FIJI'S STATE OF ENVIRONMENT REPORT

2013

Rerevaka na Kalou ka doka na Tui

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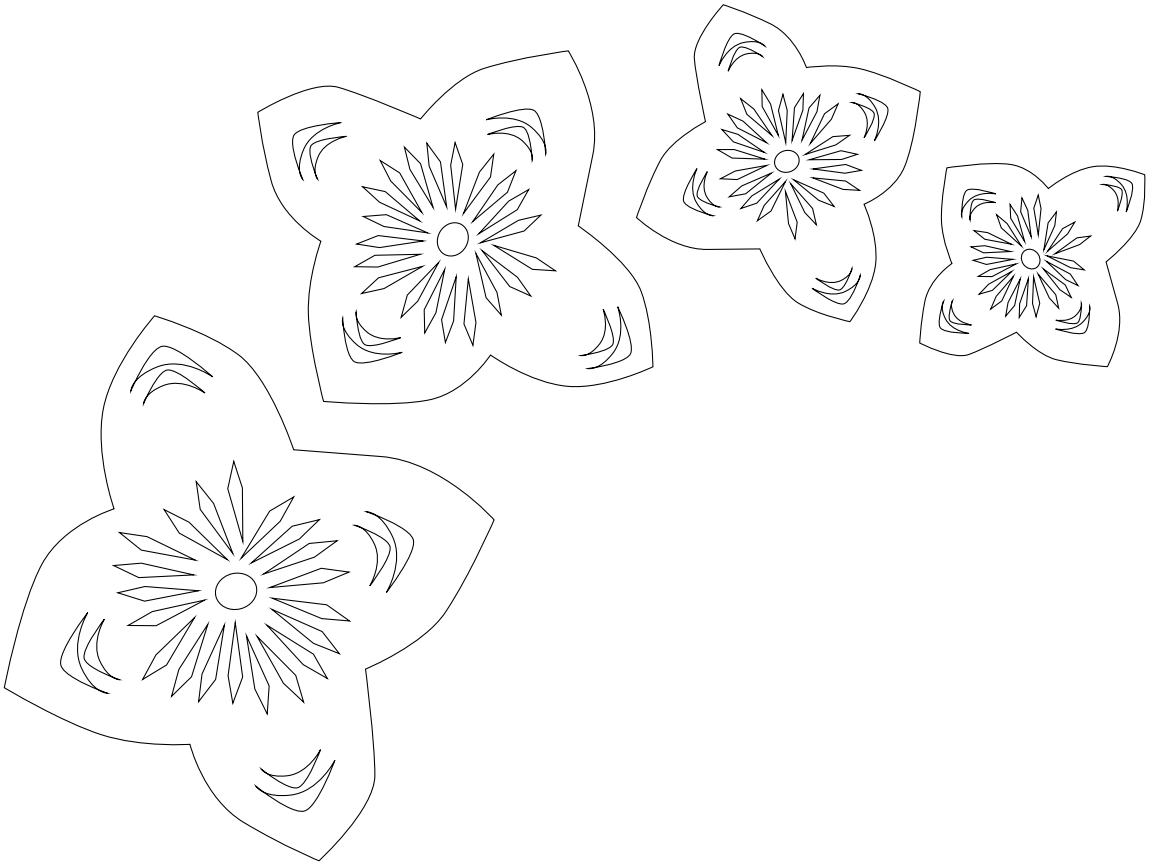

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The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

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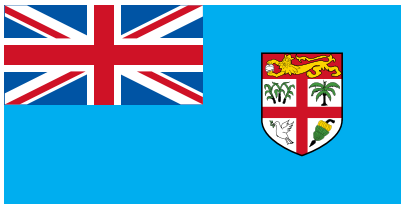

SPREP

Secretariat of the Pacific Regional Environment Programme

MESSAGE FROM THE MINISTER FOR LOCAL GOVERNMENT, URBAN DEVELOPMENT, HOUSING AND ENVIRONMENT, REPUBLIC OF FIJI

The 2013 Fiji National State of Environment Report is the first state of Environment Report for Fiji in over 20 years. It represents two years of consultation between my Ministry and other national agencies including ministries, Statutory Authorities, Non-Government Organizations (NGOs), Universities, Community Support Organizations (CSO), outer islands and regional organizations like the Secretariat of the Pacific Environment Programme (SPREP) and the Secretariat for the Pacific Community (SPC).

