocean acidification data are still being gathered. Rainfall projections remain unclear, but rainfall intensity is likely to be more severe. Natural disasters that are associated with geological processes have occurred over millennia and their impacts to the environment can be catastrophic. Climate driven natural disasters are becoming frequent due to climate change. Their impacts are costly to the economy, environment and to the lives of the people. Samoa's response to climate change and natural disasters is through adaptation and mitigation programmes of action. A national coordination framework is in place that is active and is responding to national emergencies.

Environmental governance



Environmental governance theme covers three indicators focusing on funding to the environmental sector, reporting to multilateral environmental agreements (MEAs) and gender equity and equality. The government's annual funding remains consistent over the last decade (between SAT 20 to 27 million), which covers operational, key personnel salary and some capital costs. External funding is the main source that enables the implementation of many of the environmental projects. About USD 100 million of external funds were used for environmental and climate change projects over the last few years. Samoa is a member of 24 MEAs. Some of the MEAs require regular reporting on national progress. About 50% of the MEAs have their reporting requirements met on time, the reports for other MEAs are not required or are outdated. There are still some gaps on gender equity in the environmental sector. Seventy-two per cent of all environmental employees are male, however, some of the sections within the Ministry are dominated by female employees, such as the legal service, energy sector, disaster management office, corporate services and the environment unit. Some of the roles that were traditionally perceived as 'male', such as field and outdoor work, are now seeing more females participating in it.

Recommendations

Many recommendations are specific to each of the indicators and sub-indicators assessed. Specific recommendations that are common throughout the various indicators are summarised below and provides the big picture recommendations that should be addressed through a sector-wide approach.

- Regular monitoring and data collection need to be prioritised and implemented. The value of having accurate data is critical when making policy decisions and development management plans. Data will help with understanding the state of the environment over time.
- Securing resources and building the staff capacity are key to achieving success in programmes and project implementation. This will require developing a strategy to entice and secure resources, and identify areas where capacity is needed, and where assistance can be sourced.
- Developing a digital visual library, where satellite and other imageries can be stored, provides strong evidence on environmental changes to the landscape. This would assist the authority in developing actions and response plans. Some of these are already in place, but they need to be coordinated under a single metadata base.
- Review environment-related plans across the various sectors, so that progress can be tracked and lessons learned can be shared. The state of environment reports often require the input of many sectors, including agriculture, fisheries, health, education, police and judiciary, cultural institutions and tourism. Each of these sectors have a role to play in the environment and therefore should be key stakeholders in the SOE reporting process.
- There is a benefit in understanding and tracking community-based and driven projects. This will provide a holistic picture of all environmental projects, outcomes and achievements throughout the country. Given the role of the Ministry of Natural Resources and Environment (MNRE) in leading SOE reporting, it is the natural focal point for such a repository of information.
- Strengthen and encourage the support (both financial and capacity building) for community engagement and co-management of projects, natural resources and environment. This approach gauges the buy-in and ownership of communities that are critical for effective implementation, enforcement and management of the environment.
- Invest in continuous research to enhance monitoring and evaluation, and to inform effective management of natural resources and the environment. Advanced research provides updated and real time local data and information that will assist with enhancing Samoa's national reporting obligations to MEAs, as well as inform policy and decision making across sectors.
- Scale up efforts to strengthen the enforcement of laws and legislations governing the management of resources and the environment, to ensure compliance and secure protection and sustainable management of natural resources.
- Continue and increase efforts to raise the awareness of the public and promote the importance of environment conservation and sustainable management of resources. Effective awareness programmes must also be tailored towards building and complementing the understanding and knowledge of the communities in environmental protection and governance, as well as integration into the school curriculum to nurture the interest amongst the younger generations.

Acknowledgements

The State of the Environment (SOE) Report 2023 has been made possible through the hard work and invaluable contributions of our stakeholders and partners. We thank you for your time, commitment and support. We acknowledge with gratitude the ongoing support of SPREP in particular the Environment Monitoring Governance team through the INFORM Project and the UN Joint Programme for Ecosystem Services for financial support. Lastly we acknowledge with much appreciation the technical assistance of Dr. Posa Skelton in the final preparation of the Report.

Faafetai tele lava.

Acronyms

ADB	Asian Development Bank
ADO	Automotive Diesel Oil
ADRA	Adventist Development and Relief Agency
AFOLU	Agriculture, Forestry and Other Land Use
AOSIS	Alliance of Small Island States
BOM	Bureau of Meteorology (Australia)
BPoA	Barbados Plan of Action (1994)
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CEAR	Comprehensive Environmental Assessment Report
CFCs	Chlorofluorocarbons
CITES	United Nations Conference on International Trade in Endangered Species of Wild Flora and Fauna
CME	Compliance Monitoring and Enforcement
CROP	Council of Regional Organisations of the Pacific
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAC	Disaster Advisory Committee
DCA	Development Consent and Approval
DEC	Division of Environment and Conservation
DMO	Disaster Management Office
DPK	Dual Purpose Kerosene (Jet Fuel)
DPSIR	Drivers, Pressures, States, Impacts, Response model of SOE reporting
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Niño Southern Oscillation
EPC	Electric Power Corporation
EpiNET	Regional Exposure Prevention Information Network
ESCAP	Economic and Social Commission for Asia and the Pacific
FAL	Fire Attack Level
FAO	Food and Agriculture Organisation of the United Nations
FDI	Fire Danger Index
FFA	Pacific Islands Forum Fisheries Agency
FRA	Forest Resources Assessment
FW & WW	Fuelwood and Wood Waste
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEF-PAS	Global Environment Facility Pacific Alliance for Sustainability
GHGs	Greenhouse Gases
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IBAs	Important Bird Areas
ICT	Information and Communication Technology
IEA	Integrated Environmental Assessment
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISSG	Invasive Species Specialist Group
IUCN	International Union for the Conservation of Nature
IUCN SSC	International Union for the Conservation of Nature

	Species Survival Commission
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
J-PRISM	Japan's Project for Promotion of Regional Initiative on Solid Waste Management
KBA	Key Biodiversity Area
KIOST	Korean Institute of Ocean Science and Technology
LDD	Land Degradation and Drought
LDN	Land Degradation Neutrality
LMMA	Locally Managed Marine Areas
LPG	Liquefied Petroleum Gas
MAF	Ministry of Agriculture and Fisheries
MARPOL	International Convention for the Prevention of Pollution from Ships
MDG	Millennium Development Goal
MEA	Multilateral Environmental Agreement
MEPS	Minimum Energy Performance Standards
Mogas	Motor Gasoline (Unleaded Petrol)
MNRE	Ministry of Natural Resources and Environment
MOU	Memorandum of Understanding
MRV	Monitoring, Reporting and Verification
MTI	Marine Trophic Index
MWTI	Ministry of Works, Transport and Infrastructure
NAP	National Action Programme
NAPA	National Adaptation Programme of Action
NBSAP	National Biodiversity Strategy and Action Plan
NEOC	National Emergency Operation Centre
NFI	National Forest Inventory
NGO	Non-Government Organisation
NISSAP	National Invasive Species Strategy and Action Plan
NRM	Natural Resource Management
NZAID	New Zealand Agency for International Development
ODA	Official Development Assistance
ODS	Ozone Depleting Substance
OLSSI	O Le Siosiomaga Society Incorporated
PA	Protected Area
PABITRA	Pacific-Asia Biodiversity Transect Network
PACC	Pacific Adaptation to Climate Change
PACLII	Pacific Islands Legal Information Institute
PBIF	Pacific Biodiversity Information Forum
PCCSP	Pacific Climate Change Science Programme
PDS	Pathway for the Development of Samoa
PEAR	Preliminary Environmental Assessment Report
PEIN	Pacific Environment Information Network
PGRFA	Plant Genetic Resources for Food and Agriculture
PICCAP	Pacific Islands Climate Change Assistance Program
PICTs	Pacific Island Countries and Territories
PIFACC	Pacific Islands Framework for Action on Climate Change
PIFL	Pacific Islands Forum Leaders
PIFS	Pacific Islands Forum Secretariat
PIGGAREP	Pacific Islands Greenhouse Gas Abatement Renewable Energy Project
PIP	Pacific Invasive Partnership
PIREP	Pacific Islands Renewable Energy Programme
PIRMSP	Pacific Islands Regional Marine Species Programme
PIROP	Pacific Islands Regional Ocean Policy
PIRT	Threatened Species Working Group of the Pacific Islands Round Table for Nature Conservation
POP	Persistent Organic Pollutants
PPACC	Pacific Partnership for Adaptation to Climate Change
PUMA	Planning and Urban Management Agency
RCP	Representative Concentration Pathway
RE	Renewable Energy
REDD	Reduced Emissions from Deforestation and Degradation
SBS	Samoa Bureau of Statistics

SDG	Sustainable Development Goal
SCCF	Special Climate Change Fund
SCS	Samoa Conservation Society
SIDS	Small Islands Developing States
SLM	Sustainable Land Management
SMSMCL	Strengthening Multi Sectoral Management of Critical Landscapes
SOE	State of Environment
SPC	Secretariat of the Pacific Community
SPCZ	South Pacific Convergence Zone
SPFF	South Pacific Forum Fisheries Convention
SPREP	Secretariat of the Pacific Regional Environment Programme
SPRIG	South Pacific Regional Initiative on Forest Genetic Resources
SWB	Special Weather Bulletin
SWMPOR	Solid Waste Management Project in Oceania Region
TJ	Terajoule
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of Sea
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNU-IAS	United Nations University - Institute of Applied Sciences
UNWTO	United Nations World Tourism Organisation
USP	University of the South Pacific
VDCRM	Village Disaster and Climate Risk Management
WALS	Water Abstraction Licensing Scheme
WCPFC	Western and Central Pacific Fisheries Commission
WDPA	World Database on Protected Areas
WHC	World Heritage Centre
WHO	World Health Organisation
WMP	Watershed Management Plans
WWF	World Wide Fund for Nature

SECTION 1: Introduction

Introduction

Located 2,900 km northeast of New Zealand, and 4,200 km southwest of Hawaii, independent Samoa is a small island country that makes up the Samoa Archipelago (with American Samoa – a United States unincorporated territory). Independent Samoa (referred to as Samoa hereon) lies between the latitudes of 13-15° South and Longitude 168-173° West. There are four main islands that are inhabited and several small uninhabited islands. Savaii is the largest island, whereas Upolu is where most of the population reside, as well as the administrative capital of the country Apia (Figure 1). Samoa's total land area has contracted due to rising sea levels and coastal erosion, losing around 89 km^2. The current total land area is 2,846 km^2 (MNRE 2022).

Figure 1: Map of Samoa (Picture credit: GISGeography.com)

Samoa is an oceanic volcanic archipelago that originated in the Pliocene. The islands were formed in a westerly direction with the oldest eruption, the Fagaloa volcanoes, on the eastern side. The archipelago is still volcanically active, with the last two eruptions being in 1760 and 1905-11 respectively. Much of the country is mountainous; 40% of Upolu and 50% of Savaii are characterised by steep slopes, descending from volcanic tops with montane forest. The highest point is Mount Silisili (1,860 m) on Savaii island, and on Upolu island, the highest point is at 1,100 m (MNRE 2022).

Samoa's climate is hot and wet with a dry season (April to November) and a wet season (December to March). The southeast trade winds cause rain shadow areas in the north west parts of the main islands, as well as the southeast side of Savaii. Annual rainfall is about 3,000 mm (range of 2,500 mm to 6,000 mm), with most of the rainfall occurring during the wet season. The rapid changes due to climate change have caused a noticeable change in weather patterns, especially with regards to the wet and dry seasons, which are no longer following the traditional patterns. Tropical cyclones are common in Samoa, although many pass the archipelago with limited to no impacts; however, some devastating severe tropical cyclones have hit the country, the most recent being Cyclone Evan in 2012.

Samoa's population was 205,557 in 2021 (Samoa Bureau of Statistics 2022) residing in about 330 villages mostly along the coast (MNRE 2022). The majority of the population lives on Upolu island, with only 22% residing in Savaii. A big proportion of the population resides along the northwest coast side of Upolu island. The capital Apia, home to the main international seaport, continues to expand and absorb the fringes around the north-central area of Upolu island. Salelologa is the main urban area on Savaii island, and is located on the southeast coast. Migration from rural and remote areas to urban areas (but mostly to Apia) is common, as people seek education and work opportunities for their families. The median age of Samoans is 22 years. On average more males are born per annum (51%) than females (49%). The life expectancy is 74 years for males, and 77 years for females (SBS 2022).

Samoa's real Gross Domestic Product in 2020 was SAT 2,033,270 million. The nominal per capita GDP was SAT 11,056.3 for 2020. The COVID-19 pandemic has had an adverse impact on the country's GDP with a 4.2% decline for the first quarter of 2020, compared to 2019. The average inflation rate to January 2023 was 11% (SBS 2023), which is a big increase on the 2022 inflation rate of 4.5%, and 2021 at -2.4% (SBS 2022).

Environmental Reporting

The Ministry of Natural Resources and Environment (MNRE) oversees the protection, conservation, and sustainability of Samoa's environment in partnership with local communities, civil society groups, the private sector, government agencies and development partners. A crucial part of this mandate is monitoring Samoa's state of the environment (SOE) on a regular basis.

This is the fourth State of the Environment Report for the country with previous reporting in 1993, 2006 and 2013. The SOE reports have led to the development of Samoa's management strategies, including the first released in 1993.

State of the Environment Report 1993 and the National Environment Management Strategy 1993:

The NEMS 1993 prioritised 12 major environmental issues following the completion of the 1993 SOE.

- **I.** unsustainable population growth
- **II.** management of water resources
- **III.** management of sea and marine resources
- **IV.** waste management
- **V.** combating deforestation
- **VI.** management of land use
- **VII.** conservation of biological diversity
- **VIII.** atmospheric protection
- **IX.** planning for climate change
- **X.** preservation of traditional arts, culture and history
- **XI.** human resources development
- **XII.** sustainable economic development.

State of the Environment Report 2006

The second SOE included an assessment of state and trends of the environment in the key areas of climate change and ozone; coastal and marine resources; water resources; land resources; forestry resources and biodiversity resources. A feature was the inclusion of an assessment of cross-cutting issues such as poverty, health, trade, disaster management, population growth and urbanisation, culture, energy, tourism and agriculture. This work was at the juncture of the regional PRISM programme where CROP and national agencies came together to agree on consistent economic, social and environmental indicators. It was also immediately after the Pacific's inputs into the Global Environmental Outlook No. 3 and the complementing of the Pacific Environment Outlook (2005) where the DPSIR and scenario planning method were combined. Both cemented a regional agreement to environment and development indicators. Overall, the report highlighted a continuing trend of the same environmental issues identified in 1993.

State of the Environment Report 2013

The 2013 State of the Environment Report focused on an 'integrated habitat-based approach' to assessment using the DPSIR framework to determine the health of key habitats including: (1) upland habitats and cloud forests, (2) lowland habitats, (3) coastal habitats, (4) inshore marine and offshore habitats, (5) rural and urban built environment, (6) rivers and streams, (7) protected areas, sanctuary and key biodiversity areas, and (8) atmosphere, weather and climate.

The key outcome of the 2013 SOE was the role and influence of climate change in accelerating extreme weather events causing major damage to Samoa's natural environment. Economic developments pursued in various government sectors were also contributing to environmental change.

State of the Environment Report 2023

This 4th Samoa SOE (2023) is in line with the needs of the Government of Samoa and the regional support provided through SPREP (Inform Project). It takes an approach of using the 'Drivers, Pressures, State, Impact, Response' (DPSIR) model but emphasising the importance of Drivers and Pressures on the environment as the focus for future action. This makes it consistent with contemporary causal analysis assessments that aim for actions that target causes rather than just the impacts. The narratives for each key indicator, by updating status and trends, aim to show that simple linear cause-and-effect relationships are often not the case: there can be complex interactions, including cumulative and historical effects where multiple drivers and pressures are involved.

The DPSIR model is an internationally accepted approach for reporting on the environment (Figure 2). Drivers are the factors that indirectly affect the environment. These drivers exert pressures that directly affect the environment, which may result in observable changes in trends or conditions. The impacts of these changes will affect communities, economies and ecosystems. By understanding this system, informed responses can be applied to manage the various factors in this process.

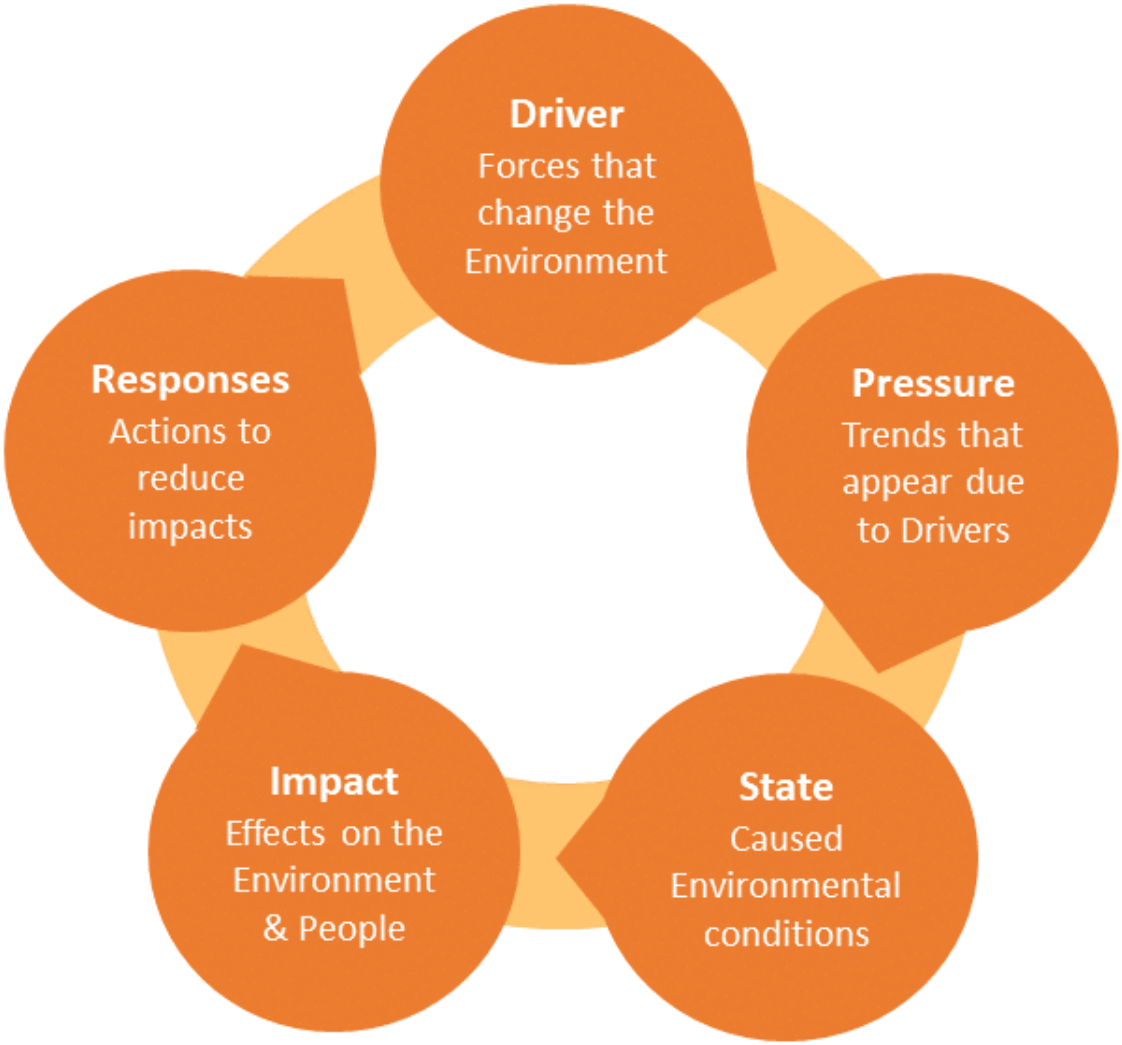


Figure 2: Drivers, Pressures, State, Impact and Response (DPSIR) model

Purpose of the State of the Environment Report

The purpose of the Samoa SOE Report 2023 is to present the best available information about the current state of the environment as the basis for effective environmental management and planning. The SOE Report examines the major drivers of change to the environment that emerge from global, regional and national factors. The SOE Report evaluates the main environmental pressures created by these drivers, and examines their social, economic and environmental impacts.

SOE reporting is an internationally accepted reporting method that analyses the condition of a geographic area or jurisdiction's ecosystems, and associated natural resources. SOE Reports compile and analyse quantitative and qualitative data from a variety of local, national, regional, and international sources to provide an holistic picture of a location's current state of the environment. SOE Reports also identify environmental trends, including anthropogenic impacts to natural environments.

SOE Reports prioritise the most important environmental attributes of a given location and identify issues that impact the state of the location's environment. The reports have included the condition of flora and fauna species as well as habitats such as native forests, marine and inland water bodies, land, soils, and vegetation cover. The reports also address key aspects of highly modified agricultural and built environments.

The main audiences for the Samoa SOE Report are:

- All Government Ministries, agencies and their staff
- Samoan community, both within Samoa and abroad
- Development partners, especially donor organisations

- Non-governmental organisations, both on island and overseas
- Inter-governmental organisations, researchers and research institutions
- Friends of Samoa (including volunteers and the general public) with an interest in Samoa's natural environment, culture and traditions and the people.

Methodology and Process

Samoa's 4th State of the Environment Report has been possible through the collaboration between the Government of Samoa, under the MNRE and SPREP. A series of workshops and consultations with local stakeholders assisted in identifying the pressing environmental issues and thematic areas of focus. A number of thematic areas were identified as important, but given the time constraints, four were chosen to provide a representative of the state of the country's environment. The Natural Environment encompasses the biggest thematic group, essentially covering the terrestrial environment and the coastal and marine areas. The Built Environment is another important thematic area, whereby daily activities are shaping and influencing the state of the environment. The Atmosphere, Climate and Disasters theme is an increasingly influential driver of environmental change, through changes in our climate. The last Thematic Area is Environment Governance, covering key management responses to safeguard the environment. Another thematic area that was also considered relates to Culture and Traditions, recognising the importance of maintaining cultural and traditional connection to the natural environment. Due to time constraints, it was not possible to collate and assess the data to determine the state and impact of culture and traditions on the environment.

A total of 50 indicators and sub-indicators were selected, based on the available data. The quality of the data varies considerably, and further assessments required access to scientific publications, online websites, personal communications with local and regional experts and accessing the grey literature (consultants' reports). A two-day write-shop among the Technical Working Groups, allowed intense scrutiny of the data and the interpretation for the purpose of the SOE Report. Several consultants were involved in the assessment and preparation of the SOE report. It is important to note that these thematic areas and their respective indicators are artificial in their groupings. Many indicators fall under a number of thematic areas. The report aims to highlight these connections and guide the reader throughout the document. Finally, the overall report follows the SOE Guidelines prepared by SPREP, and adopted by its member countries.

How to Read the Report

The 4th State of the Environment Report has a comprehensive Executive Summary to allow the reader to immediately gauge some of the key issues that are covered. Key messages from the Government of Samoa, and the Director General of SPREP, provide the guidance and personal key messages to the readers on actions they can take to assist with safeguarding Samoa's natural environment. There are four sections of the report. The first is the general introduction to Samoa and the purpose of the SOE. The second section covers the drivers and pressures that are causing environmental change to Samoa. Section 3 is the SOE Report theme and indicators. This is the comprehensive assessment of the indicators undertaken by leading local experts, based on the results of research and surveys and their personal involvement on key issues, which spans two to three decades for many. The final section provides the summary and the recommendations, which should help guide national management strategies.

Another important consideration of the report, which should assist readers, is the inclusion of the traffic-light colour symbols to determine the state of the indicator, whether good (green), fair (amber) or poor (red). Further details provided below (Guide to the SOE Symbols).

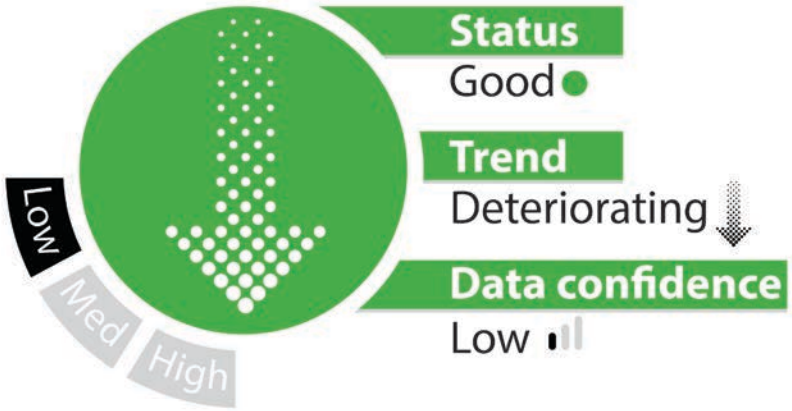
Guide to the SOE Symbols

Samoa's State of the Environment Report assessments integrate many data sources and expert views, which ultimately decide whether the state of an indicator is good, fair, bad or transitioning (see Figure 3). An important consideration of the state of the indicator is the trend. By analysis of past data, we are able to predict how things are likely to pan out in the future. This is represented by the arrows inside the green, fair or poor state. In some cases, part of the data may indicate that portions of the indicator are getting better, whereas another part is deteriorating. This will be represented by two arrows, with one pointing up and the other, down. Where there is no trend prediction or the trend is unknown, a horizontal arrow will point left and right, or a question mark will appear. Data confidence is represented by the dark box surrounding the words, Low, Med and High. The more data points and time-lapse surveys over the past decades, the higher the confidence is on the quality of the data. In some cases where the data points are low, the status will be assessed based on the advice of local experts.

Status: **Good**

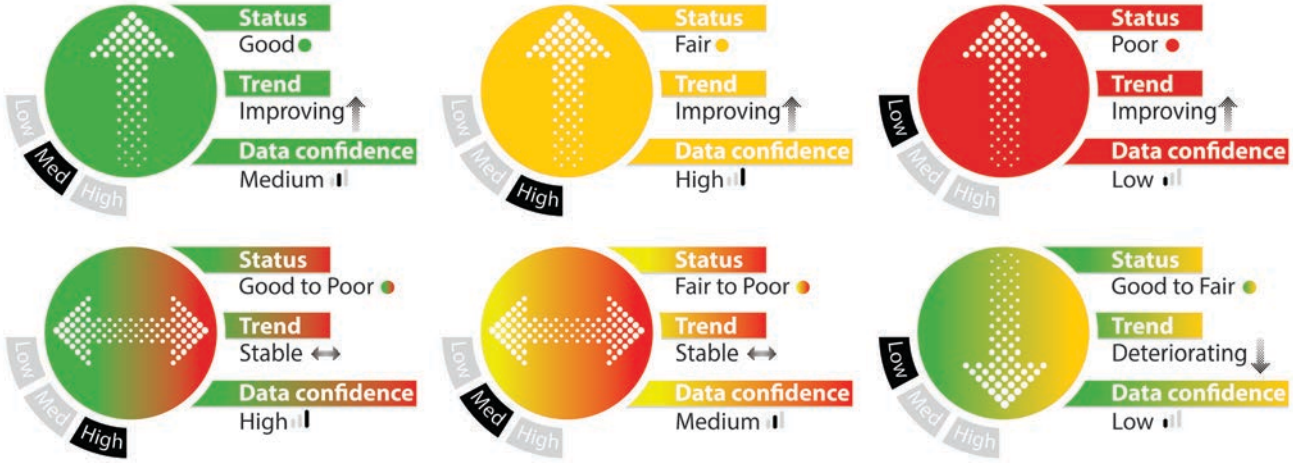
Trend: **Deteriorating**

Data confidence: **Low**



Bottom bars of **Low**, **Medium** and **High** indicate confidence in data and assessment.

COLOUR indicates state of: **Good**, **Fair**, **Poor** or can be a **Range**



ARROW indicates trend of **Improving**, **Stable**, **Deteriorating** or **Mixed**

Figure 3: Explanation of indicator symbols (Picture credit: SPREP)

Samoa's State of Environment and Global Targets

Samoa's environmental agenda is guided by and aligned to global multilateral environmental agreements (MEAs) that the country is a member of. Samoa recognises the importance of global partnership and a shared responsibility for managing human activities to minimise harm to the environment, and the future of the planet. Samoa's 4th SOE report has been developed with links to some of the key MEAs, both at the global and regional levels.

2030 Agenda for Sustainable Development

Samoa, alongside many other members of the United Nations, adopted the 2030 Agenda for Sustainable Development in 2015. This 2030 Agenda builds on 40 years of global agreement for improving the lives of the people and to protect the environment. The 2030 Agenda is a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its core are 17 Sustainable Development Goals (SDGs) (Figure 4), which are an urgent call for action for the world. The SDGs provide clear guidelines and targets for all countries to adopt in accordance with their own priorities and the environmental challenges of the world at large. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with others.

Figure 4: Sustainable Development Goals icons. (Picture credit: https://sdgs.un.org)

Convention on Biological Diversity

Figure 5: The 20 Aichi Biodiversity Target icons. (Picture credit: https://cbd.int)

- **Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets.**
  Samoa continues to be an active member of the UN Convention on Biological Diversity. In 2011, Samoa endorsed the world's Strategic Plan for Biodiversity 2011-2020, which contained five strategic goals and 20 biodiversity targets (known as the Aichi Biodiversity Targets). Samoa adopted the strategic goals and targets in its National Biodiversity Strategy and Action Plan (NBSAP) 2015-2020. Each Aichi Biodiversity Target is represented by a unique icon (Figure 5).
- **Kunming-Montreal Global Biodiversity Framework.**
  At the 15th Conference of the Parties to the UN CBD, Samoa, alongside other members, adopted the Kunming-Montreal Global Biodiversity Framework. The Framework builds on the previous Strategic Plan for Biodiversity and the Aichi Targets, and it further aligns the CBD with the Sustainable Development Goals. The new Kunming-Montreal Global Biodiversity Framework contains four goals for 2050, and 23 targets for 2030.

Environmental Data Management

Knowledge and understanding are important for driving and bringing about informed decision-making. The project, Building National and Regional Capacity to Implement Multilateral Environmental Agreements by Strengthening Planning and the State of Environmental Assessment and Reporting in the Pacific, referred to as the Inform Project, recognises the need for this data-driven decision-making. The project establishes a Pacific island network of national and regional data repositories and reporting tools to support the monitoring, evaluation, and analysis of environmental information, which supports environmental planning, forecasting, and reporting requirements. The Global Environment Facility (GEF) contributes USD 4.3 million to the Inform Project, which is implemented by UN Environment and executed by SPREP.

Samoa now has an online and open source 'Country Environmental Data Portal'. The portal can be accessed online via the following link: http://rio-samoa.mnre.gov.ws/. This portal can be a resource for uploading, storing and sharing data in a central place, thus facilitating the process for compiling and analysing data when writing future SOE reports, NEMS and policies.

SECTION 2: Drivers and Pressures on Samoa's Environment

As Samoa becomes increasingly interconnected with the world and its global affairs, it also becomes vulnerable to the ripple effect caused by nations and actions thousands of miles away. It is pertinent that Samoa is cognisant of the nature of these drivers and develops strategies and policies to safeguard the environment and the people. There are many drivers of change that influence Samoa's environment. Some are locally driven; however, many are from outside of the country. The following are some of the drivers that are contributing to environmental change in the country.

Drivers of Environmental Change

Picture credit: © Stuart Chape.

Our natural environment, including ecosystems, habitats and species, continues to change, largely due to increasing population, climatic change and economic inequity. These drivers affect the environment directly, or often interact together to cause immediate or long-term changes that can be irreversible. The extinction of species is one of those irreversible consequences that stem from these driving forces. Other major drivers including urbanisation and technology, cause environment change. These drivers are impacting every country, including Samoa.

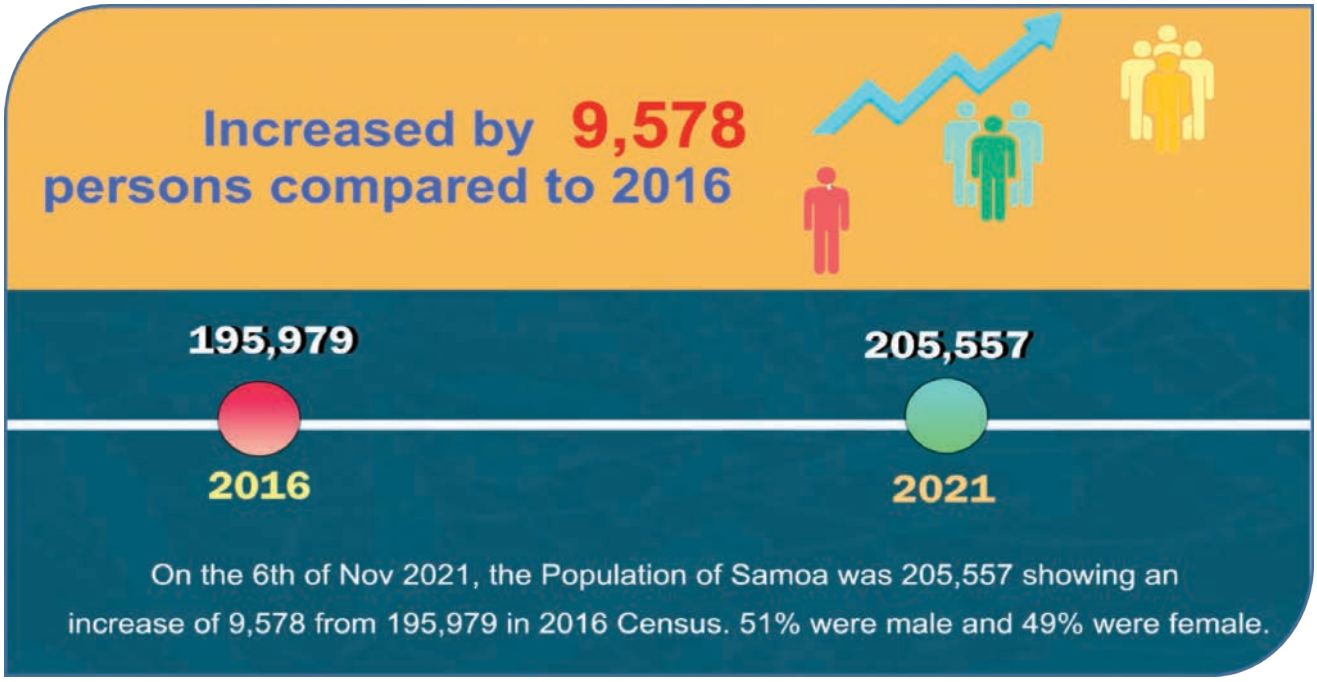
There are specific forces that are contributing to environmental change in Samoa. The population, including the demographic characters and migration, is affecting Samoa's environment. Climate change and its effect on the earth's weather patterns and systems, and geological hazards, are other driving forces that are contributing to environmental change. Economic and technological developments are other important forces that are affecting people's behaviour and actions, which also affect the environment. With technological advancement and our connectivity to the rest of the world, it has exposed Samoa to global conflicts and challenges. These conflicts and challenges drive global markets to react and ultimately impact communities and the way they interact with the environment. The three key drivers affecting Samoa's environment are detailed below:

I. Population Growth;

II. Climate Change and Natural Disasters

III. Economic and technological development

Population Growth



Picture source: SBS 2022

As Samoa's population continues to grow, the demand will also increase for the resources needed to sustain the population. If the resources are not able to keep up with the demand, it will lead to serious environmental consequences. The loss of ecosystem services and extinction of species are two of the worst outcomes from lack of sustainable management. This ultimately affects the wellbeing of all Samoan people. This challenge is faced by countries and communities throughout the world. As the world population continues to grow, wastes will continue to grow and be a burden to authorities. Greenhouse gasses will also increase unless serious interventions are made. Recent assessments have found greenhouse gas emissions to have increased twelvefold, compared to a fourfold increase in human population, since civilization began. The demand for resources is usually higher in developed countries. Although, increasingly, affluent households are also contributing to higher demand for resources. The consequence of high demand of natural resources is environmental degradation, especially in places where there is poor or lack of sustainable management regimes. Many of the environmental problems are acutely felt by people living off the land or with strong connection to their environment. At the local scale, the increase in population in urban areas (especially around Apia), is affecting natural resources, such as mangrove, seagrass and coral reef habitats. The ripple effect of the increasing population in urban areas is causing exploitation of resources in remote and rural areas to feed the demand in Apia.

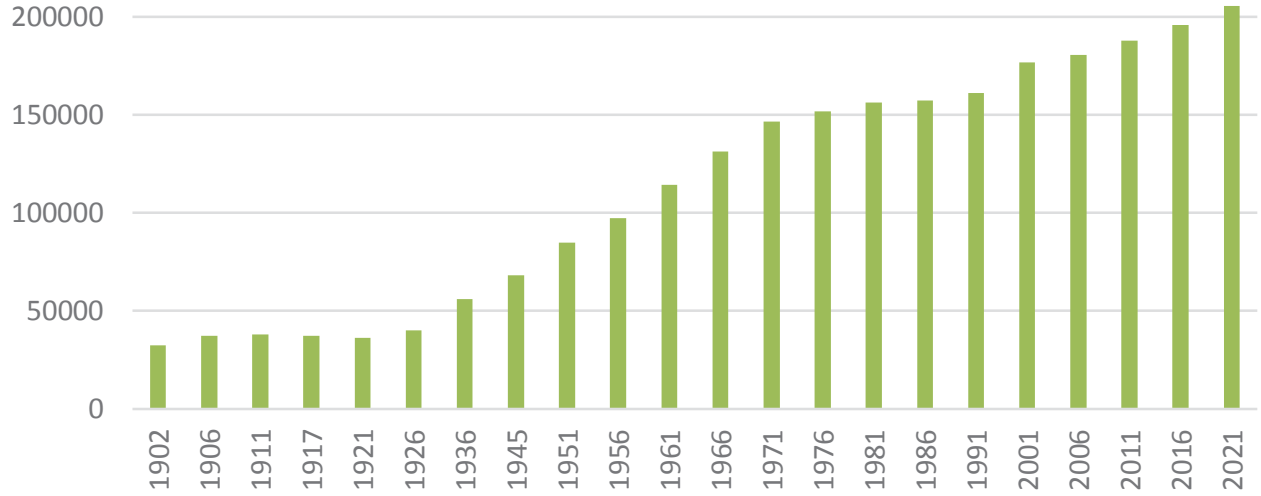
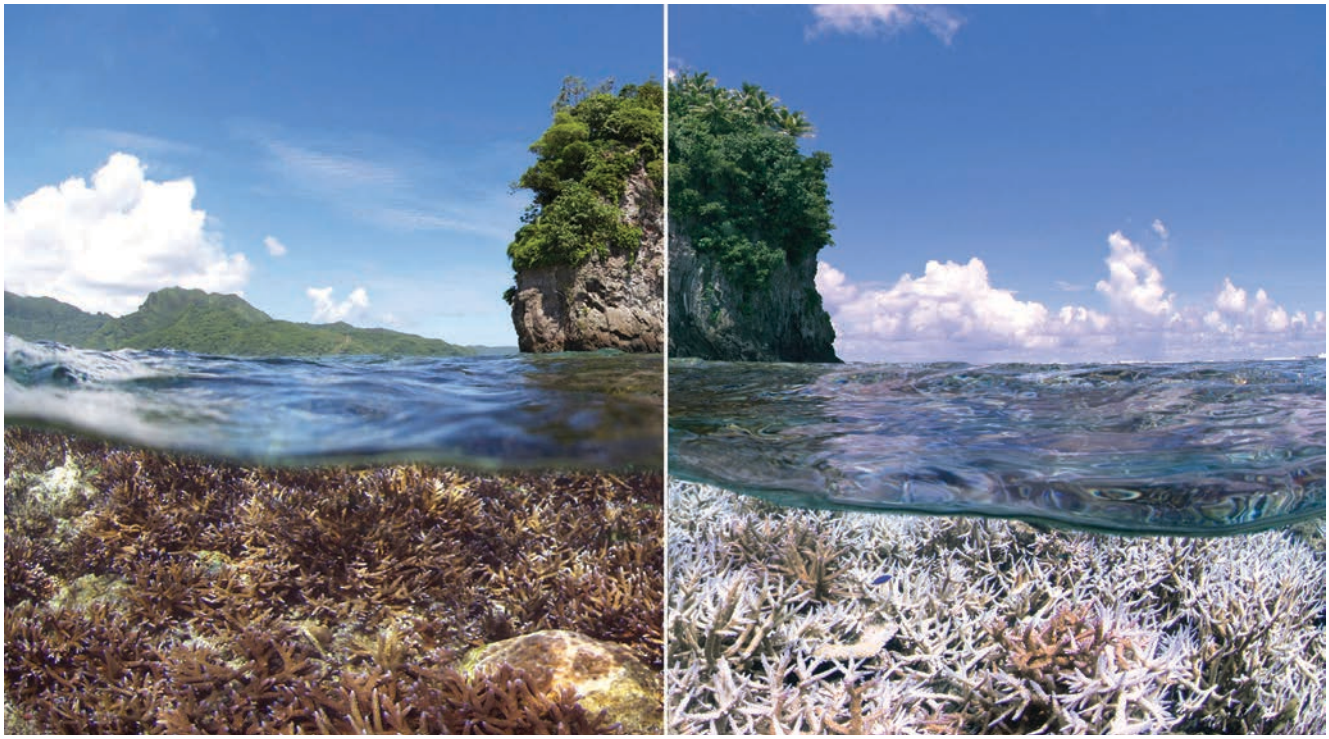


Figure 6: Samoa's population from 1902 to 2021 (SBS 2022)

Samoa has experienced an increase in population of 4.9% over the last two censuses (2016 and 2021) (SBS 2022). The most recent census found Samoa's population was 205,557, an increase of almost 10,000 people since the last census (SBS 2022) (Figure 6). The census noted a continuous migration from other islands to Upolu, often enticed by better employment and educational opportunities in Apia. The growth on Upolu island has been directed at the North-West region (37%) and less on the central Apia Urban Area region (18%). Faleata, near Apia, is the most populated district (6%), whereas Falealupo in Savaii, is the least populated (0.4%) of all the political districts. The increasing population is acutely noticed in urban and peri-urban areas, where there is an influx of migrants from remote and rural communities. With the increasing population, environmental resources are put under severe strain. The urban spread is inevitable, putting pressure on customary land, as well as on traditional systems. Coastal wetlands such as mangroves, beaches and swamps are reclaimed to allow for settlement expansion, or used as waste sites. Recent surveys of the urban Apia area found the population favouring the west side of Apia, where settlements are concentrated and are often on vulnerable areas that are prone to flooding or landslip.

Climate Change



Picture credit: © XL Catlin Seaiew Survey

Human activities have contributed rapid changes to Earth's climate. The 'normal' weather patterns are being changed, leading to extreme weather events including decade-long droughts, extreme rainfall in short periods leading to flash flooding, severe tropical cyclones damaging infrastructure and rising temperatures leading to more hot days and nights. Samoa's small land mass makes it vulnerable to climate change and natural disasters, which is exacerbated by having most of the infrastructure and settlements on low-lying areas along the coastline. Climate change will impact most of the primary sectors in Samoa, including food, water, energy and health. Biodiversity in particular will also be affected if weather patterns exacerbate drought conditions, reduce precipitation and bring about severe tropical cyclones.

These climate change and natural disaster pressures require good planning and management of developments that will enable economic opportunities for the country and allow communities to develop coping mechanisms to reduce their vulnerability to adverse climate events.

Economic and Technological Development

Picture credit: Bluebird Construction Co Ltd

The three pillars of sustainability are the economy, environment and society. They are integral and all must be considered in planning and development. Samoa aspires to sustainable living, and a good economic growth provides a means of lifting the living standards for the people, as well as the financial security for the nation. In past centuries, the economy was pursued at the expense of the environment and the people. The global economy at the moment is unsustainable. The challenge is that those who created the unsustainable economy, are not necessarily the ones paying the price. Pollution, loss of ecosystems and global warming are some of the impacts caused by our insatiable yearning for economic growth.

Technology and technological developments have had a chequered history in terms of their impact on the environment, which has largely been driven by economic goals. Land clearing, for example, was a labour-intense activity with the size of the clearing limited by the ability of the person, the strength of the animal used, and the size of the area being cleared. Technological advancement allows automated operations to clear land at a much faster rate, and covering large tracts of land. This has led to unprecedented removal of forest trees to allow for mono-cropping, increased agriculture activity, or expanded cattle farming.

With the increased focus on climate change and its impacts, the economy and technological development are re-focusing their modalities in ensuring that green technology and solutions are at the forefront of their operations. Technological developments, for example, are pushing renewable energy solutions to reduce the reliance on, and use of, fossil fuel.

Global Economics and Geographic Constraints

Picture credit: Government of Samoa

The Pacific island countries' geographical remoteness from the world provides some insulation to major global events in the past. When major events do occur, it often takes time to reach the Pacific countries, if at all. With increasing connectivity around the world, the geographic isolation is no more, and the impacts on Pacific countries are almost instantaneous. Recent examples are the COVID-19 pandemic that swept the world, and quickly affected Pacific countries, including Samoa. The ongoing conflict between Ukraine and Russia has driven the cost of living high in every country. There is also an increasing presence and influence of social media between Samoans and the world. The impact of this remains to be fully understood, but it is likely to have some influence on how Samoa views the world and their environment.

Samoa's traditional lifestyle has been transformed over the years and there is now a strong reliance (or a right) to access goods and products from overseas. Some households use imported goods to supplement, or add value to locally produced goods, whereas others rely wholly on imported goods for their survival. Many of the overseas products have waste products, such as packaging, which need to be disposed of, and many foods are processed with high sugar, fat and salt contents. There is also a high risk of the introduction of invasive species through trade and visiting tourists.

Traditional and Cultural Values Systems

Picture credit: Alvaro Hoyos

Samoa's Constitution recognised the authority of the villagers over their lands and the resources within. The majority of the land in Samoa is customary owned (MNRE 2022). Samoa's Constitution recognised the authority of the villagers over their lands and the resources within. Traditional and cultural value systems in Samoa extend to the protection of the environment. Samoan society has a deep reverence for nature and a strong belief in the interconnectedness between humans and the natural world. This belief system is reflected in various aspects of Samoan culture, including village bylaws and traditional practices. Village bylaws are regulations enacted by village to govern various aspects of community life, including the environment. These bylaws are designed to ensure the well-being, sustainability, and protection of the local environment. While specific provisions can vary depending on the jurisdiction, village bylaws typically address several environmental concerns.

The Ministry of Women Community and Social Development oversees the village bylaws within the communities. To date, there are 45 villages with village bylaws that govern the environment. Here are some common ways in which village bylaws govern the environment in Samoa:

- **Land use:** Village bylaws often include regulations on land use which control how land can be developed and what types of activities are permitted in different areas. These regulations help prevent environmental degradation by designating specific zones for residential, commercial, industrial, or conservation purposes, and ensuring that development adheres to certain environmental standards (faasaina ole eli ina ole oneone i nuu).
- **Environmental protection:** Village bylaws may include provisions to protect natural resources such as forests, wetlands, water bodies (rivers), wildlife habitats and require permits or impose restrictions on activities that could harm these sensitive areas or species (faasaina o fagafaga i totonu o nuu).
- **Waste management:** Bylaws often address waste management practices, including the collection, disposal, and recycling of solid waste and hazardous materials as well as penalties for improper disposal (faasaina ole faalapisi / faamamaina o aai).
- **Conservation and sustainability measures:** Bylaws may promote conservation practices, such as fisheries conservation, marine life conservation and environmental conservation (faasao i tua i nuu).

Environmental Pressures

Environmental pressures are direct consequences of the drivers (see Drivers of Environmental Change). Population growth puts enormous pressure on natural resources, production of wastes and the amount of energy used. Climate change drives the warming of the planet leading to extreme weather events. While there are many pressures on Samoa's environment, some of the key pressures include climate and natural disasters, land development, resource use and extractions, waste production, invasive species and agriculture and rural development.

Climate Variability and Disasters

Picture credit: Kevin Hadfield, AusAID (CC BY 2.0)

Climate change is driving weather patterns to extreme variability, which can sometimes lead to nation-wide disasters. Samoa is highly vulnerable to natural disasters both caused by climate change and geological processes. Disasters have caused destruction of native forests, coral reefs, infrastructure, and loss of lives. Progress and developments that took years to develop, can be reversed instantly when a disaster hits. For many coastal communities, their homes are only a few metres from the shoreline, and a few metres above sea level. King tides, floods, tropical cyclones, storms, tsunamis and increasingly, sea level rise, are threatening people's homes. Many Samoans have lived through tropical cyclones, floods, and earthquakes, and the consensus is that these events are becoming more frequent. The increasing warming of the planet means the temperature will rise with more hot days and nights, reduced precipitation and high evaporation rates providing ideal conditions for bushfires, severe tropical cyclones and rising sea level. Climate change and disasters can contribute to the hardship faced by many households, and add to the economic challenges that the government and the private sector are grappling with. The consequences of responding to natural disasters usually means that some other area of social needs is placed on the back-burner.

Land Development and Use

Picture credit: PASkelton

Land developments are driven by population growth and the need to expand community housing needs. In addition, economic drivers are also contributing to land development through agriculture use, the building of tourism facilities, and expansion of industrial and commercial areas. Climate change is also a contributing driver, whereby infrastructure and settlements are being relocated to inland areas, away from flood-prone sites, or areas that are vulnerable to inundation by tides and rising sea level. The land tenure in Samoa comprises of customary land (81%), Government owned land (15%) and freehold (4%) (Table 1).

Table 1: Land tenure in Samoa. (MNRE 2022)

LAND TENURE	UPOLU (km^2)	SAVAII (km^2)	TOTAL (km^2)	%
Customary	784	1521	2305	81
Government	256	171	427	15
Freehold	112	2	114	4
TOTAL	1152	1694	2846	100

The population of Apia continues to grow; estimated at 35,974 people or 17.5% of total population (SBS 2022). Most of the land development and expansion is happening to the northwest of Apia, covering approximately 311 km^2. Major population growth will continue along the northwest coast, putting pressure on coastal vegetation, mangrove forests and coral reef areas.

Resource Use and Extraction

Picture credit: Huggard Tongatule ©

Resource use and extractions are one of the key environmental pressures that is driven by the increasing population and economic demands. Land and marine resources have been the mainstay for the people since the islands were settled. With the increasing population, the demand for water, food and shelter has put enormous pressure on these resources. This has consequences such as extinction of some species, and cultivars, or species becoming very rare. The increase in waste and pollution of streams, rivers, forests and the marine environment adds more pressure on natural resources. The tragedy of the commons has led to overharvesting of resources, in a race for fast economic gains.

The fisheries are an important sector for Samoa. Subsistence and traditional customary use of nearshore fishery resources is important for Samoan households, whereas commercial

fishery takes place in offshore areas. The shift from subsistence fishing to a cash-based economy, has led to overharvesting of marine resources. The consistent pressure has made it impossible for many marine species to reproduce and thrive. The water quality, especially near urban areas, is poor and this is affecting marine resources and raises health concerns for locals.

Consumption and Waste

Picture credit: SRWMA

The increasing population leads to increases in consumption and waste output. The improvement in economic outcome for many households in Samoa continues to push consumption of local and imported goods to higher thresholds. The increase in GDP per capita since 2000, has led to an increased demand for imported goods. Almost all imported goods produce wastes that need to be managed. Increasing wastes per household are challenging the government on how best to manage and reduce them, and to minimise pollution to the environment. Efforts to redress the growing wastes require collaboration with the private sector and communities to raise awareness on waste minimising, recycling and reusing of wastes.

Agriculture and Rural Development

Picture credit: Ministry of Agriculture and Fisheries, Samoa

Economic developments are a key driver for conversion of many forests into pastoral and agricultural land. These activities often require clearing of lands and replanting them with faster growing and better yielding plants. Herbicides and fertilisers are often applied and if not managed properly can have a negative impact on soil biodiversity, as well as pollution of waterways.

Agriculture remains a key sector for Samoa's economy. Up to 75% of households generate subsistence income through agricultural activity. Up to 80% of fresh fruit, tubers and vegetables are home produced. Most households in Samoa, even those within Apia, are involved in agricultural production and gardens. In some of the more remote areas of Samoa, traditional cultivated areas have been abandoned largely due to the influence from urban lifestyles. Faster growing introduced weeds and trees will take over abandoned cultivated lands, making the invasive species challenge worse. As land space in urban areas becomes full, the urban boundary starts to expand outwards, and new areas are being used for farming. These lands are often on steep slopes or in valleys near streams. Erosion is an ongoing challenge especially for the security of the people and their belongings. Erosion also contributes to environmental problems, usually with pollutants being transferred to waterways.

Invasive Species

Picture credit: Ministry of Natural Resources and Environment

Invasive species are introduced primarily through international shipping and flights. The high inflow of goods in containers, vehicles and other equipment being brought into the country, provide opportunities for invasive species to be transported. Other invasive species were deliberately introduced, as a potential resource for the people (e.g. Mozambique Tilapia, Rubber Tree, and African Tulip). These introduced species are driving changes in the environment, specifically many native forest areas are being replaced by faster growing invasives. Many of the secondary forests are made up of invasive trees. Although there is a lack of solid data in Samoa on the impacts of invasive vertebrates on native species, there is a lot of evidence from other islands showing the devastation caused by introduced rats, cats and snakes on bird and reptile populations. Invasive species numbers in Samoa have increased significantly over the past decades. Historically, introduced species are starting to become problematic as developments expand into new areas, and climate change impacts are undermining ecosystems.

References

MNRE (2022). The Master Plan. To guide the sustainable management of Government Lands under the control of the Land Board 2022-2032. Apia, Samoa. 61p.

Samoa Bureau of Statistics (2022). Samoa Population and Housing Census 2021. Apia, Samoa. 93p.

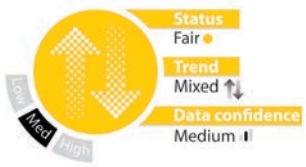
SECTION 3: State of the Environment

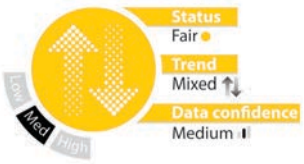
Theme 1: Natural Environment

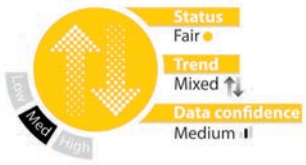
Savaii upland forest - Samoa (Picture credit: © Stuart Chape)

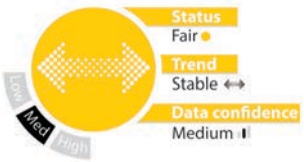
Terrestrial and inland waters

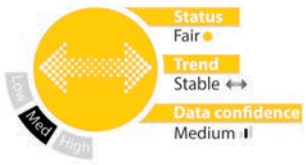
Overview and Highlights

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Terrestrial species • Avifauna • Land mammals • Reptiles • Insects • Plants • Threatened and endangered species		Knowledge on Samoa's biodiversity continues to improve over the past 10 years due to assessments and research by local and international researchers. The populations for selected key indicator species are variable, with some showing improvement, whereas others are declining. The latter is attributed to habitat loss, invasive species competition and predation, human activities and climate change impacts.	Samoa advocates at all levels of society, including at the global forums, the need for conservation actions and the protection of native biodiversity. The Pathway for the Development of Samoa (2021-2026) presents the government's priorities, and conservation and sustainable use of natural resources, are a key area of focus. There is an increased focus on conservation areas, and promotion of sustainable and innovative use of natural resources for the development of the country. The implementation of the PDS (2021-2026) is guided by national strategies and plans such as the NBSAP, NESP, Management Plans for Community Conservation Areas.

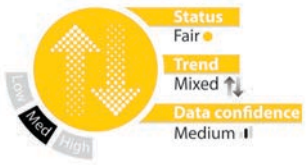
INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
			Where certain biodiversity species are at risk of extinction, specific strategies are developed such as recovery managements plans for the Manumea and the Ma'oma'o (two critically endangered species of Samoa). Some of the key recommendations for enhancing the conservation and protection of Samoa's terrestrial species include the following: • *Addressing the key threats to native biodiversity is critical, especially managing invasive species, habitat loss and hunting.* • *Conservation actions include replanting of native plants, declaring protected areas and engaging communities to be part of the management plan.* • *Implement an effective monitoring program to provide accurate and up-to-date information on the state of Samoa's terrestrial biodiversity.*
Water Catchment & water resources • Water resources demand and abstraction • Water related ecosystems • Water quality • Watershed management		Water resources include surface water and groundwater. Distribution of water resources is variable, although eastern Upolu has most surface water, whereas Savaii has widespread groundwater. Most of the water catchments are seasonal relying on rainfall for replenishment. Water catchments are important sources of drinking water for the population, however, hydropower generation consumes around 73% of water resources. The water related ecosystems appear to be declining based on data from 2005 to 2020. The decline is small at 1.5%. The quality of surface and groundwater was found to be contaminated with bacteria associated with faeces from animals and humans. Groundwater resource is particularly of concern due to leachate of raw and untreated sewage.	A number of watershed management plans have been developed, covering an area around 3.65 km^2. A watershed at risk guide has been drafted, which will provide a tool for managing watersheds and water catchment sites. The Management Plan of Upland Areas of Lake Lanotoo National Park 2015 also emphasized the importance of wetland under the Ramsar Conventions and the declaration of the first Ramsar Site for Samoa in 2004. *Undertake surveys of all catchment areas including associated biodiversity.* *Implement watershed management plans, and ensure that appropriate support and resources are provided.* *Urgently address pollution and contamination sources around catchments, especially groundwater systems, to ensure that drinking water supply is protected.* *Discourage the building of infrastructure, including piggeries and animal farming near catchments.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Inland Wetlands		Samoa has eight wetlands that have been identified in its Wetland Inventory in 1993. Lake Lanoto'o National Park and the O Le Pupū Pu'ē National Park are Ramsar sites. A few of the wetland sites have been surveyed and management plans developed. Resources and staff capacity are some of the factors delaying the surveying of the other wetland areas. Some of the key threats to wetlands are invasive species and human activities near some of the sites, especially farming and planting of crops. Wetlands found near homes are often used as dumping sites (e.g. Mutiatele, Aleipata.	There is no single policy specific to Samoa's inland wetlands. A number of national strategies including the NBSAP and the National Environment Sector Plan 2017-2021 highlight the importance of wetlands. • Urgently implement the National Upland and Watershed Conservation Policy. • Continue to monitor and document the state of wetlands through Upolu and Savaii. • Build strong and close relationship with communities that own and live around sensitive wetland sites, so they are advocates for their protection.

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Forests		Forests enhance watershed capacity, control soil erosion, and are habitats for many native and endemic biodiversity. They provide materials for people to use and are vital to mitigate the impacts of climate change. Samoa was once heavily forested, but human settlement and activities, as well as tropical cyclones and other natural events have contributed to the decline in forest cover. The forest cover reached 58% (in 2013), which includes primary, secondary and plantation sites. Savaii has a high forest cover (40%) compared to Upolu (17%) for the 2013 year. Most of the forests are under customary ownership. An ongoing tree planting campaign engaged the interests of the communities and private organisations including religions which started from 2009. More than 3 million native trees have been planted in areas infested by invasive species and protected areas.	Legislation includes the Forestry Management Act 2011, the National Parks and Reserves Act 1974, the Protection of Wildlife Regulation 2004, and the Land Survey and Environment Act 1989. There is a Code of Logging Practices. The Forestry Division under MNRE provides a cross-sector approach to sustainable forest management and development. National policies include the National Policy on Forestry and Sustainable Development 2007. • *Continue to protect and preserve critical forest areas, and undertake regular monitoring of forest activities/operations.* • *Manage the threat to forests through controlling human activities and removal of invasive species.* • *Rehabilitate degraded forest sites by planting more native trees strengthening the current 3 Million Tree Planting Campaign 2022 - 2028 and ongoing tree planting activities.* • *Urgently implement national policies, by ensuring that the staff capacity is adequate, resources are provided and engagements with communities are prioritised.* • *Strenghthen the enforcement and monitoring of forestry activities through the licensing and permitting systems under the Forestry Management Act 2011 for harvesting and utilising of forestry resources and collaborations of relevant stakeholders.*
Soil resources and management		Samoa's soils are volcanic in origin, geologically young and consist mostly of basaltic rocks. The challenge remains on how best to use the soil sustainably for now and the future.	

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Lands and Land Resources • Land tenure • Land management • Land use • Agriculture • Land restoration		Samoa's total land area is 2,846 km^2. The land tenure is comprised of customary land (81%), freehold land (4%) and government land (15%). Samoa's land resources include all materials that are deemed valuable from an environmental, ecological, economic, social and cultural perspective. Efforts to conserve Samoa's natural resources continue to improve, however, the management is challenging, due to competing needs. Samoa's land use remains at moderate to high intense levels, largely due to subsistence agriculture needs. The use of mechanised tools and technologies has accelerated the clearance of forested areas for commercial ventures including agriculture and developments. Agriculture is one of the key priorities that affect Samoa's land ecosystem. It is an important agenda for improving rural livelihood and food security. Almost all of Samoa's households (94%) undertake agriculture activities. Land degradation due to natural hazards, or poorly managed land use has contributed to the decline in land health. Land restoration programmes have included the profiling of soil, replanting and reforesting of mined areas and the removal of invasive plants.	*Surveys and ground-truthing have allowed the government to accurate map Samoa's total land area. Developments have put pressure on customary land to be freed through long-term leases. .*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Terrestrial conservation and protected areas		Conservation and protected areas in Samoa are broadly classified as reserves, catchment areas, national parks, community conservation areas, marine reserves and fish reserves. The majority of protected areas are land based (90%) comprising 782 km^2, or 37% of priority sites. Community conservation areas are under customary ownership and management, with the majority having management plans. The past decade has seen an influx of protected and conservation areas established, including Mauga-o-Salafai (59.7km^2), Cornwall National Park (Masamasa-Falelima) 24.9km^2, Vaipu Swamp Forest Conservation Area (2.8km^2), Malololelei Conservation Area – (0.21km^2), and Malololelei BioPark – 0.096km^2.	The protected area network continues to expand providing more protection to ecosystems and vulnerable species. Management plans have been completed for some of the national parks and reserves, and community conservation areas. Legal protection is in place for national parks and reserves through national legislations, whereas community conservation areas are protected under specific village by-laws alongside CCA management plans. To further enhance the protection of Samoa's ecosystems and species the following recommendations are proposed: • *Establish new protected areas, with a specific focus on Lefaga-Falelatai, Falealili-Aleipata, and the Aopo Lava Shrub Forest Reserve.* • *Explore and identify other effective area-based conservation measures (OECMs) that promotes the conservation and protection of nature biodiversity.* • *Research and regular monitoring on Samoa's biodiversity in conservation and protected areas.* • *Managing key threats (human impacts and invasive species) in conservation and protected areas is important.* • *Build the capacity of government staff in biodiversity research, as well as the capacity of communities in monitoring of their conservation sites.* • *Implement an effective monitoring program to provide accurate and up-to-date information on the state of Samoa's terrestrial biodiversity.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Invasive species management		Invasive species are a challenge for the country. Priority invasive species and sites for management have been identified in the NISSAP. Results from invasive species management activities over the past decade have shown positive impacts, especially when there are concerted efforts to remove invasive species and the engagement of the community and stakeholders. Rattan eradication has been successful in some of the sites, whereas some sites require ongoing removals. Water lettuce is an invasive species of water ways but imported into the country through the gardening and the ornamental trade. Early detection and prompt response by the staff led to the eradication of water lettuce. A pest control program at Malololelei started in 2017 to control rat population. Early results indicate a decline in rat population with a corresponding increase in bird sightings in the area. A recent approach to managing long-term invasive species problem focuses on the introduction of natural enemies as natural solution (NENS), or the use of biological control agents.	Developed the National Invasive Species Strategic Action Plan (2019-2024), under the guidance of the Samoa National Invasive Species Task Team. Developed the Samoa Invasive Species Emergency Response Plan, including awareness raising of the plan and simulation exercises. Invasive species management plans drafted for Malololelei Reserve and Mt Vaea Reserve. Management efforts undertaken to manage coconut rhinoceros beetles, rattan, water lettuce, ivory gourd, African tulip, myna birds, invasive weeds and rats. Rapid response by invasive species management staff to public concerns relating to invasive species, including the management of water lettuce, mongoose, and cane toad. • *Continue to advocate for resources (especially funds) for the management of prioritised invasive species, as well as rapid response to invasive species threats.* • *Encourage the use of invasive species management tools, such as biological control, to manage some of the worst invasive species.* • *Build and retain the capacity of staff in invasive species management.* • *Review the National Invasive Species Strategy and Action Plan, ensuring alignment to the Global Biodiversity Framework and relevant international and regional instruments.* • *Strengthen the collaboration with all national stakeholders, but in particular, between the two line Ministries (MAF & MNRE), for national coordination and implementation of management measures for invasive species.* • *Continue to monitor priority invasive species and conduct public awareness and community outreach programs to seek community support and buy-in.* • *Strengthen community participation and engagement in CRB control programs at the village level.* • *Explore management measures for CRB, such as potentional biological control agent (OrNV), to ensure success.*

Impacts

Increasing water resource exploitation is a concern. Groundwater sources provide approximately 23% of annual average water supply distribution so far. This is expected to rise as exploration of sustainable groundwater aquifers increases, as more and more surface water sources become affected by natural and human induced impacts. As such the management and allocation of water resources is a priority to ensure the sustainable utilization of the limited resources in light of the increasing impacts of climate change on the quality and quantity of this resource.

Generally, the river corridors remain intact (SOE 2013) although in the most urbanised catchments (Gasegase, Loimata o Apaula, Vaisigano and parts of the Fuluasou watershed), 20 to 30% of the riparian zones were estimated as developed – including gardening and plantations, livestock grazing and waste disposal. The steeper land is particularly vulnerable to erosion.

Unsustainable development within the upper watershed areas which are considered "natural water tanks", pose a risk to the headwaters feeding the flood plains and the coastal areas. Removal of forest cover in the uplands to accommodate the inland movement of the population and services, affect the watershed areas by reducing infiltration of rainfall and increasing runoff which result in flashfloods in the lower plains. This also increases soil erosion and sedimentation impacts on water quality.

Response

The Water Resources Management Act 2008 is complemented by water resources management policies and regulations, which contribute to the sustainable development of water resources in Samoa. A Water Abstraction Licensing Scheme currently ensures that the use of water resources by the different industries of the economic sector, is maintained at sustainable levels. There is also a draft Upland Watershed Conservation Regulation being consulted, to further protect our natural water towers from unsustainable development.

The Ministry of Natural Resources and Environment is responsible for watershed management and protection of water resources. The Division has used the Integrated Water Resources Management and Ridge to Reef approaches to carry out watershed characterisation, sustainable land management planning, and determination of best management practices. As of 2023, 28 Watershed Management Plans (WMPs) have been developed covering more than 118 villages and more than 3.65 km2 of land under rehabilitation (Figure 29). Buffer zones have been delineated around each storm runoff route in the country, as part of a national flood hazard risk reduction mapping initiative (UNDP 2019, World Bank 2020).

Community and stakeholder consultations and engagement is critical given the significance of traditional leadership, land ownership and customs associated with water resources and watershed areas in Samoa. As such, there is significant investment into annual programs and events to ensure community-led and community relevant initiatives and support.

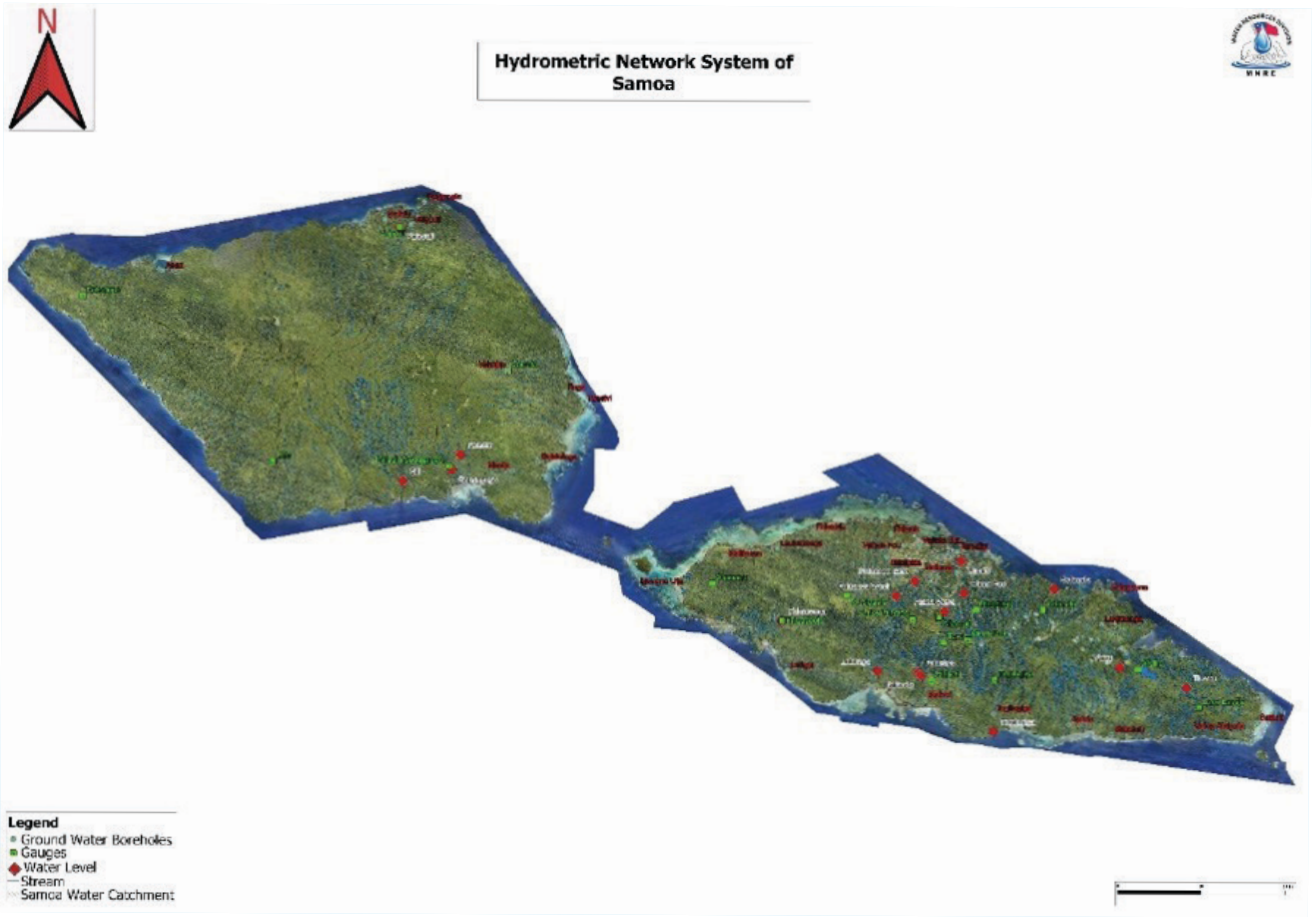
An established hydrometric network consisting of 18 rainfall gauges, 19 water flow and water level stations as well as 30 groundwater boreholes, currently gathers information on the quality and quantity of the water resources around the country. This network contributes to the national Multi Hazard Early Warning System and requires further investments to facilitate maintenance/upgrades, and extension to other areas currently not monitored.

Recommendations

1. There is still a lot to understand about Samoa's water resources and watershed areas. As such, priority should be given to research and monitoring to extend knowledge on water quality and quantity, freshwater ecosystems, watershed characteristics and water related hazards (flooding and droughts). There is limited information on Samoa's groundwater resources due to capacity (financial and human resources) and technological limitations to explore and monitor this critical resource;
2. There is a need to ensure that the water resources policy and legislative framework including watershed management plans, are being implemented and enforced. This requires sufficient support and resources for not only the Ministry but also for the communities and relevant stakeholders;
3. Risks associated with the degradation of catchment areas need to be identified and addressed. This requires community engagement and partnership in implementing protective measures and rehabilitation activities. This includes appropriate mitigation actions such as setbacks for agricultural and housing developments;
4. Protection of upland watershed areas (natural water towers) is a national concern, due to the sensitive nature of these ecosystems. The remaining forest cover and head waters are important to the maintenance of water supply and flood retention;

5. A Watershed at Risk Guide has been developed (Atherton 2019), although a number of caveats exist due to limited data available. A number of recommendations in the guide will help improve it and provide the government with the information needed to safeguard communities and the environment. These recommendations include:

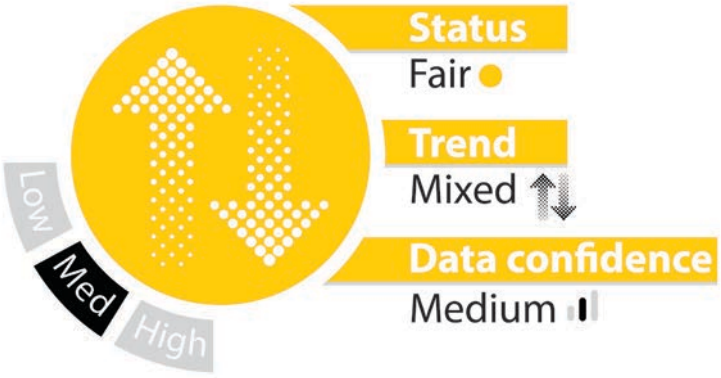
- Quantify riverflow and discharge rates in a range of watersheds;
- Quantify soil erosion impacts from infrastructure developments, such as roads, creek crossings and deforestation.
- Quantify soil erosion rates under different forest conditions (e.g. native forest versus forest dominated with invasive plants).
- Analysis of satellite, aerial or drone imagery, to study sediment plumes from watersheds after heavy rainfall events.



Manono Island. (Picture credit: © Stuart Chape)

Samoa is part of the Polynesia-Micronesia Biodiversity Hotspot, where extraordinary levels of biodiversity and endemism are found. It is also a region where high levels of threats to biodiversity exist (Conservation International 2010). Efforts to assess the state of Samoa's biodiversity have found 11 land-based and 65 marine-based species to be globally threatened. The reality is that many more species are threatened, but are yet to be assessed by experts. Some of the threats contributing to species decline include habitat loss caused by land clearance for agriculture and poorly planned developments, overharvesting of resources (e.g. logging of timber trees, hunting of pigeons and bats and overfishing) and the spread of invasive species. Our knowledge of Samoa's biodiversity continues to be improved, although there is no single treatise on the total floral and faunal species. The best enumeration for some biodiversity groups includes 2,500 insects, 770 native plants, 64 native snails, 100 bird species including 31 breeding birds, 14 reptiles and three native mammals. In the marine environment, there are 890 reef fish documented, over 200 coral species, three turtles, whales and dolphins. Marine invertebrates are poorly known, although some targeted species, such as certain holothurians and giant clams, their populations are decreasing as evident by declining harvesting numbers.

INDICATOR 1: Terrestrial species



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 12	15 LIFE ON LAND 15.5A, 15.7, 15.C	Ramsar Convention on Wetlands CMS CITES	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) 2050 Strategy for the Blue Pacific Continent	• Strategy for the Development of Samoa and Samoa 2040 • Samoa Climate Change Policy 2020 • Samoa Ocean Strategy 2020-2030 • Samoa's National Biodiversity Strategy and Action Plan 2015-2020 • National Environment Sector Plan 2017-2021

Indicator definition

Samoa's terrestrial environment provides many ecological services that have supported communities for thousands of years. The degradation and overexploitation of natural resources has serious implications for the future of all Samoans.

This indicator assesses some of the key groups of terrestrial species, particularly their population and their management.

State and Key Findings

The knowledge in Samoa's species and habitats continues to improve, largely due to biodiversity assessments being carried out in protected areas, and other key biodiversity sites. The partnerships with leading scientists, taxonomists and research institutions have helped build the capacity of local staff in species collecting and processing methods, but also in the process of identification and mapping. Long-term monitoring sites are established for future assessments. The results show that new species are still being discovered, and that some rare species that were described nearly 100 years ago, are being re-discovered (Atherton and Jefferies 2012; Edwards et al. 2017; Fisher et al. 2012; Fisher and Uili 2012). Furthermore, the population of some species continues to decline, whereas others are likely to be extinct. The threats to these species are the loss of habitat and forage sites, overharvesting of species and plants that some of the species rely on for their life-history, the widespread predation by invasive species and climate change impacts.

Bird Info Data

- Samoa is one of the richest areas for avian diversity in Polynesia, with 100 species recorded (Lepaige, 2023); it is critical that conservation efforts must be implemented to safeguard this diversity.
- National Terrestrial Biodiversity surveys carried out from 2021 to 2023 showed an overall declining trend in bird diversity and population. A few endemic species are showing a steady population, and in some cases increasing in population numbers. These species include the Iao (Wattled Honeyeater), Fuia (Samoan Starling) and Peapea (White-rumped swiftlet) (DEC-TBCS, 2023).
- Data collected at specific sites, such as along the Vaisigano Catchment Area, shows fluctuating data of bird population and species variation between 2018 – 2023 of common bird species (DEC-TBCS, Bird Butterfly and Water Lettuce Survey, 2023). On the other hand, birds of interest such as the Maomao (Large Forrest Honeyeater) has seen a drastic population increase in the area, namely Malololelei (DEC-TBCS, Malololelei Pest Management Progress Report, 2023).
- The population of the critically endangered Manumea (Tooth-Billed Pigeon) continues to be in a precarious situation with the last confirmed sightings in 2019. Recent surveys of the 2019 sighting locations failed to record the presence of the bird (DEC-TBCS, Samoa National Terrestrial Biodiversity Survey, 2023). However, a confirmed sighting at Uafato, and a recent report from Luatuanu'u (Masibalavu pers. comm.) have provided some hope that there's a population still existing in low-land forested areas. A sighting of the bird from a new site near the top of Mt Silisili was recorded in 2020 (DEC, 2020).
- The Samoa Woodhen (Gallinula pacifica) is declared extinct (Pratt and Mittermeier 2016).
- Five introduced and invasive bird species (Jungle Fowl, Common myna (Figure 8), Jungle myna, Rock Pigeon, and the Red-vented Bulbul). Efforts to control myna birds have not been successful despite repeated efforts for a number of years.
- The Seabird (Tahiti Petrel) is recorded to be nesting at inland craters. The Tropical shearwater (Puffinus bailloni) also now known to be breeding in the highlands of Upolu (Baird pers comm. 2023).
- 13 Important Bird Areas identified: Aleipata, Eastern Upolu Crater, Uafato-Tiavea, Community Conservation Area (CCA), Tafua CCA, Salelologa CCA, Falealupo CCA, Faleaseela CCA, O Le Pupū Pu'ē National Park, Apia Catchment, Central Savaii rainforest, Luatuanu'u, Nu'utele and Nu'ulua Offshore Islands.
- Some endemic species are restricted to lowland forests, whereas others, such as the Samoan White-eye (Zosterops samoensis) and the Samoan triller (Lalage sharpei) are restricted to upland and cloud forests (Pratt and Mittermeier 2016) (DEC, 2020.
- The endemic Mao or the Large Forest Honeyeater (Gymnomyza samoensis) is Endangered with around 500 individuals left. It is found in Savaii and Upolu islands (extinct in Am. Samoa), although their presence is considered patchy. Only one egg per nesting season, which slows the population growth considerably (Stirnemann et al. 2015). Efforts to manage invasive species at Malololelei have led to more sightings of the Maomao, with high presence along the Vaisigano Catchment Area (DEC-TBCS, Malololelei Pest Management Progress Report, 2023).
- The Falealupo crater is now included in the list of priority sites for further surveys, due to the potential of hosting a healthy population of the Pacific pigeon and Fruit doves (DEC-TBCS, Samoa National Terrestrial Biodiversity Survey, 2023). The site may also host the Manumea (BirdLife International specialist pers. comm.)

Figure 7: Flat billed Kingfisher. (Picture credit: iNaturalist - © Bird Explorers – (CC-BY-NC))

Key Threats to Samoa's Avifauna

- Habitat Loss (forest clearance)
- Hunting and overharvesting
- Predation by introduced invasive species (including rats and cats)
- Competition with introduced invasive species for food and nesting sites
- Extreme weather events, especially tropical cyclones, flooding and land erosion.

Figure 8: Common Myna. (Picture credit: Insel Fehman)

Land mammals

Samoa has 13 land mammals but only three are native. Of the introduced mammals, most have had a negative impact on Samoa's biodiversity, particularly the rats, cats and pigs.

Land Mammal Info Data

- Three native land mammals are found – the Samoan Flying Fox (Pteropus samoensis) (Figure 9), the Tongan Flying Fox (Pteropus. toganus) and the Sheath-tailed bat (Emballonura semicaudata).
- The Samoan Flying Fox's native distribution includes Fiji (extinct in Tonga). Roosts in small groups in secondary forests, plantations or near villages. Classified as 'Near Threatened' in the IUCN Red List. The population remains unknown, but observations indicate that the species is becoming rare.
- The Tongan Flying Fox roosts in colonies of hundreds to thousands.
- Conservation areas around Samoa are providing some refuge for the flying foxes, which are still being hunted when they forage near settlements and plantations.
- The Sheath-tailed bat (Emballonura semicaudata) is found in various Pacific island countries as subspecies, including Fiji, Micronesia, Palau, Tonga and Vanuatu. It is a priority species for conservation. It roosts in caves, sometimes with swiftlets. Classified as 'Endangered' in the IUCN Red List. It is likely that this species is now extinct in Samoa, Tonga and Vanuatu.
- A recent Flying Fox survey found relatively healthy populations especially at Fasito'o-uta (more than 15,000 recorded), with other significant sites at Uafato Community Conservation Area, Lalomanu and Tafua, each with counts of over 1,000 individuals. The majority of the population were the Tongan Flying Fox species (DEC-TBCS, National Terrestrial Biodiversity Monitoring Survey & National Flying Fox Site Assessment and Monitoring Survey, 2023). Of concern were sites that previously recorded the presence of flying foxes, and were devoid of any individuals in the recent survey. This included Falese'ela, Malololelei and Togitogiga (DEC-TBCS, National Terrestrial Biodiversity Monitoring Survey & National Flying Fox Site Assessment and Monitoring Survey, 2023).
- The ten other mammals found in Samoa are recent introductions, with some considered to be worst invasive species in the country.

Figure 9: The Samoan Flying Fox roosts solitary or in small groups. (Picture credit: iNaturalist - ©Tavita Togia – (CC-BY-NC))

Threats to Samoa's Mammals

- Habitat Loss, especially the food trees and roosting sites.
- Hunting for local consumption and for export in the 1980s, until it was banned.
- Predation by introduced invasive species (including rats and cats)
- Extreme weather events, especially tropical cyclones, flooding and land erosion. Up to 80% of flying fox population declined after cyclone Waka in 2001 (Mc Conkey et al. 2004). After Cyclone Evan in Dec. 2012, there were increased reports of illegal harvesting of flying foxes throughout Samoa. Most of the flying foxes roosted on fruit trees close to people's homes, making them vulnerable to hunters (DEC 2013).

Reptiles

Samoan reptiles include species that live in water and on land. This indicator focuses on land-based reptiles, with marine turtles discussed further in the Coasts and Marine sub-theme.

Land Reptile Info Data

- Our knowledge on Samoa's reptiles (skinks, lizards and geckos) continues to be improved following the work of Zug and Ineich (1992), Brian Gill (1993) and various BIORAP surveys (Atherton and Jefferies 2012; Richmond et al.et al. 2017; Fisher and Moeumu 2012, Kerslake and Pouli 2014).
- There are 15 reptile species: five geckos, eight skinks and two snakes. (Figure 10 – Figure 12).
- Most reptiles are widely distributed throughout the Pacific islands, with exceptions to four regional endemics. Two are introduced – house gecko and the blind snake.
- During the National Terrestrial Biodiversity (NTB) Survey, 2022, a total of 135 reptiles were recorded which included the endangered endemic Samoan Skink, Micronesian Skink, Green Skink and the Rare Pacific Boa as well as other common reptiles. However, records from the 2023 NTB survey indicated a decline in the overall recorded reptile populations, a decline in Pacific Boa sightings, and the absence of the Green Skink (DEC-TBCS, Samoa National Terrestrial Biodiversity Survey, 2023) (DEC-TBCS, Terrestrial Biodiversity Survey, 2022). This decline over a period of 1 year can be due to a number of factors with the leading theory being visibility issues during the night surveys.
- Despite the harmless nature of the Pacific Boa snake, it is often harmed or killed when they are encountered. The public would contact the Ministry after the death of a snake. There is much work needed to educate all Samoan's on the importance of the Pacific Boa to the ecosystem, and the need to protect the animal from harm.
- The highest elevation for a lizard was 1260m in the rainforest in central Savaii, but most were found at 900m and below.
- No reptiles were found above 1320m.

Figure 10: Polynesian Slender Skink (Emoia tongana), is fairly common throughout Samoa. (Picture credit: PAS)

Figure 11: Black Emo Skink (Emoia nigra). (Picture credit: PAS)

Figure 12: The Micronesian Skink (Emoia adspersa) is an endangered species. (Picture credit: i-Naturallist – CC-BY- NC ©jqrichmond)

Threats to reptiles of Samoa

- Habitat loss, including deforestation.
- Invasive species, particularly cats, rats, pigs and yellow-crazy ants.
- Competition with introduced invasive reptiles for food and nesting sites.
- Extreme weather events, especially tropical cyclones, flooding and land erosion.

Insects

Due to the high diversity of insects, the focus is on moths, butterflies and dragonflies of Samoa, in particular the species diversity and their status.

Moth & Butterfly Data

- Our knowledge continues to be improved on Samoa's butterflies and moths with every surveys carried out by international and local researchers. The work by Tennat (2006), Edwards (2010) and surveys by the GCF-VCP Bird, Butterfly and Water Lettuce Survey, and the National Terrestrial Biodiversity (NTB) have led to the development of Samoa's Butterfly Database.
- The two most commonly recorded butterflies are the Blue Moon (65 individuals at 6 sites), and the Blue tiger butterfly (197 individuals at 6 sites). Other notable butterflies were the Samoan Ranger butterfly and the Easter Pacific Albatross butterfly recorded in 2022 (DEC-TBCS, Samoa National Terrestrial Biodiversity Survey, 2023).
- Sites along the Vaisigano Catchment has shown a fluctuating trend in the presence butterfly species observed with the data peaking in 2020 and its lowest point in 2022 – 2023. This decline in individual species could be attributed to the loss of flowering host plants in the area as well as non-ideal weather during the implementation of surveys (DEC-TBCS, Bird Butterfly and Water Lettuce Survey, 2023).
- A total of 329 moth and butterfly species have been catalogued for Samoa. Many new species were found and are being described. A list of some endemics is provided in Table 4.
- One of Samoa's large and conspicuous butterflies, the Samoan Swallowtail butterfly, is now confirmed extinct from Upolu and Savaii islands. The species is still found on Tutuila in American Samoa, although its distribution is limited and remains extremely vulnerable.
- A few species that were recorded in the 1920s were recently seen for the first time since, including Exeristis pollosta, Adoxophyes libralis, Anticrates difflua, Mormecia lachnogyia, Cymodegma buxtoni, Banisia lithophora, Thylacoptila gonylasia, Odontopaschia stephanuchra, Latagognoma dacryodes. See Edwards et al. (2017) for a list of species.
- Lowland forest areas are invaded by exotic moths, including many pest species.
- Elevated areas at 1200 m have high diversity of moths and host most of the endemic genera and species. At 1650 m diversity was lower, but new records and species were higher than lowland areas.
- The genetic origin of Samoan butterflies has been mapped for 24 species (Bruschini et al. 2022). The Samoan moths and butterfly fauna appears to have a close link with Fiji montane fauna and high level of endemism. Although, the genetic origin of most of the butterflies traces back to predominantly Australia, and then from Orient- Asia (Bruschini et al. 2022). The six endemic butterfly species are: Phalanta exulans, Hypolimnas erabunda, Deudorix doris, Jamides argentina, Eurema hecabe and Papillio godeffroyii (Bruschini et al. 2022).

Threats to moths and butterflies Samoas

- Habitat loss, especially losing host plants due to extraction or land clearing.
- Invasive species, particularly ants, cats and rats.
- Competition with introduced invasive moths.
- Extreme weather events from frost conditions in upland areas to severe tropical cyclones that can devastate large tracts of lands.

Figure 13: Samoan Swallowtail butterfly – Papilio godeffroyi. (New Zealand Manaaki Whenua / Landcare Research Institute, Brian Patrick and Eric Edwards)

The endemic Samoan Swallowtail butterfly (Figure 13) was common near people's homes and gardens, but disturbances including the removal of its host plant (Talafalu – Micromelum minutum) have led to the species being extirpated from Upolu and Savaii. A small swallowtail population (estimated at 5% of its total range) is still found on Tutuila Island (American Samoa). It is vulnerable to predation and being parasitised during most of its life stages. An unidentified encyrtid wasp parasitises the eggs of the Swallowtail butterfly, and it is likely that pathogens, geckos, ants and birds will also predate on the butterfly larvae and pupae (Banko 2016).

Discussion to reintroduce the butterfly back to Upolu and Savaii from American Samoa is continuing, with the Samoa Conservation Society pursing this further (Atherton pers com. 2023).

Plants

There are a number of important publications on the flora of Samoa including the most recent Flora of Samoa (Whistler 2022), and the rare plants of Samoa (Whistler 2011).

Samoa's Flora Data

- Vascular flora is estimated at 831 native and naturalised flowering plant species.
- Samoa's flora comprises 550 native species of flowering plants, making it the second largest flora in Polynesia).
- 100 species of orchids, making them the largest family of flowering plants.
- Knowledge continues to improve, however, compared to other islands, Samoa still lags.
- The late Dr Art Whistler was the botanical expert of Samoa's flora and accumulated over 8000 specimens of Samoan' plants and published extensively. His collection is at the Bishop Museum, Hawaii.
- Recent surveys have found the talafalu, Micromelum minutum, (Figure 14), the host plant for the Samoan Swallowtail butterfly in Aopo.
- Recent surveys also found three new plant species an orchid and two shrubs.

Key Threats to Samoa's Flora

- Habitat loss
- Competition by introduced invasives
- Herbivory
- Abandonment of cultigens
- Climate change
- Landslides and floods
- Droughts and bushfires

Rare Plant Species of Samoa

- Centipeda minima
- Capparis marina
- Crateva religiosa
- Acacia simplex
- Gyrocarpus americanus
- Sida parviflora
- Manikara samoensis
- Melicope apetiolaris (sp. nov)
- Cordia aspera
- Atuna racemosa
- Xylocarpus moluccensis

Figure 14: Flowers of talafalu (Micromelum minutum), the host plant for the extirpated Samoan Swallowtail butterfly. (Picture credit: iNaturalist ©ryanthughes CC BY-NC)

Threatened and endangered species

The IUCN Red List is a globally recognised list of threatened species, whose status has been assessed by experts, and categorised from data-deficient to extinction. The number of Samoan species being assessed under the IUCN Red List continues to rise (Samoa's Sixth National Report to CBD 2018). Around 2000 species have been assessed (Table 2); mostly categorised as Least Concern. The Red List includes species that have distributional range beyond Samoa's borders, where population may be stable or healthy. However, the same species may be vulnerable in Samoa, due to localised threats. A particular concern for Samoa is the state of endemic and native species that are of cultural importance. When species status is categorised as Critically Endangered, such as the Manumea (Tooth-billed Pigeon), there is grave concern for its existence. Twelve species found in Samoa are listed as Critically Endangered, representing around one per cent of Samoan species assessed under the IUCN Red List (Figure 15).

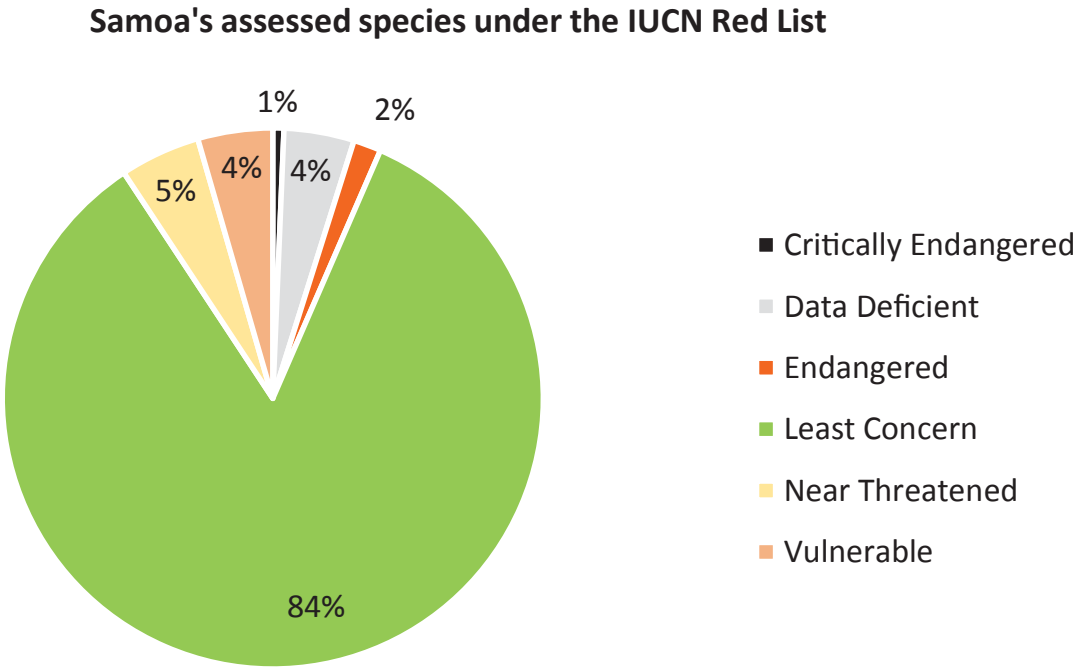


Figure 15: Distribution of IUCN Red List species from Samoa. (IUCN Red List – www.iucnredlist.org)

Table 2: IUCN Red List of Samoan species in order from most high risk to data deficient. (IUCN Red List – www.iucnredlist.org)

IUCN RED LIST CATEGORY	SPECIES NUMBER
Critically Endangered	12
Endangered	27
Vulnerable	81
Near Threatened	87
Least Concern	1524
Data Deficient	76
Species Total	1822

Critically Endangered and Endangered species

There are 12 species reported from Samoa that are at extreme risk of becoming extinct (Critically Endangered) (Table 3), and 27 species that are Endangered, or are at a very high risk of extinction.

Table 3: Samoa's Critically Endangered species as assessed under the IUCN Red List. (IUCN Red List)

SPECIES	COMMENTS
Clinostigma savaiiense | Niu vao	This tree is endemic to Savaii in a restricted distribution from montane to cloud forest at 900-1600 m elevation. It is only found in one location. The species is threatened by the loss of dispersers and pollinators.
Cryptocarya samoensis	This tree species is endemic to Upolu and Savaii, and has a restricted distribution. Not much is known about this tree, as most of the information is based on a 1931 collection. The tree grows in lowland to montane forests, which are constantly under threat of deforestation and habitat destruction.
Didunculus strigirostris | Manumea	The Manumea's population is extremely small and sighting of the birds continue to be rare. The threats are largely human driven, either by direct hunting, or the degradation of its habitat and food source. Invasive species are also a threat to this national bird.
Eua mauga | Mauga land snail	This species is restricted to a single site on Upolu's upland forest (covering less than 10 km^2), and it has been under threat from habitat loss and degradation, and the Platydemus manokwari flatworm. Likely to become extinct.
Manilkara samoensis | Pau	This species has a restricted range on the western end of Savaii, at the Falealupo Peninsula (Atherton 1999; Whistler 2011, Armstrong 2013). Overharvesting of this species, together with its vulnerability to tropical cyclones, places the population in jeopardy.
Pareudiastes pacificus |(formerly Gallinula pacifica) | Samoan Moorhen	This species has not been seen since 1873, and is likely that it is extinct due to predation by cats, rats, pigs and dogs, and hunting.
Samoana stevensoniana | Stevenson's snail	This rare snail is endemic to Savaii and Upolu. The most recent survey in 2012, found the snail at one site on Savaii. Its presence on Upolu is becoming tenuous, and recent surveys have failed to find any (Gerlach 2016); the species may already be extirpated from Upolu. Platydemus manokwari was introduced to Savaii in 2001 and was present on Upolu in 1998. This invasive species is known to predate on land snails in this family in other Pacific Island countries.
Balaka insularis | Palm	This is a rare palm that is endemic to Samoa. It grows in wet upland areas (above 500 m). A similar species, Balaka tahitensis, is also endemic to Samoa, with a similar distributional range, however, it has not been assessed under the IUCN Red List system.
Pseudobulweria becki | Beck's Petrel	A critically endangered species with a declining global population; the last count was 300 individuals at Silur Bay (Solomon Islands), in 2016. Predation by cats and rats is one of the key factors of its decline. There is no recent record of this seabird from Samoa, although the IUCN Red List includes Samoa in its geographic range.
Carcharhinus longimanus | Oceanic whitetip shark	The Oceanic Whitetip Shark Carcharhinus longimanus is a large, wide-ranging, oceanic species, distributed from tropical to temperate seas worldwide. The species is caught globally as a target or bycatch species. Steep population declines have occurred in all oceans. The Oceanic Whitetip Shark was once one of the most abundant pelagic shark species in tropical seas worldwide but is now rare in some regions.
Eretmochelys imbricata | Hawksbill Turtle	Throughout its distributional range, there is extensive decline in the Hawksbill's population, due to overexploitation, degradation of nesting habitats, fishing impacts, and degradation of marine habitats.
Dermochelys coriacea | Leatherback Turtle	The geographic range of this species is wide, from the China Sea, to north America and the South Pacific. Samoa is included in its range, although it is rarely encountered. The population continues to decrease, similar to the Hawksbill Turtle.

There are many Samoan species that need to be assessed, revised and updated on the IUCN Red List, to reflect their current risk of extinction. For example, 33% of Samoan butterflies are endemic, and most are at a high risk of extinction (Patrick and Edwards 2011). These endemics are not on the IUCN Red List, except for the Samoa Swallowtail butterfly (Papilio godeffroyi) that is listed as Endangered (also refer to Insects above). No doubt a revision would elevate the risk of extinction for the Samoa Swallowtail to Critically Endangered, given that it is extirpated from Samoa (Upolu and Savaii islands), with a remnant but small population on Tutuila Island (American Samoa). The endemic Samoan butterflies that are vulnerable to extinction are listed in Table 4.

Table 4: Samoa's endemic butterfly species that are considered to be vulnerable to extinction. (Patrick and Edwards 2011)

SPECIES	COMMENTS
Acraea andromacha	Glasswing – subspecies from Samoa only).
Oriens augustula alexina	Samoan August Dart. Endemic subspecies.
Hypolimnas errabunda	Samoan Eggfly Butterfly. A Samoan endemic species. The caterpillars eat Cypholophus microcephalus.
Phalanta exulans	Samoan Ranger. Endemic to Upolu and Savaii. The larvae feed on Melicytus samoensis a forest tree scattered throughout the remnant native forest at 350 m elevation.
Deudorix doris	Samoan cornealian. Endemic.
Papilio godeffroy	Pepe ae / Samoan Swallowtail butterfly. Endemic.
Appias athama manaia	Eastern Pacific Albatross Butterfly – the subspecies is endemic to Samoa and Tonga.
Jamides argentina	Samoan Cerulean Butterfly. The species is endemic to Samoa and Niue.
Euploea algea schmeltzi	Samoan Crow Butterfly. Subspecies is endemic to Samoa.
Tirumala hamata melittula	Blue Tiger Butterfly. Subspecies is endemic to Samoa.
Hypsipyla swezeyi	A Samoan Snout Moth that is endemic.
Latagognoma dacryodes	A Samoan endemic species. First recorded in 1924.
Odontopaschia stephanuchra	Pyralid Snout Moth - A Samoan endemic species that was first recorded in 1925.
Thylacoptila gonylasia	A Samoan endemic species. First record since 1924.
Ambia ellipes	Larvae in this genus are often on wetland plants. Endemic to Samoa. First record of this moth since 1924.
Ambia tendicularis	Larvae in this genus are often on wetland plants. Endemic to Samoa.

It is important to reflect that while the IUCN Red List provides an indication of the state of selected Samoa's species, there are many gaps. Some species such as the endemic Samoan Dragonfly, Hermicordulia cupricolor, is assessed as 'Data Deficient' on the IUCN Red List, when the data indicate the species to have a very restricted distribution in the high altitude zone of Savaii (a single island) (Marinov et al. 2013), and its population is vulnerable to extinction, especially to a severe cyclone. Such a species deserves a higher ranking, such as 'Endangered'.

If Samoa is to prevent the extinction of its biodiversity, urgent actions are needed to assess the population of these species, to understand the basic biological and ecological information, and to undertake conservation measures, such as public awareness and advocacy. Species extinctions have already occurred in Samoa. For example, the Pacific Sheath-tailed Bat (Emballonura semicaudata), the Samoan moorhen (Pareudiastes pacificus) (Waldien and Scanlon 2021), Horse Hoof Clam (Hippopus hippopus) (Skelton et al. 1998), and the Samoan Swallowtail butterfly (Papilio godeffroyi) (extinct from Upolu and Savaii islands).

Impacts

The threats to Samoa's biodiversity are the degradation and loss of habitats, the spread of invasive species, as well as their predation on native species, and the overharvesting and destructive activities that impact native species directly or indirectly. Increasingly, natural disasters, including climate change influenced extreme weather events, have added to the threats. Tropical cyclones are particularly devastating to forested sites and other key habitats for native species. Tropical cyclones often defoliate forest trees leaving them bare for many weeks. This provides open spaces for faster growing introduced species to gain foothold in forested sites, and proliferate.

Figure 16: New Guinea Flatworm, an introduced invasive species that predates on native snails. (Picture credit: iNaturalist ©mcano – CC-BY-NC)

Invasive species are particularly harmful to native biodiversity, such is the impact of the New Guinea flatworm, Platydemus manokwari, (Figure 16), which has contributed to the extinction of many native and endemic snails in Samoa, and throughout the Pacific islands (Fisher and Ineich 2012). Feral cats and rats predate on birds, chicks and eggs, as well as reptiles (skinks, turtle eggs and hatchlings, and lizards). Feral pigs disturb forests, when rooting for food, by eating roots and shoots of many native plants and are a threat to any burrowing nesting seabirds in the Procellarid family.

The clearing of forested areas for agriculture and settlement is also reducing the habitat for some of the species, especially birds and lizards. This encroachment is pushing species to be more exposed, and thus more vulnerable to being hunted by people, and predated on by invasive species.

The ecosystem services provided by many of Samoa's species are often taken for granted. The failure to recognise the role of these species in supporting livelihoods, economic activities and human wellbeing can have serious consequences on the species, and therefore on the development of policies and decision-making (Ram-Bidesi et al. 2021).

Samoa's biodiversity has taken many years to evolve and adapt to their environment. Many species rely on other species for habitat, food and part of their biological life-cycle. The Samoan Swallowtail butterfly's relationship with the Talafalu shrub demonstrates this reliance and connection amongst native species. Any threat to native species can have devastating impacts on other species. The extirpation of the Samoan Swallowtail butterfly may be partly due to the loss of habitat and cyclones (Patrick et al. 2018).

As more species become extinct, a part of Samoa's natural heritage is also lost. Some of the species are of cultural importance, and are often incorporated in traditional ceremonies, and in legends. When species become rare, it indicates that the ecosystem is losing many of the parts that serve to provide services for humanity. The economy will suffer, as well as society. The threats to Samoa's species and ecosystems have largely been driven by human actions. Climate change looms as the biggest threat and driver to loss of ecosystems and ultimately, the loss of species.

Response

Samoa is an active participant at the global level in advocating for the protection, conservation and wise use of natural resources to sustain its current and future population. Through a partnership and collaborative approach with other Pacific island countries, Samoa is able to voice its concern on issues that are important to its people and its environment at international forums (e.g. Conferences of Parties to the CBD). Samoa's bilateral and multilateral relationships with its development partners have assisted in securing the much-needed resources to undertake conservation activities. This has helped to enhance the knowledge on Samoa's ecosystems and biodiversity, as well as building the local capacity to lead these activities.

The Ministry of Natural Resources and Environment is one of the key agencies responsible for safeguarding the country's environment and natural resources. Mainstreaming the environmental agenda at the national level, has ensured that other agencies consider the environment in their respective roles and responsibilities. Many of these agencies are engaged with communities to raise awareness on the various aspects of the environment and biodiversity conservation.

The National Biodiversity Strategy and Action Plan is the blueprint for biodiversity protection, conservation and sustainable use. The protection for some of Samoa's endemic flying species is under the Protection of Wildlife Regulations 2004, stating that no person shall harm any flying species endemic to Samoa. Some of Samoa's response to addressing biodiversity includes developing Recovery Plans (Manumea Recovery Plan and the Mao Recovery Plan 2006, and undertaking regular monitoring for threatened species such as the Tooth-billed Pigeon, the Forest Honeyeater, and rare plants.

Biodiversity assessments over the past 10 years have built the capacity of local staff in the areas of species identification and species interactions with the environment, but also species distributions through GIS mapping. The assessments have provided an updated knowledge on the state of Samoa's native species, and confirm old records collected nearly 100 or more years ago. They also confirm that some of the vulnerable species continue to face enormous pressure, especially from invasive species, climate change impacts and unsustainable harvesting. Capacity building

through hands-on participation at rapid assessments and surveys has allowed MNRE staff to independently carry out assessments on Samoa's KBAs.

The important contributions of international, regional and local NGOs in raising awareness on the decline of many species, as well as the degradation of the environment cannot be understated. Many of these partners assist the Government of Samoa in raising funds, building and enhancing local capacity, and undertake research, surveys and other monitoring initiatives in key biodiversity areas. The Samoa Conservation Society in particular has been leading the work on surveying and mapping Samoa's rare plants, undertaking propagation and display at the Vailima Botanical Gardens and the NUS Peace Garden, developing rare plant nurseries at Aopo and Falealupo, and supporting the development of village conservation areas on Upolu and Savaii island. The Society has been leading the work to locate and protect the Manumea (Manumea campaign), as well as research into the state of the Mao bird. Managing invasive rats is also a key focus of the Samoa Conservation Society.

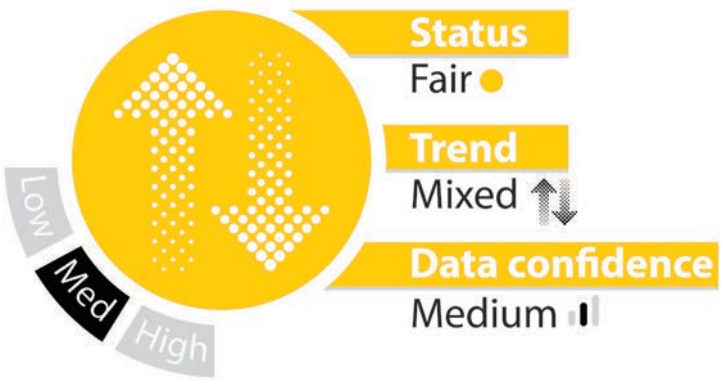
The identification of Key Biodiversity Areas, provides target priority sites for biodiversity assessments. Some of the KBAs have been assessed including the Uafato-Tiavea Coastal Forest, (survey 2016), the Falealupo Peninsula (survey 2016), the Upolu Craters (Vaipu survey 2016), Aopo Central Savaii (2012), and the Central Savaii Rainforest (survey 2012). Some of the KBAs have some level of protection, either through community actions or as government designated national parks (e.g. Lake Lanoto'o NP and O Le Pupū Pu'ē National Part).

Rare plants are being surveyed and collected, with the aim of propagating them. The plants include Clinostigma samoense, Manilkara samoensis, Alectryon samoensis and Vavaea samoense. Niu Vao - This is a target species for Samoa's national native species nursery propagation programme spearheaded by the Samoa Conservation Society with the support of MNRE through the divisions of DEC and Forestry. The objective is to improve population size and distribution where possible.

Recommendations:

- The introduction of exotic species for economic development must be closely scrutinised to ensure that efforts to preserve native and endemic species are not compromised. Enhanced biosecurity measures to reduce and prevent the introduction of invasive species should be prioritised. Implementing the National Invasive Species Strategy and Action Plan should also be a priority.
- In-situ and Ex-situ options to preserve vulnerable native species must be explored and, where feasible, must be prioritised for action. This should include the re-introduction of the endemic Swallowtail Butterfly to Samoa, as well as replanting of native plants.
- Conservation, in the context of Samoa, is long-lasting when a village council takes charge, and the participation of villagers is prioritised and facilitated. Engage local communities and empower them to put in place conservation measures and to promote sustainable use of their natural resources.
- Conservation areas should include pristine ecosystems (such as primary forests) that provide a variety of habitats and food sources for native species. Addressing the key threats to Samoa's endemic species will require the protection of key biodiversity areas, especially for birds and other vulnerable groups.
- Undertake targeted research on many vulnerable groups of species, such as avifauna, to enhance knowledge for better conservation measures and outcomes. The recent discovery of the tropical shearwater on Upolu suggests that there could be more procellariid seabirds breeding in Samoa than is currently known.
- There is a need to re-survey many of the areas that were visited by early researchers. Rapid biodiversity assessments have proven successful in augmenting current knowledge, as well as building local capacity. These surveys need to continue including building and retaining local capacity.
- Where feasible use new and effective technology to assist with biodiversity surveys. For example, using acoustic recorders are relatively cheap and easy to undertake and should be a priority to discover breeding sites for management and protection of seabirds.
- Addressing key environmental threats including banning the hunting of vulnerable endemic species. Monitor the harvesting of resources that endemic species rely on.
- Review and update conservation policies, plans and legal instruments, to ensure that any shortcomings are addressed and that resources, including funding and capacity are secured.
- Developing a national threat ranking system, which will better reflect the risk faced by Samoa's native species, which can work in parallel with the IUCN Red List system.
- Improve the data management system for Samoa's biodiversity, so that information can be easily accessed to assist with monitoring and reporting.
- Raise awareness of the public on the importance of nature reserves and actions they can do to assist with protecting Samoa's biodiversity.

INDICATOR 2: Water catchments and water resources



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8 14 15	6 CLEAN WATER AND SANITATION 14 LIFE BELOW WATER	Ramsar Convention on Wetlands UNFCCC	SAMOA Pathway (64)	• Pathway to the Development of Samoa • FY 2021/22 – FY 2025/26 • National Environment Sector Plan 2017-2021 • Water For Life Sector Plan • FY 2020/21 – FY 2024/25 • National Water Resources Management Act 2008 • National Water Resources Management Regulations 2013 (Amendment Regulation in 2020) • National Water Abstraction Licensing Regulations 2013 • Village Bylaws and Watershed Management Plans

Indicator definition

Water-related ecosystems are critically important to the sustainability of environmental services, and provide social and economic benefits to communities and the entire country. Some of these benefits include the provision of drinking water and sanitation, maintenance of aquatic habitats to support biodiversity and fisheries, water supply for key sectors such as energy and agriculture, and recreational opportunities. Due to the important roles of clean water, important water-related ecosystems must be protected and restored.

There are many challenges in establishing trends and the overall status of Samoa's water resources over time. Water quality and quantity are highly affected by the seasonality of rainfall, climate change, sea level rise, geology, topography, natural disasters, varying locality demands, land-use management, and others.

Furthermore, there are still limitations to the available data and information, as water monitoring networks and capacities continue to be improved and expanded to cover the whole of Samoa. Groundwater particularly is challenging to monitor given its reserves and dynamics are not visible at the surface.

The following sub-indicators highlighted in Table 5, are an attempt to establish some status and trends for Samoa's water resources over time, through available water quality and water quantity monitoring data.

Table 5: Water resources indicators and parameters.

INDICATOR TYPES	DEFINITION	PARAMETERS
Water Quantity and Extent (availability and demand)	• Hydropower generation-surface water abstraction. • Groundwater quantity abstraction; • Headwater extent tracking changes over time to water ecosystems using aerial imagery of surface water bodies such as lakes.	Mega Liter (ML) Mega Liter (ML) ha
Water Quality	Surface water quality for monitored rivers and coastal springs.	E. coli (cfu/100ml), Faecal coliform (cfu/100ml), Enterococci (cfu/100ml), Conductivity (S/m), Salinity (ppt), Total dissolved solids, Dissolved oxygen (ppm), Temperature (oC) pH
Watershed Management	Hectares of watershed areas managed.	ha

State and Key Findings

The water resources of Samoa consist of a combination of surface water streams within steep sided small watersheds, and groundwater resources within permeable volcanic strata. The distribution of these two types of water resources is highly variable on both islands, primarily controlled by the age of the underlying volcanic geology, and the consequent amount of the rock weathering to clays, which prevents groundwater recharge and promotes rapid surface water runoff. As the oldest rocks are in eastern Upolu island, this area is dominated by surface water courses, whereas western Upolu, and Savaii island, which have younger and therefore less weathered rocks, have little surface water but widespread groundwater. Accessing deep groundwater is problematic in Samoa, and hence groundwater is mostly exploited within 5 km from the coastal area.

Some of the watersheds have seasonal surface water flows, only limited to the wettest times of the year, whilst others exhibit storm event runoff only. These ephemeral surface waters are mostly limited to central Upolu and eastern Savaii island. The availability of surface water during the dry season is highly variable, depending on the size of the watersheds (which are small).

Figure 17, shows the distribution of perennial (year-round) surface water, ephemeral (seasonal) surface water and accessible groundwater. Groundwater is accessible in northwest Savaii but it is mostly saline, and communities there rely mainly on rainwater and piped supplies from along the coast. Recent production boreholes have been established further inland at Falealupo, Neiafu, Sataua and Asau with pump testing conducted to determine safe yields, which will ensure sustainable water supply from this sensitive aquifer.

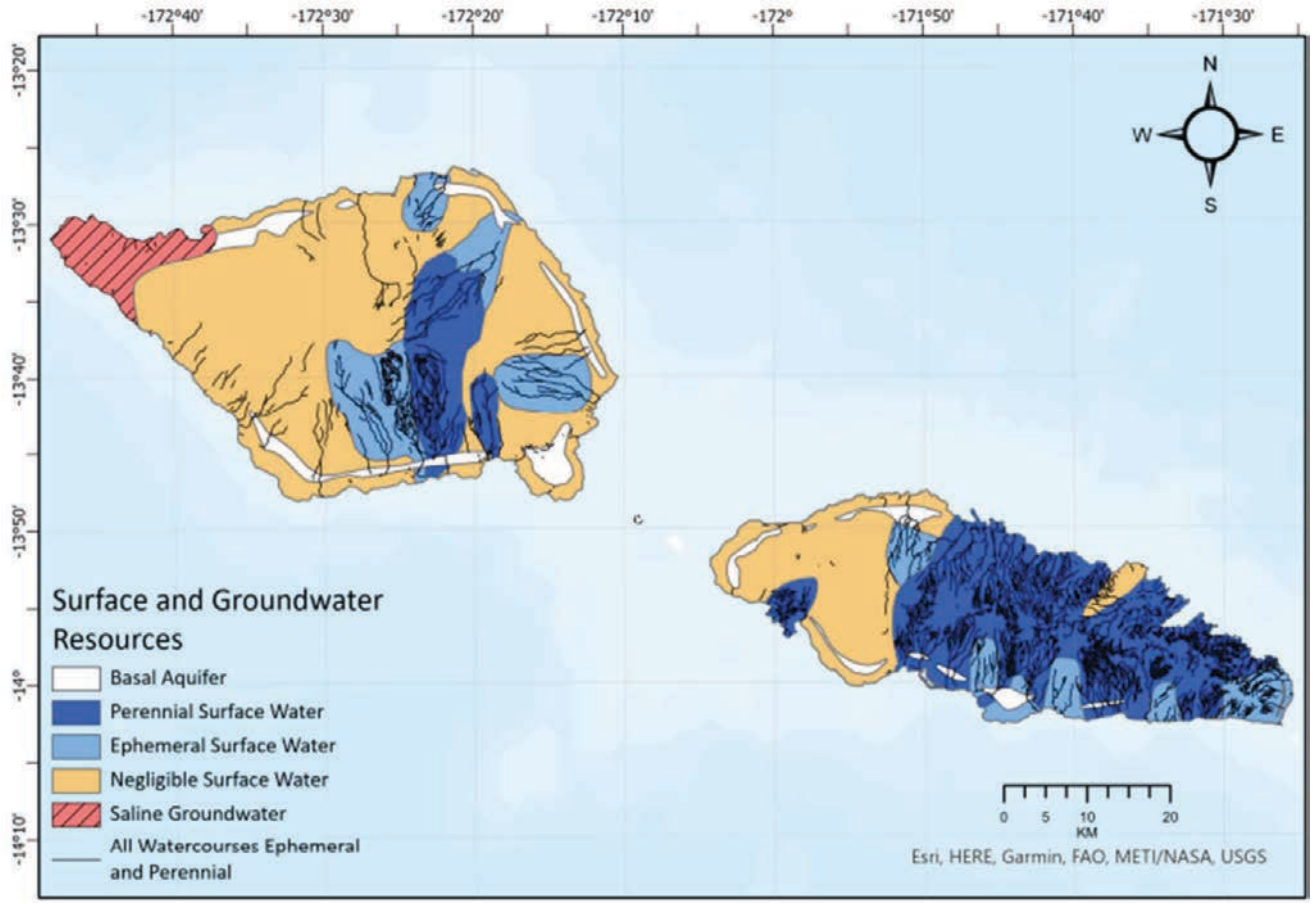


Figure 17: Landscape characterised by groundwater and surface water resources (MNRE 2023)

Water Resources Availability

Rainfall is the primary mechanism by which water enters each watershed and aquifer. Establishing the volumes of rainfall per year, and the variability in the rainfall inputs both seasonally and annually, and especially during dry periods, is essential to assessing water availability in each watershed and aquifer basin.

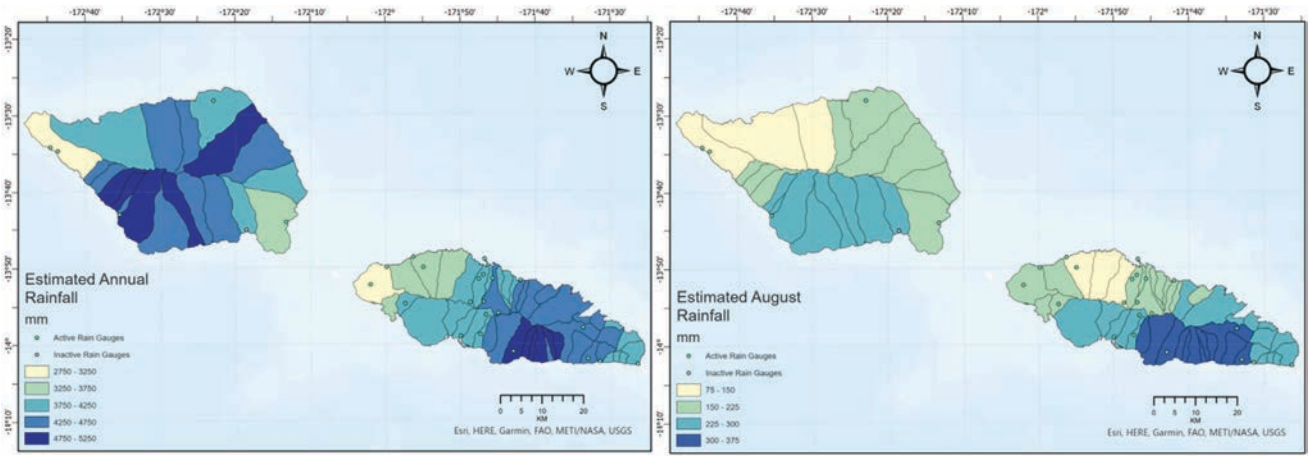


Figure 18: Estimated average annual rainfall (left) and average August rainfall per watershed in mm/yr. (MNRE 2023)

In 2021, an estimation of the average rainfall per watershed in mm/year was conducted with the support of GWP Consultants, during the development of the Draft National Water Resources Management Plan 2023. It also looked at estimating effective rainfall, which is rainfall remaining after evaporation, a measure of rainfall contributing to surface water stream flow and to recharge aquifers (MNRE 2023). Figure 18 shows the average annual rainfall and the average August rainfall, selected as

the driest month for each watershed, estimating water availability in the dry months.

Annually the wettest watersheds receive 50% more rainfall (> 4,500 mm/yr) than the driest watersheds (< 3,000 mm/yr). Approximately 75% of the watersheds, including most of Savaii (except for the central southern catchments) and northwest Upolu, are defined in the lowest rainfall category during the driest month, typical of Samoa's small and steep watersheds, whose low flows reduce rapidly in the dry season (MNRE 2023).

This is further demonstrated by the annual average surface water flow (rivers/streams) as well as estimated sustainable groundwater yield per watershed (Figure 19).

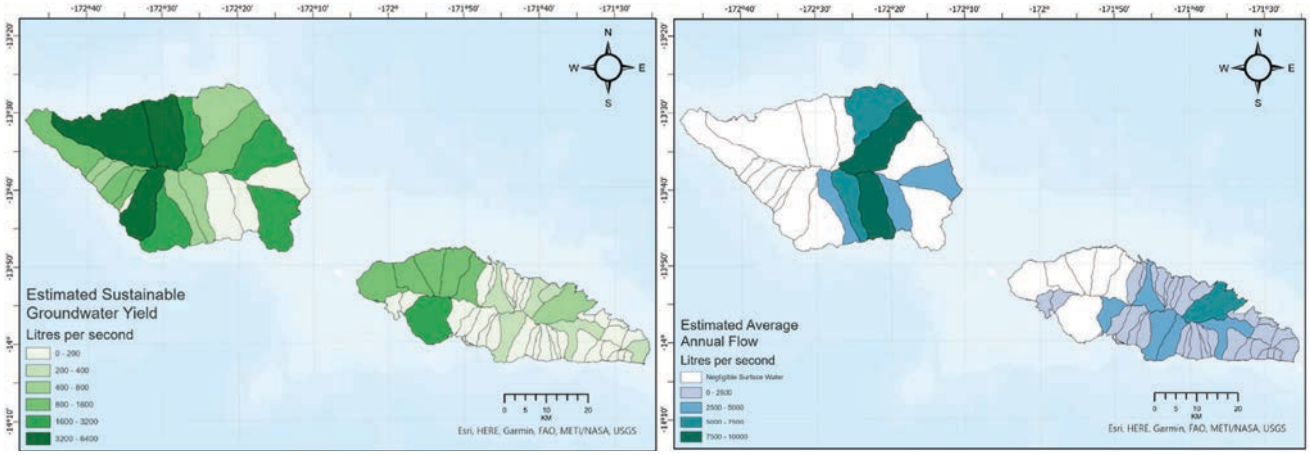


Figure 19: Estimated average flow (left) and groundwater yield (right) per watershed in l/s. (MNRE 2023)

It is envisaged that as monitoring of water resources and amount of data expand, the reliability of the information will increase, thus allowing for more comparisons into the future, to indicate trends associated with climate change and natural disasters, as well as impacts of development and land-use change on the different watershed areas.

Water resources demand and abstraction

There has been a steady increase in the demand for water resources over the years as recorded by the Samoa Bureau of Statistics (SBS) Annual Water Accounts, and the MNRE through its Water Abstraction Licensing Scheme (WALS). Hydropower (non-consumptive use) and water supply (consumptive use) are the major uses of water, constituting about 72% and 24% of the annual demand, respectively (Figure 20).

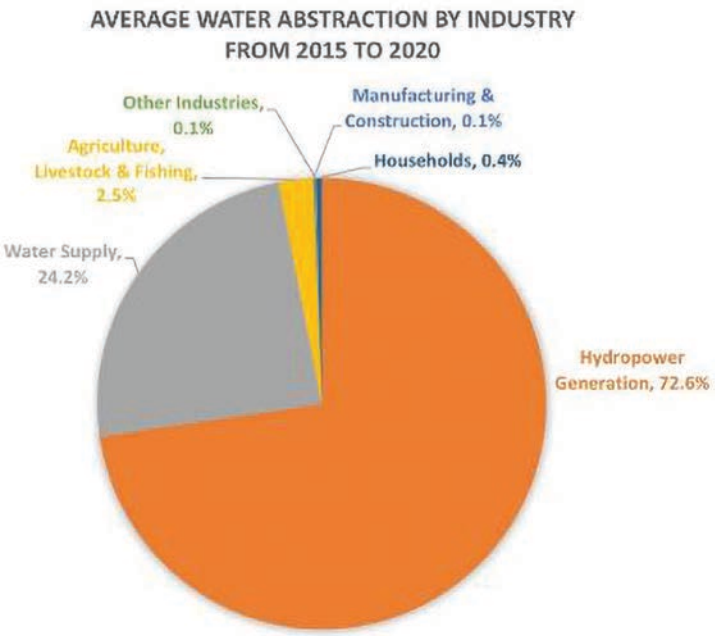


Figure 20: Estimated annual average water abstraction by industry (SBS 2020)

Table 6 shows an increase in water resources demand for hydropower generation since 2015, with a significant surge after 2018, following the successful commissioning of the first hydropower station on the big island of Savaii in Palauli, and the Tafitoala Hydropower Scheme in the south coast of Upolu. Prior to these new stations the average abstraction was recorded at 80 GL/year, the current demand is now 110,000 GL/year. As part of the WALS, a total of eight hydropower plants and operations have been licensed, and new schemes will result in more surface water resources being abstracted to generate electricity.

Table 6: Total water abstraction in Samoa: 2015-2016 to 2019-2020, in ML (SBS 2020)

	2015-16	2016-17	2017-18	2018-19	2019-20
Total Abstraction by Water Type	**101,836**	**82,530**	**114,144**	**163,005**	**136,951**
Surface Water	93,335	74,045	106,846	155,587	129,212
Ground Water	7,912	7,843	6,634	7,147	7,448
Rainwater (a)	589	641	665	272	291
Total Abstraction by Industry & Households	**101,836**	**82,530**	**114,144**	**163,005**	**136,951**
Industries	101,247	81,892	113,482	162,733	136,660
Electricity	68,130	50,180	80,050	130,060	106,230
Water Supply Industry	29,727	28,164	29,949	28,783	28,180
Agriculture, Livestock & Fishing (b)	3,127	3,277	3,393	3,538	1,899
Manufacturing & Construction	83	92	66	333	297
All other Industries	180	180	25	19	54
Households	**589**	**637**	**662**	**272**	**291**

Estimated total volume of abstraction for water supply has been consistent from 2015-2020 between 28-29 GL/year, significantly from surface water sources. Trends on water abstraction may indicate an abundance or shortage of available water resources for some of the major water uses annually.

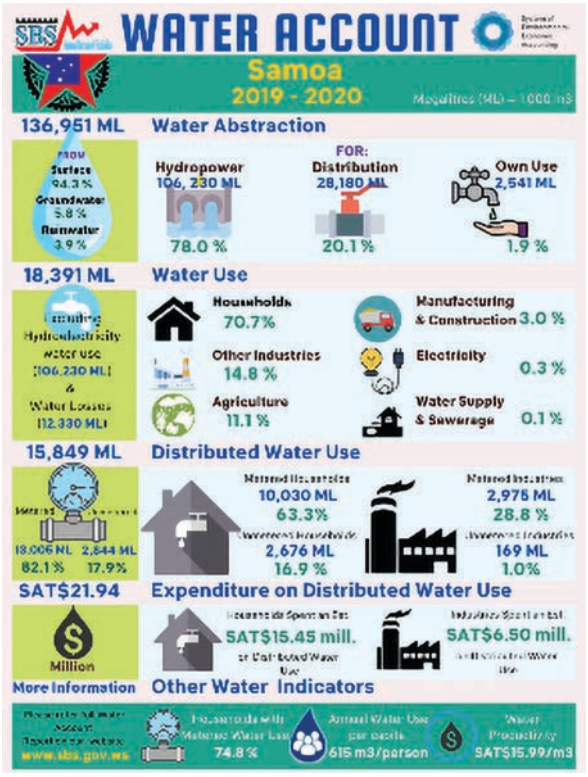


Figure 21: Samoa water account 2019-2020 (SBS 2020)

Water abstraction also varies with the seasons. Figure 21 features hydropower surface water abstraction for each of the monitored schemes from 2019-2022. It indicates correlation between peak surface water abstraction and the rainy season in Samoa, when the average rainfall and average flows within the main river systems are higher.

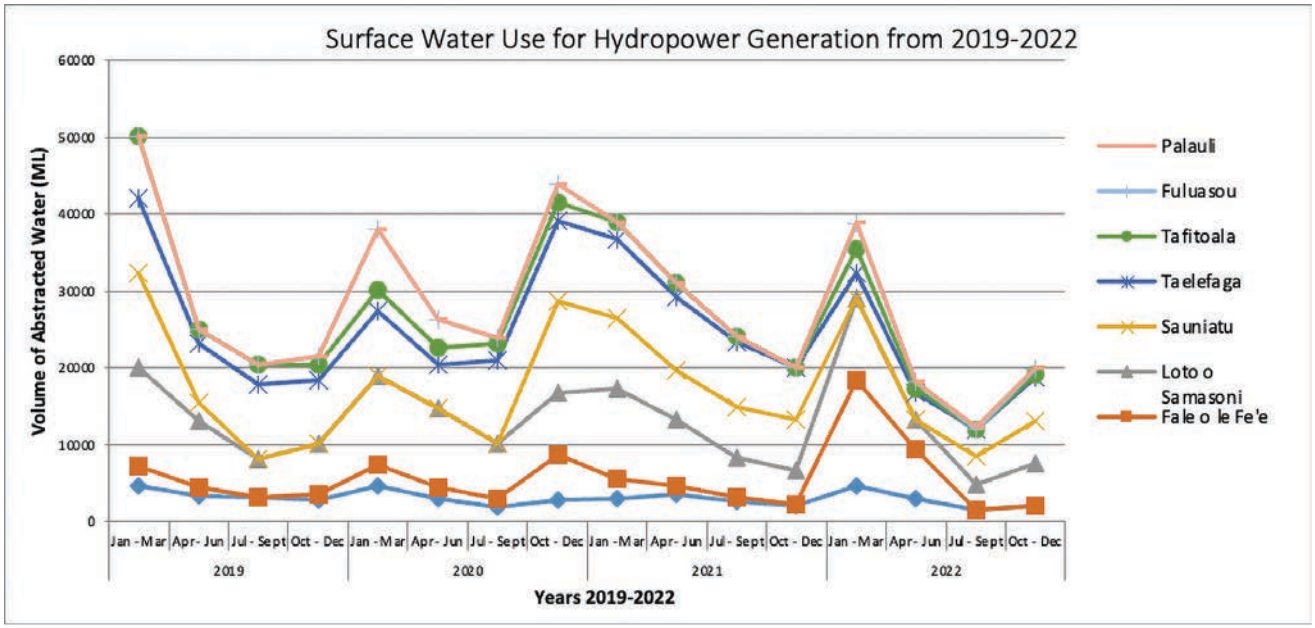


Figure 22: Water abstraction for hydropower generation (MNRE WALS)

Whilst surface water sources account for much of Samoa's water needs (93.4%), groundwater sources (6.2%) and rainwater harvesting (0.4%) are also significantly important for areas where there are no rivers, springs or services by water reticulation networks.

A total of 51 groundwater abstraction licenses have been issued under the WALS, with more than 80% issued for the main water supply utility, the Samoa Water Authority (Figure 23).

The administration of the WALS has seen an increase in the amount of regulated water use from Samoa's groundwater aquifers, with an average of 75,000 Megalitres (ML) of groundwater abstracted annually by various users (Table 6 and Figure 22).

Groundwater sources provide approximately 23% of annual average water supply distribution so far. This is expected to rise as exploration of sustainable groundwater aquifers increase, as more and more surface water sources become affected by natural and human induced impacts.

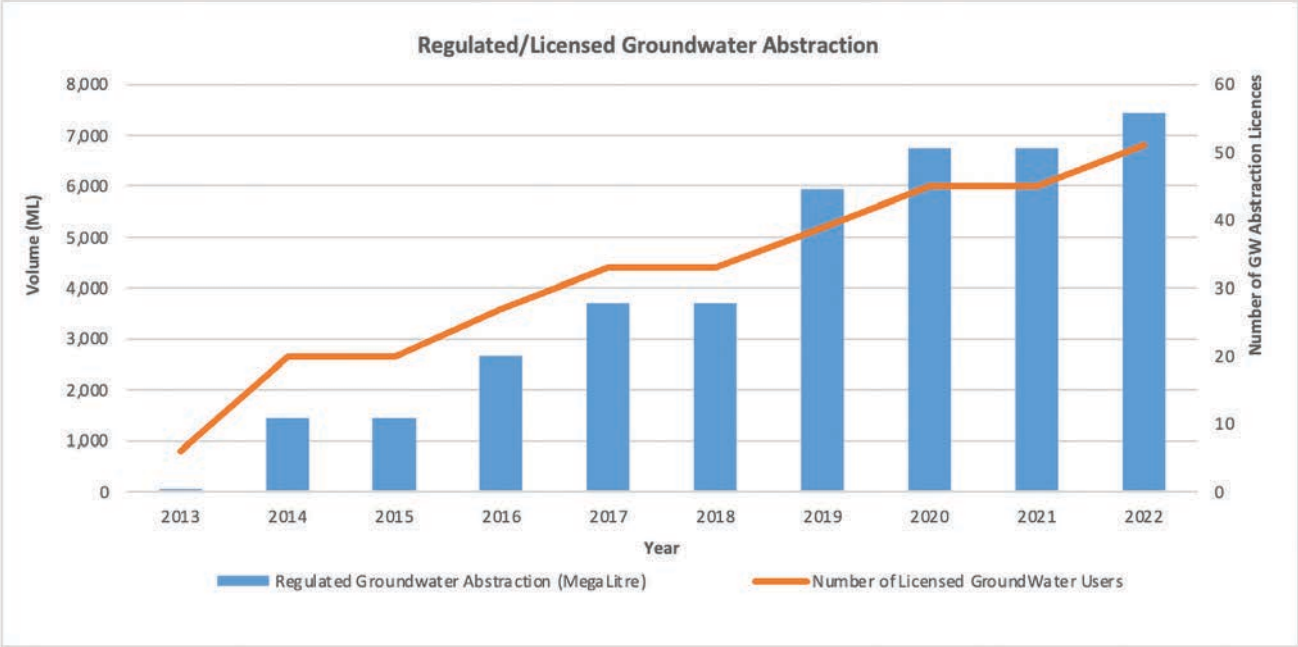


Figure 23: Volume of groundwater abstraction through approved licenses (MNRE WALS)

Water-related ecosystems

The UN Water in 2016 approximated the spatial extent of Samoa's water-related ecosystems using earth observation data. These ecosystems include lakes, rivers, estuarine and artificial water bodies, such as the Afulilo lake and hydropower/ water supply reservoirs, and was conducted as part of SDG-6 reporting. Figure 24 highlights the declining area of open water extent in the last 15 years if compared to pre-2005. However, it is important to note that the total area of decline is considered negligible at less than 1.5%.

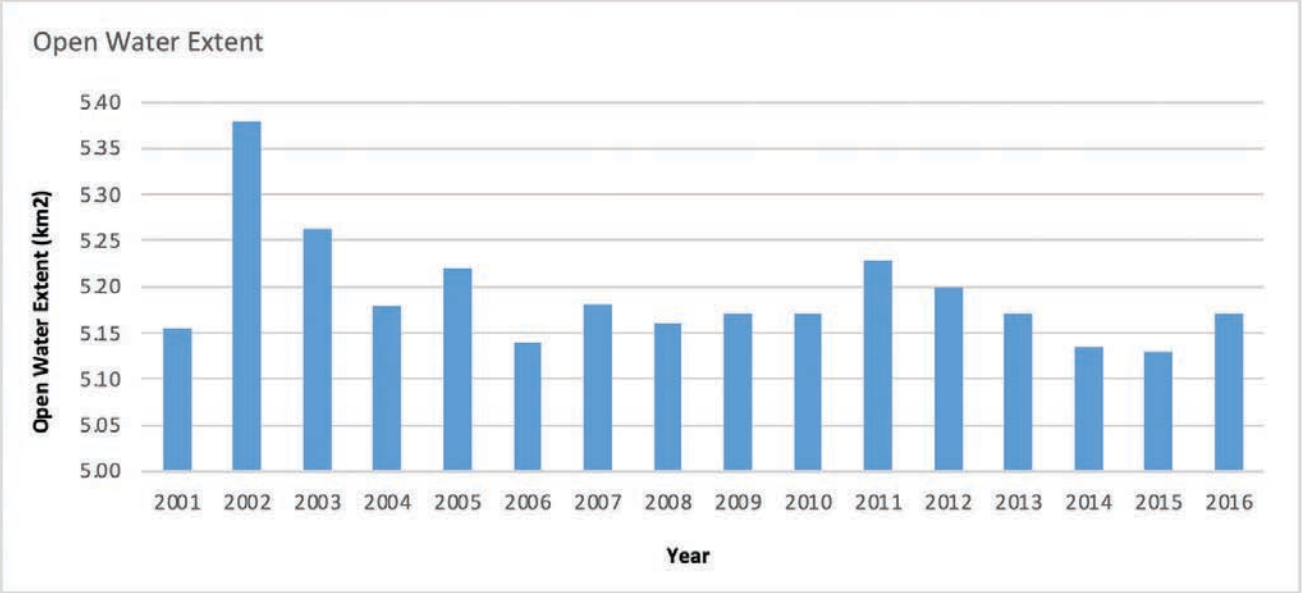


Figure 24: Estimation of Samoa's open water extent coverage from 2001-2016 in km^2 (UNEP/UN Water: https://www.sdg6data.org/en/tables).

The update for post-2016 with national data (Table 7) indicates a decline in open water extent areas for some lakes.

Table 7: Spatial area extends for Lake Lanoto'o, Lanoanea and Lanoto (MNRE)

LAKES	2015	2018	2023	% CHANGE	NET LOSS/GAIN
Lanotoo	11.62	11.45	11.48	1.20	Loss
Lanoanea	1.23	1.65	0.91	26.02	Loss
Lanoto	3.18	9.04	2.19	31.13	Loss

Lake Lanoto'o is a significant landmark and a Ramsar site (See INDICATOR 5: Lands and land resources). It is considered the headwater for most of the urban rivers that supply not only the entire Central Business District and industries, but also a large expanse of the northwestern villages of Upolu island, towards Faleolo Airport. Lake Lanoto'o was used as a supplementary source for water supply to the new settlements after the 2009 tsunami. Figure 25 illustrates a spatial comparison between the area extent of Lake Lanoanea, using 2015 LiDAR images and the 2023 Google Earth image.

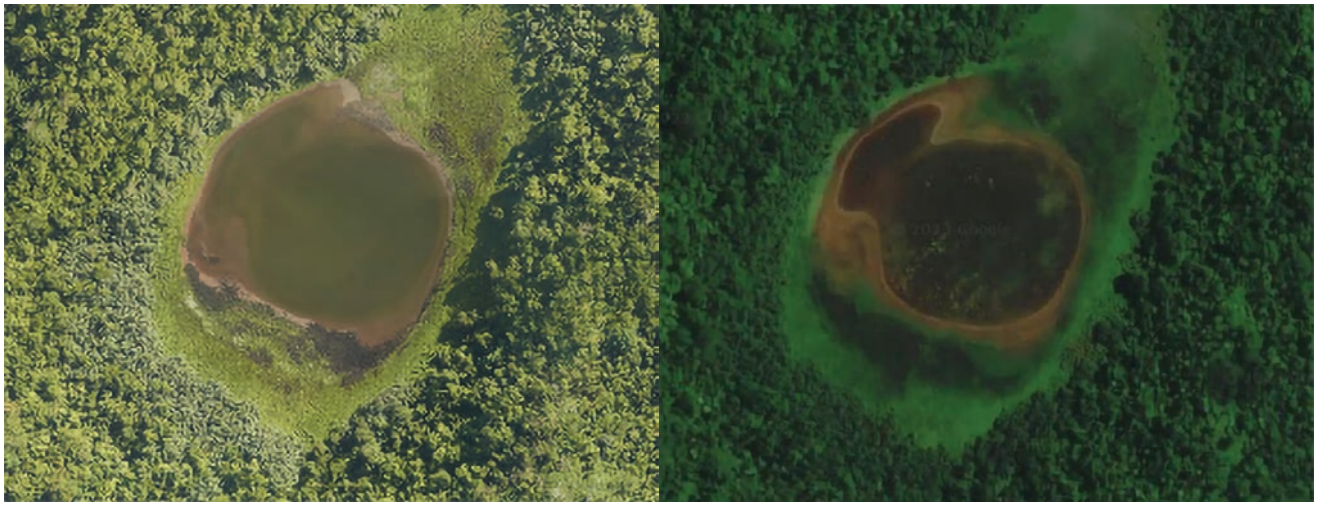


Figure 25: Spatial images of Lake Lanoanea in 2015 (left) and 2023 (right) showing a decline in water area (MNRE and Google Earth).

Water Quality

Microbiological assessment of river water quality took place in 2015 and 2017 through the Water and Sanitation Sector Research Initiative Program. The studies were carried out over a number of months to get seasonal variation. The presence of total and faecal coliform was evident in many of the rivers, providing evidence of pollution from human activities (Amosa 2017). Faecal contamination was determined to have originated mainly from humans, with some proportions from ruminants and birds. Land use maps were used to try and determine the source of the pollution. The results indicated that high faecal coliform counts were from sites close to houses, latrines and piggeries. Some sites, subject to further analysis, indicated that leaching of untreated wastewater from latrines into the groundwater systems adjacent to the river was the source of bacterial contamination (Amosa et al. 2015)

Rabieh et al. (2020) analysed freshwater and saltwater around Upolu island to characterise water quality conditions. Among the elements, chlorine, sodium, calcium, silicon, and magnesium were dominant in freshwater samples, with the concentration range (µg/L) of Chlorine: 8.9–133,023; Sodium: 1277–90,863; Calcium: 915–24,663; Silicon: 1564–15,887; and Magnesium: 893–19,571. All, but Chlorine, were present in all the samples; Chlorine was not detected in 14 samples. The highest concentration of Chlorine and Sodium was obtained in the Falease'ela River. The rivers located in Vailima, Falease'ela and Mulivaifagatola had the highest concentrations of calcium, silicon, and magnesium.

Watershed management

Samoa's watersheds are typically characterised as small in size with steep sloped gradients, resulting in rapid responses to rainfall events. Unfortunately, with this profile comes significant sediment loads during extreme events. Atherton (2019) conducted a pre-qualified preliminary GIS based watershed assessment of Samoa's 66 catchments, looking at erosion potential (Figure 26) and development index (Figure 27), and combined these two aspects to provide a composite threat index for the entire country (Figure 28).

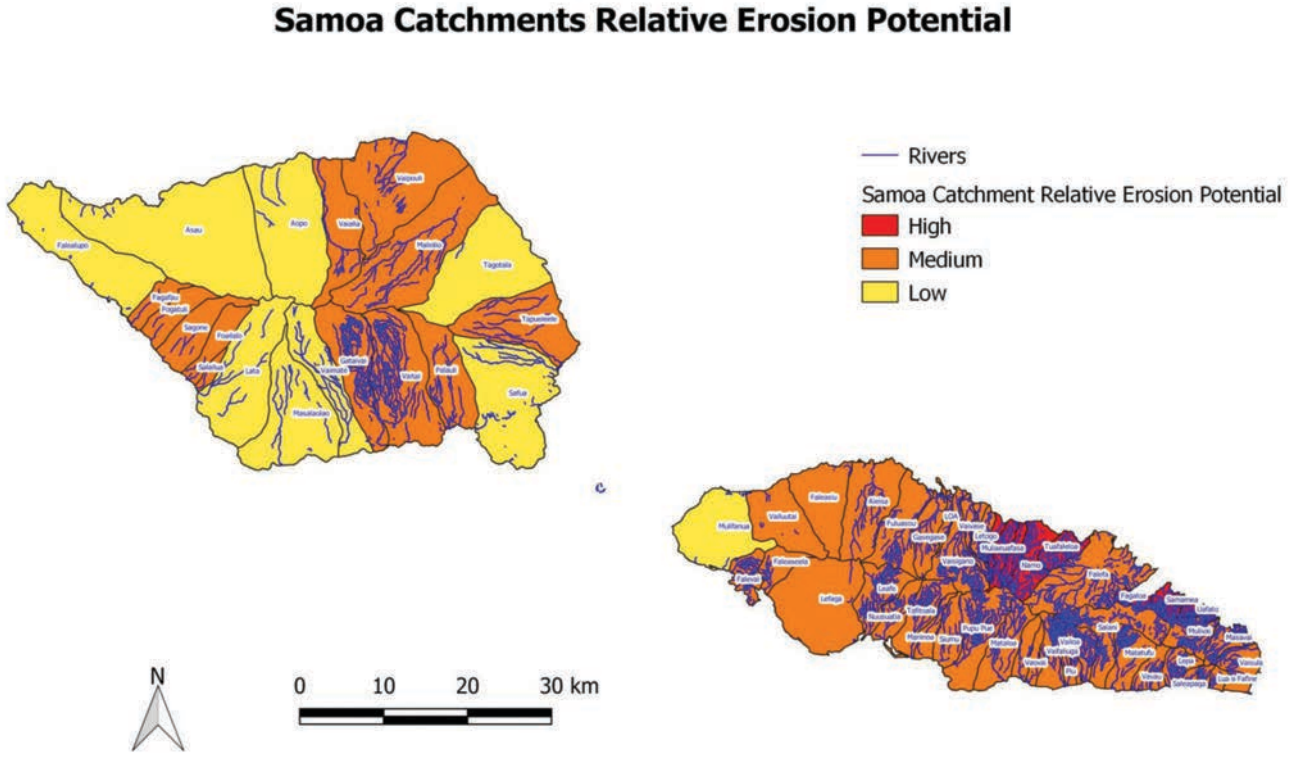


Figure 26: Relative erosion potential for Samoa (Atherton 2019)

The assessment indicated that all watershed areas in Samoa experienced low to medium erosion potential, except for the north-central catchments and the Fagaloa catchment of Upolu which register high potential, and often deal with landslides and slips. In terms of development, much of Savaii is experiencing low development, whereas the urban areas towards the western areas and eastern catchments of Upolu show medium to high development activities, and therefore register a medium to high composite threat index.

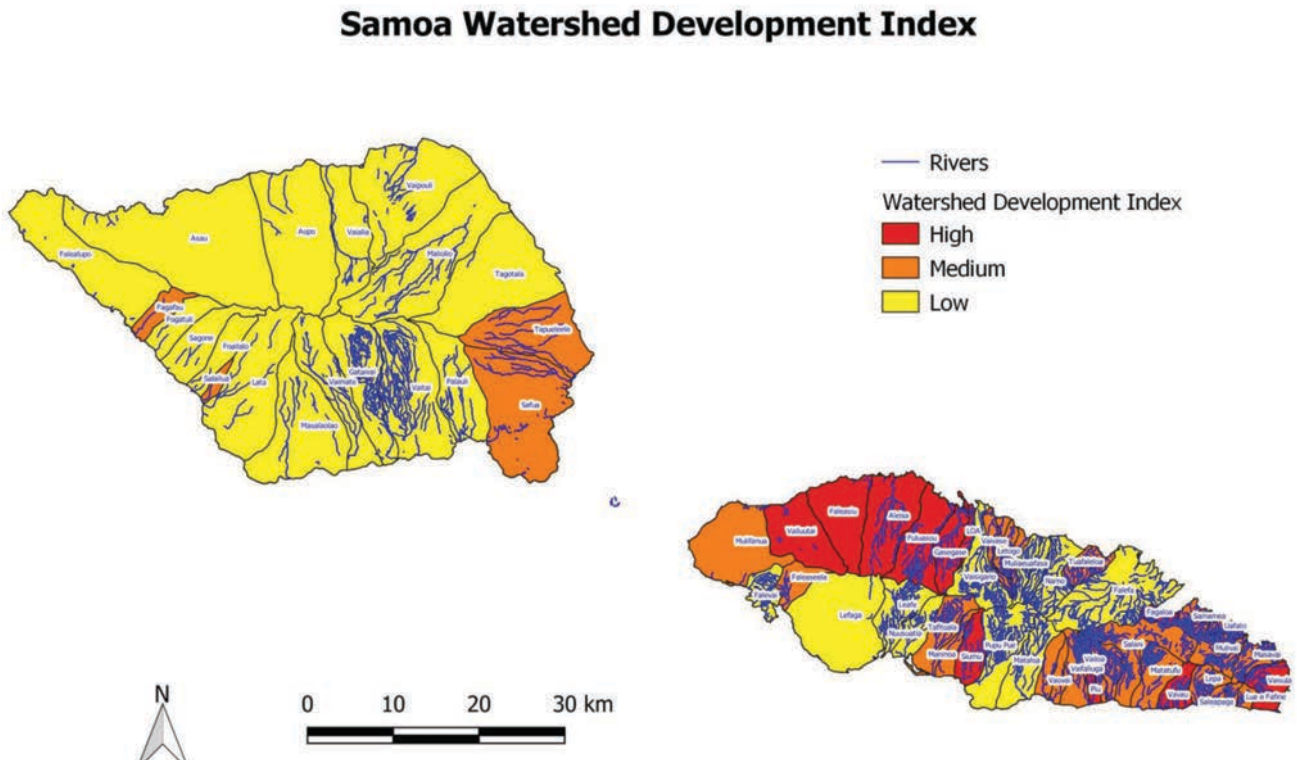


Figure 27: Development index of all the watershed areas in Samoa (Atherton 2019)

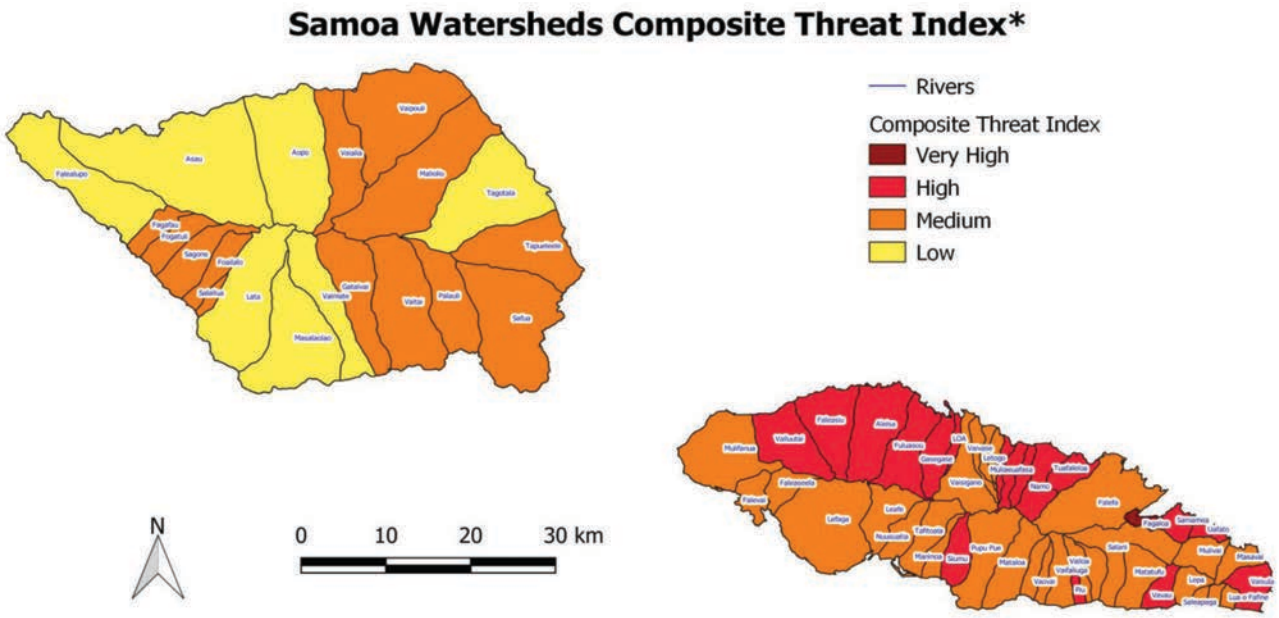


Figure 28: Samoa watershed composite threat index (Atherton 2019)

Impacts

Increasing water resource exploitation is a concern. Groundwater sources provide approximately 23% of annual average water supply distribution so far. This is expected to rise as exploration of sustainable groundwater aquifers increases, as more and more surface water sources become affected by natural and human induced impacts. As such the management and allocation of water resources is a priority to ensure the sustainable utilization of the limited resources in light of the increasing impacts of climate change on the quality and quantity of this resource.

Generally, the river corridors remain intact (SOE 2013) although in the most urbanised catchments (Gasegase, Loimata o Apaula, Vaisigano and parts of the Fuluasou watershed), 20 to 30% of the riparian zones were estimated as developed – including gardening and plantations, livestock grazing and waste disposal. The steeper land is particularly vulnerable to erosion.

Unsustainable development within the upper watershed areas which are considered "natural water tanks", pose a risk to the headwaters feeding the flood plains and the coastal areas. Removal of forest cover in the uplands to accommodate the inland movement of the population and services, affect the watershed areas by reducing infiltration of rainfall and increasing runoff which result in flashfloods in the lower plains. This also increases soil erosion and sedimentation impacts on water quality.

Response

The Water Resources Management Act 2008 is complemented by water resources management policies and regulations, which contribute to the sustainable development of water resources in Samoa. A Water Abstraction Licensing Scheme currently ensures that the use of water resources by the different industries of the economic sector, is maintained at sustainable levels. There is also a draft Upland Watershed Conservation Regulation being consulted, to further protect our natural water towers from unsustainable development.

The Ministry of Natural Resources and Environment is responsible for watershed management and protection of water resources. The Division has used the Integrated Water Resources Management and Ridge to Reef approaches to carry out watershed characterisation, sustainable land management planning, and determination of best management practices. As of 2023, 28 Watershed Management Plans (WMPs) have been developed covering more than 118 villages and more than 3.65 km2 of land under rehabilitation (Figure 29). Buffer zones have been delineated around each storm runoff route in the country, as part of a national flood hazard risk reduction mapping initiative (UNDP 2019, World Bank 2020).

Community and stakeholder consultations and engagement is critical given the significance of traditional leadership, land ownership and customs associated with water resources and watershed areas in Samoa. As such, there is significant investment into annual programs and events to ensure community-led and community relevant initiatives and support.

An established hydrometric network consisting of 18 rainfall gauges, 19 water flow and water level stations as well as 30 groundwater boreholes, currently gathers information on the quality and quantity of the water resources around the country. This network contributes to the national Multi Hazard Early Warning System and requires further investments to facilitate maintenance/upgrades, and extension to other areas currently not monitored.

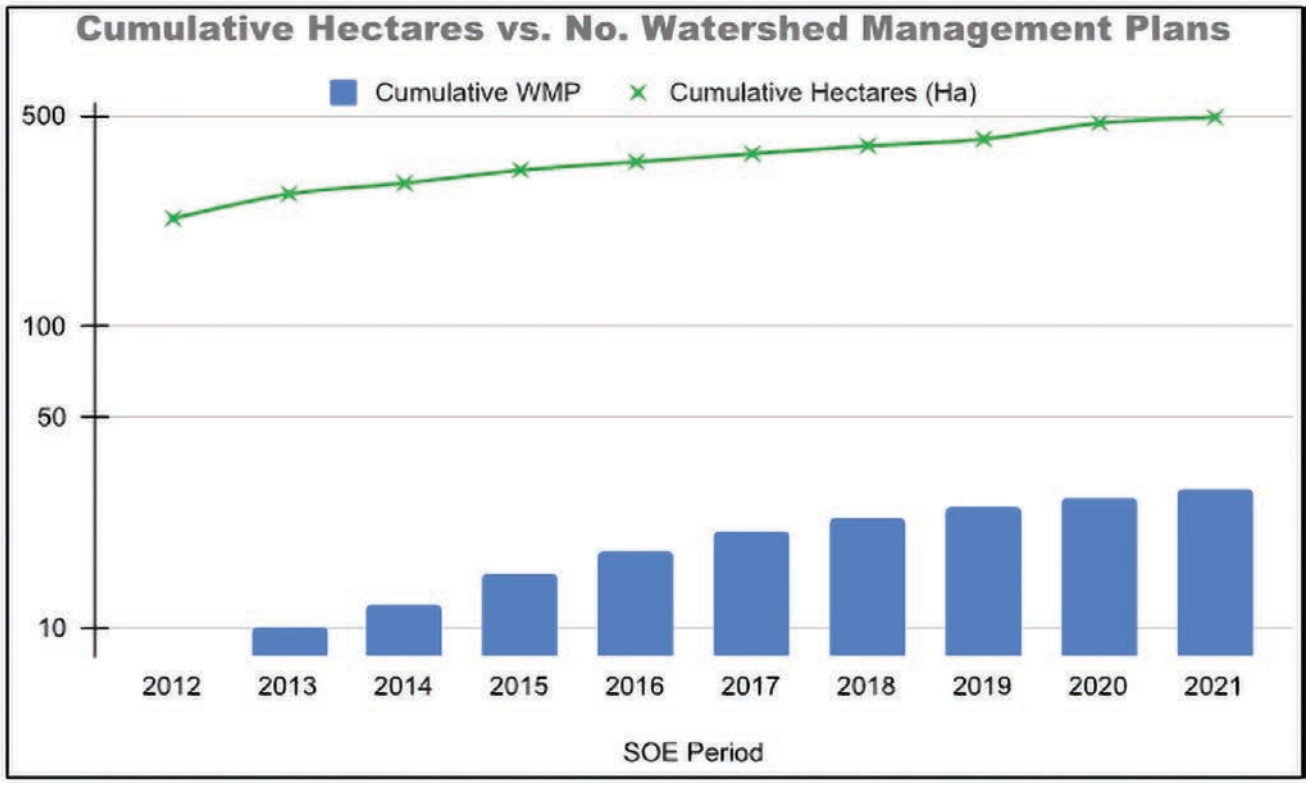
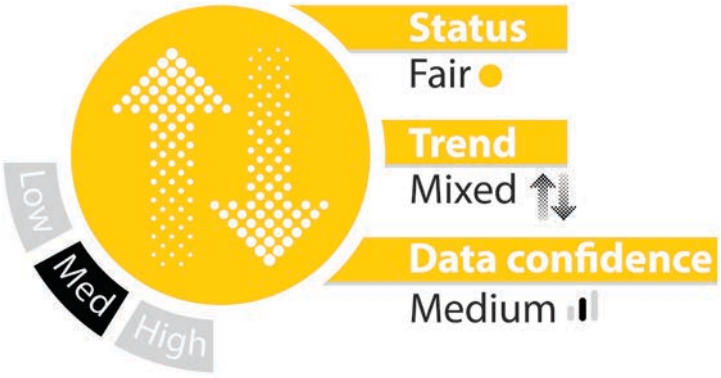


Figure 29: Watershed management plans covering some 3.65 km² (MNRE)

Recommendations

1. There is still a lot to understand about Samoa's water catchments and associated biodiversity. Only one freshwater biodiversity survey has been carried out, although much more is needed to cover some of the remote and rarely visited sites. Surveys must be undertaken to characterise and prioritise watersheds for conservation.
2. There is a need to ensure that watershed management plans are being implemented and that support and resources to allow staff and communities to undertake the implementation are secured.
3. Pollution and contamination of catchment areas need to be urgently addressed. This will require working with communities that are residing around the catchments to put in place protective measures and undertake rehabilitation activities. This must include the removal of all toilet facilities from catchments and putting in place a policy prohibiting building near these sites. All piggeries and other animal farming should be relocated away from catchment sites.
4. The use of pristine catchment areas for cultivation, whether it is plantation or fish farming should be avoided to minimise any adverse impact on the catchment and nearby environment. Areas of upland watersheds should be prioritised for protection due to their sensitive nature to human activities.
5. A Watershed at Risk Guide has been developed (Atherton 2019), although a number of caveats exist due to limited data available. A number of recommendations in the guide will help improve it and provide the government the information needed to safeguard communities and the environment. These recommendations include:
   - » Quantify river flow and discharge rates in a range of watersheds.
   - » Quantify soil erosion impacts from infrastructure developments, such as roads, creek crossings and deforestation.
   - » Quantify soil erosion rates under different forest conditions (e.g. native forest versus forest dominated with invasive plants).
   - » Analysis of satellite, aerial or drone imagery, to study sediment plumes from watersheds after heavy rainfall events.

INDICATOR 3: Inland wetlands



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 7, 12, 14	1, 2, 6, 8, 11, 13, 14, 15	Ramsar Convention on Wetlands; CITES	SAMOA Pathway 90, 94(d)	• Target 11 NESP • Watershed Protection and Management Regulations 1992\

Indicator definition

Conservation status, including baseline surveys and management actions and plans, implemented for priority inland wetland areas. Inland wetlands include montane marsh, montane bog and swamp forest and are superficially distinguished from coastal wetlands due to the strong influence of freshwater systems. Coastal wetlands, including mangrove forests, seagrass beds and coral reefs are addressed in INDICATOR 12: Coastal wetlands. The indicator assesses the number of inland wetlands that have a management plan and are being surveyed or monitored.

Status and Key Findings

Eight inland wetlands were listed in Samoa's Wetland Inventory in 1993 (Schuster 1993; Samoa State of Environment Report 2013). Lake Lanoto'o National Park, and O Le Pupū Pu'ē National Park are recognised as wetlands of international importance (Ramsar Convention), having been designated in 2004 and October 2017, respectively. Further details on these two Ramsar sites are provided in INDICATOR 7: Terrestrial conservation and protected areas below.

The state of Samoa's wetlands needs to be urgently reviewed. Inland wetlands that are in the upland areas, and generally at a distance away from plantations and homes, are often in a better condition, compared to those found closer to homes or near the coastal areas. Wetlands closer to people's homes are often used as a dump site. Only a few inland wetlands are included in conservation or protected areas.

Maugaloa Marsh (Olo Manu Uta Marsh, Savaii island)

This wetland contains a large herbaceous marsh in the eastern highlands of Savaii island, at an elevation of 625 m above sea level. Not much is known about the state of this wetland, nor information on its biodiversity.

Lake Mafane and Lake Mautalano (Savaii)

Two crater lakes with fringing marshes and a large area of herbaceous marsh in the eastern highlands of Savai'i, are still in a healthy, relatively undisturbed condition and well protected from human disturbance because of their isolated location. Lake Mafane is approximately 50 ha, and much smaller Lake Mautalano, are small freshwater lakes with fringing herbaceous marshes, situated at steep-sided volcanic craters about 4 km apart. The crater rims rise to peaks at 1,000 m and 716 m, respectively. Olo Manu Uta Marsh (Maugaloa Marsh) is a large herbaceous marsh situated at 625 m above sea level on the southwestern slopes of Mount Olo Manu Uta, east of Mount Maugaloa. Other small volcanic craters further west along the crest of Savai'i contain smaller and as yet unmapped wetlands. These wetlands remained to be surveyed and should be prioritised for future research.

Mount Silisili Bog (Savaii)

Mount Silisili Bog (highland marsh) is located near the summit of Mount Silisili (elevation > 1500 m) and appears to be the only significant montane bog in the country (Schuster 1993). The site has not been delimited, and surveys have been limited, with a few observations made by researchers (Schuster 1993; Whistler 2012). Whistler (2012) recognises the Carex bog as part of four or five plant communities. Whistler (2012) also referenced the Pandanus swamp forest, as a key part of the plant communities. Schuster (1993) noted that the White-browed Crake (Porzana cinerea) and Spotless Crake (Porzana tabuensis) may occur in the area. He further suggested that there's a possibility that the endemic Samoan Woodhen (Gallinula (Pareudiastes) pacifica) could be found, although recent surveys have suggested that this species is possibly extirpated from Samoa.

Lalomauga Swamp Forest (Upolu)

A small patch of degraded swamp forest near the northeast coast of Upolu. Most of the original swamp is covered with village plantations, and there is an electricity power plant in the swamp which supplies the eastern coast of the island.

Vaipu Swamp Forest (Upolu)

Vaipu Swamp Forest is located in the northern uplands of eastern Upolu, about 24 km southeast of Apia at an elevation of 240 m. The size of the wetland is 183.3 hectares. The site is a valued catchment area for the Salani River system. This wetland is a rare swamp forest hosting endemic species, including the Pacific Boa and the Manumea. Surveys of the wetlands found the presence of invasive species including myna, bulbul and pigs, although their numbers were considered low (MNRE 2017). The area is customary owned by the Fagaloa community.

Funding was secured under the Nagao Wetland Fund (NWF) of USD 18,000 to enhance the conservation and wise use of Samoa's last remaining and rarest swamp forests; the Vaipu Swamp Forests at Fagaloa. A management plan for the Vaipu Swamp Forest has been completed.

Lakes and marshes of the Aleipata uplands

The site contains a series of small lakes and herbaceous marshes in a chain of about ten volcanic craters in the Aleipata uplands of eastern Upolu. Two of the craters contain water (Crater Lano-o-Lepa and Crater Lanoto). About seven of the craters contain wetlands. The site is mostly protected from human impact because of their high altitude. The site includes a lowland rain forest (Schuster 1993). A community integrated management plan was developed for the area in 2018. The plan was agreed to by the majority of the villages that reside around the area.

Impacts

Inland wetlands are important sites from a water catchment and biodiversity perspectives. Any negative impacts to the wetlands will have consequences on Samoa's biodiversity, and water security. From a biodiversity perspective, many of the native species that have adapted to wetland ecosystems are likely to suffer if wetlands are degraded. Faster colonising invasive plants that tolerate a much wider range of conditions than native species are likely to take advantage of degraded wetlands and will proliferate. Much of the water that is used by communities is from catchment areas that include some of the important wetlands. When drought persists, as it has done over the past few years, water catchment is impacted and rivers and streams run dry. These rivers and streams are often the key water sources for households. Underground water is also affected by drought, and could potentially run dry if extraction exceeds the replenishment rate.

Some of the key threats besides weather conditions are human activities, especially the expansion of plantations, cattle farming, logging, building of infrastructure, and hunting of native species. One of the wetlands (Punataemo'o Swamp Forest) was impacted by a recent infrastructure development (Afulilo-Hydroelectric power project).

Response

Samoa is a party to the Ramsar Convention on Wetlands since 2005, and celebrates World Wetlands Day on February 2nd . Three wetlands are listed under the Convention, with more being identified as potential candidates. Regular reports to the Convention are submitted when required. Management plans have been drafted for the two wetlands (Lake Lanoto'o National Park and O Le Pupū Pu'ē National Park).

Wetlands are included under a number of national policies, although there is a need to amalgamate these so it is easier to monitor wetland health.

Samoa has developed legal instruments that if properly enforced will provide the protection for many critical habitats, including inland wetland areas and cloud forests. Some of the legal instruments included the PUMA Act 2004 and PUMA (EIA) Regulation 2007 and the Lands Survey and Environment Act 1989, and Forestry Management Act 2011. A review was undertaken for the Environmental Management and Conservation (EMC) Bill with amendments made to the EMC Regulations. The EMC Bills encompass management strategies for the overall sustainable management of wetlands in Samoa.

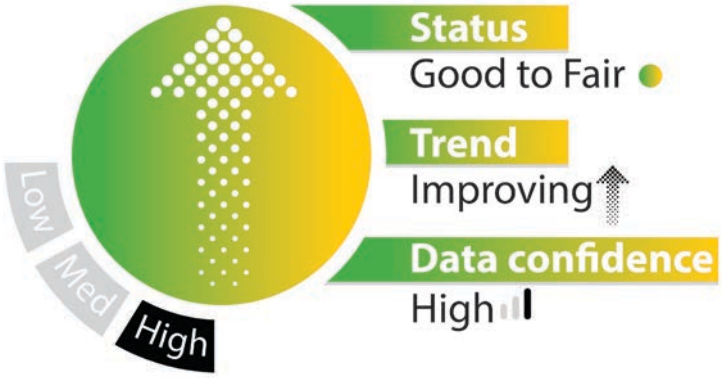
Watershed management plans have been developed for various villages to assist with effective management of watershed areas. Village bylaws were also instigated for villages of Lalomauga, Fagalii, Salailua and Letogo for sustainable management of water resources. Management for the Vaipu Swamp Forest was developed with the consensus of the District of Fagaloa to preserve the pristine remainging resources of the swamp.

The Government of Samoa recognises and values the in-depth knowledge of communities on the wetlands in their customary land. This knowledge is valuable when working with scientists in developing strategies to help mitigate the impacts of climate change.

Recommendations

- The protection of Samoa's inland wetlands requires the implementation of existing laws, especially in assessing development applications for activities on or near wetlands. This may also require assessing whether existing laws are adequate for the protection of wetlands.
- Research and monitoring of wetlands and wetland biodiversity should be carried out annually or as often as necessary to ensure that wetlands remain protected and in pristine condition. An important part of the research includes identifying cultural values and key threats to the wetlands. Developing management response is important for the protection of wetlands.
- Continue to promote and encourage the listing of more wetlands under the Ramsar Convention and provide the necessary support to ensure that they are protected.
- Build and secure resources to allow for the management of wetlands. This will include prioritising wetlands in government policies, and securing funds through projects or bilateral agreements, and build the capacity of local staff to undertake the management work required.
- Raise awareness amongst the community and engage them to protect wetlands on their customary land.
- Effective coordination and national implementation of wetland activities and programmes in Samoa relies on the cross-sectoral integrated approach for both related government ministries, NGO's, private sector and particularly local communities.

INDICATOR 4: Forests



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	5 7 11	15 LIFE ON LAND 1, 2, 6, 8, 11, 13, 14, 15	United Nations Forum on Forests 2003 REDD+ UNFCCC, CBD UNFCCC Ramsar Convention on Wetlands CITES	SAMOA Pathway 90, 94(d)	• Forestry Management Act 2011 • National Forestry Plan 2016-2020 (draft) • NESP 2017-2021 • Samoa Code of Practice for Harvesting of Native Forest and Plantations 2001 • National Biodiversity Strategy and Action Plan • National Invasive Species Strategy and Action Plan • National land use planning policy • Two Million Tree Planting Campaign National Strategy and Action Plan 2015-2020.

Indicator definition

Forests are an important ecosystem that provides ecological services, such as enhancing watershed capacities, and controlling soil erosion, as well as habitats and food for Samoa's native biodiversity. Forests also provide resources for communities including timber for houses and crafts, medicines and food. Forests are important in mitigating climate change, through their ability to sequester carbon. This indicator focuses on forest cover. Tne national definition according to the Samoa's FRA 2010 report is " land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees capable of reaching these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use"

Status and Key Findings

Samoa's total land area is estimated at 2,831.7km^2, of which 1650.49 km^2 include types of forest cover. The forest cover of Samoa includes all major 6 types of forests; FC, FS, FM, FP, M, FO. There are some discrepancies with regards to the total land area, which may in part be attributed to land loss along coastal areas due to rising sea levels and coastal erosion (MNRE 2018). There are different forest types such as closed forest, open forest, secondary forest, medium dense forest, plantation forest and mangrove forest. Samoa once had large areas of forests but logging, agriculture and farming have contributed to their decline. Pressures from settlement and housing, and natural disasters, are also contributing to loss of forest cover, or degradation of primary forest. Invasive species are also replacing many of the native trees, and some invasive trees form dense secondary forests.

Around 80% of Savaii island was covered in forests in the early 1950s, whereas forests covered around 65% for Upolu island (Table 8; Figure 30). By the late 1980s, forest cover had declined significantly for both islands (Figure 31). Incidentally, this corresponded with the peak in logging operations. By the late 1990s, further forest cover decline was noted for the whole of Samoa; rate loss was estimated at around 2% from the 2004 - 2014 (Figure 32). Coastal and lowland forests were often impacted due to the expanding population, and the inland relocation of households following the 2009 tsunami (MNRE 2021a).

Table 8: Forest cover changes 1954 – 2013 (FAO 2005, cited in Sesega 2009; SamFRIS 2014)

YEAR	UPOLU (%)	SAVAII (%)	TOTAL (%)
1954	65	79	74
1987	43	63	55
1990	25	59	46
1999	46	69	60
2013	17	40	58

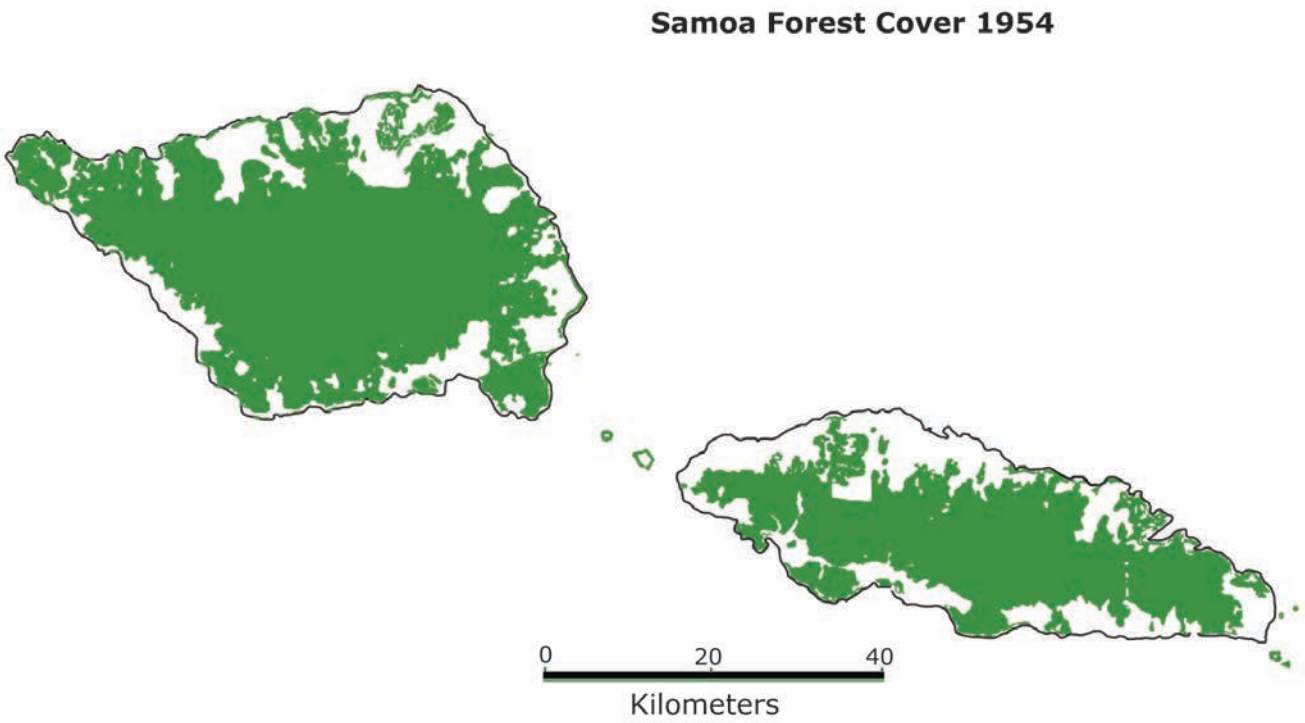


Figure 30: More than half of the islands were covered by forests in 1954 (FAO)

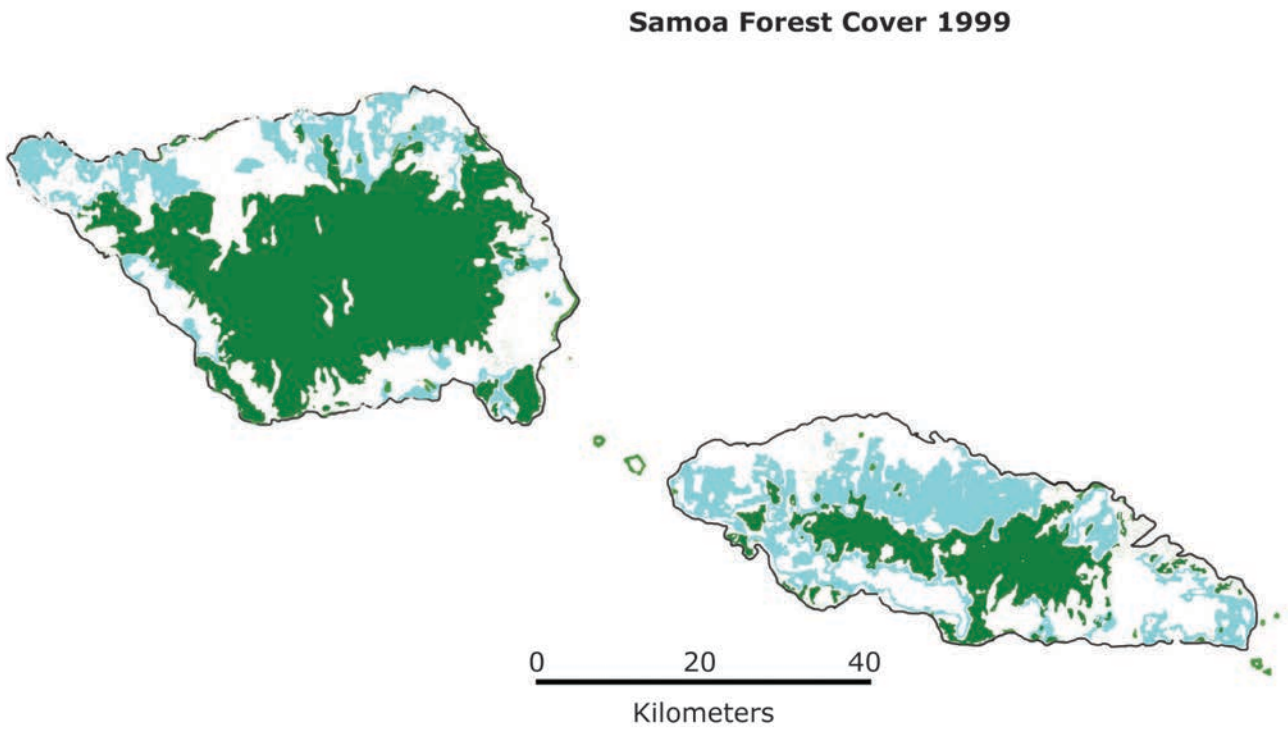


Figure 31: Forest cover in 1999 (FAO)

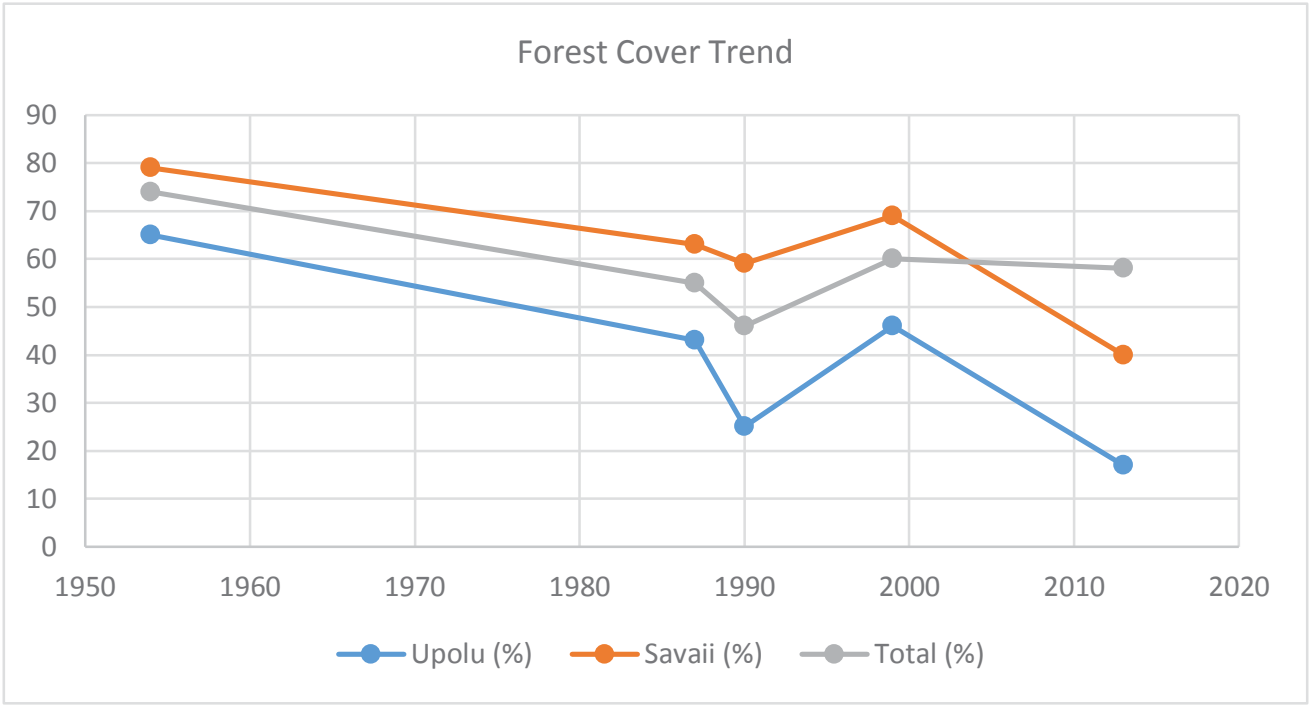


Figure 32: Forest cover trend from 1954 to 2013. (SamFRIS 2014). Note an increase in forest cover trend from 1990 to late 1990, was due to a different sampling method.

The most recent forest inventory was published in 2014, with the key findings included in the 2013 SOE Report (Figure 33). The findings suggested a small reduction in forest cover, with some positive trends observed for forests on Savaii (especially the upland and cloud forests) (Table 9). Forest cover on Upolu had also increased, but this was attributed to faster growing invasive trees (SO, 2013).

Table 9: Forest cover per island. (SamFRIS 2014)

	ALEIPATA (HA)	APOLIMA (HA)	MANONO (HA)	NU'USAFE'E (HA)	SAVAII (HA)	UPOLU (HA)	TOTAL (HA)
Native Forest	117.7				92180.47	31565.39	123863.56
Non Forest	30.79	99.13	185.64	1.54	56215.89	61587.99	118120.98
Plantation Forest					4549.25	493.68	5042.93
Secondary Forest			105.57		17254.55	18782.28	36142.4
Total	148.49	99.13	291.21	1.54	170200.16	112429.34	283169.87

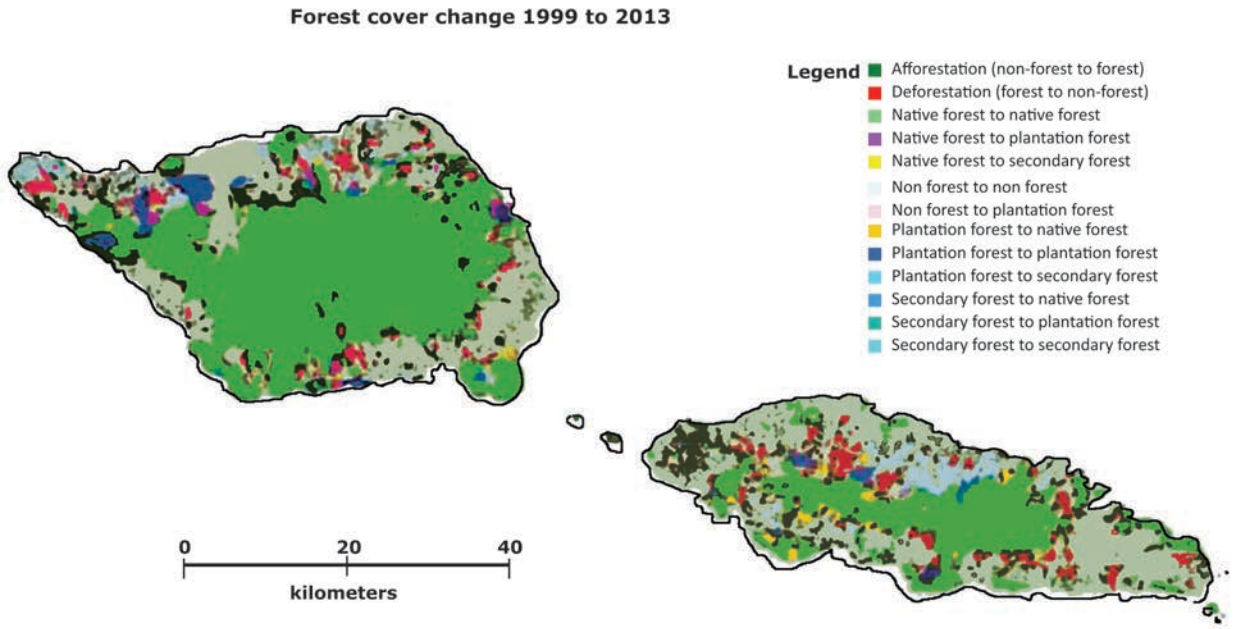


Figure 33: Forest cover trend (SamFris 2014)

Samoa's land cover is dominated by native forests (44%) and non-forest (which includes all other land classes, including scrubland) at 42%. Plantation forests and secondary forests make up 14% of the total land and forest cover (Figure 34) (SamFris 2014).

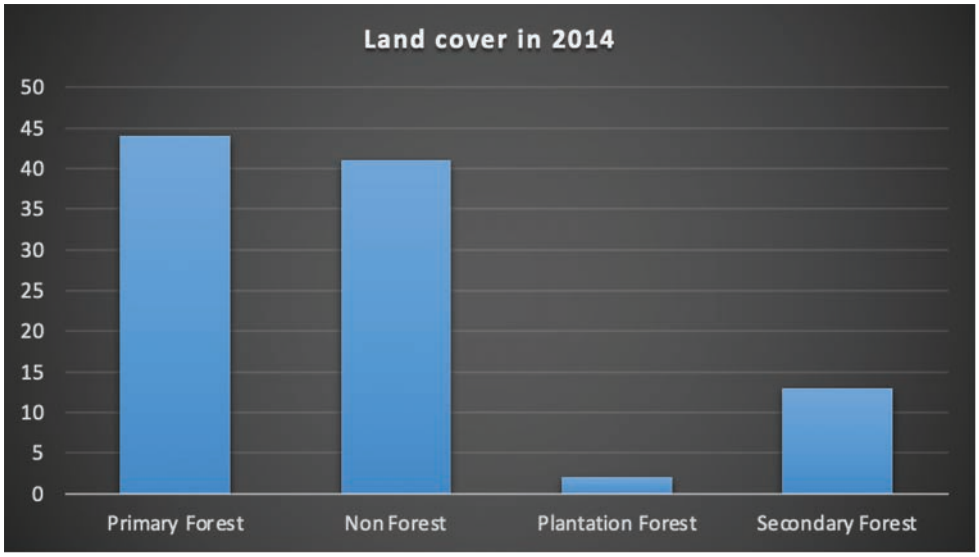


Figure 34: Land cover for the year 2014 (SamFRIS 2014)

Most of the primary forest areas are customary owned and under the control of villages. The government recognises the importance of the forestry sector, as it looks towards the next decade in transforming the country to a higher growth path (Ministry of Finance 2021). The national agenda set for 2040 identifies opportunities to stimulate the national economy, which will promote employment opportunities, income growth and raise living standards. Forestry is a key component of the broader agriculture and fishing focus. With the national agenda set, the assessment of production forest is currently around 83,536 ha. Protected forest makes up approximately 81,513 ha, and non-forest at 118,120 ha (Figure 35).

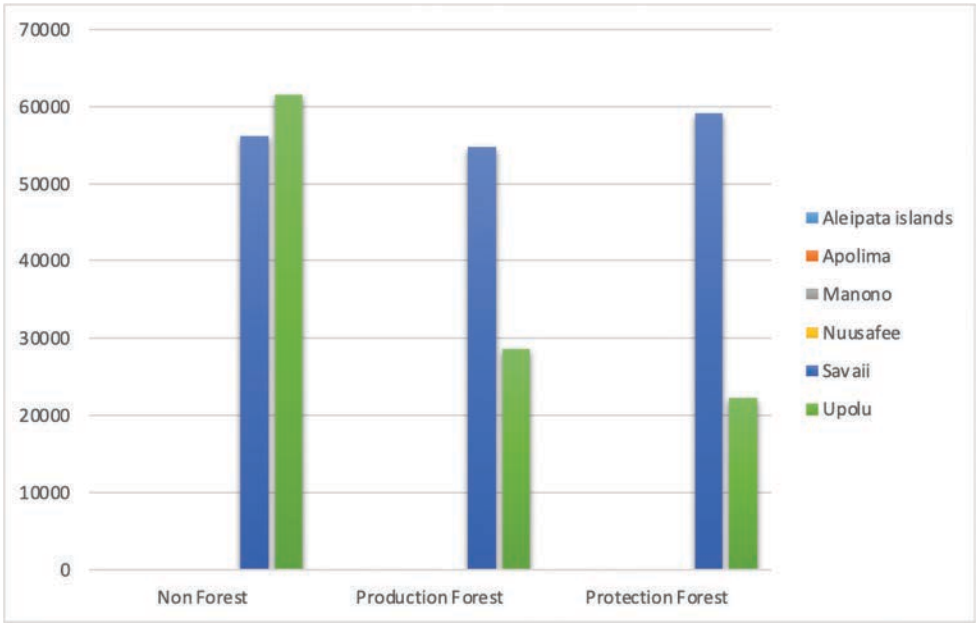


Figure 35: Non-forest (41.71), Production Forest (29.50) and Protection Forest (28.79) for Samoa islands (SamFRIS 2014).

Impacts

Forests are a valuable ecosystem to life in Samoa. The forests provide Samoans with timber, food and medicines. Forests also sequester carbon and provide homes for many of Samoa's vulnerable species. The heavy exploitation of Samoa's primary forests in the 1950s, up until early 1990s, has seen a big decline in forest cover. Logging, expansion of agriculture production, and settlement in forested areas are direct impacts on Samoa's forests. Other impacts are the introduction of invasive species, such as cats, rats, wild pigs, snails, weeds and vines, and flatworms have led to extinction of some of the endemic species, and the degradation of the ecosystems. There may be a correlation between the loss of forest ecosystems with the number of species at risk of extinction. Faster growing introduced species often colonise de-forested areas. In 2012, Cyclone Evan hit Samoa, and many of the faster-growing introduced tamaligi became missiles destroying properties as it flowed and slid downstream.

Mangrove forests and those around wetland areas are particularly vulnerable from development expansion, as these areas are often regarded as of low value. The impacts to adjacent ecological systems, such as coral reefs, seagrass beds and lagoonal areas, may have contributed to the decline of seafood availability, as well as pollution and the proliferation of unwanted seaweed.

Efforts to redress the loss of indigenous forest trees were largely focussed on planting exotic species that could be harvested to support a logging industry. However, several severe tropical cyclones during the 1990s devastated much of the re-forested sites, which ultimately affected the industry. There is a renewed and concerted effort, especially under the million-tree planting campaign, an initiative by the government, to plant native species. These efforts are challenged by population expansion, and incentives for agricultural production. However, these are managed through proper planning and using sustainable practices, such as agro-forestry and applying integrated pest management, under partnerships with the Ministry of Agriculture and Fisheries.

The available merchantable stock is very limited. No large scale logging operations, but only small scale logging, where portable sawmills are permitted to harvest forests under the Forestry Management Act 2011 (FM Act 2011). Logging is not permitted in watershed areas including watershed buffer zones and protected areas including nature reserves and national parks. Logging is also on a licence/permit system where logging operations are strictly managed, as per the FM Act 2011.

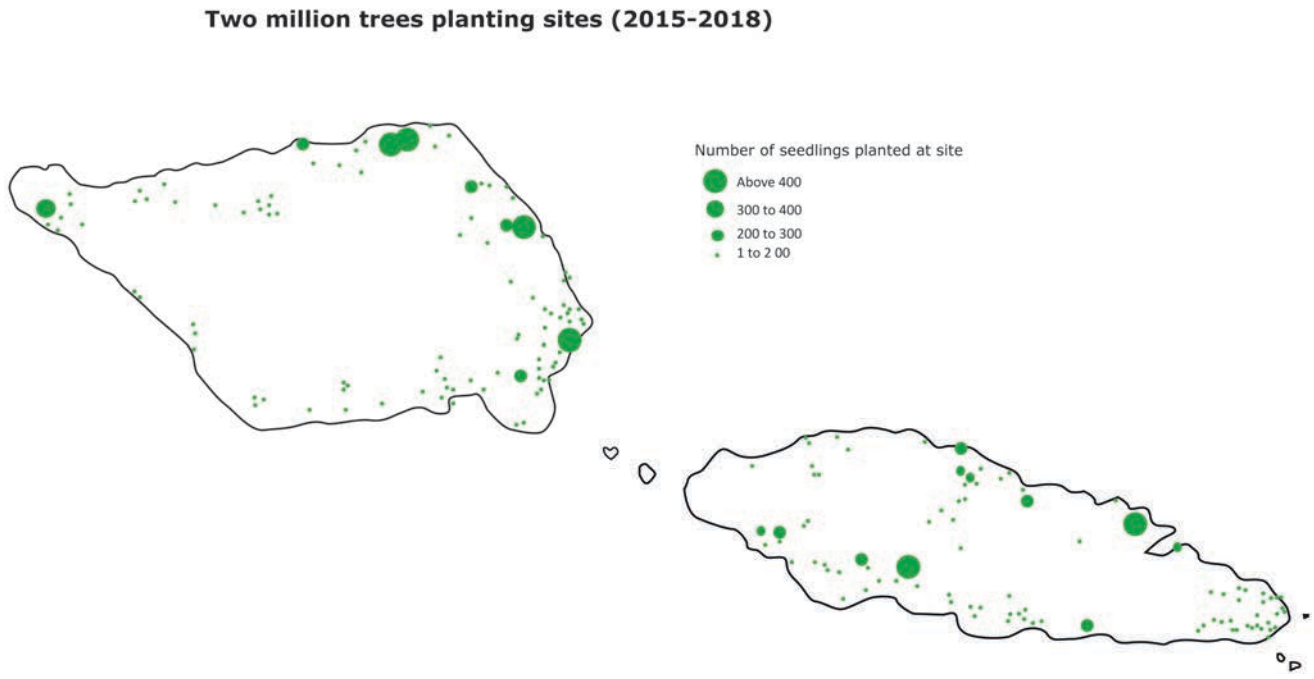


Figure 36: 2-million trees planted over the campaign (MNRE 2021b)

Response

In response to the declining forest cover in Samoa, the government established five national parks and ten nature reserves, bio-park, forest state-land, and botanical areas, encompassing 80 km^2 on lands under its control, which represents around 6.3% of the total forest area (Sesega 2009). However, the biggest forest areas are under customary control. Some of the communities have established community conservation areas within their customary lands.

Key legislation relating to forests include the National Parks and Reserves Act 1974, the Land Survey and Environment Act 1989, and the Protection of Wildlife Regulation 2004, and the Forestry Management Act 2011, which supersedes the Forest Act 1967 and the Forest Regulations 1969.

The institutional arrangement where the forestry sector is included under the broader framework of the Ministry of Natural Resources and Environment, allows a closer working arrangement with water, land, parks and reserves agents. This promotes the sustainable management of forest resources.

Some key national policies and plans include the Pathway for the Development of Samoa (PDS), the NBSAP, the Environment Sector Plan 2017-2021, National Policy on Forestry and Sustainable Development 2007 and the National Adaptation Programme Action.

National tree planting campaigns

It initially started as a 1-million tree planting campaign in 2009, which quickly gained momentum and became very successful. At the conclusion of the campaign in 2012, a 2-million target was encouraged and launched in 2015 for a 5-year period (Figure 36). The campaign's aims were to respond to climate change, rehabilitate forests, water and degraded habitats, raise awareness and promote green livelihoods. The 2-million tree campaign reached its target at the end of the campaign in 2020 (Table 10). A renewed campaign has recently been launched during the Environment Week 2021 for 3 million trees to plant for 6 years ending 2028.

Table 10: Number of seedlings and area planted by various stakeholders.

PARTNERS	NO. OF SEEDLINGS	AREA PLANTED
Ministry of Agriculture and Fisheries	1,122,993	n/a
STEC	112,033	398.55
SFFI	248,600	n/a
PRIVATE/	62,052	n/a
SERENDI	4,511	n/a
MNRE	510,596	620.56
WIBDI	10,000	n/a
TOTAL	2,070,785	1019.11

Recommendations

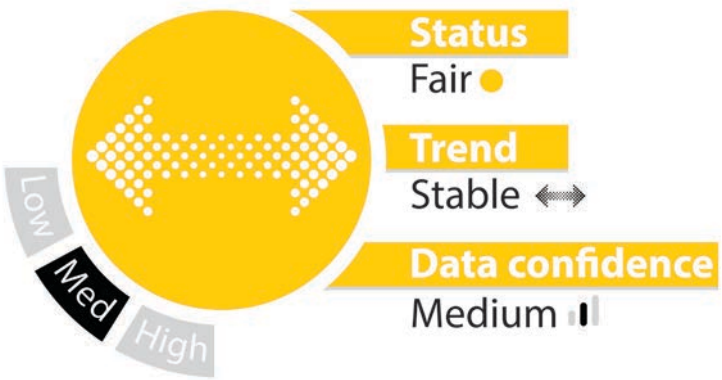
- The protection and sustainable use of pristine forests of Samoa remains a high priority. Many of these pristine forest areas are under the authority of the villages, which can be challenged from time to time. There is an urgent need to develop management plans for these areas, including identifying a framework that will have a long-lasting outcome for the protection of pristine forest areas.
- The introduction of exotic and often fast-colonising invasive trees and vines has caused an adverse impact on native biodiversity. There is a need to remove these invasive trees and replace them with indigenous trees. This may necessitate the building of local capacity and infrastructure in nursery and propagating native plants.
- Mangrove and lowland forests and wetlands are extremely vulnerable due to the close proximity of settlements. There is a need for more awareness activities surrounding the ecological services they provide, and that protection and conservation are needed, especially from settlement expansion and commercial developments.
- The million-tree campaigns have been a positive initiative over the years, with many positive outcomes, such as the promotion of native tree planting, increased awareness on the value of forests for carbon sequestration, the engagement of schools, the private sector and public groups and organisations and stronger environmental stewardship. These campaigns should continue to be promoted and encouraged.
- Monitoring Samoa's forest cover trend is a critical component of the forestry sector, and vital information to the overall management of Samoa's forest and

land system. This service should be supported and the capacity and technology provided used to ensure that it continues to provide up-to-date information for managers and decision-makers.

- Forests are important habitats for many endemic and native species. Some of these species are at the risk of extinction, with some relying on specific trees for food. When their food trees are rare or no-longer available, it puts these species at risk. There is a need to identify these tree-species relationships and to develop botanical gardens and other similar initiatives, as a controlled conservation measure with a view of rewilding Samoa's forests.
- National forestry policy and plans have been developed, and these need to be urgently supported to allow for their implementation. This will include building the capacity of forestry personnel, as well as the provision of resources (equipment and technology) to allow the staff to fulfil their roles and responsibilities.
- Review and where appropriate develop legislation to improve the management of forestry resources. Build capacity to improve enforcement and monitoring components of the national legislation.
- Build local capacity to undertake scientific research in carbon assessment of forest trees, tree health and growth with a particular emphasis on pests and disease management.

Picture credit: Forestry Division.

INDICATOR 5: Soil resources



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	5, 7, 11	1, 2, 6, 8, 11, 13, 14, 15	Ramsar Convention on Wetlands; CMS; UNCCD	SAMOA Pathway	• NESP 2017-2021 • Pathway for the Development of Samoa 2021-2027

Indicator definition

Soil is vital for plant growth in Samoa. Soil is an important factor from an economic perspective, especially when farming and agriculture are high on the national agenda as Key Priority Area 7 of the Pathway for the Development of Samoa (2021-2027). It is also an important component of the Key Strategic Outcome 4: Secured Environment and Climate Change of the PDS 2021-2027.

The indicator assesses the soil characteristic of Samoa and their state.

Status and Key Findings

Samoa's soils are mostly volcanic in origin (parent material is olivine basalt), with a few areas that are comprised of corals and sand. Kear and Wood (1959) identified 55 soil types consisting predominantly of stony latosols of varying fertility. Most of the soils are found in forest areas and there are marked differences between lowlands and uplands soils. The high altitude soil tends to be thicker with minerals attributed to heavier ash deposits (Wright,1963). Low altitude soil weathers rapidly due to high temperatures (Wright 1963). Upland and highland soils decline in soil fertility rapidly once forest cover is removed. This is attributed to loss of forest peat, which is a stabilising feature of soil. In terms of soil content, Samoa's soils are low in potassium and phosphate (Blakemore 1973), which are common nutrients typifying fertile soils. Rainfall has significant influence on soil productivity. In areas where annual rainfall exceeds 4200 mm per annum, soil leaching is very common (Wright 1963).

In terms of soil fertility, Wright (1963) recognised 10 classes based on observations on land fallow, fertility trials on farmer's crops and chemical analysis. Wright's system was based on interviews with farmers to determine the length of time when lands were left to fallow, field trials in farmers plots and analysing soil samples. Forty years after Wright's work, analysis of 33 soil types by ANZDEC (1990) supported Wright's research. The key influences to soil fertility are volcanic lava age, climate, altitude and slope and wind exposure.

Samoa's topsoil is porous with fine structure and is considered to be of very good condition, with plenty of dark organic matter (Figure 37). Carbon analyses confirms the good condition. At first contact the soil may seem to be sandy, but wetting a sample and rubbing it between the fingers will yield the stickiness of clay along with the grittiness of sand and smoothness of silt. These particles that make up the soil

structure are the fundamental building blocks of soil, and are held together by two kinds of glue: the combination of soil organic matter and oxides, mainly of iron and aluminium. These stabilise the structure and help the soil resist erosion and maintain its porosity. The soil is open to receive the entry of water and air needed for plant growth.

Where there is poor land management due to overworking of the soil and removal of vegetation cover, soil erosion is common and fertility is poor (Figure 38).

Figure 37: High porosity topsoil typical of many Samoan garden plots. The soil is very aggregated, and the risk of erosion is low.

Figure 38: A poorly aggregated soil structure with low capacity to absorb water. The risk of erosion is great.

Soil surveys were carried out on the four main islands in 2016 focusing on the physical and chemical characteristic.

A soil survey was undertaken in March 2016 on all the four islands of Samoa; Savaii, Upolu, Manono and Apolima. Soil samples were obtained from four representative villages of Savai'i to give an idea of the physical and chemical characteristics of the soil. The same soil survey was carried out for all other islands using the same methodology. Most of the soils were found to require some input to improve their fertility (Table 11).

Table 11: Results of soil analysis from the four main islands of Samoa.