As the report outlines, Fiji is undergoing substantial changes. Some of these changes are impacting the natural environment that we have relied on for centuries for food, shelter, well-being, a rich cultural heritage and a national sense of what it means to be Fijian. Let us remember that as we continue to develop as a nation, build our economy, our infrastructure and social services, the very things we rely on to grow: food, clean water and air, marine resources, forests and rich soils are intricately tied to the health of our society and economy. Quite simply, if we ignore the environment, we risk our own development as a strong and independent nation.

The report also outlines the challenges and successes that we, as a nation, have had protecting our environment. It is my hope that this will stir us to action and optimism to build on what we are doing well, and improve where we have challenges. I am optimistic that Fiji can protect her environment and grow sustainably. It is also my hope that this report will help all us plan and prioritize better in the future to protect our environment. That is why the State of Environment Report and the National Environment Strategy have been developed together, so that our planning is influenced by what we observe is happening in our environment.

Lastly, I would like to acknowledges the technical support of the Secretariat of the Pacific Regional Environment Program (SPREP) and all its partners to develop the Fiji State of Environment Report.

Thank You.

Hon. Parveen Kumar
Minister for Local Government, Urban Development, Housing and Environment

MESSAGE FROM THE PERMANENT SECRETARY FOR LOCAL GOVERNMENT, URBAN DEVELOPMENT, HOUSING AND ENVIRONMENT, REPUBLIC OF FIJI

The Ministry of Local Government, Urban Development, Housing and Environment is pleased to release the 2013 National State of Environment Report, which is a mandatory requirement under the Environment Management Act of 2005. This report, which was facilitated through the Department of Environment, outlines the state of 7 broad themes in our national environment and cultural heritage. I think this is a report that Fiji can be proud of, a report that, for the first time in over 20 years, informs us of the major environmental challenges we face and provides a baseline for further assessment.

As the report outlines, Fiji is faced with challenging issues such as the decline of agriculture and its related impacts on food security, biodiversity and urbanization; the spread of environmentally damaging invasive species, the huge spectre of managing waste in the midst of ever increasing consumption with limited resources and space, and the unsustainable use of natural resources in the marine and terrestrial environment. Many of these issues are daunting and require a thoughtful and comprehensive response. It is encouraging to see that some of our traditional responses, like the qoliqoli community management system can work well hand-in-hand with modern regulations. We need to learn not only from our mistakes, but also from what we have done well and replicate what works it in areas that need further protection and management.

One challenge we face here in Fiji is enforcing the policies and regulations we have in place to protect the environment. The Department of Environment plays an important role in maintaining environmental sustainability, but it is the responsibility of all ministries, and indeed all people, to care for our national environment. Therefore, it is crucial that we integrate our planning, share our information and cooperate to meet our goals. The State of Environment report represents that integration required between ministries, authorities, universities and NGOs and to our broader regional partners like SPREP and SPC.

The 2013 Fiji State of Environment will help set priorities for planning, improved legislation and policies now and into future years. It will also set priorities around ensuring that monitoring in key areas continues and new monitoring is planned to meet information gaps.

A big appreciation to all our partners who took part in developing this report and a special acknowledgment to the Secretariat of the Pacific Regional Environment Program (SPREP) for their assistance in developing the 2013 Fiji State of Environment.

Thank You.

Mr. Samuela Namosimalua

Permanent Secretary for Local Government, Urban Development, Housing and Environment.

Photo: Stuart Chape

EXECUTIVE SUMMARY

The 2013 State of Environment Report (SOE) for Fiji is a follow up from the previous SOE report in 1992. The 2013 SOE uses the DPSIR model of reporting (Drivers, Pressures, State, Impact and Response). The main objectives of this report are:

- To document the key drivers and pressures in Fiji that are behind the changing environment in Fiji.
- To provide a full assessment of Fiji's environment (since the last SOE in 1992), using the best available information on the state of Fiji's environment for 7 key themes: Atmosphere and Climate, Inland Waters, Land, Marine, Biodiversity, Culture and Heritage and the Built Environment.
- To document the impacts on Fiji's society, economy and environment from changes in the state of the environment.
- To document current responses by Fiji to address the environmental changes, to protect and better manage Fiji's resources.
- To provide recommendations for Fiji to address key challenges, and build on existing strengths. These recommendations will then link with actions outlined by the National Environmental Strategy (NEMS).

Drivers and Pressures in Fiji

Fiji is a rapidly changing nation, and the environment is changing along with it. Activities changing Fiji's environment are driven by broader social, economic, technological and cultural forces referred to as "drivers". Population growth, urbanisation, tourism, increased access to external markets, a growing middle class, the clash of traditional and contemporary values and the increase in technological access are key drivers behind the change in Fiji. Drivers of Fiji's economic, societal and environmental change can be a source of further pressure on the environment, but they can also offer potential solutions to traditional problems. Climate Change is one driver that poses more of a threat than an opportunity to Fiji, particularly in areas vulnerable to extreme climatic events like flooding, sea level rise and cyclones.