ISLAND	RESULTS OF SOIL CHEMICAL AND PHYSICAL ANALYSIS FOR SOILS IN SAMOA	
	ANALYSIS TYPES	FINDINGS
Savaii	Chemical Analysis	• Savaii soils have very low amounts of P, K, Ca, and Mg • Very low amounts of Phosphorus could be attributed to the volcanic nature of Savaii soils, which have very high P fixing capacity • Soils are mostly acidic, therefore will require improving for plant growth • Soils have low micro and macro nutrients, which are important for plant growth and development • Soils have high amount of organic carbon and nitrogen, which could be attributed to the abundance of crop residues on the surface soils
	Physical Analysis	• The implications of this soil physico-chemical data to soil management is that there is really a need to properly manage the soils in Savai'i to make these more sustainable for crop production. • Another major soil problem in Savai'i is the very low amounts of topsoils in most volcanic soils that are planted to crops. The continuous addition of organic matter is one prime management practice that should be adopted. • Likewise the addition of the combination of organic and inorganic fertilisers to increase crop production is another aspect of integrated nutrient management that is also worth trying in this island.

ISLAND	RESULTS OF SOIL CHEMICAL AND PHYSICAL ANALYSIS FOR SOILS IN SAMOA	
	ANALYSIS TYPES	FINDINGS
Upolu	Chemical Analysis	• Presents the results of the soil chemical analysis of the 7 at different places in Upolu: • The soil pH values ranged from 5.45 to 7.90 indicating a basic to alkaline condition. The amounts of exchangeable bases were generally low with values ranging from 2.16 to 17.7 cmol (+)/kg soil for exchangeable Ca; 0.878 to 3.35 cmol (+) /kg soil for exchangeable Mg and 0. 253 to 0.664 cmol (+)/kg soil for exchangeable K. • The organic carbon content was of the medium range from 4.00 to 10, 1% while the % total N ranged from 0.396 to 0.95 which can be classified as medium to high according to the Blakemore et al. (1987). • These relatively higher values of nitrogen and carbon could be attributed to the application of organic fertilisers such as chicken manure as indicated by the farmers in our interviews with them. • On the other hand the levels of micronutrients are relatively low except those values obtained from iron which showed higher amounts in Faleapuna, Aleisa East and Lepa. • These soils have acidic pH which could be the reason for the relatively high values of Fe in these areas.
	Physical Analysis	• In terms of its texture, most of the soils have higher sand content which could be explained by the volcanic nature of most soils in Samoa. The textural classes of soils from Upolu were described as sandy and sandy clay loam indicating the dominance of sandy soil particles in most of these soils.
Manono & Apolima	Chemical Analysis	• The soils in the islands of Manono are relatively fertile with soil pH values ranging from 6.67 to 7.83 which is from near neutral and slightly alkaline at this pH levels, most of the macronutrients such as N, P, and K and the exchangeable cations are highly available of are their maximum amounts. • The values for exchangeable Ca ranged from 11.9 to 22.3 cmol (=)/kg soil. On the other hand, the values for exchangeable Mg ranged from 2.08 to 7.52 while that of exchangeable K ranged from 0.203 to 6.31 cmol (+)/kg soil. • The values for per cent total nitrogen ranged from 0.238 to 0.511 which is within the low to medium ranged (Blakemore et al. 1987) from % organic C is from 2.66 to 5.8 which are also from low to medium range. Surprisingly the amounts of available P (Olsen method) ranged from 17.5 to 36.5 which are classified by Blakemore et al. (1987) as low to high. • This is expected because the pH levels have relatively increased as compared to those in the islands of Savai'i and Upolu. The levels of micronutrients such as Fe, Mn, ZN and Cu are relatively low which is common for high pH soils.
	Physical Analysis	The textural classes for Manono soils are sandy loam and sandy clay loam while that of Apolima are clay and sandy loam. From the results presented, we can say that the soils in Manono and Apolima are more fertile compared to the soils in Upolu and Savai'i islands. These observations were supported by the results of the soil chemical analyses and the performance of crops in these two islands.

Impacts

Some of the soil challenges for Samoa are attributed to land use activities. Soil erosion in some of the areas is exacerbated by the removal of vegetation for agriculture and housing settlements. Plantation and garden crops on steep slopes are contributing to the challenge. These areas are vulnerable to extreme whether events, including heavy rain, droughts and cyclones. Erosion has not featured as a major issue in previous soil reporting, however, it is now an issue that needs to be addressed given that land use for cropping is a major consideration for development.

Erosion is a major concern to cropping farmers because of the loss of productive soil. The sediment released into the landscape by erosion, and especially into water bodies, is also a very significant concern for water contamination. Soil particles reduce light penetration in water, and can choke aquatic animal habitats. Organic matter adhered to particles releases phosphorus, nitrogen, and faecal matter into waterways.

Responses

Our knowledge on Samoa soils continues to be improved built on the work by soil researchers from the early 1900s and more recently in 2020. Their work has provided the baseline information with relevant data on soil types and profile characteristics. Some of the pioneering works include the following:

- **1938: The soils and agriculture of Western Samoa by Hamilton and Grange.** The survey was focused mainly on the Crown Estates (then known as New Zealand Trust Estates) and some plantations owned by Europeans on the northern lowlands and foothills of Upolu.
- **1963: Soils and Landuse of Western Samoa by NZ Soil Bureau Survey (Wright 1963).** Provided a complete survey for Upolu and Savaii islands, with national soil maps at 1: 100,000 scale and a comprehensive technical report with soil descriptions, some laboratory analysis and fertility indicators for selected soils. Soil maps of Upolu (8 sheets) at 1:40,000 scale were also compiled.
- **1986: Soil taxonomy and fertility in the South Pacific.** A training course in soil classification using USDA Soil Taxonomy, held in Samoa with 12 soil profiles on Upolu being fully described and with complete laboratory analyses.
- **1989: Land Resource Planning.** A project focusing on an updated soil survey, laboratory analysis for soil, land use capability assessment, established GIS capability and digitised soil maps.
- **2010: Samoan soil resource interpretative manual (Leslie 2010).** A collation of information about soils and their management. This is a reference manual for understanding and managing soil resources of Samoa, produced in collaboration with UNDP and FAO.
- **2016: Soil conservation and land management in Samoa:** status and way forward 2016. Produced under the Strengthening Multi Sectoral Management of Critical Landscapes (SMSMCL) project, this research publication details a literature review of all historical research on soils of Samoa.

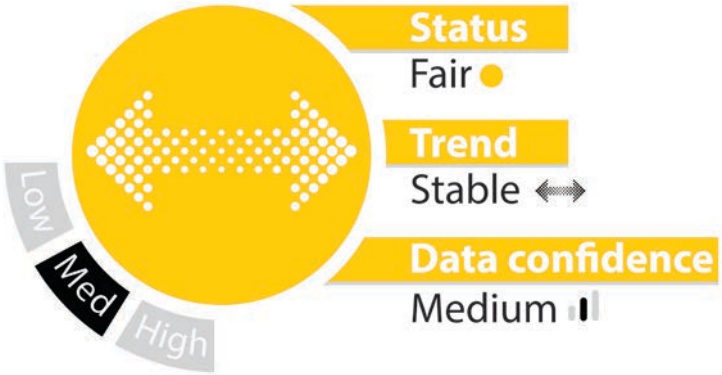
During the process of putting together the ***Soil Conservation and Management Manual 2016 by Annabella B. Tulin and Muhammed Umar***, a review of four literatures related to soil aspects of Samoa and soil management and conservation picked the most important documents in the making of the soil and land conservation manual that is applicable to Samoa. Based on the review of these materials, it was surmised that a lot of studies have already been done regarding the soil aspects of the various soils in Samoa. The important features included the following:

- A thorough characterisation and classification of the different soils in Samoa based on landform characteristics, agro-ecological zones
- The classification of the soils according to the international systems of Soil Taxonomy (Soil Survey Staff 1990, 2003) and FAO/UNESCO (1974) as reported in the work of Leslie 2010.
- Land suitability rating and maps for 58 different crops in Savai'i and Upolu island.
- The soil fertility evaluation of different soils based on the ratings of Sanchez 1982.
- Land and soil constraints that significantly affect crop growth for each soil unit shown on the soil map.
- Assessment of the natural fertility of Samoan soils, and their nutrient status.
- GIS-generated crop suitability maps were made for both Upolu and Savai'i (110 maps). These indicate areas of potential for each of the 58 crops.

Recommendations

- Maintaining soil health ensures that ecological systems continue to produce and provide the services critical for all life on the island. Raising the awareness at the village level on activities that will assist in the maintenance of soil health should be a priority.
- The formal education system should be used to assist with educating students on the importance of soil health. This should include collaborating with IRETA Farm, School of Agriculture and Food Technology (the University of the South Pacific), where there is already expertise and resources that should be used.
- At the national level, develop the necessary plans and strategies for the conservation and protection of soil systems. This may include developing a Code of Conduct for Soil, or a Soil Manual that will guide developments along slopes and fragile areas.
- Erosion is a serious problem in Samoa. With extreme weather events, such as flooding, droughts and cyclones, these can exacerbate the problem. Efforts to mitigate the damage caused by erosion, should include a serious focus on human activities in sensitive areas. Agriculture and farming are important for Samoa's economy. They can influence the state of the land and are therefore important stakeholders in soil conservation and land management.
- Encourage further research into developing products (such as organic fertilisers and pesticides) that can assist with improving crop production and soil health.

INDICATOR 6: Lands and land resources



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
			World Forest Charter (WFC) 1994 UNFCCC 2001 – UNCCD 1998 Kyoto Protocol 2000 World Heritage Convention 2001 Ramsar Convention on Wetlands 2004 CITES	SAMOA Pathway 90, 94(d)	• National Forest Policy • National Biodiversity Strategy & Action Plan 2015-2020 • National Land use Policy 2001 • National Population and Sustainable Development Policy 2001 • National Biosafety Policy 2004 • National Heritage Policy 2004 • National Policy on the Conservation of Biological Diversity Policy 2005 • Pathway for the Development of Samoa (PDS) 2021/22 – 2025/26 • Codes of Environmental Practice 2006 • O Le Pupū Pu'ē National Park Management Plan (Ramsar Site) 2020-2030

Indicator definition

Samoa's lands and land resources are important components of its heritage and identity. The management of Samoa's lands and resources is complex due to the land tenure system and various authorities over the resources. From the government's approach, the management of resources involves various departments and agencies working in collaboration with village councils and village groups. There are a number of sub-components of this indicator, hence it addresses land tenure, land resources, land use, land degradation and agriculture.

Status and Key Findings

Land tenure

The total land area of Samoa has been assessed via a number of methodologies, including some of the latest technology. Using the light detection and ranging (LIDAR) technology, Samoa's total land area is calculated at 2,846 km^2 (LIDAR 2015). LIDAR is a remote sensing system that has been used to create high resolution maps, or to map vegetation over large areas. A ground-truthing survey under the Samoa Forest Resources Information System (SamFRIS) 2013, confirmed Samoa's land area as the same as that calculated by the LIDAR technology.

Samoa's land is classified as customary land, freehold land or public land under the Constitution. Customary land comprised of 81%, freehold land (4%) and government lands at 15%. Under the Constitution, customary land cannot be alienated by way of sale, and that land cannot be traded or used for collateral. Recently, there has been concerted pressure on customary land for developments. A significant number of customary lands have been transitioned into long-term leases (20 to 100 years), whilst other lands, including freeholds, are acquired by the government for public purposes.

The next LIDAR survey is planned for 2025. It is anticipated that significant changes to Samoa's lands will be observed, which will impact the total land area of the country. For land tenure, there is a current ongoing effort through the Land Registry of MNRE to obtain and analyse all possible relevant data and information of registered lands under different land tenure on the SOLA system.

Land resources and management

Land resources encompass the physical, biotic, environmental, infrastructural and socio-economic components of the environment. These resources are the backbone for the wealth and the wellbeing of Samoa's society and economy. Although Samoa has made significant progress towards the protection and conservation of its natural resources, some challenges remain especially balancing the competing demands of the current population, while maintaining the integrity of the ecosystem for future population. Some of the challenges come from land use activities such as agriculture, farming, tourism, settlement and logging. To address this, Samoa has adopted a sustainable land management (SLM) approach, with the aim of maintaining and enhancing land productivity levels and minimising land degradation. A key step of the SLM is the engagement, participation and advice from communities, which in Samoa is vital due to the land tenure system.

One of the key activities undertaken for the sector was analysis of land resources capability, which was completed at the reconnaissance level using available data and information. This mapping was originally completed for rural and agricultural development processes.

To promote the SLM approach, a project (SMSMCL) was initiated that included the adoption of landscape management approaches. It was also the first upscaling initiative by Samoa to ensure land degradation issues and adverse effects, which cut across all levels of society, are well addressed through the integration of sustainable land/ landscape management into the planning framework and actions across multi-sectoral arrangements to achieve the long-term project goal.

The project ensures that Samoa's productive landscapes are protected and sustainably managed to combat land degradation and to increase soil carbon sequestration so as to contribute to poverty alleviation and mitigation and adaptation to climate change impacts, as well as to contribute to global environmental benefits by overcoming barriers to integrated sustainable land management.

The project strengthened local capacities, incentives and actions for integrated landscape management to reduce land degradation and greenhouse gas emissions, and promoted conservation whilst enhancing sustainable local livelihoods

Land use

Samoa's total land area is 2,846 km^2, of which a big proportion is covered in a range of forest types (see Table 9 and Figure 33). While primary native forest cover has declined over the years due to logging and other uses, other areas that were deforested are seeing secondary growth forests. Settlement areas are largely confined to the coastal areas of all islands.

From the SOE 2023 perspective, the land use refers to sensitive sites (native forests, inland wetlands and catchment areas) that are being affected by human activities. Some of the pressures are also discussed in the other sections of the SOE, including the Water Catchments (Indicator 2), Inland Wetlands (Indicator 3), Forests (Indicator 4), and Soil Resources (Indicator 5). The data that is being assessed are from the Samoa Bureau of Statistics – Agriculture Censuses (1999, 2009 and 2019). While this provides some useful information, it also has its limitations, as it focuses on only one sector.

Compared to past censuses (1999 and 2009), land under permanent crops has continued to decrease, a difference of 12% compared to 2009, while land under temporary crops and livestock have continued to increase. There was a 16% increase in land under temporary crops and a 1% increase in land under livestock compared to 2009.

Agriculture

Agriculture is one of the key sectors that continues to have an impact on Samoa's landscape and environment (MNRE 2015). A community consultation for Samoa's Aligned National Action Programme (NAP) 2010-2020 to combat land degradation, found agricultural land to be one of the four priority affected ecosystems. In terms of land area cover and distribution, forests predominate, with agriculture being an important land use. Agriculture is also a key priority for the nation to assist with improving the livelihood opportunities for rural communities.

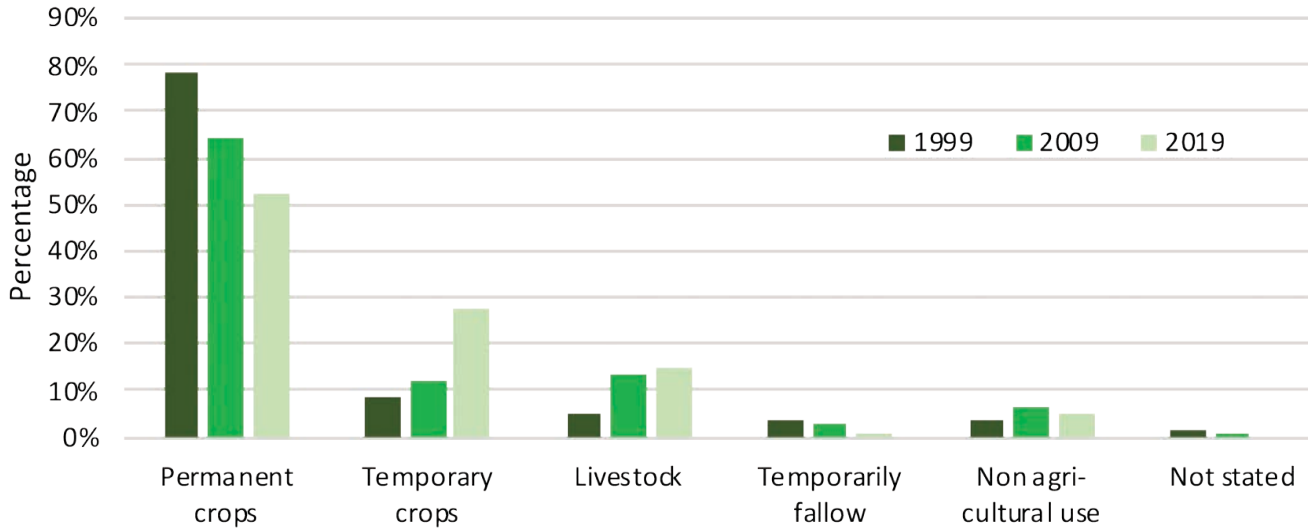


Figure 39: Land use primarily for agricultural purposes by all households from 1999 to 2019. (Source: SBS 2019).

The Samoa Agricultural Census (2019) noted 26,776 out of 28,516 households growing crops (or 94%), compared to 2009 where 19,538 households grew crops (Figure 39). There was a substantial increase in the number of households growing crops in all four regions with the highest numerical increase in North West Upolu, the region with much of the commercial and crop agricultural activities. However, the Apia Urban Area had the highest percentage growth with a 72% increase in the number of households growing crops. The increase in the number of growers is not reflected in the amount of land used for crops, with the growth in small holdings.

A number of agricultural households reported planting forest trees in 2019 – 1,655 households overall. Of these, the largest number of forest tree planting households were in the more rural area of the Rest of Upolu with 726 households, or 43.9% of the total.

The total area that is being used for agriculture is around 453 km^2 (45,378 ha), of which the majority (375 km^2) is customary land (SBS 2019). Most of the households grow a variety of crops including banana, breadfruit, cocoa, coconut, ta'amu and taro. Coconut plantations use the biggest land area covering 201 km^2, followed by taro (42 km^2) and banana (26 km^2).

Land degradation and restoration

The degradation of Samoa's terrestrial environment is caused by natural hazards and disasters, exacerbated by poorly planned and unsustainable land practices and water management. The pressures attributed to development needs for settlement, and for agriculture and infrastructure have led to land clearing, deforestation, and water extractions for consumption and for hydro-power. The building of roads and other infrastructure (water systems, electricity or telecommunication) often requires excavation and clearance of land, which is then followed by mining for soil, aggregates, asphalts and other materials. These materials are excavated from land or beaches, which can impact the environment. Intensive farming using fertilisers and weed killers can affect the fertility of the land, especially if land is not being left to fallow over time. With extreme weather events, especially intense rainfall, soil erosion becomes a problem, as well as roads being washed away causing further land problems.

While there is no quantifiable data to measure progress on land degradation, there are numerous reports and anecdotes to support progress in addressing the issue. Some of these include the following:

- The rehabilitation and transformation of a government degraded quarry land at Vaitele-Fou into a National Reserve.
- The restoration of an important mangrove wetland at Lano, Savaii island.
- The restoration of a section of the Vaipouli Catchment area at Avao, Savaii island.

- The construction of a Sustainable Land Management office at the Asau Forestry site, which became a Rural Farmer's Training and Learning Centre for farmers in the Asau District, Savaii islands.
- The formulation from the collective experience and learning from these and other environmental programmes and projects of Samoa's first GEF-funded multi-sectoral project for the sustainable management of critical landscapes called the SMSMCL 2014-2019 project.

In the development of Samoa's National Action Plan to the UN Convention in Combatting Desertification, consultation was carried out with communities to identify the key drivers for land degradation. Communities identified agriculture as the key driver, followed by unsustainable development and overexploitation. The latter issue was linked to poverty and village obligations. Climate change was also recognised as another key driver to land degradation. Some of the challenges identified through the community consultations include:

- Governance at the village level.
- Lack of awareness of LDD issues.
- Government policies and programmes for economic development, such as tourism ventures.
- Settlements at vulnerable sites including coastal areas and slopes.
- Growing population.
- Changing natural climate processes.
- Fragmented coordination at the national levels of the various programmes.
- Livelihood opportunities.
- Unregulated development.

One of the outcomes of Samoa's second or Aligned NAP 2015-2020, was the implementation of the SMSMCL project where a number of issues were addressed including:

- Sustainable management of productive landscapes.
- Rehabilitation of degraded lands.
- Carbon sequestration.
- Soil fertility for crop production.

One of the targets of the SMSMCL project is to rehabilitate 62,730 ha of agriculture and forest land through improved soil and water conservation, and management practices. At least 18,000 ha will be managed using ecologically sustainable traditional practices, integrated with ecologically friendly climate and pest resistant crop varieties. About 43,800 ha will be restored with indigenous tree plantations managed by the community.

Impacts

The people have used the land for their survival and subsistence living since the islands were settled. The level of use and the impacts would be moderately low in the early years of settlement, but has since intensified with widespread implications since the arrival of Europeans and other new settlers. The impacts have been severe, which include the loss of biodiversity and the scarring of the land through reclamation, deforestation and agriculture farming. The use of mechanised tools accelerated the clearing of the land, usually for the purpose of farming or settlement. Utilities, such as roads, electricity, waters pipes and communication towers, provide the main incentive for the widespread impact.

Reclamation of coastal seas and parts of rivers and streams for additional lands for purposes of protection and resilience against climate change and rising sea levels or for recovery of eroded lands due to aggressive high-tidal waves and/or occurrence of recent regular king tides and occasional storm surges.

Response

Remediation of degraded lands has been a key focus of the government through programmes, initiatives and targeted projects. This includes research on soil characteristics (refer to Soil Indicator) and land use activities, leading to programmes such as reforestation and rehabilitation.

Samoa signed up to the UN's Convention to Combat Desertification (UNCCD) in 1998, recognising the importance of addressing land degradation throughout the country. It prepared and submitted its National Action Programme (NAP) to the Convention in 2006, where it was aligned closely with other MEAs, such as the National Adaptation Programme of Action (NAPA) and the National Biodiversity Strategy and Action Plan (NBSAP). Many of the activities identified in the NAP are also included in the NBSAP and NAPA. The NAP was revised, taking into account the UNCCD Ten Year Strategic Plan (2008-2018), which encouraged members to identify drivers of land degradation and droughts in priority areas of affected populations and ecosystems. Samoa's second NAP report (2015-2020) was developed after consultations with communities and other national stakeholders. The report was heavily driven by the communities based on their lived experience and learning. This also encouraged ownership and engagement by the community. The second NAP report identified the issues of land degradation through soil fertility, biodiversity loss, salinity incursion and invasive species.

The implementation of the SLMSMC project has led to the development of a number of useful tools to aid in managing land degradation:

- **Soil Conservation and Management Manual 2016** | Provides guidelines to support the implementation of sustainable and integrated land management outcomes of the SMSMCL project.
- **SLM Training Programme Manual in Farm Lands of Samoa 2017** | Provides training for farmers and other stakeholders on Sustainable Land Management practices
- **Key Biodiversity Area Management Plans for Community Conservation Areas 2019-2024** | Developed management plans for Uafato, Tiavea and Falealupo.
- **Sustainable Village Development Plans (SVDPs) 2019-2024** were developed for all the project sites for both Savaii and Upolu islands, for example at Falease'ela and Safa'ato'a of Lefaga District.

The Planning and Urban Management Act 2005 is the overarching legislation that provides the oversight for mining of resources. Any mining of earth materials (sand, silt, gravel, scoria and other quarry soils and rock aggregates) and reclamations of coastal areas, riverbeds and swamp areas requires applications to the Planning and Urban Management Authority (PUMA). Refer to Indicator 20: Environmental compliance for additional information.

Some new policies and legislation being proposed including the Soil Resources Management Bill 2021 and the National Sustainable Landuse Management Policy 2023.

Some environmental safeguards exist including:

- Sustainable Agriculture – MAF, through its Agriculture Sector Plan 2016 – 2020.
- Samoa Food systems Pathway 2030.
- SACEP farm programmes promotes, through its vision, sustainable agriculture.

And in so doing, sustainable aspects of agriculture are integrated into their consideration processes by way of environmental safeguards and in the application of sustainable land management practices and approaches on major commercial farms and communal farm projects. Some of the major agricultural developments with commercial significance are processed through the PUMA development consent application and approval (DCAs) process.

Land use in Samoa had mainly been defined, apart from forestry developments, by agricultural cultivation and related activities. Traditionally, the agricultural cycle of taro, ta'amu, and other staple food crops involved about two years of production followed by 8-10 years bush fallow. With increasing demands on production, reduction in fallow periods, and shifts to less fertile lands, careful management of soil fertility and minimising land degradation are critical for achieving sustainable production.

In agricultural terms, there are three main types of agricultural land use zones in Samoa:

1. A coastal zone with an almost continuous canopy of coconut palms. This zone extends inland to varying degrees and frequently supported patches of root crops, cocoa or bananas.
2. Inland of the coconut zone was the mixed cropping zone which was dominated by bananas with plantings of cocoa and root crops.
3. The third zone which was inland of the mixed cropping zone was the major area, prior to the arrival of taro leaf blight, for taro planting. Plantings of taro were made in newly cleared forest areas with a high content of organic matter. As the economic importance of taro continued to grow the forest edge was continuously pushed further back.

Mining of sand, scoria and other soils and land aggregates by individuals especially by commercial operators have become increasingly popular and prevalent, and whilst most operations are legal, some mining operations for commercial reasons are illegal and significantly indiscreet at unsustainable levels.

Reclamation of coastal seas including parts of rivers, creeks and streams are visibly evident along the coastal lands or the open coasts of the two main islands: Upolu and Savaii. Some are legal whilst others are illegal without permit issuance. Such patterns of behaviour can be attributed to critical demands for urgent needs of reclamation for reasons of protection from damage to land properties due to coastal flooding and erosion from natural hazards or disasters.

Sustainable agriculture, food security and food safety in Samoa and the rest of the Pacific islands are more urgent goals than ever as we enter the new season and era of high consumption rates yet slow production yields, due to both natural and human-induced factors. In a developing country such as Samoa, the agriculture sector has multiple roles: to help ensure food security, anchor rural development, provide resources for the livelihood and adequate incomes of a majority of people, and to do this without destroying the ecological nature of the environment. There are thus two inextricably linked components, social and environmental, to agricultural sustainability.

Governments in a number of countries including Samoa have taken precautionary steps to halt or curb commercial production and imports, and in some cases, even banning certain types of technologies. Meanwhile, the ecological, social, health and economic fall-out of chemical-based agriculture continues to unfold despite the acknowledgment in Agenda 21 by the world's political leaders that such production systems were proving to be environmentally unsustainable. Like other countries in the world, Samoa has taken several strategies in making sure its environment is ecologically, socially and economically sustainable.

Such strategies are geared to common challenges such as population growth, food security, conserving limited natural resources, limited arable farming land and the need for a sustainably healthy environment. This has raised the need for strategies for sustainable food security and the need to conserve natural resources as emphasised at the World Commission on Environment (Agenda 21 1992).

The Agriculture Sector Plan (ASP) 2016-2020 recorded about 24% of Samoa's household income is from agriculture and forestry activities (2014) and 25% of Samoa's labour force are engaged in the sector as their main source of income (2012). The Agriculture Census 2019 discloses the size of land use under agricultural cultivations or landholdings as 53% of land parcels per agricultural households were under permanent crops, 25% under temporary crops, 17% under livestock, 4% under non-agricultural use and the rest under temporary fallow.

The FAO data informs that the approximate size of Samoa's arable lands, which by FAO definition is land under temporary agricultural crops is about 600 km^2 of the total landmass of about 2846 km^2, which is approximately 21%. And compared to forest cover is about 1616.7 km^2 of the total landmass which is about 57%.

The Government of Samoa, through MAF's national policy initiative, namely Samoa Food Systems Pathway 2030, calls for transformation of food systems for a resilient and healthy Samoa where no one is left behind, with emphasis on sustainable food and nutritional security and affordable healthy diets.

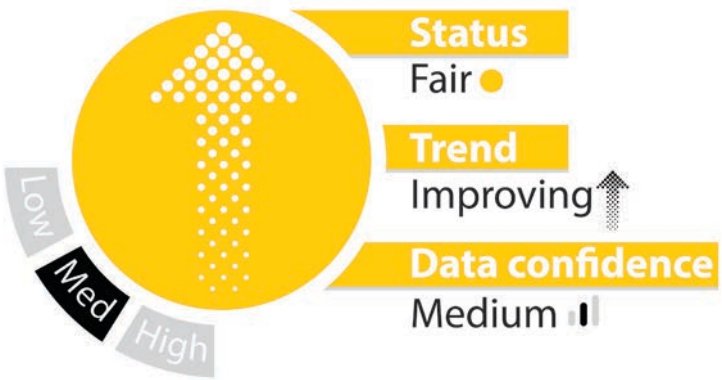
Also, the MNRE under the SMSMCL project, produced a Sustainable Agriculture Programme/Plan (SAP) Manual for Farmers. This initiated a number of Training of the Trainers (TOT) programmes and projects which focused on Sustainable Land Management (SLM) in Farm Landscapes of Samoa. It highlights sustainable agricultural practices, and landscape-based farm planning as major building blocks towards SLM.

The SLMFL training programme consists of training of trainers or TOT at the national level, and training of farmers at the villages and districts. It is hoped that through this component of the SMSMCL, farmers can effectively play their role as prime stakeholders in sustainable land management by advancing sustainable farms anchored on landscape-based farm plans and sustainable farming practices.

Recommendations

- There is a need to strengthen national land development and land use policies through regular reviewing, enforcement and implementation.
- Increasing the awareness of the public and the business community on the rules that govern land use and development should be promoted.
- The monitoring of all land use and land development activities should be carried out.
- Many of the sites that have been mined need to be rehabilitated, which will help improve soil quality and attract biodiversity.
- Where appropriate use existing legislation to improve the conservation and protection of land and land resources. This may require acquiring of land for conservation and public use, overseeing land reclamation and monitoring of development activities.
- The development of Samoa's Community Integrated Management Plans need to be reviewed and consideration must take into account the geomorphology, geology, soils and land degradation characterisation.

INDICATOR 7: Terrestrial conservation and protected areas



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	14	15 LIFE ON LAND 13 CLIMATE ACTION	World Forest Charter (WFC) 1994 UNFCCC 2001 – UNCCD 1998 Kyoto Protocol 2000 World Heritage Convention 2001 Ramsar Convention on Wetlands 2004 CITES	SAMOA Pathway 90, 94(d)	• Masamasa-Falelima National Park Management Plan 2021 - 2030 • National Biodiversity Strategy & Action Plan 2015-2020 • National Land use Policy 2001 • National Population and Sustainable Development Policy 2001 • National Biosafety Policy 2004 • National Heritage Policy 2004 • National Policy on the Conservation of Biological Diversity Policy 2005 • Strategies for the Development of Samoa (SDS) 2005 - 2007 • Codes of Environmental Practice 2006 • O Le Pupū Pu'ē National Park Management Plan (Ramsar Site) 2020-2030 • Vailima National Reserve Management Plan 2011-2015

Indicator definition

Protected areas play a vital role in protecting biodiversity and maintaining the diversity and quality of ecosystems. The more pristine and intact the protected area, the more resilient it is, with the capacity to adapt to changes. Protected areas in Samoa are either under the administration of the government, or are under community ownership and management. More recently, private land-owners are also setting aside private lands for conservation purposes (e.g. Malololelei Recreational Reserve). This indicator focuses on the total number of areas being protected either under the government, community or other, and the total land mass under management. This indicator focuses on the terrestrial environment, however, it is acknowledged that in some protected areas both land and marine are included.

Status and Key Findings

A summary of Samoa's terrestrial protected areas is provided in Annex 4: Samoa's Terrestrial Protected Areas. A three-timeline series (2009, 2014 and 2017) is provided to track progress on the total protected area. A total of 13,576.94 ha of land has been identified as terrestrial reserve area (Annex 4: Samoa's Terrestrial Protected Areas). Samoa's protected areas have been mapped (Figure 40 to Figure 42). A significant outcome of terrestrial protected areas is the in-situ conservation of biodiversity, especially with regards to the expansion of the areas being protected.

The terrestrial protected areas make up 92% of the landscape under conservation, with the marine area around 8%. A large proportion of the terrestrial protected areas fall within the boundary of KBAs. The KBAs are mostly customary owned, therefore engaging with communities is a critical part of conservation management in Samoa. There are around 54 terrestrial protected areas, and 126 marine conservation areas.

Samoa's Conservation and Protected Areas Info Data

- Total areas protected: 78,248 ha (782.48 km^2). This equates to 37% of priority sites for conservation being protected. The national target for protected areas was 15% (NBSAP 2008) and the CBD - Aichi Target was 30%.
- 91% of the total protected areas are terrestrial, and the other 9% are marine.
- The government has earmarked 136 km^2 of its land for conservation areas (MNRE 2022).
- 54 terrestrial protected areas are documented. These are included under six broad conservation categories: i) terrestrial reserve, ii) catchment areas; iii) national park; iv) community conservation area; v) marine reserve; vi) fish reserves.
- Estimated areas under KBAs: 104,844 ha (1,048.44 km^2). Most of the protected areas are within the KBAs.
- Six Important Bird Areas identified and are all included in the KBAs.
- 26% by area of KBA have not been prioritised as conservation/protected area (2018).
- Most of the conservation and protected areas are under customary ownership; there is strong support from local communities for their protection.
- Management Plans completed for Four Management Plans completed; OLPP, Lake Lanotoo, Mt. Salafai, Masamasa-Falelima Aleipata. Five declared National Parks with a total area of about 23,320ha of which four already completed Managment Plans (O Le Pupu Pu'e, Lake Lanotoo, Mt. Salafai and Masamasa-Falelima NP).

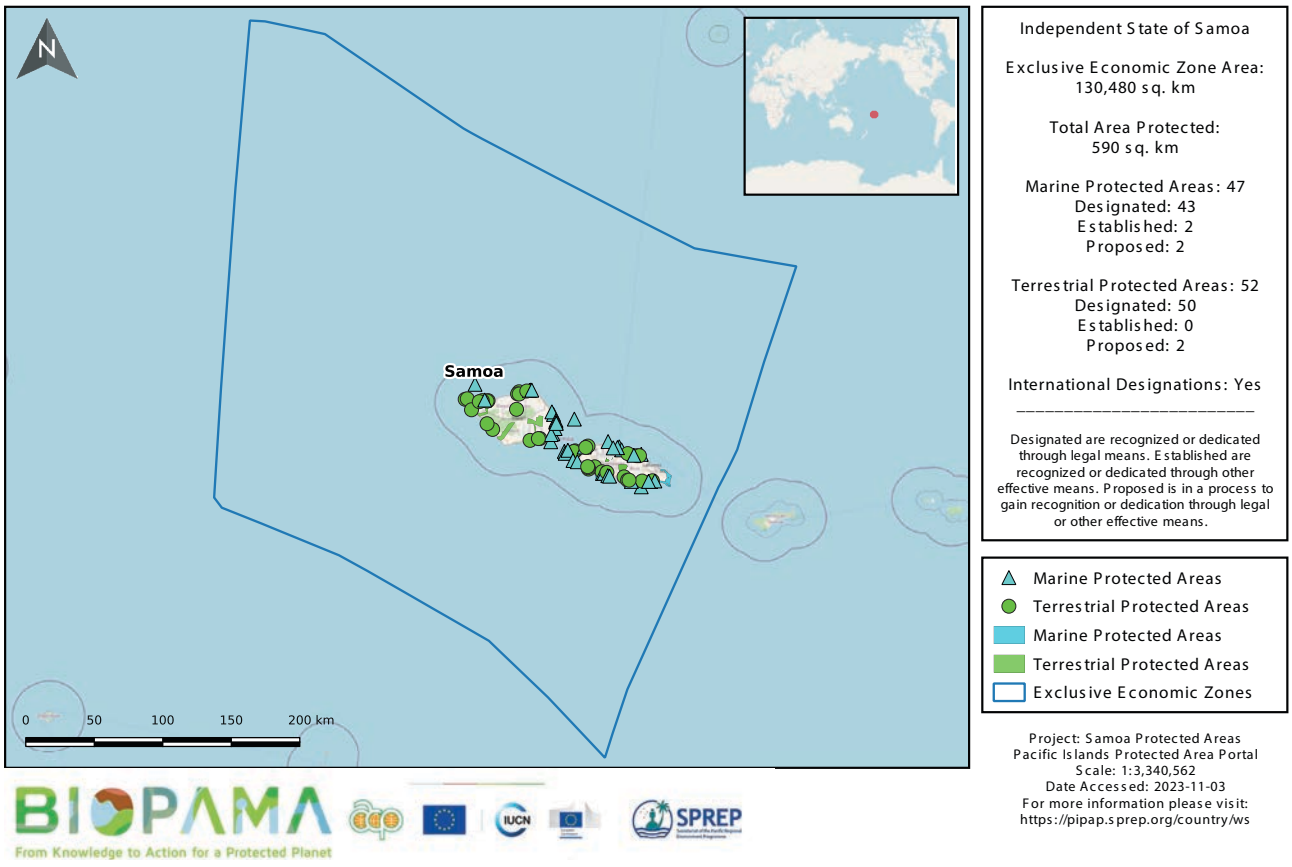


Figure 40: Samoa's protected area map. (https://pipap.sprep.org/country/ws)

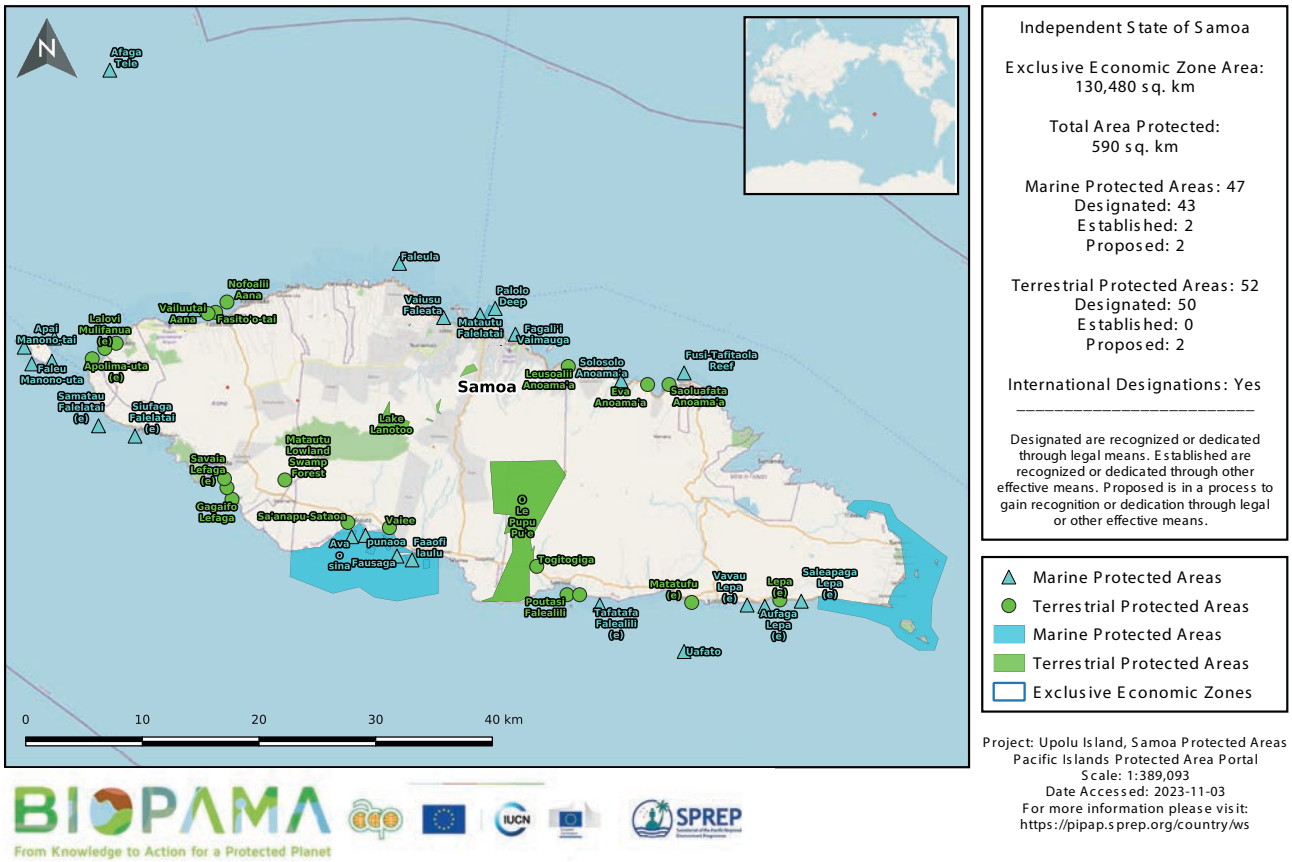


Figure 41: Protected areas throughout Upolu island. (https://pipap.sprep.org/country/ws)

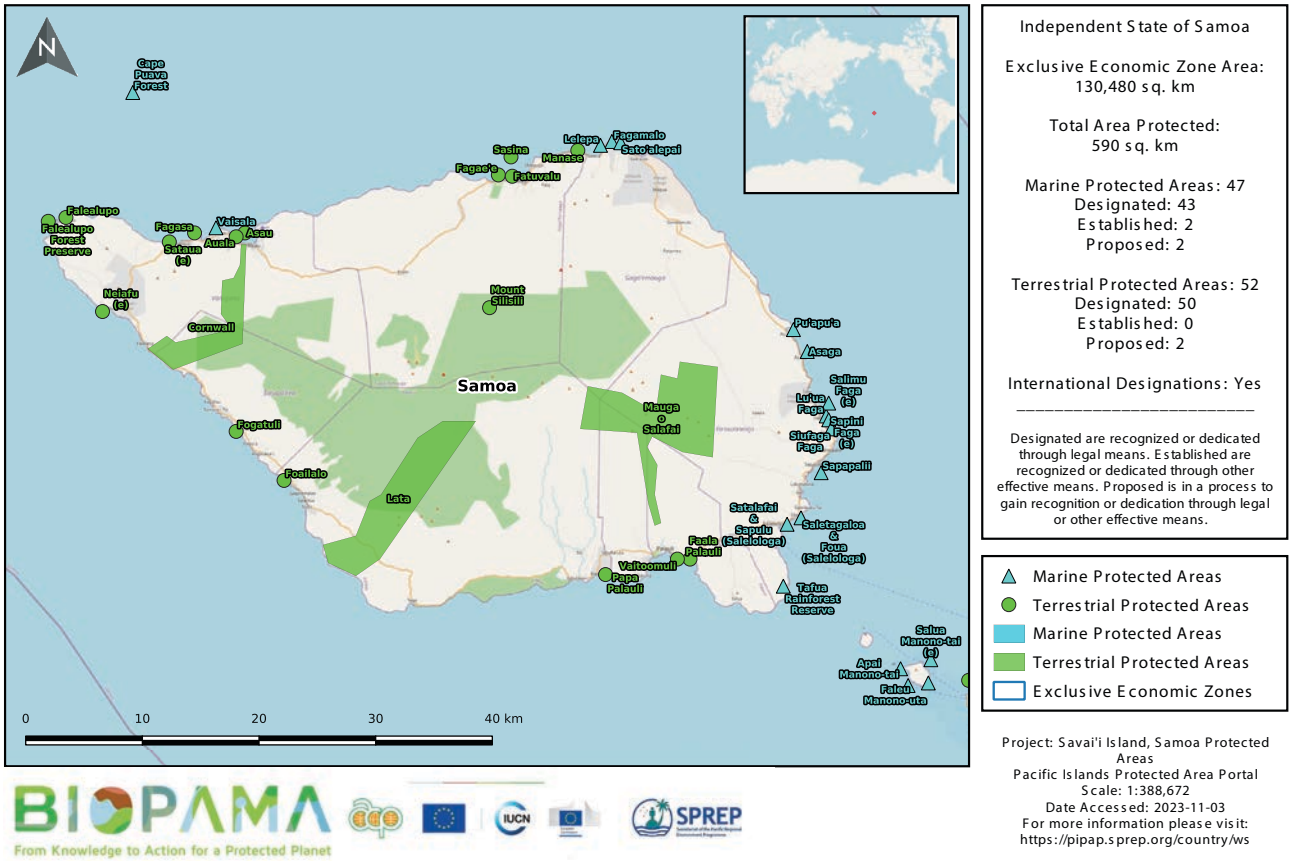


Figure 42: Protected areas on Savaii island. (https://pipap.sprep.org/country/ws)

O le Pupū-Pu'ē National Park

The National Park was established in 1978, under the National Parks and Reserves Act 1974. It is one of the first national parks declared in the South Pacific region. It has not been formally gazetted but protection is accorded to the site after it was declared by the Head of State. The National Park was officially designated as a Ramsar site in October 2017, it is a Key Biodiversity Area (KBA), Important Bird Area (IBA), and is included under the Queen's Commonwealth Canopy (accreditation gained in June 2018). The total area of the National Park is 50.19 km^2, after the forestry plantation on the west coast, and the recreational area was added. The National Park is within government land; however, the boundaries have not been delimited, which is a problem, especially with encroaching farming and settlements operations.

The National Park extends from the highest point of Upolu island down to the rugged Le Pupū lava cliffs on the south coast. The National Park is home to two montane herbaceous marshes, as well as parts of the Mataloa River and the Vaalega River. The National Park includes large tracts of forest dominated by native plants, and is considered the island's best-preserved remaining tropical forest. It includes parts of the Togitogiga water catchment, the main water source for four villages, and also boasts waterfalls that are prime tourist sites. Its diverse habitats support four of the eight globally threatened bird species of Samoa including the critically endangered tooth-billed pigeon (Didunculus strigirostris), and the endangered Mao (Gymnomyza samoensis), whose populations have severely declined in recent years. Very little is known about the freshwater biodiversity of Samoa; it is likely that the freshwater ecosystems in the National Park support significant biodiversity. Several management actions are being undertaken to address the vigorous spread of invasive plants after the severe tropical cyclones of 1990 and 1991 caused extensive damage to the lowland forests. The National Park has a management plan: O Le Pupū Pu'ē National Park Management Plan, Ramsar Site 2020-2030 (MNRE 2021a), which was launched during the World Wetland Day in 2021. Important highlights of the management include regular monitoring, managing invasive species, restoring degraded areas, protecting catchment sites and improving water quality, and engaging with communities for co-management opportunities.

Aleipata-Marine Protected Area Info Data

- **Established: 1999 (Figure 43)**
- **Total Area covered: 4998 ha (49.98 km^2) – Marine 4.8 km^2, Terrestrial 0.16 km^2**
- **Unique features:**
  - **The Protected Area includes both the terrestrial and marine environment – including the islets of Nu'ulua, Nu'utele, Namu'a and Fanuatapu.**
  - **One of Samoa's Key Biodiversity Areas.**
  - **Ecosystems include lowland rainforest, coral reefs, mangrove forests and islands.**
  - **Nesting sites for turtles, seabirds and the Samoa ground dove (Tuaimeo).**
  - **Also a site for the 'Critically Endangered' Manumea.**
- **Key Threats: Natural disasters, invasive species, fishing developments**

Figure 43: The Aleipata Marine Protected Area includes some important terrestrial vegetation.

Lake Lanoto'o National Park

Established:	**2004**
Total Area:	**4,089 ha (40.89km^2)**
Location:	**Central highland, of Upolu island. It consists of three crater lakes – Lake Lanoto'o, Lake Lano'ata'ata, Lake Lanoanea. (Figure 44)**
Ramsar Site:	**Designated as a Ramsar Site in July, 2004**
Unique Features:	**Near pristine crater lakes with highest elevation at 800m.**
	An important part of the Apia catchment area feeding into Fuluasou and Vaisigano catchments.
	Important water source for villages residing on the south side of the island within Siumu and Safata districts.
	Important bird areas where the Tooth-billed pigeon, the Mao, Samoan starling (Aplonis atrifusca), Samoan whistler (Pachycephala flavifrons), Samoan broadbill (Myiagra albiventris), and the Samoan triller (Lalage sharpei) are found.
	The endangered Samoan bush palm (Clinostigma samoense) is found here.
	73% of the NP is montane rainforest and 21% secondary forest, 4% non-native ecosystem and 3% are the lakes.
	Flora is 85% native species with introduced plants, including seven of the worst invasive species in the world.

Figure 44: The main lake was originally a volcanic crater.

Community Reserves

A number of community reserves has been established under a memorandum of understanding between the government and communities. Some are listed below.

Government designated reserves

Community Reserves:

- Mulinu'u Point
- Apia Waterfront
- Tusitala
- Sinave
- Falefatu
- Gataivai
- Maugafiafia
- Lelata
- Loto-o-Samasoni
- Vaiteletai
- Vaiteleuta
- Malaevaalele

Marine Reserves:

- Fisheries Protected Area (Palolo Deep)
- Village Conservation Areas (Savaia village)
- Inland Lagoon (Alataua, Upolu, Amoa, & Itu-o-tane, Savaii

Wetland Reserves:

- Apolima-uta (Aiga-i le Tai)
- Manono-uta
- Satuimalufilufi Vaipu Swamp

Impacts

Protected areas provide a last hope in ensuring that the species and ecosystems remain intact so that they can continue to provide the services that the people depend on. Most of Samoa's resources are under severe stress from overharvesting, climate change, loss of habitats due to encroachment, natural disasters, waste and pollution, and competition with invasive species.

As the population continues to increase, these pressures on the terrestrial environment will only worsen. Extraction of water and natural resources will lead to degraded ecosystems and depletion of target species. Economic pressures and developments are also challenging existing protected areas, especially if they are not yet formalised or endorsed by the relevant stakeholders.

Response

Samoa's protected area network continues to grow and expand, which will protect more ecosystems and species. Management plans are being developed for most of the national parks, as well as management plans for community conservation and reserves. However, there is a serious gap with regards to the implementation of the plans.

At the national level, the National Biodiversity Strategy and Action Plan provides the strategic direction for conservation and protected area work. The National Target 11 is the overall goal for the country:

By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective areas.

By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective areas.

Identified actions in the NBSAP include establishing protected areas, community conservation areas and marine protected areas. Ensuring legal protection for 50% of the protected areas, and undertaking ecological surveys, especially for newly established protected areas.

Some of Samoa's national policies that are important in the terrestrial conservation and protected area realm include:

- National Forest Policy – advocates the monitoring of protected areas and to prosecute those who undertake unlawful activities.
- The Master Plan – Guide to Sustainable Management of Government Lands 2022-2032. The Plan stipulates additional lands, under government control, that will be designated for protection and conservation. A total of 136 km^2 land will be protected.

Legislation: A number of legislations provide legal support to areas that are designated for conservation.

Forestry Management Act 2011: Part VIII. Protected Areas. Prohibiting forestry operations that may affect national parks and reserves, as well as any sites that are likely to be designated as protected areas. Protected areas may also be designated under the authority of the Act for the purpose of protecting biodiversity, protecting endangered species and or forestry resources, protecting catchments or areas of national, religious, historic, legendary or archaeological significance, and protecting sites for tourism and public use.

National Parks and Reserves Act 1974: The Act contains a provision to establish national protected and conservation areas.

Land Surveys and Environment Act 1989: The Act promotes the conservation and protection of Samoa's natural resources and environment.

The MNRE has developed more than 20 Watershed Management Plans with communities to guide the rehabilitation and restoration of key catchments. The MNRE will continue to work collaboratively with Samoa Conservation Society (SCS) to implement the Carbon Offset Project for OLPP NP Ramsar Site.

Water Resource Management Act 2008: The Act provides for the management, protection and conservation of water resources in Samoa. The legislation advocates for the sustainable management of water resources including regulating the use of water and establishing watershed management programmes and plans.

Recommendations

A lot of progress has been made in establishing conservation areas throughout the country. The engagement with communities to develop, designate and protect sites of local and national significance, has been one of the key factors in achieving these outcomes. This needs to continue to ensure that conservation measures are supported, respected and implemented by communities and the Government of Samoa.

Wider capacity building and educational trainings should be cater for the communities ensuring thier interests and understandings in the manangement of the national parks.

Rehabilitation activities continues to degraded areas aiming at maintaining the natural biodiveristy existing supporting the 3 MIllion Tree Planting Campaign 2022 - 2028.

The engagements of the Park Rangers in the monitoring of the National Parks and patrolling to minimize the encroachment should be strengthened and Park Rangers to be well trained.

The importance of living sustainably must be promoted to all households throughout the country. Engaging the Alii ma Faipule and encouraging their participation in managing natural resources will help achieve sustainable living, which will lead to a better future for all Samoans.

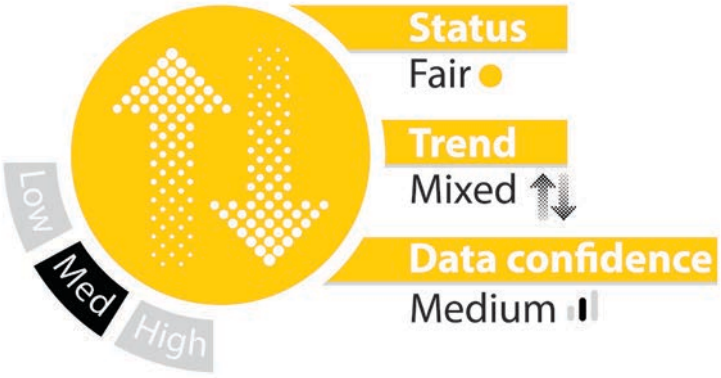
Research and monitoring are a critical part of protected areas and conservation management. It is easier to convince the public of the need for protected and conservation areas, if the evidence is available to support their designation. The research should focus on ecosystem services, biodiversity and ecological connection, population dynamics and status, and the interactions amongst the species and the environment.

Proactive management, such as the removal of invasive species, especially invasive trees, shrubs and vines, and to create adequate buffer zones, will ensure that conservation areas are protecting the natural biodiversity and environment.

Foster partnerships with development partners to secure resources, especially technical and financial resources, to assist the staff in field surveys, monitoring and documentation of conservation biodiversity data, and to develop management plans. The capacity of staff needs to be built and developed so that they are able to carry out conservation management measures.

The implementation of conservation and protected area management plans is lacking. More efforts are needed to ensure that these conservation areas, especially village level conservation areas, are meeting their purpose of protecting biodiversity.

INDICATOR 8: Invasive species management



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	9 12	6 CLEAN WATER AND SANITATION 15 LIFE ON LAND	Ramsar Convention on Wetlands CMS CITES	SAMOA Pathway 58 (e), 95 (a-c) Guidelines for Invasive Species Management in the Pacific	• Strategy for the Development of Samoa and Samoa 2040 • Samoa Climate Change Policy 2020 • Samoa Ocean Strategy 2020-2030 • Samoa's National Biodiversity Strategy and Action Plan 2015-2020 • National Environment Sector Plan 2017-2021 • National Invasive Species Strategy and Action Plan.

Indicator definition

Invasive species have a negative impact on Samoa's economy, biodiversity and livelihood. Samoa has suffered the economic impact of invasive species (e.g. phytophora). Continuous invasion of Samoa's environment by introduced species is still taking place, such as the widespread movement of the giant African snail.

This indicator focuses on environmental invasive species (excluding agricultural and health pests). Marine invasives are another problem, although very little information exists in the Pacific and Samoa. Marine invasive species assessment is not included in this SOE report, but it should be considered in future iterations. An important part of the assessment focuses on priority invasive species, as listed in the NISSAP 2019-2024, as well as the management of invasive species from priority sites.

State and Key Findings

Samoa recognised the threat posed by invasive species to ecosystems and native biodiversity. A National Invasive Species Strategy and Action Plan (NISSAP) was developed by the Samoa National Invasive Species Task Team (SNITT), and it is now in its 2nd iteration. Priority species have been identified for management (Table 12). Protected areas are key components of priority sites for invasive species management. These protected areas include Mt Vaea Reserve, Aleipata islands, Malololelei Reserve, Biodiversity Park, Conservation Areas in Uafato and Falealupo and Marine Protected Areas in Aleipata, Safata, Palolo Deep and Traditional Fishing Reserves. Invasive species management has been undertaken at a few protected areas including the Aleipata islands and the O Le Pupū Pu'ē National Park. Eradication of many of the established species is expensive and challenging, however, there are some actions being undertaken to try and mitigate their impacts.

Table 12: Samoa's priority invasive species for management (NISSAP 2019-2024)

SPECIES	COMMON NAME	SAMOAN NAME
Invasive Mammals		
Rattus rattus	Pacific rat	Isumu
Rattus exulans	Polynesia rat	Isumu
Rattus norvegicus	Ship rat	Isumu
Invasive Birds		
Acridotheres tristis	Common myna	Maina
Acridotheres fuscus	Jungle myna	Maina
Columbia livia	Rock pigeon	Lupe palagi
Pyconontus cafer	Red vented bul-bul	Manulele palagi
Invasive invertebrates		
Achatina fulica	Giant African snail	Sisi Afelika
Anoplolepsis gracilipes	Yellow Crazy Ant	Loi
Bactrocera xanthodes	Fruit fly	Lago
Oryctes rhinoceros	Rhinoceros beetle	Manu ainiu
Invasive Plants		
Albizia chinensis	Silktree	Tamaligi uliuli
Calamus spp	Rattan	Latana
Castailla elastic	Rubber tree	Pulu mamoe
Cinnamomum verum	Cinnamon	Tinamoni
Clerodendrum fragrans	Honolulu Rose	Losa Honolulu
Leucaena leucocephala	Leucaena	Lusina
Clidemia hirta	Koster's curse	La'au lau mamoe
Cordia alliodora	Cordia	Kotia
Falcateria moluccana	Albizia	Tamaligi paepae
Funtumia elastic	Rubber tree	Pulu vao
Hyptis pectinate	Mint weed	Vao mini
Kylinga polyphylla	Navua sedge	Tuise tele
Lantana camara	Lantana	Lantana
Decalobanthus (Merremia) peltata	Merremia vine	Fue lautele
Mikania micrantha	Mile-a-minute	Fue saina
Solanum torvum	Torvum weed	Lapiti
Spathodea campanulata	African tulip	Faapasi
Elaeocarpus angustifolius	Blue quandong	
Invasive Aquatic Plants		
Eichorina crassipes	Water hyacinth	Lili vai
Pistia stratiotes	Water lettuce	Lakisi Vai
Marine Invasives		
Acanthaster planci	Crown-of-thorns starfish	Alamea
Codium arenicola	Dead-man's fingers	Limu meamata
Spatoglossum macrodontum	Broad leaf brown seaweed	Limu enaena

Invasive species management at Aleipata islands

Four islands make up the Aleipata islands, with a total land area of 1.68 km²: Nu'utele (1.08 km²), Nu'ulua (0.25 km²), Namu'a (0.20 km²) and Fanuatapu (0.15 km²) (Figure 45).

Figure 45: Aleipata islands, comprising of Nu'utele and Nu'ulua. (Picture credit: Google Earth – accessed 22 March 2023)

The Aleipata islands are customary owned, with at least four chiefly titles linked to the islands. The islands are less than 1.5 km from the closest point of the Upolu mainland. It is one of the sites identified as a KBA, due to hosting unique native biodiversity, absence of permanent settlement and relative protection from invasive species. Records of invasive species on the islands include:

- Subulina octona (Stringer et al. 2000)
- Anoplolepis gracilipes (Smith 2003)
- Hemidactylus frenatus (Fisher 2012)
- Rattus exulans (Park et al. 1992)
- Sus scrofa
- Decalobanthus (Merremia) peltata
- Wedelia biflora
- Albizia falcataria

Two species that were targeted for management in a project carried out in 2009, were the Yellow Crazy Ant and Polynesian rat. Aerial baiting for the rats took place in 2009 and the outcome was deemed successful for Nu'ulua but not Nu'utele (Serra and Faleafaga 2015). Observations by staff from MNRE indicated rapid forest regeneration and an increased population of some animals (Buttler et al. 2011; Tye 2012). Work on managing yellow crazy ants started in 2010, but due to change of focus, the work was never completed. Pigs were also identified for management, and removal was planned for 2007. Pigs are still found on Nu'utele, possibly due to lack of awareness on the adverse impacts caused by pigs on the environment (Serra and Faleafaga 2015).

O Le Pupū Pu'ē National Park

O Le Pupū Pu'ē National Park is one of the first to be established in the country (Figure 46). It is located 15 km south of Apia and covers 5,019 ha. Some of the key invasive species activities of the park include a reconnaissance survey in 2015, for invasive species (Atherton 2015). A Decalobanthus (Merremia) peltata mapping was carried out in 2014, with an operational plan developed for the restoration of the park (Atherton 2015). Atherton's survey found high disturbance in the park due to tropical cyclones, although invasive species dominance was considered low to medium in the survey sites. Some of the invasive species recorded at the park include Yellow-Crazy Ants, Giant African Snails, Bulbul, cattle, pig and some chickens. The invasive plants were mostly Albizia falcataria, Koster's curse, rubber tree, Merremia, Lopa, Clidermia, and Honolulu rose (Atherton 2015).

Although no concerted effort has been made to eradicate many of the priority invasive trees, some management efforts are focusing on removing and replacing some in key biodiversity areas (e.g. Mt Vaea). The overall trend for invasive trees is continued growth and expansion.

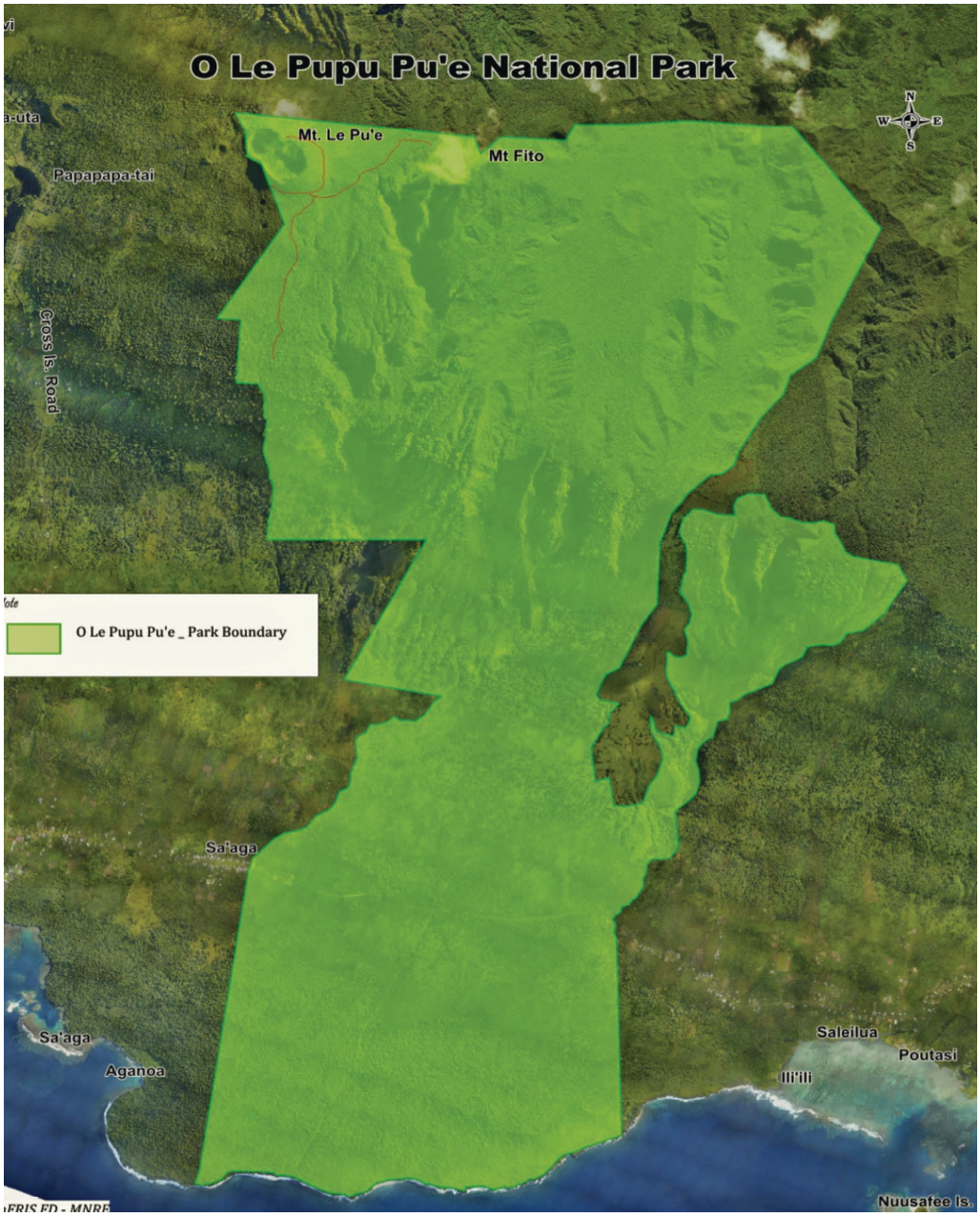


Figure 46: O Le Pupū Pu'ē National Park map. (Picture credit: MNRE)

Aquatic invasives

The aquatic environment has not received the same level of attention in terms of the presence and impact of invasive species, apart from the water lettuce that continues to be contained in people's gardens, and recorded in a survey by Jenkins et al. (2008). Jenkins and team's survey found three introduced species, Oreochromis mossambicus, Carasius auratus and Poecilia mexicana. Where these species occurred, it coincides with a depauperate and/or absence of native species. Lake Lanoto'o is a Ramsar Site, and no native species was found by Jenkins et al. (2008). Instead, goldfish (Carasius auratus) and tilapia (Orechromis mossambicus) were present, with the latter increasingly taking over.

The marine environment focuses on the containment and removal of the Crown-of-thorns starfish, when there is an outbreak. The COTS feeds on coral polyps, and in large numbers can cause serious damage to reefs.

Myna Management

Figure 47: Myna birds are introduced invasive bird species.

Myna (Figure 47) surveys were carried out in 2015, in both Upolu and Savaii islands. Three habitats were surveyed (plantation, mixed crop and urban). Myna bird population was estimated at 159,000 birds. The majority are on Upolu island (approx. 130,000). The urban environment is the preferred habitat, but more birds are moving towards plantation and mixed crop areas, as the urban environment becomes saturated.

Crown-of-thorns starfish (COTS) management

Figure 48: Crown of thorns starfish – a serious predator of corals

Crown of thorn starfish (Figure 48) or alamea outbreaks are not rare events in Samoa, with episodes in 1969, 1977-1986, 2011 to 2015 (Zann and Bell 1991; Kwan et al. 2016). COTS outbreaks can be caused by increased nutrients in coastal ecosystems, which can be fed by pesticides and fertilisers being washed to sea from flooding events. COTS are removed manually and disposed of on land by staff from the Fisheries Division and the Marine Section of MNRE (Tiitii 2011; Kwan et al. 2016).

KEY STRATEGY	OBJECTIVES	ACTIONS TAKEN
Strategy 1: Manage established invasive species	Objective: To develop appropriate programmes and procedures to minimise the impacts of established invasive species by eradicating them where practicable, or otherwise control them.	Control and eradication programmes were undertaken for the following species, all with varying degrees of success at site level or on the national scale. Species specific • Terrestrial plants: Rattan; Merremia vine; albizia trees, 2 rubber trees, African tulip, • Weeds and vines: mile a minute, mint weed Navua sedge, pico, milkweed, giant sensitive weed, wild peanut, lantana, sida, blue rats-tail, Honolulu rose, knobweed, sword weed. • Terrestrial animals: myna birds; rats, mongoose; Cane toad; dog; African snail Yellow crazy ant, fruit fly, rhinoceros beetle. • Marine and aquatic: crown of thorns; water lettuce (Figure 49). • Area specific • Protected Areas and Reserves: Mt Vaea Reserve, Aleipata islands, Malololelei Reserve, Biodiversity Park. • Conservation Areas; Uafato; Falealupo. • Marine Protected Areas and Reserves: Aleipata and Safata MPA; Palolo Deep Marine Reserve: Traditional Fisheries Reserves. • Watershed and Forestry replanting and community forestry rehabilitation programmes.

Water Lettuce

Figure 49: Water lettuce an aquatic pest in many countries. (Picture credit: iNaturalist © Richard Fuller CC BY-NC)

- Water lettuce is an aquatic plant that grows fast, forming dense mats that choke out aquatic systems. It produces a foul smell due to the anoxic environment it creates and the leaves contain calcium oxalate crystals that can cause illness if ingested.
- It is popular in aquatic gardens that MNRE officers first became aware of it when found in a pond in Moto'otua in 2012. Investigation found the plant to have been shared and purchased by a number of gardeners, and the spread included the villages of Vaivase, Vaigaga, Vailoa, Vaisigano, and Tamaligi.
- Seven years after the first detection of the aquatic weed, continuous monitoring of around 27 sites found the plant in two sites. One of the sites was aware of the invasive nature of the plant, whereas at the other site, the owners were not aware and planned to remove it.
- A public awareness campaign was launched on local media and brochures distributed about the plant.

Impacts

Invasive species have caused serious economic, environmental and health impacts to Samoa. In most cases of invasion, the species are beyond eradication and cost for ongoing management can easily exceed millions. The taro leaf blight outbreak wiped out most of the taro varieties, brought taro exports to a halt and caused an economic loss of around USD 3.2 million. Another example of invasive species impact is the Giant African Snail that has affected garden vegetables for many households. The snails predated on many of Samoa's native and ornamental plants. Aquatic invasive species are poorly researched but it is expected that an introduction from an invasive aquatic organism can have serious impact on food security, given that a big proportion of Samoan households rely on the coastal inshore reefs for protein.

As urban spread continues and with the expansion of road systems, the spread of invasive species into new areas will continue. This is of concern, especially in key biodiversity areas such as montane and cloud forests, where more cats, rats, pigs and yellow crazy ants will spread. Recent evidence from rapid biodiversity assessments is showing reduced reptile presence, when yellow crazy ants are present.

Response

Invasive species have been a key issue for a number of Government of Samoa agencies. The Ministry of Agriculture and Fisheries is one of the key stakeholders in invasive species management.

- Samoa Quarantine Service – works under the Biosecurity Act 2005. Prevent and control the introduction and spread of pests and diseases. Carry out Import Risk Analysis. Raise awareness with the public on biosecurity matters.
- Animal Production and Health Division (APHD) – undertaken animal disease surveillance and control. Liaise with the Quarantine Service on animal quarantine matters.
- Crops – Integrated Pest Management, Coconut Rhinoceros Beetle Control Programme, Plant Health Clinic, Fruit Fly management.
- Fisheries Division – respond to outbreaks of the crown of thorns starfish, especially in marine and fish reserves.

Invasive species awareness actions

- Matautu Lefaga Conservation Area – *Ecosystem restoration and invasive species management*
- Falease'ela Community Consultation on Manumea – *Invasive species threats on the Manumea*
- Vaisigano Catchment Area – *Raise awareness on the impacts of the Water Lettuce in the Catchment Area.*
- School presentations in Apolima Tai on invasive species management

The Ministry of Natural Resources and Environment is another key government agency that manages invasive species, especially those that affect the ecosystem and biodiversity.

- National Reserves and Parks Section under the Forestry Service (28 staff).
- Terrestrial Conservation Section under the Environment and Conservation Service (5 staff) - undertakes a range of invasive species tasks including awareness raising and removal of invasive weeds.
- Marine Conservation Section under the Environment and Conservation Service (4 staff).

The Samoa National Invasive Species Task-Team (SNITT) was established as a cross-sectoral and multi-agency group, with the aim of coordinating the management of invasive species in the country. A National Invasive Species Strategy and Action Plan was developed for a four-year period (2008-2011), which was updated to the NISSAP 2019-2024. Some of the key outcomes from the first NISSAP 2008-2011 included the development of the Samoa Invasive Species Emergency Response Plan, the production of awareness materials, monitoring and responding to invasive species incursions and eradication campaigns on priority invasive species and site-led invasive species management projects.

Samoa has drafted two key invasive species management plans including the Pest Control Manual for Malololelei, and the Mt Vaea Ecosystem Resilience and Forest Restoration Monitoring Protocol.

An important part of Samoa's response to managing invasive species has been the development of the Samoa Invasive Species Emergency Response Plan (SISERP). The SISERP provides the national framework for responding to incursions and new introductions, and it involves various ministries and agencies. The plans have been in the planning since the taro leaf-blight outbreak. It is an important part of biosecurity, and roles and responsibilities are outlined in the document.

Recommendations

- The implementation of the NISSAP 2019-2024 requires financial investment and commitment by national stakeholders in order to gain the upper hand in managing invasive species.
- Having a specific unit or a fulltime staff to coordinate and facilitate administrative matters relating to invasive species management would help in making progress towards implementing the NISSAP 2019-2024.
- Technical capacity remains a challenge, especially when dealing with new incursions. Capacity development should remain a priority for the government and partners in the invasive species management sector.
- Priority sites, including key biodiversity sites, need to be monitored and removal of invasive species carried out on a regular basis.

References (Terrestrial Environment)

Atherton, J., and Jefferies, B. (2012). Rapid Biodiversity Assessment of Upland Savaii, Samoa. MNRE, CEPF, SPREP. Apia, Samoa. SPREP. 176p.

Banko, PC. (2016). Understanding factors affecting decline of Samoan Swallowtail Butterfly. Pacific Island Ecosystems Research Centre. (https://www.usgs.gov/ - accessed 1 March 2023).

BirdLife International. (2014). Endemic bird area factsheet: Samoan Islands. BirdLife International, Cambridge, UK. www.birdlife.org (accessed 14 Jul 2014).

Bruschini, C., Edwards, ED., Talavera, G., Vaurasi, VD., Latu, GF., and Dapporto, L. (2022). A complete COI library of Samoan butterflies reveals layers of endemic diversity on oceanic islands. Zoologica Scripta. 2023: 00: 1-16.

Butler, DJ., Tye, A., Wylie, M., Tipama'a FT. (2011). Eradicating Pacific Rats (Rattus exulans) from Nu'utele and Nu'ulua Islands, Samoa – some of the challenges of operating in the tropical Pacific. Pp. 407-412 in Veitch, CR., Clout, MN. and Towns, DR. (eds) Island Invasives: Eradication and Management. IUCN, Gland.

Conservation International – Pacific Islands Programme, Ministry of Natural Resources and Environment, Secretariat of the Pacific Regional Environment Programme. (2010). Priority Sites for Conservation in Samoa: Key Biodiversity Areas. Apia, Samoa. 32p.

Cowie, RH., and Robinson, AC. (2002). The decline of native Pacific Island faunas: changes in status of the land snails of Samoa through the 20th Century. Biological Conservation 110 (2003): 55-65.

DEC. (2013). Tongan Flying Fox (Pteropus tonganus). Initial Inspection Report. Terrestrial Conservation Section. Division of Environment and Conservation. Apia, Samoa. 5p.

DEC. (2019a). Terrestrial bird and butterfly monitoring report. Vaisigano Catchment Area. 17-21 June, 2019. Department of Environment and Conservation – Terrestrial Conservation Section Report. Apia, Samoa. Government of Samoa. 25p.

DEC. (2019b). Samoa National Invasive Species Strategy and Action Plan (NISSAP) 2019 – 2024. Ministry of Natural Resources and Environment, Government of Samoa. Apia, Samoa.

DEC, 2020. PPCR BioRap Survey, Avifauna, MNRE. DEC-TBCS, 2022. Terrestrial Biodiversity Survey, Apia, MNRE.

DEC-TBCS, 2022. Bird Butterfly & Water Lettuce Survey, Apia, MNRE.

DEC-TBCS, 2023. Terrestrial Biodiversity Survey, Apia, MNRE.

DEC-TBCS, 2022. Malololelei Pest Management Progress Report, Apia, MNRE.

DEC-TBCS, 2023. National Terrestrial Biodiversity Monitoring Survey & National Flying Fox Survey, Apia, MNRE.

Duffy, L., and Atherton, J. (2018). Sixth National Report to the Convention on Biological Diversity. Ministry of Natural Resources and Environment, Government of Samoa. Apia, Samoa. pp 35-36.

Edwards, E., et al. (2017). Chapter 3: Report on the Survey of moths and butterflies (Lepidoptera) of the Falealupo Peninsula Coastal Rainforest, Central Savaii Rainforest and Uafato-Tiavea Coastal Rainforest. Pp. 139 – 190.

Fisher R., Uili, M., Iese, C., and Enoka, F. (2012). Reptiles of the Aleipata Islands. Report to the Secretariat of the Pacific Regional Environment Programme, Aleipata Islands Reptile Surveys 2009-2010. 23 pp.

Fisher, R., and Inejich, I. (2012). Cryptic extinction of a common Pacific lizard Emoia impar (Squamata, Scincidae) from the Hawaiian Islands. 2012 Fauna and Flora International Oryx pp. 1-9

Fisher, R., and Uili, M. (2012). Report on the reptiles of Upland Savaii. In. Atherton, J., and Jefferies, B (Eds). Rapid Biodiversity Assessment of Upland Savaii, Samoa. SPREP, Apia. Samoa. pp. 63-85.

Gerlach, J. (2016). Icons of evolution: Pacific Island tree-snails of the family Partulidae. Phelsuma Press. ISBN: 978-0-99322-033-3.

Gill, BJ. (1993). The land reptiles of Western Samoa. Journal of the Royal Society of New Zealand. 23: 79-89.

Jenkins, AP., Keith, P., Marquet, G., and Mailautoka, KK. (2008). A preliminary survey of Samoa freshwater macro-faunal diversity. Wetlands International-Oceania and Paris Museum of Natural History. 32p.

Kear, D. and Wood, BL. (1959). The geology and hydrology of Western Samoa. New Zealand Geological Survey Bulletin. Prepared for the Government of Western Samoa, Apia.

Kwan, S., Ward, J., Satoa, M., Faitua, J., and Male, F. (2016). Crown of thorns starfish control operation in Samoa 2015 - 2016. Marine Conservation Section, Division of Environment and Conservation: Apia, Samoa. p 15.

Lepage, D. (2023). Checklist of the birds of Samoa. Avibase, the World Bird Database. Retrieved from https://avibase.bsc-oec.org/checklist.jsp?lang=EN&region=ws&list=clements&ref=l_oce_ws [2023-03-06]

Marinov, M., Chinn, W., Edwards, E., Patrick, B., and Patrick, H. (2013). A revised and updated Odonata checklist of Samoa (Insecta: Odonata). Faunistic Studies in South-East Asian and Pacific Island Odonata 5(2013): 1-21.

Mc Conkey, KR., Drake, DR., Franklin, J. and Tonga, F. (2004). Effects of cyclone Waka on flying foxes (Pteropus tonganus) in the Vava'u Islands of Tonga. Journal of Tropical Ecology 20: 555-561.

Ministry of Finance. (2021). Pathway for the Development of Samoa FY 2021/22 – FY 2025/26. Economic Policy and Planning Division. Apia, Samoa

MNRE. (2022). The Master Plan. To guide the sustainable management of Government Lands under the control of the Land Board 2022-2032. Apia, Samoa. 61p.

MNRE. (2021a). O Le Pupū Pu'ē National Park Management Plan (Ramsar Site) 2020-2030. Apia, Samoa. 35p.

MNRE. (2021b). Two Million Tree Planting Campaign 2015 - 2020 Final Report. Apia, Samoa.

MNRE. (2018). Community Integrated Management Plan. Aleipata Itupa I Lalo – Upolu. Implementation Guidelines 2018. Ministry of Natural Resources and Environment. Apia. 89p.

MNRE. (2017). Baseline ecological survey (BES) of Vaipu Swamp Forest, Upolu, Samoa. April 2017. Fauna Biodiversity Synthesis Report. Key Finds and Recommendations. Apia. 6p.

MNRE-WRD. (2012a). Aufaga Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 40p.

MNRE-WRD. (2012b). Falease'ela Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 41p.

MNRE-WRD. (2012c). Fuluasou Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 43p.

MNRE-WRD. (2012d). Gasegase Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 42p.

MNRE-WRD. (2012e). Loimata o Apaula Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 38p.

MNRE-WRD. (2012f). Palauli Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 42p.

MNRE-WRD. (2012g). Solosolo Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 40p.

MNRE-WRD. (2012h). Tafitoala Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 40p.

MNRE-WRD. (2012i). Vaipouli Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 44p.

MNRE-WRD. (2011). Togitogiga Watershed Management Plan. Ministry of Natural Resources and Environment. Apia, Samoa. 40p.

NBSAP. (2015-2020). Samoa's National Biodiversity Strategy and Action Plan. Ministry of Natural Resources and Environment, Government of Samoa. Apia, Samoa.

Park G., Hay, R., Whistler, A., and Lovegrove, T. (1992). The national ecological survey of Western Samoa. The conservation of biological diversity in the coastal lowlands of Western Samoa. Unpublished report Department of Conservation, Wellington, New Zealand.

Patrick, B., and Edwards, E. (2011). Capacity building to secure endemic Samoan Swallowtail Butterfly as a model for valuing and conserving butterflies distinctive in the Polynesia-Micronesia Hotspot. Conservation International – Biodiversity Conservation Lessons Learned Technical Series. Part 2. 22p.

Patrick, B., Edwards, E., and Böhm, M. (2018). "Papilio godeffroyi. The IUCN Red List of Threatened Species." e.T122530 997A122603026. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T122530997A122603026.en.

Pilcher NJ. (2021). Review of the status of sea turtles in the Pacific Ocean 2021. Secretariat of the Pacific Regional Environment Programme, Apia, Samoa. 136 pp.

Pratt, HD., and Mittermeier, JC. (2016). Notes on the natural history, taxonomy and conservation of the endemic avifauna of the Samoan Archipelago. The Wilson Journal of Ornithology 128(2): 217-241.

Ram-Bidesi, V., Mulipola, AP., Wendt, H., Reddy, C., Kaitu'u, J., and Gauna, M. (2021). Samoa Marine Ecosystem Service Valuation. Summary Report. GCCA+ (The EU, MNRE, IUCN), Suva, Fiji. 15pp.

Richmond, J., Mulder, J., Enoka, F., Onesemo, M., Timoteo, A., and Keleti, K. (2017). Chapter 2: Report on the land reptiles survey of the Falealupo Peninsula Coastal Rainforest, Central Savaii Rainforest and Uafato-Tiavea Coastal Rainforest. In. Ministry of Natural Resources and Environment, Conservation International Pacific Islands Programme. 2017. Rapid Biodiversity Assessment of Key Biodiversity Areas: Falealupo Peninsula Coastal Rainforest, Central Savaii Rainforest, and Uafato-Tiavea Coastal Rainforest, Samoa. Apia, Samoa. pp. 103-138.

Samoa's Bureau of Statistics. (2019). Report on the Samoa Agriculture Census 2019. Samoa Bureau of Statistics, Government of Samoa. 2021. Apia, Samoa. pp 154-155

Schuster, C. (1993). Western Samoa. In Scott, DA (ed.). A directory of wetlands in Oceania. IWRB, Slimbridge, UK and AWB, Kuala Lumpur, Malaysia.

Schuster, C. (nd). Important Bird Areas of Samoa. Birdlife International, Conservation International, O Le Siosiomaga Society Inc., Ministry of Natural resources and Environment. 52p.

Serra, G. (2017). Review of implementation of Manumea Recovery Plan 2006-2016. September 2016-September 2017. Report for the Ministry of Natural Resources and Environment, Samoa. 50 pp.

Serra G., and Tipama'a, T. (2015a). Invasive alien species survey, Aleipata islands, Samoa, September-December 2015. Report to Ministry of Natural Resources and Environment/ Department of Environment and Conservation, GEF-PAS Invasive Alien Species project/Samoa. 39 p

Serra, G., and Tipama'a, T. (2015b). Review of invasive alien species management in the Aleipata Islands, Samoa. GEF-PAS Invasive Alien Species Project – Samoa. Ministry of Natural Resources and Environment, Department of Environment and Conservation. 25p.

Stirnemann, RL., Potter, MA., Butler, D., and Minot, EO. (2015). Slow life history traits in an endangered tropical island bird, the Ma'oma'o. Bird Conservation International, available on CJO 2015 doi:10.1017/S095915000234.

Stringer I., Parrish R., and Sherley, G. (2003). Report on the first monitoring visit to Nu'utele and Nu'ulua islands, 25-31 July 2000. IAS Technical Report N. 2003/10. Institute of Applied Sciences, The University of South Pacific. 15 pp

Tennent, WJ. (2006). A checklist of the butterflies of Melanesia, Micronesia, Polynesia and some adjacent areas. Zootaxa 1178: 1-209.

Tiitii, UT (2011). Report on the collection of Crown-of-thorns starfish (Alamea). Fisheries Division, Ministry of Agriculture and Fisheries: Apia, Samoa. p 8.

Tye, A. (2012). CEPF Final Project Completion Report. SPREP, 33 pp.

Waldien, DL., and Scanlon, A. (2021). Emballonura semicaudata. The IUCN Red List of Threatened Species 2021. www.iucnredlist.org/species - access Feb 2023.

Watling, D. (2001). A guide to the birds of Fiji and Western Polynesia. Environmental Consultants Ltd., Suva, Fiji.

Whistler, A. (2011). The rare plants of Samoa. In. Atherton, J., and Duffy, L. (Eds). Conservation International Pacific Islands Program. Biodiversity Conservation Lessons Learned Technical Series 2. 1-213 pp.

Whistler, A. (2022). Flora of Samoa. Flowering Plants. National Tropical Botanical Garden.

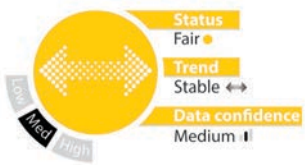
Young, S., and Serra, G. (2015). 2015 Myna Survey. Report to inform the Samoan Myna management Plan. GEF-PAS Invasives Project. MNRE/DEC, SPREP, UNEP. Apia, Samoa. 32p.

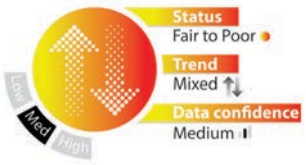
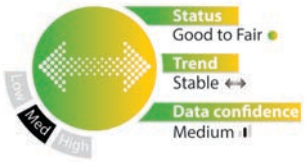
Zug GR. (2013). The Reptiles and Amphibians of the Pacific Islands: A Comprehensive Guide. University of California Press. 320 pp.

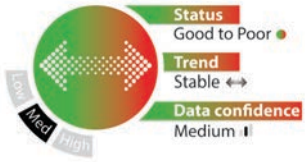
Marine and Coast

Picture credit: Charles Netzler

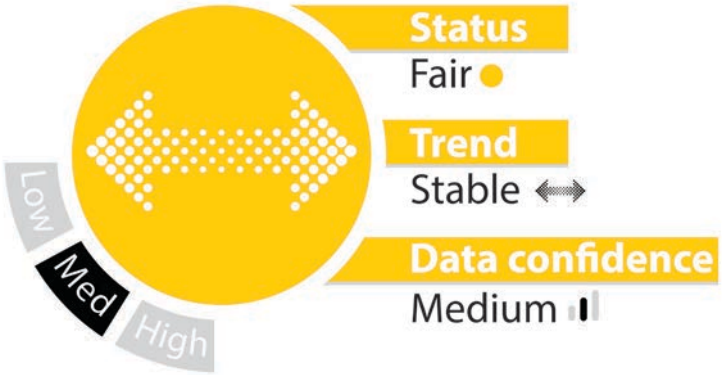
Overview and Highlights

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Coral reef health – coral cover		Live coral cover of the inshore reefs is generally in very good condition with over 40% coral cover. Those on the foreshore reefs were in poor condition, with some dead two years after a bleaching event. While in the past Savaii coral reefs were in better condition than those of Upolu and Manono islands, recent expeditions are showing a reverse trend. Upolu coral reefs are trending positively with higher coral cover and rugosity, whereas Savaii coral reefs are declining.	• Establishing marine protected areas has provided protection to coral reefs. • Legislation has also provided protection for coral reefs, banning destructive fishing practices and regulating harvesting of marine resources. • Engaging communities in the management of resources has also led to the establishment of fish reserves, which included corals and other ecosystems.

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Marine species of national significance		Samoa is an important pathway for some of the migratory species. Whale numbers visiting Samoan waters are still low, indicating their populations remain vulnerable. Turtles remain vulnerable due to harvesting, including turtle eggs. Nesting sites are impacted by coastal developments and climate change. Shark and ray numbers are low in many places, and when compared to other Pacific islands, Samoa is well below the average. The main threats are over exploitation including bycatch, and climate change.	Establishing the Marine Sanctuary has provided the much-needed protection for significant marine species. Developing the Samoa Ocean Strategy provided the national framework for the management of Samoa's marine environment and biodiversity. Legislation has been enacted for the conservation and sustainable use of marine resources. Data on the state of Samoa's marine species of special interest remain incomplete, and there is a need for regular monitoring and building the capacity to undertake this work.
Coastal fisheries		The inshore reef and lagoon area are among the most productive ecosystems in Samoa. Over 2/3rd of Samoan households participate in fishing activities, mostly carried out in the shallow reef area. The number of fishers is declining due to employment opportunities and the declining quantity and quality of fish catch.	• The Samoa Fisheries Division is the key agency to manage the inshore fisheries. Engaging with communities, and empowering them to manage the marine resources has seen many inshore reef areas being protected from fishing. • Legislation has been developed to oversee the management of Samoa's fisheries resources. • Ongoing monitoring of marine resources, including regular surveys of reef health inside fish reserves and outside would provide much valuable data for future assessments.
Offshore pelagic fisheries		Samoa's exploitation of its offshore fisheries resources relies on some local and foreign fishing vessels. Fisheries licenses are issued yearly by the government, therefore providing some revenue for the nation. Long-line fishing is the primary fishing method used by foreign vessels. Some local vessels also bottom-fish or troll. Tuna are the target species, with the majority of the catch sent overseas to NZ and America, or to the cannery in American Samoa.	The management of the tuna stocks throughout the region is under the guidance of the WCPFC. According to them, most of the tuna stocks are in good shape. Regular assessments on the tuna and other species stocks are undertaken regularly with advice being shared with its members, including Samoa.

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Marine conservation and protected areas		A national target is for 30% of Samoa's waters to be conserved by 2030. Currently, some 782 km^2 of the marine area is now under conservation, which is less than 1% of the total EEZ of Samoa.	Samoa's marine protected areas continue to strengthen, with the designation of a number of district MPAs, and establishing the Marine Sanctuary. The community-based fish reserves are an additional safeguard to Samoa's marine environment.
Quality of coastal water and sediment		Generally, the level of heavy metals in seawater, sediment and mangroves, is within a safe limit, except for a few sites around Vaiusu Bay, Apia Harbour and Safata. The quality of the water is within the normal range, particularly the pH, salinity and dissolved oxygen. The concentration of Faecal coliform and E. coli was found to be extremely high at Vaitoloa and Moata'a indicating an unsafe environment for human exposure	Legislation to prevent pollution of the marine environment (Marine Pollution Prevention Act 2008). Villages are protecting their coastal environment through Community-Based Fisheries Management Plans. Baseline research continues to improve the country's knowledge on the state of the coastal sediment, water, rivers and mangroves.
Coastal wetlands		Samoa's mangroves are highly fragmented and large areas have been lost due to reclamation and overexploitation. Mangroves, especially around Vaiusu Bay, are being affected by urban developments, and climate change associated impacts (flooding and tropical cyclones). The total mangrove area was estimated at 7.52 km^2, but it continues to decline at a rate of 0.09km^2 from 2010 to 2018. Mangrove area for Samoa is estimated at 2.32 km^2.	National ban on reclamation of mangroves in the north coast of Upolu island. Mangroves are being protected under MPAs and other conservation initiatives. Communities are replanting mangroves and also prohibiting reclamation in mangrove sites. Government has identified mangrove clusters for protection. Establishment of Community Management Plans to protect and conserve mangrove areas.

INDICATOR 9: Coral reef health – live coral cover



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6 10	13 CLIMATE ACTION 14 LIFE BELOW WATER	Ramsar Convention on Wetlands CITES	SAMOA Pathway 58 (e) Pacific Island Regional Ocean Policy Pacific Oceanscape SPC – The Noumea Strategy	• National Biodiversity Strategy and Action Plan 2015-2020 • Samoa Ocean Strategy 2020-20230 • Samoa Climate Change Policy 2020 • National Environment Sector Plan 2017-2021

Indicator definition

Corals are the backbone of reef systems, and their health provides a good indication of the state of the reef. They provide many resources for communities throughout Samoa. They are an ecosystem that provides habitats for many marine species, as well as tourism and recreational opportunities for many. Coral reefs protect coastal villages from ocean waves, king tides and rising sea levels. While there are many reef types found in Samoa, the threats and stresses to them are uniform. Approximately 80% of the country's 403 km coastline has been classed as either 'sensitive' or highly sensitive to coastal erosion, flooding or landslip. Much of this has been attributed to natural hazards, but it is also heavily influenced by human degradation pressures. There has been much modification of the coastal environment over many years, from reclamation, to excavating channels through the coral reefs to filling mangroves and development over coastal plains and waterways. This indicator assesses the state of live coral covers in selected sites throughout Samoa.

Status and Key Findings

Coral reefs began formation some 10,000 years ago after the last glacial period. The northern parts of Upolu towards the west of the island, are where the largest reef is found. Savaii reefs are patchy comprising around 52 km^2 around the north-east side of the island (Salelologa to Pu'apu'a to the east, and Saleaula to Manase on the north. The reefs are mostly fringing in nature, with submerged patch reefs scattered throughout the islands (Figure 50). The total current reef area is estimated at 10,000 km^2 (Tiitii et al. 2014).

Samoa's coral reef health varies considerably. The inshore reefs (those between the beach and the reef crest, or generally in the lagoon) have high coral cover, but are also highly vulnerable to human activities, especially overfishing and pollution (Satoa et al. 2015). The reefs around Manono island are in poor state, with very low coral cover (Satoa et al. 2015; Ziegler et al. 2017). Fore-reef coral cover has been subjected to COTS outbreaks and coral bleaching events. The impact from human activities is usually low, due to the perceived danger from crashing waves and the deep ocean.

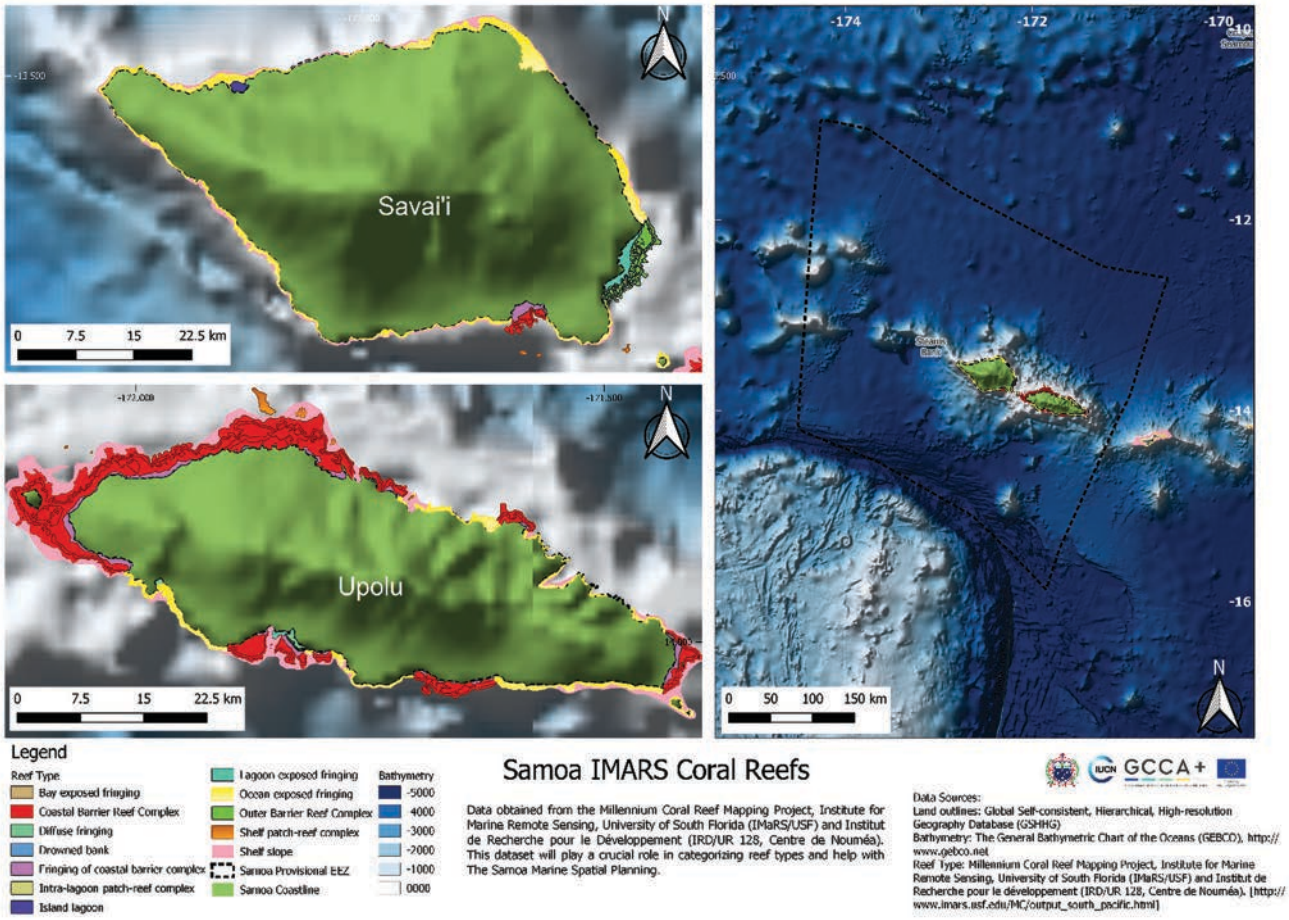


Figure 50: Distribution of coral reefs throughout Samoa (Source: MNRE)

Coral reef health (live coral cover)

Samoa's coral reef health is divided between the state of the inshore (back-reef) and foreshore reefs. The available data on the foreshore and inshore reefs are sporadic and the methodologies used to obtain the data vary depending on the researcher. From these data, the inshore reefs appear to be in good condition whereas foreshore reefs were poor. Data prior to 2000 suggested that inshore reefs were generally in poor condition, attributed in part to fishing activities, whereas those on the foreshore reefs were in good condition (Green 1996). The frequency of elevated sea surface temperatures since 2000 may have contributed to the demise of the foreshore reefs.

Kendall et al. (2011) also found coral cover in Samoa as high, with around 60% of Savaii island reef being of high (over 30%) coral cover, and 30% of Upolu reefs having high coral cover. The north and north-east reefs of Savaii island are where the high coral cover was found, whereas on Upolu island the reefs were highly variable but those along the north and west side towards Manono island had very low coral cover.

In 2015 surveys were carried out to assess the impact of elevated sea surface temperature in Samoa. The results showed inshore reefs were not badly affected with mostly good live coral cover (Figure 50 – Figure 52) (Satoa et al. 2015). There were a few sites that were impacted, but signs of recovery were noted around six months after the event. Some of the impacted corals were the result of a COTS outbreak. Similar results in 2007 of the inshore reefs found live coral cover to be in good condition at 43% (range of 20-66%) (Samuelu and Sapatu 2009).

A couple of surveys were undertaken after the 2015 bleaching event. The first by Tara Pacific Expedition (November – December 2016), and the other by the Scripps Institution of Oceanography under the 100 Island Challenge (December 2017). Both surveys focused on the fore-reef areas.

In 2020 the development of the Aleipata Marine Protected Area discovered that hard coral percentage coverage includes live corals, dead corals and bleached corals. The outer reef had the highest coverage of dead corals of 35%, which was a similar percentage (38%) of live corals. Live coral coverage was highest in the back reef (48%), followed by the lagoon (41%) and the coastal reef are (40%). Good live coral coverage was noted within the no take zones or fish reserves. Dead corals had low coverage in these habitats ranging from 13% to 21%. Bleached corals were also noted in these three habitats with a coverage of less than 2%

(Sapatu 2020). In September 2022, an expedition was carried out along the northwestern and southwestern forereefs of the main islands of Samoa, with the aim of providing a comprehensive and systematic snapshot of the state of coral reefs across the country. In total, 36 sites were surveyed, returning standardized data on benthic composition, reef fish communities, macroinvertebrate communities, coral recruitment, reef rugosity (structural complexity), and water quality. Of these sites, 13 were resurveys of sites previously surveyed in 2017 and 2019 using identical methods. Overall mean coral cover was 20.9%, and coral cover was higher on Upolu than Savai'i. Time series data from resurveyed sites show a consistent increase in coral cover on Upolu since 2017, likely indicating recovery from a 2015 coral bleaching event. Finally, the mean density of juvenile corals was similar on both islands, with an overall mean of 5.7 individuals m-2

Coral bleaching events

Coral Bleaching

- Samoa has experienced a number of coral bleaching events in the past.
- Based on degree heating weeks (DHW), Samoa experienced bleaching conditions in 1994, 2002, 2003, 2005, 2007, 2010, 2014, 2014, 2015, 2016, 2017, 2019, 2020. The most serious bleaching events took place in 1994, 2003, 2015, 2017, 2019 and 2020, where the DHW exceeded 10 weeks in a row (Figure 51).
- In 1997-1998, 16% of the world's reef were lost due to coral bleaching, although the level of impact on Samoa's coral reefs was probably less, due to normal sea surface temperature.
- The coral bleaching event in 2015 was interesting, in that most of the corals that were affected were found in deeper waters (fore-reef), with many reef areas having near 100% mortality. Corals in the inshore or lagoonal areas (back-reef) were affected but not to the severity experienced by fore-reef corals. Surveys two years after the bleaching events confirmed many sites on the north-central to north-west of Upolu island, were dead with very little recovery seen (Sandin et al. 2017, Ziegler et al. 2017). Corals on the north-west side of Savaii island, were also badly affected, however, surveys two years after the 2015 bleaching, showed a faster recovery compared to Upolu island. Corals on the inshore and lagoonal areas were less affected (See Table 13).

Figure 51: Dead corals due to bleaching.

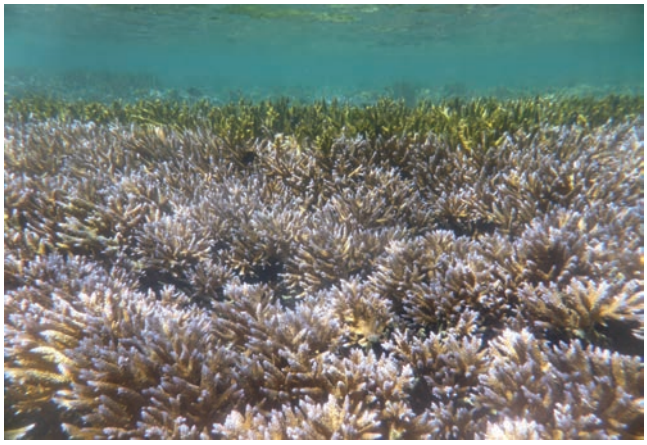


Figure 52: Corals at Satuiatua. (Picture credit: MNRE)

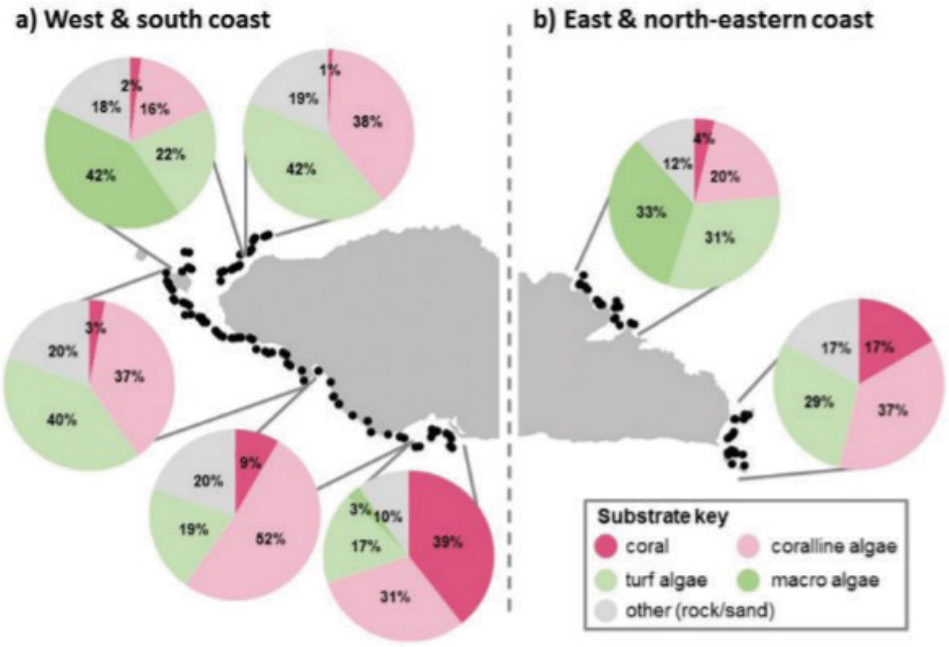


Figure 53: Summary of substrate cover between 1 and 11 m water depth along west & south coast (a) and the east & north east coast (b) of the island of Upolu (Source: Tara Pacific Expedition 2017, (Ziegler et al. 2017)

Tara Pacific Expedition surveyed 83 km of fore reefs around Upolu island (Ziegler et al. 2017, Figure 53). A total of 124 sites were surveyed, comprising 89 sites located to the west-southwest to central south; 18 sites located to the east; and 17 sites to the north-east. The survey results found coral cover to be low on the west and south coast of the island (1-39% live coral cover), and low also on the East and North-East at 4-17% live coral cover. Tara Pacific Expedition also visited sites that were surveyed over 20 years ago (Green 1996) and the results showed a decline in coral cover. The Lefaga site, on the south-west of Upolu island, had 30% live coral cover in 1996, whereas the 2017 surveys found 1-5%. Fagaloa decreased from 68% in 1996 to below 1% in the 2017 report. Sa'anapu (at Safata bay, Central South of Upolu island) remained stable at 15% coral cover, with a high coral cover inside the Bay at 60-80%). The Tara Pacific Expedition found two areas with healthy coral cover. The first at Safata bay, on the central south coast (60% coral cover), and the east coast at Lalomanu and Satitoa, with a 40% coral cover.

In 2020 the development of the Aleipata Marine Protected Area found the outer reef was 38% live coral cover and 35% dead corals. Live coral coverage was highest in the back reef of 48%, followed by lagoon 41% and coastal reef 40%. Good live coral coverage was noted within the no take zones or fish reserves. Dead corals had low coverage in these habitats (back reef, lagoon and coastal reefs), ranging from 13% to 21%. Bleached corals were also noted in these three habitats with coverage less than 2% (Sapatu 2020).

Surveys carried out in 2015 found reefs on the south side of Upolu to be in poor condition due to bleaching and COT outbreaks, with only 1.2% live coral cover, and 97% dead coral cover. Surveys on the east of Upolu (Lalomanu area) found 30% coral cover near the shallow parts, whereas at deeper water (10 m depth), coral mortality was high (89%). Surveys in the north-central of Upolu (east of Apia) that was carried out in a village fish reserve (inshore reef) found coral cover to be high at 75%.

Table 13: Survey of inshore coral cover in selected sites throughout Savaii, Upolu and Manono islands (Satoa et al. 2015)

ISLAND & LOCATION	CORAL COVER (%)	NOTES
Fatuvalu	30-40	Inshore reef
Faletagaloa	20-30	Inshore reef
Manase	40-50	Inshore reef
Pu'apu'a	25-35	Inshore reef
Fogapoa	50-60	Inshore reef inside a fish reserve. High COT numbers noted.
Satuiatua		90% bleaching/95% recovery
Aganoa Beach	5	Inshore reef. Corals mostly dead
Papa Puleia	25-35	Inshore reef. Some bleaching noted on tips of corals.
Salua, Faleu, Apai & Lepuiai		70-80% corals died due to bleaching and COTS.
Samatau		Survey inside fish reserve, inshore reef. 70% dead coral and around 10% recently dead due to COTS predation.
Fagaloa Bay (Lona & Musumusu villages)	40	Inshore reef. 5-10% of corals were bleached.
Vavau		Inshore reef. 85-95% dead corals or rubble, due to Cyclone Evan (2012)
Matatufu	15-25	Inshore reef flat. Cyclone Evan impacts noted
Palolo Deep		Inshore reef. 10% of corals died from earlier bleaching.
Falefa	15-25	Inshore reef. 40% of dead coral was caused by COTS.
Faleula	15-25	Inshore reef.
Vailu'utai	30	Inshore reef.
Fasito'otai	20-30	Inshore reef. Visibility was poor due to silt in the water column.

Impacts

Up until the 1990s, Samoa's inshore reefs had been subjected to human activities especially harvesting of marine resources, disposal of household wastes, and discharging of sewage directly into the sea. The state of the inshore environment was degraded and many of the marine species were overharvested. From the 1990s onwards, there has been a concerted effort to address these threats by managing sanitation, waste and pollution, addressing overfishing by establishing community-based fisheries management, and by strengthening the legislation. The elevated impact of climate change to Samoa's reefs has been felt by corals and reef communities on the foreshore, where frequent and prolonged elevated seawater temperatures are causing devastating and widespread damage. To add to this pressure are frequent outbreaks of COTS predating on corals, leading to their death or vulnerability to diseases. The deaths of corals at a large scale have a domino effect on marine resources, which affect households that rely on the ocean for their well-being. This also has implications on many sectors, including the tourism industry that often relies on the marine area as an asset.

The implications for loss of health of reefs and lagoons include:

- Increased incidence of coastal erosion.
- Increased incidence of storm surges and inundation flooding.
- Costly maintenance of heavy sea walls that protect essential infrastructure and utility services – often encourage long-shore drift and consequential coastal erosion.
- Changes to sand balances to lagoons and beaches (failure of eroded beaches to accrete sand after storms).
- Loss of community heritage assets such as community pools – or damage to these
- Loss of historic village areas and need to relocate villages.
- Loss of tourism through impacts on operations or loss of aesthetic appeal of locations.

Response

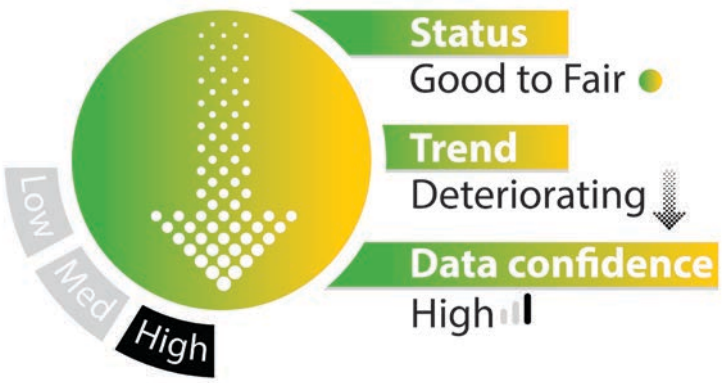
Two key government agencies have the responsibility of managing and safeguarding Samoa's coral reef and marine resources – the Fisheries Division (MAF), and the Division of Environment and Conservation (MNRE). However, to fully manage the marine resources the participation of villages through the Alii ma Faipule (village council) is vital. Without the engagement, agreement and commitment from the Alii ma Faipule, there will be little to no success. Many of the villages have developed community-based fisheries management plans, and have also established fish reserves, in an effort to mitigate the impact of overfishing, and to try and replenish depleting stocks. This has been an ongoing partnership with the Samoa Fisheries Division.

Legislation has been developed (Village Bylaws) to ensure legal support is provided to villages in enforcing fisheries management rules. The important legislations are the Fisheries Management Act 2016 (No. 8 of 2016), the Land Surveys and Environment Act 1989, the Marine Pollution Prevention Act 2008, Maritime Zones Act 1999. National policies include the National Environment Sector Plan (NESP) 2017-2021, the NBSAP 2015-2020, Samoa Ocean Strategy 2020-2030. Two key outcomes under the National Environment Sector Plan are: (i) sustainable management and development of natural resources and environment, and (ii) sustainable and resilient built environment.

Recommendations

- To continue to monitor the state of coral reefs, both on the inshore and foreshore reef areas to determine the live coral cover percentage. In addition, to undertake surveys in MPAs vs non-MPAs, to assess the effectiveness of MPAs.
- Ensure that the data are analysed and communicated to relevant stakeholders, to ensure that they are informed. A national repository should help in safe-keeping the data.
- To secure resources to allow for emergency response to events such as elevated sea-surface temperatures and possible bleaching events, COTS outbreaks, tropical cyclones, earthquakes or other natural disasters.
- Continue to engage villages and other stakeholders and encourage establishing marine protected areas to safeguard fishery resources and biodiversity.

INDICATOR 10: Marine species of national significance



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 11, 12, 13	14.C.1	CITES UNCLOS FAO Code of Conduct for Responsible Fisheries CMS	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) New Song Noumea Strategy (SPC) Pacific Islands Regional Marine Species	• National Biodiversity Strategy and Action Plan 2015-2020 • Samoa Ocean Strategy 2020-2023 • National Environment Sector Plan 2017-2021

Indicator definition

Samoa's ocean is an important route for many globally important migratory species. From sharks, rays, whales, dolphins to marine turtles, tuna and seabirds, many are regular visitors to Samoa's Exclusive Economic Zone (EEZ). Many of these species are also globally threatened and it is important for all countries to create safe corridors to allow their populations to increase. While there are numerous factors dictating the migratory paths of these species, the premise is that many will use safe passage to their feeding and breeding grounds. By providing these safe corridors, Samoa should be able to monitor the population and diversity of species visiting its shores.

This indicator focuses on the number of migratory species (in particular whales and dolphins) and marine turtles that visit Samoa. Tuna, which is an important group of species of special interest, is assessed in the INDICATOR 14: Offshore pelagic fisheries. The limitation of this indicator is due to species not being detected whilst migrating through Samoan waters, as there is a lack of capacity to undertake regular monitoring.

"…the problems whales face as ocean-dwellers will ultimately impact us all."

Status and Key Findings

Marine migratory species are a vital part of Samoa's ocean and are species of special interest. Monitoring of cetaceans (dolphins and whales) has been ongoing for the past two decades (SOE 2013). The MNRE staff undertake surveys to document the numbers of spinner dolphins, rough-toothed dolphins, short-finned pilot whales and humpback whales.

While the results are assisting in understanding their population dynamics, regular monitoring is needed. Data from surveys undertaken in 2012, 2015 and 2018, indicate the humpback numbers as declining, whereas spinner dolphins (Stenella longirostris) were frequently encountered (Marine Conservation Section 2015, Kwan et al. 2018).

While forms of protection are in place for all of these marine animals, these are inadequate to secure their populations. Many species of special interest continue to experience rapid declines caused in part from pollution, bycatch and targeted overextraction (GOS 2020).

Cetaceans

Historical records indicate that some cetaceans were abundant, particularly sperm (Physeter macrocephalus) and humpback whales (Megaptera novaeangliae). Whaling in the 19th to 20th centuries has depleted the population of many species so that recovery will take some time. The list of cetacean species reported from Samoa waters are included in Table 14 (Pacific Islands Regional Plan 2023; Paton and Gibbs 2002; Goldin 2002). Only a few are considered to be endangered, vulnerable or near threatened, with the majority in the least concern category of the IUCN Red List. Spotting whales in Samoa is best done around September to October, where they can be seen or heard close to shore (Table 15).

Table 14: Cetaceans recorded from Samoa (SPREP 2021)

COMMON NAME	SCIENTIFIC NAME	IUCN REDLIST STATUS
Blainville's beaked whale	***Mesoplodon densirostris***	Least Concern
Bottlenose dolphin	***Tursiops spp***	
Bryde's whale	***Balaenoptera edeni***	Least Concern
Cuvier's beaked whale	***Ziphius cavirostris***	Least Concern
Dwarf sperm whale	***Kogia sima***	Least Concern
False killer whale	***Pseudorca crassidens***	Near Threatened
Fraser's dolphin	***Lagenodelphis hosei***	Least Concern
Humpback whale	***Megaptera novaeangliae***	Endangered
Melon-headed whale	***Peponocephala electra***	Least Concern
Minke-like whale	***Balaenoptera sp.***	
Orca	***Orcinus orca***	Data Deficient
Risso's dolphin	***Grampus griseus***	Least Concern
Rough-toothed dolphin	***Steno bredanensis***	Least Concern
Short-finned pilot whale -	***Globicephala macrorhynchus***	Least Concern
Sperm whale	***Physeter microcephalus***	Vulnerable
Spinner dolphin	***Stenella longirostris***	Least Concern
Striped dolphin	***Stenella coeruleoalba***	Least Concern

Table 15: Cetacean surveys from 2001 to 2018.

YEAR	FINDINGS	REFERENCE
2001	Humpback whale population is low. Average whale sighting per day was 0.125	
2003	20 pod sightings were made of six species. Humpback whale, Long-snouted spinner dolphin, short-finned pilot whales, beaked whale, bottlenose dolphin and rough-toothed dolphin. It is noted that an earlier survey in 2001 confirmed humpback populations remain low. Average whale sighted per day was 0.4.	Walsh and Patton (2003)
2006	Average whales sighted per day 2.4. The increase in sightings per day does not always suggest an increase in the population of whales.	Cited in Marine Conservation Unit (2015)
2012	Survey carried out on the south coast of Upolu with an average rate of 0.65 whales per day.	Cited in Kwan et al. (2018)
2015	Surveys carried out over five days (41 hours). Seven pods of whales and dolphins were surveyed. Humpback whales and spinner dolphins were the main groups sighted. Samoa remains a low-density area for humpback whales.	Marine Conservation Unit (2015)
2018	Surveys carried out over five days, with a focus on the southern coast of Upolu. Of the five pods, one was a humpback whale of a mother and calf, and the rest were spinner dolphins. Dolphin pods varied from 6-10, the lowest, to 20-30 the largest. The low number of whales may be attributed to the late in the season survey, when most of the humpbacks are already in Antarctica. Average whales sighted per day was 0.2	Kwan et al. (2018)

Turtles

A total of five species has been recorded from Samoa Archipelago: Green turtle (Chelonia mydas), the IUCN Red List 'Endangered' - Hawksbill turtle (Eretmochelys imbricata), the Leatherback (Dermochelys coriacea), the 'Vulnerable', Loggerhead (Caretta caretta) and the Olive Ridley (Lepidochelys olivacea) (Goldin 2002). Only the Hawksbill and Green turtles have been confirmed to nest in Samoa (MNRE 2023; Ward and Lemalu 2020; Kwan et al. 2017; Witzel 1982), with an estimate of around 5 to 15 female nesters (Mortimer and Donnelly 2008; Nicolas 2021). There is an unconfirmed report of a Leatherback trying to nest at Falealupo, Savaii (Kwan et al. 2019). Turtles nest almost all year round, however, early in the year (January-February) is when they are most active. Turtle monitoring has been ongoing for a few years, and a summary is provided in Table 16. Turtle tagging began in 2014, and a total of 36 tags have been deployed. None of the tags (turtles) have been recovered. A total of 49 turtle encounters (28 Green turtles and 21 Hawksbill turtles) are recorded in the Turtle Research Database System (TREDS) from 2013 to 2022.

Historically, the Aleipata islands are where most of the turtle nesting has been recorded to take place. Nesting on other sites is now being reported from remote communities, largely due to easy access to mobile services and social media.

Despite the fact that the legislation has been passed to ban turtle harvesting, except for cultural purposes, there is still ongoing capturing of turtles by locals. Removal of turtle eggs for consumption is seriously affecting their survival rate. Some turtles are kept in enclosed ponds, and are fed inappropriate diets (e.g. processed food), whereas others are tethered to cement or other structures and left in the shallow reef flats (Satoa 2018). Other threats to turtles, especially their nesting sites, include seawater inundation due to king tides, built structures along the coast, changing tidal flows, beach-mining especially for sand and aggregates, and predation by other animals. Lights from households and tourism facilities are also having an impact on turtles coming to shore to nest, as well as hatchlings. Hatchlings are confused by the lights, causing them to spend longer periods on land where they are vulnerable to predation.

Table 16: Turtle surveys and activities in Samoa

SITE	DATE	COMMENTS
Falealupo, Savaii island	May 2018 Follow up survey on 18---23 February 2019.	A number of beaches at Falealupo were surveyed, initially in 2008-2009, and then in 2018 and 2019, early in the year (Jan-Feb), as this was the nesting season. The surveys found Falealupo to be an important nesting site for turtles. An unconfirmed report of a leatherback turtle trying to nest at the site but abandoned its efforts due to human disturbances. Villagers continue to harvest turtles and eggs, and some were held captive in a village pond for tourism purposes. King tides and sand mining are likely to be impacting nesting sites. Tropical cyclones and also natural disasters (tsunami of 2009) were also key threats for turtle nesting sites. Predation by crabs, including coconut crabs, is also a threat.
Lepuiai, Manono island	July 2018	MNRE received a report of turtles being kept captive by a family. MNRE staff found two Green turtles with holes drilled through their carapace and tethered to a brick. The staff were advised that the turtles were kept to manage seagrass beds. Both turtles were documented before release.
Lefaga, Upolu island	2017	16 Hawksbill hatchlings were recorded, located close to Faimafili Village Resort. Assessment of the nest found a total of 20 hatched eggs. The lights from the resort may have distracted the hatchlings from taking a direct path towards the sea. All turtles were released to the sea, with the help of local children.
Nu'utele island	2015	Nu'utele, Nu'ulua and Namu'a islands in the Aleipata district are known nesting sites for marine turtles. The 2015 survey did not find nesting turtles but turtle tracks were detected on Nu'utele island.

Sharks

Global shark species are being threatened with extinction, due to harvesting, or as bycatch in fishing operations. The exact number of shark species recorded from Samoa remains unknown, although the expected number according to the IUCN Red List is around 20 species (Table 17). The most frequently encountered sharks in Samoa are the reef sharks (Black Tip Reef Shark and White Tip Reef Shark) and Grey Reef Shark. Surveys of sharks in Samoa are limited, with some data collected by the Fisheries Division, from market sales. The Fisheries data are provided to the Western Central Pacific Fisheries Commission.

In 2017, shark and ray surveys were conducted at 99 sites at Falealili and Aleipata on Upolu (Figure 54), using a baited remote underwater video system (BRUV) (Satoa 2018). The surveys found a very low number of sharks and rays, well below what is seen in other parts of the Pacific (Figure 55).

Figure 54: Sites where the BRUV surveys took place. (adapted from Global FinPrint 2018)

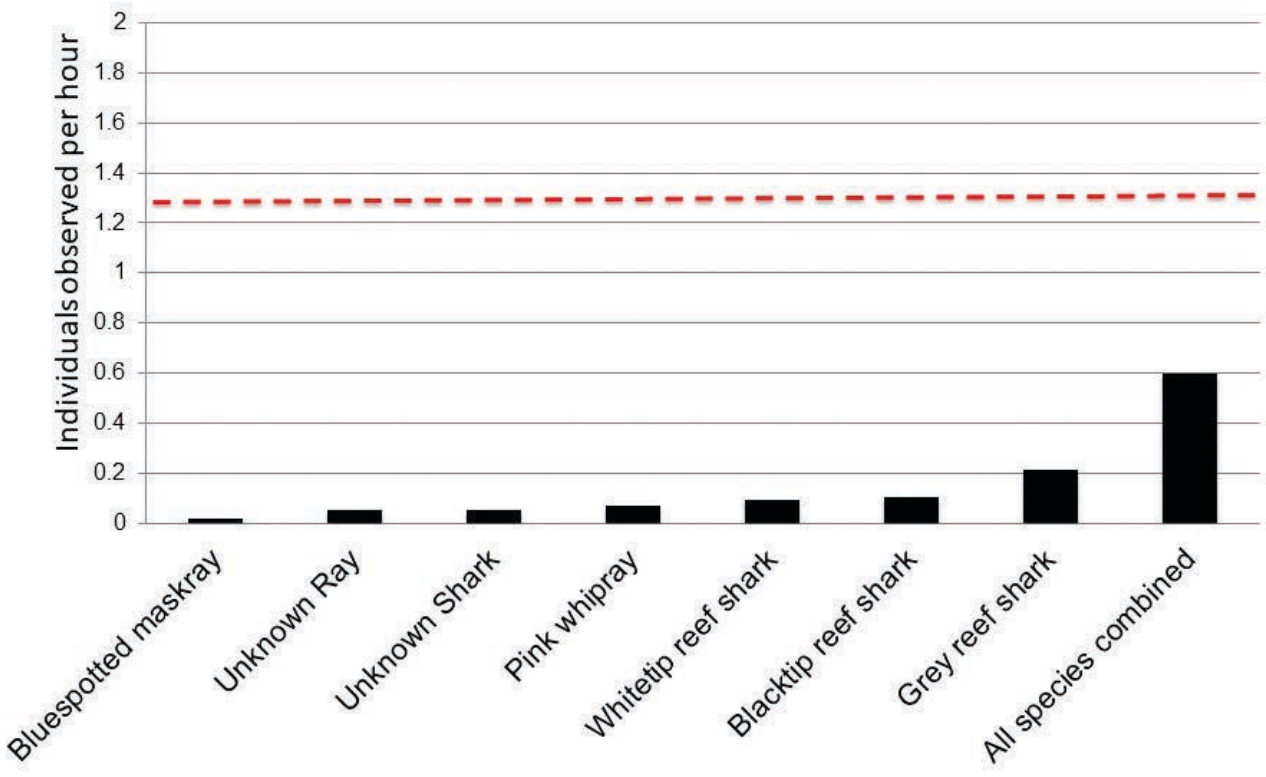


Figure 55: Results of the BRUV surveys for sharks and rays. The dashed red line is the average number of individuals sighted all species throughout the Pacific Islands. (Global FinPrint 2018)

Other ad hoc surveys are carried out during cetacean surveys, especially targeting Whale Sharks (Rhincodon typus). Surveys from the Aleipata and Falealili areas confirmed the presence of reef sharks and tiger sharks. Although the quantitative data are lacking for sharks and rays, the limited ones available, particularly the BRUV surveys, indicate very low shark numbers.

Table 17: Shark species from Samoa as included in the IUCN Red List (accessed April 2023)

SPECIES	COMMON NAME	COMMENTS
Alopias pelagicus	Pelagic Thresher	Listed as Vulnerable in the IUCN Red List.
Alopias superciliosus	Bigeye Thresher	Listed as Vulnerable in the IUCN Red List.
Carcharhinus amblyrhynchos	Grey Reef Shark	Listed as Endangered in the IUCN Red List.
Carcharhinus falciformis	Silky Shark	Listed as Vulnerable in the IUCN Red List. Included in the government survey for the Convention on Migratory Species
Carcharhinus leucas	Bull Shark	Listed as Vulnerable in the IUCN Red List.
Carcharhinus limbatus	Blacktip Shark	Listed as Vulnerable in the IUCN Red List. A target species for its high value meat and fins. Population is considered in good numbers in some areas, whereas overfished in others.
Carcharhinus longimanus	Oceanic Whitetip Shark	Listed as Critically Endangered in the IUCN Red List, with a decreasing population.
Carcharhinus melanopterus	Blacktip Reef Shark	Listed as Vulnerable under the IUCN Red List, with its global population reduced by up to 50%. Threats are due to overharvesting and the declines in habitat quality.
Carcharodon carcharias	White Shark	Listed as Vulnerable, as well as Moderately Depleted in the IUCN Red List.
Cetorhinus maximus	Basking Shark	Listed as Endangered in the IUCN Red List. A large migratory species. Not a target species although it is sometimes caught in fishing activities. Population has declined to around 80%.
Galeocerdo cuvier	Tiger Shark.	Listed as Near Threatened in the IUCN Red List
Isurus oxyrinchus	Shortfin Mako	Listed as Endangered under the IUCN Red List.
Megachasma pelagios	Megamouth Shark	Listed as Least Concern in the IUCN Red List. Occurs in tropical waters from the surface down to 1500 m.
Nebrius ferrugineus	Tawny Nurse Shark	Listed as Vulnerable in the IUCN Red List.
Negaprion acutidens	Sharptooth Lemon Shark	Listed as Endangered in the IUCN Red List
Prionace glauca	Blue Shark	Listed as Near Threatened in the IUCN Red List
Rhincodon typus	Whale Shark	Listed as Endangered and Largely Depleted in the IUCN Red List. Included in the government survey for the Convention on Migratory Species
Stegostoma tigrinum	Zebra Shark	Listed as Endangered in the IUCN Red List
Triaendon obesus	Whitetip Reef Shark	Listed as Vulnerable in the IUCN Red List. Inhabits similar environment as the Blacktip Reef Shark. Its population has declined by near 50%.

Seabirds

The Pacific supports around 42 breeding species of seabird with 17 of those unique to the region. Seabirds are globally highly threatened, and their status continues to decline facing threats both on land and at sea. Threats include invasive predators (e.g. rats, cats and pigs), pollution, habitat loss, degradation and modification and impacts from climate change.

The ecology and status of Samoa's seabirds is not well known (Atherton and Tipama'a, undated). Formal surveys of seabird colonies have rarely been carried out in Samoa although checklists of birds of Samoa have been published such as by Tarburton (2001). Watling (2001) is the definitive text for birds of Fiji and Western Polynesia but it is now 40 years old. SPREP's recently released Seabird Action Plan in the Pacific Islands Regional Marine Species Programme (PIRMSP) 2022-2026 identifies seven confirmed extant breeding seabirds for Samoa and a further nine resident/ suspected breeding and seven regular non-breeding migratory seabirds (Table 18).

Gaskin (2022), refers to a Samoan storm petrel (Fregetta

lineata) (SSP) which was collected in 1839 during the US Exploring Expedition. A single specimen was obtained on Upolu island, from where it was said to breed in holes very high up in the mountains. This single specimen now resides in the US National Museum in Washington. Recent surveys (October 2022 and April 2023) as part of capacity building with MNRE and the Samoa Conservation Society, have been undertaken on the Aleipata islands, best-known site for breeding seabirds as part of efforts by the Government of Samoa to establish baselines for these species. The Aleipata islands support good breeding populations of red-footed and brown boobies and brown noddy. Good numbers of red-footed booby are also known to breed on Apolima Island. White terns and white-tailed tropic birds are also common on the Aleipata islands, and on the main islands where they breed in forest, for example at Malololelei.

An at sea survey, circumnavigating Upolu was undertaken in November 2022 (Gaskin 2022), to see whether the Samoan storm petrel was still present in Samoan waters, and to document other seabirds. The survey identified two species not previously shown to be breeding in Samoa, the Tropical shearwater (Puffinus bailloni) (TS) and the wedge-tailed shearwater (Ardenna pacifica). Subsequent to this survey a fledgling TS was found near Tiapapata in February 2023, and adult birds have been regularly heard flying at night over Malololelei, between March and May 2023 (Baird K. pers comm), confirming their likely breeding in the mountains of Upolu island. The existence of the TS breeding in Samoa is highly suggestive of the potential for other unknown breeding seabirds to still exist in the rugged mountains. For example, a Tahiti petrel (Pseudobulweria rostrata) (TP) was found during a BIORAP survey in the mountains of Savaii. A single specimen was found calling on the ground. This indicates breeding activity, however, that discovery was not followed up. Seabirds of the Procellariidae family such as the TP, TS and SSP are known to breed in rugged forested mountainous regions in the Pacific, making it very difficult to find where they nest (likely in burrows) and to monitor. They are generally nocturnal in habit while on or over land and most likely migrate away from Samoa when they are not breeding and hence will not be visible in Samoan waters for several months. Other tropical seabirds in Samoa such as boobies, terns and noddies are diurnal (active during the day) and move between breeding and feeding grounds daily, making monitoring them much easier for establishing baseline population estimates.

Table 18: Seabirds of the Samoa Archipelago (Pacific Islands Regional Marine Species Programme, 2022-2026; Gaskin 2022)

COMMON (SCIENTIFIC) NAMES	BREEDING STATUS	IUCN THREAT STATUS
Tahiti petrel *(Pseudobulweria rostrata)*	Suspected breeding	Near Threatened
Wedge-tailed shearwater *(Ardenna pacifica)*	Suspected breeding	Least Concern
Tropical shearwater *(Puffinus bailloni)*	Confirmed breeding	Least Concern
Polynesian storm petrel *(Nesofregetta fuliginosa)*	Resident/ suspected breeding	Endangered
Samoan storm petrel *(Fregetta lineata)*	unknown	Data Deficient
Red-tailed tropicbird *(Phaethon rubricauda)*	Regular non-breeding/migratory	Least Concern
White-tailed tropicbird *(Phaethon lepturus)*	Confirmed breeding	Least Concern
Brown booby *(Sula leucogaster)*	Confirmed breeding	Least Concern
Red-footed booby *(Sula sula)*	Confirmed breeding	Least Concern
Masked booby *(Sula leucogaster)*	Resident/suspected breeding	Least Concern
White tern *(Gygis alba)*	Confirmed breeding	Least Concern
Black noddy *(Anous minutus)*	Resident/suspected breeding	Least Concern
Sooty tern *(Onychoprion fuscatus)*	Resident/suspected breeding	Least concern
Grey-backed tern *(Onychoprion lunatus)*	Regular non-breeding/migratory	Least Concern
Bridled tern *(Onychoprion anaethetus)*	Confirmed breeding	Least Concern
Black-naped tern *(Sterna sumatrana)*	Resident/suspected breeding	Least Concern
Great crested tern *(Thalasseus bergii)*	Resident/suspected breeding	Least Concern
White-necked petrel *(Pterodroma cervicalis)*	Vagrant	Vulnerable
Collared petrel (*Pterodroma brevipes)*	Vagrant	Vulnerable
White-winged petrel *(Pterodroma leucoptera)*	Vagrant	Vulnerable
Mottled petrel *(Pterodroma inexpectata)*	Regular non-breeding/migratory	Near Threatened
Black-winged petrel *(Pterodroma nigripennis)*	Regular non-breeding/migratory	Least Concern
Flesh-footed shearwater *(Ardenna carneipes)*	Regular non-breeding/migratory	Near Threatened

COMMON (SCIENTIFIC) NAMES	BREEDING STATUS	IUCN THREAT STATUS
Short-tailed shearwater *(Ardenna tenuirostris)*	Regular non-breeding/migratory	Least Concern
Sooty shearwater *(Ardenna grisea)*	Regular non-breeding/migratory	Near Threatened
Buller's shearwater *(Ardenna bulleri)*	Regular non-breeding/migratory	Vulnerable

Impacts

Samoa's marine resources have been vital for sustaining families over thousands of years. Cultural aspirations and legends have strong connections with the ocean and its inhabitants. Some marine species are totems or have a strong cultural connection with certain villages or family groups. Extirpation or extinction of these species can impact on these cultural mores and can weaken the connection between people and their environment.

All marine species are an important part of the coastal ecosystems, providing many services for the benefit of the people. Overharvesting of certain marine species can have serious consequences for the overall health of the coasts. The long and slow life cycles for some of the marine species means that replenishing their population requires years. With increasing population and likelihood of having more people fishing, the chances for these species to recover are remote. Some of the migratory species are still recovering from the commercial exploitation in the 19th century, whereas others are still being fished despite their vulnerable population and global moratorium.

Developments along coastal margins can also have an effect especially on tidal flows and sand build up, usually kilometres from where a development takes place. Vigilance must be applied when assessing developments along the coasts to ensure that downstream adverse effects are minimised. Coastal mining for sand and aggregates can be detrimental to the marine environment if not done in a sustainable way.

The increasing waste and pollution of the coast through direct dumping of rubbish, leachate from sewage or run-off, can create a toxic environment that kills species, or causes a shift from healthy reef area to one with algal blooms, or dead corals.

Response

There has been a lot of attention given to the management of marine species of Samoa. The work by the Samoa Fisheries Division (MAF) and the Division of Environment and Conservation (MNRE) in identifying the declining population of many marine species and putting in place measures, such as developing the legislation and national policies, to safeguard marine species. These agencies work with communities to raise awareness on the state of marine resources, and encourage the adoption of community-based fisheries management plans, which often include designating parts of their traditional fishing grounds as protected areas. Some of the significant responses by the Government of Samoa and people include:

- Designating the **Samoan Marine Sanctuary**. Samoa was one of the first Pacific island countries to declare its waters a sanctuary for sharks, whales, dolphins and turtles in 2003.
- Developing the **Samoa Ocean Strategy**. Migratory and resident species are identified as important for conservation.
- Passing **National Legislation**. The key legislations include the Fisheries Management Act and the Marine and Wildlife Protection Regulation.
- Aligning with the **Samoa Development Strategy 2016-2020** and other national and regional plans. Specifically aligning with the Community Integrated Management Plans (CIM Plans), the regional Blue Pacific and the Pacific Oceanscape.
- Holding awareness activities including community consultation workshops and district level workshops, focusing on marine species, and providing guest lectures at the National University of Samoa.

National legislations and policies

Marine Wildlife Protection Regulation 2009

The regulation provides protection for marine mammals (viz. whales and dolphins), turtles, sharks and marine species that migrate in schools to spawn, and species of conservation concern. Certain parts of the regulation requires the Pulenu'u (village mayor) to report matters relating to the legislation (e.g. mammal stranding, turtle captured or killed, or a tagged animal found), to the relevant authority.

Fisheries Management Act 2016

The Fisheries legislation provides for the conservation, management and development of the fisheries in the country. It further regulates the licensing of foreign and local fishing vessels. Key parts of the legislation relating to conservation management are the use of precautionary and ecosystem approaches. It advocates the use of the best available information to assist with decision making, and to prevent and eliminate overfishing.

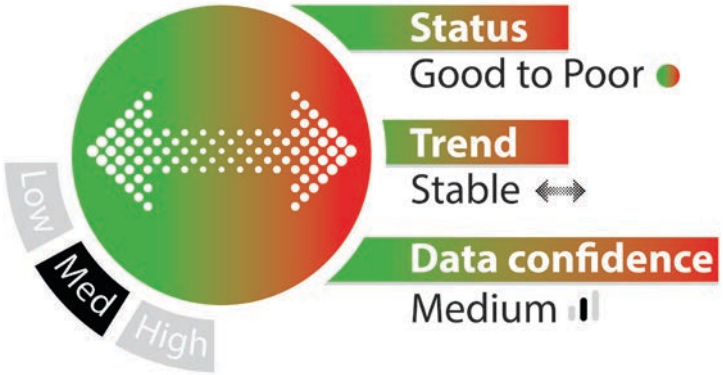
Samoa Ocean Strategy 2020–2030

The main objective of the strategy is sustainable management of Samoa's ocean, and marine resources for the benefit of its people. The development of the strategy aligns it closely with other national, regional and global policies, especially to the Sustainable Development Goals. A key target of the strategy is to protect 30% of the ocean by working closely with communities and development partners. The strategy focuses on governance and coordination, sustainable financing, research, monitoring and surveillance, legislation, and building capacity and awareness. A number of targets relating to marine species have been set, including understanding the distribution and movement of migratory species within Samoa's ocean.

Recommendations

- Capacity building and retention of staff continues to be a challenge in the marine species realm.
- Baseline surveys and regular monitoring are hampered by the limited resources available to do and monitor the work and its impacts. Access to boats and costs of fuel, can drain the marine division unit's budget, thereby compromising the integrity of the work.
- Enforcement remains a challenge, especially with ensuring that the law is protecting vulnerable marine species.
- The role of the village mayor, and village chiefs, is very important in the protection of marine species. Ongoing engagement and support of village chiefs will ensure that the law is implemented.
- Ongoing and well supported research and assembly of data are needed. The focus should be on shortfalls to implement successfully the actions and initiatives that cascade out of the two key legislative frameworks for endemic, pelagic and migratory marine species, and the Samoan Ocean Strategy:
- Support dedicated surveys to confirm breeding seabirds in Samoa and keep detailed records.
- Establish regular monitoring programmes for selected seabird species and colonies.
- Support further capacity building of staff in seabird monitoring.
- Support eradication of rats from Nu'utele island (Aleipata islands).

INDICATOR 11: Coastal water and sediment quality



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6 10	14 LIFE BELOW WATER 14.C.1	Codex Alimentarius CITES UNCLOS FAO Code of Conduct for Responsible Fisheries	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) New Song Noumea Strategy (SPC) Marine Pollution Prevention Act	• Marine Pollution Prevention Act

Indicator definition

The health of the people is dependent on many factors and consumption of clean and safe food and water is a key factor. Over 85% of Samoans rely on marine resources for their sustenance (SBS 2018). The inshore reefs along the coasts are hotspots for families to collect seafood. The inshore reefs are also vulnerable to land-based activities, especially from wastes and pollution. The use of herbicides and pesticides can result in high concentrations of heavy metals in aquatic systems. Some of the heavy metals can affect the endocrine system leading to obesity, and can also be toxic for aquatic life (Ra et al. 2015). The primary means of exposure to some of the heavy metals is by exposure while swimming and bathing in contaminated waters or consumption of seafood that may be affected.

This indicator assesses the quality of sediments and water around the country. The data used for this indicator are usually based on a single survey, however they do provide baseline data, which will be useful for ongoing monitoring.

Status and Key Findings

Heavy metals in coastal sediments

There is only a limited dataset available on heavy metal concentrations in coastal sediment, and from rivers and seawater of Samoa. The concentration of sampling has been from around Apia Harbour and Vaiusu Bay, with a few taken at Safata Bay on the south side of Upolu island. These do provide a good indication of the concentration of heavy metals in urban and rural settings. The datasets come from researchers of the Korea Institute of Ocean Science and Technology (Kwon and Lee 2015), the Faculty of Science at the National University of Samoa, and the Hydrology Division of MNRE, and their research partners from the New York University College (Bromage et al. 2020; Rabieh et al. 2020), and Dr Sapa Saifaleupolu and Elisara-La'ulu (2013) from O le Siosiomaga Society Inc.

Vaiusu Bay is an important part of the coastal area of Apia township. The easternmost part of the Bay is the Mulinu'u Peninsula, and approximately eight villages along the coast going westward to Vaitele village. The area is heavily impacted by coastal developments, with large areas being reclaimed by villages to build houses, and businesses. The coastal mangroves of Vaitoloa Village, located in the central

part of the Bay, was the main municipal waste site, until early 2000s, when the new waste management site was relocated inland to Tafaigata Landfill. Rehabilitation of the waste site has been inadequate, and large items of rubbish are exposed to the elements. Stormwater drains from Apia flow directly to the bay, and often with the frequent flooding of Apia and neighbouring villages, the volume of water entering the bay can be large. There are also two rivers (Vaimoso and Fuluasou) and streams that flow directly into the bay. Vaitele Bay also contains the largest but fragmented mangrove stands in Samoa. The bay's reef flat is a popular foraging site for many seabirds including long-distance migratory species (Sapatu and Kennar 2020). Coastal villagers, especially women and children fish in mangroves and the reef flats, with some selling their catch on the roadside.

Figure 56: Vaiusu Bay (shaded area) with the location of four sites having high concentrations of heavy metals (Ra et al. 2015)

Four sites at Vaiusu Bay had high concentrations of heavy metals: Vaitele, Vailoa (border with Vaiusu), Vaitoloa and Sogi (Figure 56).

Four sites at Apia Bay had a high concentration of heavy metals: Fish Market, the inner Harbour area near the mouth of the Vaisigano River, the Port, and outside of the Port channel (Figure 57).

Four sites at Safata Bay had a high concentration of heavy metals (Figure 58): Vaie'e, Malaetuli, Fusi and Fausaga.

The heavy metals of concern are Chromium (328.1 mg/kg) and Nickel (152.9 mg/kg), both exceeded the Threshold Effect Level (TEL) (Chromium 52.3 mg/kg; Nickel -15.9 mg/kg) and the Probable Effect Level (PEL) (Chromium - 160 mg/kg; Nickel – 42.8 mg/kg) – see Table 19, (MacDonald 1994).

Threshold Effect Level – the concentrations above which adverse biological effects occur on an organism.

Probable Effect Level - the concentration at which a large percentage of the population of an organism show adverse biological effects.

Other heavy metals of concern include Zinc, Arsenic and Copper (Table 19), and all exceeded the Probable Effect Level. Sediments in the reef flats, and near the reef crest, had low concentrations of heavy metals. Incidentally, these are the areas where most of the gleaning and fishing take place.

Figure 57: Apia Bay showing sites with a high concentration of heavy metals (Ra et al. 2015)

Figure 58: Safata Bay showing four sites with a high concentration of heavy metals (Ra et al. 2015)

Table 19: Heavy metal analyses in coastal sediments at Vaiusu, Apia and Safata bays (Coastal sediment - Choi et al. 2015; TEL and PEL - MacDonald 1994)

ELEMENT	COASTAL SEDIMENT	TEL	PEL
Aluminium (%)	2.96 (0.01-8.55)%		
Lithium (mg/kg)	19.15 (0.89-51.67) mg/kg		
Chromium (mg/kg)	328.1 (7.7-1191.5) mg/kg	52.3	160
Nickel (mg/kg)	152.9 (3.70-526.1) mg/kg	15.9	42.8
Copper (mg/kg)	26.65 (1.10-87.43) mg/kg	18.7	108
Zinc (mg/kg)	85.25 (0.91-229.2) mg/kg	124	271
Arsenic (mg/kg)	11.36 (0.97-34.71) mg/kg	7.24	41.6
Cadmium (mg/kg)	0.12 (0.001-0.33) mg/kg	0.676	4.21
Lead (mg/kg)	5.55 (0.10-27.96) mg/kg	30.2	112
Mercury (mg/kg)	0.022 (0.001-0.066) mg/kg	0.13	0.70

Heavy metal concentrations in mangrove swamp water and seawater are generally at a safe level (Table 20) (Rabieh et al. 2020). This is particularly for toxic heavy metals such as Cadmium (Cd) and Lead (Pb). Concentrations of other elements (Bromine, Calcium, Copper, Magnesium and Nickel) in seawater samples are higher than typical values reported in the literature.

Seawater and Mangrove swamp water quality are considered in the normal range (Table 21). The salinity is influenced by many factors, especially the presence of freshwater, therefore the salinity range for seawater is 13-54 o/oo, whereas the mangrove swamp water range from 1-34 o/oo (Rabieh et al. 2020). The pH for both seawater and mangrove swamp ranged from 6.9-8.1, which is within the range of 7.5-8.5. The Dissolved Oxygen for both mangrove and seawater sites were within the safe level, indicating that it is unlikely to cause eutrophication and algal bloom. Although an anomaly was detected at the Vaisigano River, where the Dissolved Oxygen reading of 47% saturation was found. The normal Dissolved oxygen level for aquatic life should be above 80-90% saturation (Rabieh et al. 2020).

Table 20: Analysis of saltwater and mangrove swamp water samples for heavy metals and other elements throughout Upolu island (Rabieh et al. 2020)

ELEMENT	SALTWATER SAMPLES	MANGROVE WATER SAMPLES
Aluminium (%)	7.5 (1.2-24) µg/L	3.6 (2.1-6.2) µg/L
Lithium (mg/kg)	145 (53-505) µg/L	25 (3.8-72) µg/L
Chromium (mg/kg)	Not tested	Not tested
Nickel (mg/kg)	11 (5.6-19 µg/L)	5.9 (0.13-19) µg/L
Copper (mg/kg)	6.2 (1.2-12) µg/L	1.6 (0.13-5.5) µg/L
Zinc (mg/kg)	16 (0.60-45) µg/L	4.44 (0.15-14) µg/L
Arsenic (mg/kg)	Not tested	Not tested
Cadmium (mg/kg)	undetected	0.20 (0.043-0.45) µg/L
Lead (mg/kg)	0.98 (0.050-5.0) µg/L	0.23 (0.0070-0.77) µg/L
Mercury (mg/kg)	undetected	undetected

Table 21: Water quality parameters for saltwater and mangrove swamp water samples from Upolu island (Rabieh et al. 2020)

PARAMETERS	SALTWATER SAMPLES	MANGROVE WATER SAMPLES	'NORMAL' RANGE
Salinity (o/oo)	37 (13-54)	3 (1-34)	0.5-35
pH	7.9 (7.8-8.1)	7.5 (6.9-7.8)	7.5-8.5
Dissolved O2 (ppm)	96 (84-176)	145 (19-186)	

There are only a few biological datasets available (Table 22) (Saifaleupolu and Elisara-La'ulu 2014). The total coliform counts and E. coli numbers from the two locations – Vaitoloa and Moata'a were very high and are unsafe for human exposure. The Vaitoloa site, apparently had much higher readings than those in Table 22, but time and flushing of the site due to tidal movement may have contributed to the lesser readings. The Moata'a site is extremely concerning, given that this is a populated area, with many households living next to the coast. The main source of biological contamination is an inadequate sanitation system, and having animals roaming freely around the site.

Table 22: Coliform and E. coli counts from two sites (Saifaleupolu and Elisara-La'ulu 2014)

	VAITOLOA	MOATA'A
Total Coliform Count	780-1570 cfu/100ml	650-2100 cfu/100ml
Escherichia coli	400-800 cfu/100ml	450-1850 cfu/100ml

Impacts

A healthy ocean supports an ecological system with diverse marine life that is the backbone for food security in many communities throughout Samoa. Lagoon systems (including mangroves, intertidal, back-reef, reef crests and tidal pools, and fore-reefs) are favoured fishing areas for around 86% of Samoan households (SBS 2019). The close proximity of the reefs to the coast, means that land runoff, and other coastal activities have a major influence on the quality of the marine ecosystem. The discharge of raw sewage directly to coastal water-ways, the dumping of rubbish in the ocean and excessive inundation from flood events kill marine life and weakens the protective role of reefs and mangroves. Not only are the coastal infrastructures vulnerable to storm surge inundations, but the health of communities is compromised through the consumption of unsafe seafood, and exposure to potential diseases in the water column.

Heavy metals in particular, are a concern due to their toxicity. Heavy metals are toxic to human health, with some affecting the brain and central nervous system leading to physical, muscular and neurological degeneration. Some heavy metals bio-accumulate in marine organisms, which eventually could be consumed by the people leading to deadly health problems.

Response

There has been insufficient knowledge on the state of Samoa's coastal waters and sediments. The recent focus by local and international researchers is providing the much-needed baseline to understand the current state of the coastal environment, and will guide the development of policies and strategies. While this baseline information is being established, there is an acknowledgement that land-based activities are affecting the state of the marine environment. Efforts to address these land-based activities had traditionally linked activities with the impact it is having on marine resources (specifically fisheries resources). The information on the presence of heavy metal concentrations in sediment, seawater and mangroves builds on actions to address land-based activities and their adverse impact on the marine environment.

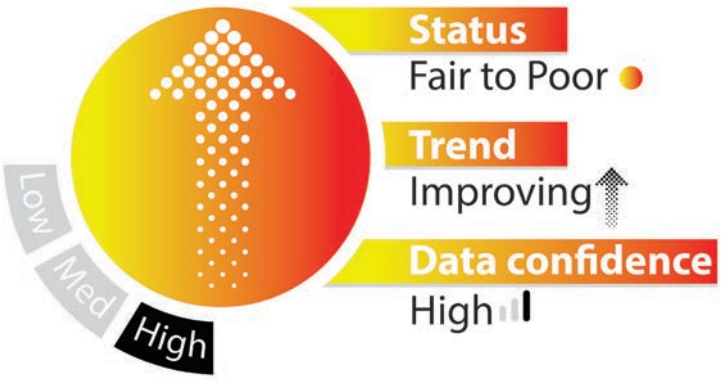
One of the biggest impacts by Samoa has been the collaborative partnership between the government and the village councils throughout Upolu, Savaii and Manono communities. Empowering the villages to develop community-based fisheries management plans, where activities are prohibited or limited, and reserves are established, have helped in improving the conditions and state of sediment, seawater and mangroves.

The government has also passed legislation, such as the Marine Pollution Prevention Act 2008, to prevent pollution in the coastal environment.

Recommendations

- Ongoing monitoring of heavy metal presence in coastal sediment, water column and in rivers and other large bodies of waters is needed. Some marine species should also be tested, as some heavy metals bio-accumulate in the tissue of species.
- Land-based activities remain a threat to the marine environment, especially with regards to the disposal of chemicals into aquatic systems, and the use of herbicides and fertilisers. Continuous awareness programmes should be developed to educate the public on the proper and safe way to handle toxic chemicals.
- Climate change impacts are likely to affect seawater quality, especially with increasing sea surface temperatures and its influence on dissolved oxygen, salinity and pH. Research into this area is recommended.

INDICATOR 12: Coastal wetlands



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 11, 12, 14	15.5A, 15.7, 15.C	Ramsar Convention on Wetlands, CMS, CITES	SAMOA Pathway 90, 94(d)	• National Biodiversity Strategy and Action Plan 2015-2020 • Samoa Ocean Strategy 2020-20230 • National Environment Sector Plan 2017-2021 • National Policy on Forestry for Sustainable Development

Indicator definition

Coastal wetlands are important habitats for many animals and plants. Samoa's coastal wetlands, under the Ramsar Convention's terminology, includes swamps and marshes, estuaries, tidal flats, mangroves and coral reefs. The coral reefs have been addressed earlier, whereas in this indicator, the focus is on the state of mangrove forests, in particular the size of Samoa's mangroves over the past ten years.

Status and Key Findings

Samoa's mangrove forests continue to be impacted by human activities, climate change and natural hazards (Figure 59). The total area of mangrove forests has declined due to a range of factors, such as sea level rise, and coastal erosion, associated with king tides, floods, tropical cyclones and storms, and the 2009 tsunami. The total mangrove forest area was estimated at 7.52 km^2 (Siamomua-Momoemausu 2010). Other reports suggest the mangrove forest area, at just over 3.70 km^2 (Bhattarai and Giri 2011; Ellison 2018; and Percival 2018). The difference in the two figures, perhaps suggests a serious loss in mangrove forests over several years.

Global Mangrove Watch shows that the extent of Mangroves in Samoa has decreased by 0.09km2 between 2010 and 2018. It increased again by 0.03km2 between 2018-2020. As of 2020 the area of Mangrove habit in Samoa was 2.32km2 (2020).

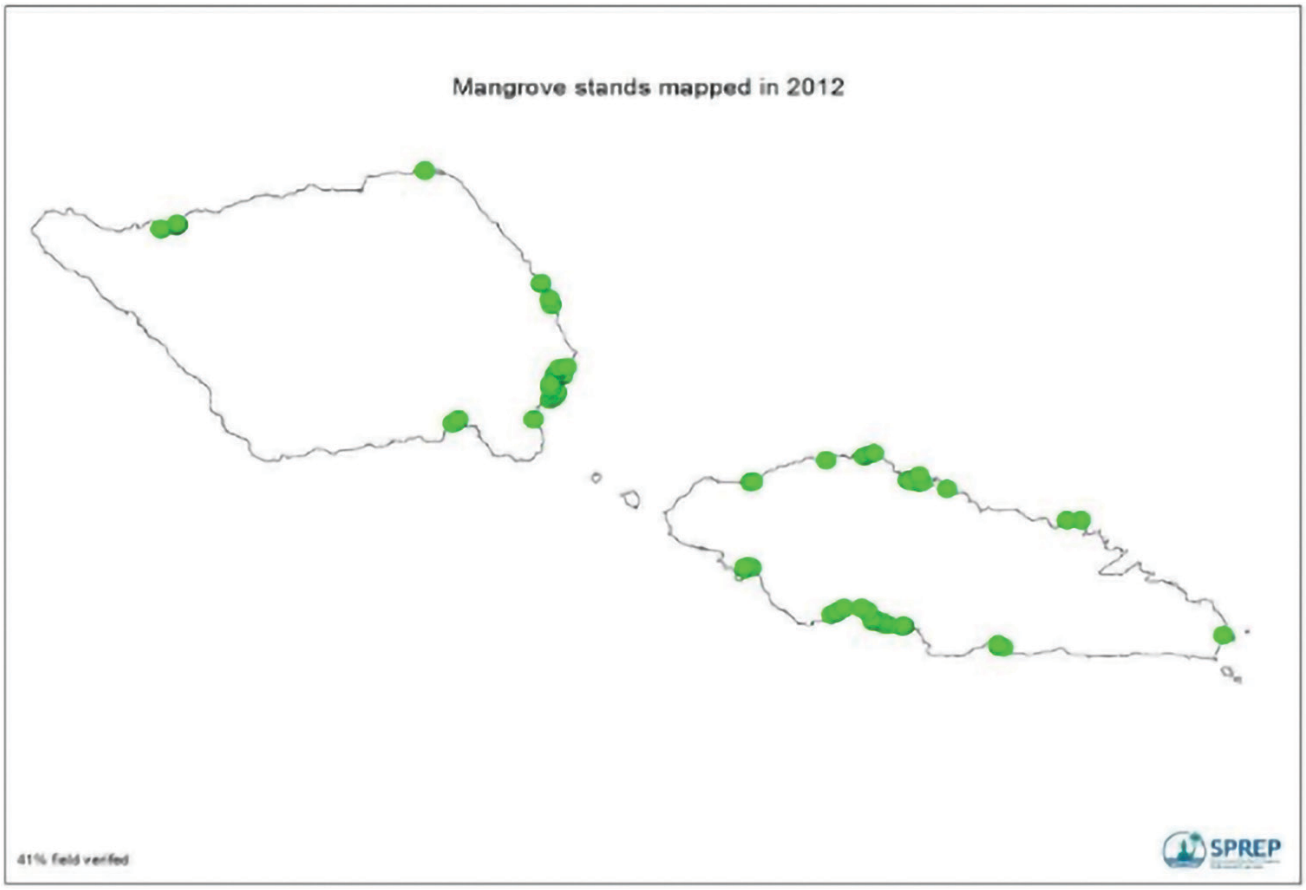


Figure 59: Mangrove distribution in Samoa (MNRE)

The Vaiusu mangrove straddles the coastline of the Vaiusu Bay on the north coast of Upolu. It is the largest area of mangroves in Samoa, covering the urban Apia area, starting with Mulinu'u Peninsula, and then along Sogi, Fugalei, Vaimoso, Vaitoloa, Lepea, Vailoa, Vaigaga, Vaiusu and Vaitele areas. Being within the Apia urban area, the mangroves face enormous pressures from human activities. Assessments undertaken in 2013 (Saifaleupolu and Elisara-La'ulu 2013) and 2020 (Sapatu and Kennar 2020) found the Vaiusu Bay mangroves to be in very poor condition. Mangrove fragmentations are rife, with large areas being encroached upon, and covered with earth and other materials to allow homes and businesses to be built. The Vaitoloa area was used as a municipal waste site, which was later rehabilitated when the site was closed. Where soil was used to bury the wastes, invasive shrubs and vines are proliferating. Large wastes are still deteriorating, releasing toxins and other pollutants into the environment. The area remains bare and heavy metals (lead and mercury) concentrations are considered high. The Rhizophora mangrove is fast growing, and its recovery can be seen in areas where human interaction is reduced. The 2020 survey found that mangrove associated biodiversity is recovering, with positive diversity of fish and crustaceans seen. However, overfishing remains a threat, as only small sized fish were collected during the surveys.

The distribution of mangrove forests throughout the Pacific noted that Samoa is the eastern most limit of their natural range. Mangroves have recently become naturalised in Hawaii and French Polynesia. Mangroves are considered invasive species in Hawaii (Hawaii Invasive Species Council: https://dlnr.hawaii.gov). Samoa's largest mangrove forest is located at Vaiusu Bay on the north coast of Upolu island (0.86 km^2), followed by Sa'anapu-Sataoa at 0.82 km^2, and Le Asaga Bay (0.47 km^2) (Ram-Bidesi et al. 2014). There are two dominant species: the Oriental mangrove - Bruguiera gymnorhiza; and the Red Mangrove – Rhizophora samoensis (Iakopo, 2006), and another three species that are key mangrove forest species (Acrostichum speciosum, Pemphis acidula and Xylocarpus granatum) (Duke et al. 2012).

Samoa's mangroves provide carbon sequestration, worth about SAT 384,201 (USD 146,084) each year (Ram-Bidesi et al. 2021).

Impacts

Coastal wetlands are important habitats for many animals and plants. They are also important areas providing ecosystem services that many communities rely on. Unfortunately, some of the coastal wetland areas, especially mangrove scrubs and forests, are seen as wasteland, and therefore are used as a rubbish dump site (such as the Vaitoloa dump site), or encroached on to build homes, businesses, agriculture expansion, roads and other infrastructure. One of the concerning impacts to coastal wetlands is due to

climate change and sea level rise, where mangrove forests are retreating due to permanent saltwater incursion, as witnessed in mangroves in Tutuila Islands (Ellison 2018).

Response

The protection and conservation of Samoa's coastal mangroves is one of Samoa's most critical and urgent priorities. These national assets are important and must be safeguarded. Mangroves not only protect the erosion of coastal areas and destruction of marine ecosystems, but also, in the long-term, provide essential and effective coastal protection against the:

- Impacts of sea level rise.
- Effects of tropical cyclones and tsunamis.
- Destruction of natural habitat for marine biodiversity.
- Damage to mangroves as carbon sinks to mitigate the impacts of climate change.

A key action for the protection of mangroves is the current ban on coastal reclamation along the north-west coastline of Upolu, where population pressure is at its highest. Under the Samoa Land Master Plan, there is a proposal to extend the reclamation ban to cover all of Samoa's coastline. This effectively means that from the high-water mark and extending three metres to the sea, there will be a ban on reclamation for the whole of Samoa.

The NBSAP 2015-2020 identifies mangrove loss due to reclamation logging and waste site as a key concern, and encourages the protection and replanting of mangroves as key actions (Target 5 of the NBSAP). The NBSAP further advocates the protection of mangroves as a mitigation measure against climate change impacts (Target 15 of the NBSAP).

The Samoa Land Master Plans proposed a new mangrove cluster reserve, with an estimated area of 15 km^2 to protect individual or small mangrove stands along the coastal areas. It is expected that the new reserve will expand the existing national coastline boundaries towards the sea by three metres continuously around Samoa (MNRE 2022).

A National Policy on Forestry for Sustainable Development has a conservation objective to protect coastal forests, especially mangrove ecosystems, and restrict any non-sustainable use of them.

Table 23 provides a list of mangrove conservation efforts and initiatives that was conducted over the years. Samoa has completed 31 mangrove biodiversity audits, and undertook rehabilitation and restoration activities in key degraded mangrove sites. Several villages have Mangrove Management Plans developed, and one village, Puipa'a, is currently in the process of developing theirs (MNRE Marine Section Mangrove Conservation Database).

Recommendations

- Identify and develop a National coordination mechanism focusing on the conservation of Samoa's mangrove forests and coastal wetlands. This will necessitate the collaboration and partnerships amongst the following key players:
  - » Collaboration between government agencies (Fisheries and MNRE).
  - » Collaboration between villagers and the government.
  - » Review, enhance and expand the current mangrove national database so that all elements of Samoa's mangroves and coastal wetlands are captured.
- Annual survey and mapping of all mangroves and coastal wetlands. A review is much needed, as this has not been done in a very long time.
- National strategy and policy governing coastal wetlands. Review current national strategies and plans relevant to mangroves and coastal wetlands, with an emphasis on working with communities to develop:
  - » Mangrove community management plans.
  - » Legislation for the protection of mangroves and coastal wetlands, including expanding the current ban on coastal reclamation to cover the whole of Samoa.
  - » Developing a network of mangrove protected sites.

CASE STUDY – Mangrove conservation at Fusi, Saoluafata village

Over 1000 mangroves were planted by Fusi villagers to help rehabilitate their mangrove forest (Figure 60). The site was used as a rubbish dump site, which led to its degraded state. Conservation International partnered with the Ministry of Natural Resources and Environment, to work with Fusi villagers to rehabilitate the site. By rehabilitating the mangrove forest, it provides the village with protection against the impacts of climate change. It also encourages marine species to complete their lifecycles in a healthy mangrove environment. Many of these marine species are also harvested for food. The rehabilitation effort also provided data on the state of mangroves for the area. Two key mangrove species are found at the site (Red Mangrove – Rhizophora samoensis; Oriental Mangrove – Bruguiera gymnorrhiza). Community awareness and discussions, led to an ad hoc waste-clean up with six truckloads of wastes being removed from the site (Figure 61). This was the first time for many villagers to explore the mangrove forest, and to see the piles of waste accumulated over many years. The community voiced their concern and the need to ban the dumping of rubbish in mangrove areas. The community is now working on developing a management plan to ensure that the mangroves are protected.

Figure 60: Fusi villagers planting mangroves (MNRE/CI 2022)

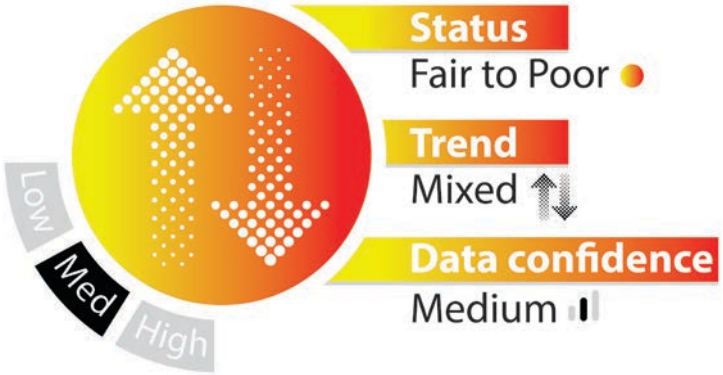
Figure 61: Six truckload of rubbish removed from the Fusi mangrove forest (MNRE/CI 2022)

Table 23: Government proposed mangrove conservation sites (MNRE 2022)

VILLAGE	LOCATION	COMMENTS
Fagalii	Vaimauga, Upolu island	Mangrove Audit Assessment Completed.
Faleapuna	Anoamaa, Upolu island	Mangrove Audit Assessment Completed (2018)
Faleaseela	Lefaga, Upolu island	Mangrove Audit Assessment Completed (2018) Mangrove Planting (2017), Mangrove Planting YCAN (2018)
Faletagaloa	Faasaleleaga 1, Savaii island	Mangrove Audit Assessment Completed (2018)
Faleula,Fogaa	Sagaga, Upolu Island	Mangrove Planting Fogaa Methodist Youth (2015)
Fausaga	Safata, Upolu Island	Mangrove Planting (2015)
Friendship Park	Apia, Upolu Island	Mangrove Planting (PUMA & MNRE, 2022)
Fugalei	Apia, Upolu island	Biodiversity Audits for Mangrove Wetlands OLSSI (2013)
Fusi Saoluafata	Anoamaa, Upolu island	Mangrove Audit Assessment Completed (2022)
Le Asaga Bay	Safata, Upolu island	Mangrove Biodiversity Assessment Report (MESCAL Project) 2013 Economic Valuation of Mangroves Safata District (MESCAL Project 2014)
Lepea	Faleata, Upolu island	Biodiversity Audits for Mangrove Wetlands OLSSI (2013)
Lotoso'a	Saleimoa, Upolu island	Mangrove Assessment Audit Completed; Waste audit completed
Malaela-Lotopue	Aleipata-i-Lalo, Upolu island	Mangrove Audit Assessment Completed (2020) Management Plan developed Mangrove Planting PPCR project (2020)

VILLAGE	LOCATION	COMMENTS
Malaemalu	Falealili, Upolu island	Mangrove Audit Assessment Completed 2015
Matafa'a	Falease'ela, Upolu island	Biodiversity Audit for Mangrove Stands Completed by OLSSI (2011)
Matautu Lefaga	Lefaga, Upolu island	Mangrove Site Assessment and Coastal Replanting (2020)
Matavai Safune	Gagaifomauga 2, Savaii island	Mangrove Audit Assessment (2015)
Moata'a	Fuaiupolu, Upolu island	Biodiversity Audit for Mangrove Stands Completed by OLSSI (2013)
Mulinuu	Apia, Upolu island	Biodiversity Audits for Mangrove Wetlands OLSSI (2013) Mangrove Planting DEC Leulumoega & Faleata College (2017) Mangrove Planting RLSS (2018)
Nuusuatia	Safata, Upolu island	Mangrove Audit Assessment Conducted
Poutasi	Falealili, Upolu island	Mangrove Audit Assessment Completed (2020) Management Plan developed
Pu'apu'a	Faasaleleaga 4, Savaii island	Mangrove Audit Assessment Completed (2020) Mangrove Planting (2016)
Puipa'a	Faleata, Upolu island	Mangrove Audit Assessment Completed (2022) Management Plan Completed (2023)
Saleaula	Gagaemauga 2, Savaii Island	Mangrove Planting PACRES Project (2022)
Saleimoa	Sagaga, Upolu Island	Mangrove Planting DEC (2018)
Sa'anapu and Sataoa	Safata, Upolu island	Transition Strategy 2000-2002 Mangrove Biodiversity Assessment Report (MESCAL Project) 2013 Economic Valuation of Mangroves Safata District (MESCAL Project 2014)
Saipipi	Faasaleleaga 3, Savaii Island	Mangrove Planting PACRES Project (2022)
Sapapalii	Faasaleleaga 2, Savaii island	Mangrove Audit Assessment Completed (2016) Management Plan Developed (2017) Replanting (2017)
Sapulu	Faasaleleaga 1, Savaii island	Mangrove Audit Assessment Completed (2019)
Satoalepai	Gagaemauga 3, Savaii Island	Mangrove Planting
Satuimalufilufi	Aiga le Tai, Upolu island	Mangrove Audit Assessment Completed (2018) Mangrove Planting (2020)
Sogi	Apia, Upolu island	Biodiversity Audits for Mangrove Wetlands OLSSI (2013)
Siufaga	Falelatai, Upolu island	Mangrove Audit Assessment Waste Audit Mangrove Replanting Guardians campaign (2018)
Siutu, Salailua	Palauli West, Savaii Island	Mangrove Planting Completed PACRES Project (2022)
Tafatafa/Matavai	Falealili, Upolu Island	Mangrove Planting Completed PACRES Project (2022)
Tuanai	Sagaga, Upolu Island	Mangrove Replanting Completed PACRES Project (2022)
Uafato	Fagaloa, Upolu Island	Mangrove Replanting PACRES Project (2022)
Ulutogia	Aleipata, Upolu Island	Mangrove Replanting Completed PACRES Project (2022)
Vaigaga	Faleata, Upolu	Waste Audit and Replanting Completed (2023)
Vailoa	Faleata, Upolu island	Mangrove Biodiversity Audit Assessment Completed (2015) Mangrove Planting (2017), Mangrove Planting (2019) Mangrove Replanting (2022)
Vailuutai	Aana, Upolu island	Mangrove Audit Assessment Complete (2019)
Vaimoso	Faleata, Upolu island	Biodiversity Audits for Mangrove Wetlands OLSSI (2013)
Vaitoloa	Faleata, Upolu island	Chemical and Microbiological contamination on Mangrove and Ecosystem conducted (2009)
Vaitoomuli	Palauli, Savaii Island	Mangrove Planting PACRES Project (2022)
Vaiusu	Faleata, Upolu island	Mangrove Audit Completed (2020) Management Plan developed. Waste audit completed. Replanting Completed CSSP project (2020)
Vaovai	Falealili, Upolu island	Mangrove Audit Assessment Completed (2020) Management Plan developed

INDICATOR 13: Coastal fisheries



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 12, 13	14 LIFE BELOW WATER 14.C.1	Codex Alimentarius CITES UNCLOS FAO Code of Conduct for Responsible Fisheries	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) New Song Noumea Strategy (SPC)	• Coastal Fisheries Plan 2017; • National Aquaculture Plan 2013-2018 • Community-based Fisheries Management Program, • Samoa Agriculture Sector Plan 2016-2020

Indicator definition

The majority of Samoan households (86%) rely on marine resources for their sustenance (SBS 2019). Unfortunately, the use of destructive and overly efficient fishing methods, combined with the impacts of climate change and pollution, have contributed to the declining health condition of reefs. This has had an impact on the coastal fishery. The coastal fishery, also referred to as the inshore fishery, is an important part of the government's management oversight. This indicator assesses the state of the coastal fisheries, based on the most recent information from the Samoa Fisheries Division, Ministry of Agriculture and Fisheries. The quality of lagoon waters, which is an important factor to the state of the coastal fisheries, is considered in the Lagoon Water Quality indicator.

Status and Key Findings

The inshore reefs of Samoa are considered one of the most productive and diverse of all ecosystems. Most of the fishing activities in Samoa are carried out in the inshore reef areas, with the immediate foreshore reef areas and freshwater systems, as other important fishing areas (Figure 62).

Over two-thirds of Upolu households participate in fishing activities, which is higher than Savaii fishing households (SBS 2019). According to Tiitii et al. (2014), men and women fish three times per week, with men fishing for an average of four hours per trip and catching 13.7 kg of seafood per fishing trip. Women fish on average of five hours and catching around 10 kg per trip. Over the past 30 years, the number of households fishing continues to seriously decline, a loss of 75%. From 10,884 households fishing in 1989, to just under 7,000 in 1999, to 5,752 in 2009, and finally 2,759 fishing households in 2019 (Figure 63).

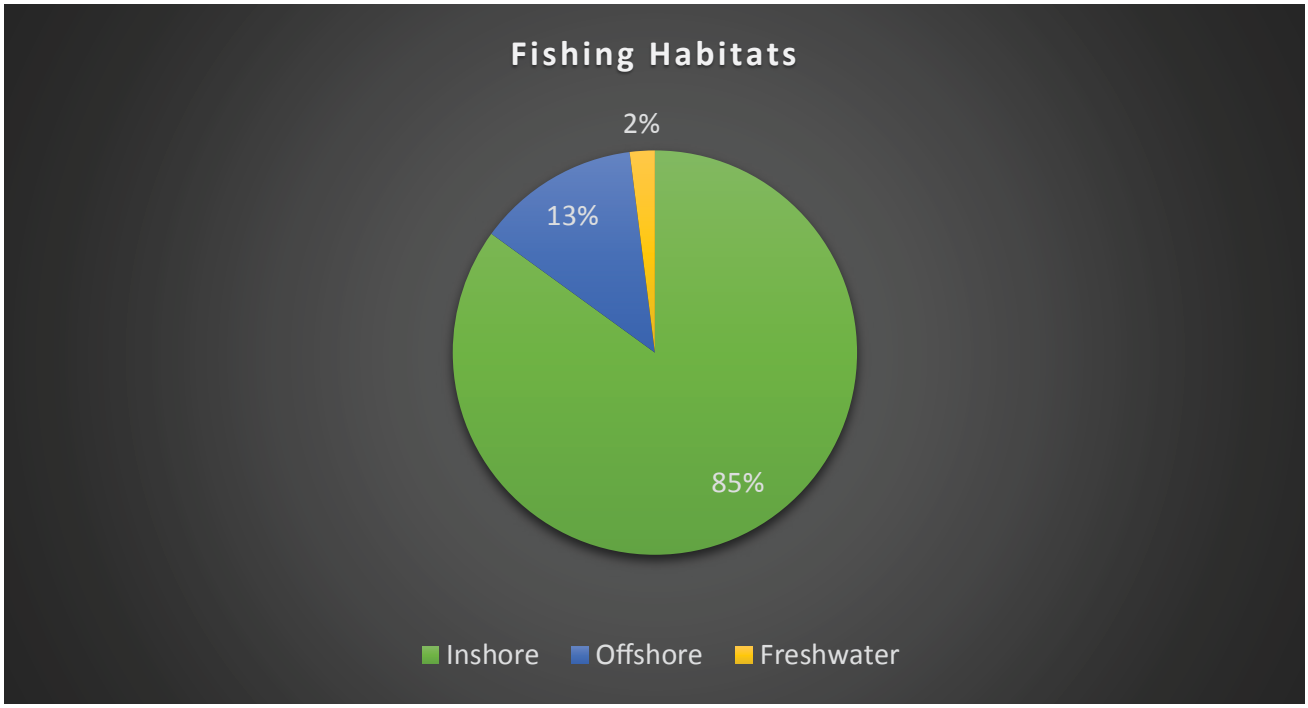


Figure 62: The majority of fishing activities take place in the inshore reef areas, with offshore and freshwater being the other important fishing areas (Ah Leong et al. 2009; SBS 2019)

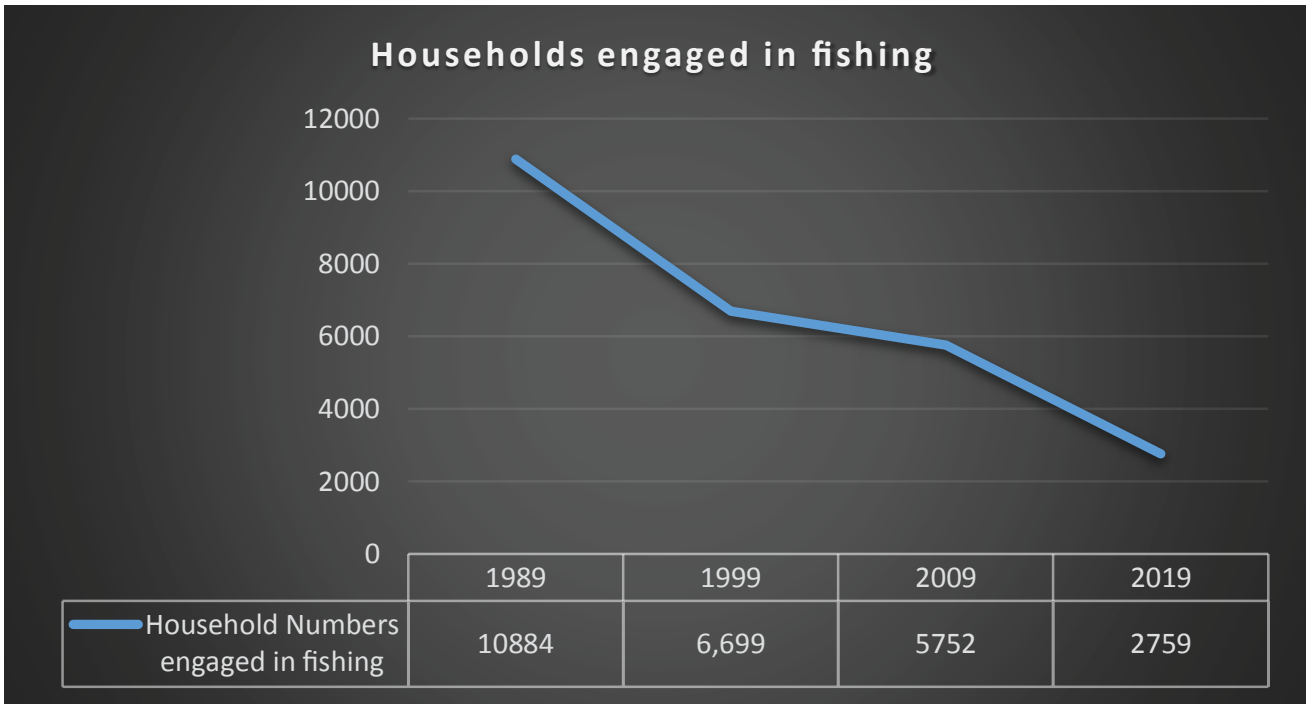


Figure 63: Households engaged in fishing (SBS 2019)

The most common fishing methods are spearfishing, fish netting, and hook and line (Tiitii et al. 2014). Gleaning for invertebrates and seaweeds, trolling, trapping and long-line fishing are also widely used. Some households use small crafts, such as outrigger canoes, and motorised boats, for fishing. Motorised boats are increasingly popular with around 520 boats registered in 2019. Traditional outrigger canoe numbers continue to decline from about 2000 canoes in 2009, to 954 canoes in 2019 (SBS 2019). It is suggested that access, and to a degree, the perception of wealth associated with motorised boats, may be a factor in the declining interest in outrigger canoes. Furthermore, motorised canoes allow the fishers to explore new areas, as well as areas that are beyond the reach of outrigger canoes.

The primary purpose for fishing has been for home consumption, although recent data indicate that this is declining. In 2009, 61% of households fished for home consumption, and by 2019 it has decreased to 54%. Fishing for the sole purpose of selling for cash, has increased by around 10% in 2019 (SBS 2019). Most of the catch are finfishes, invertebrates and seaweeds. These are sold at the Apia Fish Market, the Fugalei Agricultural Market and the Salelologa Market. Roadside selling and selling to supermarkets, restaurants and hotels are also points of sale, for the inshore fishery.

The catch per unit effort was estimated at 1.8 kg in 1990, 2.1 kg in 1997, and 2.24 kg in 2007 (Valencia et al. 2007). The catch per unit effort in 2012/2013 was 4.3 kg/hour for men and 2.22 kg/hour women (Tiitii et al. 2014). The value of the coastal fisheries, specifically subsistence fisheries, has been estimated at up to SAT 52 million with a catch of around 5,438.5 mt (Ram-Bidesi et al. 2021). Most households are likely to continue to rely on the marine environment for their sustenance due to affordability of imported and processed foods (Ram-Bidesi et al. 2021).

Impacts

Overfishing in the inshore area will continue to threaten the integrity and sustainability of coastal resources and coral reefs. The underlying drivers are the combined effect of population, the open access nature of coastal fisheries resources, and the increasing demands of an increasingly cash based lifestyle in rural communities. Climate change is also affecting the coral reef ecosystems, thereby impacting the fish diversity and abundance.

Response

The management of fishery resources falls within the remit of the Samoa Fisheries Division. Managing resources is near impossible if there is a lack of understanding of the size, the scale and the distribution of resources. While the Fisheries Division has its headquarters in Apia, the majority of fishing activities take place around coastal villages. There are some gaps in understanding the true level of marine resource harvesting around the country.

In the early 1990s, a co-management approach (Community-Based Fisheries Management) was adopted by the government to engage villages in the management of the resources. This recognises the authority of the villages over its resources, and that the management regime can only be successful if it is co-designed and co-implemented with the villagers.

The Fisheries Division also undertakes a number of activities that continues to enhance knowledge on the state of inshore fishery, including ecological assessments of fish reserves, monitoring of resources and monitoring of ciguatera fish poisoning.

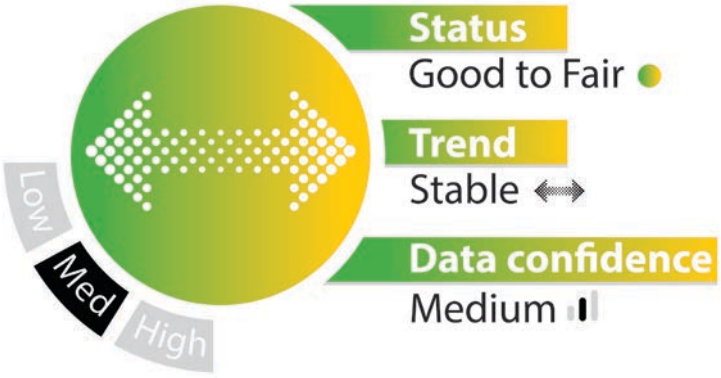
The key legal framework for managing the inshore fishery is the Fisheries Management Act 2016. In addition, villagers through the Village Fono are able to legislate activities under the Village Fisheries Bylaws to ensure that all persons comply with directives pertaining to the coastal marine reserves.

Sustainable fisheries management is important for Samoa's economy, food security and the marine environment. Investment in fisheries has shown positive outcomes in terms of the increase in number of villages participating in the community-based fisheries management programme, as well as the updated policies, strategies and legislative framework to ensure sustainable management of fisheries resources (NESP 2017).

Recommendations

- Engage with villages and encourage co-management of marine resources. Empower communities to establish marine protected areas, develop rules and regulations on the use of the marine area and to support their management of the resources.
- Build the capacity of the local staff and provide the necessary resources to allow the staff to undertake regular surveys of marine resources.
- Implement a national database on natural resources, and encourage the population of the database for safe-keeping. Ensure there is regular assessment of the database, and communicate the value of this to management authority.

INDICATOR 14: Offshore pelagic fisheries



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 12, 13	14 LIFE BELOW WATER 14.C.1	Codex Alimentarius CITES UNCLOS FAO Code of Conduct for Responsible Fisheries	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) New Song Noumea Strategy (SPC) Tokelau Agreement	• Samoa Tuna Management and Development Plan 2017-2021; • Tuna Fisheries National Monitoring Control and Surveillance Strategy 2016-2020, • Samoa Agriculture Sector Plan 2016-2020 • Fisheries Management Act 2016 • Samoa Ocean Strategy

Indicator definition

The context of offshore pelagic fisheries refers to commercial harvesting of pelagic fishes in the open ocean, which differentiates it from coastal and deep-water (or sometimes referred to as bottom) fisheries. The fish catch is either sold locally, or shipped to overseas markets. The target species are primarily tuna (albacore, bigeye, skipjack and yellowfin), but may also include marlin and swordfish. These fish are often referred to as highly migratory stocks (HMS), due to the distance they traverse, which often includes the exclusive economic zones (EEZ) of many countries. This indicator assesses the state of Samoa's EEZ and pelagic fisheries, through the review of fisheries catch and effort data. It also includes bycatch or non-targeted species.

Status and Key Findings

Samoa's offshore pelagic fisheries consist of trolling and longline. Domestic and foreign fishing boats are the two main fishing parties, and they all require fishing licenses to fish in Samoan waters (EEZ - 120,000 km^2). In 2015, Samoa permitted ten foreign fishing boats to operate within its EEZ. This had an immediate impact on fish catch volume. The number of licenses issued to foreign vessels has consistently been between 14 and 16 over the past five years (Table 24), with most of the vessels flagged to Vanuatu and the Cook Islands. All these offshore fishing vessels are longliners, with a few local boats that do longline, troll and bottom fishing. Over the past 10 years, just over 50 local fishing boats or alia were licensed with the majority around 8-11 metres long (Table 25). Domestic fishing boats, or alia, are flexible in terms of their target species due to the conditions and consumption demands. They often fish a few miles offshore. Purse seine fishing is limited to 150 days per vessel under the agreement between the USA and Pacific Island Countries (US Treaty), and none are based or

have fished in Samoan waters.

Table 24: Foreign fishing vessels and where they are flagged. (Samoa Fisheries Division 2020)

GROSS REGISTERED AND TONNAGE	LENGTH (IN METRES)	FISHING METHOD	FLAG	2016	2017	2018	2019	2020
50 - 200	> 20.5m	Longline	Cook Islands	1	1	6	6	5
			Kiribati	1	0	0	0	0
			Vanuatu	8	10	10	9	10
			Taiwan	4	4	0	0	0

Table 25: Domestic fishing vessels and their size (Samoa Fisheries Division 2020)

GROSS REGISTERED AND TONNAGE	CLASS	LENGTH (METRES)	FISHING METHOD	2016	2017	2018	2019	2020
0 - 10	A	>8 - 11	Mixed	57	49	42	48	26
10 - 50	B	>11 - 12.5	Longline	0	0	0	0	1
	C	>12.5 - 15		1	1	1	1	1
	D	> 15 - 20.5		6	7	4	4	3
50 - 200	E	> 20.5		4	4	4	4	3

All fish catches are landed and processed in Samoa, before they are exported to various overseas markets, and to the domestic market. The volume of catch varies considerably from year to year, largely due to the highly migratory nature of the stocks, and to some extent, the weather conditions. The years 2015, 2018 and 2019 saw low fish catches, compared to 2016 and 2017, and a further decline in the fish catch was seen during the COVID-19 lockdown. Fish exports decreased from 5,131 mt to 4,216 mt (Table 26), largely due to the COVID-19 lockdown in 2020. However, those that were able to be exported were sent to American Samoa canneries, or to New Zealand and America. Of the 1731 mt of landed catch in 2020, it was valued at USD 8 million (Ruaia et al. 2020). The tuna catch from Samoa accounts for around 0.3% of the total tuna catch in the western and central Pacific, and is the biggest export earner for the government since the 1990s (MAF n.d.).

Table 26: Highly migratory fish exports 2016-2020 (Samoa Fisheries Division 2020)

YEAR	2016	2017	2018	2019	2020
TOTAL	4345	4104	4165	5313	4216

The target species are primarily tuna: albacore (Thunnus alalunga), yellowfin (Thunnus albacares), bigeye (Thunnus obesus), and skipjack (Katsuwonus pelamis) (MAF 2021). Albacore accounts for 59% of all catch (1516 mt), followed by Yellowfin (25%, 648 mt), Bigeye (6%) and the rest are non-target species (Table 27). The majority of albacore tuna is exported frozen to American Samoa, whereas Yellowfin and Bigeye are exported fresh or chilled to New Zealand and America.

Most of the fish exported are primarily from the offshore fisheries and the volume continues to remain steady, from 5703 mt in 2016, to 5726 mt in 2019 (Fisheries Division 2021). The contribution of the sector to Samoa's GDP is SAT 44 million in 2019, reducing slightly due to COVID-19 in 2020 (SAT 38 million). Adjusted for inflation, the contribution was 2% of the total in 2019, compared to 2.4% in 2009. Ram-Bidesi et al. (2021) estimated commercial fisheries production to be valued between SAT 50-54.4 million.

According to the most recent WCPFC stock assessments, all four tuna species are estimated as not overfished, or experiencing overfishing (WCPFC 2019, 2021a, 2021b, 2022).

Table 27: Annual catch estimates for Samoa's national fleet for the WCPF Convention Area 2016-2020 (Samoa Fisheries Division 2020)

	2016	2017	2018	2019	2020
South Pacific Albacore Tuna	946	2374	1684	2408	1516
Bigeye Tuna	61	150	62	145	166

	2016	2017	2018	2019	2020
Black Marlin	4	6	3	2	3
Blue Marlin	6	83	33	51	79
Blue Shark	0	0	0	0	0
Hammerhead Shark	0	0	0	0	0.2
Mako Shark	1	0	0	0	0
Oceanic Whitetip Shark	0	0	0	0	0
Silky Shark	1	0	0	0	0
Skipjack Tuna	20	62	44	188	132
Striped Marlin	3	2	2	2	1.8
Broadbill Swordfish	4	16	11	15	17
Thresher Shark	0	1	0	0	0
Yellowfin Tuna	239	644	401	486	648

Samoa's longline fishing takes place year-round and is limited within the 120,000 km^2 EEZ. Fishing is highly variable and there are no favoured locations, nor specific periods for when catch is highest. As can be seen by the following figures (Figure 64 to Figure 68), catch sites vary from year to year. In 2016, concentration of fishing effort took place on the northern part of the EEZ (Figure 64), whereas in 2017, fishing took place all around the EEZ with some fishing on the south side (Figure 65). In 2018, fishing effort was mostly on the south, south-west and west parts of the EEZ (Figure 66), before it moved to the north to north-west parts of the country (Figure 67). By 2020, fishing was distributed throughout the whole EEZ (Figure 68).

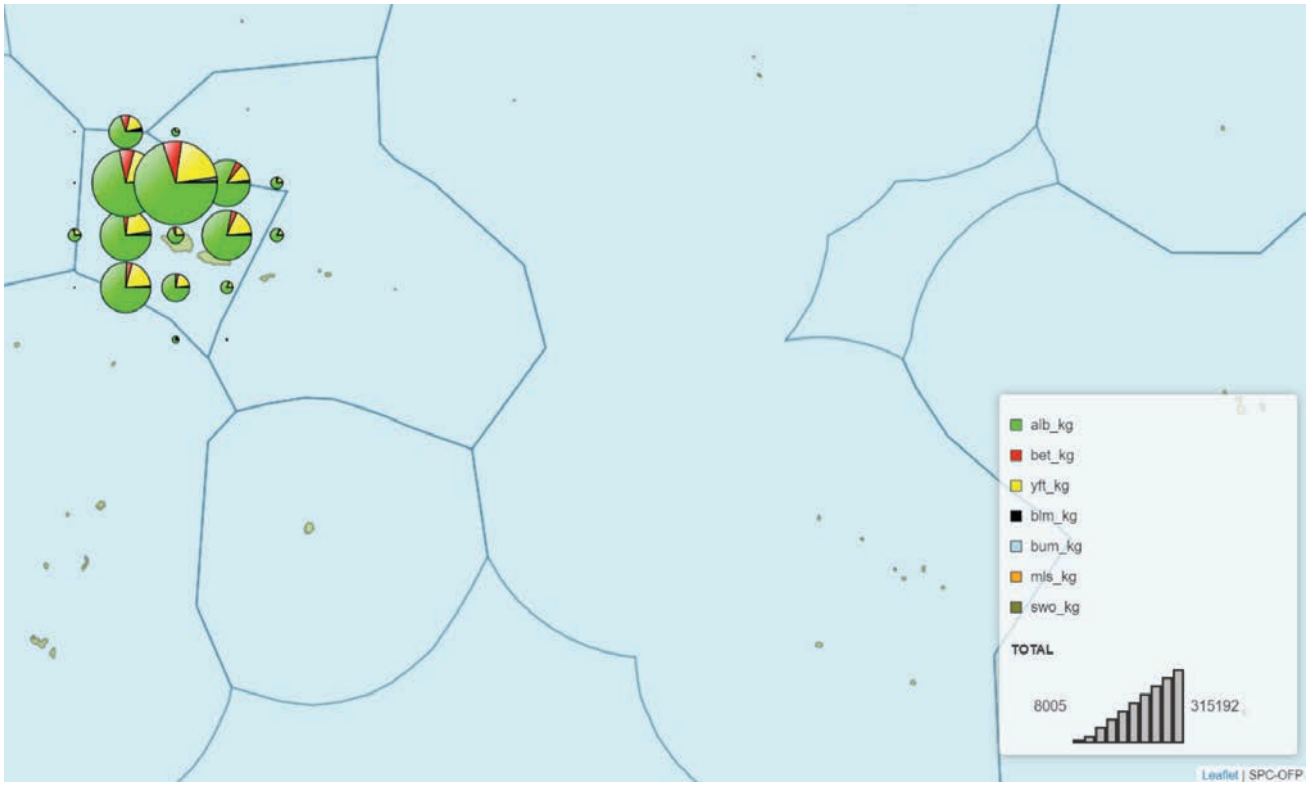


Figure 64: Fishing in 2016, took place on the northern part of the EEZ (Samoa Fisheries Division 2020)

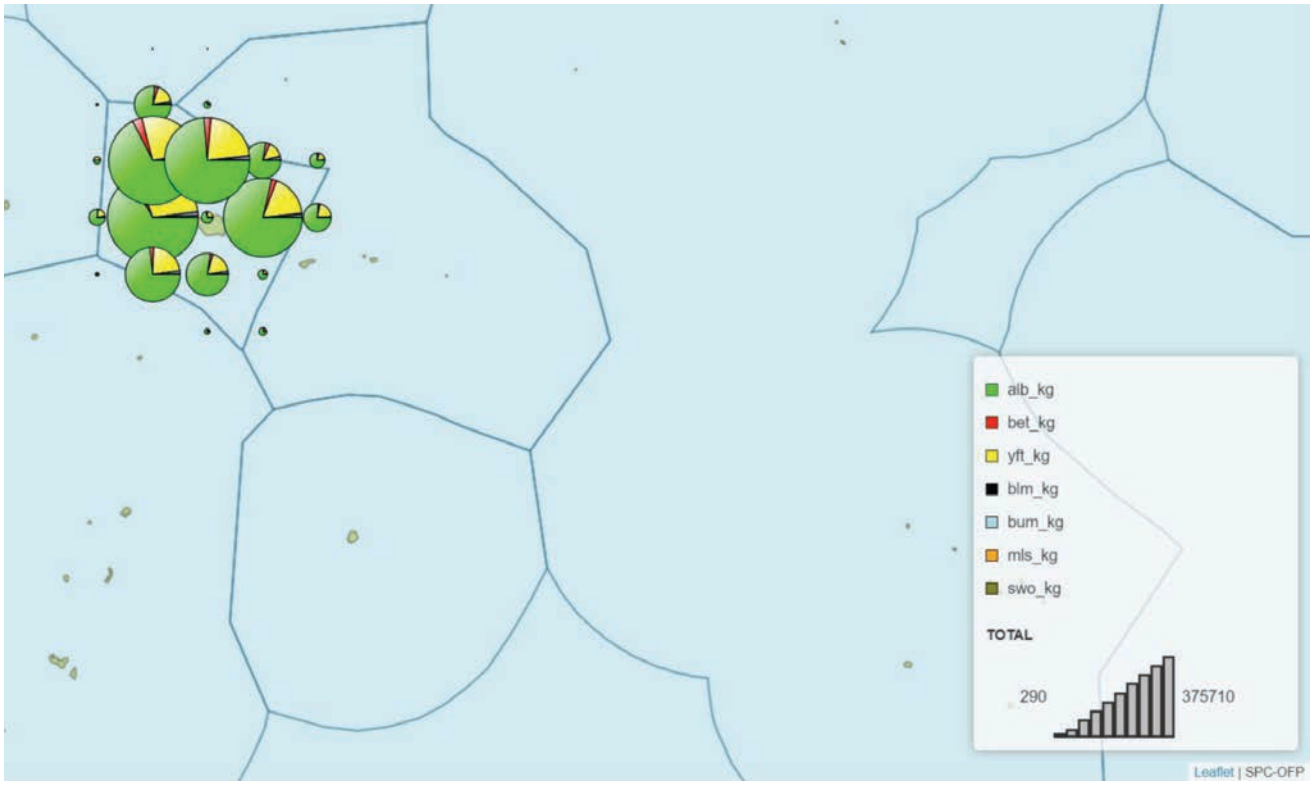


Figure 65: Fishing in 2017 was distributed throughout the EEZ (Samoa Fisheries Division 2020)

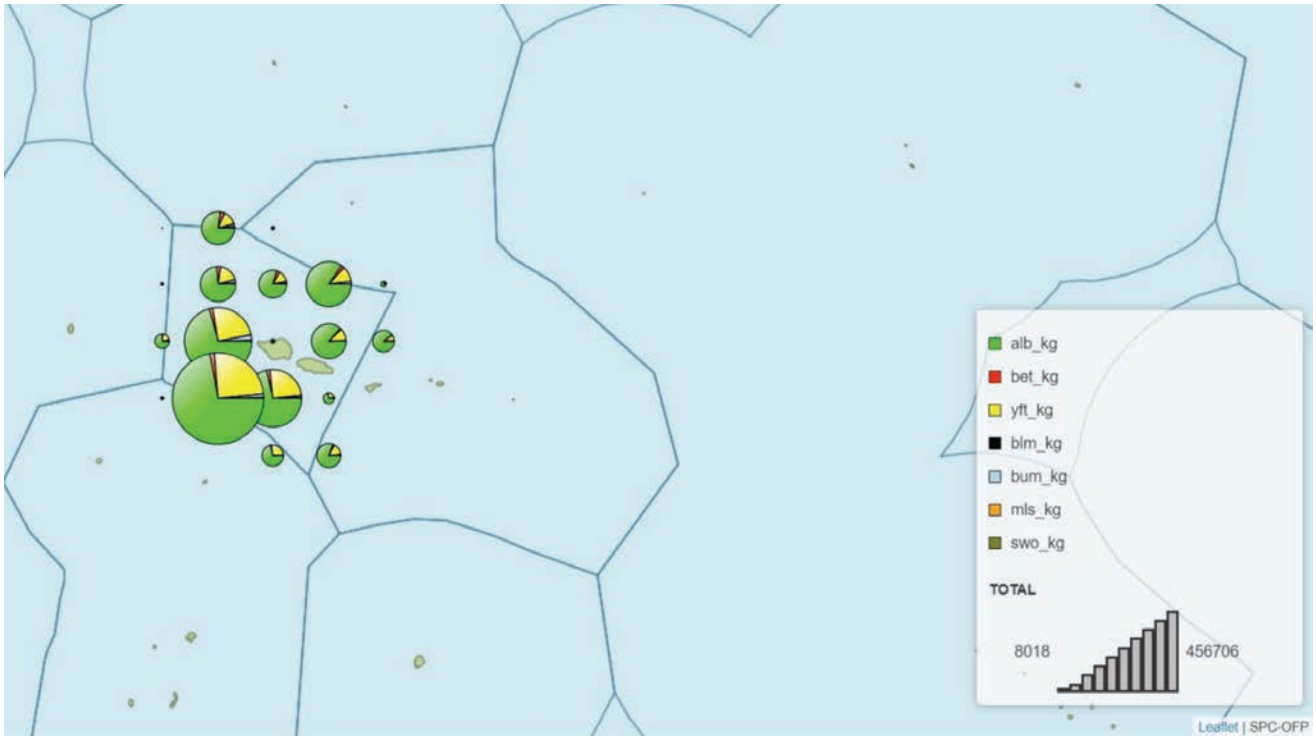


Figure 66: Fishing in 2018, was concentrated on the south to south-west section of the EEZ (Samoa Fisheries Division 2020)

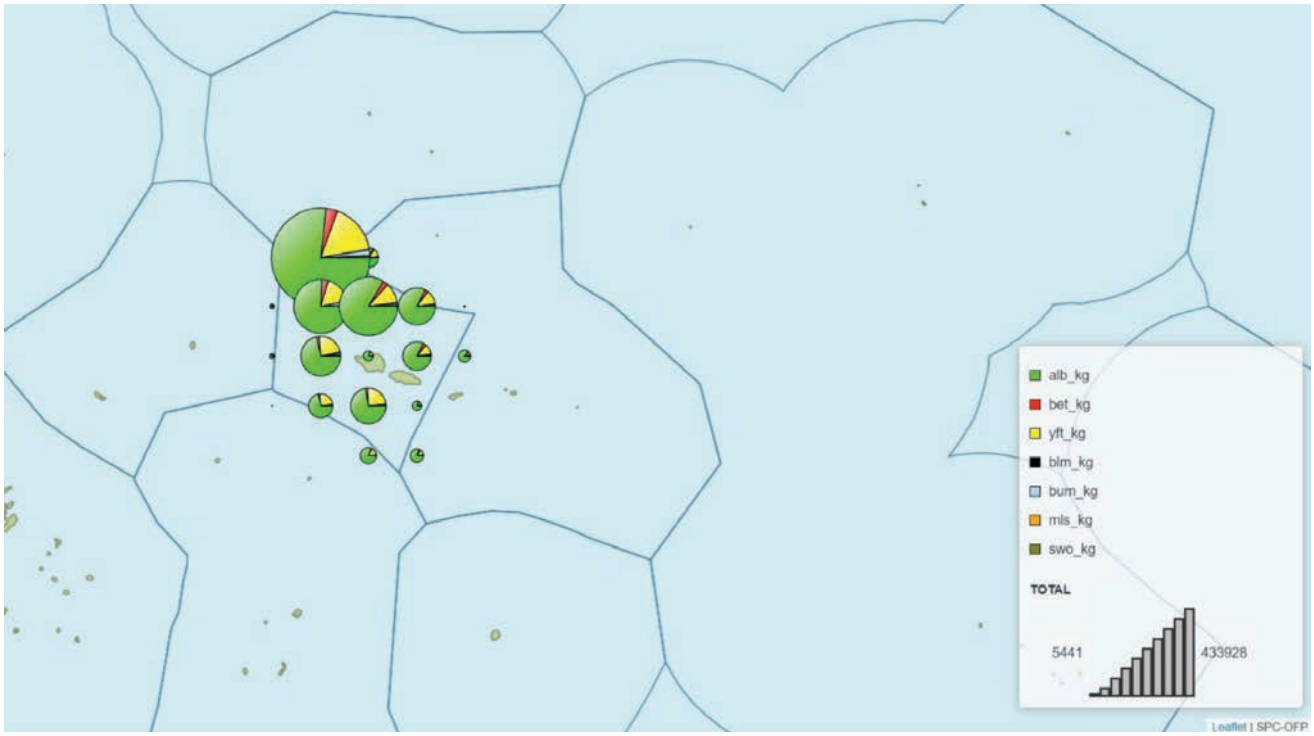


Figure 67: Fishing in 2019, took place mostly on the north to northwest parts of the EEZ (Samoa Fisheries Division 2020)

Figure 68: Fishing in 2020, took place throughout the EEZ (Samoa Fisheries Division 2020)

Bycatch

Non-targeted species totalled 331.57 mt from 2016 to 2020 (Samoa Fisheries Division 2020). Wahoo were the most common non-targeted species (161 mt) followed by Dolphin-fish (66.74 mt) for the period of 2016 to 2020 (Table 28). Thresher shark, considered Endangered on the IUCN Red List, had the lowest incidence of bycatch. Other species of special interest include the Oceanic White-tip where 19 individuals were released in 2019 observations, and Silky Shark, with eight released (Table 29). Bycatch is relatively low at around 3%.

Table 28: Species bycatch from 2016 to 2020 recorded from the Samoan longline fleet

(Samoa Fisheries Division 2020)

	2016	2017	2018	2019	2020
Thresher Shark (Alopias spp)	0.02	0	0	0	0
Blue Shark (Prionace glauca)	0.09	0	0.0059	0	0
Common Dolphinfish (Coryphaena hippurus)	5.4	36.78	10.29	6.189	8.085
Great Barracuda (Sphyraena barracuda)	0.16	0.07	0.083	1.535	2.563
Mako Shark	0.09	0	0	0.062	0
Moonfish (Lampris guttatus)	0.19	0.07	3.33	5.423	1.714
Oilfish (Ruvettus pretiosus)	0	2.84	1.25	10.2	6.95
Pomfret	0.01	0	0	0.047	0.165
Indo Pacific Sailfish (Istiophorus platypterus)	0	3.9	2.44	0	5.435
Shark spp	0	0.12	0	0	0
Shortbill Spearfish (Tetrapturus anguistrosris)	0	8.88	6.95	14.29	4.141
Sickle Pomfret	0	0	0.12	0.588	0.708
Sunfish	0	0	0	0	0
Silky Shark (Carcharhinus falciformis)	0	0	0	0	0
Tuna spp	3.82	11.35	0	3.873	0
Wahoo (Acanthocybium solandri)	14.87	52.77	30.01	39.917	23.778
TOTAL	**24.65**	**116.78**	**54.4789**	**82.124**	**53.539**

Table 29: State of shark species of interest (Samoa Fisheries Division 2020)

SPECIES	RELEASED INDIVIDUAL	STATUS ON RELEASE
Oceanic Whitetip (Carcharhinus longimanus)	19	Unknown
Silky Shark (Carcharhinus falciformis)	8	Unknown
Total	27	Unknown

Impacts

One of the big unknowns for the Offshore Fisheries sector, is the impact of climate change on the life-cycles of many of the highly migratory fish stocks, as well as the availability of their food source. Spatial ecosystem and population dynamic modelling have been carried out by Senina et al. (2018) to project changes in the biomass and catch of targeted tuna species. Under the high-emission scenario (RCP 8.5), the projections are for an eastern shift in the biomass of skipjack and yellowfin tuna over time, with a large and increasing uncertainty for the second half of the century, especially for skipjack tuna. The projections do not consider the effect of continuous fishing of the stock over the same time period.

The Government of Samoa relies on the income from the fisheries sector to implement many of its policies. Any negative impact in the sector will have implications for some of the national programmes.

Some of the target and non-target species are considered at risk of extinction if they are indiscriminately caught or killed during fishing operations. These species include turtles, cetaceans, sharks and sea-birds, which are vital to the health of the ocean and coastal ecosystem.

Response

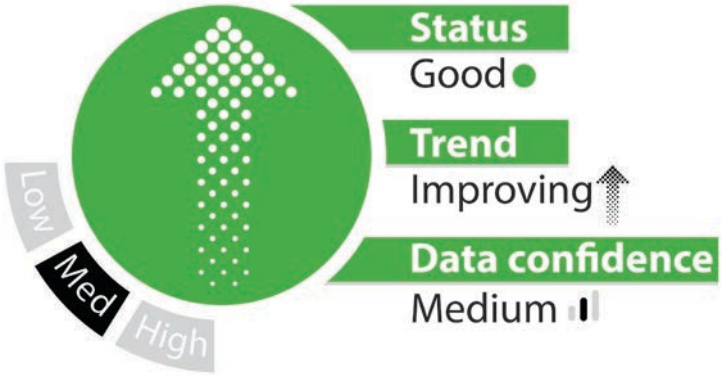
Samoa is a member of various regional organisations whose mandate is exploitation and management of fisheries resources, including the Western Central Pacific Fisheries Commission that was established to manage highly migratory fish stocks, the Secretariat of the Pacific Community (SPC) and the Pacific Islands Forum Fisheries Agency (FFA). The fisheries sector is managed by the Samoa Fisheries Division under the Ministry of Agriculture and Fisheries. The Fisheries Division works closely with these regional partners to collect data on fish catch, effort, fishing locations, and DNA samples to better understand stock movement. Part of the management of the offshore fisheries is through training of boat captains on e-reporting. The Fisheries Division continues to survey around 99% of domestic longline fishing vessels, focusing on catch, effort, species caught including bycatch. Samoa is currently reviewing some of its policies, including the Tuna Fisheries Management Plan 2017-2021, the Tuna Fisheries National Monitoring Control and Surveillance Strategy 2016-2020, and the Fisheries Management Act 2016.

The Samoa Ocean Strategy 2020-20230 identifies offshore waters as an important thematic area, which requires an integrated and multi-sectoral approach so that they can be sustainably managed (Government of Samoa 2020).

Recommendations

- As technology continues to improve and access becomes affordable, there is an opportunity to modernise the collection and analysis of fisheries data, including real-time sharing with key partners. This will require the upskilling of local staff and the provision of appropriate technology. Assistance from development partners will be needed to improve Samoa's capability to monitor and manage highly migratory fish stocks within its waters.
- Encourage and prioritise research on the impacts of climate change on migratory fish species, especially the impact to their life cycles, the availability of their food sources, and ongoing fishing pressure.
- More training is needed for the industry to ensure that bycatch and other species of interest (non-target) are safeguarded and released safely back to the ocean. Some of the shark species are critically endangered (e.g. Oceanic Whitetip - Carcharhinus falciformis) and efforts to protect them should be adopted.
- Strengthen knowledge on bottom fish stocks and put in place appropriate management measures to ensure that the resources remain viable into the future.

INDICATOR 15: Marine conservation and protected areas



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	6, 10, 12, 13, 14, 15	14.C.1	Codex Alimentarius, CITES, UNCLOS FAO Code of Conduct for Responsible Fisheries, UNFCCC, UN Fish Stocks in the Western and Central Pacific Ocean, CMS, Ramsar	SAMOA Pathway 53,59, 68, 94 Noumea Convention (SPREP) New Song Noumea Strategy (SPC)	• National Biodiversity Strategy and Action Plan 2015-2020 • Samoa Ocean Strategy 2020-20230 • National Environment Sector Plan 2017-2021

Indicator definition

This indicator acknowledges that some conservation areas in Samoa straddle the terrestrial and the marine environments. It further acknowledges that there is a diversity of conservation measures existing within Samoa, which may not necessarily conform to the traditional perception of marine protected areas. The indicator focuses on the percentage of the coastal and marine area that is being managed or has some level of interventions, whether by the village, district or national levels.

Status and Key Findings

The conservation of the marine environment, including designation of national parks, marine protected areas, community-based fisheries reserves and national sanctuary, has been a national priority for the government for some years. The Samoa Ocean Strategy encapsulated the progress made so far, and it provides the foresight for priorities and actions for the country. The bigger achievements have been the designation of Samoan waters as a marine sanctuary for whales, sharks, turtles and dolphins in 2003. The sanctuary effectively prohibits the fishing of any of these marine species.

Another important milestone for marine conservation is the development of the Samoa Ocean Strategy, which lists national targets on marine protected areas. The Ocean Strategy commits Samoa to protect 30% of its waters by 2030. Another important target under the Ocean Strategy was identifying marine special planning (MSP), which requires understanding of special, unique marine areas (SUMA). There are 11 inshore SUMAs identified for Savaii, 15 on Upolu and 6 offshore sites (Figure 69 and Table 30).

Samoa's Ocean Strategy I MPA Network

- 2021 – Samoa commits to protect 30% of its waters.
- 2022 – MPAs are identified based on the MSP.
- 2023 – coastal and offshore marine areas for protection are mapped and approved.
- 2025 30% of Samoa's ocean included in MPAs.

Samoa's Special, Unique Marine Areas (SUMA)

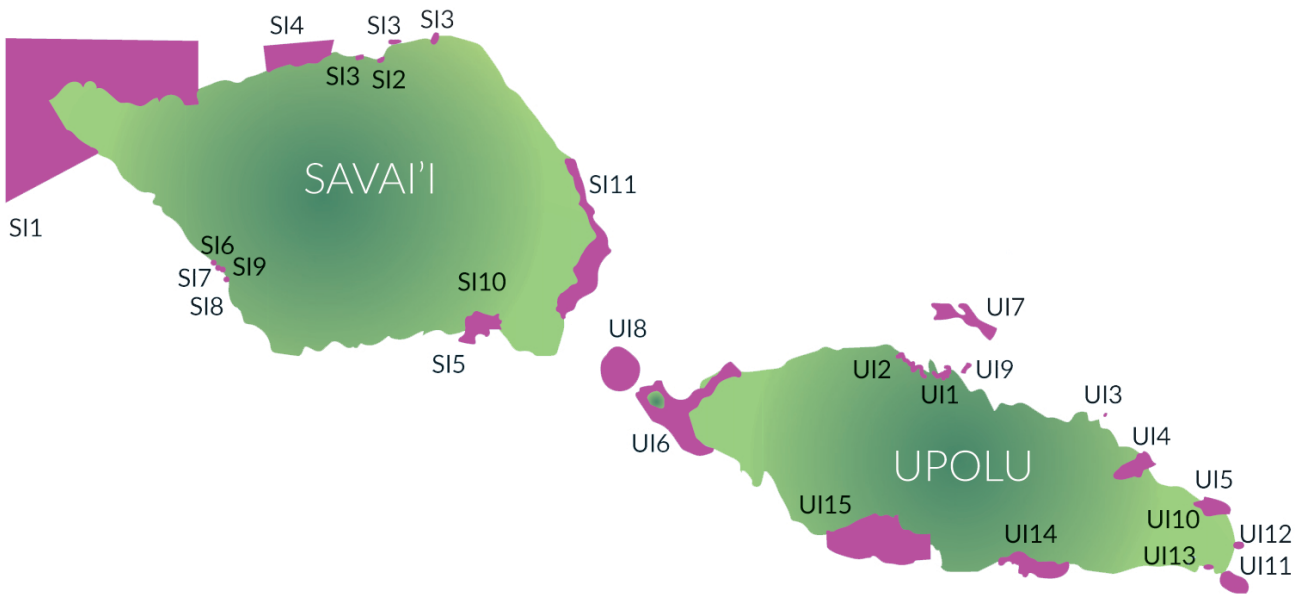


Figure 69: Samoa's Special, Unique Marine Areas. The legends are given in 23. (IUCN n.d.).

Table 30: Samoa's Special, Unique Marine Areas (Ceccarelli et al. 2020)

UPOLU ISLAND
U1 – Vaiusu Bay mangroves
U2 – Toamua-Fale'ula mangroves
U3 – Lufilufi / Faleapuna Fish Reserve
U4 – Fagaloa Bay
U5 – Tiavea Area
U6 –Manono Reef Flats
U7 – Five Mile Reef
U8 – Apolima
U9 – Palolo Deep
U10 – Tiavea Mangrove Area
U11 – Nu'utele & Nu'ulua bird nesting and foraging area
U12 – Mutiatele Mangrove Area
U13 – Tuialamu Palolo site
U14 – Salani-Poutasi Reefs
U15 – Safata MPA

SAVAII ISLAND
S1 – Northwest Savaii
S2 – Faletagaloa mangroves
S3 – Saftu, Sasina and Safune palolo harvesting area
S4 – High shark area
S5- Satupaitea to Fa'ala
S6 – Foailalo Community-Based Fish Reserve
S7 – Foailuga Community-Based Fish Reserve
S8 –Salailua Community-Based Fish Reserve
S9 – Satuiatua Community-Based Fish Reserve
S10 – Palauli Community-Based Fish Reserve
S11 – Multiple Community-Based Fish Reserves

OFFSHORE AREAS
Southern trench
Seamounts, ridges, guyots & escarpments
Geomorphological cluster 2
Geomorphological cluster 3
Eastern seamount
Whale migration route.

The total marine area that is under conservation is estimated at around 782 km^2 (Duffy and Atherton 2018), although if the Marine Sanctuary is included, then the area is around 130,480 km^2, or the total EEZ plus coastal areas (https://pipap.sprep.org/country/ws). Around 23% of the coastal areas are considered important Key Biodiversity Areas (CI 2010). The bigger marine protected areas are found in Safata (62 km^2) and Aleipata (50.35 km^2). Other notable protected areas include the Palolo Deep National Marine Reserve that was established in 1974 but formalised in 1979 (1.38 km^2), the Fagaloa Bay – Uafato Tiavea Conservation Area and O Le Pupū Pu'ē National Park. The Fagaloa and O Le Pupū Pu'ē are primarily terrestrial conservation areas, but they also include some of the coastal areas.

As of 2019, there were 73 village-level fish reserves and two national MPAs in Samoa (Figure 70).

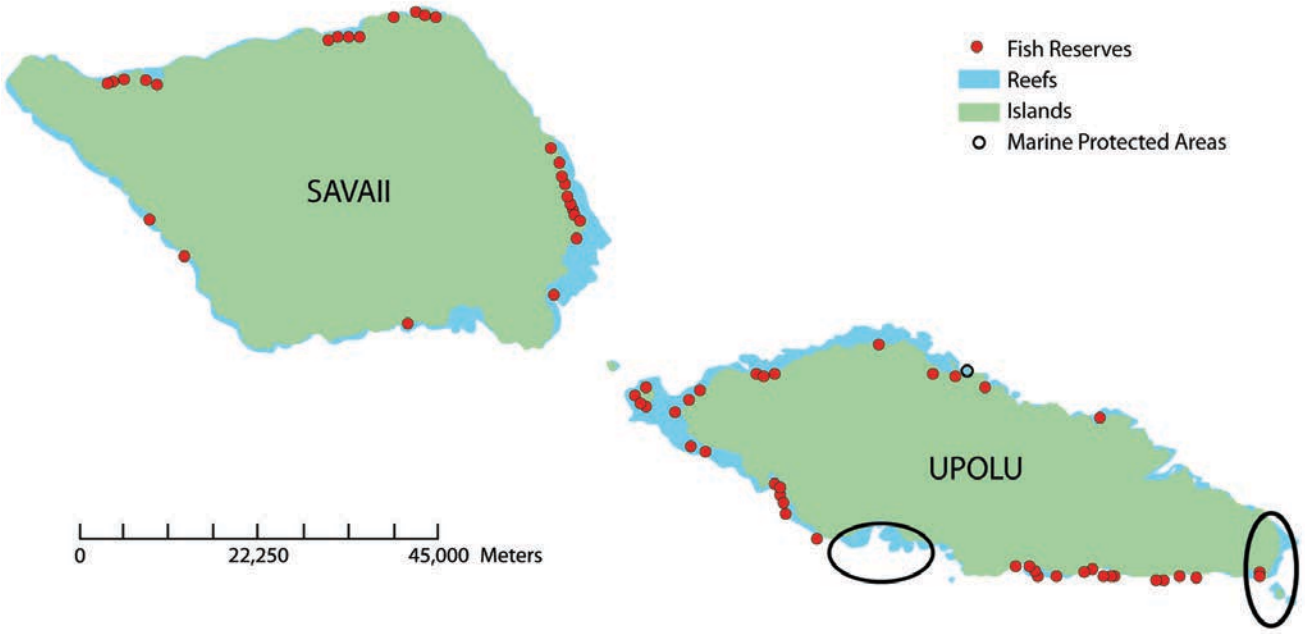


Figure 70: Village fish-reserves distribution and the two national marine protected areas (Duffy and Atherton 2018)

Impacts

The ongoing exploitation of marine resources, coupled with pollution and coastal sedimentation, are causing serious stress to the marine environment. The frequency of COTS outbreaks and elevated sea surface temperatures leading to coral bleaching since 2000, adds more pressure on the marine environment. The increasing population, especially along the coastal areas, will lead to a high demand for seafood and other marine resources (aggregates, corals, sand, seawater, etc.). It will also contribute to increased development along the coast, leading to high erosion and run-off into the inshore and lagoon areas. Climate change with extreme weather events can cause flooding, which may affect agricultural and farming lands, leading to pesticides and fertilisers being washed into water systems and ending up in the coasts. While many of these are beyond the control of coastal village communities, there are certain actions that they can take to build resilience in order to safeguard their environment and the marine resources.

Response

Samoa's progress in designating protected or conservation areas has been very positive. The concept of marine protected areas has been used primarily as a management tool to address overfishing in many of the inshore reef areas. The Fisheries Division has worked with many villages since the early 1990s to develop management plans for the marine resources, which includes the designation of fish reserves. The legislation was developed, to support the villages in their efforts to manage their resources. Samoa has also designated some national parks and district level conservation areas since the 1970s, with the aim of protection and conservation of native biodiversity. Many of these sites are protected under legislation. With the diversity of conservation areas, a national summit was held to categorise the conservation areas. The results are listed below:

- Community Based Coastal and Marine Management Area
- General Use Management Area
- Sustainable Use Area
- Limited Use Management Area

- Habitat Protection Management Area
- No-Take Marine Reserve
- Unique Marine Reserve

Recommendations

- There is a need to review the existing legislation, particularly the Fisheries regulations, to address any shortcomings and to strengthen the enforcement component. There is also an urgent need for more capacity building on the implementation of the legislation, in particular the enforcement side.
- Integrated marine surveys are needed, including targeting threatened taxa, to provide an improved basis to monitor the effectiveness of existing managed sites and to improve the knowledge base for targeting new sites Additional surveys need to be undertaken in the KBAs that have been identified, as more rare species are likely to exist in these areas.
- Conservation areas have been proven to provide refuge and protection for many marine species. There is a need to continue to identify key areas where many of the vulnerable species congregate, either as feeding grounds, nurseries or spawning areas, and work with the relevant communities to protect these areas. Priority should be given to locations that have no current protection and represent special habitat like Five Mile Reef, and Apolima Reef area. The reef crest, slope, and offshore reefs are generally under-protected in Samoa, it is important to consider extending the boundary of MPAs no take zones to the extent of the reef slope.
- Working with villages provides the best solution for the management and conservation of marine resources. This work, especially by the Fisheries Division, should be supported and enhanced so that it will continue to reap benefits for villagers and biodiversity.

References (Marine and Coast)

Atherton, J., and Jefferies. (2012). Rapid Biodiversity Assessment of Upland Savai'i, Samoa. (Eds). Secretariat of the Pacific Regional Environment Programme (SPREP). 176p.

Atherton, J., and Tipama'a, F. (undated). Review of the Status of knowledge of Samoan Avifauna https://library.sprep.org/content/review-status-knowledge-samoa-avifauna

Ceccarelli, DM., Wendt, H., Kaituu, J., Mulipola, A., Satoa, M., Reddy, C., (2020) Biophysically Spe…"

Conservation International – Pacific Islands Programme, Ministry of Natural Resources and Environment, Secretariat of the Pacific Regional Environment Programme. 2010 Priority Sites for Conservation in Samoa: Key Biodiversity Areas. Apia, Samoa.

Duffy, L., and Atherton, J. (2018) Sixth National Report to the Convention on Biological Diversity. Ministry of Natural Resources and Environment, Government of Samoa. Apia, Samoa.

Duke, NC, J. Mackenzie and A. Wood 2012, 'A revision of mangrove plants of the Solomon Islands, Vanuatu, Fiji, Tonga and Samoa', Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) Publication 12/13, James Cook University, Townsville, 22 pp.

Ellison, JC. (2018). Effects of climate change on mangroves relevant to the Pacific Islands. Pacific Marine Climate Change Report Card. Science Review 2018: 99-111.

FAO (2022). Fishery and Aquaculture Country Profiles. Samoa. Country Profile Fact Sheets. Fisheries and Aquaculture Division [online]. Rome

Gaskin, C. (2022) Does Fregetta lineata still exist in Samoa https://library.sprep.org/content/birds-new-zealand-pacific-islands-bird-conservation-and-reserach-fund-does-fregetta-lineata

Gilman, E., Ellison, J. and Coleman, R. (2007) Assessment of mangrove response to projected relative sea-level rise and recent historical reconstruction of shoreline position, Environmental Monitoring and Assessment, 124, 105-130.

Global FinPrint. (2018). State of Sharks and Rays in Samoa. Highlight video: https://vimeo.com/257004034.

Global Mangrove Watch (2020). Mapbox Open Street Map. https://rb.gy/5gks78

Goldin, MR. (2002). Field Guide to the Samoan Archipelago fish, wildlife, and protected areas. The Bess Press. Honolulu, Hawaii, USA. pp xiv + 1-330.

Government of Samoa (2020). Samoa Ocean Strategy 2020–2030, Integrated Management for a Healthy and Abundant Future of Samoa's Ocean. Apia, Samoa. 44p.

Iakopo, M. (2006). Mangroves of Samoa, Status and Conservation. Apia: Ministry of Natural Resources, Environment and Meteorology.

Kwan, S., and Iene, F. (2017). Report on hatched turtles in the Faimafili Village Resort in Lefaga. Marine Conservation Section. Division of Environment and Conservation. MNRE. Samoa. 5p.

Kwan, S., Satoa, M., Fatutolo, I., Male, F., and Polataivao, M. (2017). Turtle nesting and crown of thorns starfish monitoring. February, 2017. Marine Conservation Section. Division of Environment and Conservation. MNRE. Government of Samoa. Apia, Samoa. 10p.

Kwan, S., Satoa, M., Iene, F., Polataivao, M., Male, F. (2018). Monitoring the trends and distribution of humpback whales migrating through. Summary Report. Marine Conservation Section. Division of Environment and Conservation. MNRE. Government Samoa. Apia, Samoa. 6p.

Kwan, S., Satoa, M., Iene, F., Polataivao, M., Male, F., and Seumanufagai, M. (2018). Turtle Nesting Survey for Falealupo. May 2018. Marine Conservation Section. Division of Environment and Conservation. MNRE. Government of Samoa. 9p.

Kwon, MS., and Lee, CM. (2015). Coastal Marine Environment Survey: Independent State of Samoa 2014. Editors. KIOST Tropical Pacific Project – V. Korea Institute of Ocean Science and Technology (KIOST).

MacDonald, DD. (1994). Approach to the assessment of sediment quality in Florida coastal waters. Vol. 1 – Development and Evaluation of Sediment Quality Assessment Guidelines. Florida Department of Environmental Protection. Florida, USA. 140p.

MacDonald, DD., Ingersoll, CG., and Berger, A. (2000). Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems.

Mackenzie, J., Duke, NC., and Wood, A. (2013). MangroveWatch assessment of shoreline mangroves in Samoa. MESCAL Report No. 13/53. Centre of Tropical Water and Aquatic Ecosystem Research (TropWATER). 35p.

MAF. (n.d.). Tuna Management and Development Plan 2017-2021. Ministry of Agriculture and Fisheries, Government of Samoa.

Marine Conservation Section (2015). Report on the current status of Humpback Whales in the northern coast of Upolu, 2015. Division of Environment and Conservation, MNRE. 5p.

Ministry of Natural Resources and Environment, Conservation International Pacific Islands Programme. (2017). Rapid Biodiversity Assessment of Key Biodiversity Areas: Falealupo Peninsula Coastal Rainforest, Central Savaii Rainforest, and Uafato-Tiavea Coastal Rainforest, Samoa. Apia, Samoa. 285pp.

Mortimer, JA., and Donnelly, M. (2008). Eretmochelys imbricata. In: IUCN red list of threatened species, V. 2010.1. IUCN, Gland. Available at: www.iucnredlist.org

Percival, JEH. (2018). The importance of seascape structure on fish communities in the mangroves of Samoa.

Pilcher, NJ. (2021). Review of the status of sea turtles in the Pacific Ocean 2021. Secretariat of the Pacific Regional Environment Programme, Apia, Samoa. 136 pp.

Ra, K., Kim, K-T., Jeong, H. (2015). Chapter 4. Heavy metals in coastal marine environments. In. Kwon, MS., and Lee, CM. (2015). Coastal Marine Environment Survey: Independent State of Samoa 2014. Editors. KIOST Tropical Pacific Project – V. Korea Institute of Ocean Science and Technology (KIOST).pp. 23-44.

Rabieh, S., Bayraraa, O., Romeo, E., Amosa, P., Calnek, K., Idaghdour, Y., Ochsenkuhn, MA., Amin, SA., Goldstein, G., and Bromage, TG. (2020). MH-ICP-MS Analysis of the Freshwater and Saltwater environmental resources of Upolu island, Samoa. Molecules 2020 (25): 1-23.

Ram-Bidesi, V., Mulipola, AP., Wendt, H., Reddy, C., Kaitu'u, J., Gauna, M. (2021). Samoa Marine Ecosystem Service Valuation. Summary Report. GCCA+ (The EU, MNRE, IUCN), Suva, Fiji. 15pp.

Ram-Bidesi, V., Siamomua-Momoemausu, M., and Faletutulu, M. (2014). Economic valuation of mangroves of the Safata District in Samoa. Ministry of Natural Resources and Environment, Samoa. IUCN-Oceania.

Roebeck, U. (2023). Samoa TREDS Report 2013-2022. Secretariat of the Pacific Regional Environment Programme pp. 1-9.

Ruaia, T., Gu'urau, S., and Reid, C. (2020). Economic and Development Indicators and Statistics: Tuna Fisheries of the Western and Central Pacific Ocean 2020. Forum Fisheries Agency, Honiara, Solomon Islands. https://www.ffa.int/node/2596 (Accessed 15 March, 2023).

Saifaleupolu, T., and Elisara-Laulu, F. (2013). Biodiversity Audits for Mangrove Wetlands in Vaimoso, Lepea, Fugalei, Sogi, Mulinuu and Moataa . O le Siosiomaga Society.

Samoa Bureau of Statistics (2019). Report on the Samoa Agriculture Census 2019. Government of Samoa. 2021. Apia, Samoa. Pp 135-136

Samoa Fisheries Division (2020). Annual Report to the Commission. Part 1: Information on fisheries, research and statistics. Ministry of Agriculture and Fisheries, Government of Samoa. Apia, Samoa. 16p.

Samuelu, J. and M Sapatu. (2009). Status of coral reefs in Samoa 2008. Global Coral Reef Monitoring Network 2008

Report. Fisheries Division, Ministry of Agriculture and Fisheries. Apia, Samoa. 33 pp.Sandi, S., Zgliczynski, B., and Bonito, L. (2018). Cruise Report Samoa. December 4 – December 18, 2017. 100 Island Challenge. Scripps Institution of Oceanography. 9p.

Sapatu-Kennar, MF. (2020). Aleipata Marine Protected Area: Marine Assessment Report, DEC-MNRE.

Sapatu-Kennar, MF. (2020). Vaiusu Mangrove Audit Report. 27p.

Satoa, M. (2018). Captive turtles at the Sunset View Fales on Manono Island. July, 2018. Division of Environment and Conservation. MNRE. Government of Samoa. Apia, Samoa. 4p.

Senina, I., Lehodey, P., Smith, N., Hampton, J., Reid, C., and Bell, J. (2018). Impact of climate change on tropical tuna species and tuna fisheries in Pacific Island waters and high seas areas. SAN 6003922. Conservation International. http://www.fao.org/fileadmin/user_upload/common_oceans/docs/Final-report-PacificTunaClimateChange.pdf (Accessed 15 March, 2023).

SPREP (2023). Seabird survey of Aleipata offshore islands 24-26 October 2022 https://library.sprep.org/content/seabird-survey-aleipata-offshore-islands-24-26-october-2022-report

Tarburton, MK. (2001). Observations on the status of the land birds, wading birds and seabirds of Samoa in Emu, 101. 349-360.

Tiitii, U., Sharp, M., and Ah-Leong, J. (2014). Samoa socio-economic fisheries survey report – 2012/2013. Secretariat of the Pacific Community (SPC), Noumea, New Caledonia. 1-64.

WAITT Institute, Conservation International, Ministry of Agriculture, Ministry of Natural Resources and Environment (2022) Samoa Coastal Marine Expedition 2022 Report.

Walsh, SA., and Paton, DA. (2003). Final Report on the Survey of Whales and Dolphins in Samoa. September 2003. South Pacific Island whale and Dolphin Program, South Pacific Whale Research Consortium.

Ward, J., and Kwan, S. (2012). Improving the understanding on the distribution and monitoring trends of humpback whales migrating through Samoa, MNRE.

Ward, J., and Lemalu, F. (2020). The independent State of Samoa. In: Sea Turtles in Oceania MTSG Annual Regional Report 2020 (Work TM., Parker D. and Balazs G.H., eds). pp. 486-505.

Watling, D. (2001). Birds of Fiji and Western Polynesia. 2001.

WCPFC. (2019). Skipjack tuna (Katsuwonus pelamis) stock status and management advice. SC15 2019. Scientific Committee, Western and Central Pacific Fisheries Commission. https://www.wcpfc.int/doc/03/skipjack-tuna.

WCPFC. (2021a). WCPO Yellowfin tuna (Thunnus albacares) stock status and management advice. SC16 2020. Scientific Committee, Western and Central Pacific Fisheries Commission. https://www.wcpfc.int/doc/02/yellowfin-tuna.

WCPFC. (2021b). WCPO Bigeye tuna (Thunnus obesus) stock status and management advice. SC16 2020. Scientific Committee, Western and Central Pacific Fisheries Commission. https://www.wcpfc.int/doc/01/bigeye-tuna.

WCPFC. (2022). South Pacific Albacore tuna (Thunnus alalunga) stock status and management advice. SC17-2021. Scientific Committee, Western and Central Pacific Fisheries Commission. https://www.wcpfc.int/doc/04/south-pacific-albacore-tuna.

Witzell, WN. (1982). Observations on the green sea turtle (Chelonia mydas) in Western Samoa. Copeia, 1982(1): 183-185. doi:10.2307/1444286.

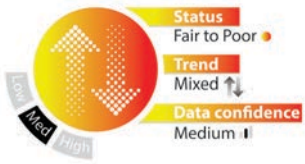
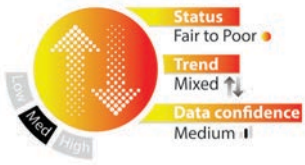
Zann, LP. (1994). The status of coral reefs in South Western Pacific Islands. Marine Pollution Bulletin 29: 52-61.

Ziegler, M., Quere, G., Ghiglione, J-F., Iwankow, G., Barbe, V., Boissin, E., Wincker, P., Planes, S., and Voolstra, CR. (2017). Status of coral reefs of Upolu (Independent State of Samoa) in the South West Pacific and recommendations to promote resilience and recovery of coastal ecosystems. Report prepared for the Government of Samoa and the Ministry of Natural Resources and Environment. Tara Pacific Expedition Team. September, 2017. 18p.

Theme 2: Built Environment

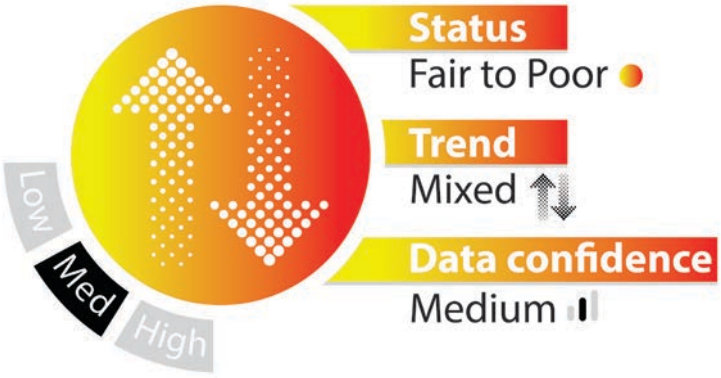
The “Built Environment” refers to the human driven modifications to the natural environment, including the infrastructure, to service the needs of the people. Built Environment covers issues such as building types, road and transport, civil infrastructure, utilities and coastal structures such as seawalls and jetties. While the Built Environment affects the whole of Samoa, it is perhaps more pronounced in urban settings, such as Apia and Salelologa, and high tourism sites along the coast. The fact that the majority of the population resides along the coast, means the environmental impact is likely to be severe.

Overview and Highlights

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Waste management		Waste audit completed in 2020. 27,057 mt waste generated per annum. Less than 3% is being recycled or reused. Upolu generates 123 kg of waste per person annually. This is twice the amount compared to other islands. On average households generate about 1.9 kg of waste per day (693.5 kg/year). Paper and cardboard are the main wastes, followed by cars and organic wastes. Landfill will reach full capacity by 2032. Hazardous wastes (asbestos, e-waste, medical and sewage) are disposed of at the landfill. Health-wastes have increased significantly from 38,000 kg per annum in 2014 to 431,000 kg per annum in 2022 estimation.	A National Waste Management Strategic Plan 2019-2023 has been developed. Legislation (Waste Management Act 2010) also provides the legal oversight in managing waste. Collection of wastes has reached around 97% of all households. *Hazardous waste, including but not limited to a problematic wastes, such as asbestos, e-wastes, waste oil, healthcare and chemical wastes, need mandatory legal oversight to ensure that they are not being imported if globally banned, and if they are to be imported, that they are properly managed, including storage and disposal.* *Recycling and reusing of wastes need to be promoted to reduce waste going into the landfill.* *Raise awareness with communities on managing and reducing waste, especially organic waste, from being dumped at the landfill.*
Sanitation and state of sewage treatment systems		Majority of households (97%) have access to improved sanitation. Flushed toilets are the main sewerage system used by Samoans. Most of the households use septic tanks, and some use pit latrines. Piped sewerage system operates only in the Apia central, servicing government and commercial buildings.	Key responsible agencies for sanitation include PUMA, MNRE, MWCSD, SWA, PAS and SRC. *Protection of groundwater systems from sewage contamination needs to be further investigated and measures put in place to minimise harm to the people.*
Potable water management		Samoa's reticulated system covers around 89% of Samoa's population. Only a few households utilise village water schemes, although most of these are being absorbed under the reticulated system. Samoa's water supplies are mainly through rivers and boreholes. About 99% of the households have access to safe and improved potable water.	The Samoa Water Authority is the key responsible agency in managing the supply of water to the majority of the population. A National Drinking Water Standard provides the safe parameters for monitoring the quality of water. Some of the key policies in management of Samoa waters, include the Samoa Water Authority Corporate Plan 2021-2024 and the National Water Resources Policy. *Assess the current state of groundwater systems and the rate of abstraction in view of developing a management strategy.* *Improve water quality monitoring ensuring that data are shared amongst relevant agencies.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Apia urban environment		Apia is the main urban area of Samoa, with Salelologa on Savaii island, being developed into another urban centre. Apia urban area contains about 20% of the population (35,974 people – Census 2021) and it covers around 150 km^2. Population density for Apia is 239 people/km^2 compared to 72 people/km^2 for the whole of Samoa. Growth of the Apia urban environment is likely to be on the south side and northwest of the current boundaries.	A number of policies and legislations are in place to manage the Apia Urban environment and expansion. The Planning Urban Management Act 2004, is the key legislation for urban planning and development. *Develop a land zoning plan for Apia.* *Update outdated maps of the Apia area, as new areas are being absorbed into the urban expansion.*
Environmental Compliance		The number of complaints received and resolved continues to vary from year to year, but with an average of around 157 per year from 2012 to 2021. When capacity and resources are provided, over 90% of complaints are resolved. Overall, the number of complaints to be resolved. Stop orders issued due to infringements average at five per year. Development consent is required before any work can commence. The number of Development Consent applications has been increasing since 2004, with over 1000 applications received in 2020 and 2021. The high number of DC applications is attributed to public awareness of the law.	The key legislation for environmental compliance is the PUM Act 2004. *Provide the necessary resources to allow for the implementation of the PUM Act 2004.* *Build staff capacity and recruit sufficient personnel to implement the agency's responsibilities.* *Review the legislation and strengthen areas such as stronger penalties to deter infringements.* *The restructuring of the Agency has been disruptive and has affected its operation, and staff morale. Some permanency is needed to allow the Agency to consolidate its base and strengthen its capacity.*

INDICATOR 16: Waste management



LINKS TO REPORTING OBLIGATIONS

CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
8 10 15	7 AFFORDABLE AND CLEAN ENERGY 11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 14 LIFE BELOW WATER	Stockholm Convention Rotterdam Convention Minamata Convention Basel Convention, including Amendments on the Control of Transboundary Movements of Hazardous Wastes Chemical Weapon Convention	SAMOA Pathway 58 (d), 70, 71 (a, d). Waigani Convention Asbestos Convention Asbestos Free Pacific – A regional strategy and action plan. Asbestos Management Legislative Reform Pathway Noumea Convention	• National Waste Management Strategy 2019-2023 • Waste Management Act 2010 • Waste (Plastic Bag) Management Regulations 2018 • Public Notice Plastic Prohibition (Ban) 2019 • Samoa Waste Audit Report 2020 • Marine Pollution Prevention Act 2008 • Waste Management (Importation of waste for electricity and energy recovery) Regulation 2015 • National Health Care Waste Management Strategy 2020-2025 • Chemical and Hazardous Waste Policy 2022 • Review and Update of the National Implementation Plan (NIP) for the Stockholm Convention on Persistent Organic Pollutants (POPs) 2019 • Minamata Initial Assessment Report for Samoa 2018

Indicator definition

Waste continues to be a challenge for all Samoans. This indicator assesses the amount of wastes generated, calculated based on the volume being managed at the landfill, and correlates it with the number of households, whose wastes are captured by waste collectors. It further assesses the average daily per capita generation of solid waste, and the type of waste being generated.

Status and Key Findings

Solid waste

A waste audit for Samoa was completed in 2020 and a key outcome was determining the total amount of waste being generated. The audit also analysed the waste generation characteristics and how they vary between households and the commercial sector (Figure 71). Some of the findings from the audit include:

- 27,057 mt of waste generated annually.

- 745 mt per year (plastics, glass, metals and tyres) are recovered annually, or less than 3% are being recycled or reused.
- There's potential to save 12,000 m3 per annum from landfill, and 22% in volume through waste recovery.
- The total waste generated per island per year:
  - » 22,888 mt for Upolu. Or 123 kg/person/year
  - » 4,094 mt for Savaii
  - » 69 mt for Manono
  - » 6 mt for Apolima
- On Upolu, 337 g of waste is generated per person per day (123 kg/person/year), which is twice the amount of the other islands.
- 270 g waste/person/day reaches the Tafaigata Landfill (98 kg/person/year) (around 80%).
- 1.9 kg of waste generated per household per day on Upolu island (693.5 kg/household/annum).
- Paper and cardboard are the largest waste type, comprising 6,258 mt per year. End-of-life vehicles were the second largest waste type comprising 5,880 mt per year, followed by organics at 4,674 mt per year.
- Most of the organic waste is used locally.
- 180,000 m3 of wastes are disposed of at the landfill. Without any waste recovery, the landfill will reach full capacity by 2032. If all recyclables are recovered, this will extend the landfill life to 2050.

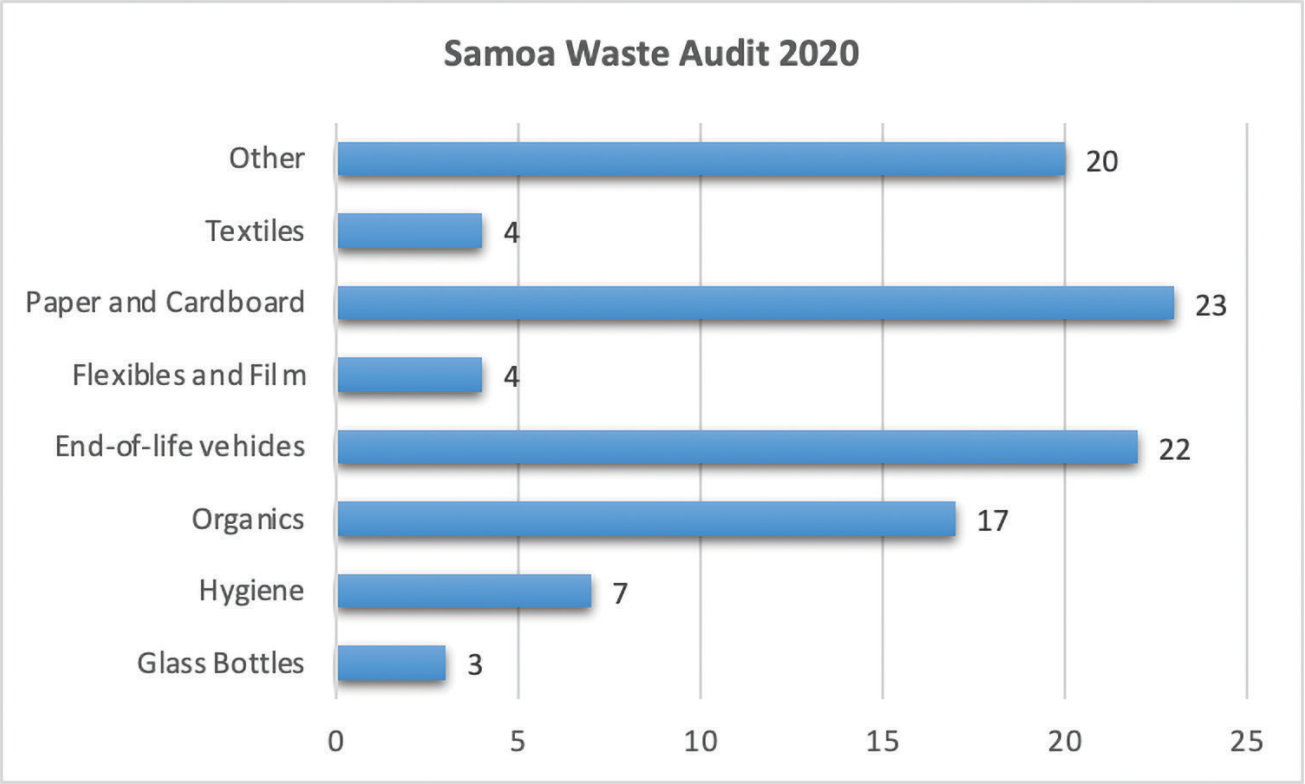


Figure 71: Composition of waste materials generated across Samoa annually (MNRE 2020)

The waste generation per capita per year reached a peak in 2011 to 2013 at over 170 kg of waste per person per annum (Table 31). The lowest waste generated per year, per person was recorded in 2020 from areas outside of Upolu island, at 0.98 kg/person/annum.

Table 31: Waste generated per person per year from 1999 to 2020 (MNRE).

YEAR	1999	2011		2013		2020	
		Apia Urban	Rural	Apia Urban	Rural	Upolu	Rest of Samoa
Waste per Kg/ person/year	0.99	175	130	171	131	123	0.98

Chemical and Hazardous Wastes

Healthcare waste management

The Ministry of Health's Healthcare Waste Section is in charge of handling medical waste, which includes the collection, sorting, storing, transporting, treating, and disposing of wastes. Two new specialised healthcare waste trucks (1 Upolu, 1 Savaii) were purchased in 2021 with the correct technical parts and specifications in terms of movable ramps, storage bins containment and holding bins (Figure 72). Collection of medical waste per day from the islands' nine hospitals (2 main and 7 district), three healthcare facilities (all on Upolu island), 37 private clinics, four morgues, and five pharmacies. The non-medical wastes are dumped at the Landfill, whereas all infectious wastes, pharmaceutical wastes and sharps are sent to the healthcare waste incinerator at the Tafaigata (Upolu) and Vaiaata (Savaii) Waste facilities for treatment (Figure 73). The ash from the incinerator is buried at an ash-pit close to the incinerator facility. As part of the UNICEF WASH Project, color-coded bins have been sent to all hospitals, private clinics and mortuaries, to ensure correct separation of medical wastes from non-medical wastes.

Previous estimates of healthcare waste for Upolu and Savaii, provided through the EU funded PacWaste project in 2014, determined the following quantities of healthcare waste generated in Upolu and Savaii (Table 32) with estimates of 735 kg of healthcare wastes generated per week or approximately 38 tonnes annually.

Figure 72: MOH received two new trucks to assist with the transport and safe disposal of medical waste.

Table 32: Health waste generations estimate (PacWaste Project Report 2014)

SAMOA	WEEKLY (KG)	ANNUALLY (KG)
Upolu	600	31,000
Savaii	135	7,000
Total	735	38,000

A more recent assessment carried out for this SOE found the healthcare waste generation to have increased to 8,301 kg/week, or around 431 tonnes per annum (Table 33) (Isaia pers comm. 2023). This latest assessment was based on a 6-month of data collection from the Tafaigata Landfill weighbridge for healthcare wastes from the Tupua Tamasese Meaole Hospital (TTMH), as well as wastes from other hospitals, clinics and the National Kidney Foundation. The average weight per bin was then used to estimate healthcare wastes on Savaii collected from the Malietoa Tanumafili II Hospital and other healthcare clinics. This is a significant difference which resulted in further investigation and shows the value in empirical information over rapid estimation techniques particularly when there are many other sources of healthcare waste and not just the main hospitals.

Table 33: Healthcare waste generation estimate (Source: TA Healthcare Waste Assessment 2019)

SAMOA	WEEKLY (KG)	ANNUALLY (KG)
Upolu	7,301	379,000
Savaii	1,000	52,000
Total	8,301	431,000

Figure 73: Health officials preparing for the transport of healthcare wastes to the Tafaigata Landfill.

Asbestos

Asbestos was once widely used in the building industry due to its many versatile properties including being a good insulator and fire resistance. Unfortunately, asbestos can easily be airborne and inhaled by people, leading to lung problems, or asbestosis. In 2015, a survey to determine the state of asbestos in the Pacific was carried out, including one for Samoa (PacWaste 2015). Components of the survey include reviewing management options for asbestos in the region and providing recommendations for future management interventions. The findings from the survey of 2800 houses found only a single residential building suspected of having

asbestos. If this is to be extrapolated throughout the country, an estimated 10 houses would have asbestos containing material. There are 12 sites in Samoa that are considered to be of moderate to high risk with regards to the wellbeing of the occupant or the general public's exposure to asbestos. The remaining sites identified are considered to present a low to very low risk to human health. Management of the low risk sites will be required to ensure the risk to human health is not elevated further as the buildings condition deteriorates with age.

Asbestos fibres chrysotile, amosite and crocidolite have been detected in building materials in 18 of 48 samples analysed. The percentages of fibres detected ranged from 3 – 25% with chrysotile the most commonly detected asbestos fibre. There are some loose sheets and broken asbestos observed at Fasitoo-Tai village, the Meteorological Station, Apia, and probably other locations – e.g. an unoccupied building at Fagamalo. The John Williams Building in Apia had an asbestos roof which tested positive. It was in the process of being demolished at the time of the inspection and hence became the subject of an investigation with recommendations to tighten up on site procedures and carry out a clean-up.

E-waste

E-waste includes electrical and electronic equipment at the end of its useful life. This covers home or business items that use power, such as televisions, computers, laptops and screens, mobile phones, microwaves, printers, and others. E-waste is a significant problem in Samoa and e-waste quantities are increasing due to changes in technology, more affordable consumer electronics, and better access to electricity. There is some documentation of electronic goods and products coming into the country under the Ministry of Customs and Revenue, with some data collected by the Samoa Bureau of Statistics during national census surveys. This can provide some level of understanding on the potential quantity of e-waste. However, it requires the establishment of a national system that can harvest the current information and allow closer communication amongst the key actors from the various government departments, and the private sector. This is something that is currently being explored under the PacWaste Plus project (Fiasoso pers. comm. 2023).

Samoa does not have an e-waste recycling scheme, but a few local recyclers have collaborated to recover reusable and recyclable materials for e-wastes collected from diverting wastes at the landfill. Some data were collected in 2010 from the Ministry of Finance (MOF) and Ministry for Revenue (MfR) through a PacWaste project implemented by MNRE. The data from MOF was mainly from the 'write off' of e-products from various government ministries from 2010 to 2014 (Figure 74). Recovery is effective for these write off e-products via the auction process of the MOF.

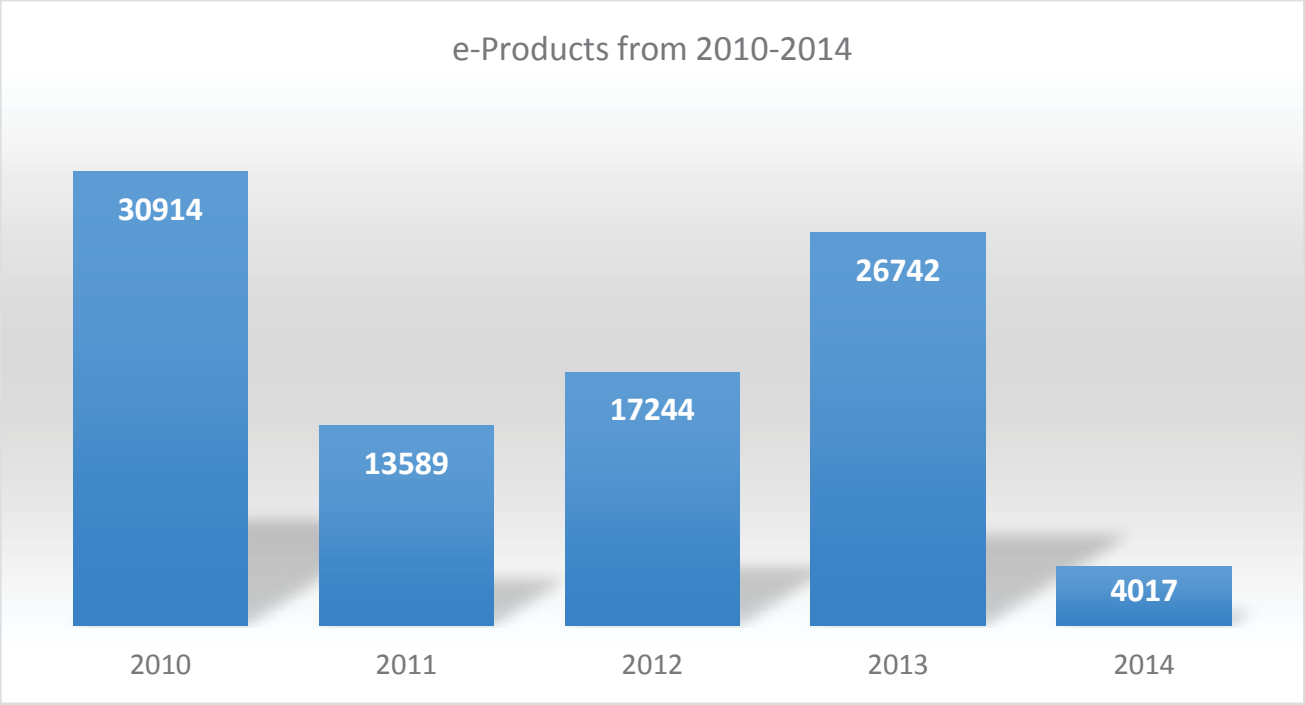


Figure 74: Quantity of e-Products from 2010 to 2014.

Plastic Waste

Plastic pollution is now treated as a global, regional and national challenge. Samoa's limited economy and a non-producer of plastic is at the forefront of the plastic pollution, both on land plastics and in seawater – micro-plastics. Plastic wastes are easily transported via ocean currents, thereby are transboundary by nature, impacting many coastal communities throughout the Pacific Ocean. Samoa introduced a ban on plastic, through the Waste (Plastic Bag) Management Regulation in 2018. The plastic management regulation has been implemented in stages, with a view on ensuring alternatives to plastic are available for the public and businesses. Overall, the regulation prohibits the import or the manufacturing of plastics, the sale and use of plastic shopping bags and plastic straws in June 2019, and by 2020 styrofoam was phased out.

Waste challenge

Samoa, like other Pacific island countries, has a serious waste challenge due to increasing volume, and limited adequately designed disposal sites. As more recyclables are being recovered, there is a challenge to find markets to process these resources. The volume of PET plastic is increasing rapidly due to a surge in local bottled water production, with over 10 different plants. In addition, Coca Cola has recently replaced the traditional glass bottles with PET plastic bottles. Other important waste challenges are the technical capacity and the legal framework with enforcement capacity to manage the sector.

Impacts

Poor management of waste generated at households and businesses impacts on human health and the environment. Low collection levels of healthcare wastes are synonymous with high sanitary disease levels. Putrescible waste especially can lead to anaerobic conditions on land, in waterways and within urban areas affecting health of humans, animals and plant life. Ecosystem function and services can be seriously curtailed by the pollution that prevails.

The following key challenges faced by Samoa with regards to waste management:

- Illegal dumping, burning of waste and littering.
- Insufficient public awareness of waste issues and solutions.
- Free waste collection services provide no incentive to reducing volumes of waste.
- Lack of adequate facilities and expertise for chemical and hazardous waste management.
- Lack of technological knowledge and resources to manage problematic wastes.
- National recycling system for plastics and glass is inadequate.
- High cost of exporting recyclable materials to markets overseas (energy costs with distance), and increasingly, the lack of markets for recyclable wastes.
- Poor logistics and lack of socioeconomic volumes to enable value chains to facilitate waste and recycling.
- With no sustainable 'internal' financing mechanisms for solid waste management there will continue to be insufficient annual waste budgets to progress capacity.

Response

Samoa has developed its National Waste Management Strategic Plan 2019-2023, where a number of stakeholders are identified as responsible for its implementation. It has also passed national legislation (Waste Management Act 2010) to provide the legal framework for waste management and recycling activities. One of the key activities was to ban the importation and use of single use plastic items, including shopping bags and plastic, straws and cutlery (refer to the Waste (Plastic Bag) Management Regulations 2018). Another important action by the country was ratifying the Basel Convention Amendments on the Control of Transboundary Movements of Hazardous Wastes in 2020. This is in addition to its membership to the Stockholm, Rotterdam, Minamata and the Waigani conventions.

The current waste management collection system covers 97% of all households. Samoa has two main waste disposal sites. The main site is at Tafaigata, and a semi-aerobic landfill site is on Savaii island, at the village of Vaiaata. With the improved national collection of household wastes, incidences of unregulated dump sites are no longer occurring. Only the Tafaigata site enables segregation and storage for recyclable materials and composting. However, it has been irregularly used, due to a lack of staff and skills. Previously it was noted there was a lack of expertise, equipment and facilities for managing e-waste, tyres and motor vehicles (MNRE 2019). Much of this material is stockpiled and it is estimated there are 139 m3 stockpiled tyres at the Tafaigata site. This Tafaigata site is nearing capacity with waste cells full and unlined landfill areas now being used. Without the implementation of recycling and recovery of materials or reuse provisions at the source it will reach capacity by 2032 (World Bank 2021).

The National Disaster Waste Management Response Plan is undergoing a final review before it is endorsed by DAC.

Waste projects

Sustainable Waste Actions in the Pacific (SWAP)

The Pacific-AFD Waste Management Programme, called the Sustainable Waste Actions in the Pacific (SWAP), is addressing

cost effective and sustainable management of waste and pollution. The objective of the programme is, "to improve sanitation, environmental, social and economic conditions in the Pacific Island Countries and Territories through proper waste management". This objective is addressed by developing good practices on waste management through:

a) Helping communities and local authorities to develop national waste management policies with a global approach from collection, sorting, recovery and proper disposal.

b) Improving the delivery of waste services through development of waste management infrastructures and implementation of pilot projects.

c) Strengthening communities and local authorities' capacity in the areas of technical waste management and institutional governance.

Two national pilot programs are implemented under the SWAP project.

a) Marine Litter Pilot Project

b) Used Oil Pilot Project

Samoa Waste Oil Management Program

The Samoa Waste Oil Management Program (SWOMP) was established in 2019 through a partnership with the Samoa Recycling and Waste Management Association (SRWMA); one of the first such arrangements in the region. Under the programme, an oil waste transfer station was to be built in 2021 at the Tafaigata landfill site. Automobile waste oil was to be collected by Nissan Samoa (a member of the Waste-Management Association), and a charge of 20 sene per litre was levied to companies for the management of their waste oil. Unfortunately, there is no recycling or collection programme for lubricating oils in Samoa. Often it is stockpiled in backyards (SPREP 2014). A Product Stewardship System was developed in 2014, with a 'Draft Used Oil Management Plan for Samoa', which was finalised in 2020.

PacWaste

PacWaste (2014-2018) provided the opportunity for Samoa to undertake baseline surveys, build capacity in healthcare waste and e-waste management.

The PacWaste Plus is a 14 Pacific Island Countries plus Timor Leste project funded by the European Union. The aim of the project is to sustainably and cost effectively improve regional management of waste and pollution. The project focuses on hazardous wastes, solid wastes and waste water. E-waste management and sustainable finance mechanism are the priority components, where e-waste policy, e-waste regulation, e-waste dismantling and storage facility and Advanced Recovery Fee Deposit (ARFD) are to be developed and established under the funding.

JPRISM I & II

The Japan International Cooperation Agency (JICA), through SPREP, has assisted Samoa in managing solid waste. JICA's contributions include building the capacity of staff, and the development of the first National Waste Management Strategy 2019–2023. To enhance contributions and participation by communities, JPRISM II has managed to develop a user pays system for waste collection, despite the fact that a cost benefit analysis should be conducted in the next phase of the project. The project has managed to develop a monitoring system for waste collection to ensure the compliance of waste collection contractors for their respective collection zones. This was achieved by using a system to track every collection truck in real time. The system was developed with technology from a local start-up company, SkyEye Samoa, which allows real-time reports to be sent via emails. There has been a significant reduction of complaints from the public since the system has been adopted. The project has assisted Samoa in the development of the National Disaster Waste Management Response Plan. The Plan is now submitted to the DMO/NEOC for the Disaster Advisory Committee (DAC) to endorse for its implementations.

CERO Waste

As part of UNDP's wider post COVID-19 recovery programme, the Circular Economy for the Recovery of Waste (CERO) project pairs climate action with COVID-19 socio-economic recovery to explore and test innovative, scalable, in-country, circular solutions for the recovery of low-value waste streams, namely plastic, glass and paper into value-added products.

The project is designed to pilot value chain development of circular processes for low-value waste recovery with a twofold objective to:

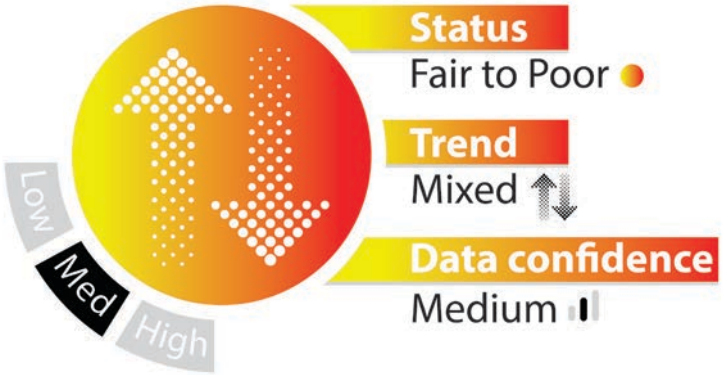
I. divert recyclable waste from landfill to address immediate waste management and pollution issues in Samoa and Tokelau, and

II. unlock the potential of green employment, particularly for unemployed youth including young women, to accelerate the exploratory transition into a comprehensive circular economy that diversifies and strengthens resilience of the national economic base in circular waste management.

Recommendations

- Review and where appropriate update solid waste management policies, strategies and plans.
- Regularly review waste management operations, including collections and landfill sites.
- Undertake public awareness programmes that focus on specific waste management issues such as illegal waste dumping, recycling and waste segregation, and preventing the importation of hazardous waste materials.
- The government to develop the necessary legislative framework to prohibit the import of asbestos, including asbestos containing materials (ACM). Ensure the legislative framework places the ownership of managing asbestos and ACM on the importer or the shipper.
- Build the capacity of Customs officials in identifying goods that may contain asbestos and ACM.
- Develop and implement a national strategy to recover recyclable materials, such as a national container deposit scheme for glass and PET plastic.
- Work with the private sector to encourage more recycling of PET plastic and glass.
- Invest in and create downstream value chains for e-waste.
- Improve household collection systems to reach a full 100% coverage of urban areas, and a similar target for rural communities.
- Rehabilitate the current landfills and engage with communities to secure lands for future waste management.
- Submit the Circular Economy Policy to NPCC for endorsement for implementation.
- Seek endorsement of the National Disaster Waste Management Response Plan from the Disaster Advisory Committee, for implementation and mainstreaming in the National Disaster Plan.

INDICATOR 17: Sanitation



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	3 8	3 GOOD HEALTH AND WELL-BEING 6 CLEAN WATER AND SANITATION 11 SUSTAINABLE CITIES AND COMMUNITIES 12 RESPONSIBLE CONSUMPTION AND PRODUCTION		SAMOA Pathway 64 Noumea Convention	• National Sanitation Policy • Water for Life: Water and Sanitation Sector Plan 2016-2020. • Water for Life: Water, Sanitation & Hygiene Sector Plan 2020/2021-2024/2025 • Sewerage and wastewater Regulations 2009

Indicator definition

While good sanitation is strongly linked to the prevention and the spread of disease, its impact on the environment is also an important consideration, especially untreated sewage and waste that flow into aquatic systems and directly into coastal wetlands and marine ecosystems. This can result in algal blooms and the fouling of the environment, as well as exposing communities to diseases, through contaminated water, sediment and seafood. Communities that rely on bores and groundwater for their drinking water will also be impacted by poorly managed sewerage systems. By managing sewage throughout the country, and particularly in urban environments, Samoa can be confident in protecting the marine environment and the health of the people.

The indicator assesses the percentage of the population having access to safe sewage management.

Status and Key Findings

The data used for this assessment come from the various Government Censuses over the past few years, in particular the 2001, 2011, 2016 and 2021. Since 2001, most Samoan households (93%) are using flushed toilets. Ten years later, the percentage of households using flushed toilets increased to 95%. By 2016 and again in 2021, the percentage of households using flushed toilets reached 97% (Figure 75). Other sewerage systems used include pit latrines, ventilated improved pit latrine, pit latrine with a concrete slab, and finally pit latrine without a slab or an open pit (Figure 76). The last system is considered inadequate and poses a significant risk to the environment and the health of the people. Fortunately, the number of households with open pits is very low (less than 1%).

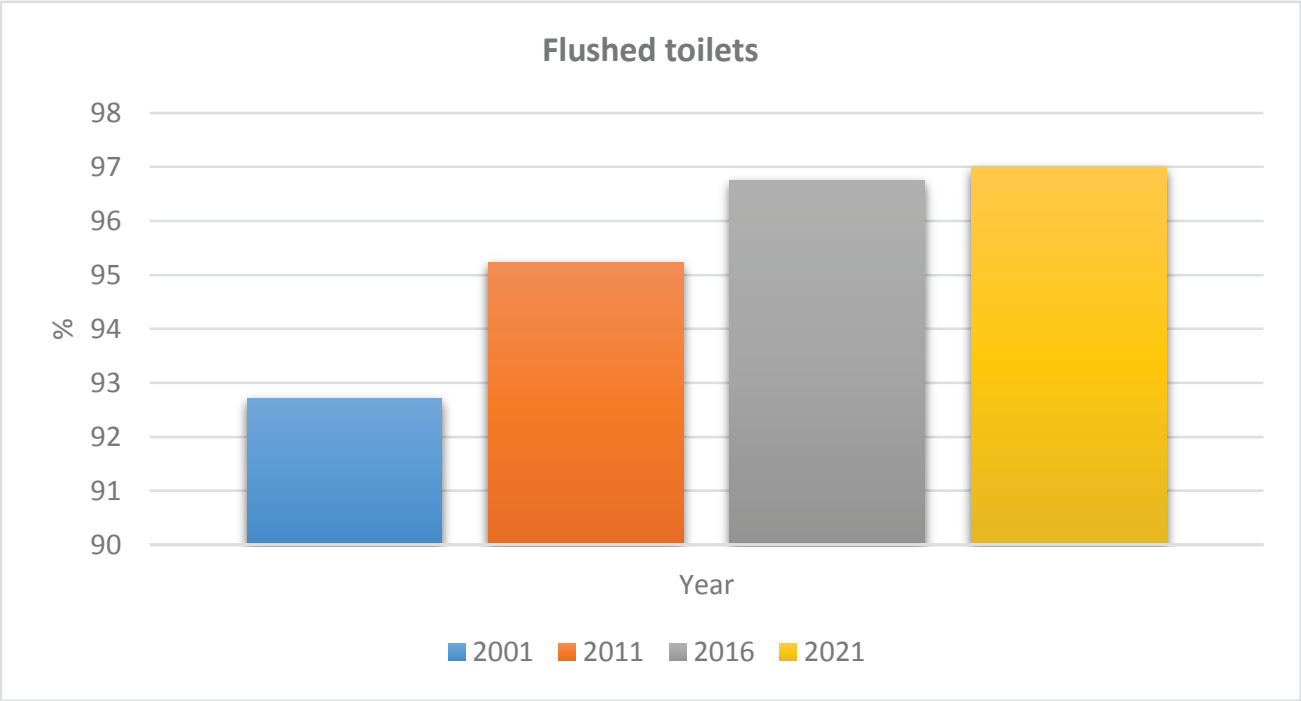


Figure 75: Percentage of households with flushed toilets as their main means of sewage treatment (Samoa Bureau of Statistics Census reports for 2001, 2011, 2016 and 2021)

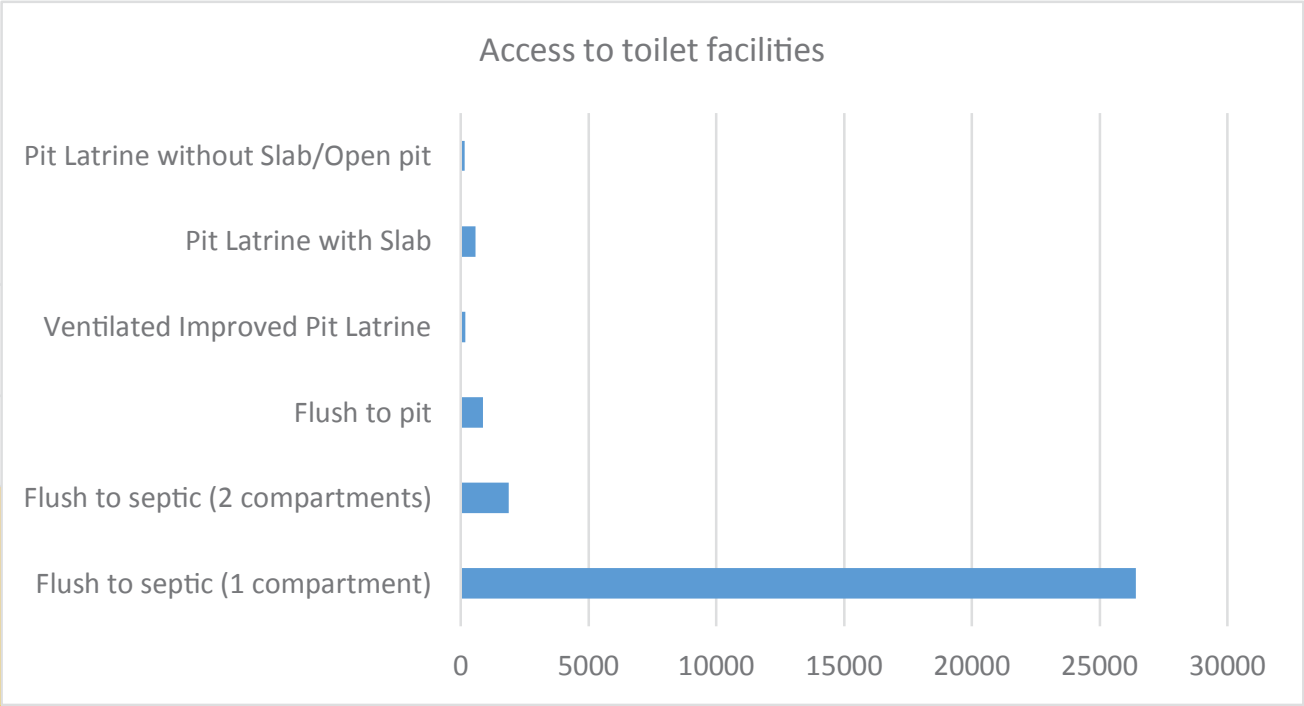


Figure 76: Samoan households and access to toilet facilities for the year 2021 (SBS 2021)

Apia urban sewerage system

The Apia urban area is unique by being the only area in the country that has a sewerage system servicing government buildings and offices, as well as businesses within the Central Business District. The Samoa Water Authority is the responsible agency and it operates the Wastewater Treatment Plant located at Sogi. Sewage is piped from more than 300 commercial operations and it flows into the Wastewater Treatment Plant. The treated sewage solids are taken to semi-aerobic landfills at Tafaigata and Vaiaata, where they are deposited alongside sewage collected from household and commercial septic systems. A biogas digester is further used to recycle animal and human waste to produce electricity and gas (WaSH Sector Plan, 2020-2025). The demand continues to rise for access to the sewerage system, with more than 300 connected (Figure 77) (WaSH Sector Plan, 2020-2025).

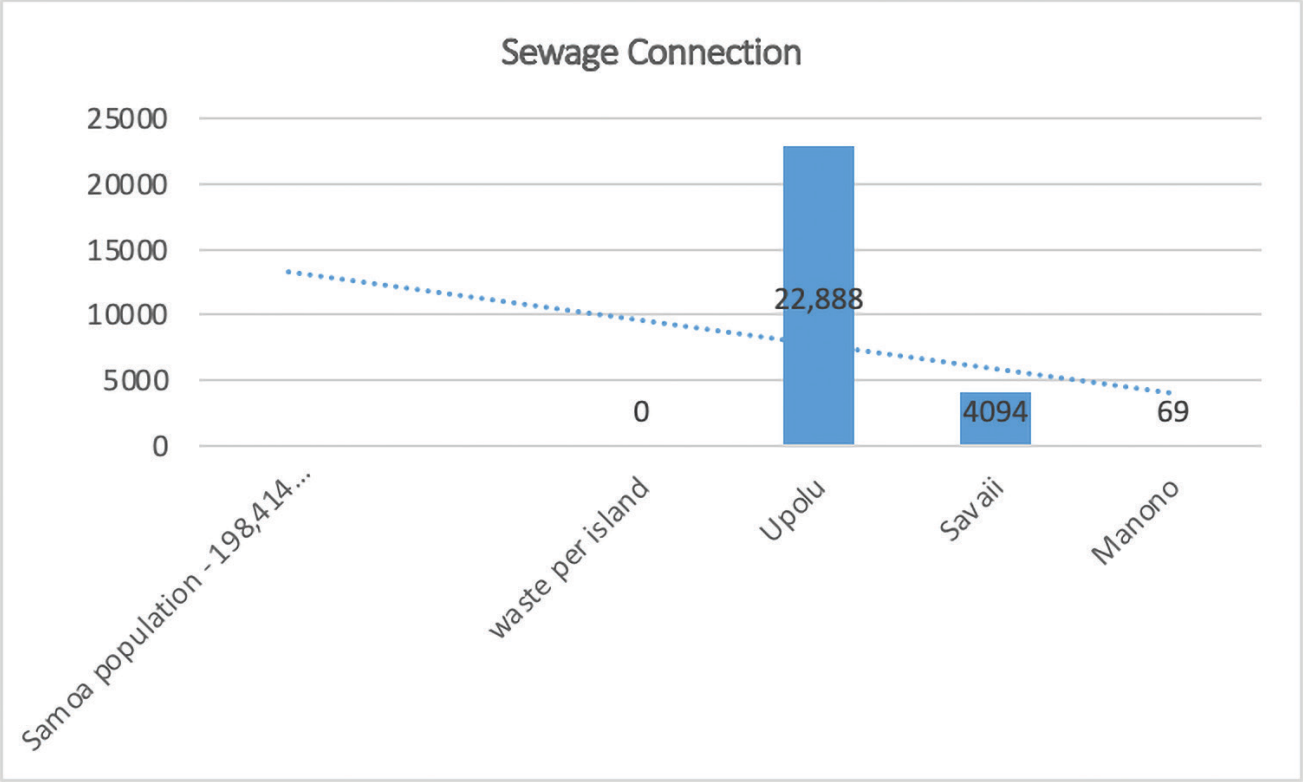


Figure 77: Connections to the sewerage system in Apia Central Business District (MNRE)

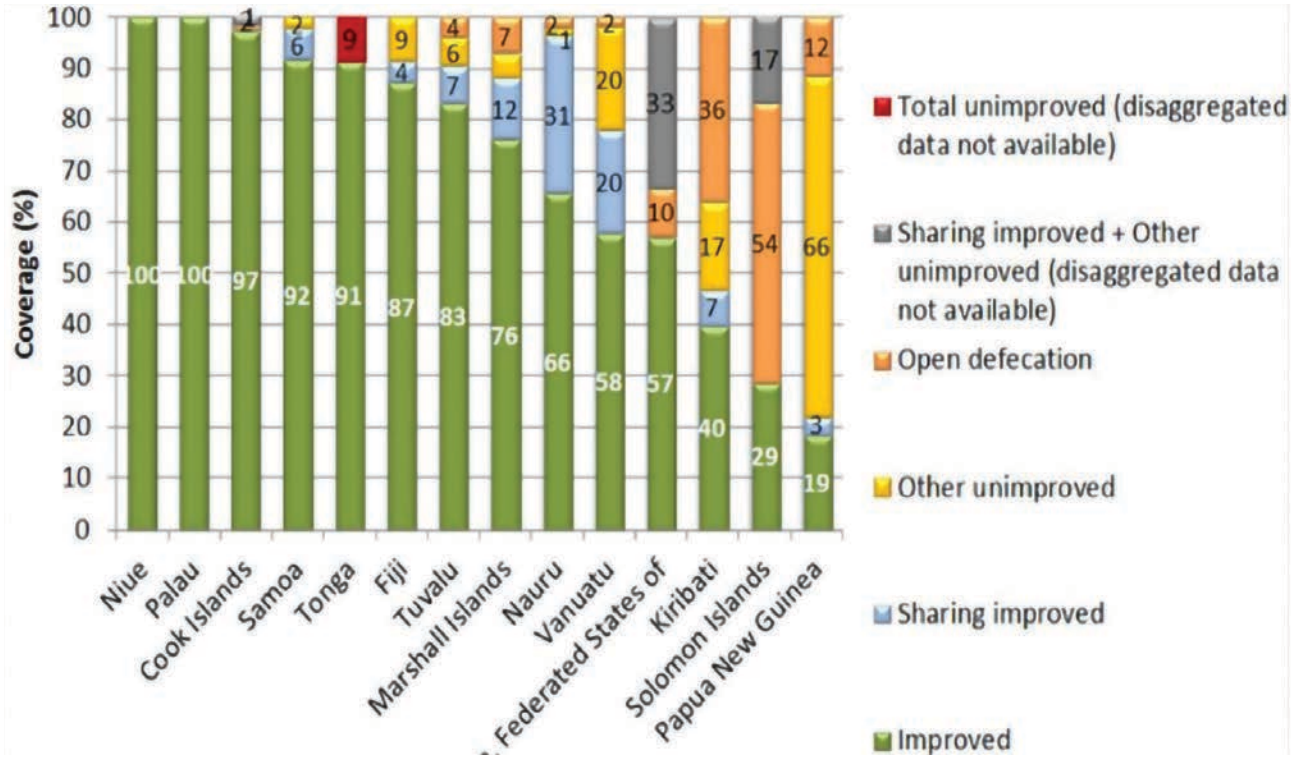


Figure 78: Pacific performance for improved access to sanitation (JMP 2014)

The JMP, given the advent of the SDGs, monitors the progress of regions and countries in meeting targets for 2030 (Figure 78). The same publication referred to above indicates that Samoa, while a leader in the Pacific, is on a trajectory that does not meet the 2020 target for SDG 6.2 Sanitation and Hygiene (Figure 79) (MNRE 2017).

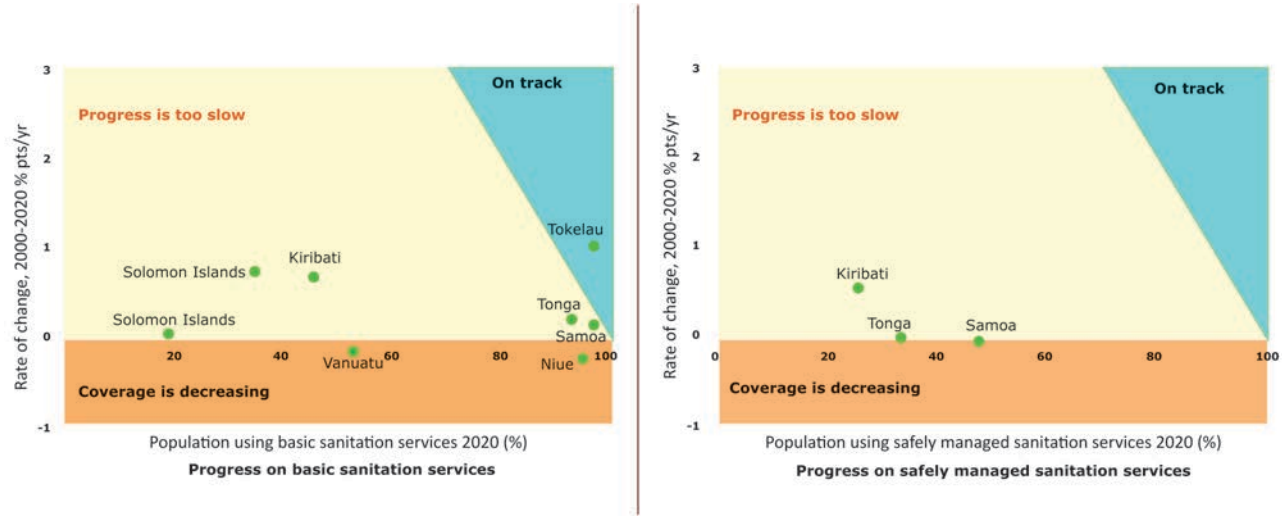
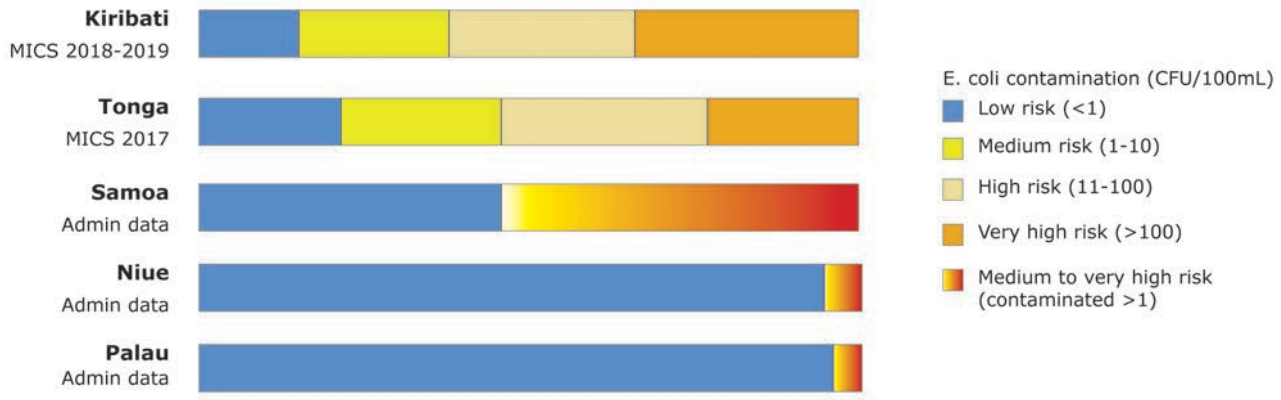


Figure 79: Progress of Pacific Island countries in meeting the 2030 target for SDG 6.2 (JMP 2014)

While Samoa will be slightly below the 100% target to meet the SDG target of universal access to basic sanitation, at just below 50% there is a large deficit in meeting the 100% target of access to safely managed sanitation services. The data shows that only Tokelau is on track to meet the 2030 target of universal access to basic sanitation (100%). Faecal contamination of drinking water is still of great concern for Samoa with risk of E. coli contamination of >1 CFU/100ml being 54% of random samples from households (Figure 80) (2017-2019). This is a medium-high risk determined by UNICEF's Water, Sanitation and Hygiene – WASH Data system (MNRE, 2017).



E. coli risk levels at the point of collection from admin data and slected household surveys 2017-2019

Figure 80: E. coli risk levels at the point of collection from admin data and selected household surveys 2017-2019

Impacts

Poor management of sanitation can often have an adverse impact on people's health. Diarrhoea incidents from mid-2014 to 2015 have shown some improvements in that threshold levels have not been breached, as illustrated in Figure 81 below. Cyclone Evan in late 2012 and the lingering effects in 2013, led to a slight spike in cases. In 2014, more incidents were recorded due to poor hygiene practices with bottle-fed babies and poor weaning and nutrition substitutes. An important contributing factor to some diarrhoea cases is the unregulated use of traditional medicines, especially in treating sick children (MNRE 2017).

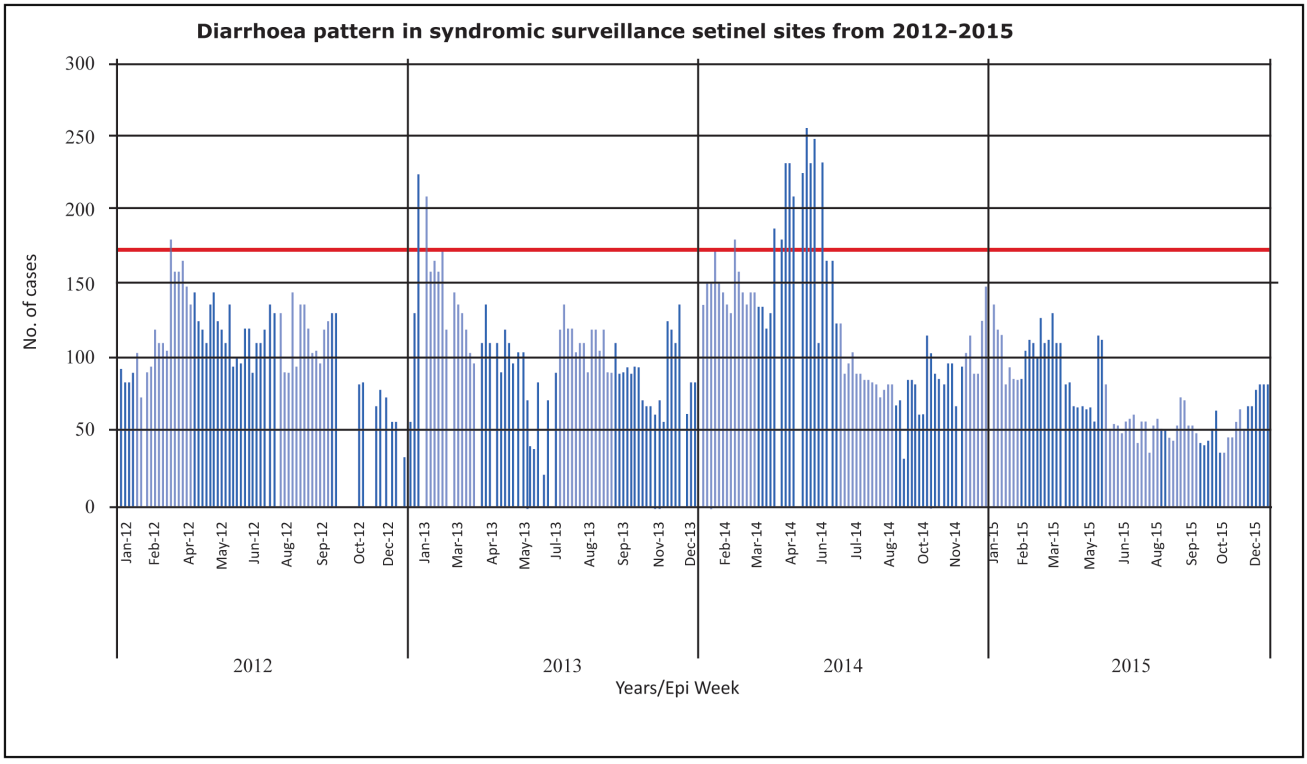


Figure 81: Incidences of diarrhoea in Samoa from 2012 to 2015 (MNRE)

Typhoid fever is endemic in Samoa. The trend of 'Lab positive' Typhoid cases is provided in Figure 82 below.

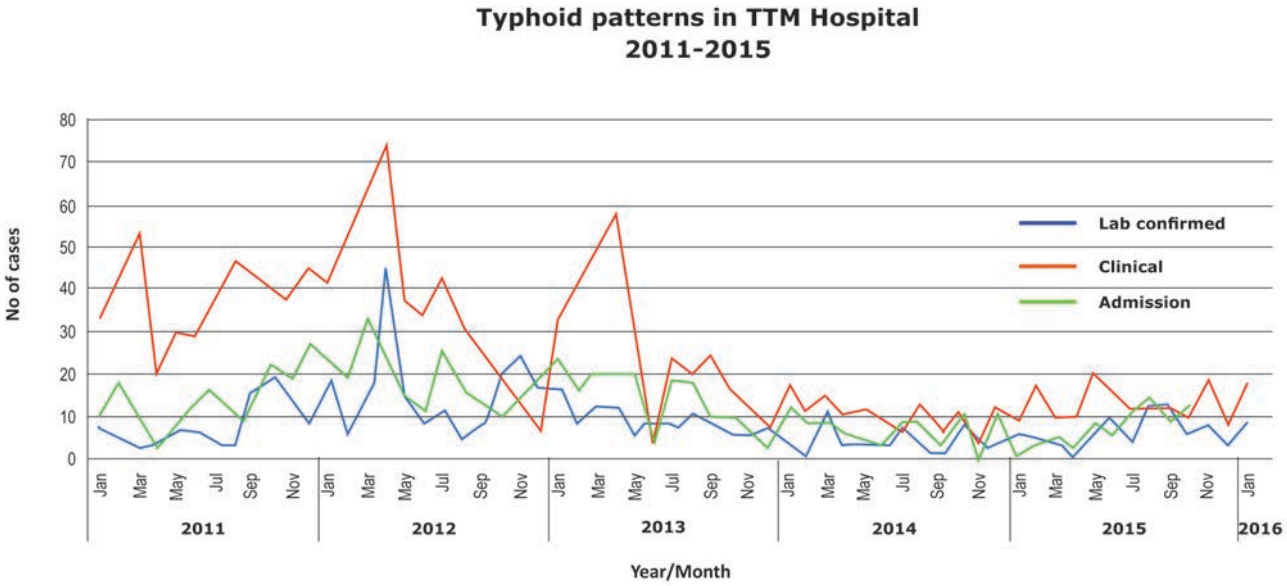


Figure 82: Typhoid cases from 2011 to 2015, as recorded at the TTM Hospital (MNRE)

Response

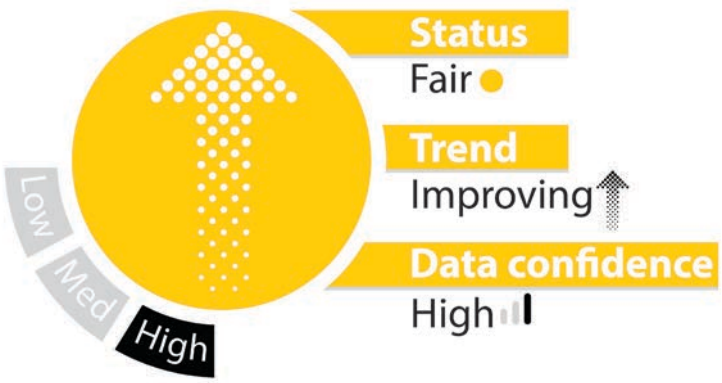
The present plan for Samoa is Water for Life: Water, Sanitation and Hygiene Sector Plan (WaSH) 2020/2021-2024/2025. The key agency responsible for overseeing septic tanks and sewerage systems is the Planning and Urban Management Agency (Sanitation sub-sector). There are also key supporting partners such as MNRE (RED), MWTI (PUMA, Asset Management Division). MWCSD, SWA, PAS and SRCS, that have a role in this sector. The Sanitation and Wastewater Subsector adopted the following medium-term strategies in the 2016-2020 period:

- Improve access to basic sanitation.
- Annual commemoration of the National Sanitation Day.
- School awareness campaign programmes.
- Pacific Adaptation to Climate Change and Resilience building (PACRES).
- Installation and maintenance of garden toilets by Samoa Tourism Authority in Samoa.
- Strengthening the regulatory framework (legal and policy) and compliance.

Recommendations

- Accelerate the implementation of the Water for Life (WaSH) sector plan.
- Assess, improve and maintain sector infrastructures to ensure that they continue to operate and service the nation in a safe and sound manner.
- Review and update national policies, plans and legislative framework to help guide the sector over the coming years. This may include the development of a national plan to climate proof the sector.
- Enhance and build capacity, including securing resources to assist with the implementation of sector plans.
- Raise the awareness of the public and implement educational programmes to encourage water saving and water conservation measures, in order to safeguard and sustainably use water resources.

INDICATOR 18: Potable water management



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	4 6	11 SUSTAINABLE CITIES AND COMMUNITIES	Rio Declaration on Environment and Development	SAMOA Pathway Noumea Convention	• National Water Resources Management Plan (2021-2030) for Samoa (Draft) • Water Authority Act 1993/1994 • Samoa Water Authority Act 2003 • Samoa Water Authority Corporate Plan 2021-2024 • National Water Service Policy 2010 • Samoa national Drinking Water Standard 2016 • Strategy for the Development of Samoa • Samoa Water Resources Management Act 2008

Indicator definition

Trend and the percentage of the population having access to safe and improved drinking water.

Status and Key Findings

Samoa's main water supply is the responsibility of the Samoa Water Authority. The Samoa Water Authority provides reticulated water through a piped network, serving around 89% of Samoa's population (SWA Annual Report 2019-2020). Those not under the Samoa Water Authority system use the independent village water schemes, although increasingly many are being integrated into the national system. Water that is used in the reticulated system comes from rivers (about 75%) and bores (25%), which is treated before it is piped. Water meters have been rolled out since 2012, and have increased at an average of 1,100 per year, from 23,500 in 2012 to about 29,000 in 2017 (SWA Corporate Plan 2021-2024). There are 14 water treatment plants and 45 groundwater boreholes, which are used to service the population.

The most recent Census report found Samoan households accessing various water systems including reticulated piped water, groundwater through borehole and springs, rain water, water truck, bottled water, and rivers and streams. Around 99% of these households access safe drinking water through piped systems, protected springs, tanker trucks, rainwater, water kiosk and bottled water (Figure 83) (SBS 2021).

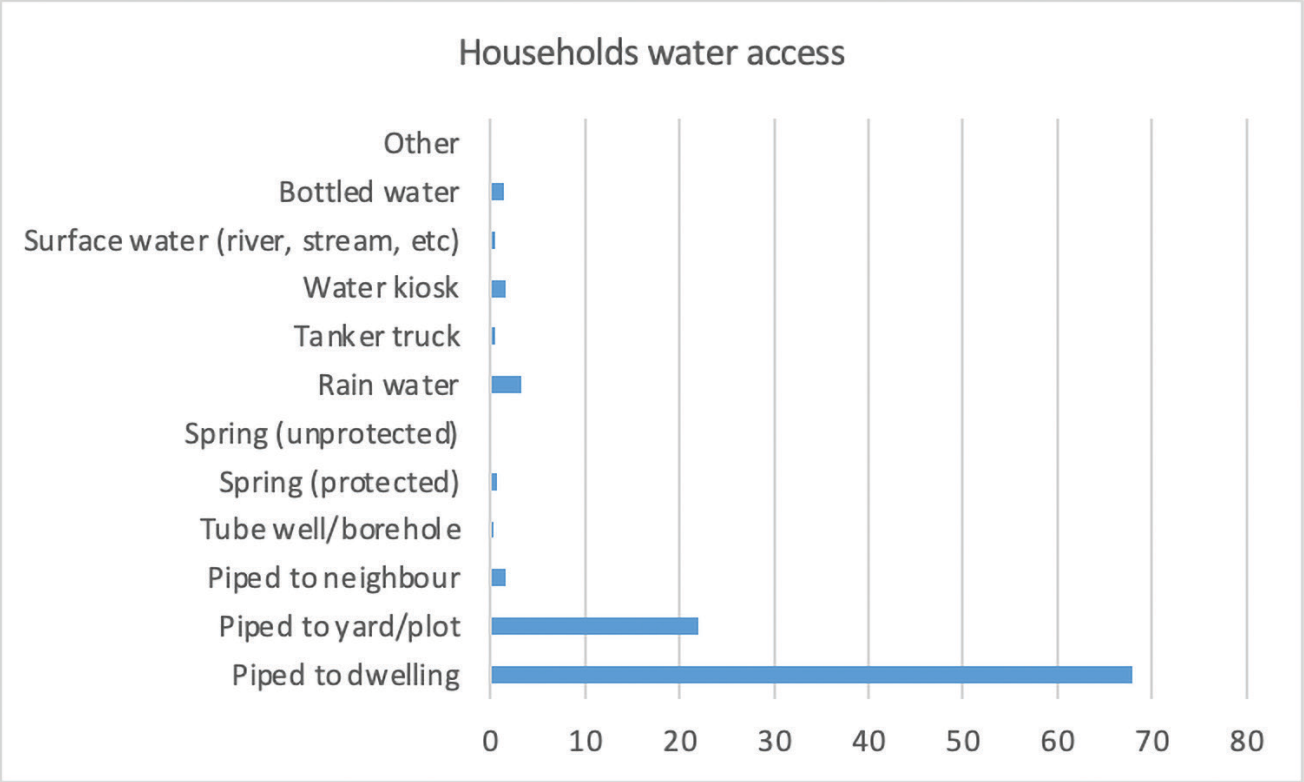


Figure 83: Samoan households' access to water sources (SBS 2021)

Water quality

Samoa's National Drinking Water Standard provides the guidelines that are used by the Samoan Water Authority during the treatment of drinking water. Chlorination is the main treatment used for ensuring the water is safe for consumption.

Impacts

Climate change impacts are contributing to some of the challenges faced by the country in supplying safe water to its population. Specifically, the uncertainty attributed to rainfall and prolonged droughts will likely cause some rivers, that are the main water supplies, to run dry or high in sediment. With encroaching seas and tides, and the threats along the coastal areas, some households are relocating inland, and often on higher ground, which requires extension of the reticulated water system to challenging terrain. Natural disasters are also a threat to the safe supply of water to households.

Another major challenge to safe water supply is the aging piping infrastructure that results in water leakage and loss. The cost to replace the infrastructure is often beyond the national budget, therefore a piecemeal approach is being adopted. A more serious issue is that the original infrastructure is located in private lands, without the benefit of easements. New landowners have presented challenges, demanding compensation for access or removal/relocation of the water mains.

Some of the households are accessing drinking water via springs, boreholes or rivers and streams. This presents a serious health threat, especially due to wastewater contamination. Septic tanks and open pit toilets that are poorly managed have the potential to contaminate ground and surface water.

Response

The Samoa Water Authority has developed its Corporate Plan 2021-2024, identifying strategies to secure and improve water services to the population. These strategies include:

- Community engagement
- Service delivery
- Sustainability
- Integrated water management
- Organisational capacity

The National Water Resources Policy (MNRE 2007) is the main policy framework for the conservation, sustainable use and management of Samoa's water resources. It contains seven objectives covering:

I. knowledge and understanding of water resources (rainfall, recharge, surface water flows, water extraction, and water quality).

II. water resources conservation.

III. protection of water resources using EIA procedures.

IV. maintaining water quality.

V. increasing community awareness.

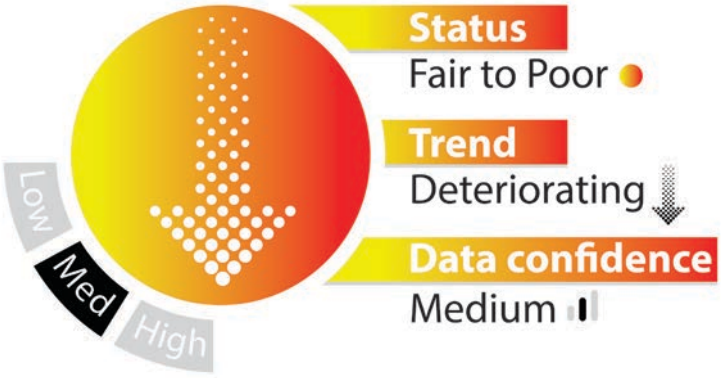
VI. increasing community participation.

VII. controlling allocation.

Recommendations

- There is an urgent need to survey the quantity and assess the state of the groundwater resource, in view of the current level of use. With the unpredictability of weather patterns caused by climate change, this information would allow the relevant agencies to manage the resource in a sustainable manner.
- Improve the current water resource monitoring and assessment programme. This may include enhancing local capacity to undertake monitoring and assessment protocols. Resources will need to be secured to enable the staff to carry out monitoring and assessment protocols.
- Ensure that priority watersheds that are key sources for drinking water to the population are adequately protected and any risks are appropriately managed.
- Water Resources Division, SWA and MoH should agree to a national water quality monitoring programme, collaboratively and cooperatively designed and implemented, enabling optimised sampling to be undertaken and shared across all the agencies.

INDICATOR 19: Apia urban environment



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
			Rio Declaration on Environment and Development	SAMOA Pathway Noumea Convention	• Samoa National Urban Policy (2014) • City Spatial Plan, • City Development Strategy 2015, • Apia Urban Design Standards 2018

Indicator definition

Samoa's only true urban centre is Apia, although Salelologa on Savaii island continues to develop and build its infrastructure and is likely to be the next urbanised environment. The indicator assesses the current state and trend for the Apia Urban Area.

Status and Key Findings

The PUM Act 2004 does not define urban but uses the term "urban" in the context of urban development and urban form. PUMA recognises that urban development pressures extend beyond the current boundaries of villages including the bounds of Apia. Apia is the major urban area on Upolu, and it is significantly larger than Salelologa, the urban area and ferry terminal on the island of Savaii. Apia is the capital of Samoa and the seat of government. It is the centre of industry and commerce for the country as well as being home to over 20% of the country's resident population. It is host to many workers and visitors from outside of the urban area that commute into the city by bus or private vehicles. Apia is the economic and social hub of Samoa. As an intensely developed urban settlement it has the potential for the greatest environmental impacts on the lagoon, reef and other natural systems within its influence. It is historically significant as the site of colonial administration and the genesis of the Mau movement, and it is also culturally significant.

There is a clear population shift in recent years where land is more readily available for acquisition particularly in the districts of Vaimauga East and Faleata West. There are a number of drivers to this shift: strong ecological reasons, coupled with population characteristics, the extent of urban services and infrastructure networks. Some villages, due to their locations, are within the threshold of a proposed regulation that clearly defines the city and urban environment.

Apia Urban Area

The Apia Urban Area (AUA) encompasses four electoral constituencies, including Vaimauga East, Vaimauga West, Faleata East and Faleata West (Figure 84). These constituencies have since been sub-divided into eight districts (Vaimauga 1, Vaimauga 2, Vaimauga 3, Vaimauga 4, Faleata 1, Faleata 2, Faleata 3, and Faleata 4). Recent planning and policy documents have embraced these constituencies as the official boundaries for the AUA. The Census 2021 recognises AUA as comprising Vaimauga 2, 3, 4 and Faleata 1, with the rest (Northwest Upolu, Rest of Upolu and Savaii) considered as rural areas.

The Apia Central Business District (CBD) is the commercial centre of the capital city. This area is demarcated by Fugalei Street on the west, Vaitele St on the south, Faatoia Rd/Vaialavini Rd on the East and the Apia waterfront coast in the north (Figure 85). Central landmark buildings located within the CBD include the Parliament House, the main international seaport, central government headquarters and offices, the main bus terminal, local market centres (fish and vegetables) and the headquarters of all financial banks and commercial services.

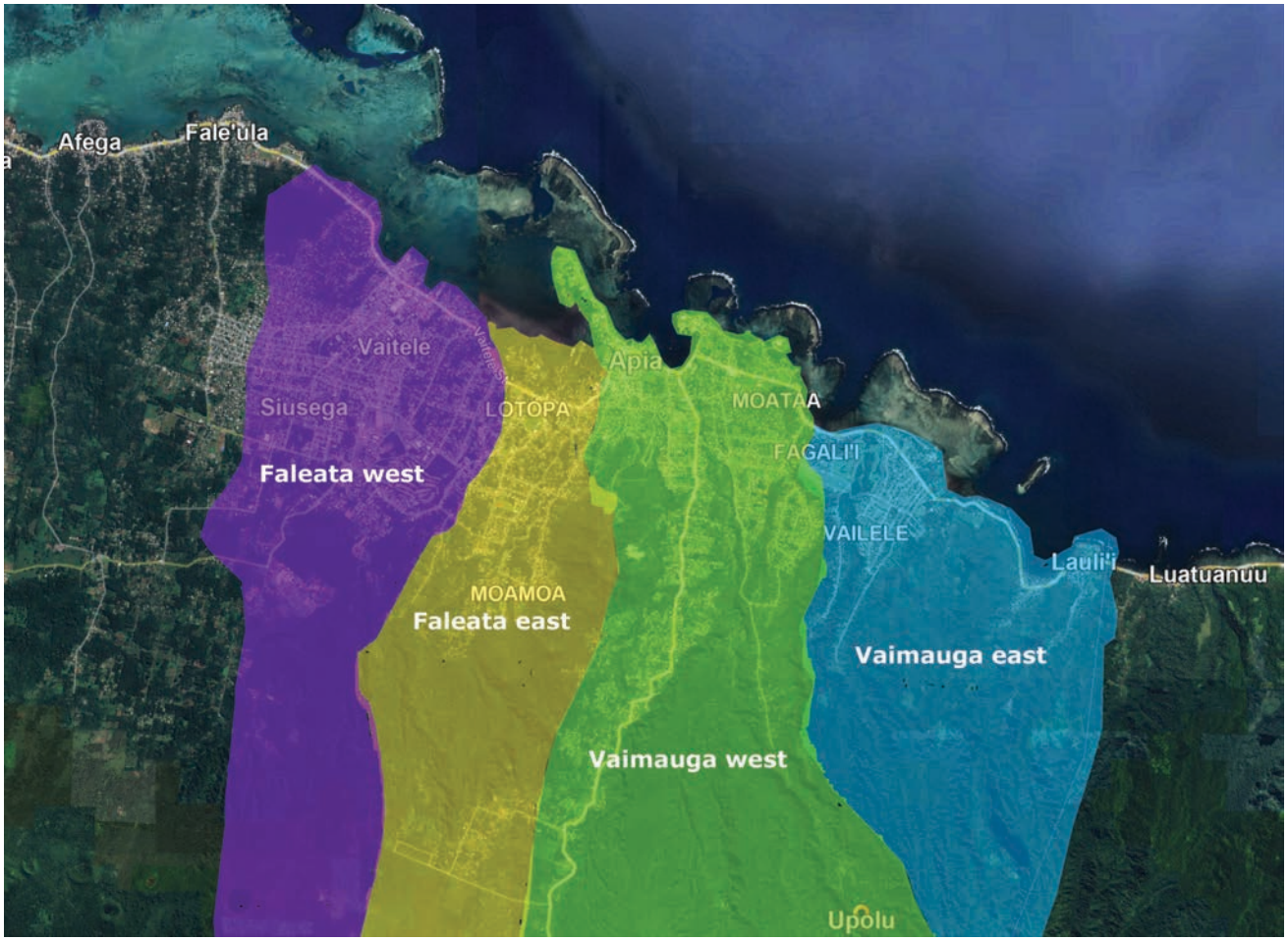


Figure 84: The Apia Urban Area boundaries incorporate the four major electoral constituencies of Vaimauga East, Vaimauga West, Faleata East and Faleata West (MNRE)

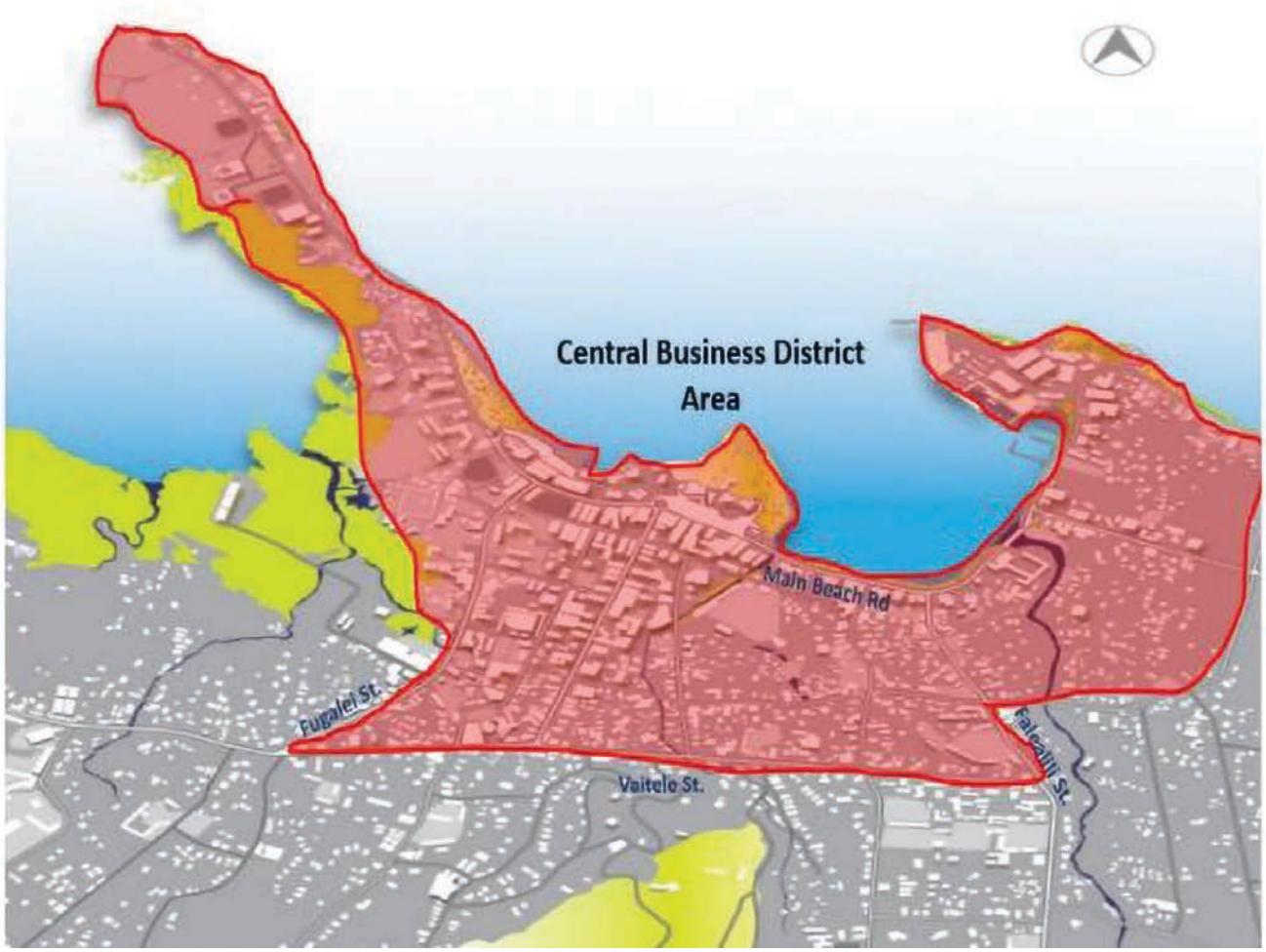


Figure 85: The Apia Central Business District area highlighted in red (MNRE)

The AUA population (35,974) represents around 20% of the total population. In the 2021 Census, this represents a population density of 239 people/km^2 for the AUA compared to 72 people/km^2 for the whole of Samoa. In comparison with other Pacific Island Countries and Territories, Samoa is less densely populated, whereas Apia is similar to that of American Samoa (Table 34). Recent Census data show a population decline (18%) in the Apia Urban Area, with the Northwest Upolu (NWU) gaining most of the growth for Samoa (37%) (Figure 86).

Table 34: Population density of selected Pacific Island Countries and Territories (Worldometers; SBS 2021)

PLACE	LAND SIZE (km^2)	POPULATION	DENSITY (PEOPLE/km^2)
American Samoa	199	54,852	275
Apia	150	35,974	239
Cook Islands	240	17,609	73
Fiji	18,272	935,162	51
French Polynesia	3,521	285,526	81
Kiribati	811	124,798	154
Niue	261	1,657	6
Samoa	2,846	205,557	72
Tonga	747	109,153	146
Vanuatu	12,189	328,567	27

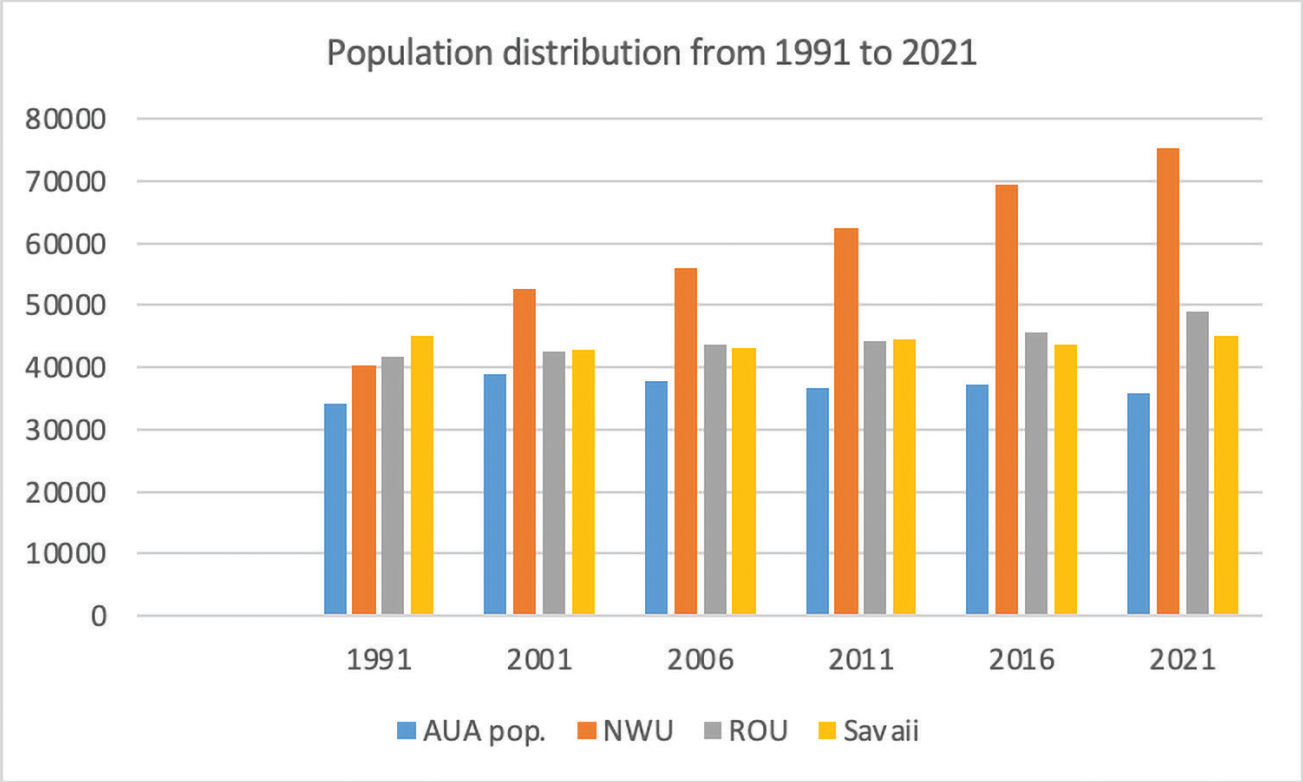


Figure 86: Samoa's population is distributed through the four key regions (AUA – Apia Urban Area; NWU – North West Upolu; ROU – Rest of Upolu)

The AUA covers an area of around 150 km^2, which is 13% of Upolu island, and 5% of the total land area of Samoa. The City Spatial Plan 2014 and the City Development Strategy 2015, noted the rapid population growth towards the western electoral constituencies (Sagaga East, Sagaga West and Aana Alofi 1). The population and urban growth projections are for continued urban expansion towards Faleolo Airport on the northwest corridor. The areas west of Vaitele (Northwest Upolu), are currently attracting a population increase with projections that this will continue. Another area of high growth is south of Vailima, towards the mid-island mountain ridge (Figure 87).

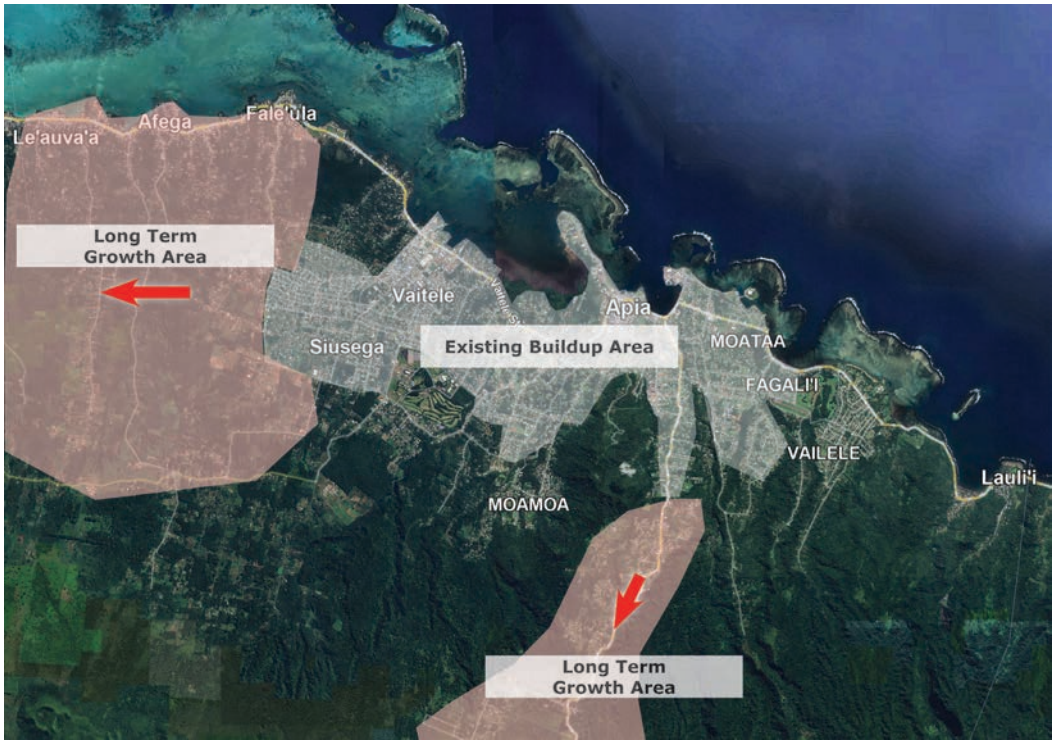


Figure 87: Apia Urban Area showing area of projected population growth (PUMA)

The areas of potential high growth were determined from Census data and trends prior to 2015. Another consideration was that these areas are easier to develop for residential or commercial purposes due to their easy access and flat landscape. Other factors conducive to the projected growth were most of the lands are freehold and the proximity to CBD amenities. In 2021 the projections and forecasts in these plans from 2014 and 2015 were verified with the 2016 and 2021 population Census data recording population growth in these areas and also through physical changes in the land observed in orthophoto maps from Light Detection and Ranging Remote Sensing (LiDAR) surveys in 2018. The areas that were marked as high growth areas from 2014 did in fact show an increase of land cleared, buildings and other signs of development increasing the built environment of the Apia Urban Area.

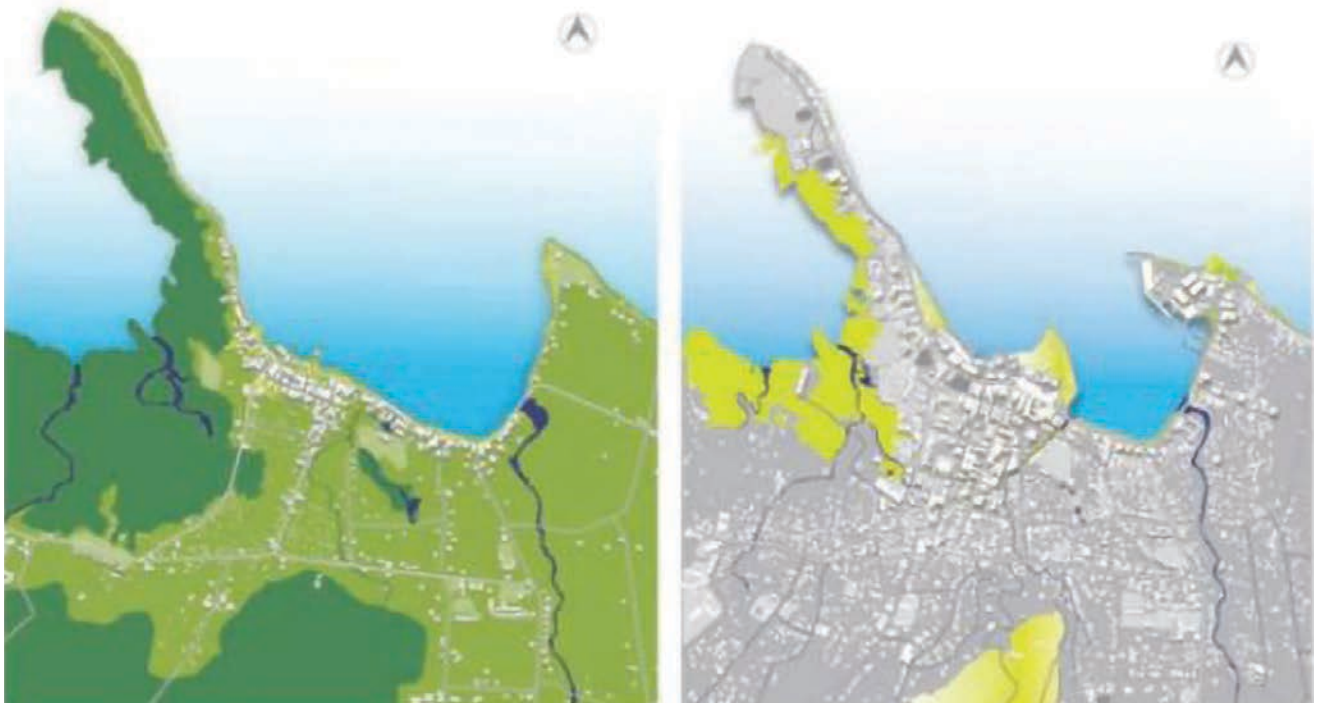


Figure 88: Visual Map of Urban intensification from 1954 to 2010 (PUMA)

Impacts

The Apia urban system is an emerging issue of national concern and presents a substantial challenge. Figure 88 demonstrates the rapid development and settlement changes that have occurred during the last 50 years. Samoa faces a significant urban challenge to improve the current situation and provide strategic long-range direction. Samoa is stepping into the future with various urban management constraints that largely reflect the absence of formal urban planning in the past. Some of the challenges present today include:

- inadequate drainage and waste disposal systems.
- uncontrolled urban sprawl.
- traffic congestion.
- a lack of safe open spaces.
- conflicting land uses.
- poorly planned and maintained infrastructure and buildings.

Response

Efforts to develop an urban plan began with the development of the Downtown Apia Plan in 1972, and later the Apia Town Plan in 1984. The plans identified key issues that continue to be a challenge today. There was no formal planning, or legal framework that would have enabled the implementation of these plans. The enactment of the Planning and Urban Management Act 2004, provides the legal framework to start the process of urban planning and development. Table 35 provides a summary of the planning instruments to help guide developments in Samoa.

Table 35: Planning instruments for Samoa (PUMA)

Planning and Urban Management Act 2004	The Planning and Urban Management Act 2004 is the principal legislation with the purpose to establish a Planning and Urban Management Agency and to implement a framework for planning the use, development, management and protection of land in Samoa in the present and long-term interests of all Samoans and for related purposes.
Planning and Urban Management (Environmental Impact Assessment) Regulations 2007	Regulations for providing guiding principles and standards on Environmental impacts Assessments requirement of the development Consent Process under the Planning and Urban Management Act.
National Urban Policy, 2013	The National Urban Policy provides long-term national level strategic goals to guide the development of Samoa. It's a framework to guide urban development and planning, growth and change. This Policy was developed in 2013 and is approaching its 10-year mark and it's in need for a review and updating.
Apia City Spatial Plan 2014	A Spatial Plan was developed to provide a structure to help address challenges in the development and growth of the Apia City and Apia Urban Area and inform the sustainable development of Apia in the short, medium and long term. The plan provides the main goals that highlight the long-term aspirations of what we would like Apia to grow towards, as well as guiding principles and some initiatives that demonstrate how the goals can be achieved.
Apia City Development Strategy (draft 2015)	The Samoa City Development Strategy (CDS) is a plan that provides a strategic framework for land use planning, development, and environmental management decision-making for the City of Apia. It is intended to provide PUMA and the community with a planning framework to address the future urban development of the city in a manner that is sustainable, provides for a low-carbon future and incorporates both climate change and disaster risk reduction measures.
Apia Urban Design Standards, 2018	The purpose of the Urban Design Standards (UDS) is to set minimum (achievable) standards for developments in Apia. They are intended to be helpful to all interested parties including landowners, developers, designers and government agencies. By adhering to these standards, urban developments will help create a sustainable, resilient and inclusive city, and improve urban conditions for all. As a result, stakeholders will be contributing positively to urban design in Samoa.
Vaitele Sustainable Management Plan	The Vaitele SMP contains land use zones and development standards for the government owned lands of Vaitele. All provisions of the SMP relevant to an individual parcel of land must be complied with before a DC will be granted. A DC is required for both land use and development, unless otherwise stated in the SMP provisions.
National Building Code 2017	National Code providing standards for the design and construction of structures within Samoa.
National Infrastructure Sector Plan	The National Infrastructure Plan (NISP) delineates the Government of Samoa's priorities and strategic directions for major initiatives in the economic infrastructure sector over the next 5-10 years. This focuses on the basic infrastructure facilities that support everyday life and business activity, such as electricity, water, transport and communications. The NISP focuses on priorities for major infrastructure initiatives in the following sectors: • Energy • Telecommunications • Water and Waste related services • Transport

Recommendations

Samoa does not have a national land use zoning plan. This underpins the challenge of effective urban planning due to the lack of guidance on the land and suitable use purpose. Part of the reason for the lack of Land Zoning plans is due to land tenure, as the majority of the land is customary owned. Cultural protocols need to be addressed if this issue is to be resolved. In 2012, a pilot project to develop a land use zoning plan (called a Sustainable Management Plan) for the Vaitele area was launched. This was possible largely due to the fact that most of the Vaitele land is government owned.

A comprehensive land use survey has not been completed for Samoa. The buildings GIS layer (PCRAFI 1999) is one of the available spatial data on existing land use particularly in the Apia Urban Area as the relational database indicates a 'use' for each building. However, it is now 20 years old, and it does not cover the whole of Samoa and does not include many new buildings including significant changes about the coastal hazard areas. It also does not pick up the multi-use of buildings that often occurs. A more updated, extensive survey on current land uses as well as building uses is much needed, and this information will greatly assist with environmental and development planning in Samoa. It will also give accurate land use data that will enable planners to determine the patterns of use, which will also give a better idea on resolutions that will help stimulate sustainable growth whilst reducing the impacts on the natural, built, social and economic environments.

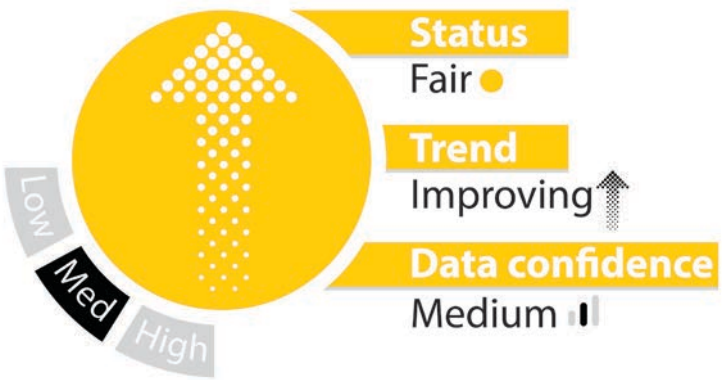
The land use surveys should identify at least the following:

- Location, size of land parcel, types of uses,
- site coverage (i.e. age of buildings (estimate),
- eight of buildings (single or double storey),
- form of building (basic metal, prefabricated, masonry, etc.),
- condition of building (informal structure, solid construction, etc.)
- interface/risk issues (e.g. whether on steep land, in waterway flood plains)
- interface issues, building form/type and site cover.

This information can be documented in a database that can be linked with the GIS system. Such information will enable better characterisation of the hazards, vulnerabilities, and levels of risk, which have now been collated in the PPCR database. Additional processing of the LiDAR data will enable the update of the Buildings GIS layer – a major gap for the PPCR ECR project.

An eventual validated land use plan for villages will reveal current encumbrances to development and make 'risk' areas more immediately identifiable. The precedents of development form against risks and constraints can also be noted. For instance, with flood modelling known flood-prone land and waterways can be mapped against known land use, buildings, infrastructure, easements, structures and known habitation.

INDICATOR 20: Environmental compliance and monitoring



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	4 6	2 ZERO HUNGER 6 CLEAN WATER AND SANITATION 7 AFFORDABLE AND CLEAN ENERGY 11 SUSTAINABLE CITIES AND COMMUNITIES 12 RESPONSIBLE CONSUMPTION AND PRODUCTION 13 CLIMATE ACTION 14 LIFE BELOW WATER 15 LIFE ON LAND	Rio Declaration on Environment and Development	SAMOA Pathway Noumea Convention	• Planning and Urban Management Act • Environmental Impact Assessment Regulations 2007

Indicator definition

Any development work that has the potential to impact the environment requires the oversight of the relevant government authority. This is to ensure that any adverse impacts to the environment and to the health of the people are minimised. This indicator assesses the trend in the management of environmental issues raised by the public in response to developments.

Status and Key Findings

There are a number of government departments that deal with complaints regarding activities that may impact the environment, or the health of the people.

- Ministry of Works, Transport and Infrastructure - Planning and Urban Management Agency (PUMA).
- Ministry of Natural Resources and Environment - Land Management (Land Development Section).
- Ministry of Commerce Industry and Labour - Occupational Health and Safety division.
- Ministry of Health.

The most relevant from the State of Environment perspective are the two sections under PUMA: Urban Management Section, and the Compliance, Monitoring and Enforcement Section.

Urban Management Section (UMS)

The UMS receives complaints from the public regarding the possible threats to the environment of an area, which may generate health risks and concerns. Some of the risks include foul odours, excessive noise, and faulty septic tanks and soak pits, fumes from illegal burning of rubbish, dust and others. Data from 2013 to 2022 provide a mixed trend with regards to managing and resolving complaints (Figure 89). Some of the complaints were withdrawn or were unconfirmed, whereas over 80% of the complaints were resolved. The years 2014-2016 and 2017-2018, were the best for the UMS with over 90% of complaints being resolved. Most of the complaints are resolved almost immediately, whereas others take time to find a resolution. A number of stop-orders were issued, mostly from 2016 to 2021 with an average of five per annum (Figure 90).

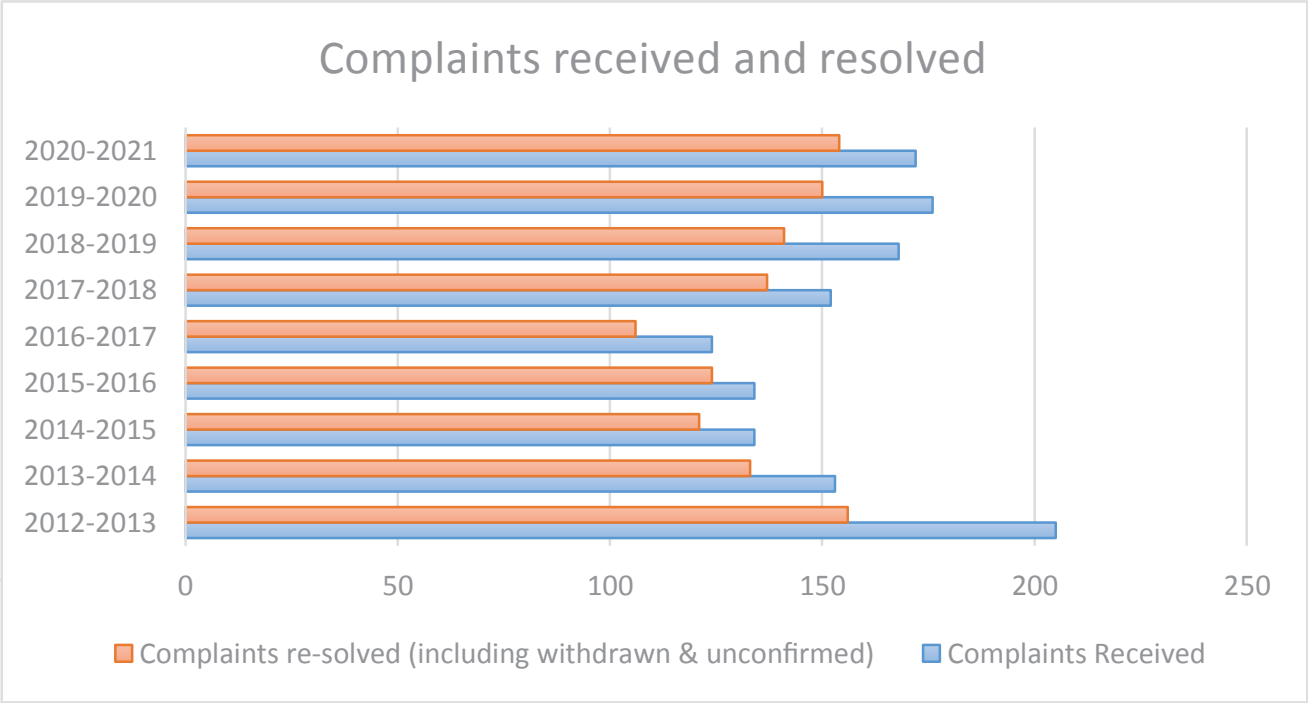


Figure 89: Number of complaints received and resolved from 2012 to 2021 (PUMA)

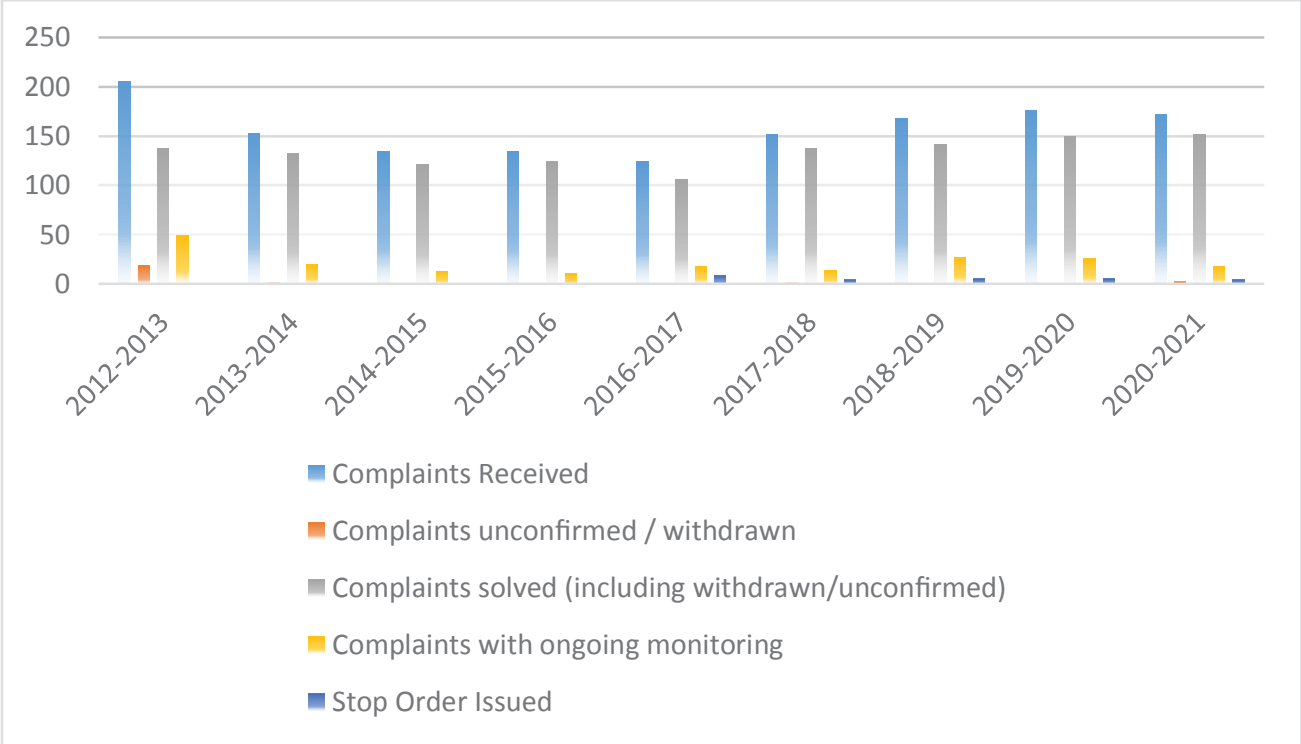


Figure 90: Complaints received and categorised by the Urban Management Section of PUMA for the years 2012-2021 (PUMA)

The number of complaints received has remained steady at just over 157 per year from 2012 to 2021. The highest number of complaints received was in the 2012-2013 period with 205. The number of complaints being resolved over the 2012-2021 period continued to trend positively with on average 133 complaints resolved per annum, or around 85% on average. Complaints that remained to be resolved continue to trend downwards (Figure 91).

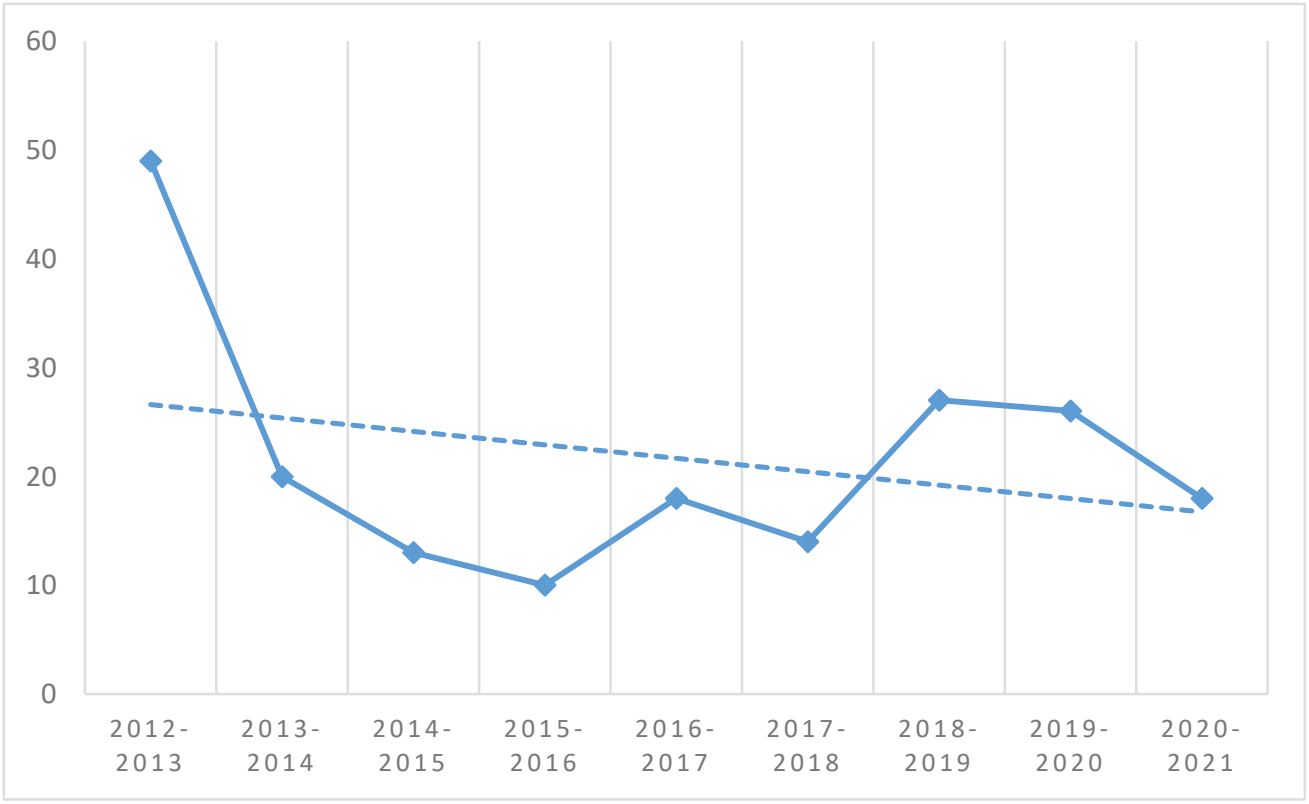


Figure 91: Ongoing monitoring of complaints for the period 2012-2021 (UMS)

Compliance, Monitoring and Enforcement Section (CME)

One of the key roles for the CME section is to ensure that the public apply for a development consent (DC) before they can commence their development work or activity. The other important responsibility of the CME is to ensure that the work is carried out in accordance with any conditions or requirements as per the DC approval. The CME also investigates any concerns raised by the public directly in relation to any projects that have been granted a DC. The increasing volume of inquiries from the public, necessitated the need to invest more capacity in the section. An Enforcement Order (or Stop Order), is issued immediately if a development work is found to have breached the conditions of its DC. The proponent of the project is required to take remedial actions to resolve the issue, or further legal actions are imposed.

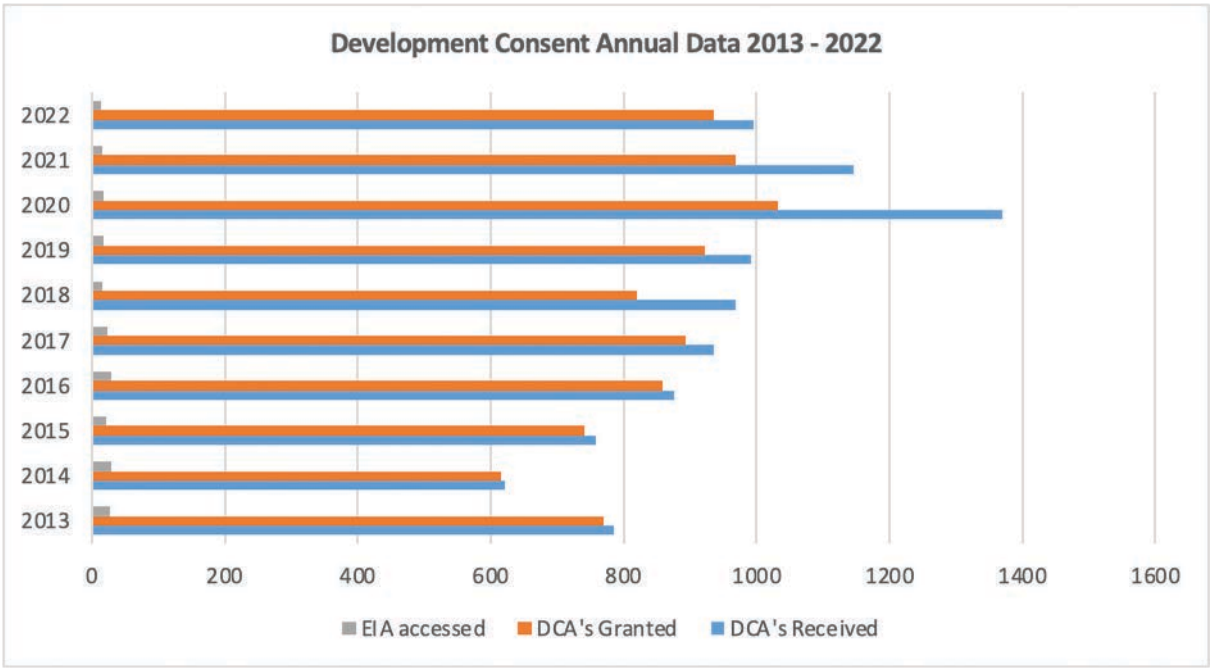


Figure 92: Summary of Development Consent for the year 2013 to 2022 (Agency Data)

The number of DC applications received varies from year to year, but can reach over 1000 in a year (Figure 93). The period 2013 to 2022 showed a high increase in DC applications compared to the previous 10-year period (2003-2012). A big part of the reason for the increase was due to public awareness of the law, and the requirement to obtain a DC before work can start. The number of DC applications recorded does not reflect the actual number of project developments being undertaken. The challenge remains in reaching many rural areas (especially in Savaii, Manono and Apolima islands), where the work is carried out without a development consent being granted.

Most DC applications are assessed and granted; however, some require further assessment by other government agencies. About 92% of DC applications are approved per annum. The 2020-2021 period, however, saw a lower number of DC applications being approved (75%), and this was attributed to health epidemics, measles and then COVID-19, that led to national restrictions in movement. With the adverse impact on the local economy, many projects were deferred indefinitely.

MNRE is one of the government agencies that assists with assessing DC applications. In the 2020-2021 period, MNRE received 23 DC applications for assessment, of which 10 were required to provide a preliminary environmental assessment report (PEAR), four applications to provide an Environmental and Social Impact Assessment report (ESIA), and seven required to provide an Environmental Management Plan (EMP), and two requiring design plans (MNRE 2020-2021).

An environmental impact assessment (EIA) is required if the agency assesses that a DC application will likely have an impact on the environment or the health of the people. All EIAs are governed under the PUMA Environmental Impact Assessment Regulations 2007. There are two levels of EIAs: the first is a Comprehensive Environment Assessment Report (CEAR) and the second is a Preliminary Environment Assess Report (PEAR). Only a small proportion of DC applications require an EIA (around 2.4%).

The number of complaints received due to DC not being followed varied over the past 10 years (Table 36) (Figure 93). For the years 2014 – 2016, low numbers of Enforcement Orders were recorded. The reasons may include low capacity due to high staff turnover, lack of resources, especially fuel and vehicles, and management. The number of Enforcement Orders increased from 2017 reaching a high of 497 in 2020-2021 period. This was attributed to Compliance, Monitoring and Enforcement becoming an established section, thereby increasing its capacity and resources. A total of 497 Enforcement Orders were issued within the FY 21/22 period. The highest number of orders were issued in February 2021 with a total of 114 Stop Orders. The least of which is April during the COVID-19 lockdown State of Emergency period.

Table 36: Development complaints received, resolved and enforcement orders issued from 2012-2021 (PUMA)

	DEVELOPMENT COMPLAINTS RECEIVED	DEVELOPMENT COMPLAINTS RESOLVED	ENFORCEMENT ORDERS
2012-2013	0	0	174
2013-2014	0	0	184
2014-2015	60	52	20
2015-2016	73	16	6
2016-2017	80	53	13
2017-2018	145	35	94
2018-2019	114	15	70
2019-2020	112	0	172
2020-2021	143	0	497

	DEVELOPMENT COMPLAINTS RECEIVED	DEVELOPMENT COMPLAINTS RESOLVED	ENFORCEMENT ORDERS
2012-2013	0	0	174
2013-2014	0	0	184
2014-2015	60	52	20
2015-2016	73	16	6
2016-2017	80	53	13
2017-2018	145	35	94
2018-2019	114	15	70
2019-2020	112	0	172
2020-2021	143	0	497

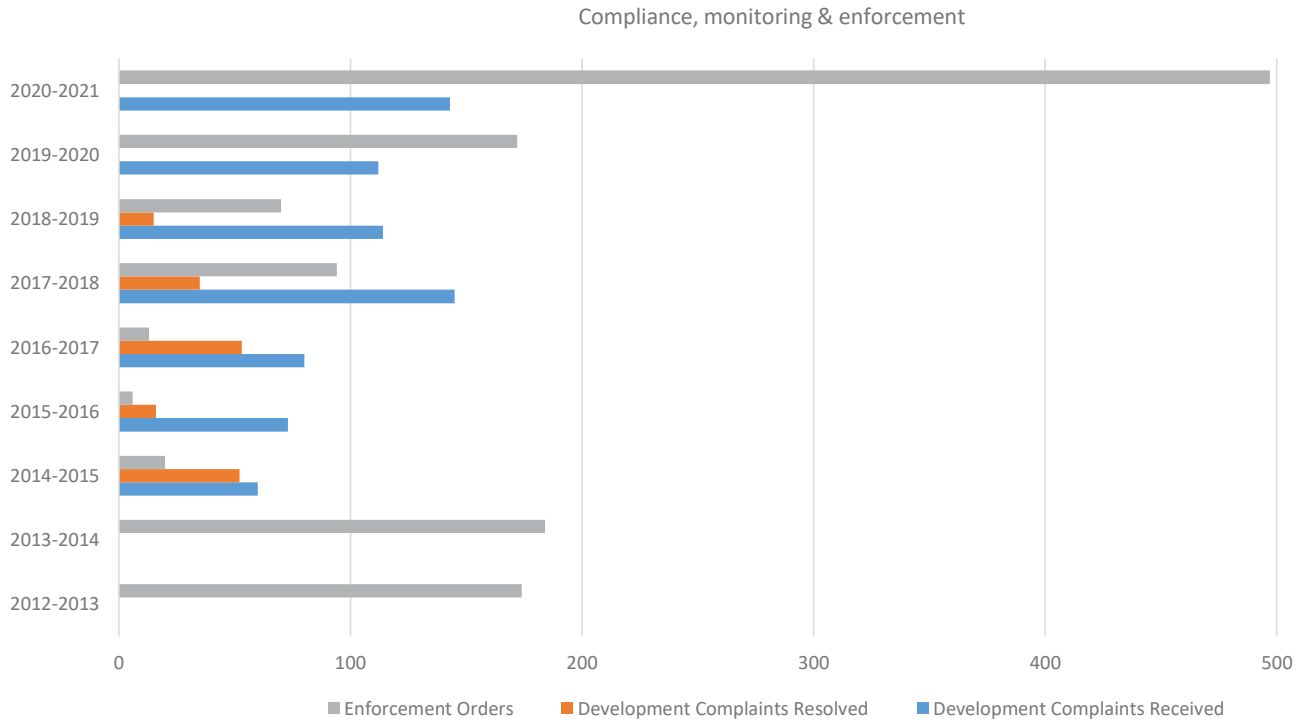


Figure 93: Compliance, Monitoring and Enforcement Data for 2012-2021 (PUMA)

Impacts

The existence of such regulatory and enforcement powers under the PUM Act 2004 clearly provides a much-needed platform to assess and monitor the impacts created by new developments on the environment and society. PUMA has received numerous complaints over the past ten years all in which the agency has attempted to the best of its ability to resolve and minimise any/all impacts to the environment and people. Due to the shortage of human and other resources, it is difficult to ensure all development complaints as well as non-compliance issues are completely covered and resolved in a timely and effective manner.

The existing legislation provides the framework to assess development projects. The challenge with the current framework is the capacity to implement the legislation. The lack of proper EIAs can have adverse impacts on the environment and to the wellbeing of the people.

Response

The Planning and Urban Management Act 2004 provides the legal support to oversee development, management and protection of Samoa's environment and people. In particular, the Act provides for the sustainable use, development and management of land, including the protection of natural resources and the maintenance of ecological processes and genetic diversity. The Act enables the establishment of the Planning and Urban Management Agency, and a Board. Development consent and environmental impact assessments are also important components of the Act.

One of the activities by a local non-governmental organisation, the Samoa Conservation Society, is conducting energy and carbon audits, and assisting organisations to offset their carbon emissions (Atherton pers. comm. 2023).

Recommendations

The ability to respond and resolve possible environmental infringements is largely dependent on the workforce and the provision of adequate resources. The data being collected are as good as the capacity and the capability of the responsible agency. There were years when complaints were low which, unfortunately, was attributed to insufficient staffing and resources, rather than development proponents doing the right thing. To address such shortcomings the following are recommended:

- Provide the necessary resources including adequate financing of the agency to allow them to fully implement the intention of the legislation (PUM Act 2004).
- Build the capacity of staff and ensure that there are sufficient personnel to successfully implement the agency's responsibilities.
- The current process under the legislation is arduous and it does not deter non-compliance. A review of the legislation is needed to strengthen compliance and enforcement. Tougher penalties may be needed to discourage non-compliance.
- The restructuring of the PUMA Agency has been disruptive and has affected its operation, and staff morale. For example, the PUMA Agency has changed ministries four times since it was established in 2002. Some permanency is needed to allow the PUMA Agency to consolidate its base and strengthen its capacity.

References (Built Environment)

ADB (2013). Solid Waste Management in the Pacific. Samoa Country Snapshot. © Asian Development Bank Publication Stock No. ARM146613-2. www.adb.org/Samoa. 4p.

Climate Change Knowledge Portal. 2023 (accessed). Country – Samoa.

MNR (2017). Water and Sanitation Sector Plan: Framework for Action 2016 – 2020, Ministry of Natural Resources and Environment, Government of Samoa, May 2017.

MNRE (2020-2021). Annual Report 2020-2021. Ministry of Natural Resources and Environment. Apia, Samoa. 85p.

MNRE (2019). National Waste Management Strategy 2019–2023. Ministry of Natural Resources and Environment. Government of Samoa.

NRE (2014). Used Oil Management Plan for Samoa. Apia, Samoa. 38p.

PacWaste (2015). Survey of the Regional Distribution and Status of Asbestos-Contaminated Construction Material and Best Practice Options for its management in Pacific Island Countries. Report for the independent state of Samoa. Secretariat of the Pacific Regional Environment Programme. Apia, Samoa. 86p.

Samoa Waste Characterization and Situation Analysis Report, Asia Pacific Water Consultants for World Bank, September 2021

SPREP (2013). Cost-benefit analysis of used oil management options for Samoa. Apia: SPREP.

SWA (2019-2020). Samoa Water Authority Annual Report. 43p.

SWA (2021-2024). Samoa Water Authority Corporate Plan 2021-2024. 29p.

The World Bank (2020). Samoa Waste Audit Report – Analysis of 2020 Waste Generation and Disposal Data. Summary based on a report prepared by the Asia Pacific Waste Consultants. 4p.

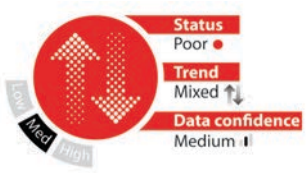
The World Bank (2021). Samoa Waste Characterization and Situation Analysis Report, Asia Pacific Water Consultants for World Bank, September 2021. 132p.

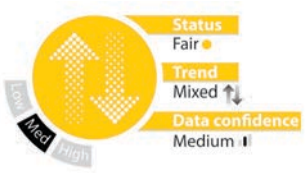
Theme 3: Atmosphere, Climate and Disaster Management

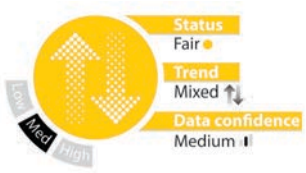
Overview and Highlights

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
GreenHouse Gas emission		It is crucial to recognize the concerning trend in Samoa's greenhouse gas (GHG) emissions over the last decade (2010-2020), which has been from fair to poor. GHG emissions increased by 17% during this period, mainly driven by the energy sector. Although there was a noticeable decrease from 2019 to 2020, emissions still surpass the 2010 level. Conversely, emissions from the Industrial Processes and Product Use (IPPU) sector were apparent in 2019, whereas emissions from the Agriculture, Forestry, and Other Land Use (AFOLU) sector declined since 2015, falling below the 2010 emission level.	National climate change policy 2020 provides strategic coordination on actions to combat climate change. The nationally determined contributions outlined Samoa's commitment to reduce GHG emissions by 2030. A National Inventory Database on GHG has been completed. To address Samoa's concerning greenhouse gas emissions trend, it's crucial to prioritize renewable energy adoption, implement stringent energy efficiency measures, and enforce regulatory frameworks. Investing in reforestation and sustainable agriculture, raising public awareness, fostering international cooperation, and developing adaptation strategies are also essential. These multifaceted approaches can collectively mitigate emissions and enhance resilience against climate change impacts. *Greater collaboration and institutional coordination are needed to ensure that data and information needs are shared to allow for a comprehensive development of national reports and advice for all government sectors.* *Explore efforts to reduce GHG emissions, especially at the energy and waste sectors.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Consumption of ozone depletion substances		Samoa began phasing out the importation and use of HCFC since the global agreement was reached in 2013. A 10% reduction in ODS reduction (HCFC) was achieved for Samoa in 2015, and an additional 35% in 2020. The projection is for all ODS HCFC to be eliminated by 2040. HFC emissions have risen since 2000 and represent a significant source of GHG emissions for the country.	Samoa has fulfilled some key obligations under the Montreal Protocol, relating to the control of ODS and keeping within the allowable consumption. According to the 2021 annual consumption report 97% of the HCFC baseline was phased out in 2021, this is well within the allowable consumption for Samoa. HFC is another important target for Samoa and efforts to phase down HFC have started, especially with data collecting.
Energy and renewables		Energy accounts for 2016 and 2020 have been completed. Energy sources come from imported fossil fuel (70%) and natural sources (30%). Samoa's total energy supply was 5281.8 TJ in 2020. Energy use was estimated at 4853.5 TJ highlighting energy loss of 428.3 TJ. Households are the largest consumer of energy, followed by industry. Renewable energy continues to increase in outputs, towards the national grid. A national target of 70% renewable sources into the national grid by 2031, is achievable if efforts to maintain energy output remain at a rate of 2-3% per annum.	Energy Management Act 2020 has been enacted providing the national framework for cooperation and collaboration amongst the various sectors. While renewable energy falls under the responsibility of MNRE, the legislation identifies the Electrical Power Corporation as a key stakeholder in the renewable energy mission. To achieve Samoa's goal of 70% renewable energy by 2031, a concerted effort to increase investment in renewable infrastructure, implementing supportive policies and investing in research and development must be vigorously pursued. Capacity-building programs, public awareness campaigns, and partnerships with international stakeholders can further accelerate progress. Additionally, upgrading the national grid and diversifying renewable sources are essential steps. Monitoring and evaluation mechanisms will ensure effective tracking of progress towards targets. Through these measures, Samoa can advance towards a more sustainable energy future while reducing dependence on fossil fuels. *Undertake regular energy audits* *Promote energy efficiency and conservation at the village and business levels.*

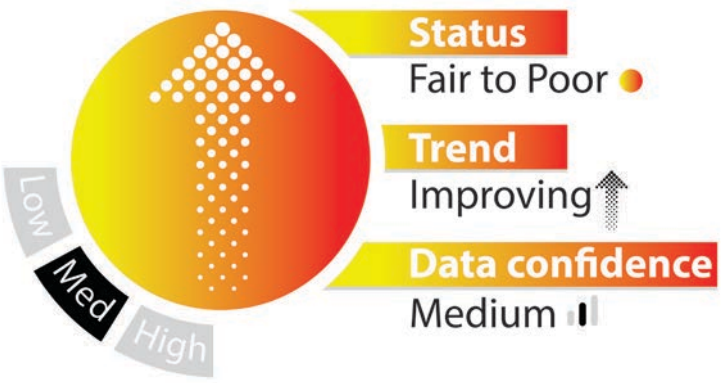
INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Physical climate trends • Temperature • Rainfall • Ocean acidification • Sea level rise		Global temperatures continue to rise. Weather patterns are erratic and extreme conditions are increasing. Samoa's mean annual temperature has increased by 0.59oC over a century of data. Maximum temperatures have increased by 0.67oC and minimum temperatures increased by 0.18oC. Samoa's annual rainfall ranges from 2000-7000 mm. The north-west coast of Upolu and Savaii receives less rain (2000-3000 mm) compared to the rest of the country. Rainfall mean has increased slightly. Projections for Samoa's rainfall remain unclear. Ocean acidification is increasing in many parts of the world due to increased carbon in the atmosphere and ocean. The impacts of acidification on Samoa's marine environment is concerning. Ocean acidification data for Samoa are at its infancy. Sea level rise for Samoa is at 5.2 mm per annum. Projections are for Samoa's sea level rise to reach 70-170 mm by the year 2030, and 400-870 by 2090.	Samoa has completed a national vulnerability assessment report as part of the country's adaptation program of action. Vulnerable sectors to climate change and sea level rise were prioritised for action. Coastal communities are responding to the threat of sea level rise and are relocating assets and homes to inland areas. Some communities are planting mangroves and declaring protected areas to help reduce the impact of storm surges to their homes. *Adaptation provides a good solution to try and mitigate the threat caused by climate change. Adaptation includes more open space and landscaping in villages and urban environments, shading and softening of hard surfaces. Using hard and soft options for coastal protection should consider the coastal geomorphology and tidal flows.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Natural disasters • Climate driven disasters • Earth driven disasters (natural geotechnical hazards) • Preparedness for Disasters and Emergencies		As the planet continues to warm, the associated and unprecedented weather extremes will lead to disasters with devastating impacts on the environment, the economy and the people. From 2000 to 2010 was one of the most deadly and costly decades for Samoa due to natural disasters. SAT 5,211 million was the economic loss and 155 lives lost. From 2013-2023, the number of climate change driven natural disasters was low, and so was the impact. The estimated economic loss was SAT 93 million, with no lives lost. Geo-hazard disasters are caused by natural geological processes that when combined with human activities can result in environmental degradation and loss of infrastructure. The biggest geo-hazard disasters to affect Samoa in recent times was the 2009 tsunami that was triggered by an 8.1 magnitude earthquake. The tsunami caused 34 deaths, affected 5,300 people and damages estimated at USD 200 million. Coastal erosion is exacerbated by climate change, human activities and geological processes. Building of seawalls in response to coastal erosion has resulted in further problems in other parts of the coastline. Landslides and rockfalls are also serious disasters that are exacerbated by human activities. Samoa's preparedness and planning involves engagement with villages and developing community disaster and climate risk management programmes.	For all natural disasters the Meteorology Office issues the warnings, whereas the Disaster Management Office coordinates the response at the national level with the Disaster Advisory Committee (DAC). A number of policies and legislation have been developed to address and mitigate against climate change and disasters including the National climate Change Policy, Disaster and Emergency Management Act 2007, and the National Management Plan 2017-2020 *National coordination is critical prior to, during and post disaster events.* *Monitoring and assessing data provide information and knowledge to inform policy and management responses.* *Adaptation and mitigation measures require adaptive management, given the nature of information and knowledge being driven by modelling and technical processes.* *Funding continues to be an important part of the national response to climate change impacts.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Climate adaptation and mitigation		National consultations that focused on various sectors such as agriculture, forestry and fisheries were completed. Investment in adaptation and mitigation totals around USD 59 million over the past 11 years, or around USD 5.3 million per annum. Many other projects relating to climate change adaptation and mitigation are not captured under the government database, but are carried out by civil society and other agencies.	National response to climate change adaptation and mitigation including the Samoa Climate Change Policy and the National Adaptation Programme of Action. *National coordination is critical in climate change adaptation and mitigation measures.* *Adopting a holistic approach in adaptation and mitigation to climate change, could include better land use planning, ecosystem-based resource management and ridge to reef.* *Adequate funding is needed to support adaptation and mitigation measures.* *Community engagement is important, as is empowering communities to undertake local actions such as rehabilitating mangrove sites and establishing marine protected areas to mitigate against rising sea level and storm surges.*

The vulnerability of Samoa is an interplay of factors such as remoteness, vulnerability to natural disasters, ecological fragility, and high degree of economic stress, small internal markets and limited natural resources. According to the World Bank, Samoa is ranked 30th of countries most exposed to three or more hazards (GOS 2012).

INDICATOR 21: Greenhouse Gas emissions



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8, 10, 15	7 AFFORDABLE AND CLEAN ENERGY; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER	United Nations Framework Convention on Climate Change Cartagena Dialogue	SAMOA Pathway	• Samoa Climate Change Policy 2020-2030 • Samoa Ocean Strategy 2019-2029 • Nationally Determined Contribu-tions Enhancement 2020-2025 • Climate Change Bill • National Greenhouse Gas Abatement Strategy 2007-2017

Indicator definition

The earth's greenhouse is essential for life on Earth, by helping to regulate the temperature, making it habitable for life on earth. The greenhouse is made up of several gasses, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3), which together create the greenhouse effect.

Acronyms:

AFOLU	Agriculture, Forestry, Other Land Use
GHG	Greenhouse Gas
IPPU	Industrial Processes and Product Use

While the greenhouse effect is a natural process, it has been enhanced over the past centuries due to human activities, such as the burning of fossil fuels, deforestation and agricultural production. Carbon dioxide, for example, has increased from 277 ppm in 1750 to 412 ppm in 2020 (CSIRO 2021). Samoa is committed to reducing its contribution to the greenhouse effect and has taken efforts to measure and reduce its greenhouse gas emissions. The Government of Samoa has made significant progress in its efforts to address climate change since signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

This indicator provides the state of Samoa's GHG emissions.

Status and Key Findings

A third National inventory Report documenting Samoa's GHG emission inventory has been completed (MNRE 2020). It is an update of the emission status of Greenhouse gases activities for the years 2010 to 2020. The inventory focused on four key sectors:

I. Energy

II. Industrial processes and product use (IPPU)

III. Agriculture, forestry and other land use (AFOLU)

IV. Waste

2020 Status

Samoa's GHG emissions totalled 496,332 tons of CO_2 equivalent in 2020 (Table 37). The energy sector represents the largest source of GHG emissions, accounting for 46% of the national total (Figure 94). The Agriculture, Forestry and Other Land Use sector accounts for 28%, followed by Waste (21%) and Industrial Processes and Product Use (5%).

Table 37: Samoa's total GHG emissions from the 4 key sectors for 2020 (GHG Inventory Report, MNRE 2020)

SECTOR	TCO_2	CH_4 (TCO_2E)	N_2O (TCO_2E)	HFC (TCO_2E)	TOTAL (TCO_2E)	PERCENTAGE
Energy	229395	268	507	NO	230170	46.%
AFOLU (Sources)	NE	128715	9048	NO	137763	28%
Waste	93	104436	NA	NA	104529	21%
Industrial Process and Product Use (IPPU)	251	NO	NO	23619	23870	5%
				Total	**49, 6332**	**100%**

*NO- Not Occurring, NE- Not Estimated, NA, Not Assessed.

Low data for Waste and IPPU sectors as shown in Table 37, includes either those specific gases that do not occur within their operations, or are yet to be assessed. Since Samoa's IPPU is still in its infancy, data for this sector remain small or unavailable.

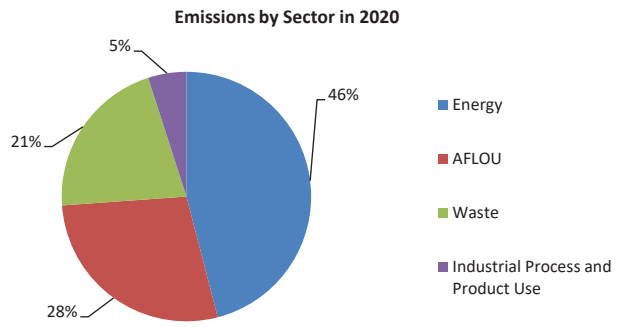


Figure 94: The four main sources of Samoa's GHG emissions in the year 2020 (Picture Source: GHG Inventory Report- MNRE 2020)

In 2020, carbon dioxide and methane were the highest emitting GHG accounting for 46% and 47% of total CO_2e emissions respectively (Figure 95) (MNRE 2020). Other gases indicated were HFC and Nitrous Oxide, however their levels of significance are much lower than those of CO_2 and CH_4.

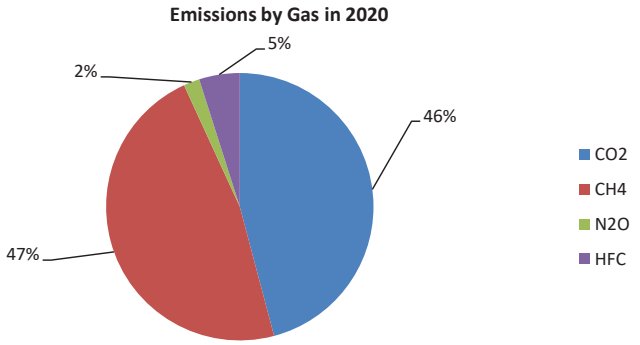


Figure 95: Contribution of key GHG to Samoa's total CO_2 emissions for the year 2020 (Picture Source: GHG Inventory Report - MNRE 2020)

Decadal trend GHG emissions 2010-2020

Over the decade (2010-2020), Samoa's GHG emissions grew by 17% (Figure 96). The energy sector has been the key driver of the GHG emissions increase (Table 38), although there is a noticeable reduction from 2019 to 2020, it still is above the 2010 level. Conversely, the IPPU sector emissions were evident in 2019. The AFOLU sector emissions declined from 2015, going below the 2010 emission level.

Table 38: Total CO_2 emissions per sector (MNRE)

SECTOR/ YEAR (tCO_2e)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy	181,726	184,151	178,960	185,590	192,775	202,087	225,451	227,130	221,744	243,732	230170
AFOLU	147,494	154,673	159,548	165,574	171,601	177,646	169,666	161,686	153,691	145,726	137763
Waste	73,911	79,041	83,697	87,801	91,202	94,398	97,033	99,106	101,093	102,858	104529
IPPU	313	333	163	191	-	104	226	136	128	203	23870
Total Annual GHG Emissions	403,444	418,198	422,368	439,156	455,578	474,235	492,376	488,058	476,656	492,519	496,332

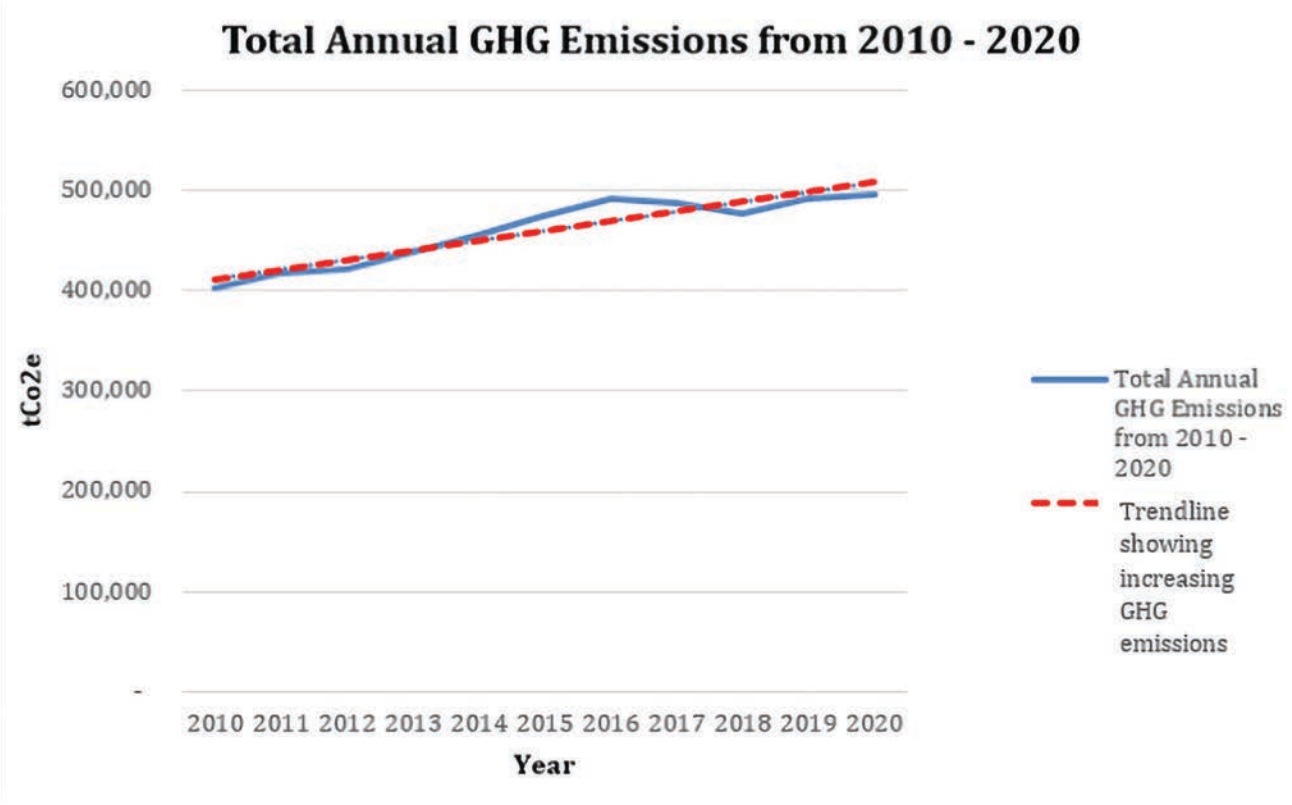


Figure 96: Total annual GHG emissions from 2010 to 2020 (Picture Source: GHG Inventory Report-MNRE 2020)

Industrial Processes and Product Use (IPPU) sector emissions first appeared in 2020, when data collection began. While it is the smallest percentage of emissions of the four sectors, it still indicates that it is a significant contributor of the total emissions (5+%).

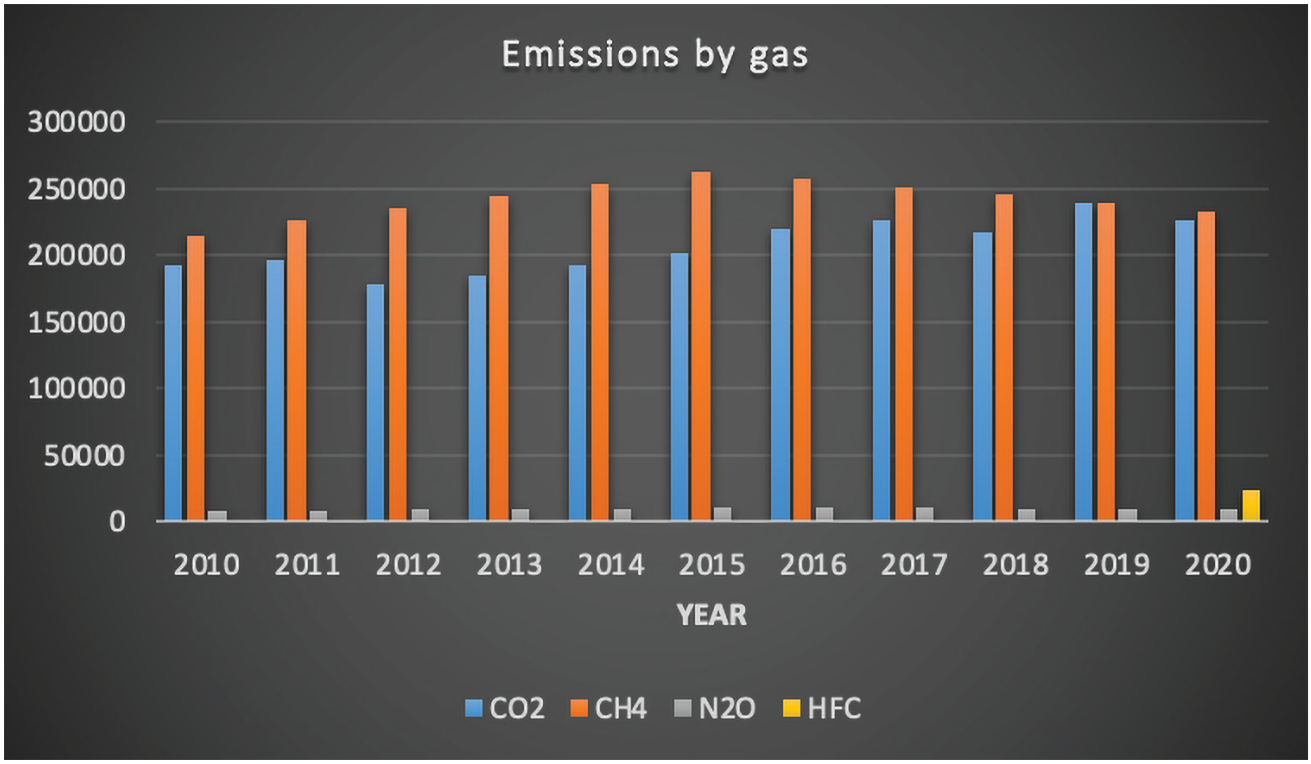


Figure 97: Emissions by the four main gasses from 2010 to 2020 (GHG Inventory Report – MNRE 2020)

Methane gas was the main contributor to GHG emissions, reaching its highest peak in 2015 (26,226 tCO_2e), followed by CO_2 with some contributions from Nitrous Oxide and HFC (Figure 97). CO_2 emissions have seen growth from 2013 through 2017 with a reduction in 2018, and a slight growth in 2019. In 2020 there was again a drop in the rate of emissions. This drop coincided with the occurrence of the COVID-19 pandemic's impact on production and consumption. Nitrous oxide remained constant from 2010 to 2020. HFCs were first tracked as part of GHG Inventory in 2020.

Impacts

Continued GHG emissions will contribute to global mean surface warming, ocean warming, sea level rise, higher occurrence and intensity of extreme weather and climate events or both (IPCC 2013). The impacts of high GHG emissions for Samoa include the following:

- Greater maximum air temperature, and warmer monthly temperatures.
- Greater frequency in extreme daily rainfall events.
- Increase of sea level rise.
- Increases in ocean acidification and coastal erosion.
- Higher sea-surface temperatures.
- Tropical cyclones, and longer, more frequent droughts.
- Changes to physical climate conditions, creating dryer areas.
- Consistent rainfall volumes but through more intense and fewer events.

Samoa is extremely vulnerable to the impacts of climate change primarily because about 70% of the population and the key infrastructure are located along the low-lying coastal plains. Further, most people rely on primary industries such as agriculture and fishing, which are vulnerable to natural and climate induced hazards. Biodiversity impacts will likely see species migrate into different 'foreign' habitats in search of amenable conditions.

The International Panel for Climate Change noted previously that "Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions".

Response

Samoa is a key player in international efforts to address the threats posed by Climate Change. It is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), as well as to the Paris Agreement, whereby nationally determined contributions were pledged to reduce GHG emissions by 2030.

At the national level, the Ministry of Natural Resources and Environment through its Climate Change and GEF Division, launched the National Climate Change Policy 2020, which is a high-level strategic document that aims to guide and coordinate all the climate change efforts and climate action across all sectors and stakeholders in Samoa.

As of early 2023, there is also momentum on finalising the Draft Climate Change Bill (Table 39) in hopes of establishing a formal legislation to strengthen the actions around climate change. This demonstrates the aspirations and importance placed by the Government of Samoa on strengthening climate adaptation, resilience and mitigation actions to respond to impacts of climate change as well as achieving our national and international obligations.

The establishment of a National Inventory Database on Greenhouse Gas is also in the pipeline for 2023 to be housed under the MNRE Climate Change/GEF division, to manage, compile and analyse the national data on GHG from across all of its sectors. This database will be updated annually to inform policy decisions of Samoa as well as assist in the compilation of its national communications and transparency reports to UNFCCC.

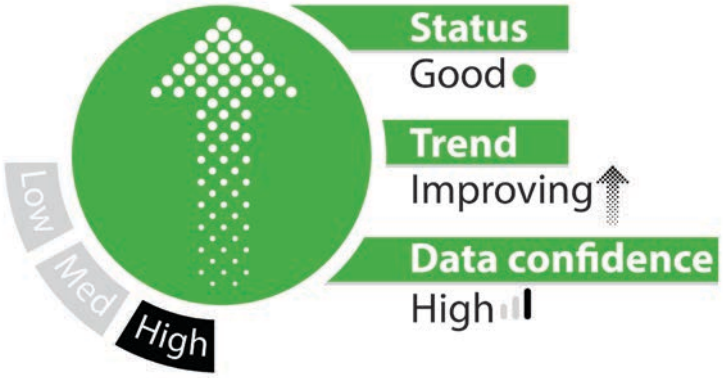
Table 39: Climate change governance activities (MNRE)

CLIMATE CHANGE GOVERNANCE		
Activity	Timeframe	Status
1. Samoa Climate Change Policy	2020-2030	Endorsed by Cabinet – Launched Nov. 2021
2. Samoa Ocean Strategy	2020-2030	Endorsed and Launched – October 2020
3. Community Integrated Management Plans (CIM) 43 plans	2019-2029	Complete and implementation ongoing; both English and Samoan versions available
4. National Environment Sector Communication Strategy		Endorsed and Launched – November 2020
5. Draft Climate Change Bill	2022-2026	Legal Review
6. National Climate Change Adaptation Strategy	2021-2031	In Draft
INTERNATIONAL OBLIGATION TO UNFCCC		
1. GEF 7		Complete validation workshop in Sept. 2021
2. Development of the First Biennial Update Report	2020-2024	Progress Ongoing
3. Nationally Determined Contributions Enhancement	2020-2025	Samoa Second NDC submitted to UNFCCC 30 July 2021

Recommendations

- Greater collaboration and institutional coordination are needed to ensure that data and information needs are shared to allow for a comprehensive development of national reports and advice for all government sectors.
- Explore efforts to reduce GHG emissions, especially at the energy and waste sectors.

INDICATOR 22: Consumption of ozone depleting substances



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8, 10, 15	7 AFFORDABLE AND CLEAN ENERGY; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER	Montreal Protocol on Sub-stances that Deplete the Ozone Layer (and subse-quent amendments – Lon-don, Copenhagen, Montre-al, Beijing & Kigali) Vienna Convention for the Protection of the Ozone	SAMOA Pathway Apia Convention Noumea Convention Waigani Convention	• Ozone Layer Protection Regulations 2006

Indicator definition

The ozone layers help limit the penetration of dangerous ultraviolet radiation from reaching and causing harm to life on earth. The use of certain synthetic substances has resulted in holes in the ozone layer, which are particularly severe in the Arctic and the Antarctic regions. The reduction in the use of these substances has been a key focus of the global community.

Acronyms:

CFC	Chlorofluorocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IPPU	Industry Processes & Product Use
MNRE	Ministry of Natural Resources & Environment
ODS	Ozone Depleting Substances

This indicator measures Samoa's response in managing ODS, as part of its obligations towards these global agreements.

Status and Key Findings

Samoa acceded to the Vienna Convention and the Montreal Protocol in 1992. Since then, the government has endeavoured to meet its obligations as per the Protocol phasing schedules. Phasing out of Chlorofluorocarbons and Halons was achieved by 2010, and was reported on in the 2013 State of Environment Report.

Hydrochlorofluorocarbon (HCFCs)

Hydrochlorofluorocarbons are used in refrigeration and air conditioning equipment. The phase-out of HCFCs was initiated in 2013 where parties agreed to freeze consumption at a baseline calculated for 1 January 2013. The phase out programme follows the schedule from the Protocol which is indicated in Figure 98. A quota system was agreed for developing countries and consistent with those decisions, Samoa's quota system enables importers of controlled substances to import specific amounts that are approved by the government through MNRE. Figure 99 below shows the HCFC consumption trends from 2000 to 2021.

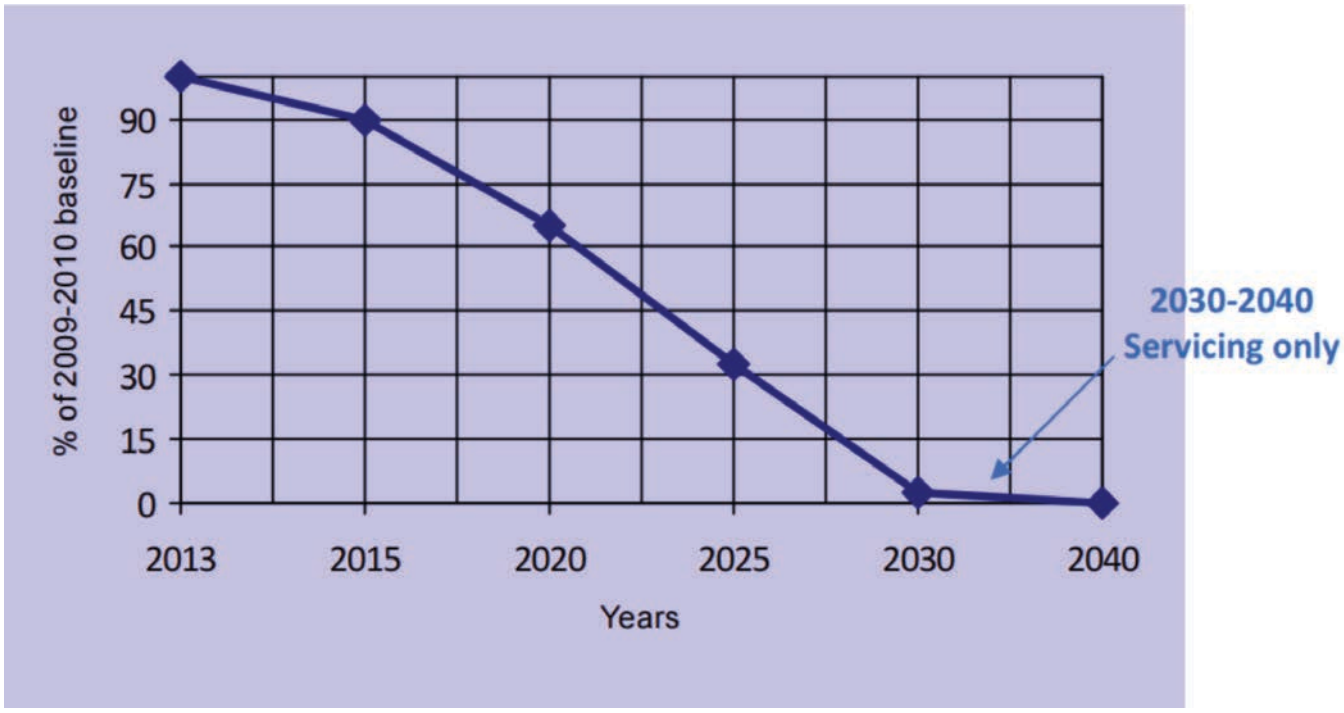


Figure 98: Phase out schedule under Article 5 of the Montreal Protocol (MNRE)

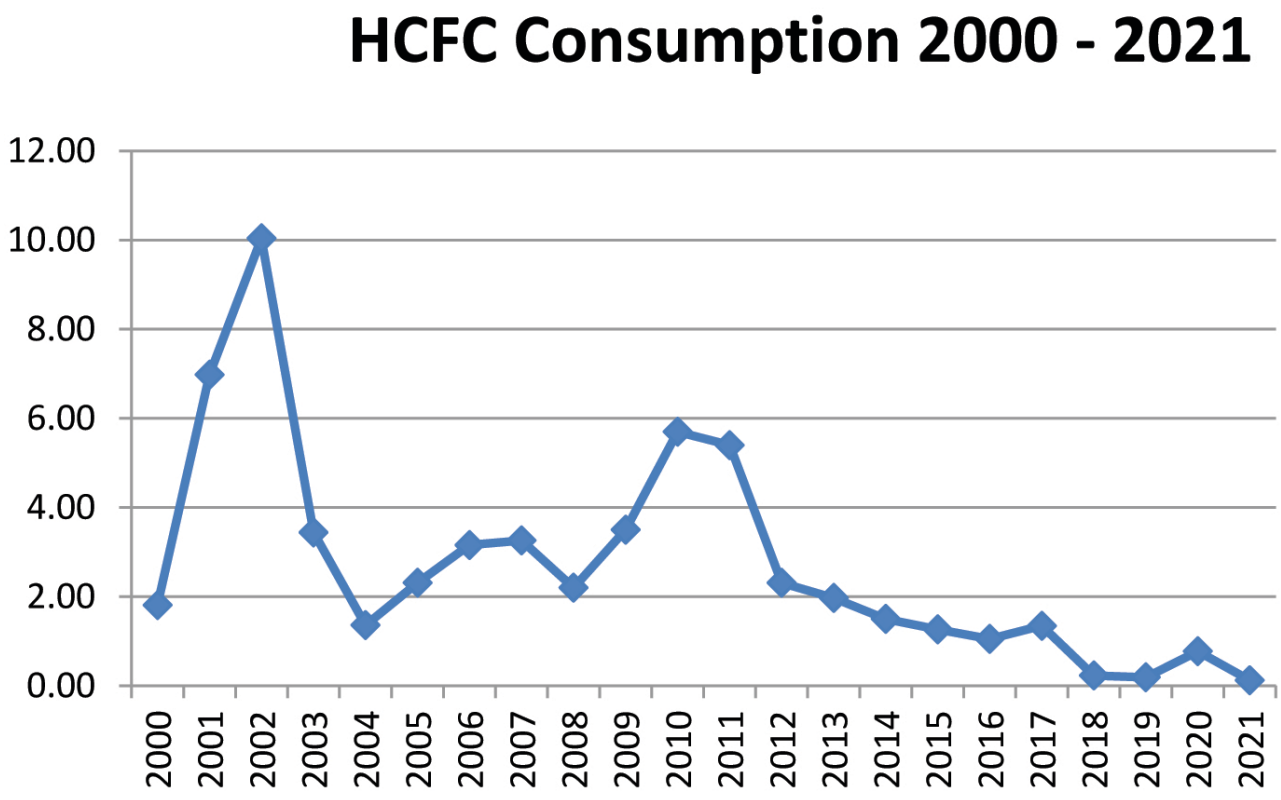


Figure 99: HCFC consumption in Samoa from 2000 to 2021 (MNRE)

Hydrofluorocarbons (HFCs)

Nationally, emissions from HFC have risen dramatically since 2000 and now represent one of the significant sources of GHG emissions, especially from the Industry Process & Product Use (IPPU) sector (Table 40). Emissions from the HFC had increased by approximately 362% since 2007 when emission was 5,253 tCO_2e. In 2020, emissions from the Industrial

Processes and Product Uses sector (IPPU) were 24,527 tCO_2e accounting for 5% of Samoa's total GHG emissions (Table 40). Emissions from the substitution of ozone-depleting substances accounted for most emissions from the IPPU sector, representing 99% of total emissions.

In preparations for the phase-down of HFCs the government has collected data on HFC consumption since 2012 (Table 41). While not regulated under the Montreal Protocol to do so, this exercise will be to Samoa's advantage under the Kigali Amendment to the Protocol. It will be used to establish the baseline for the commencement of the initial phase down in 2024.

Table 40: HFC emissions from the Industrial Processes and Product Use (IPPU) sector (MNRE 2020)

A		B	C	D	E	F
Quantity of HFCs Sold in Inventory Year		Quantity of HFCs Sold in Prior Year	Emission Factor (Loss of Current Year's Use)	Emissions of HFCs from Other Applications	Global Warming Potential	Emissions of HFCs from Other Applications
Chemical	(ton)	(ton)	(fraction)	(ton)	GWP	tCO_2e
				D = A * C + B * (1 - C)		F=D*E
HFC 32		0.68	50%	0.34	675	229.50
HFC134a	2.7728	1.068	50%	1.9204	1430	2746.17
R404 A	3.31868	3.2208	50%	3.26974	3922	12823.92
R 410 A	3.6472	4.472	50%	4.0596	2088	8476.44

Table 41: Hydrofluorocarbon imports 2012-2021 (MNRE)

ODS ALTERNATIVE	IMPORTS (MT)									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
HFC-32	0	0	0	0	0.018	0	0.006	0.68	0	0
HFC-134a	2.362	2.517	3.144	3.644	3.3728	1.8496	2.7814	1.068	2.7728	1.6592
HFC-404A	1.102	1.143	1.584	1.279	4.4744	2.0284	2.8274	3.2208	3.3187	1.1425
HFC-407C	0.159	0.034	0.000	0.000	0.0544	0.226	0	0.10	0	0.197
HFC-507A	0.256	0	0	0.095	0	0.0565	0	0.10	0	0
HFC-410A	1.591	1.633	1.741	2.002	3.6128	2.8288	4.7144	4.4720	3.6472	1.3386

Impacts

Chlorofluorocarbons (CFCs) and HCFC destroy the earth's protective ozone layer in the stratosphere, which shields us from harmful ultraviolet (UV-B) radiation. CFCs and HCFCs also warm the lower atmosphere by trapping heat, contributing to global warming. HFCs, which originally were developed to replace CFCs and HCFCs, also absorb and trap infrared radiation or heat in the lower atmosphere.

Stratospheric ozone depleting results in potential direct harm to human health and the environment, including through:

- increased incidence of skin cancer and cataracts.
- immune system damage.
- damage to terrestrial and aquatic plant life.
- increased formation of ground-level ozone (smog).

Indirect impacts expected from atmospheric change include:

- Rising sea levels.
- Natural species extinctions.
- Habitat loss and/or habitat migration.
- More frequent heavy rainfall and flooding.
- Heat stresses in summer and extension of extreme heat episodes.
- Increasing health risk from insect and water-borne diseases.

Response

Global concerns on the ozone layer began in the 1970s, which led to the adoption of the Vienna Convention for the Protection of the Ozone Layer in 1985. This led to the signing of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987. By 1992, the problem of the ozone layer was shown to be worse than expected and an agreement was made to end production of halons by 1994 and CFCs by 1996. These measures have led to the reduction of ODS emissions and an optimistic view of the ozone coming right in the future.

Samoa became a party to the Vienna Convention and the Montreal Protocol and made commitments and implemented measures towards fulfilling its obligations to the Convention and the Protocol. In 2010, Samoa completed the phase out of CFCs and halons, and started the phasing out of HCFC in 2013, with the expectation that this to be completed by 2040. The phasing out of HFC (a greenhouse gas), which has been an alternative to CFC and HCFC, will start in 2024. HFC emissions rose significantly in 2020 for Samoa (MNRE 2022).

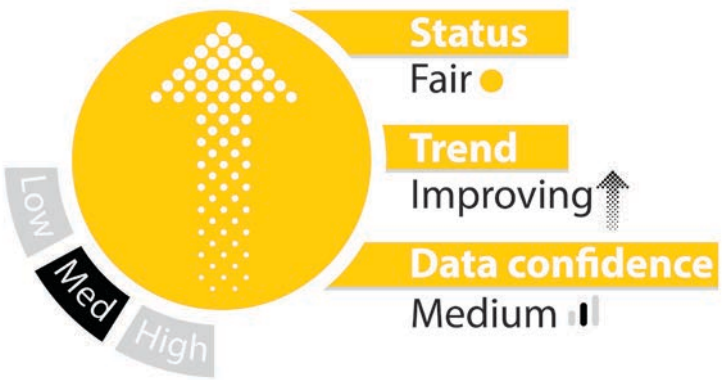
Samoa has enacted the Ozone Layer Protection Regulations 2006.

Samoa established a dedicated Ozone Unit in 1997 (and later became the Ozone Section in 2013), under the Meteorological Services, to help fulfil its obligations under the Montreal Protocol. The Section monitors the importation of ODS through licensing of ODS importing companies, including data collection and training of personnel. It also enforces national legislation, as well as engaging with the public to raise awareness on the ozone layer.

Recommendations

- Samoa is unable to capture all of the HFC sources in its database, due to lack of technical capacity. This is a serious barrier to the total estimate of its current ODS emissions. It is highly desirable that the technical capacity is addressed and the necessary resources and tools provided to mitigate this issue.
- Review existing policies and legislative framework and secure resources to implement and enforce legal provisions so that ODS are properly managed.
- Regularly undertake awareness activities to improve understanding on ODS and its impacts on the environment.

INDICATOR 23: Energy and renewables



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	3, 10, 15	7 AFFORDABLE AND CLEAN ENERGY; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION	UNFCCC Paris Agreement IRENA	Framework for Energy Security and Resilience in the Pacific (FESRIP)	• Nationally Appropriate Mitigation for Action [NAMA] • Low Emission Development Strategy [LEDS] • 1st & 2nd Nationally Determined Contributions • NDC Roadmap and Investment Plan • National Renewable Energy Policy (draft) • Energy Sector Plan 2017-2022 • Energy Management Act 2020

Indicator definition

The demand for energy has increased, leading to increase in the importation of fossil fuels for the transport and electricity sectors. This has led to challenges relating to availability, sustainability, affordability and accessibility to clean energy. Efforts to address the challenges have included the ramping up of renewable energy sources, and the promotion of energy efficiency and conservation (Energy Sector Plan 2017-2022).

The indicator assesses the state of energy and renewables using the following data sources:

- Total energy supply and use.
- Share of fossil fuels in total energy use.
- Energy use by households per capita.
- Renewable energy share in total energy use.

State and Key Finding

Samoa has produced two Energy Accounts (EA) reports, the first in 2016 and the most recent in 2020 (SBS 2020). The energy accounts track Samoa's progress in the energy sector, as part of its commitment to the Global Agenda (Sustainable Development Goals - SDG 7), and national target of 70% renewable energy use by the end of 2031, through transitioning into a low carbon economy by utilising renewable energy sources (PDS 2021/2022). A summary of Samoa's Energy Audit is provided below. Figure 100 provides the overview of the energy flow in Samoa. Fossil fuels and electricity are the main energy components being assessed in the EA.

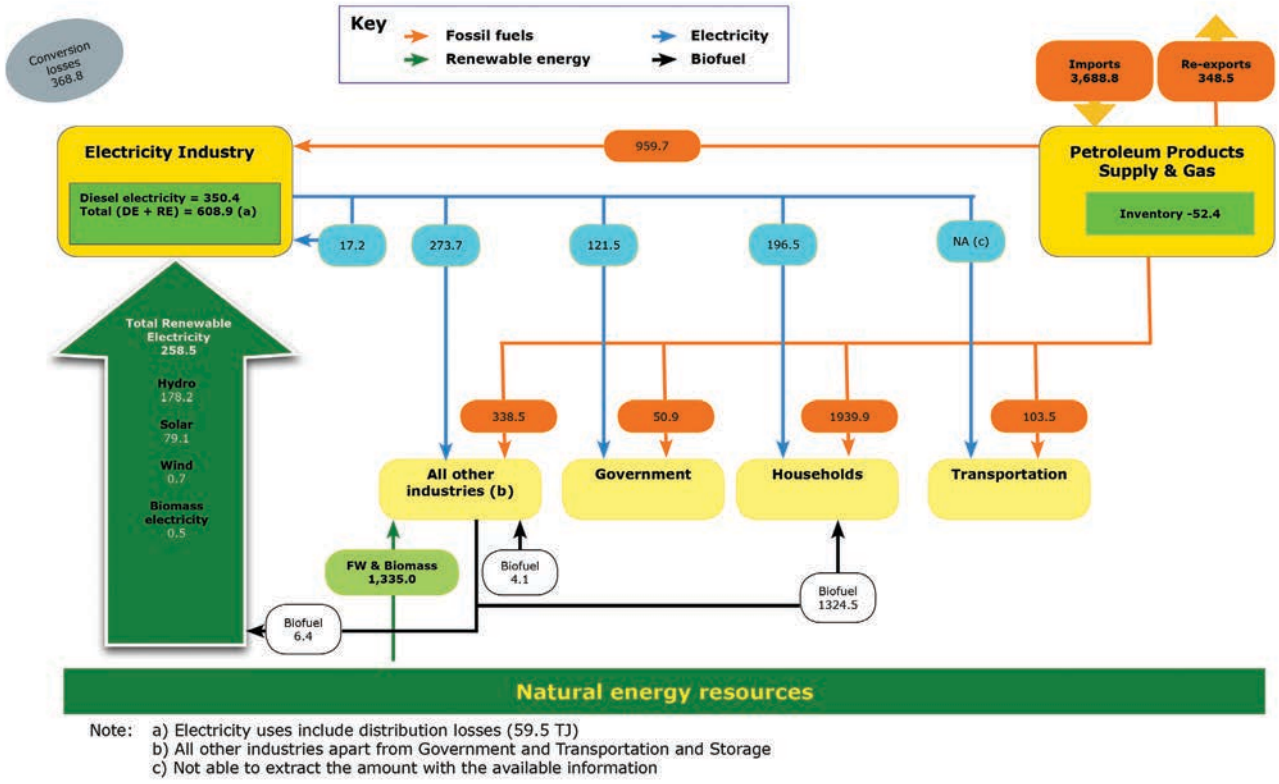


Figure 100: Samoa's energy flow (Picture Source: MNRE)

Samoa's Energy Supply:

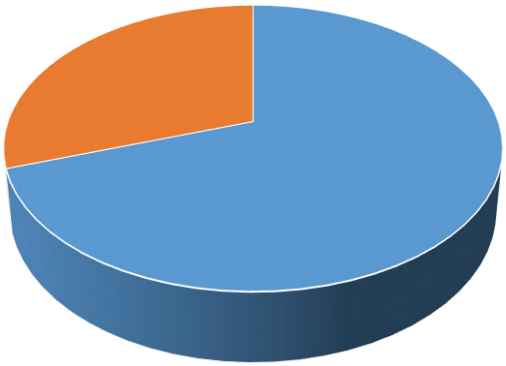


Figure 101: Samoa's energy supply is dominated by imported products (fossil fuels) (SBS 2020)

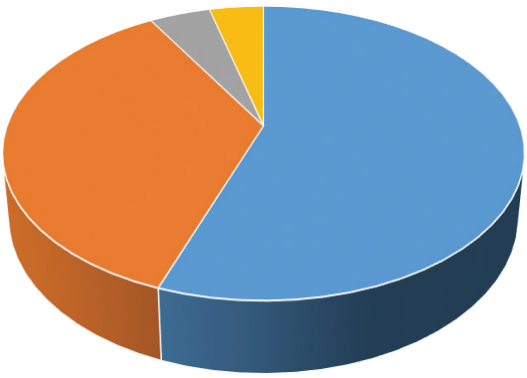


Figure 102: Imported fossil fuel by energy products (SBS 2020)

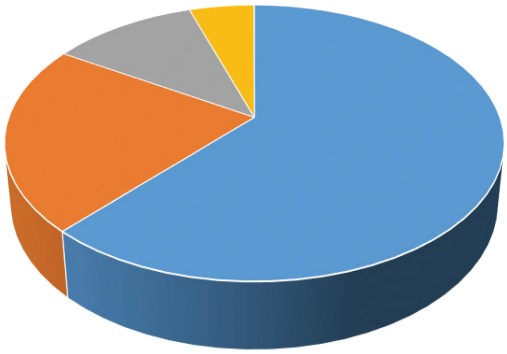


Figure 103: Energy sourced from natural sources (SBS 2020)

The bulk of Samoa's energy supply is from imported fossil fuels. Samoa's total energy supply was 5,281.8 TJ calculated for the year 2020. Fossil fuel provided the majority of this energy supply at 70% (Figure 101). An estimated 3,689 TJ is attributed to fossil fuels, with the remaining 1,593 TJ from natural sources (e.g. firewood). Of the imported fossil fuel, automotive diesel oil (ADO) accounts for 2,048 TJ, motor gasoline (Mogas) 1,327 TJ, dual purpose kerosene (DPK) 168 TJ, with the remaining 146 TJ from liquid petroleum gas (LPG) (Figure 102).

Energy sourced from natural inputs is mostly from firewood and wood waste (983 TJ), followed by biomass (351 TJ) with the remainder from hydro and solar (Figure 103).

Samoa's total end use of energy products is estimated at 4853.5 TJ. The difference between the total supply and the total end use is 428.3 TJ. The reasons for the difference are due to conversion and other losses by the electricity industry.

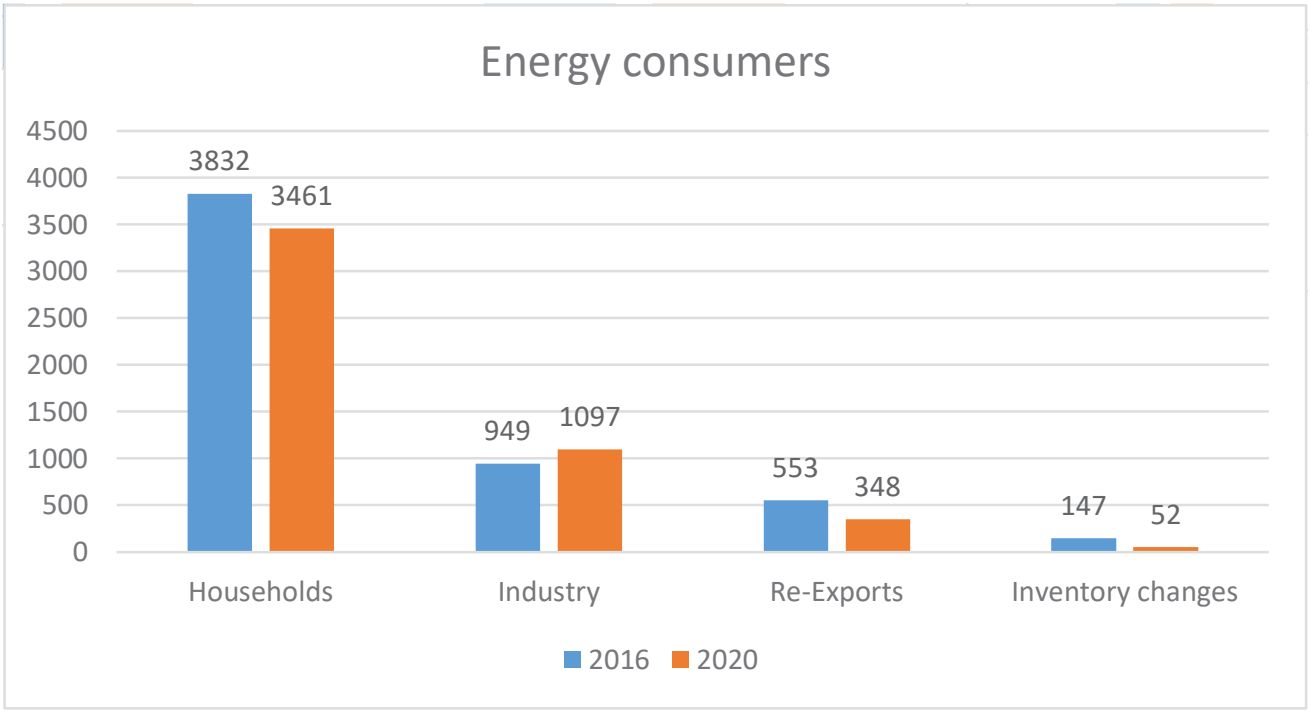


Figure 104: Energy consumers for the 2016 and 2020 periods (SBS 2020)

Households are the main consumers for energy, consuming 3461 TJ in 2020. Industry (including industries and government) is the next largest energy user (1,097 TJ, with the remaining 348 TJ used for exports and -52 TJ for inventory (Figure 104).

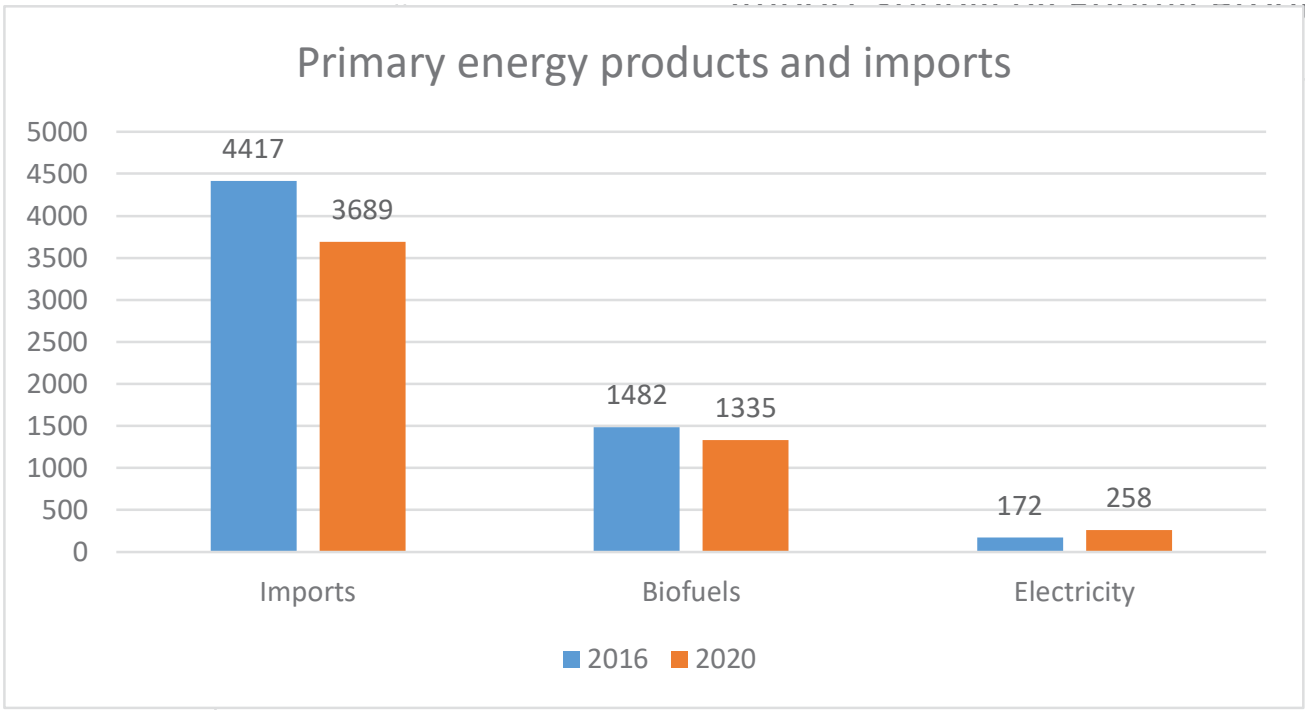


Figure 105: Samoa's energy use for 2016 and 2020 (SBS 2020)

Comparison of the two energy accounts (from 2016 and 2020) in Figure 105, shows a decrease in energy imports (fossil fuel) and biofuels (fuelwood, wood waste and coconut biomass). Electricity consumption increased from 544 TJ in 2016 to 610 TJ in 2020, which is attributed to an increase in household numbers. A further breakdown of the energy consumption by products is provided in Figure 106. One of the obvious changes from the 2016 energy audit to the 2020 account, was the decline in DPK fuel use, which was caused by limited to no flights during COVID-19 lockdowns.

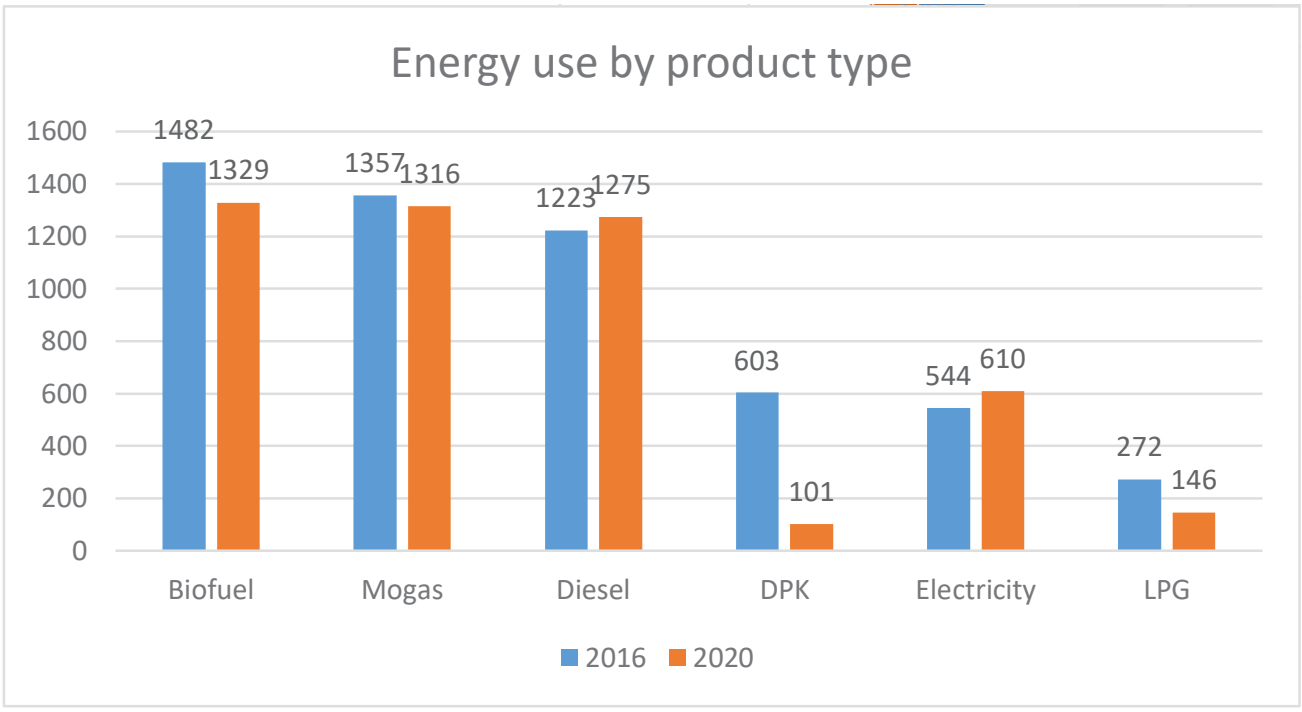


Figure 106: Energy use by product type for the year 2016 and 2020 (SBS 2020)

Renewables

One of Samoa's major goals, as highlighted in the Pathway for the Development of Samoa 2021/22- 2025/26, is achieving 70% renewable energy use by the end of 2031. Households are the largest energy users of all sectors. If Samoa aims to achieve its set target, household energy use must be prioritised. Samoa's renewable energy sources are primarily hydropower and solar. Their contributions to the grid continue to increase from 31.5% in 2016, to 42.4% in 2020 (Table 42). If the rate of renewables increases by 2-3% per annum, then Samoa will easily reach the target by 2031. With increased outputs from renewable energy sources to the grid, the amount of savings is expected to increase, as the demand for diesel decreases (Figure 107).

Table 42: Electricity generation by source for 2016 and 2020 period (SBS 2020)

ELECTRICITY SOURCES	2016 (TJ)	2020 (TJ)	2016 (%)	2020 (%)
Total Diesel	372.6	350.4	68.5	57.6
Total Renewable Electricity	171.6	258.5	31.5	42.4
Hydro Electricity	117.2	178.2	21.5	29.2
Solar Electricity	54.4	79.1	10.0	13.0
Wind Electricity	0.0	0.7	0.0	0.1
Biomass Electricity	na	0.5	na	0.1
Total Electricity Production	544.3	608.9	100.0	100.0

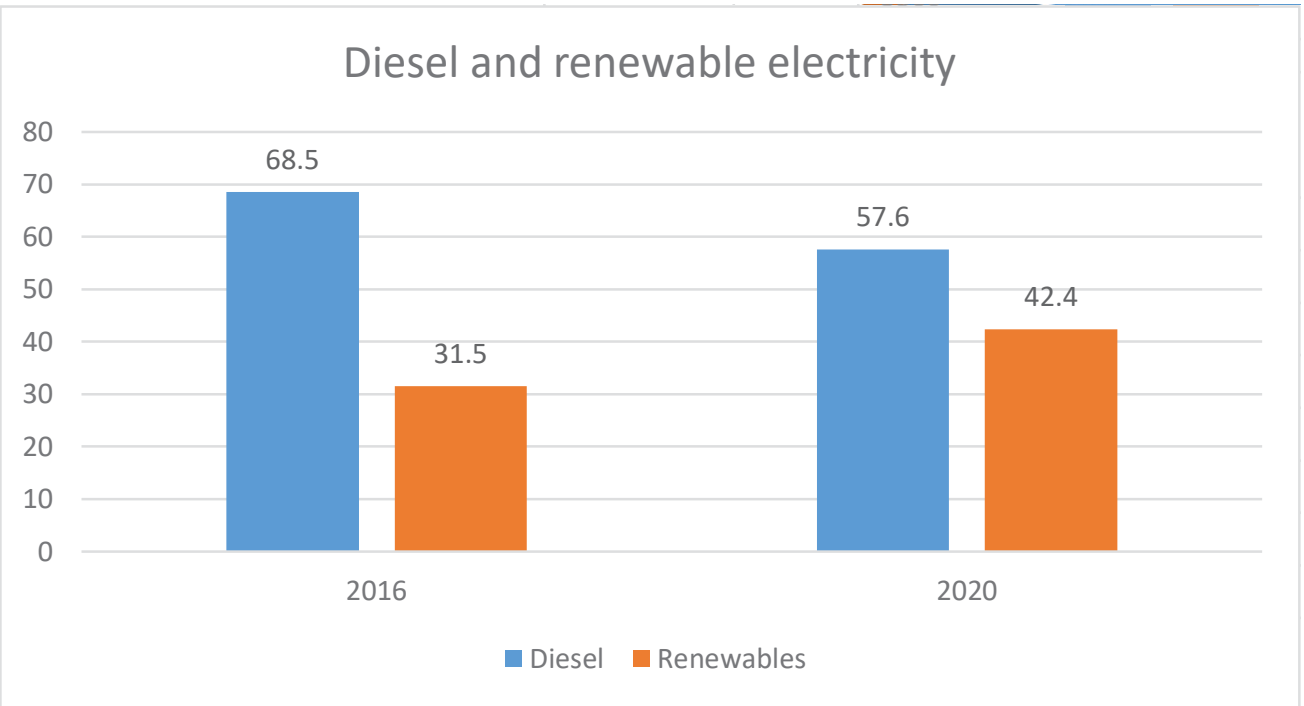


Figure 107: Share of diesel and renewable energy sources to the national grid for 2016 and 2020 (Picture Source: SBS 2020)

Impacts

Global markets and regional conflicts are contributing to the increased cost of energy that fuels national economies. Samoa is not immune from these international activities, and the impacts are felt at the household level with the cost of fuel, basic items and food being very expensive. The recent COVID-19 pandemic, which closed down national borders and halted much of the international trade, further contributed to the increase in fuel prices adversely impacting households and businesses. Fuel prices in Samoa hit unprecedented levels in August 2022 with the selling price for unleaded petrol at 436.38 sene, diesel at 469.25 sene, and dual purpose kerosene at 424.30 sene (Government of Samoa – Petroleum Prices – www.mof.gov.ws) (Table 43).

Table 43: Comparison of petroleum prices from 2012 to 2022 (Government of Samoa – Petroleum Prices – www.mof.gov.ws)

YEAR	UNLEADED PETROL (SENE)	DIESEL (SENE)	DUAL PURPOSE KEROSENE (DOMESTIC) (SENE)
August 2022	436.38	469.25	424.30
August 2012	285.07	297.81	275.94

The volatility in the global economy has had an impact in Samoa's effort to transition to renewable energy in particular financial assistance, either through bilateral relationships with traditional donors, or remittances from relatives. Technology transfer is also impacted by these global activities (IUCN 2016). Furthermore, our geographical and physical constraints often limit the deployment of renewable energy projects, making Samoa less attractive to investors. Without financing and with high capital costs for these

technologies, we continue to face challenges in scaling clean energy projects, making the need for greater access to finance indispensable to implementing ambitious national targets and NDCs.

Response

National Response

Samoa enacted the Energy Management Act 2020 with the purpose of providing a coherent institution and regulatory framework for the management, planning and coordination of the energy sector, including renewable energy. A key component of the legislation is the development of a five-year energy sector plan. The 2nd iteration of the five-year energy sector plan concluded in 2022, and a new one is being developed (Moira Faletutulu pers. comm. 2023). The Act stipulates that renewable energy is the responsibility of MNRE, although the Electric Power Corporation is included as

an implementing partner (with MNRE) in the implementation of renewable energy and energy efficiency projects (Energy Management Act 2020). Under the EMA 2020, refrigerators, freezers, lighting products, and air conditioners must meet the MEPS and carry standard labelling rules.

National policies and strategies have also been developed including the Nationally Appropriate Mitigation for Action for the transport sector, Low Emission Development Strategy, Nationally Determined Contributions, NDC Roadmap and Investment Plan, National Renewable Energy Policy, and the Energy Sector Plan. These are all in place to assist in planning and programming Samoa's climate actions towards a low-carbon future.

Samoa has secured several grants to assist with its renewable energy transition, including a USD 6 million grant for a 750-kW biomass gasification plant at Afolau, Mulifanua, and several biogas community projects in Papauta Girls College (Upolu island), Sasaai (Savaii island), Faleula Methodist Atinae (Upolu), STEC Mulifanua (Upolu) and Vaisala (Savaii). In addition, 300 solar streetlights were installed for selected community groups, churches and schools (Figure 108 - Figure 109) (MNRE 2021).

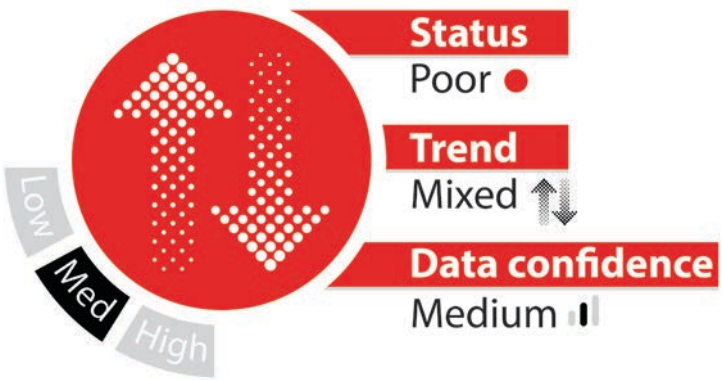
Recommendations

- Regularly review national policies, plans and legislation to ensure that they are relevant and provide the guidance on how the energy and renewable sector can operate efficiently and effectively.
- Regular energy audits provide the most up-to-date information for the country to monitor progress towards achieving its national targets and goals. Collecting and collating of data has been one of the key challenges that need to be addressed to allow for all relevant stakeholders and partners to share information in a timely manner. Checks and balances on the energy audits need to be strengthened, which will enhance accuracy of the information presented.
- Engage with a range of energy and renewable stakeholders and experts to assist with transitioning the country to a low carbon economy. This will necessitate the development of private and public sector partnerships, engaging communities to develop community owned and operated renewable energy projects and raising awareness at all levels on practical actions that can help in improving energy use.
- The national target of 70% renewable energy use in the Energy Sector by 2031 is fast approaching, and there is an urgency to double the effort, if this target is to be achieved.
- Develop and implement positive incentives to encourage the uptake of renewable energy sources in all new building developments, as well as major building renovations and retrofitting.
- Encourage the use of hybrid and electric vehicles with Government Ministries taking the lead, and ensuring the landscape and infrastructure for electric vehicles are available.
- Build the technical capacity in the country to develop and maintain renewable energy systems.
- Continue to promote energy efficiency and energy conservation in all businesses and households, including energy efficient buildings, biofuels for cars and improve ride-shares on public transportation.

Figure 108: Footing prepares at the Racecourse Renewable Project.

Figure 109: Erecting solar panels

INDICATOR 24: Physical climate



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8, 10, 15	7 AFFORDABLE AND CLEAN ENERGY; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION; 14 LIFE BELOW WATER	UNFCCC; Montreal Protocol	SAMOA Pathway; Apia Convention; Noumea Convention; Waigani Convention; WBG – Regional Partnership Framework 2017-2021	• National Climate Change Policy 2020 • Second Nationally Determined Contribution • Intended Nationally Determined Contribution • Second National Communication • First National Communication • MET Act 2021

Indicator definition

As global average temperatures continue to trend upwards, the weather patterns become more volatile with extreme conditions causing infrastructural and environmental damage, as well as the potential loss of life. Samoa is vulnerable to these extreme weather patterns and not a decade passes without some severe climatic events that cost lives and millions in economic losses. Samoa needs to adopt measures that will safeguard its people, the environment and the economy, as it faces a very uncertain future.

The indicator assesses the trend in climate change through the following parameters: temperature patterns, rainfall trends, ocean acidification and sea level rise.

Status and Key Findings

The data used for this indicator is based on historical data collected by the Apia weather station. The historical data have been, and continued to be used by many regional and international partners in their modelling and reporting (Faasau pers. comm. 2023).

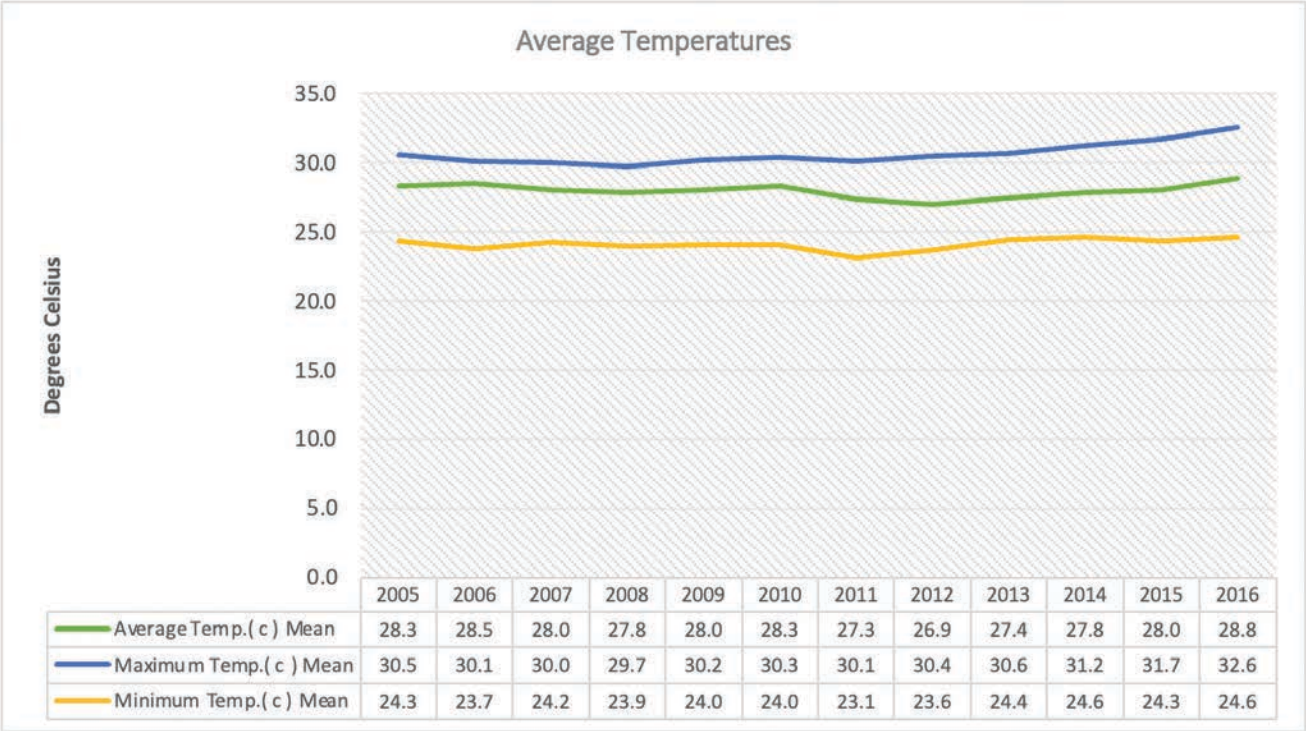
Samoa is experiencing higher than average temperatures, greater frequency in extreme daily rainfall events, and sea level rise (Samoa's Second National Communication to UNFCCC), as well as increases in ocean acidification and coastal erosion (Turner and McIntosh 2019). Changing weather patterns and natural disasters are impacting Samoa's settlements, as 70% of the population and infrastructure are located in low-lying coastal areas.

In terms of general climate change trends in Samoa there has been a warming of approximately 0.6 degrees Celsius between 1980 and 2018. While this is alarming it is a warming trend that is slightly lower than the global average.

Temperature

Meteorological data going back to over 100 years, show the mean annual temperature has increased by 0.59° C, with the minimum and maximum temperature increasing by 0.67° C and 0.18° C, respectively (Figure 110), and across the Pacific, the numbers of hot days and hot nights have increased significantly (Second National Communication to the UNFCCC; CSIRO and SPREP 2021). The inter-annual variability has increased, with a significant upward trend of maximum temperatures over the preceding years (Figure 111).

These observations are further confirmed by the Berkeley Earth Dataset, which shows a significant increase in the rate of warming post-1980, in the vicinity of Samoa, where it has warmed by approximately 0.6° C (Figure 112) (Carbon Brief 2023).



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Temp.(c) Mean	28.3	28.5	28.0	27.8	28.0	28.3	27.3	26.9	27.4	27.8	28.0	28.8
Maximum Temp.(c) Mean	30.5	30.1	30.0	29.7	30.2	30.3	30.1	30.4	30.6	31.2	31.7	32.6
Minimum Temp.(c) Mean	24.3	23.7	24.2	23.9	24.0	24.0	23.1	23.6	24.4	24.6	24.3	24.6

Figure 110: Samoa's temperature records from 2005 to 2016, showing an increasing warming trend (Picture Source: MNRE)

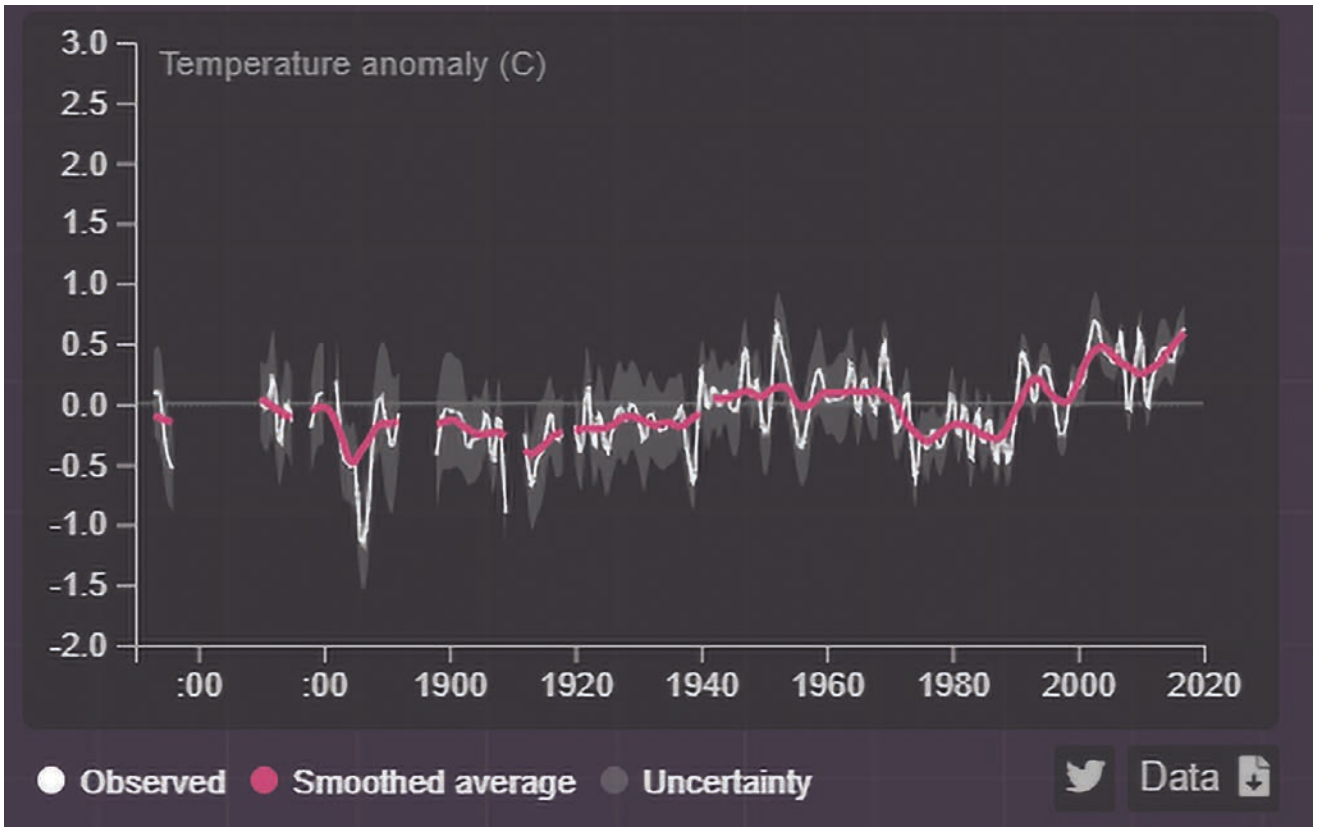


Figure 111: Temperature changes near Apia (Picture Source: Carbon Brief 2023)

Projections are the temperatures will continue to climb towards levels that are uncomfortable for the human body. There is a very high confidence that the temperatures in Samoa will rise based on theoretical and observational evidence. However future temperature rises in Samoa and likely to be below the global average. The mean annual surface air temperature under the highest emissions pathways is to reach about 2.7 degrees Celsius by 2090. This compares with the projected rise to 3.7 degrees Celsius globally.

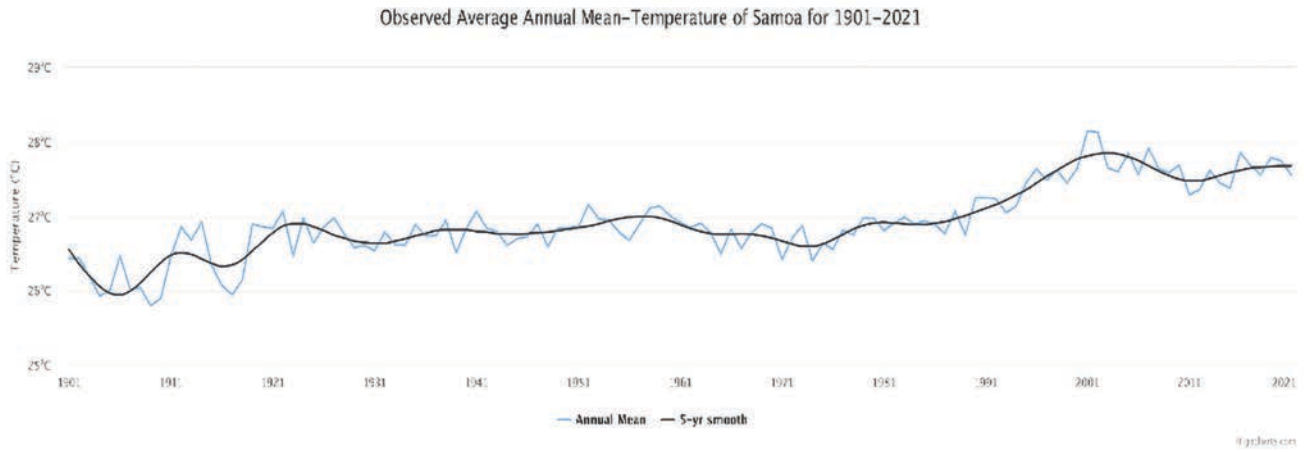


Figure 112: Samoa's temperature records from 1901 to 2021, showing increasing warming, especially post 1980s (Picture Source: Climate Change Knowledge Portal 2023)

Rainfall

Samoa's average annual rainfall ranges from 2000 - 7000 mm, although most areas receive <4000 mm (Figure 113). The highlands of both main islands receive 5000-7000 mm, whilst the north-west coastal areas of Upolu and Savaii receive the lowest rainfall averages (2000-3000 mm).

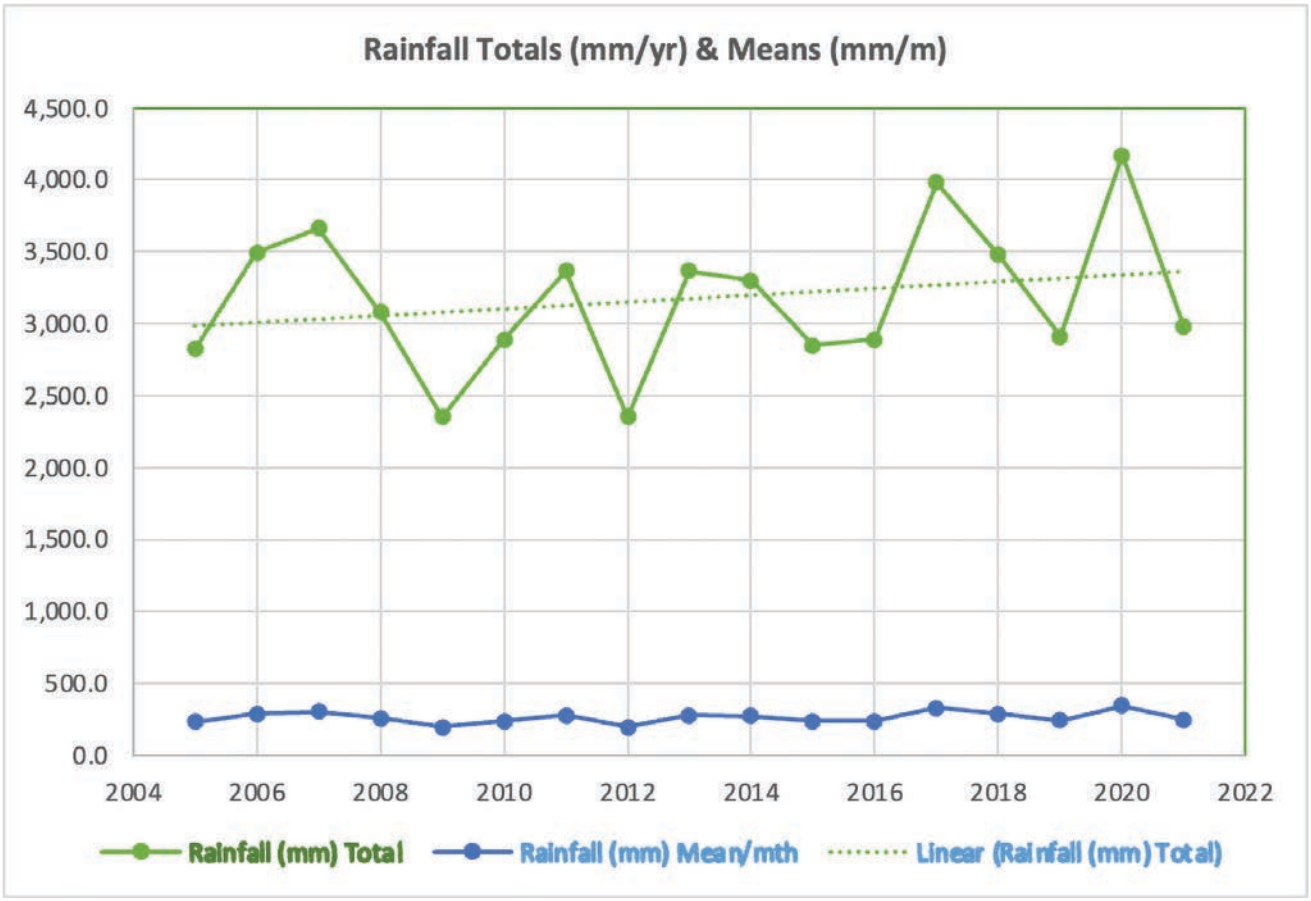


Figure 113: Samoa rainfall total from 2005 to 2021 (Samoa Meteorology Office)

Rainfall records for Apia show notable inter-annual variability associated with ENSO. The positive trends in Apia's annual rainfall suggest that either the mean location of the South Pacific Convergence Zone (SPCZ) has shifted towards Samoa, or there has been a change in the intensity of rainfall associated with the SPCZ. Samoa's rainfall is influenced by the position and strength of the SPCZ, which lies between Samoa and Fiji between November–April (wet season).

From May–October the SPCZ is normally to the north-east of Samoa, often weak, inactive and sometimes non-existent. Data suggest that Samoa's wet season has not changed significantly. There has been an increase in mean rainfall to 2006 with very unpredictable patterns since that time. There is low confidence that precipitation will remain the same into the 2030s and beyond, with the suggestion that recent modelling may have been affected by natural variability rather than global warming.

Ocean acidification

As the seawater becomes acidic due to increased CO_2 in the atmosphere and ocean, the impacts to Samoa and many other Pacific island countries, will be negative due to food insecurity (loss of seafood) and coastal erosion (weakened coral reef system).

> Aragonite saturation is used to track ocean acidification. It is a measure of carbonate ion concentration. Aragonite is a soluble form of calcium carbonate, which is used by many marine species, especially molluscs and reef building corals.

There is currently no ocean acidification data for Samoa, however, this is currently being addressed through a collaboration between the Korean Institute of Ocean Science and Technology (KIOST) and the Government of Samoa (Meteorological Office). The project, which will run until 2026 oversees the collection of samples to be analysed for aragonite saturation in Samoan waters. A monitoring buoy has been deployed at Vaiusu Bay (Figure 114) and samples will be taken regularly for analysis (Fuimaono Talia pers. comm. 2023).

As the oceans acidify in response to increasing ocean carbon uptake, the carbonate ion concentration of seawater decreases making it harder for corals to build their skeletons. Aragonite saturation levels above 5 are optimal for marine organisms; levels between 3.5 and 4 are considered adequate for marine organism's growth; levels between 3 and 3.5 are considered marginal. Below 3 is a concern, and Guinotte et al. (2003) observed no corals growing at this level. Projections from CMIP5 models indicate that under RCP8.5 and RCP4.5 the median aragonite saturation state will transition to marginal conditions (3.5) around 2030. In RCP8.5 the aragonite saturation state continues to strongly decline thereafter to values where coral reefs have not historically been found (< 3.0). Under RCP4.5 (low emissions) the aragonite saturation plateaus around 3.2, i.e., marginal conditions for healthy coral reefs. Under RCP2.6, the median aragonite saturation state never falls below 3.5, and increases slightly toward the end of the century, suggesting that the conditions remain adequate for healthy coral reefs. The level of confidence is medium in the RCP2.6 project. The impacts of ocean acidification are also likely to affect the entire marine ecosystem.

Figure 114: Buoy deployed to collected Ocean Acidification data (Samoa Meteorological Office)

While increasing ocean acidification is a significant stressor in the western tropical Pacific, it remains only one of a number of stressors facing coral reefs in the future, e.g. coral bleaching, storm damage, fishing pressure and other human impacts.

Sea level rise

As the planet continues its warming trajectory, ice sheets and glaciers will continue to melt at an unprecedented rate, and the ocean will expand due to warming water, therefore the water volume will increase. Sea level rise threatens much coastal infrastructure as well as significantly affecting the physical and natural regimes of the coastal zones. The global mean sea level rise was estimated to be in the range of 0.44 mm to 0.74 mm by 2100 (IPCC Fifth Assessment Report). Samoa's sea level rise is 5.2 mm per annum, with a maximum hourly sea level increase of 8.2 mm per annum (Figure 115) (Second National Report to UNFCCC). Research by CSIRO and BOM (2014) indicated Samoa's sea level rise may reach 70-170 mm in mean sea levels by 2030, and 400-870 mm by 2090 (Figure 116).

It should be noted that these values should be considered alongside uncertainty regarding the contribution of the Antarctic ice sheet, as well as natural inter-annual sea level variability, which has been, and is likely to continue to be, about 20 cm within the 5–95% range, after removal of the seasonal signal.

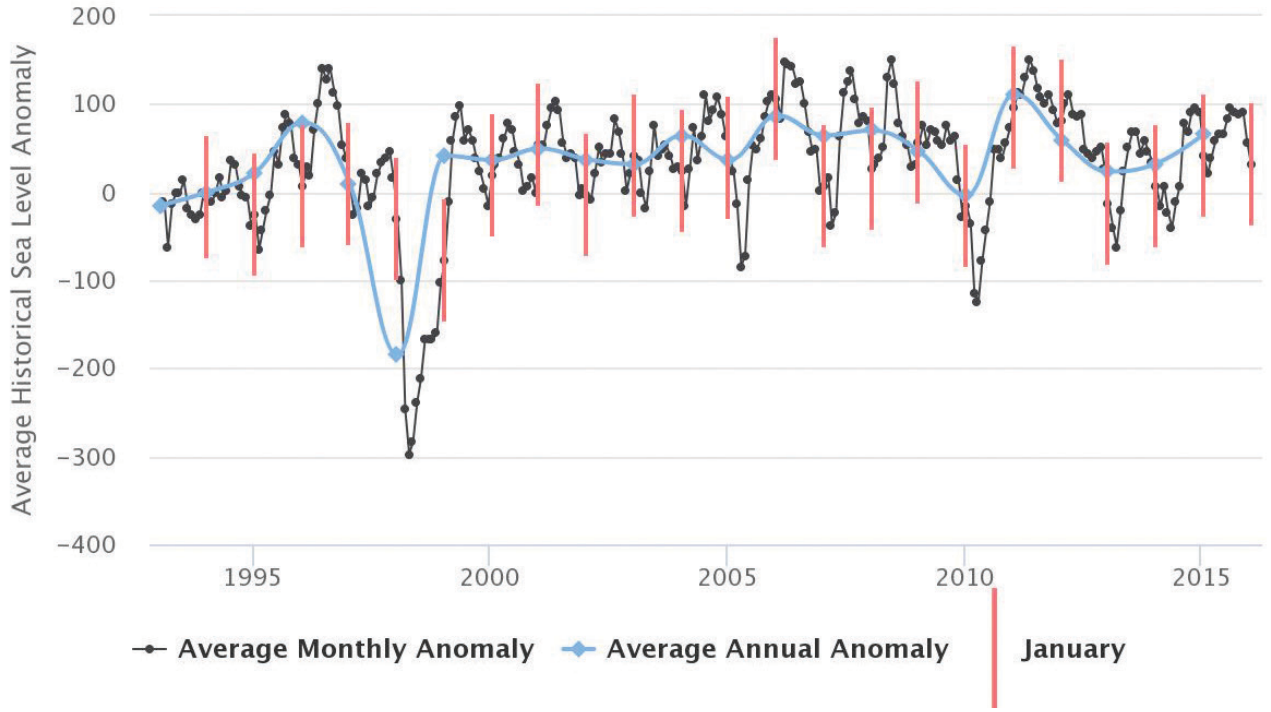


Figure 115: Samoa's sea level measurements from 1993 to 2016
(Picture Source: World Bank Group 2021 – www.climateknowledgeportal.worldbank.org)

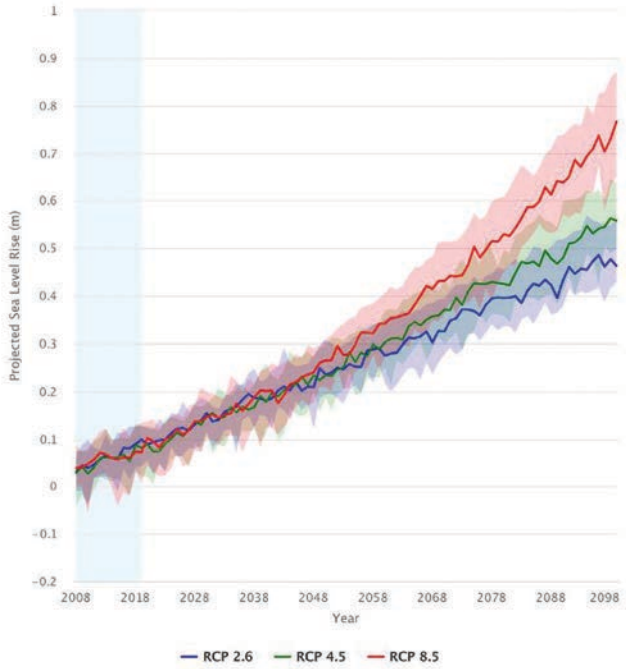


Figure 116: Projected sea level rise
(Picture Source: World Bank Group 2021
www.climateknowledgeportal.worldbank.org)

Many remote coastal villages are experiencing pressure from coastal erosion, storm surge, king tides, tropical cyclones and the sand budgets of beaches and lagoons. The natural changes to beaches are being accelerated and exacerbated by climate change. The rising sea level is perhaps the most pressing for coastal communities. Tourism provides opportunities for some of the coastal communities, where beach fales and other tourism infrastructure are constructed. Usually many of these developments are in vulnerable areas, where rising tides, storm surges and shifting coastal edges are a daily occurrence.

The focus of sea level rise quite understandably in Samoa has been on the physical impacts, wave impacts and storm surges, etc. However, there are other implications that arise which need further attention. For mangrove and wetland areas, SLR will affect the water, nutrients and biological cycling. Sediments will accrete where they have not before and erosion of some of these areas may pass on catchment sediments into areas where they have not been witnessed previously e.g. sandy beach areas. SLR can result in the squeezing of habitats against coastal cliffs and/or plains. Elsewhere in estuaries and wide flat coastal plains, changes may see the migration of wetlands and mangroves inland. This phenomenon could increase the resilience of some areas but may also impede on other healthy habitats. SLR

will eventually lead to deeper waters close to the coast in some areas. Water depth and changes to nutrient regimes may then impinge on seagrass beds which are reliant on sunlight penetration. There will be impacts also on other habitats and fauna and flora species.

Physical climate impacts

Climate change impacts on Samoa's physical climate are projected to be severe in terms of warmer weather, more extreme heat waves, more severe tropical cyclones, more intense rainfall and increased drought conditions. Water security especially where seawater inundated the groundwater system, or prolonged drought conditions will become a key challenge for the country. High intense rainfall will cause severe flooding in low-lying areas, and especially in the Apia urban area. The flooding in Apia is exacerbated by urban expansion into steeper catchments. With a change of land cover in these steep and higher catchment areas, rainfall is no longer tempered by vegetation, which leads to flash flooding of Apia. The poor drainage system in Apia allows for pooling of water, potentially threatening the health of the residents.

Increasing hot days and heat waves will have a negative impact on the health of vulnerable community members, especially children and the elderly. Heat waves and hot days will encourage conditions for bush and scrub fires. Droughts will cause growth failure of crops.

Rising sea levels create not only stress on the physical coastline, but also on coastal ecosystems. Saltwater intrusions can contaminate freshwater aquifers, many of which sustain municipal and agricultural water supplies and natural ecosystems. As global temperatures continue to warm, sea level will keep rising for a long time because there is a substantial lag to reaching an equilibrium. The magnitude of the rise will depend strongly on the rate of future CO_2 emissions and future global warming, and the speed depends on the rate of glacier and ice sheet melting.

The recharging of groundwater is expected to lessen as annual rainfall lessens. Rising sea levels will also affect coastal springs as current boundaries become flooded. Damage to water supplies, water treatment and hydrological research infrastructure is expected to be significant and costly.

Response

An assessment of Samoa's vulnerability to climate change impacts has been completed. The assessment identifies vulnerable sectors.

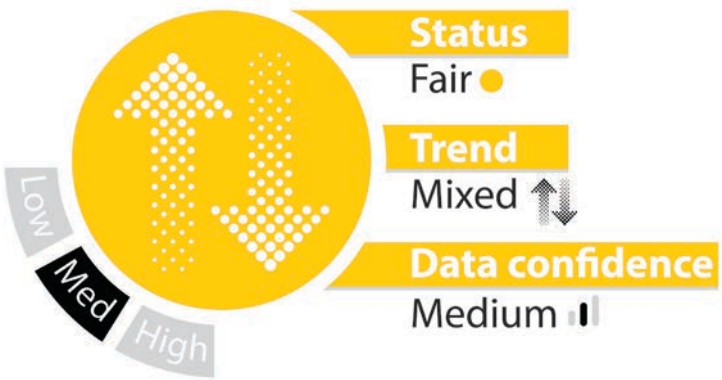
An extensive assessment of Samoa's vulnerability to climate change impacts was undertaken during the preparation of Samoa's National Adaptation Programme of Action (NAPA) and more recently the SNC V&A studies (MNRE 2007, unpublished). All sectors vulnerable to impacts of climate change and sea level rise were therein synthesised and prioritised. Discussions with stakeholders had reconfirmed the evaluations reported in the NAPA document and its basis on the synthesis undertaken.

Some communities are recognising the increased vulnerability of living along coastal areas, and have relocated inland, or have made preparations to move inland if there's a threat of storm surges, tropical cyclones or tsunamis. Some villages are undertaking coastal restoration activities, such as planting of mangroves and establishing mangrove protected areas, to help in lessening storm surge impacts to their homes.

Recommendations

- Adaptation to the various physical climate scenarios provides the government and the people the best way to manage the challenging climate projections. Adaptation includes ensuring that plans accommodate more open space and landscaping in villages and urban environments, shading and general softening of hard surfaces.
- Work with the relevant authorities to provide expert mitigating options to reduce the impact of climate change on infrastructure and the environment. This may include recommending:
  - » The use of appropriate options for coastal protections that take into consideration coastal geomorphology and tidal movements.
  - » New buildings to adopt best practice that will help climate proof buildings and infrastructures.
  - » Urban stormwater management systems to take into account the increased velocity and volume of run-off due to rain events.
- Increase coverage of robust infrastructure of observational network and enhance database to capture large scale changes in climate patterns and climate variability.
- Strengthen joint science-based research with local institutions through building of appropriate infrastructure and technology, and enhancing the capacity of staff and securing the necessary resources.
- Regularly undertake awareness raising activities to educate the public on climate change and geo-technical hazards and the need for preparation.

INDICATOR 25: Natural Hazards



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8 10 15	7 AFFORDABLE AND CLEAN ENERGY 11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 14 LIFE BELOW WATER	Sendai Framework for Disaster Risk Reduction 2015-2030 Montreal Protocol on Substances that Deplete the Ozone Layer (and amendments – London, Copenhagen, Montreal, Beijing & Kigali) Vienna Convention for the Protection of the Ozone	SAMOA Pathway Apia Convention Noumea Convention Waigani Convention Framework for Resilient Development in the Pacific.	• Disaster and Emergency Management Act (2007) • Meteorology, Geoscience and Ozone Services Act 2020 • National Disaster Management Plan (2017-2020) • Samoa Climate Change Policy (2020)

Samoa is expected to incur, on average, USD 10 million per annum in losses due to natural disasters. In the next 50 years, Samoa has a 50% chance of experiencing a disaster with a loss exceeding USD 130 million and over 325 lives lost. It has a 10% chance of experiencing a loss exceeding USD 350 million and over 560 casualties (PCRAFI 2011).

Three sub-indicators are covered:

I) Climate driven natural disasters;

II) Earth driven natural disasters (natural geotechnical hazards); and

III) Preparedness for Disasters and Emergencies.

Climate driven natural disasters

Sub-Indicator definition

As our planet continues to warm, the associated and unprecedented weather extremes will lead to disasters with devastating impacts for the environment, the economy and the people.

This sub-indicator assesses climate change related impacts on Samoa's environment, economy and people.

Status and Key Findings

The period from 2000 to 2013 was a costly one for Samoa, as a result of natural disasters. Tropical cyclones, a tsunami, bush fires, and flood events caused an estimated loss of SAT 5,211.86 million, and 155 lives lost (World Bank 2010). Over the past ten years (2013-2023), the loss attributed to natural disasters was less; estimated at SAT 93 million (Table 44).

Table 44: Natural disaster events and their impacts on Samoa since 2018. (MNRE).

DATE	DISASTER TYPE	DISASTER NAME	DEATHS	AFFECTED	ESTIMATED LOSS & DAMAGE SAT
23 April 2016	Cyclone	Cyclone Amos	Nil	Household & infrastructure	tbc
9 February 2018	Cyclone	Cyclone Gita	Nil	Households & infrastructures	12.4 million est
18 December 2020	Flood	Flooding	Nil	Households & infrastructure	80.4 million est
15 July 2022	King tide	Tide	Nil	Household & infrastructure	171,668 est
Total					**93,016,112**

Table 45: Estimated losses and damages per sector attributed to disasters. (MNRE)

	Disaster effects			Ownership by sector	
	Damage	Loss	Total	Public	Private
Productive sectors	**56,979.0**	**106,748.6**	**163,727.6**	**367.5**	**163,360.1**
Agriculture	4,905.0	58,060.5	62,965.5	275.0	62,690.5
Livestock	3,450.0	800.0	4,250.0	66.0	4,184.0
Fishing	2,069.0	5,493.0	7,562.0	25.0	7,537.0
Manufacturing	17,250.0	4,595.7	21,845.7	0.0	21,845.7
Commerce	1,605.0	15,589.9	17,194.9	0.0	17,194.9
Tourism	27,700.0	22,209.5	49,909.5	1.5	49,908.0
Social sectors	**49,182.3**	**7,587.5**	**56,769.7**	**13,462.5**	**43,307.2**
Education	7,222.1	628.0	7,850.1	6,733.9	1,116.2
Health	3,608.9	1,956.2	5,565.1	5,125.7	439.4
Housing	38,351.3	5,003.3	43,354.5	1,602.9	41,751.6
Infrastructure	**113,313.2**	**58,687.4**	**172,000.6**	**168,987.6**	**3,013.0**
Electricity	39,089.3	31,884.4	70,973.7	70,973.7	0.0
Water & sanitation	8,836.3	3,845.0	12,681.3	12,681.3	0.0
Transport	65,387.6	22,958.0	88,345.6	85,332.6	3,013.0
Cross-sectoral	**16,251.0**	**56,398.0**	**72,649.0**	**72,649.0**	**0.0**
Environment	16,251.0	56,398.0	72,649.0	72,649.0	0.0
Total	**235,725.5**	**229,421.4**	**465,146.9**	**255,466.6**	**209,680.3**

Interestingly the review indicated that 55% of disaster impacts were aligned with public sector ownership (Table 45). The most affected sectors in descending order were transport, agriculture, the environment, electricity and tourism.

Between 1970 and the 2010 season 26 tropical cyclones developed or crossed into the Samoa EEZ. This represents on average six tropical cyclones per decade. Looking forward there is a projected decrease in cyclone formation and frequency for this part of the Pacific. However, the Global Facility for Disaster Reduction and Recovery advises that the risk of cyclone hazards for Samoa will remain high.

The Australian Bureau of Meteorology (BOM) suggests that the most likely scenario is a reduction in the frequencies of tropical cyclones but there is low-confidence with this projection. Wave height and direction (and potential changes) is not yet able to be projected with high confidence.

Whether from tropical cyclones or extreme weather, flooding continues to be an issue for urban and rural areas especially along the coast. The average return interval for an extreme 6 hourly rainfall equating to 200 mm will likely increase before 2050. Flooding, especially local flooding, has tremendous implications for remote communities. Many ephemeral creeks and waterways traverse through villages and populated rural areas. Exacerbating flood events from climate change and extreme change to land use will not only see the severity of flooding but also frequencies increase. In low-lying areas along the coasts there is a myriad of minor overland flow paths that previously would not have been a flood hazard.

The World Bank Group through their series Economics of Adaptation to Climate Change, Samoa, 2010, modelled interactions between climate change and the economy to determine present value of damage to the Samoan economy through 2050 due to climate change. Without adaptation, disasters would cost the economy around SAT 104–212 million per annum (World Bank 2010). This would be equivalent to 0.6–1.3 per cent of the present value of GDP. This modelling assumes that sound development policies are adopted over time to minimise the impacts.

The most recent Cyclone Gita (2018) caused extensive landslides, coastal erosion and flood impacts along waterways and overland flow paths. The non-point damage to primary industries such as agriculture and fisheries (damage to crops, disruption to fishing fleet launches) was huge but not documented. Often the costs for such damage are not aggregated or measurable, or costs accrued in reformation works are only applied in the years after the event.

The Global Climate Risk Index report (2012) on nations suffering most from extreme weather events indicates Samoa should expect, on average over the long term, USD 10 million per year in losses due to earthquakes and tropical cyclones (World Bank 2015). Of note Samoa was ranked 51st of 179 countries as regards the levels of loss from extreme weather events. With approximately 70% of Samoa's population and infrastructure located in low-lying coastal areas, combined with projected sea level rise, storm surges, flooding and coastal erosion, loss of land and property, and dislocation will be exacerbated (WBG Climate Change Knowledge Portal 2021).

Severe weather events

A severe weather event is a hydro-meteorological event that is not a tropical cyclone or a tropical depression. It may involve very strong winds, very high and prolonged rainfall, lightning storms (that could cause fires) or even hail (Figure 117). While usually not as strong as tropical cyclones, severe weather events (including storms) can cause damage to infrastructure, assets, houses and livelihoods. They can cause extensive flooding and loss of life, which then categorised them as 'high' to 'extreme'. Severe weather events are common between October and March, or Samoa's wet season. Severe weather events can be a combination of events (e.g. intense rainfall and strong winds), or independent of each other. According to the World-Wide Lightning Location Network (WWLLN – University of Washington) Samoa receives a 'very high' number of lightning strikes each year on a global scale. Monitoring of storms in Samoa does not include records of lightning strikes or the hazards caused by them. There are anecdotal notes of bushfires being caused by lightning strikes. In September (16th) 2016, villagers on Savaii island reported hail. The conditions for the hail were due to the development of isolated deep convective clouds along the cold front, with cloud tops reaching below freezing level. Temperatures decrease rapidly due to the advection of cold aloft by the jet stream that associated with the surface front. An upper trough over Samoa at the time enhanced cloud developments over Savaii. The presence of the cold front, jet stream and upper trough increases instability, therefore the development of cumulonimbus clouds, providing conditions for hail (Samoa Meteorology Division 2016). This is the first reported hail incident for the country, and it may represent the volatility in weather patterns due to climate change.

Figure 117: Hail stones collected on Savaii island. (Samoa Meteorology Division 2016)

Young (2007) estimated that windstorms average return intervals (ARI) at 1:20 (1 in 20 years) ARI wind gust to increase from 100 knots to 107 knots by 2050, due to climate change (1 knot = 1.85 km/hr). Young (2007), further estimated the ARI for an extreme 6-hourly rainfall event of 200 mm will decrease from 1 in 30 years (1:30) to 1 in 20 years (1:20) by 2050, due to climate change. Therefore, Samoa will experience frequent extreme rainfall as it heads to the year 2050.

There are tremendous implications for remote communities and farmers. There are many ephemeral creeks and waterways that pass through villages and populated rural areas. Exacerbation of flooding events from climate change will not only see the severity and frequency of flooding along historic rivers, but also along a myriad of minor overland flow paths that previously would not have been subject to flooding.

Tropical cyclones

Tropical cyclones occur primarily during Samoa's wet season,

from November to April each year, although tropical cyclones can occur outside of the typical wet season [e.g. Cyclone Keli hit Samoa in June, 1997 (PCRAAFI 2011)]. The tropical cyclone archive for the Southern Hemisphere indicates that from 1969 to 2011, 26 tropical cyclones developed within or crossed the Samoa EEZ, representing an average of six tropical cyclones per decade (PCRAAFI 2011). There is no statistical difference in cyclone average occurring in an El Niño, La Niña or neutral years. The projection, with a low degree of confidence, is for less cyclone formation in the impact zone for Samoa (PCRAAFI 2011). However, there is still much to understand on the impact of climate change when it interacts with tropical cyclones. The known risks attributed to tropical cyclones include tidal surge along coastal areas, inundating infrastructure, gardens and homes, strong and severe wind speed and high rainfall. In 1990 and 1991, severe tropical cyclones Ofa and Val hit Samoa causing fatalities and widespread destruction with total economic losses valued between USD 300-500 million (PCRAAFI 2011).

In the capital city of Apia, a cyclone with a 100-year return period, or with a 50% change of occurring with the current generation, could likely inflict damage equivalent to 60% of GDP.

Climate Risk Country Profile: Samoa (2021): The World Bank Group

Within the last decade a number of tropical cyclones have caused damage to households and infrastructure. This includes Tropical Cyclone Amos that affected Samoa in 2016. A rapid assessment following the cyclone noted four families in Savaii and one on Upolu, were evacuated by Police and Red Cross to higher ground due to river flooding. Initial assessments from the Electric Power Corporation showed that around 70% of the country experienced power outages as a result of the cyclone. There was minimal damage and loss to crops such as banana and breadfruit. No significant impacts to education and tourism. Water supply for Rural Upolu Service areas and Savaii Service Areas were resolved within 24-48 hrs. In 2018, tropical cyclone Gita struck Samoa (Table 45), causing damage to power and water supply infrastructures, leading to disconnection of these critical services in most parts of the country. Road access around the country was disrupted due to flooding and landslides. Inter-island ferry and air transportation services were also disrupted. Telecommunications and internet connectivity remained functional with minimal disruption experienced with mobile telecommunication due to intermittent power outages. Broadcast media outlets also experienced disruption to their services due to the power outage. government and private offices, schools as well as businesses were also closed, except for essential public services. The essential services remained operational to support emergency response actions for public safety. Fallen trees and uprooted crops such as banana and breadfruit trees were observed throughout the country. A few residential homes sustained damages to the roofs as recorded by the Initial Damage Assessment Teams with more expected to be affected by the floods in some parts of the country. Some observations of the impact of tropical cyclones on biodiversity, noted that the majority of the trees that were affected were invasive species including Albizia (Tamaligi) and Spathodea campanulata (African tulip).

Storm Surges

While often associated with tropical cyclones, non-cyclonic storm surges can also be experienced especially when high tides and king tides coincide with very strong storms and/or winds. Given the very low-lying coastal areas, high local flooding occurrence (poor local drainage about villages) can exacerbate the impact of storm surges from the sea. Conversely when local flooding coincides with storm surges, low lying areas, which are common about the coastal plain, can remain inundated for days. In Samoa storm surges can also coincide with high groundwater levels again causing serious flooding and damage. Other than nuisance impacts, storm surges can still lead to loss of life and significant damage to public and private assets, including gardens. Storm surges are also noted independently as providing a severe hazard along the coastlines. These can coincide with high tides and king tides and cause huge impact especially where waterways traverse through populated villages. Low-lying areas common about the coastal plain can remain inundated for days after such events. The impact on groundwater levels is high, with risk for surface water availability within the coastal zones.

Floods

The World Bank Group's climate change knowledge portal highlights that for Samoa the increasing extreme rainfall episodes will lead to more significant flooding. Of concern is the projection of individual daily rainfall that will lead to exponential increases in flash floods. However, the multi day rainfall increases will see a broader spatial footprint meaning extensive flooding events. The data do show that rainfall events of 300+ mm, which used to be extremely rare, are predicted to occur on average, every seven years by 2050. This is consistent with trends over the past 20 years, which has seen a significant intensification of rainfall. This extreme rainfall pattern causes dangerous flooding as has been often observed in Samoa, and especially in Apia. The implications of these and smaller events, and the intensification of them, should be considered in the context of future development planning and the need for disaster risk

reduction (Second Nationally Determined Contribution 2021; Intended Nationally Determined Contributions 2015).

Drought

A climate risk report has found that drought incidents have increased in Samoa (World Bank 2021). The influence of La Nina and El Nino to Samoa's drought conditions is significant, with the latter resulting in more droughts. The impacts of drought on communities can include food security (especially if crops failed), water security (rivers and wells run dry), and bush or scrub fires (high fuel load caused by dried matters). In the second half of 2015, Samoa declared a meteorological drought (Figure 118 – Figure 119). The Samoa Climate Early Warning System (CLEWS) recorded below normal rainfall (triggering the threshold of a meteorological drought) in about 60% of the country, particularly to the north and central parts of Upolu island, and the eastern region of Savaii island (Meteorological Office Samoa 2015).

Standardised Precipitation Index (SPI) drought projections for Samoa show that the overall percentage of time that will be spent in drought conditions may slightly decrease under a low emission scenario (RCP 2.6), but will stay generally the same across other RCP scenarios. Under the highest emission scenario (RCP 8.5), the frequency of mild, moderate and severe drought events is projected to decrease slightly, but the frequency of extreme drought as well as the duration of drought events in all categories is expected to remain stable. The direction of these changes is considered with low confidence due to similar confidence levels in understanding rainfall changes, and drought projections are based on a subset of models, in addition to uncertainty in ENSO changes.

Samoa's Four types of Droughts:

- **Meteorological drought**
  This is defined usually on the basis of the degree of dryness, *below "normal" or average amount for the consecutive 3 months*. Meteorological drought is the first of four levels of severity or definitions.
- **Agricultural Drought**
  An Agricultural drought links various characteristics of meteorological, or hydrological, drought to agricultural impacts, focusing on precipitation shortages, differences between actual and *potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth*.
- **Hydrological Drought**
  Hydrological drought is associated with the effects of periods of precipitation shortfalls on surface or subsurface water supply such as stream flow, reservoir and lake levels, and groundwater. The frequency and severity of a hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually *out of phase with or lag the occurrence of meteorological and agricultural droughts*. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, stream flow, and groundwater and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.
- **Socioeconomic Drought**
  Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the other types of droughts because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Because of the natural variability of climate, water supply is ample in some years but unable to meet human and environmental needs in other years. Socioeconomic drought occurs when the *demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.*

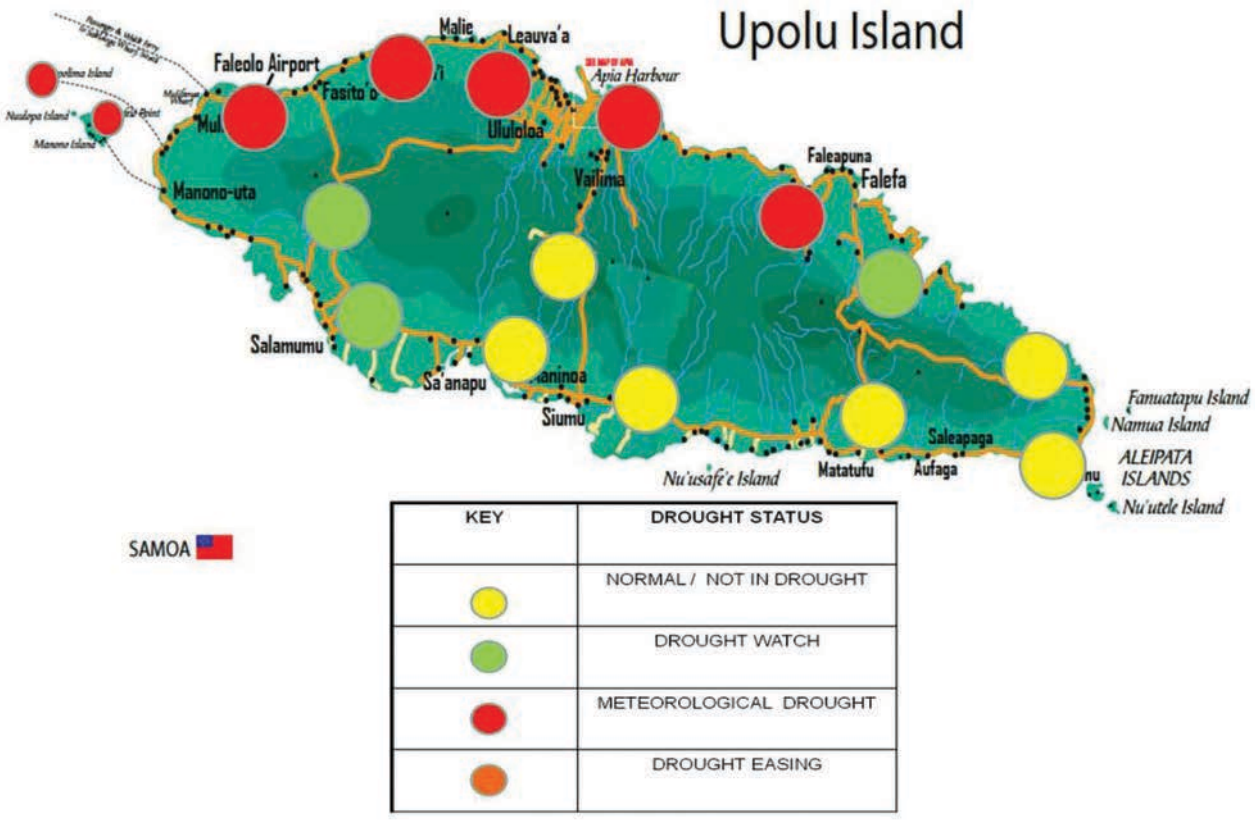


Figure 118: 2015 Meteorological drought declared by the Government over Upolu, Manono and Apolima islands (Samoa Meteorological Office)

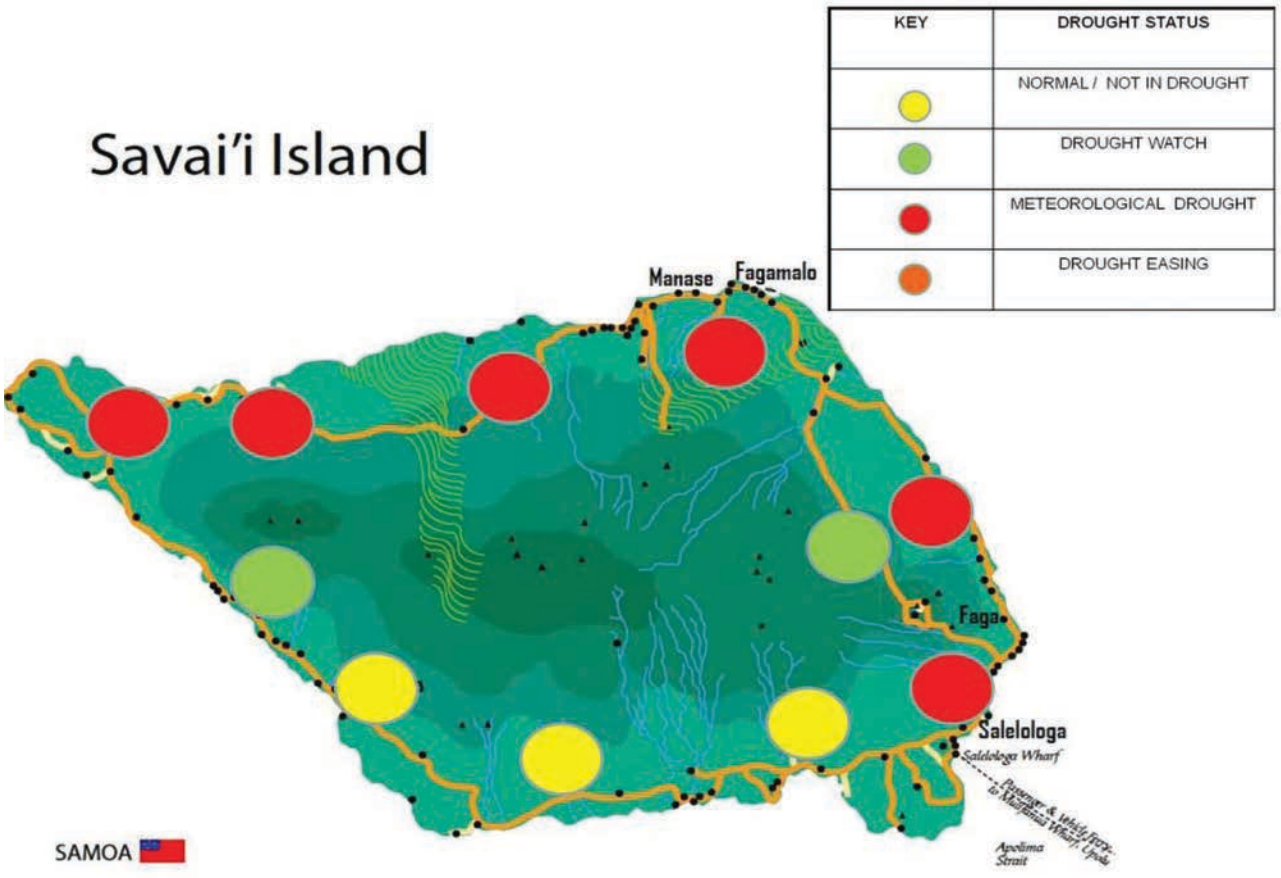


Figure 119: 2015 Meteorological drought affecting Savaii northern side (Samoa Meteorological Office)

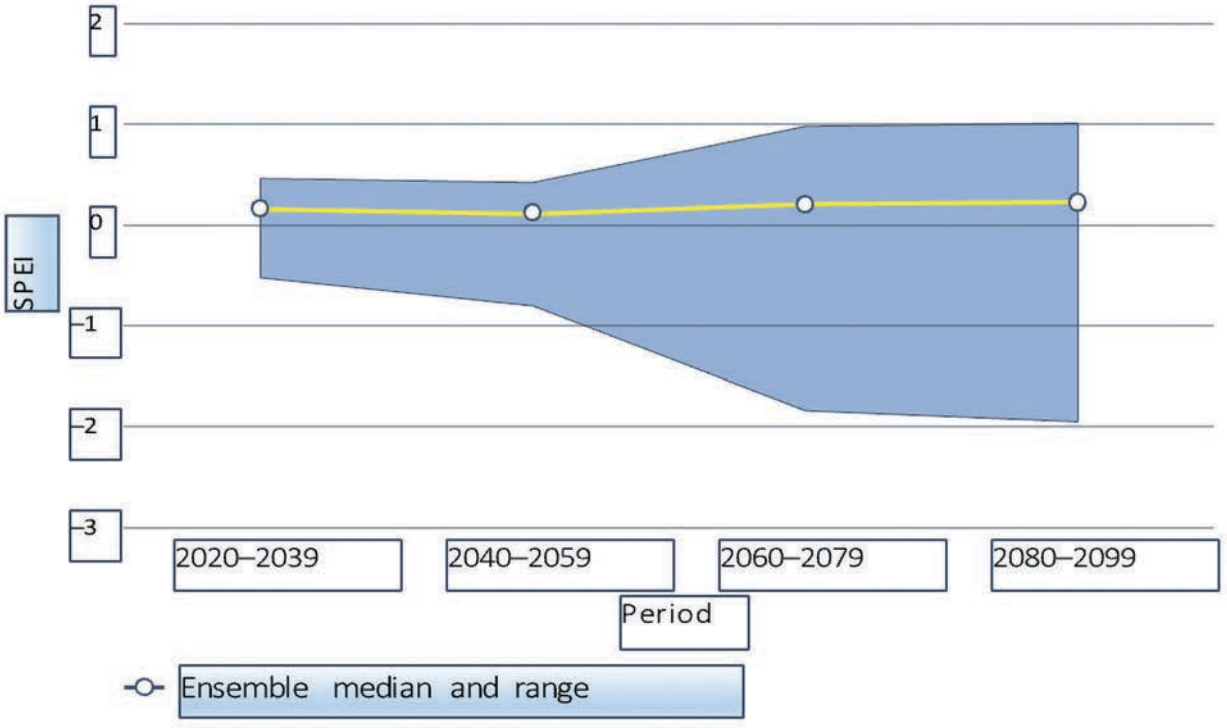


Figure 120: Looks at the projected changes in the annual mean drought index for Samoa. Positive values indicate wet or good water balance, whereas negative values indicate dry conditions. The Standard Precipitation Evapotranspiration Index (SPEI) trends to 2100 in Samoa vary considerably, therefore more research is needed.

Bushfires

Recent incidents of bushfires have increased due to long periods of drought conditions in Samoa. The majority of the bushfires have occurred on the northwest of Savaii and Upolu islands, where conditions are generally drier than other parts of the country (Figure 121). Some of the bushfires are caused by lightning, but often they are caused by human actions, such as uncontrolled burning. When high winds are present during a bushfire, extensive areas can be burned, leading to livestock and crop losses, and infrastructure, including homes destroyed. In some severe cases, loss of life can occur.

For bushfires the median projection for Samoa is that temperature will increase 2 degrees in warmer months. It is expected that 10-year drought events will continue to increase especially to the northwest dry areas of both Upolu and Savaii. However, there are uncertainties regarding the precipitation and temperature variations and the impacts on bushfires. Whichever way, expected continuation of dry areas experiencing less rainfall will see further drought events and from these the increase in bushfire hazards.

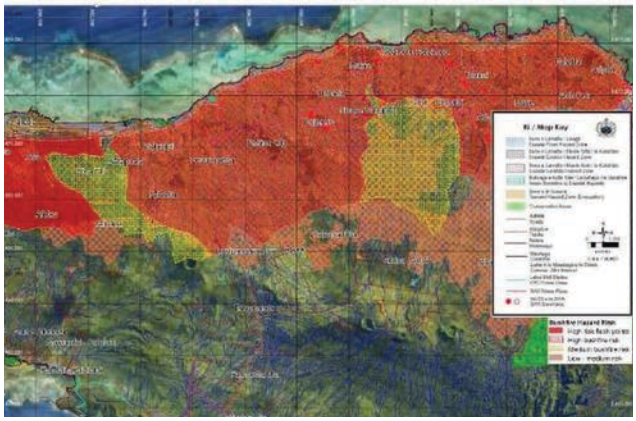


Figure 121: Bushfire hazard and risk map of Upolu island (MNRE)

Heat waves

Heat waves are defined as a period of three or more days when the daily temperature remains above the 95th percentile. For Samoa, the projections of increased heatwaves under the RCP 8.5, are high (Figure 122). The current temperature threshold is already at the higher end, and any slight increase will result in severe and uncomfortable conditions for the human body. The comfort level is also assessed by considering the impact of humidity through 'heat index'. By 2100, the projected change in the Heat Index 35 for Samoa is 274; this Index represents a change in the total count of days where the daily mean heat index rose above 35°C relative to the reference period (1986–2005), under RCP8.5. However, it is noted that further research is required to better understand the implications of climate change, and its interaction with the ENSO phenomenon, for its future regime and potential heat waves.

An additional factor for consideration is the potential for marine heat waves. Research has shown that "from 1925 to 2016, global average marine heat wave frequency and duration increased by 34% and 17%, respectively, resulting in a 54% increase in annual marine heat wave days globally". While such research has not specifically identified Samoa as under threat, the consequences of these trends may be serious for marine ecosystems in the region, which are adapted to survive under very stable temperature regimes, as well as the livelihoods dependent on them.

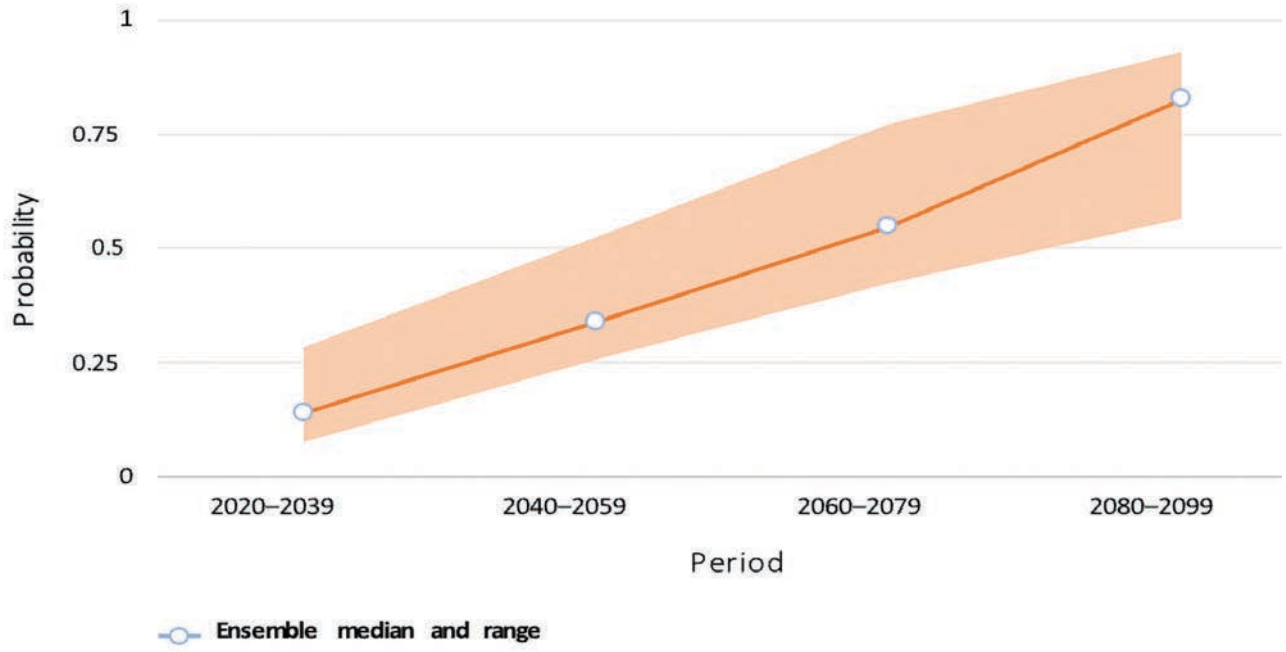


Figure 122: Projected change in probability of heat waves in Samoa under RCP 8.5 (World Bank Group – Samoa country profile, 2020)

Impacts caused by climate driven natural disasters

Climate change has influenced and continued to drive much of the changes in the global weather patterns. The influence can lead to unseasonal weather patterns, such as dry periods or tropical cyclones occurring outside of the wet season. Impacts from natural disasters driven by climate change and severe weather patterns continue to be a challenge for Samoa and in many parts of the world. While infrastructure loss is inevitable, the loss of life is a driving force for the government, to put in place measures to minimise the loss of life.

One of the many consequences of disasters is the displacement of people from homes, and from gardens and farms. Anyone that has been displaced due to disasters will be affected by the loss of their belongings, the economic impact due to relocation and starting over again, the psychological distress and the loss of connection with culture and the environment.

Changes to the catchment, including soil and water profiles may well favour the proliferation of existing or new invasive alien species (IAS, pests and disease vectors etc.). This further threatens crops and livestock, as well as human health.

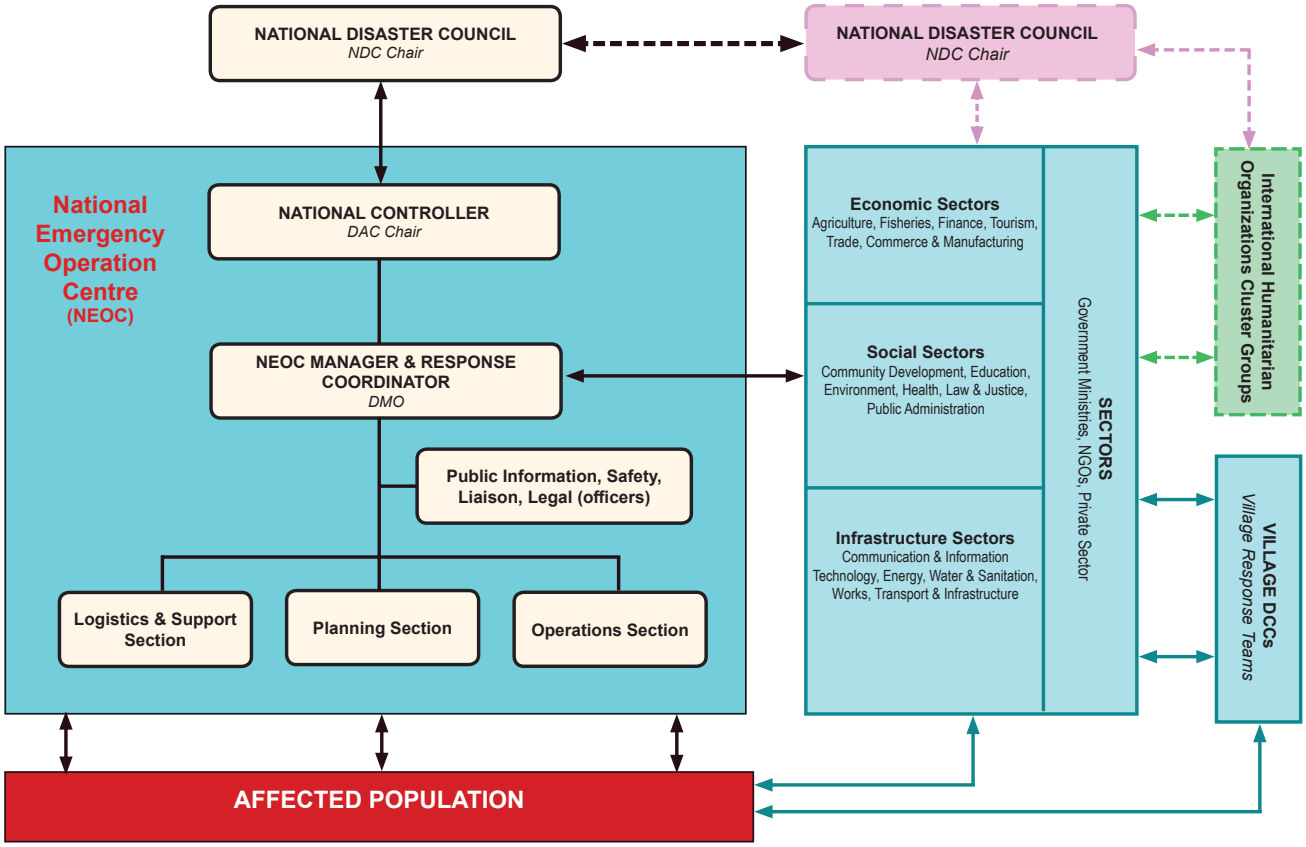
Other losses are also noted:

- Loss of tourism earnings from damaged or non-accessible landscapes and coastal areas. Tourism earnings have consistently been the largest source of foreign exchange. Total revenue of tourism grew from USD 40.6m in 1999 to USD 107.3m in 2017.
- Health and wellbeing impacts: Climate and natural disaster events disproportionately affect the poor in the community. The poor often fill the manual labour jobs, so heat stress becomes a significant issue. The poorer business owners are less likely to afford air conditioners. Poorer rural families and farmers are less able to afford water storage facilities, or improve water catchment measures, or adapt technologies such as irrigation. They too often live in flood and disaster-prone areas – so loss of life is a high potential.

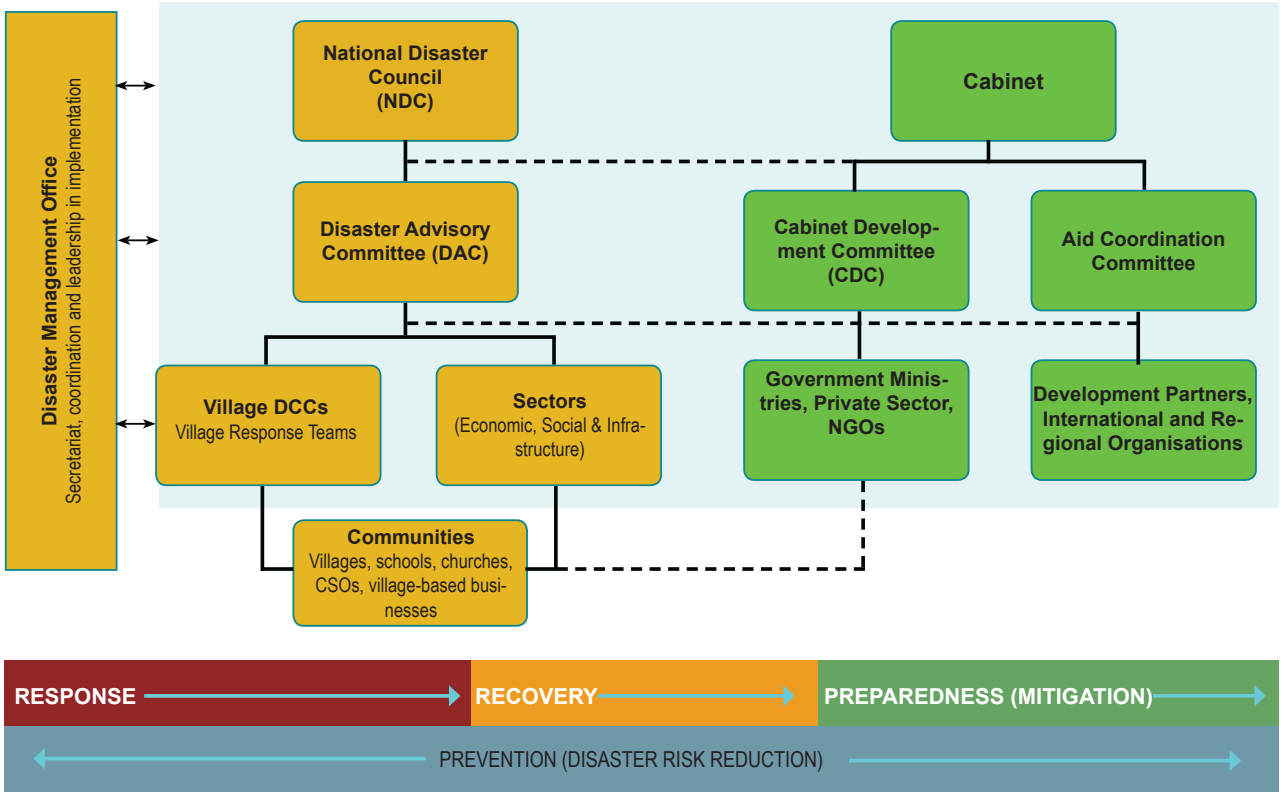
Response

Tropical Cyclone Standard Operating Procedures are in place if a cyclone is imminent. Special Weather Bulletins (SWBs) are issued to warn the public, so nation-wide preparations can begin. A national framework response has been developed, which includes the Disaster Advisory Committee and the National Disaster Council. If a cyclone is imminent, a Declaration of Disaster is issued following the recommendations from the National Disaster Council, and in accordance with the Disaster and Emergency Management Act 2007.

The Disaster Response Operations (National Emergency Operation Centre) is activated to coordinate emergency response actions by sectors, communicate with the response sectors, the public and other key stakeholders, as well as provide the necessary relief support to the displaced population (see figure below). The NEOC is overseen by the Disaster Management Office (DMO), with the support from seconded personnel from all ministries and other divisions of MNRE. Other partners outside of the government ministries are also part of the national response including the Adventist Development and Relief Agency (ADRA), the Samoa Red Cross, Chamber of Commerce, the Private Sector, and the United Nations Development Programme (UNDP).



A Disaster Risk Management Organisation Structure has been endorsed to guide the coordination and implementation across all phases: risk reduction (prevention/mitigation); preparedness; and response and recovery.



Recommendations

- Planting more native trees will reduce the impact of tropical cyclones on faster growing but easily damaged introduced species.
- Coordination and consistent monitoring of climate driven natural disasters to provide further understanding of the existing situation and to develop future plans to adapt to a changing environment.
- Ensure national Statistics on loss and damage includes, not only economic and infrastructure asset losses, but losses in agriculture, tourism and small business.
- Institute a means to account for loss of life that can be attributed directly to climate change and exacerbation of natural disaster impacts.

Natural geotechnical hazards

Sub-Indicator definition

Geotechnical Hazards are earth movements that can affect infrastructure construction plans and foundation efforts. Shifts in soil and groundwater for example can have a major effect on how a building is constructed, as additional support and mitigation may be needed to ensure long-term stability.

This sub-indicator assesses the trends with natural induced geotechnical hazards and risks

Status and Key Findings

Geo-hazards

Many inland geo-hazards, such as volcanic activities, earthquakes, landslides, tsunamis, rock slides and coastal erosion are the result of natural geological processes. When these geo-hazards occur, the impacts and outcomes can be devastating to human lives, economy and the environment. If these geo-hazards are coupled with unregulated human activities, such as the clearing of land, drilling into groundwater aquifers, cutting into steep slopes, and building on unstable slopes these geotechnical events will add further stress on the environment and humans. In terms of severity, volcanic eruptions, tsunami events, landslides hazards (rock fall, debris flow, slope failures, etc.), present the highest risk (Table 46 below). They can be heightened in areas already prone to movement or failure often characterised by highly weathered rock, highly fractured or jointed formations, whether as lava tubes or ancient geological sites. These geo-hazards are poorly documented in Samoa. Both Upolu and Savaii islands have conditions that can cause land slips and rock falls. These geo-hazards are sometimes triggered by weather events, including intense rainfalls and tropical cyclones.

Table 46: Risk levels associated with Geo-hazards

SAMOA GEO-HAZARDS RISK LEVELS		
Natural Geological Induced Events	Colour Code Risk (Loss of Life, Damages, Injuries, Vulnerability, etc.)	Frequency of Event
Land subsidence (due to tectonic events)	LOW	~ 8 mm per year
Earthquakes of magnitudes less than 5.0	LOW	~ 200 per month
Earthquakes of magnitudes between 5.0 and 6.4	MODERATE	~ one every 2 months
Earthquakes of magnitudes between 6.5 to 7.4	HIGH	Less than 5 years
Earthquakes of magnitudes greater than 7.4	VERY HIGH	From 5 to 30 years
Tsunami event	VERY HIGH	From 5 to 30 years
Landslide (rock falls, debris flow, slope failure, etc.)	VERY HIGH	From 5 to 30 years
Volcano eruption	VERY HIGH	More than 50 years
The above Geo-hazards risk levels are based on more than 30 years of seismic data recordings at the National Tsunami and Earthquake Data Centre, Meteorology Division. (Geoscience Section, Meteorology Division. Ministry of Natural Resources and Environment of Samoa 2023).		

Tsunami

Samoa's southwest location adjacent to the Pacific Ring of Fire increases the country's risk to tsunamis. Tsunamis are caused by earthquakes or other seismic eruptions, especially in the ocean. These can cause tidal waves, which run with enormous force on land, causing devastation. The Pacific Ring of Fire is an area that has witnessed high tectonic plate activity with 115 tsunamis known since 1922, many of which have led to significant damage and loss of life. A total of 12 tidal waves, classified as a tsunami, since 1868 have killed 360 people in Samoa. The 2009 tsunami led to a tidal wave of around 22 m that engulfed shores and low coastal plains about the two main islands. There were 155 lives lost in Samoa, with 34 deaths in American Samoa and 9 in Tonga (World Bank 2010; NOAA 2021). Twenty coastal villages in the south and southeast of Upolu received the full impact of the tsunami, with widespread damage to transport, power and telecommunication infrastructures. About 5,300 people were affected, with 3,000 losing their homes. It caused about USD 200 million dollars in damages. There was much alteration of parts of the coast affecting coastal processes and the interface with the coastal plains. Ongoing physical and economic impacts prevailed. Based on estimated production losses in consideration of the labour force, the assessment estimated a loss of nearly 9,600 jobs across many sectors but especially agriculture and tourism. It was projected that the GDP would be negatively affected by 0.2% by 2012, nil or in the negative by 2013 and would be a whole percentage point below forecasts by 2014. Tax revenues would be affected as would Balance of Payments for the country (Samoa Post Disaster Needs Assessment, Cyclone Evan, 2012). One of the unfortunate consequences of the tsunami was subsidence in some parts of the coastline, thereby exacerbating sea level rise's impact in those areas, by 8 to 16 mm per year.

Earthquakes

Samoa is situated in a relatively quiet seismic area but it is surrounded by the Pacific Ring of Fire, which aligns with the boundaries of the tectonic plates. These boundaries are extremely active seismic zones capable of generating large earthquakes and, in some cases, tsunamis that can travel great distances. The strongest earthquake in Samoa happened on 29 September 2009 with a magnitude of 8.1 on the Richter scale. Ten minutes after the earthquake was triggered, a tsunami struck the south coast of Upolu travelling 1 km inland in low-lying areas, and up to 22 m in some areas facilitated by the coastal topography. The projection is a 40% chance in the next 50 years, for Samoa to experience moderate to very strong levels of ground shaking. This will cause damage, ranging from light to moderate to well-engineered buildings, and even more severe damage to structures built with less stringent criteria (PACRISK 2011). The estimated average annual loss attributed to earthquakes, is USD 2.9 million. The majority of the loss is from buildings, followed by infrastructure.

Coastal erosion

Coastal erosion is a continual activity where there is often loss of coastline followed by rebuilding through natural processes. It can be influenced by geological form and is also often triggered by a combination of human activities and climate change (e.g. sea level rise). Poor catchment management, changing natural waterway flows, changing reef areas and lagoons, reclamation of coastlines and the removal of coastal vegetation contributed to coastal erosion. Paleochannel activity, longshore drift, iron bounced coastlines and high sedimentation zones along the coast are also variables that influence change. Paleochannel networks generate a series of sunken waterways, collapsed lava tubes and broken reef platforms along many parts of the coast. Abrupt changes to the paleochannel networks can result in dramatic change to the whole profile of the coastline, exacerbating erosion.

Coastal erosion can threaten key infrastructure, utility services, private property and community heritage sites, such as community pools. Where reefs have been subject to human damage coastal erosion can seriously impinge on tourism operations. Coastal erosion hazards and impacts have been exacerbated by sand mining operations, rapid development along the coast, poorly designed sea walls as well as natural processes of longshore littoral drift and the collapse of paleochannel networks.

As a response to the tsunami in 2009, followed by Cyclone Evan in 2012, an extensive programme of building of seawalls along many stretches of the coastline took place. Seawalls are known to be problematic. Often quick construction and lack of understanding of the specific coastal processes at location, results in the collapse of the sea walls, and incremental damage to coastal sand budgets. Sea walls around the globe are a common automatic response to what is perceived as an erosion risk along the coastline. Invariably hard constructions such as seawalls are prone to structural failure, overtopping and underscoring leading to complete collapse. New designs have been trialled since 2013 to protect the shoreline by absorbing wave power rather than reflecting waves.

Rockfalls and landslides

Many communities are at risk of landslide and rock fall activity. The fractured nature of the surrounding geology and its high risk can be exacerbated by poorly located development and extension of urban areas into steep lands (Figure 123). Urban and land use planning should be enhanced to firstly identify risk areas and deter development on steep lands.

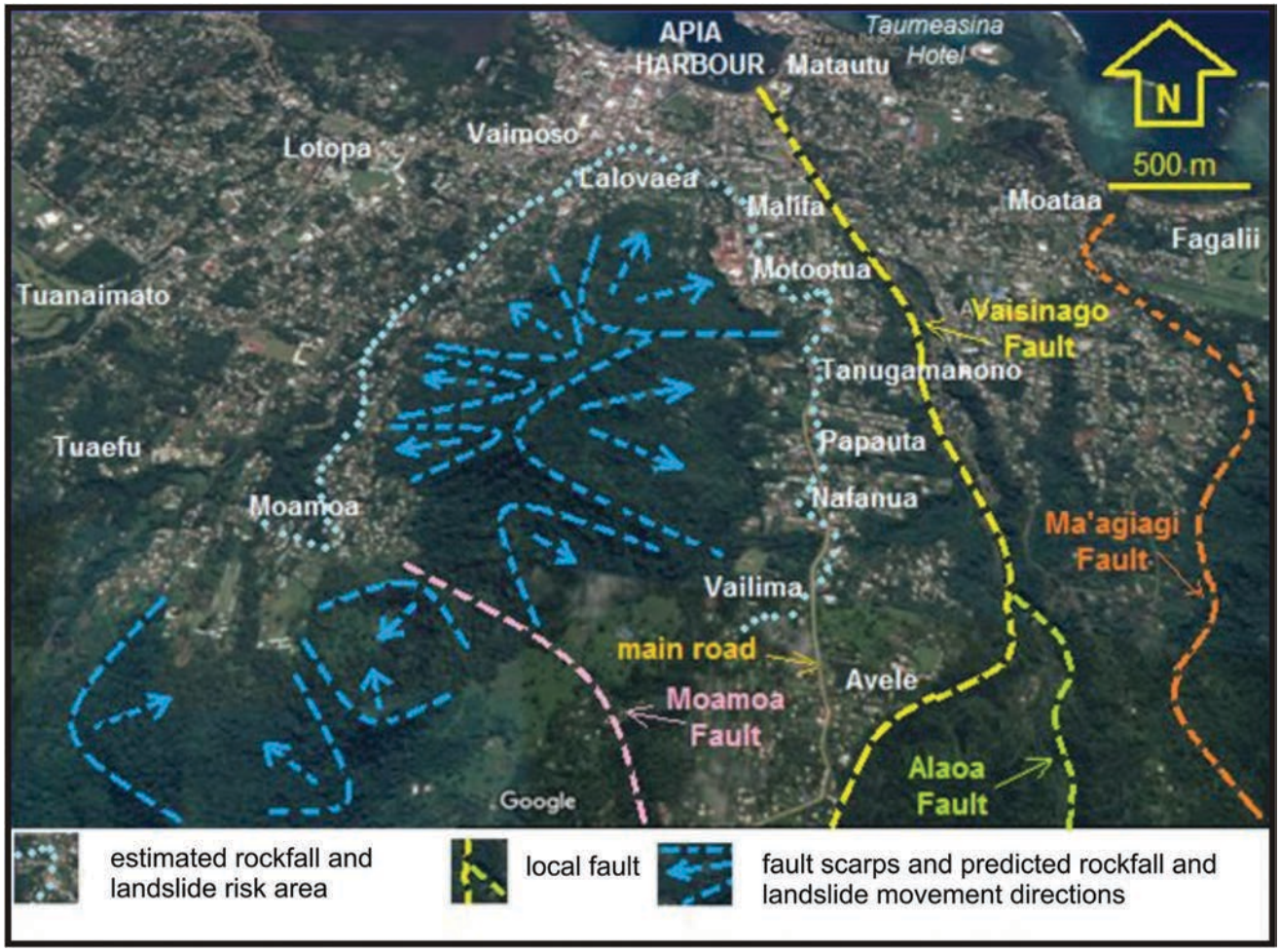


Figure 123: High risk areas inland from Apia, where a number of faults lie, posing risk of rockfall and landslides.

Natural Geotechnical Hazard Impacts

Geo-hazards, such as volcanic activities, earthquakes, landslides, tsunamis, rock slides and coastal erosion are a serious threat to the environment, community infrastructure development, national economy and the health and well-being of Samoa communities. Geo-hazards, such as volcanic activities, earthquakes, landslides, tsunamis, rock slides and coastal erosion are a serious threat to the environment, community infrastructure development, national economy and the health and well-being of Samoa communities. These natural geotechnical hazards have always been part of the history of Samoa, although some are 1 in 100-year events, whereas others are daily occurrences. With the changing landscape and the increasing impact of human footprints on the planet, many of the natural processes are increasingly becoming common. While natural hazards impacts to communities may have been tempered by the smaller population in the past, the increased population and associated activities are putting more people's lives and infrastructure at risk.

A third element to the geo-hazards and human development interphase, is climate change and associated extreme weather events. These three factors are elevating the level of risk and the frequency of events, which will have dire consequences to the environment, to the lives of the people, and the economic wellbeing of Samoa.

Response

The Samoa Meteorology Division of MNRE is the mandated government agency for monitoring and forecasting natural hazards, including meteorological, hydrological, and seismic hazards. It is also the official Tropical Cyclone Warning Centre for Samoa. The MET Division provides information on hydro-meteorological and seismic hazards to the media, NDMO, the Disaster Advisory Committee (DAC), and the National Disaster Council (NDC).

A review of climate and natural disaster hazards and risks for the 16 districts of Upolu and Savaii islands has been conducted through a World Bank and Adaptation Fund Climate Resilience project. Comprehensive mapping of various climate related and natural hazard factors and risks to communities was carried out. The various hazards and risk potential were considered in terms of the resilience of coastal systems, and economic infrastructure. This was used together with LiDAR data to produce maps for waterways, land elevation and land cover. This terrestrial based work was also tied to bathymetry data to ensure seamless imagery and mapping could also consider the confluence of terrestrial and marine related features and hazards.

The Planning and Urban Management Act (2004) and the implementing agency (PUMA), oversee all development work in the country that may have an impact on the environment and the well-being of communities. PUMA's initial focus has been in Apia, but with development activities taking place in remote and rural areas, it is imperative for PUMA to oversee these developments.

Various hazard-risk profiles are now available as a result of programmes and projects such as:

- Pacific Catastrophe Risk Assessment and Financing Initiative (SPC).
- World Bank Community Integrated Management Plans (CIM Plans and CIM Strategy).
- Australian Pacific Climate Change Science Program.
- Global Risk Index.
- Asian Development Bank and Applied Science and Technology Division SPC (formerly SOPAC) drainage capacity-building programme in flood modelling.

Broad-scale hazard and risk mapping has been carried out in a number of areas, but work needs to be duplicated and presented as combined natural disaster risk assessments for better planning. The work needs to contend with the array of hazards and risk elements as follows:

- Coastal flooding.
- Coastal erosion.
- Landslips and mudslides.
- Catchment flood hazard maps for all large river basins similar to that generated for east Apia by Water Technology Pty Ltd (for ADB). See Figure 124 below.
- Tsunami evacuation maps (originally by GNS New Zealand, 2009) and updated by the CIMs project.
- Wind hazard and earthquake ground-shaking intensities, modelled to date for Samoa as part of PCRAFI programme.

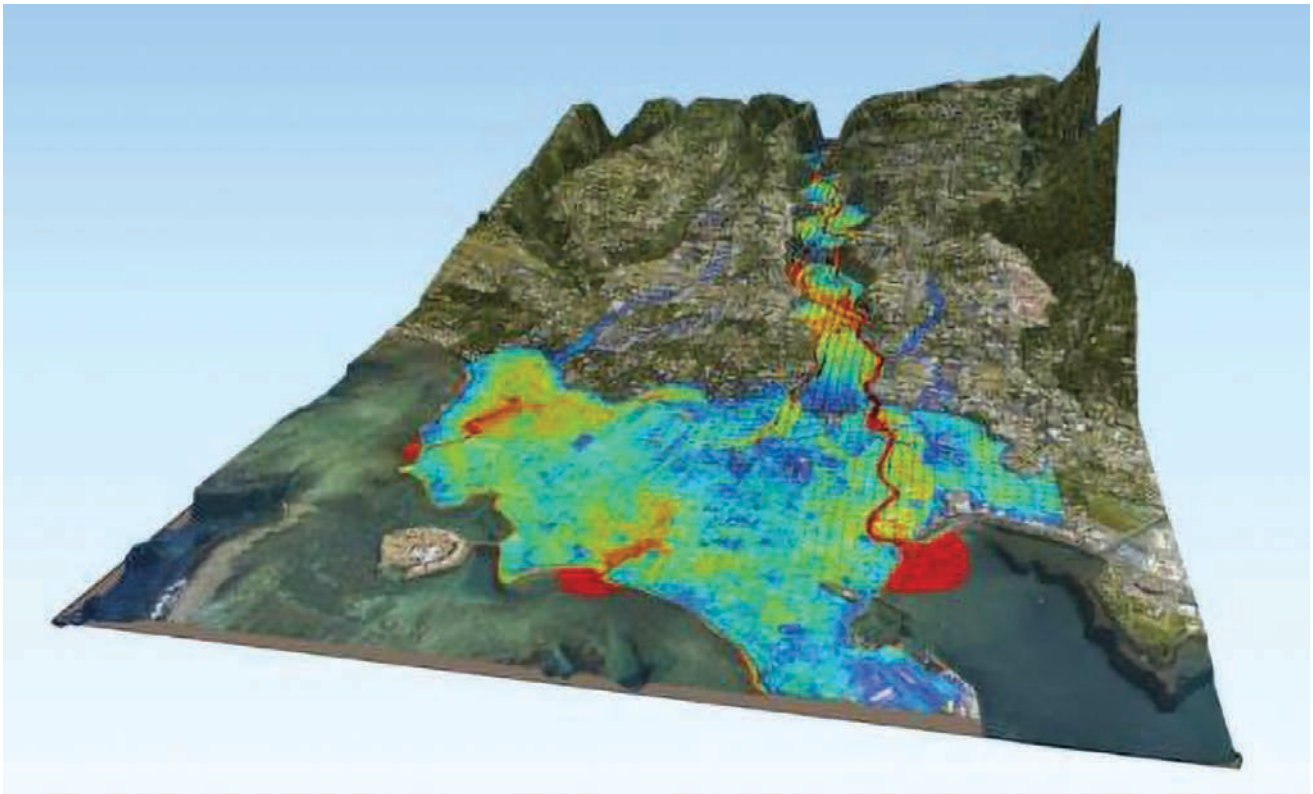


Figure 124: Flood modelling of Vaisigano River by Water Technology Pty Ltd.

Recommendations

- Contemporary risk information needs to be available and accessible to planners, decision-makers and the affected community members. Participatory methods should continue to be used to ensure risk assessments and output plans are evolved through effective knowledge sharing and understanding. A better informed and involved community will have ownership of plans to make implementation more palatable.
- Building capacity for resilience assessments and decision-making is critical but so too is ensuring disaster preparedness and response mechanisms are in place. Early warning systems need to be technologically enhanced and capacities about the two main islands strengthened.
- The Sendai Framework, and its predecessor the Hyogo Framework Action (HFA), notes that Disaster Risk Reduction (DRR) should be an "integral objective" of development and environmental management and economic development pursuits. The Frameworks recognise the cross linkages between climate, natural disasters, economic resilience and quality of life needs. There is a growing appreciation of the need to regulate human activities especially in an era of massive change. The Framework further notes the need for mainstreaming DRR through land use planning, development management (location and design) and environmental policies and plans.
- The National Building Code incorporates a number of key environmental parameters, including energy efficiency and climate change considerations. Measures to increase resilience to disasters have traditionally been the focus of the NBC, however, with evolving risks and improved knowledge, the code may need to be reviewed and amended.
- In terms of equity the human scale and impacts cannot be ignored. There is a need to improve risk assessments through including social and cultural dimensions (e.g. gender, age, education, health, social networks, cultural practices, safeguards, economic exposure, and coping capacities to climate change and natural disasters). Assessments should take account of the coping or adaptive capacities of different communities and their systems.

The following specific recommendations are focused on some of the potential hazards.

Coastal erosion: As a general rule, the 'Soft-on-soft, and hard- on-hard' should be adopted when deciding the benefits of a seawall versus the use of an ecosystem-based approach, to maintain coastal resilience. Seawall construction slope angle should not be more than 45 degrees, corresponding with the natural slope of the beach. Design should be able to

absorb the wave energy, and not to deflect the wave. Absorption of wave power will continue the flow of sand to the beach causing sedimentation, which is healthy for the coastline. When there is a strong deflection then erosion is likely to occur. Some of the activities that could be adopted include:

- Replanting native Samoa salt-tolerant species along the coasts.
- Sustaining and maintaining the integrity of marine habitats, to reduce pressures on paleochannel networks.
- Identification of thick sand deposits offshore from accumulation of sand from drift.
- Protection from hazards may necessitate the use of small groynes using natural materials, such as coconut tree trunk wood and rock.
- Construction of well-designed seawalls in the right location, correct shape, using best suited rock.

Groundwater systems: The impacts of groundwater systems can be managed in several ways, including:

- Understanding of the geological nature of the area before drilling/disturbance.
- Gather information on the structure, default network and the age of the local geology especially lava suites.
- Future groundwater expectation must be linked to long-term monitoring to balance extraction with refreshed groundwater supply.
- Pumping should be calibrated to ensure it matches source recharge rates.
- Land should be carefully managed to ensure the quality of the groundwater supply system.
- Continue program of training of SWA staff in the fields of hydrological cycling, geophysics, borehole sighting, common drilling best practice, pump testing and borehole management.
- For larger diameter boreholes, pumping rates should be restricted to 7 litres per second, fitted with monitoring systems and connected to a reliable electric source.

Landslides and rockfalls: There is limited information on landslides and rockfalls hazards and risks. An investigation by Fepuleai and Nemeth (2017) on rockfalls and landslides was linked with volcanic activities, providing a starting point for Samoa. There is a lack of ongoing detailed studies and continuity of monitoring to create valuable time series information about hazards and risks. An early warning system needs to be developed, which relies on detailed investigations and ongoing monitoring. There is a need to improve knowledge on the current seismic activity in the country, and identify high risk areas based on fault systems. Other areas needing further investigation include:

- Seismic activities along the major fissure systems.
- Prediction of eruption or possible vent action.
- Dimension of magma source material.
- Identification of risk areas for landslides and rock falls.

Volcanoes and Volcanic eruptions: Better detailed mapping tied with an understanding of seismic networks along the major fault lines would provide valuable information for future development and risk reduction measures (Figure 125).

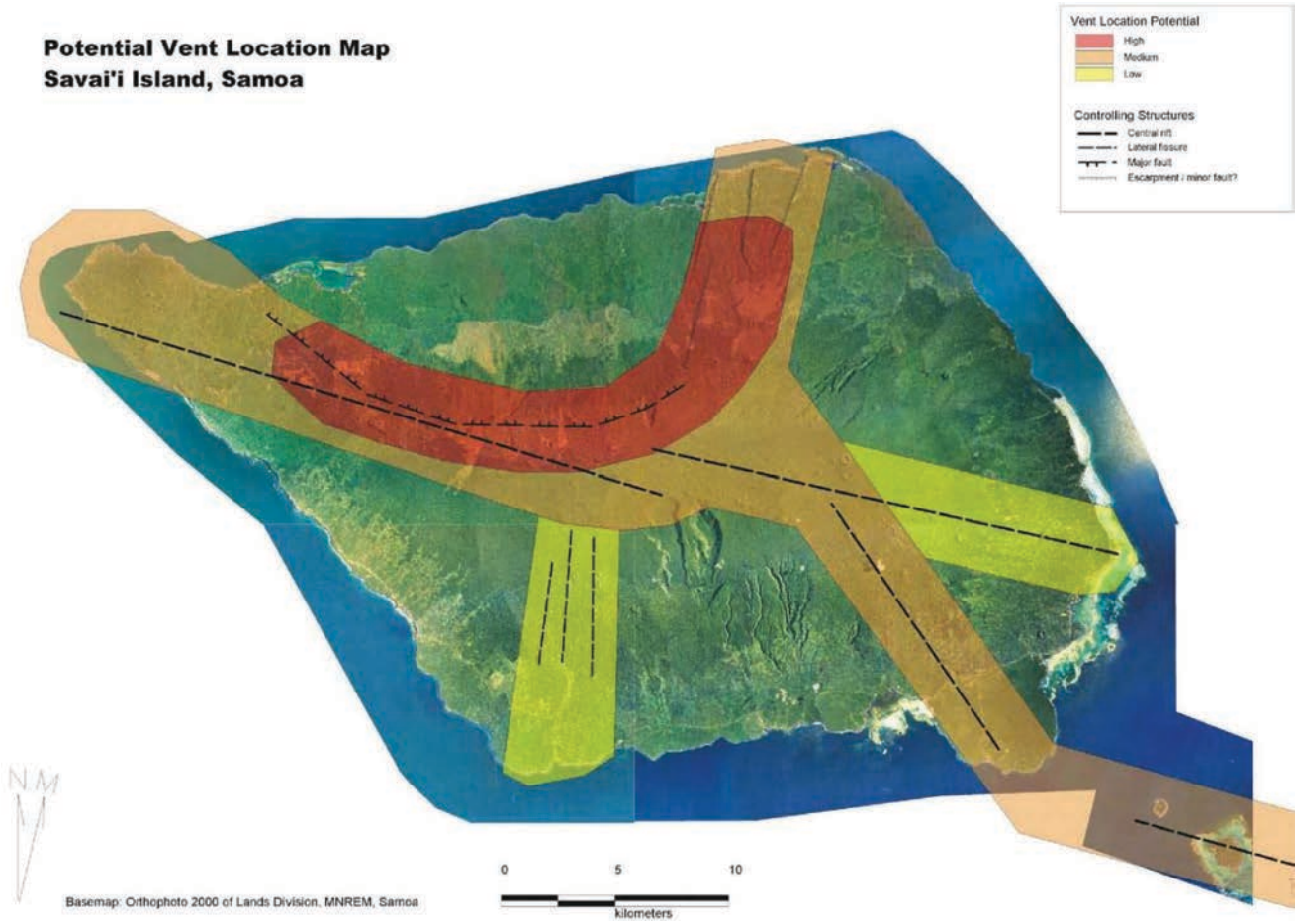


Figure 125: Volcanic vent potential zones in Savaii (MNRE)

Disaster risk management and preparedness

Sub-Indicator definition

Samoa has experienced its fair share of natural disasters, whether due to geological processes or meteorological events. The state of these processes and events is discussed elsewhere in the SOE, whereas this indicator assesses Samoa's disaster risk management and preparedness in terms of response.

Status and Key Findings

A household survey was carried out in 2018 to collect information on the vulnerability of communities, with the results to be used for developing management response, plans and strategies (MNRE 2016). The survey found a third of households' houses were vulnerable to tropical cyclones. The vulnerable houses were mostly faleo'o and tin shacks (faleapa laititi). Most households were unprepared if there was a water shortage, with most relying on others for their water supply (e.g. District or Village water scheme, or the Samoan Water Authority). Food preparation is carried out

in outside kitchens; however, food sources and security were not addressed. Most households have good access to sanitation; however, the sanitation (flush-toilets) relies on good and uninterrupted water supply, which is a risk during a disaster and recovery. Low socio-economic households tend to use an open pit privy toilet more. Household density was considered adequate in about 81% of the surveyed population. However, a small portion was considered crowded (8%) or very crowded (3%). Electricity access for most households was high at 98%, with a few that were not connected due to the location of the grid to their homes, or the cost being prohibitive for connecting. Telecommunication is an important factor in terms of disaster warnings, coordinating disaster response and to receive feedback on assistance that might be needed. The two mobile networks, Digicel and Blue Sky, provide the greatest mobile communication cover throughout the country. An estimated 95% of all households have access to, or are connected to one of these mobile networks. Only 5% of households have landlines. In terms of economic vulnerability, most households were in a fair state with diverse employment sources, with an average income of around SAT 36.28 per occupant, per week. One of the key findings from the survey was that about 2% of Samoan households will need assistance due to their highly vulnerable state.

Impacts

The impacts from any natural disaster can be devastating to communities and in many cases, can significantly alter the environment, or the landscape of the country.

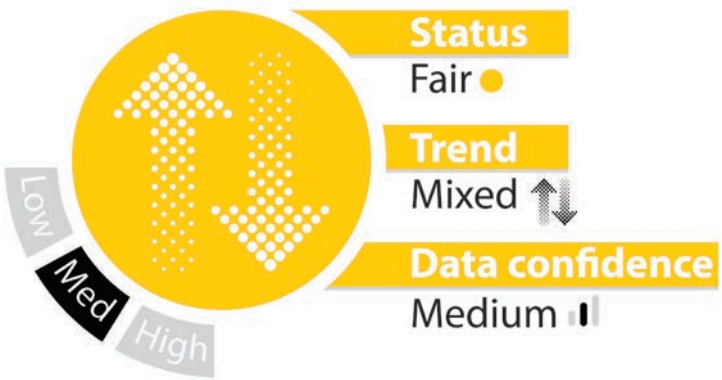
Response and Recommendations

Samoa has enacted some key legislation under the climate change and disaster risk management area, which include the Climate Change Act, the Meteorology, Geoscience and Ozone Services Act 2020, and the Disaster and Emergency Management Act 2007. Furthermore, national policies and strategies have also been developed including National Disaster Management Plan 2017-2020 (currently under review), and the Samoa Climate Change Policy (2020).

The Government of Samoa undertook the following programmes:

- Community Disaster and Climate Risk Management (CDCRM) Programme. This is a government led programme to implement the Disaster Risk Management Outreach to all villages. This takes into consideration the whole society inclusion approach. Village Response Plans have been formulated for 116 villages, using a participatory multi-agency approach involving first responders, early warning services and non-governmental organisations (NGOs). The multi-agency programme contains the following objectives:
- Conduct risk analysis with communities to identify the risks, and carry out a vulnerability and capacity assessment to identify actions to mitigate the risks, and reduce disaster impacts.
    - » Draft Village Disaster and Climate Risk Management (VDCRM) plans, identifying how the village will respond and coordinate during and after a national disaster.
    - » Train and prepare village teams on the process to respond to natural disasters. This includes educating the teams on risk zones and their risk profiles.
    - » Conduct simulation exercises to verify the VDCRM plans, as well as the capability of the village response team to disaster risk management cycle (Preparedness, Prevention, Response and Recovery).
    - » Develop hazard mapping, by identifying evacuation routes and safe locations, and ensuring that these are displayed in public areas. This includes signs and information on tsunamis.
    - » Develop toolkits as part of the capacity building plan.
    - » Establish a national coordination facility, which will assist village response teams and the general public during and after disaster events. A key role is to establish emergency communications and to have early warning systems.
- Climate Change Adaptation – a government led programme to implement the Mainstreaming of Disaster Risk Management and Climate Change Adaptation.

INDICATOR 26: Climate adaptation and mitigation funding



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	8 10 15	7 AFFORDABLE AND CLEAN ENERGY 11 SUSTAINABLE CITIES AND COMMUNITIES 13 CLIMATE ACTION 14 LIFE BELOW WATER		SAMOA Pathway Apia Convention Noumea Convention Waigani Convention	• National Climate Change Policy • National Adaptation Programme of Action

Indicator definition

Climate change is a key driver of environmental change, as well as having an impact on the national and global economies and the health of the population. The unfortunate reality of climate change is that many Pacific island countries are amongst the most affected due to increasing temperatures, sea level rise and other weather extremes that are influenced by a rapidly warming planet. For Samoa to adapt to climate change requires large investments in terms of planning, infrastructure, technology and funds. There is progress in terms of climate change adaptation and mitigation planning, technology transfer and products, and infrastructure developments. The level of funding invested in adaptation and mitigation efforts provides a health check on the commitments by the government and international partners in addressing this global challenge.

The indicator assesses the trend in investment for climate adaptation and mitigation actions. Annual total funds received for climate adaptation and mitigation projects.

Status and Key Findings

The general consensus is that the Samoan economy is resilient to tropical cyclones if it occurs once in a decade (10-year threshold). The environment on the other hand will recover at a fast rate, depending on a number of factors, such as the integrity of the ecosystem prior to a cyclone, and the severity of the event. According to a World Bank report, the 10-year threshold is low by international standards. Raising the threshold to 50 years would generate benefits that greatly outweigh the costs involved, even without any consideration of climate change, reducing the expected annual value of storm losses from 5.5% to 0.7% of GDP. Implementing measures to ensure that buildings, infrastructure, and similar assets are able to withstand storms with a return period of up to 50 years is a clear “no regrets” strategy. This will greatly reduce the economic impact of climate change under the various climate scenarios.

The government has undertaken extensive consultations to identify community priorities for adaptation to climate change under the National Adaptation Programme of

Action (NAPA). These include protection of community water supplies, support of agriculture and forestry sectors, implementation of coastal infrastructure management plans, and integrated catchment management. Some of the projects (e.g. upgrading water systems) are good development projects under current climate conditions. However, large investments in relocating coastal infrastructure should only be implemented if and when the reduction in the expected value of storm damage exceeds the yearly costs. If a 50-year storm design standard were implemented, the analysis suggests that this type of adaptation may not be justified before 2050 based on climate change considerations because the general gain from reducing storm damage is not sufficient to warrant additional expenditures. However, these actions may be justified as a measure to reduce the risks associated with non-climate hazards (for instance, risk of tsunamis associated with earthquakes).

The cost of adaptation is higher under the CSIRO climate scenarios than under the National Centre for Atmospheric Research (NCAR) scenario, because the former projects a much greater increase in the severity of flooding and storms. Under the CSIRO scenario, the cost of adaptation would rise from AUD 3.3 million per year in 2010 to 2019, to AUD 10.9 million per year in 2040 to 2049. The main cost arises from looking forward to the end of the century in setting the design standards for buildings and infrastructure constructed in the 2030s and 2040s.

Table 47: Adaptation and mitigation projects for Samoa and some key highlights (MNRE)

ADAPTATION AND MITIGATION ACTIONS		
Project Profile	**Utilisation (%)**	**Highlights**
GEF EWACC 2015-2021 MNRE/MOF USD 12,322,936	**78**	• Procurement stage for drainage upgrade works for Vaisigano Segment 1 Site 16. • Phase 3. Deepening and cleaning of waterways in catchment in the Greater Apia Areas (Vaisigano, Loimata o Apaula, Fuluasou, Gasegase, Vaipe, Lelata). • Continuous roll out of Community Disaster and Climate Risk Management Plan Programme and Small Business initiative with communities both Upolu and Savaii. • Complete construction of Vaisigano Segment One Flood Protection Wall (adaptation).
GEF 3rd NC 2020-2024 UNDP/MNRE USD 1,002,000	**5.8**	• GHG Specialist now on board for developing methodology and updating GHG inventory for Samoa. • Ongoing consultation between GHG Team and Stakeholders on data collections. • Recruitment of Database Developer for GHG inventory data as well as relevant information on climate adaptation and mitigation.

GEF IMPRESS 2017-2022
MNRE/MOF
USD 6,076,000
	72	• Training for Faleula Methodist Atiinae Community and School Awareness – 7 June.
		• Sustainable Energy Day – 23-25 June.
		• Official handover of Gas Analyser to SROS – 24 June.
		• Enhanced NDC Review – 29 June.
		• Online and Face-to-face capacity building programmes, meetings and workshops
		  • Certificate II – Sustainable Energy Training Programme
		  • Samoa's Enhanced NDC Review – 29 March
		  • Virtual training on Institutional Arrangement for the existing MRV including data management for the National Greenhouse Gas inventory 29 June – 1 Jul.y
		  • Greenhouse Gas Inventory meeting – 30 June.
		  • Virtual meeting on EU funding for waste to energy project – 2 July.

ADAPTATION AND MITIGATION ACTIONS		
Project Profile	**Utilisation (%)**	**Highlights**
GCF 2017-2023 Component 2 MNRE/MOF USD 8,800,000	75	1. Ecosystem based adaptation enterprise development progress. • 34 projects/185 completed disbursements under first all for proposals (CfP). Implementation and monitoring continued. • 319 projects approved for implementation under final CfP. Contracting phase underway. 2. Payment for Ecosystem Services Programme. • Completed full feasibility report for Stage 2 to inform implementation of pilot project at Malololelei site. 3. Cash for Work. • Ongoing rehabilitation works for designated areas at Magiagi-Fale o le Fee, Vailima and Malololelei reserves. • Complete demarcation of 138.9 acres of government land at Afiamalu for watershed protection purposes. Fencing near completion.
ECR/PPCR Project 2013-2021 IDA/World Bank USD 14,600,000	100	• Project completed in 2021.
Pacific Resilience Project 2015-2022 IDA/World Bank USD 16,293,000	54.14	• Meteorology Bill in final stages of endorsement. • National Emergency Operational Centre completed officially opened – 23 Oct. 2020. • The new Seismic Operation Centre design and supervision procurement being finalised. • ICT and Audio Visual equipment for NEOC being procured.
Total: USD 59,093,936		

Over a period of 11 years (2013-2024), the total funds spent or earmarked for climate change adaptation and mitigation is USD 59,093,936, or an equivalent of USD 5.3 million per annum. It should be noted that there are many projects and initiatives across the various government agencies that could be considered under the climate change adaptation and mitigation stream. These are not included in Table 47. Some of these projects include:

- Samoa Tourism Authority: Project on improving resilience of small-scale tourism operators. Assessments, evaluations, Tourism Development Area Plans, Best Practice Guidelines and training – 2013.
- Land Transport Authority: Implementing and refining a road hierarchy system for better road planning, traffic management and energy efficiency.

Often the response of the government for financial resourcing of environmental initiatives is guided and influenced by global trends which reflect both governance trends and societal choices. One of the key highlights over the past decade is the confluence of efforts to address climate change and disasters in many of the projects. This is seen in global and national efforts, which bodes well in the safeguarding of the environment, communities and the economy.

Impacts

Consistent resourcing for adaptation and mitigation, combined with adequate support from government, civil society organisations, the business community and the general public are essential in mobilising the change for better economic, social and environmental outcomes. While there continues to be a heavy reliance on overseas development aid to fund climate change adaptation and mitigation projects, the cross-sector and multi-agency approach to the implementation of these projects has gained support and momentum. Traditionally, silo governing approaches have been the status quo, which means that project funding for adaptation and mitigation has been sector driven with little to no consultation with other stakeholders. Climate change adaptation and mitigation projects outside of the government's knowledge, are not monitored or documented from a national perspective, thereby making it difficult to track. Fortunately, the government has developed resources and provided the framework for project monitoring, reporting and verification that could be used by all stakeholders.

"Change requires concerted, long term and consistent support and resourcing. Disparate actions are not good in engendering 'communities of practice', confidence in business and community to invest in societal ownership of the future." *Anonymous 2022.*

Response

Samoa's National Climate Change Policy 2020 – 2030 provides the framework for both national adaptation and mitigation actions, through a whole-of-country approach to build resilience to the impacts of climate change. At the community level, Samoa has developed Community Integrated Management Plans (CIM plans), which identify prioritised adaptation actions by the 368 villages. These actions are to assist the villages in building climate resilience and it builds on the successful implementation of the National Adaptation Programme of Action (NAPA).

Over the past decade, investment in climate change adaptation and mitigation projects for the country have reached USD 59 million (Table 47). With the continued, and likely increased threat by climate change on Samoa's environment, people's well-being and economy, funding to this level will need to be maintained or ramped up in order for the country to be climate ready and resilient.

Recommendations

- Pursuing sustainable outcomes, and addressing climate change adaptation and disaster risk reduction across the country, requires a high degree of coordination. There are opportunities that support the need for this coordination, and also provide the framework for this to occur, such as the 'Ridge to Reef' approach, land use planning, ecosystem-based resource management, and disaster risk development planning and management. The key is ensuring that there is an effective national mechanism that is well resourced to oversee the national coordination.
- Community engagement should be at the forefront of all planning activities relating to a low-carbon future and disaster risk management. Community knowledge and experience in disaster response should be an important consideration in all planning and programmes.
- Continue to use technology to improve national response to climate change and disaster risk variables. Monitoring and improving a data collection will go a long way in ensuring the accuracy of modelling developments and developing response plans.

Place-making is a people-centred approach to planning, design and management of public spaces. It can be used to improve all of the spaces that comprise the gathering places within a community—its streets, parks, buildings, and other public spaces…so they invite greater interaction between people and foster healthier, more social, and economically viable communities. http://www.placemakingchicago.com/about

- Land use planning for adaptation features highly in UNFCCC statements and policy, due to its influence on adaptation and mitigation responses. In terms of reducing Greenhouse Gas emissions noted methods can be employed at the strategic level: e.g. clusters of denser urban development with efficient traffic and movement linkages between the clusters; a well-coordinated transport/road hierarchy; 'place-making'; subdivision designs that focus parcel orientation to the north to facilitate renewable energy installations and increasing vegetative green spaces about the villages. Landscaped open spaces, including urban gardens, or retention of rural development options between the urban clusters can be used to sequester carbon, mitigate against the expected rise in heat as well as being employed to reduce flooding.
- There are a number of priorities needed for future planning to assist with ecosystem-based adaptation and to buffer against disasters. With Sustainable Management Plans, PUMA's focus has previously been on the Urban Area of Apia. There is intent for the work to be expanded to rural areas. The following actions need to be addressed either as part of CIM Plans or via the roll out of Sustainable Management Plans under the PUM Act, 2004:
  - » Filling or modification of mangroves, wetlands, waterways and drainage-ways continues over the coastal plains in both Upolu and Savaii – especially in areas where village land use change is evident. Community and government education is needed to address these issues and relate the implications to catchment, flood management and coastal resilience. The wetlands and mangroves of Moata'a Bay and Vaiusu Bay are of significance and due to expected intense land use change in the mid to upper catchments - should be the priority for rehabilitation and protection.
  - » Rapid ecological assessments and classification of urban and aquatic ecology within the larger villages (and Apia) should be prioritised.

References (Atmosphere, Climate and Disaster Management)

Carbon Brief. (2018). Mapped: How every part of the world has warmed – and could continue to warm. [26 September 2018]. URL: https://www.carbonbrief.org/mapped-how-every-part-of-the-world-has-warmed-and-could-continue-to-warm [accessed: 27 April 2023]

CSIRO and BOM. (2014) Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports. Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report, Australian Bureau of Meteorology and CSIRO, Melbourne, Australia. URL: https://www.pacificclimatechangescience.org/ wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf

CSIRO and SPREP (2021). 'Next Gen' Projections for the Western Tropical Pacific: Current and Future Climate for Samoa. Final report to the Australia-Pacific Climate Partnership for the Next Generation Climate Projections for the Western Tropical Pacific project. Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Secretariat of the Pacific Regional Environment Programme (SPREP), CSIRO Technical Report, Melbourne, Australia.

Fepuleai, A., and Nemeth, K. (2017). Volcanic geoheritage of landslides and rockfalls on a Tropical ocean Island (Western Samoa, SW Pacific). Geoheritage. https://doi.org/10.1007/s1237-018-0306-z. The European Association for Conservation of the Geological Heritage 2018.

GOS. (2012). Samoa Post-disaster Needs Assessment Cyclone Evan. (2012). Government of Samoa with AusAID, ACP-EU, NZAID and the World Bank.

Government of Samoa. (2020). Energy Management Act 2020. Apia, Samoa. 7p.

Guinotte, JM., Buddemeier, RW., and Kleypas, JA. (2003). Future coral reef habitat marginality: temporal and spatial effects of climate change in the Pacific basin: Coral Reefs, v. 22, no. 4, p. 551-558.

IUCN. (2016). Report on programme for Development of a Renewable Energy and Energy Efficiency Framework. Feb. 2016. 43 p.

Ministry of Finance. (2014). Samoa Energy Review 2015. Energy Policy Coordination and Management Division. Apia, Samoa. 33p.

Ministry of Finance. (2015). Samoa Energy Review 2015. Energy Policy Coordination and Management Division. Apia, Samoa. 34p.

Ministry of Finance. (2016). Samoa Energy Review 2015. Energy Policy Coordination and Management Division. Apia, Samoa. 37p.

MNRE. (2016). Economy-wide Adaptation to Climate Change. Field Report No. 1. Community Disaster and Climate Risk Management Household Survey - Final Report, Ministry of Natural Resources and Environment. (MNRE) Apia Samoa. 50p

MNRE. (2019). National Waste Management Strategy. 2019-2023. Government of Samoa. Apia, Samoa. 68p.

MNRE (2020). Green House Gas Inventory Report 2010-2020 Samoa. Report prepared by Core CarbonX Solutions Private Limited. UNDP Samoa. 43 p.

NOAA (2021). On This Day: 2009 Samoa Islands Tsunami. Available at: https://www.ncei.noaa.gov/news/2009-Samoa-Tsunami (30 April, 2023)

PACRAFI (2011). Pacific Catastrophe Risk Assessment and Financing Initiative. Country Risk Profile: Samoa. Applied Geoscience and Technology Division. SPC. 6p.

PDS (Pathway for the Development of Samoa). (2021). Ministry of Finance. Government of Samoa. Apia, Samoa.

Samoa Bureau of Statistics (2020). Environmental Statistics – Energy Accounts 2020. www.sbs.gov.ws. Government of Samoa. Apia, Samoa. 24p.

Samoa Meteorology Division (2016). Samoa hail storm, 16 September 2016. Unpublished report. 12 p.

Samoa's Second National Communication to the United Nations Framework Convention on Climate Change (ND). Apia, Samoa. 99p.

The World Bank (2020). Samoa Waste Audit Report – Analysis of 2020 Waste Generation and Disposal Data. Prepared by Asia Pacific Waste Consultants. December 2021. 4 p.

Turner, J., and McIntosh, RE. (2019). Mainstreaming Ocean Acidification into National Policies: A Handbook for Pacific Islands. Secretariat of the Pacific Regional Environment Programme. Apia, Samoa

WBG Climate Change Knowledge Portal (CCKP 2021).
Samoa. URL: https://climateknowledgeportal.worldbank.org/country/samoa

WHO (2022). Ultraviolet radiation. World Health Organisation.
https://www.who.int/news-room/fact-sheets/detail/ultraviolet-radiation).

World Bank (2015). Country Note – Samoa. Disaster Risk Financing and Insurance | Pacific Catastrophe Risk Assessment and Financing Initiative. Available at http://pcrafi.spc.int/documents/172

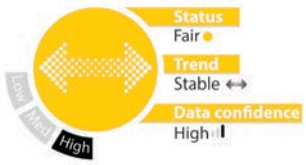
World Bank Group. (2010). Economics of adaptation to climate change. Country Case Studies: Samoa.

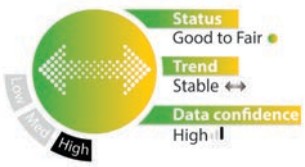
World Bank Group. (2021). Climate Risk Country Profile: Samoa. The World Bank Group. 32p.

Young, W. (2007). Climate Risk Profile for Samoa. Samoa Meteorology Division, MNRE, Apia, Samoa.

Theme 4: Environmental Governance

Overview and Highlights

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Government budget allocation for the environment		Funding to the environment sector, through the MNRE, has remained steady between SAT 20-27 million over the past 10 years. The funding allocations cover personnel, operating and capital costs. Additional funds are needed to undertake many of the functions of the Ministry. Development partners continue to be the main source of external funding (close to USD 100 million) over the past few years. Other funding revenues are through cost recovery and fees to clients. Ministerial restructuring has had an impact on the overall budget, especially when PUMA was moved to a different ministry after 2016. The engagement of other ministries in environmental activities has also resulted in further investment in the sector. However, there is a lack of tracking on the funds being committed, as well as a lack of tracking on the results of these investments.	*Creating a national data portal is providing the digital framework and backstopping in information sharing and knowledge.* *All funding towards the environment to be aggregated through the public financial management system to help track the overall investment and performance in environmental management.* *Information sharing amongst government agencies remains a challenge. This should be resolved to allow for better outcomes for the country.* *The economic impact of natural disasters is likely to increase. This should be factored into the government's response plans.*

INDICATOR	STATE & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
Multilateral Environmental Agreements and national reporting		Samoa has ratified about 24 MEAs. The Ministry of Foreign Affairs and Trade is the national focal point of all MEAs, however MNRE and other Government agencies are the operational focal points. About 50% of the MEAs that Samoa is party to have their reporting requirements met. 31% of the MEAs reporting requirements are outdated, whereas 19% of the MEAs do not have reporting requirements.	Under the environmental MEAs, Samoa has been active in fulfilling its reporting requirements. There are of course constraints, especially in terms of capacity and resources, however, efforts to mitigate these have enabled reporting to be made. *There is a need to identify the resources needed to enable MNRE, and other operational focal points, to fulfil their reporting commitments to the relevant MEAs.*
Gender equality		Females make up nearly half of Samoa's population and their life expectancy is longer by 3 years. In the workforce, 71% are males dominating the primary sector (farming, fisheries, agriculture, forestry and livestock). Women on the other hand dominate professional occupations such as the education and nursing sectors, clerical support work, and sales and services. Within the environment sector, 72% of employees are male. Of the MNRE agencies, more females are employed in the legal services, the energy sector, disaster management office, corporate service and the environment unit. Young female graduates are opting for more field-based positions (an area that was mostly male dominated). At the village social settings, women are actively participating in village affairs. There is strong encouragement for women to participate and contribute to decision-making.	Samoa has signed up to a number of international agreements, such as the Convention on the elimination of all forms of discrimination against women in 1992. Samoa has also established a Ministry of Women, and developed a national policy for gender equity 2021-2031. Key priority areas are Leadership and Decision-Making and the Environment. *There is a need to monitor and to provide an enabling environment for gender mainstreaming at all government agencies, as well as villages and the private sector.* *Secure resources to allow for the full implementation of the National Policy on Gender Equality and other gender related strategies.*

Women's role in Samoan society continues to evolve, with more women in professional occupations (ADB)

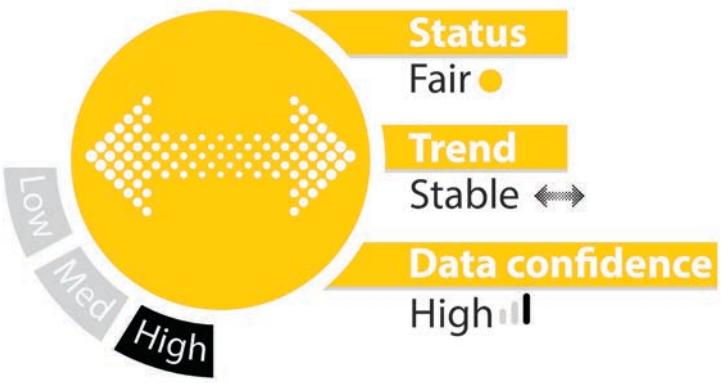
Environmental governance through village bylaws in Samoa is an effective approach to promoting sustainable practices and protecting the environment at the local level. Samoa is an island nation that places great importance on its natural resources and ecological integrity. Village bylaws, also known as "iugafono" or village council decisions, play a significant role in shaping community behaviour and regulating various aspects of village life, including environmental management. In Samoa, the traditional village governance structure is deeply rooted in the Fa'a Samoa, the Samoan way of life. The village council, made up of matai (chiefs) and other respected community members, holds significant authority and is responsible for making decisions that affect the village and its inhabitants. Recognising the importance of environmental conservation, many villages in Samoa have incorporated specific bylaws and regulations to safeguard their natural resources.

These village bylaws address a wide range of environmental concerns, such as sustainable fishing practices, protection of marine and coastal ecosystems, land and forest management, waste disposal, and conservation of water resources. By enacting and enforcing these bylaws, communities can actively participate in the stewardship of their local environment and preserve their natural heritage for future generations. The village bylaws are typically developed through a consultative process within the community. The village council engages with community members, including traditional leaders, elders, and youth, to ensure that the regulations reflect the values and aspirations of the community as a whole. This participatory approach helps build consensus and ownership over the environmental governance measures.

Once the village bylaws are established, they are enforced through a combination of traditional practices and modern mechanisms. Traditional village authorities, including the matai, play a crucial role in ensuring compliance with the regulations. Additionally, the village council may collaborate with government agencies, NGOs, and other stakeholders to provide technical assistance, capacity building, and monitoring support. The effectiveness of environmental governance through village bylaws in Samoa lies in its local ownership and cultural alignment. The bylaws resonate with the Samoan cultural values of respect for nature and intergenerational stewardship. Furthermore, the community-led approach fosters a sense of collective responsibility and empowers villagers to actively participate in environmental decision-making.

The Government of Samoa recognises the importance of village bylaws in environmental governance and supports these initiatives. It collaborates with communities to strengthen their capacities, provide legal frameworks, and integrate traditional knowledge with modern scientific approaches. Overall, environmental governance through village bylaws in Samoa demonstrates the power of community-driven initiatives in promoting sustainable practices and safeguarding the environment. By combining traditional wisdom with contemporary approaches, Samoa exemplifies a successful model of local environmental management and conservation.

INDICATOR 27: Government budget allocation for the environment



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
	4 6 20	11 SUSTAINABLE CITIES AND COMMUNITIES 11.4	Rio Declaration on Environment and Development	SAMOA Pathway Noumea Convention	• Village Fono Act • Community Sector Plan • District Development Plans • Samoa Fiscal Strategy

Indicator definition

The indicator specifically assesses the trend in government funding allocation to the Ministry of Natural Resources and Environment (MNRE) over the past 10 years. This should provide an indication of the government's commitment to empowering the Ministry to fulfil its mandate. The SOE recognises that the government also provides funds to other ministries, whose activities can impact the environment, such as the tourism, agriculture and fisheries sectors. This level of funding is not assessed under this indicator. The total government budget is also not assessed to determine the percentage it allocates to MNRE. These shortcomings may be considered in future SOE reporting.

Status and Key Findings

Data from the years 2008 to 2021 indicate the government funding allocations continue to increase slightly. It reached its highest allocation in 2011/2012, where SAT 27 million was allocated (Figure 126). The investment in the environment sector for the 2012/2013 period was calculated at approximately 4% of the national government expenditure (SPC 2015).

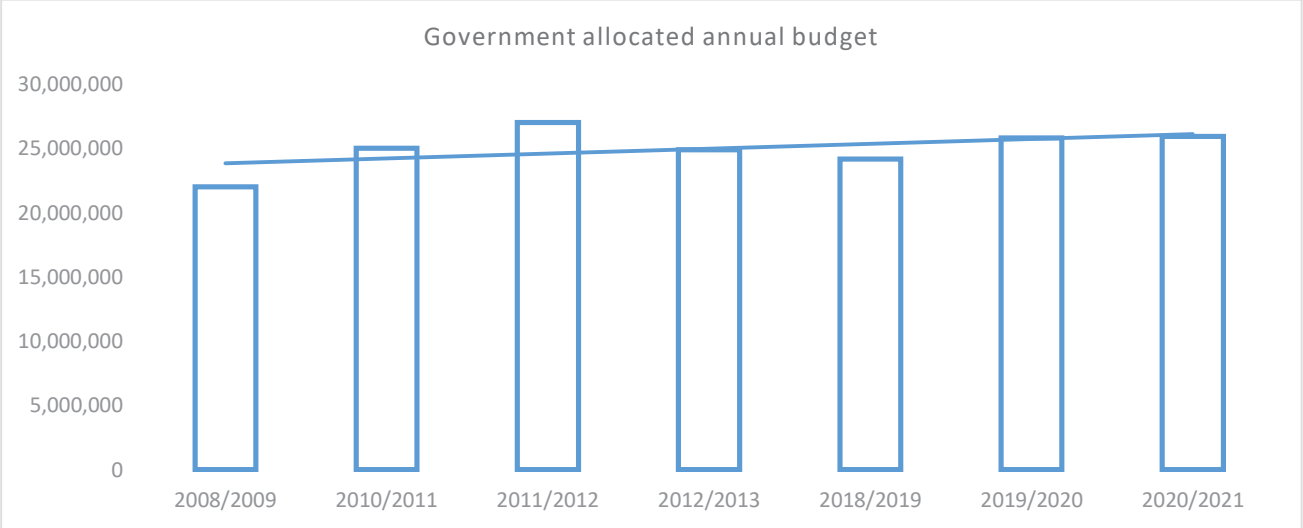


Figure 126: Total budget allocation from 2008 to 2021 (MNRE)

How the environmental sector fares against other national priorities has not been assessed in this SOE, but is highly recommended for future assessments. This would provide another perspective into the government's process and where it prioritises the environment. There is a prevailing thinking that the environment sector's overall budget is smaller than others, partly due to high contributions from regional and international partners to augment any deficit.

Table 48: Budget allocation for 2016, 2020 and 2021 (MNRE Annual Reports)

YEAR	TOTAL BUDGET (SAT)
2021	26,586,962
2020	26,428,394
2016	29,492,023

Figures from the MNRE Annual Reports (2016, 2020 and 2021) showed budgets for each of the functions of the ministry. The total budgets for 2016, 2020 and 2021 are shown in Table 48. The reports noted that much of the funding for projects and activities comes from international development organisations (World Bank, AusAID, NZAID, JICA, etc.). Between 2016 and 2020, funding allocation from the Government was reduced, which may in part be caused by the restructuring of the ministry. PUMA, which was one of the key divisions of the Ministry, was transferred to the Ministry of Waters, Transport and Infrastructure.

While MNRE remains the traditional government agency responsible for the environment, the increased engagement of other government agencies in promoting sustainable development and environment outcomes is encouraging and a clear outcome of successful environmental mainstreaming across the nation.

One of the more recent and growing influences on the environment sector and national agenda is the impact of climate change and natural disasters. At all levels of society, there are increasing efforts to address the impacts of these forces on the environment. Funding for environmental management will be incorporated into climate change funds, which is something to be aware of, when assessing the national environment budget.

Impacts

Government's investment in the environmental sector is a clear indication of its priority. As the driving forces for environmental change continue to increase, the level of commitment from the Government and partners need to keep pace. Any reduction in funding, and the lack of political support for the sector, will result in negative impacts to the environment, to many endemic species and to the lives of all Samoans. While it is encouraging that many non-environmental sectors are ensuing that environment safeguards are at the forefront of their planning and operation, this should not negate the important role of the environment ministry. Capacity and resources continue to be a challenge that needs to be addressed and resolved regularly. Policies and legislative framework need to be regularly reviewed, amended and updated to keep pace with the changing circumstances of the nation, as well as with the evolving technology and knowledge.

Response

The recently completed National Environment Sector Plan 2017-2021 highlighted funding investment for its implementation at millions of tala. This is both funding allocated from the government's national budget, and those secured through project activities and working with development partners. Investments cover a wide range of environmental and climate change issues including research, capacity building, infrastructure, and policy and legislative

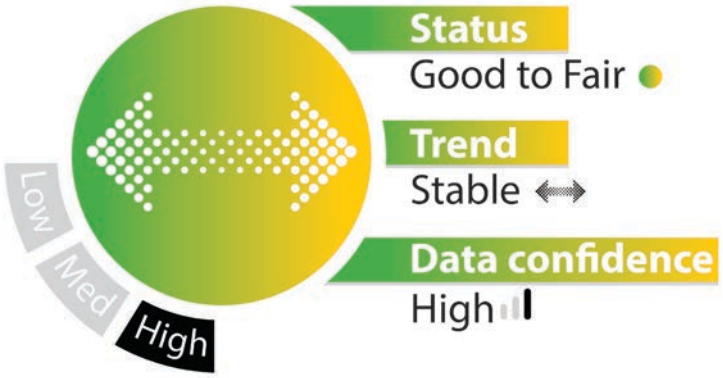
development and review. The investments have benefited many communities, especially in resource rehabilitation, creating livelihood opportunities, and preparedness for climate and geo-technical disasters.

One of the key outcomes from the government's investment in the environment is the creation of a data portal that allows for the tracking of projects, as well as providing the storage capacity for reports and documents to be used in future assessments, such as State of the Environment reports.

Recommendations

- All funding for the environment sector should be aggregated through the public financial management system, which will help track the total investment into the sector, as well as assessing the impacts of the investments.
- Encourage an effective and close working relationships amongst all key environmental organisations so that all project information and outcomes are shared. This will provide a holistic picture on the national investment in the environment sector, and it will give an accurate assessment for the country to report on to the various MEAs and other international and regional obligations.
- Samoa is vulnerable to natural disasters and climate change impacts. This brings about a real challenge in the allocation of resources to prepare against natural disasters, as well as to focus on recovery and resilience-building. The expectation is that costs attributed to climate change and natural disasters will continue to rise. The government budgets must maintain a degree of flexibility to cover impacts caused by natural disasters.
- Urgently encourage more investment into village and district councils, using the existing District Development Project, to undertake environment-related projects and initiatives.
- Continue to strengthen the environmental sector supporting and cross-cutting services, such as the Spatial Information and Technology, the Legal side and the corporate services, so that they can continue to assist the core environmental teams in the implementation of the country's national strategies and legislation.

INDICATOR 28: Multilateral Environmental Agreements and national reporting



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
		11.4	Rio Declaration on Environment and Development	SAMOA Pathway Noumea Convention	

Indicator definition

Multilateral Environmental Agreements (MEAs) are regional or international agreements for countries to collaborate on a range of issues. Samoa is a member of a number of these MEAs. An important responsibility of being a member, is regular reporting and update of national activities to the MEA secretariat. While some countries have sufficient resources to undertake regular reporting, others struggle to meet this requirement due to lack of capacity and resources. In some countries, a person can be the focal point for a number of MEAs, and often spends most of their hours preparing reports, with little time, resources or support to implement the MEA.

This indicator focuses on Samoa's ability to meet its MEA obligations. This will provide an indication of national coordination, capacity and capability in meeting the MEA reporting requirements.

Status and Key Findings

Samoa has signed and ratified at least 24 MEAs (see Table 49). The MEAs formed part of the legal and policy frameworks for biodiversity conservation and sustainable development. The Ministry of Foreign Affairs and Trade is the national focal point for all MEAs, whereas the MNRE, through its various divisions, is the National Operational Focal Point for many of the others. Other national operational focal points are the Fisheries Division and the Education Department (Table 49).

Table 49: Samoa's status on the various international Multilevel Environmental Agreements and the national focal points (MNRE)

MEA	SIGNATURE	RATIFICATION	PARTY STATUS	OPERATIONAL FOCAL POINT
Basel Convention		22 March 2002	Accession	MNRE – WMPCD
Cartagena Protocol	24 May 2000	30 May 2002	Ratification	MNRE - DEC
Convention on Biological Diversity	12 June 1992	09 Feb 1994	Ratification	MNRE - DEC
Convention on International Trade in Endangered Species of Wild Fauna and Flora	09 Nov 2004	07 Feb 2005	Accession	MNRE - DEC
Convention on Migratory Species	01 Nov 2005	01 Nov 2005	Party	MNRE - DEC
IRENA Treaty		21 July 2010	Ratification	MNRE-RED
Kyoto Protocol	16 Mar 1998	27 Nov 2000	Ratification	MNRE - CCGEF
Minamata Convention on Mercury	10 Oct 2013	24 Sept 2015	Ratification	MNRE - WMPCD
Montreal Protocol		21 Dec 1992	Accession	MNRE - SMD
Nagoya Protocol		20 May 2014	Accession	MNRE - DEC
Paris Agreement	22 Apr 2016	22 Apr 2016	Ratification	MNRE – CCGEF
Ramsar Convention	06 Oct 2004	06 Feb 2005	Accession	MNRE – FD
Rotterdam Convention		30 May 2002	Accession	MNRE – WMPCD
Stockholm Convention	23 May 2001	04 Feb 2002	Ratification	MNRE – WMPCD
The Beijing Amendment (1999)	04 Oct 2001		Acceptance	MNRE – SMD
The Copenhagen Amendment (1992)	04 Oct 2001		Acceptance	MNRE – SMD
The Kigali Amendment (2016)		23 Mar 2018	Ratification	MNRE – SMD
The London Amendment (1990)	04 Oct 2001		Acceptance	MNRE – SMD
The Montreal Amendment (1997)	04 Oct 2001		Acceptance	MNRE – SMD
United Nations Convention on the Law of the Sea	28 Sep 1984	14 Aug 1995	Ratification	MNRE - SIA
United Nations Convention to Combat Desertification		21 Aug 1998	Accession	MNRE - LMD
United Nations Framework Convention on Climate Change	12 Jun 1992	29 Nov 1994	Ratification	MNRE - CCGEF
Vienna Convention for the Protection of the Ozone Layer		21 Dec 1992	Accession	MNRE – SMD
World Heritage Convention on Cultural and Natural Heritage Sites (WHC)		28 Aug 2001	Acceptance	Ministry of Education

Samoa's reporting status to the key MEAs is mixed: 37% currently up to date, 13% recent (between 2 to 5 years), 31% reporting is outdated and 19% do not require any reports (Figure 127). Three of the biodiversity MEAs have recent reports, whereas two are outdated and may need further attention (Table 50).

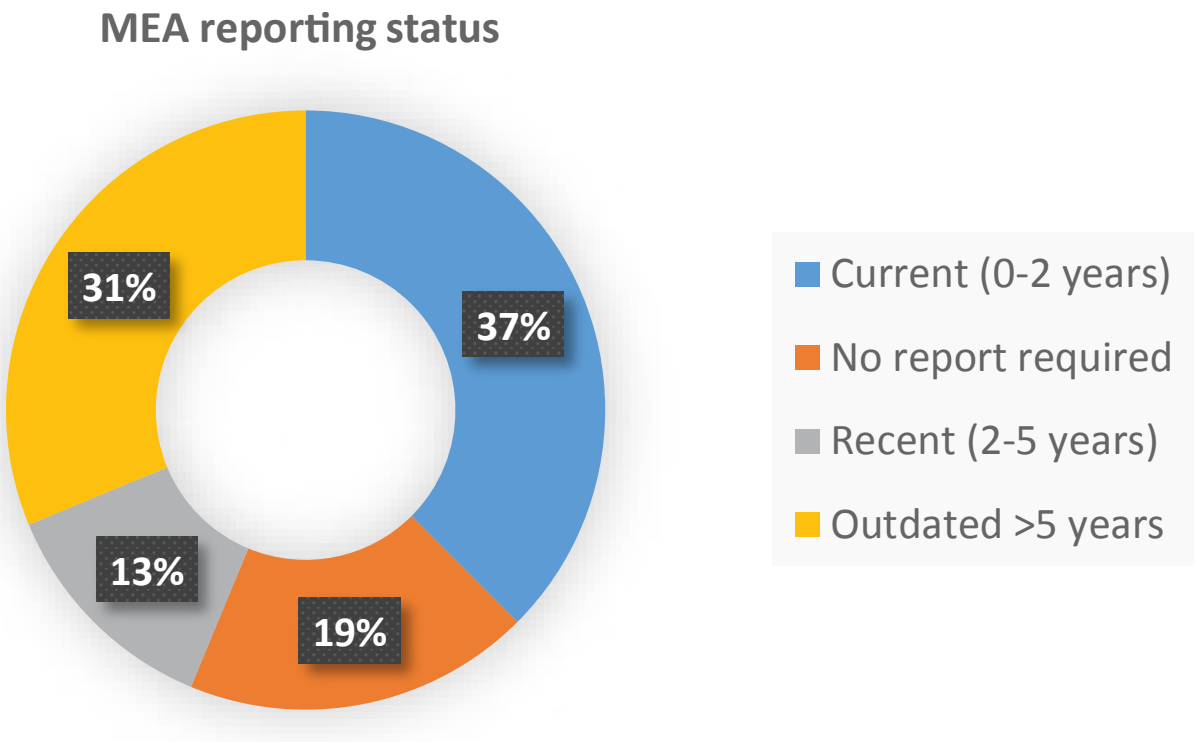


Figure 127: Reporting status to the key MEAs that Samoa is a party to (MNRE)

Table 50: The list of MEAs and the state of Samoa's reporting (MNRE)

INTERNATIONAL AGREEMENTS	REPORT PERIOD	SAMOA
SDG's Voluntary National Review	Varies	2020
BIODIVERSITY		
Convention on Biological Diversity	Sixth National Report due in 2018	2014
Convention on International Trade in Endangered Species	Due every 2 years	2017
Convention on Migratory Species	Due every 2 years	2019
Convention on Wetlands	Due every 2 years	2019
World Heritage Convention	Six-year cycle (actives 2018-2024)	
Convention on Underwater Cultural Heritage	COP every 2 years	
WASTE AND POLLUTION		
HAZARDOUS WASTE AND POLLUTION		
Basel Convention	Due annually	2016
Stockholm Convention	Last due in 2018	
Minamata Convention	Due every 3 years after joining	Initial assessment 2018
ATMOSPHERIC POLLUTION		
Vienna Convention (Montreal Protocol)	Due annually	2019
SHIP-BASED POLLUTION		
London Convention	Due annually including ML if no incidents	
CLIMATE CHANGE		
UNFCCC	Due every 4 years	2010
LAND DEGRADATION		

INTERNATIONAL AGREEMENTS	REPORT PERIOD	SAMOA
UNCCD	Due every 4 years	2018
REGIONAL AGREEMENTS		
Waigani Convention	Due every 2 years	2013
Noumea Convention	Due every 2 years	2019

Not a party; No report required	Current within last 2 years (2018-2020)	Recent within last 2 to 5 years	Outdated: more than 5 years ago

Convention on Biological Diversity

Samoa became a party to the Convention since 10 June 1994, and has also been a party to a number of protocols (Cartagena, Nagoya) under the Convention. There are a number of reporting requirements of the Convention (Table 51). Samoa has managed to provide the necessary reports, as required under the Convention and affiliated protocols, although with some delays varying from 1 month to 12 months.

Table 51: Samoa's report history to the CBD Secretariat (MNRE)

REPORT SUBMITTED AND DATE	DUE DATE	ON TIME (Y/N)
First National Report was submitted on 23 December, 1998	1 January, 1998	No (12 months)
Second National Report submitted on 23 June, 2001	15 May, 2001	No (1 month)
Third National Report submitted on 07 April, 2006	15 May, 2005	No (11 months)
Fourth National Report 24 December, 2009	30 March, 2009	No (7 months)
Fifth National Report was submitted on 22 September, 2014	31 March, 2014	No (6 months)
Sixth National Report was submitted	31 December, 2018	
National Biodiversity Strategy and Action Plan (revised) submitted 21 August, 2021		
National Biodiversity Strategy and Action Plan submitted 23 December, 1998	3	
First Regular Report on the Implementation of the Cartagena Protocol on Biosafety submitted 23 December, 1998		
Second National Report on the Implementation of the Cartagena Protocol on Biosafety submitted 03 January, 2012		
Third National Report on the Implementation of the Cartagena Protocol on Biosafety submitted 12 May, 2016		

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)

Samoa became a CITES member in November 2004. The Management Authority is with the Ministry of Foreign Affairs and Trade, whereas the Scientific Authority is with MNRE. Assistance is also provided by the Fisheries Division, MAF. CITES requires each party to submit an annual report on its CITES trade. As a CITES member, Samoa has submitted three implementation reports covering the periods from 2005-2011, 2013-2014 and 2015-2017 (www.cites.org).

United Nations Framework for the Convention on Climate Change

This does not record the status of UNFCCC related National Communications. UNFCCC Non-Annex 1 Parties are required to submit their first National Communication within three years of entering the Convention, and every four years thereafter. Most Pacific island countries are due to submit their 3rd National Communication (Table 52).

Table 52: State of NC by PICs (to Aug. 2022)

	INITIAL PARTY	NAT COMM 1	NAT COMM 2	NAT COMM 3
Cook Islands		30/10/1999	12/4/2012	7/8/2022
FSM		4/12/1997	12/11/2015	
Fiji		18/05/2006	31/07/2014	28/04/2020
Kiribati			30/10/1999	27/06/2013
RMI			24/11/2000	11/12/2015
Nauru			30/10/1999	1/04/2015
Niue			2/10/2001	17/09/2016
Palau		18/06/2003	26/08/2019	
PNG		27/02/2002	15/12/2015	
Samoa		30/10/1999	14/06/2010	
Solomon Islands		29/9/2004	14/9/2017	
Tonga		21/07/2005	2/05/2012	12/2/2020
Tuvalu		30/10/1999	19/03/2018	
Vanuatu		30/10/1999	30/08/2016	22/3/2021

Sustainable Development Agenda

The Sustainable Development Agenda commenced with the agreement by UN member States to the 17 Sustainable Development Goals in 2015. It set the 15-year plan to achieve goals of the 2030 Agenda for Sustainable Development often referred to as the Global Agenda. Samoa completed its Second Voluntary National Review on the Implementation of the Sustainable Development Goals 2020, in July 2020. At the time of submission and at the onset of COVID-19 pandemic, Samoa was on track to achieve 47% of the selected global and national indicators. The National Review highlights Samoa's achievements, despite the many challenges it faces with regards to limited resources. Some of the achievements include:

- Universal access to primary education, and compulsory fee-free for public schools.
- Near 100% access to safe and improved drinking water, sanitation and electricity. Road infrastructure is accessible by most households. Numbers of mothers dying during childbirth reduced.
- Equitable opportunities for male and female in employment opportunities, which is resulting in a high number of women in senior management roles in the public sector.
- Enhanced resilience to disasters and climate change - fully integrated across all sectors and at the community level.
- Increased domestic financing and stable ODA and FDI levels.

Samoa still has a number of challenges that it is grappling with, including:

- Biodiversity loss is deteriorating.
- Literacy and numeracy at all educational levels are declining.
- Deaths from non-communicable diseases are rising.
- Income inequality is significant.
- Violence against women and chlunaildren continues to be high.
- More households continue to struggle with the cost of living.

The near forecast for Samoa's development and momentum towards achieving the Global Agenda remains at risk due to the impact of COVID-19 on the economy. The lack of revenues from some of the traditional sources, such as the tourism sector, is holding the country back. The young population and rising unemployment rate are also contributing to the overall challenge.

Impacts

It is important for countries to monitor the progress that they are making towards achieving the goals and objectives of the various MEAs that they are party to. It is only by progressing together that nations are able to achieve outcomes to benefit humanity. Given that there is often disparity in resources and capacity throughout the world, the regular reporting to MEA secretariats, provides a reality check on the state of each party, their achievements and challenges.

One of the regular challenges that is faced by many small island countries, including Samoa, are the human and financial resources. In some situations, the national operational focal point is tasked with implementing the strategic requirements of a number of MEAs. One person may be responsible for

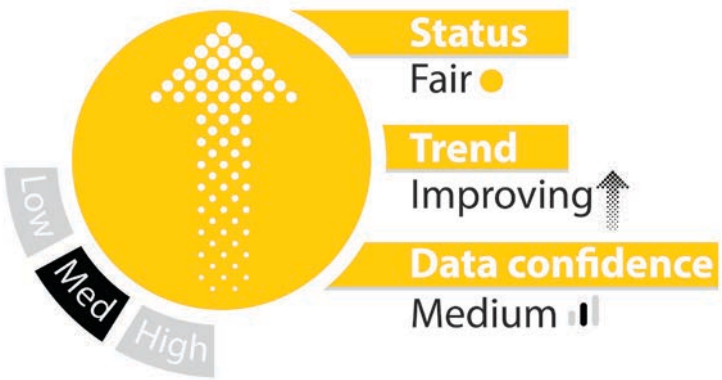
two or more MEAs. Reporting to these MEAs can take time, especially if it relates to project implementation, collating and analysing, hence a staff member could effectively be taken out of their normal duties for a good six-month period in order to draft annual MEA reports.

Response and Recommendations

Samoa has been proactive in monitoring, reporting and verifying (MRV) under the MEAs that it is party to. The commitment to the preparation of these reports is outstanding, especially the focus to demonstrate the progress made since the last reporting cycle. There have been numerous challenges, especially with regards to resources and capacity, but efforts and priority have always been to maintain standards and to fulfil its MEA obligations.

The challenge is that with different MEAs and reporting requirements, it can quickly become overwhelming for some countries, especially small island developing countries like Samoa, where limited resources are stretched to cover various reporting requirements. When one officer is responsible for a number of MEAs, it means that they are either preparing reports, or traveling to attend meetings relating to the MEAs. In Samoa, the reporting is undertaken mostly by MNRE staff, and the current capacity would benefit from additional support.

INDICATOR 29: Gender equality



LINKS TO REPORTING OBLIGATIONS	CBD	SDG	INTERNATIONAL MEAS	PACIFIC REGIONAL MEAS	NATIONAL STRATEGIES
		 11.4	Convention for the Elimination of All Forms of Discrimination against Women (CEDAW), Millennium Development Goals (MDGs),	Revised Pacific Platform for Action on Advancement of Women and Gender Equality (2005 to 2015); Pacific Plan; 42nd Pacific Island Forum commitment to increase the representation of women in legislatures and decision-making; 40th Pacific Island Forum commitment to eradicate sexual and gender-based violence	• Family Safety Act 2013 • National Policy on Community Economic Development 2021-2031 • National Policy on Gender Equality and Rights of Women and Girls 2021-2031 • National Policy on Inclusive Government 2021-2031 • MWCSD Strategic Plan 2021-2026

Indicator definition

Gender equity and gender balance in opportunity within the government and at the community level, have become a major focus of social and cultural safeguards that underpin many environmental and economic development programmes and projects. The percentage of women in senior roles in government has room for improvement but much progress has been made since 2013. Anecdotal evidence suggests that women in community level governance, civil society and in the private sector at decision-making roles advocate for stronger social and environmental outcomes.

This indicator assesses the state and the trend in gender equity in the environmental sector, with a particular emphasis on the decision-maker at the middle to senior management levels.

Status and Key Findings

Samoa's population, according to the most recent Census, is 51% male and 49% female (SBS 2021). The ratio is 104 males to 100 females at a young age; however, life expectancy is higher in females at 77 years, compared to 74 years for males.

Samoa's Labour Force represents 53% of the population (15 years and over). Males represent 71% of the labour force, whereas 29% are female (Figure 128). Females outnumber males in the Armed Forces, Professionals (Figure 129), Clerical Support Work and Service and Sales (Table 53). Gender participation at the Primary or Elementary Sectors (e.g. Agriculture, Forestry, Fisheries, Livestock, etc.) is dominated by males. These Primary Sectors and occupations, such as Managers and Professionals, have a significant bearing on the state of the environment.

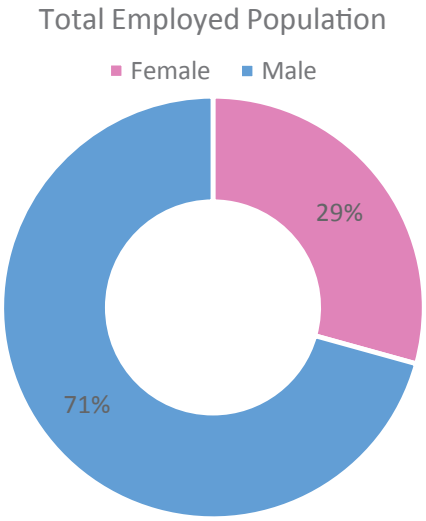


Figure 128: The breakdown in gender representation within the Labour Workforce (SBS 2019)

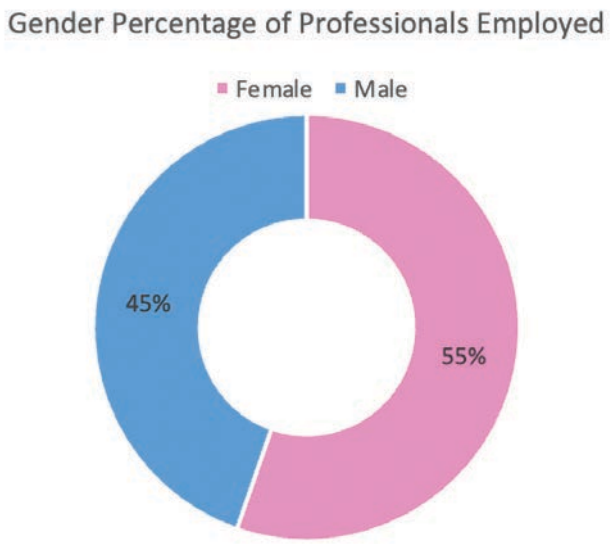


Figure 129: Professional occupation is one of the few that has more female than male workers (SBS 2019)

Table 53: Employed population by occupation in 2020 (SBS 2019)

OCCUPATION	FEMALE	MALE	TOTAL
Armed Forces	2		2
Managers	1,067	1476	2,543
Professionals	3,590	2,901	6,491
Technicians / Associated Professionals	1,206	1,733	2,939
Clerical Support Workers	1,591	811	2,402
Services and Sales	4,177	3,986	8,163
Skilled Agricultural, Forestry and Fishery Workers	3,969	20,868	24,837
Market-oriented Agricultural Workers	160	741	901
Market-oriented Agricultural Workers	8	204	212
Market-oriented Forestry Workers	5	24	29
Subsistence Farmers	3,759	19,433	23,192
Subsistence Fishers / Hunters	37	466	503
Craft and Related Trade Workers	1070	4,983	6,053
Plant and machine Operators and Assemblers	117	2,960	3,077
Elementary Occupations	1156	3,575	4,731
Agricultural Workers	335	1,962	2,297
Fishery Workers	6	104	110
Forestry Workers	3	59	62
Other Elementary Workers	812	1,450	2,262
TOTAL	**17,945**	**43,293**	**61,238**

Education sector

More females completed their secondary and tertiary education, making up 54% of the total population that completed tertiary education. At the highest level of qualification, 11,018 females received Certificates or Higher Degrees, compared to 9,442 males.

Agriculture sector

More males participated in the agriculture sector as a primary activity, accounting for more than 80%, whereas only 4% were female. Agriculture as a secondary activity (especially if they are employed), males made up 69%. The proportion of women carrying out secondary activities increased in the older age groups. Women, especially in rural areas, worked

longer hours than men in the agriculture sector.

With the crop activities, males dominate with around 60% participation, whereas 17% of females participate.

Livestock sector

In 2019, 83% of livestock raising operations in the country were managed by single operators, with the remainder being joint operators. More than one third of single operators are from the Savaii region. Most (74%) of the sole operators were male and 55% were aged 45 and over. However, the percentage of female sole operators varied across regions with the largest proportion of female operators being in the Apian Urban Area.

Fishing sector

88% of households engaged in fishing activities. In urban areas – the gap between male and female fishers is low; compared to Rest of Upolu and Savaii where the majority of the fishers are male, with very few women involved.

Village council

The DPP programme operations manual specifies that women represent 50% of the members from each of the 51 district councils. Women make up close to 50% of government village representatives (sui tamaitai).

Government Environment Agency

For this specific indicator, Managers inferred here are the senior government officials, including policy and planning managers who play a role in their respective agency's impact on the environment. The data used here are based on those reported in the MNRE Annual Reports on the staff number and gender. The data should be interpreted with caution, as there are factors that influence the annual figures, such as staff on short-term project contracts, the reshuffling of agencies (e.g. PUMA) from the environment ministry to other ministries.

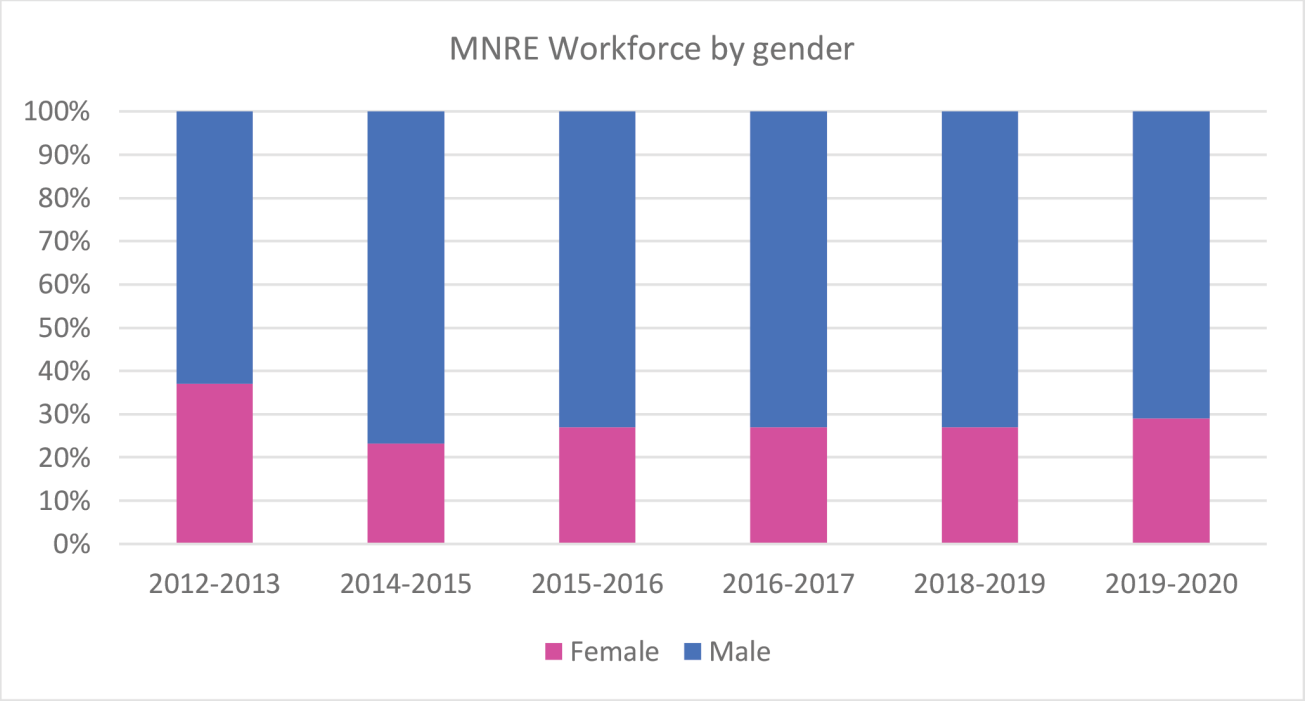


Figure 130: The percentage of male vs female from 2012 to 2020. Note that figures were not available for the 2017-2018 period (MNRE Annual Reports)

Since 2012, the ratio between male and female remains steady at around 72% of the ministry workforce consisting of male, and 28% female (Figure 130). Females dominate the Legal services, Renewable Energy, Disaster Management Office, Environment Sector, Water and Sanitation Sector and Corporate Services, and PUMA (although PUMA has since been moved to a different ministry), despite having more males in the Ministry (MNRE – Annual Reports, 2018-2019; 2019-2020). More females are applying for senior management positions, whereas males are taking up technical (field-based) positions. There is a trend with recent female graduates taking on field-based positions, especially in Water Resources, DEC, LMD, RED and DMO.

Decision-making at village levels is largely the domain of the chiefs. Increasing the role of women, such as through the Komiti o Tina ma Tamaitai (Women's Committee), is playing an important part in the decision-making process within villages. This has been demonstrated through their role in Community Fisheries Advisory Committees, and in the development of the Community Based Fisheries Management Plans.

Impacts

Decision-making can affect the state of the environment in the short or long-term. The impacts can often affect marginalised vulnerable sectors of the community, especially women and children. Women make up half of the population in society, and carry half if not more of the workload, especially in households and village affairs. There is a wealth of knowledge that many of the women have that can contribute to lasting outcomes for the benefit of the community. Environmental protection requires the engagement of everyone in the village. If a community, or a section of the community, does not feel included, the outcomes are unlikely to be successful.

Response

Samoa ratified the Convention on the Elimination of All forms of Discrimination against Women in 1992 and periodic reports that reflect the status of implementation were submitted in 2003 and 2009. In addition, Samoa is party to the International Covenant on Civil and Political Rights, which has a specific article on the gender equality applications of the agreement. Through these ratifications, Samoa committed itself to become a duty bearer for the human rights of women and girls.

At the national level Samoa has established a ministry dedicated to women's affairs, the Ministry of Women, Community and Social Development. Under the ministry a Strategic Plan has been approved to guide the work of the agency for the 2021-2026 period. A key strategy of the Plan focuses on gender and social inclusion at all levels is a key component.

The National Policy for Gender Equality 2021-2031 is the primary policy tool for the pursuit of gender balance in government and community. Key priority areas include economic, health, education, leadership and decision-making, law and justice, infrastructure and environment.

- **Priority Area 4: Leadership and Decision-Making**
- **Improved gender balance in leadership, governance and public life**
- **Priority Area 7: Environment**
- **Increased visibility, contribution and engagement of women and girls in agriculture, climate change, natural resources management and disaster preparedness and response, especially those facing multiple and intersecting barriers and forms of discrimination**

In addition to government legislation, policies and programmes, many projects have been implemented, which are led and implemented by women.

Recommendations

- Work with other government agencies (Ministry of Women, Community and Social Development), the Private Sector, Civil Society Organisations and Non-Governmental Organisations to create a positive and enabling environment for women and girls, so that they can engage in the environmental and climate change sector without any barriers or discrimination.
- Encourage and assist in the implementation of the National Policy on Gender Equality and Rights of Women and Girls 2021-2031. Ensure that appropriate resources and secured and allocated to allow for an effective and successful implementation of the national policy. Where possible develop a specific guideline to promote gender equality in the environmental sector.

References (Environmental Governance)

Government of Samoa. 2020. Samoa's Second Voluntary National Review on the implementation of the Sustainable Development Goals. "Improved Quality of Life for All". SDG's Taskforce, Ministry of Foreign Affairs and Trade. Apia, Samoa. 87 p.

Government of Samoa. 2021-2031. National Policy on Gender Equality and Righs of Women and Girls. Ministry of Women, Community and Social Development. Apia, Samoa. 36p.

NESP 2017-2021. National Environment Sector Plan (NESP) 2017-2021. Ministry of Natural Resources and Environment. Apia. Samoa. 142 p.

Samoa Bureau of Statistics. (2021). Samoa Agriculture Census 2019. Economic Statistics Division, SBS. Apia, Samoa. 330p.

SPC. 2015. Stocktake of the gender mainstreaming capacity of Pacific Island governments. Samoa. Secretariat of the Pacific Community. Noumea, New Caledonia. 52p.

SECTION 4: Summary

Samoa's environment continues to be influenced by the same drivers that are impacting many parts of the world. As Samoa's 205,000 population continues to grow, the demand for resources will also increase (SBS 2022). There is a continuous migration from rural areas to urban areas, putting pressure on surrounding areas including some sensitive coastal wetland areas and slopes along steep hills.

Climate change's influence on global weather patterns is accelerating, which is negatively impacting the natural environment. Samoa has experienced a number of climate change related events over the past 40 years, and these events are increasing in frequency and severity. Coral bleaching, attributed to high sea water temperatures, are common. Droughts, floods, bushfires and soil erosion are some of the consequences of changing climate patterns. It is also affecting the geological processes. Human activities are exacerbating many of the events.

Economic aspiration is also a driver of environmental change, which if executed correctly, can be beneficial to the environment and the people. Samoa 2040 – Transforming Samoa to a higher growth path sets out the national agenda for economic growth and development for the country. The unlocking of opportunities for economic growth relies on four focal areas: (i) tourism; (ii) agriculture and fishing; (iii) digital economy; and (iv) labour mobility. Tourism, and agriculture and fishing, rely on the environment and natural resources, as a foundation to unlocking economic benefits for the country.

Global events, such as the COVID -19 pandemic and the measles outbreak, have had significant impacts on the economy, the environment and the welfare of Samoan families. Economic impacts may include the level of imports of goods, which affects the availability and affordability of food and products for many households. During the COVID-19 pandemic, a shortage of imported goods due to lockdowns in many parts of the world drove food and fuel prices high. Many households who could not afford to buy food, relied heavily on their land and the sea for their sustenance.

The SOE 2023 is the product of work by various technical working groups, and the inputs of local and regional experts. There are some 30 indicators and sub-indicators under four thematic areas. The Natural Environment Theme is divided into terrestrial environments, marine and coastal environments, with 14 indicators. Theme 2 on Built Environment contains five indicators. Theme 3 – Atmosphere, Climate and Disasters has six indicators, and three indicators in the Environmental Governance. The technical working groups recognised the importance of other thematic areas, such as the influence of Culture and Traditions on the environment; however, insufficient time to gather and compile the relevant data means that this will need to be considered in future SOE reporting.

From assessing the indicators, Samoa's environment is in a transitional phase, but overall is in a fair state. The majority of the indicators are in Fair state (52%), followed by Fair to Poor (21%), Good to Fair (14%), Good to Poor (3%) and Good (7%) (Figure 131).

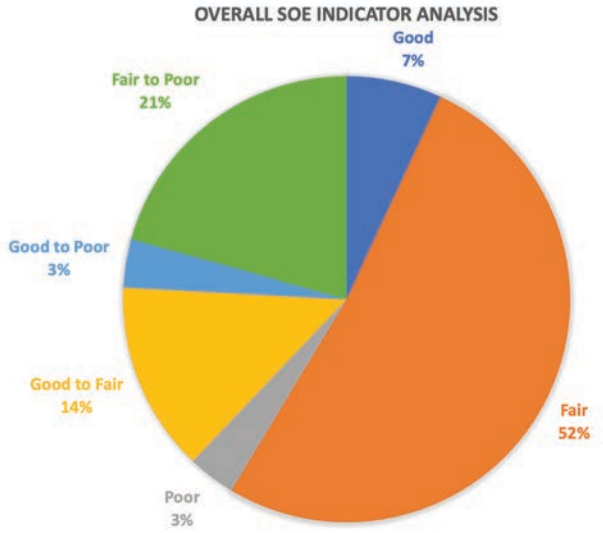


Figure 131: 2023 State of the Environment Report – the state of all the indicators showing a mixed status.

Theme 1: Natural Environment – Terrestrial and Inland Waters

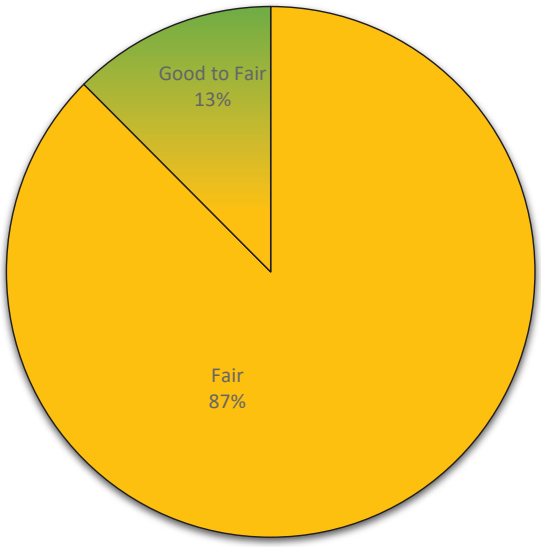


Figure 132: The state of the Terrestrial Environment sub-theme

The Terrestrial Environment was mostly in a Fair state (87%), especially on threatened species and high-profile species groups, such as birds, native mammals, reptiles, snails, butterflies and moths. The extinction and extirpation of some of Samoa's species highlights the threats that many of these species are facing.

Other indicators that are in a Fair state include invasive species management and inland wetland areas. It highlights the need for more investment and interventions to improve the management of invasive species and to safeguard inland wetland areas.

Indicators that were in a Good to Fair state include conservation and protected areas, forests and water catchments and water resources. The number of conservation and protected areas in Samoa continues to increase, especially with community conservation areas. The large national parks and conservation sites are legally protected through legislation, and some have management plans. However, there is still a gap between designating protected areas and development management plans, and the implementation of these plans and monitoring of these sites.

Theme 1: Natural Environment – Marine and Coastal

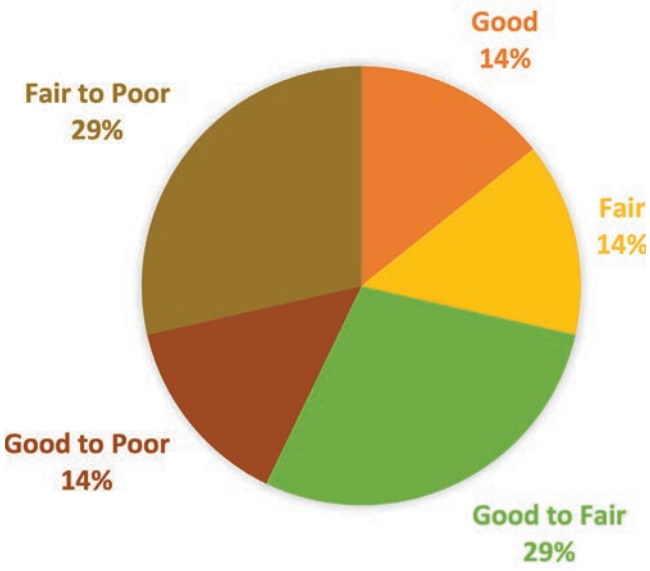


Figure 133: State of the Marine and Coastal Environment.

The Marine and Coastal environment is in a transitional phase with a third of the indicators showing Good to Fair (29%) or Fair to Poor (29%). This is followed by Good to Poor (28%) and Good (14%). Two indicators that are in a Good to Fair state are the Offshore Fisheries and Marine species of national significance. The management of offshore fisheries resources (especially migratory species) is largely the responsibility of the Western Pacific Tuna Commission. The combinations of Samoa's small fisheries fleet and limited exclusive economic zone (EEZ), do not have a significant impact on the overall Pacific tuna stocks. However, the significance of the offshore fishery relates to the revenues from licenses and export of tuna to the Samoan economy. The Marine Protected Area indicator shows a conscious effort by the government and communities to protect and conserve marine biodiversity. The designation of Samoa's EEZ as a Marine Sanctuary for sharks, cetaceans, and turtles, and the endorsement of the Ocean Strategy highlight the commitment of the government to safeguard species. This commitment is on par with the pledges of many villages to designate some of the traditional fishing areas as a no-fishing zone.

Indicators that are of concern include coastal wetlands and coastal fisheries. Coastal wetlands including lagoons and mangroves are at the forefront of human actions. Many mangrove areas are used as dumping sites, or 'reclaimed' under the perception that they are waste land. Efforts to rehabilitate some of the worst affected sites have begun, including the mangroves at Fusi, Saoluafata village, where villagers led a campaign to remove rubbish and replant mangroves. The state of coastal fisheries was determined by the continuing fishing pressure on marine resources, and the increasing investment by communities and the government (Fisheries Division) to designate fish reserves, and to develop community-based fisheries management plans. The state of coral reefs has been variable, with some years showing high coral cover, and others, low coral cover. An interesting observation in the recent state of coral cover relates to deeper corals bleaching more, than those in shallow waters. The marine species of significance indicator focuses on 'high profile' species such as turtles, sharks, cetaceans and seabirds. New data and information have confirmed that Green turtles and some seabirds are breeding in Samoa. Limited data on the state of Samoa's coastal waters showed high heavy metal concentration at some sites around Apia and Vaiusu bays, however, most are considered to be in the normal range. Coliform readings from two populated sites (Vaitoloa and Moata'a) showed presence of high contamination due to poor sanitation and free-roaming animals.

Theme 2: Built Environment

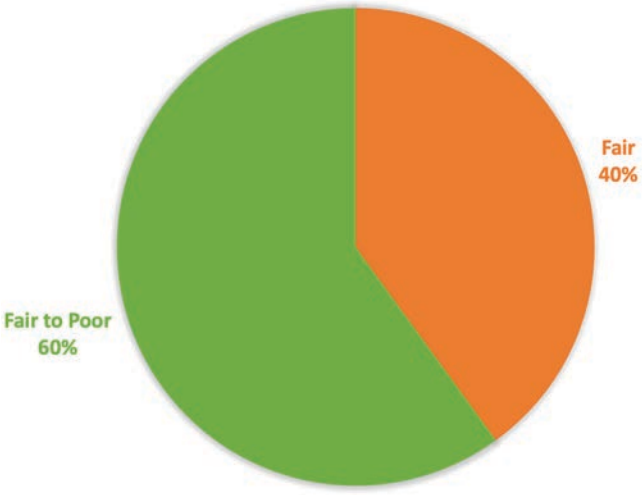


Figure 134: The state of Built Environment.

The state of Built Environment is mostly Fair to Poor (60%) (See Figure 134). The thematic area represents the state of the services and resources to cater for an increasing population. The oversight on development work that may impact the environment is an important indicator of the Built Environment. Most of the population have excellent access to safe sanitation (97% of households) and drinking water (99% households). However, there are some serious challenges to the state of septic systems and leachates to the environment, causing contamination to groundwater. While most households have access to safe drinking water, water quality data are incomplete. Public awareness on environmental regulation and compliance has increased, as reflected in the number of interactions between PUMA and the public. Waste management has been and continues to be a major challenge for the country. While there has been some progress with regards to waste collections, awareness campaigns and the banning of single use plastic, there is still some way to go manage unregulated dumpsites, recyclables and the Tafaigata waste management site that is nearing capacity.

Theme 3: Atmosphere, Climate and Disasters

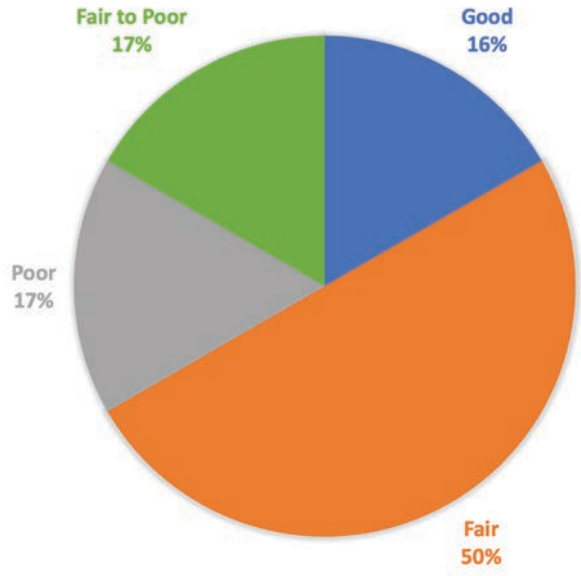


Figure 135: State of Atmosphere, Climate and Disasters.

The state of Atmosphere, Climate and Disaster theme is considered to be Fair to Fair-to-Poor (Figure 135). This is based on the six indicators being assessed, with the Ozone Depleting Substances indicator state considered to be Good. The Greenhouse Gas emissions indicator has made considerable progress in the collecting of data and assessing the various sectors responsible for the emissions. The data are tracking a slight increase in emissions, which is attributed to the energy sector. Progress towards adopting renewables to reduce the reliance on fossil fuels will assist in driving down GHG emissions. Some of the data for Samoa's physical climate are over 100 years old and they provide evidence of increasing temperatures due to climate change. Rainfall data are also reliable but they do not show any particular trend, other than being highly variable. There is data clearly supporting the global observation of rising sea levels, and Samoa's sea level is rising at a rate of 5.2 mm per annum. Natural disasters are either geologically influenced or climate change driven. The cost of natural disasters is in the millions; the period 2000 to 2010 being one of the worst in the country, costing SAT 5,211 million tala.

Theme 4: Environmental Governance

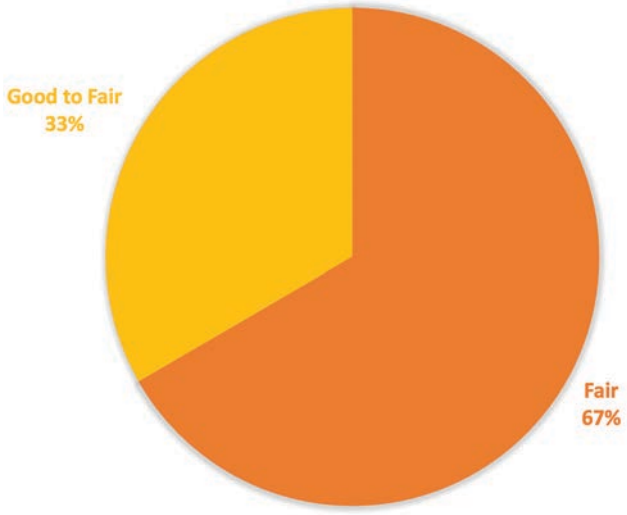
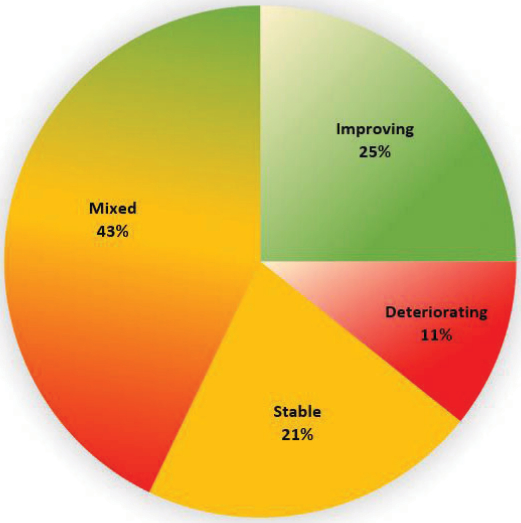


Figure 136: Environmental Governance.

The state of Environmental Governance is 33% Good to fair with 67% fair. The Gender equality indicator highlights the representation of women in the environmental sector, making up a third of the workforce. However, closer assessment noted that many of the divisions within the MNRE are dominated by women, including legal services, renewable energy, disaster management, the environment sector, corporate services and the water and sanitation sector. There are more women that are applying for senior management positions, and there are also younger female graduates opting for field-based positions, which have traditionally been seen as a male dominated position. The environment budget is considered to be in Fair state, owing to a small increase in government support, with a reliance on official development assistance (ODA) for project activities.

SOE Trends



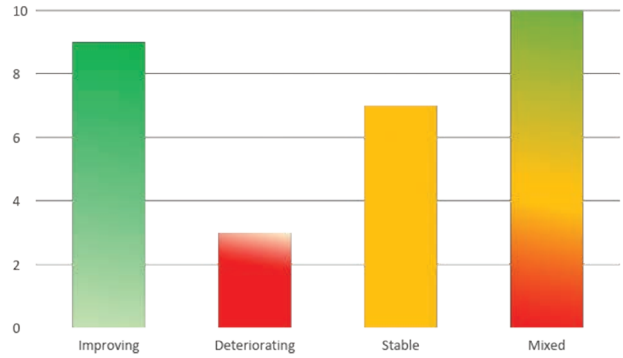


Figure 137: Samoa's environmental trends

The majority of the indicators are showing a mixed trend (43%), indicating some positive gains and also areas that need urgent interventions (Figure 137). There is improvement (25%) in some indicators and others remain stable (21%). Only a few indicators show a deteriorating trend (11%), which include the terrestrial environment (conservation and protected area indicator), the marine and coastal environment (marine species of national significance indicator) and the built environment (Apia urban area indicator).

SOE Data Confidence

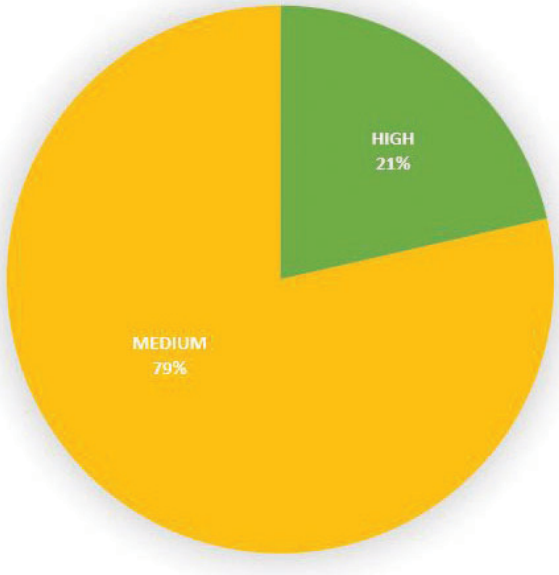


Figure 138: Level of confidence on the data and information used for the SOE assessment

The confidence in the data was generally at a good level, owing to access to many published and unpublished reports. There was not much access to raw data, which will help in future assessments (Figure 138).

APPENDICES

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Fesolai Molly Nielsen	MNRE
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Fuimaono Lameko Talia	MNRE
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Lealaisalanoa Frances Brown Reupena	MNRE
Leonardo Peseta	MNRE
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Manumaleuga Felisita Heather	MNRE
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Vainu'upo Jungblut	SPREP
Vanda Faasoa Chan Ting	SPREP
Vani Koroisamanunu	SPREP
Sharon Lesa	SWA

Annex 2: Samoa's Endemic Bird Species

COMMON/SAMOAN NAME	SCIENTIFIC NAME	DISTRIBUTION
Samoan Wood Pigeon	*Columba castaneiceps*	Upolu/Savaii endemic
Peale's Kingfisher / Tiotala	*Todiramphus pealei*	American Samoa endemic
Manu'a Shrikebill / Sega ole vao	*Clytorhynchus powelii*	American Samoa endemic
Samoan Myzomela / Sega sega mauu	*Myzomela nigriventris*	Archipelago wide
Samoan Robin / Tolai ula	*Petroica pusilla*	Upolu/Savaii endemic
Manu'a Starling / Fuia	*Aplonis manuae*	American Samoa endemic
Samoan Thrush / Tutulili	*Turdus samoensis*	Upolu/Savaii endemic
Samoan Starling / Fuia	*Aplonis artifusca*	Archipelago wide
Samoan Flycatcher / Tolai fatu	*Myiagra albiventris*	Upolu/Savaii endemic
Samoan White-eye / Mata pa'epa'e	*Zosterops samoensis*	Upolu/Savaii endemic
Manumea/Tooth-billed Pigeon	*Didunculus strigirostris*	Upolu/Savaii endemic
Samoan Moorhen / Puna'e	*Gallinula pacifica*	Upolu/Savaii endemic
Samoan Rainforest Honeyeater / Ma'o	*Gymnomyza samoensis*	Upolu/Savaii endemic
Samoan Triller / Miti	*Lalage sharpei*	Upolu/Savaii endemic
Samoan Whistler / Vasavasa	*Pachycephala flavifrons*	Upolu/Savaii endemic
Samoan Fantail / Se'u	*Rhipidura nebulosi*	Upolu/Savaii endemic
Flat billed Kingfisher / Ti'o tala	*Todiramphus recurvirostris*	Upolu/Savaii endemic

Pratt and Mittermeier (2016); Butler (2012)

Annex 3: Samoa's Reptiles

COMMON & SAMOAN NAME	SCIENTIFIC NAME	COMMENTS
Pelagic gecko (Mo'o)	*Nactus pelagicus*	Recorded from Savaii for the first time by Fisher and Uili (2016). Species distribution may be affected by Yellow Crazy Ant invasion. Common.
Mottled Snake-eyed skink	*Cryptoblepharus poecilopleurus*	Recorded from Savaii by Fisher & Uili (2016). Species distribution may be affected by Yellow Crazy Ant invasion. Classified as of Least Concern on the IUCN Red List.
Polynesian gecko (Mo'o)	*Gehyra oceanica*	Recorded from Savaii by Fisher and Uili (2016). The largest gecko in Samoa and is also widespread.
Pacific stump-toed gecko	*Gehyra mutilata*	Recorded from Savaii by Fisher and Uili (2016), common along the lava fields near the coast, although rarely seen throughout Samoa.
Mourning gecko (Mo'o)	*Lepidodactylus lugubris*	Recorded from Savaii by Fisher and Uili (2016). Widespread and associated with urban habitats.
House gecko (Mo'o)	*Hemidactylus frenatus*	Introduced and highly invasive species. Recorded from Savaii by Fisher and Uili (2016). Common near homes.
Common dwarf gecko (Mo'o)	*Hemiphyllodatylus typus*	Discussed in Fisher and Uili (2016) as a possible native species that has been recorded only three times – in 1895 and in 1992. Recorded by Richmond et al. (2017) following a BIORAP survey in Savaii (MNRE 2016).
Snake-eyed skink (Pili)	*Ablepharus boutonii*	Recorded from Savaii by Fisher and Uili (2016).
Striped Small-scaled Skink (Pili)	*Emoia adspersa*	Recorded from Savaii by Fisher and Uili (2016). Considered rare. Species distribution may be affected by Yellow Crazy Ant invasion. Listed as Endangered in the IUCN Red List.
White-bellied copper striped skink (Pili)	*Emoia cyanura*	Recorded from Savaii by Fisher and Uili (2016). Fairly common. Classified as Least Concern on the IUCN Red List.
Lawes skink (Pili oua)	*Emoia lawesii*	Recorded only from Samoa, Niue and Tonga. Classified as Endangered under the IUCN Red List.
Black skink (Pili uli)	*Emoia nigra*	Abundant throughout Samoa. Species distribution may be affected by Yellow Crazy Ant invasion. Classified as Least Concern on the IUCN Red List.
Samoan skink (Pili lape)	*Emoia samoensis*	Recorded from Savaii by Fisher and Uili (2016). Species distribution may be affected by Yellow Crazy Ant invasion. Listed as Endangered in the IUCN Red List.
Dark-bellied Copper-striped Skink	*Emoia impar*	Recorded from Savaii by Fisher and Uili (2016). Widespread and common. Classified as Least Concern on the IUCN Red List.
Polynesian Slender Skink	*Emoia tongana*	Recorded from Savaii by Fisher and Uili (2016). Classified as Least Concern on the IUCN Red List.
Moth skink (pili)	*Lipinia noctua*	Common throughout its range but poorly known in Samoa.
Pacific boa (Gata)	*Candoia bibroni*	Rare and probably predated on by cats.
Blind burrowing snake	*Ramphotyphlops braminus*	Introduced species, and spreading.

(Gill 1993; Fisher and Uili 2016)

Annex 4: Samoa's Terrestrial Protected Areas

TERRESTRIAL PROTECTED AREAS	YEAR ESTABLISHED	AREA (HA)		
		2009	2014	2017
Reserves and Conservation Areas				
Eleele Fou Recreation Reserve	2000	2.2442	2.2442	2.2442
Vaigaga Recreation Reserve	2000	0.164	0.164	0.164
Lelata Recreation Reserve	1999	0.22	0.22	0.2204
Vaimoso Reserve	1999	0.1	0.1	-
Faleata Nature Reserve	1999	9.298.1	9.298.1	9.29
Vailima Samoa National Botanical Garden Vailima	1978	12.1	12.1	12.1
Togitogiga Recreation Reserve	1978	12.1	12.1	12.1-
Robert Louis Stevenson Memorial Reserve	1978	0.4	0.4	0.4
Mt Vaea Scenic National Reserve	1958	89	170.5	101.5
Sinave Recreation Reserve	2006	0.01	0.01	0.013
Lotosamasoni Recreation Reserve	2007	0.142	0.0149	0.1409
Mulinu'u Mangrove Reserve	2003	2.42	2.42	-
Matautu Tai Reserve	2002	0.1	0.1	-
Ao-ole-Malo Reserve	2001	8.1	8.1	4.8
Faavae i le Atua Reserve	2000	0.81	0.81	0.49
Taumeasina Reserve	2000	2.4	2.4	-
Vaitele East and West Reserve	2000	0.81	0.81	0.63
Vaitele East Recreation Reserve East	2000			0.1536
Vaitele West Recreation Reserve	2000			0.228
Tiafau Recreation Reserve	2011		0.16	0.5816
Vaitele Fou Recreation Reserve	2006		4.71	4.71
Malaefatu	2000			
Malololelei Recreation Reserve	2015		21	212
Malololelei Biodiversity Park	2016			9.65
Vaimauga Recreation Reserve	2008		0.1	0.1
Community Conservation Areas				
Matautu Catchment	2016			1952
Gataivai	2016			11
Taga	2016			11
Falealupo Forest	1989	1215	1215	1215
Laulii Conservation Area	2000	400	400	400
Laulii-Falevao	2000	14000	14000	14000
Aopo Cloud Forest	1990			
Faleaseela watershed and rainforest sanctuary	2014			
Tafua Rainforest Reserve	1990			
Uafato Conservation Area	1997	1161	1161	
Sa'anapu-Sataoa Mangrove Forest Conservation Area	1997	52.9	52.9	52.9
Total Community and Conservation Areas		**2968.66**	**3054.92**	**3801.6**

TERRESTRIAL PROTECTED AREAS	YEAR ESTABLISHED	AREA (HA)		
		2009	2014	2017
National Parks				
O Le Pupū Pu'ē National Park	1978	2800	5019	5019
Lake Lanoto'o National Park	2003	1050	1050	4089
Mauga o Salafai National Park	2003	6944	6944	6944
Cornwall Aopo-Asau National Park	2012		2494	2494
Lata National Park	2009		4982	4982
Malololelei Biodiversity Park	2017			10
Total (National Parks)		**10794**	**20489**	**23538**
Total Terrestrial Reserve Areas		**13762.66**	**23543.9**	**27339.6**

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SAMOA

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