The pressures on Fiji's environment are the main human activities that can adversely impact the environment and are grouped into 3 general categories for the SOE: 1) Land Development (urban, agricultural, coastal), 2) Resource Extraction (forestry, fishing and mining/quarrying) and 3) Consumption and Waste (energy, solid and liquid waste and water).

Most of these pressures on Fiji's environment are steadily increasing, with the exception of large scale agricultural expansion which has undergone substantial decline in the past 20 years. However, with the decline in agriculture, new pressures on the environment are emerging, such as the resulting growth in informal settlements, the decrease in food security and the expansion of small scale farms onto vulnerable ecosystems. This illustrates that these pressures are interlinked, and the decrease or increase in one pressure type can lead to an increase or decrease in another.

THE STATE OF FIJI'S ENVIRONMENT AND IMPACTS ON THE ENVIRONMENT, SOCIETY AND ECONOMY

Information was gathered from Fiji stakeholders on the 7 major themes and analysed by team leads, SPREP and DOE to provide a summary of the state, impact and response to 37 key indicators of 21 topics. A brief synopsis is included at the beginning of each theme for a quick review. The following provides a summary of each major topic covered in the SOE:

Atmosphere and Climate

AIR QUALITY: Based on the limited data on air quality, urban and rural air emissions likely have increased over the past 30 years. Ground level ozone has increased in Suva along with vehicle emissions. Cane burning has also increased in cane growing areas, and household wood fuel use and open burning remains high. Efforts to understand (monitor air quality and emissions) should be undertaken to target high emitters.

OZONE DEPLETING SUBSTANCES: Ozone depleting substances have been greatly reduced in Fiji, and stratospheric ozone levels above Suva over the past 10 years indicate stability.

GREENHOUSE GASES: GHGs increased between 1994 and 2004 particularly in the energy,

INDUSTRY AND AGRICULTURAL SECTORS: However, given its large land base and relatively small population, Fiji's GHG removals remain substantially more than its emissions. Based on overall energy use in Fiji, its 2009 GHG emissions per capita are on average less than the average emissions of other PICs in 2009 (1.58 Tonnes/capita vs 3.04 tonnes/capita).

CLIMATE: In Fiji, over the past 30–50 years, there are no detectable trends in precipitation, flooding and tropical cyclones. Overall maximum and minimum temperatures, have increased significantly with a 1.15ºC increase in the maximum temperature between 1961–2012 and a 0.62ºC increase in the minimum temperature over the same period.

Inland Waters

WATERSHED CONDITION: Over one third of Fiji's watershed's are classified as highly impacted by development, roads, invasive species, agriculture and/or resource extraction. However, by area, most of Fiji's watersheds are in relatively good condition. Impacts such as gravel extraction remain unchecked, and the trend is deteriorating.

SURFACE WATER QUALITY: Major rivers in Fiji have fair to good water quality, with moderate to high faecal coliform contamination, healthy levels of dissolved oxygen and low nutrients and metals. Urban creeks have very high faecal levels, likely from improper sanitation. Most surface waters show a stable trend.

GROUNDWATER: Historically, groundwater in Fiji has been pristine and abundant. Current pressures on the resources include bottled water extraction, community source water and irrigation. Some aquifers are experiencing contamination from aboveground sources. Overall, exploitation of the resource has increased significantly, but the extent of impact is unknown.

Land

FORESTS AND MANGROVES: Closed natural forest has decreased by 14% between 1991 and 2007, converted into open forest through forestry, development and agricultural expansion onto steep slope natural areas. Mangrove areas declined by ~5% between 1991 and 2007, mostly in urban areas, which saw up to 40% decline in some places.

AGRICULTURAL LAND: Cultivation of arable land has decreased by 60% between 1991 and 2009, largely due to the decline in cane sugar production, a traditional driver of both the agricultural economy and crop diversity. Soil acidity has also increased from fertilizer and pesticide use. Other commodities, such as dalo, livestock and fruits, are performing better. Despite the decrease in leased land agriculture, there is evidence that farmers are increasingly moving on to poorer class steep slopes that are not suited for agriculture. This is impacting both the natural forest and overall soil health. In addition, the decline of agriculture has other environmental impacts such as decreased food security, and the increase of urbanisation in Fiji, particularly to informal settlements.

Marine

OFFSHORE MARINE ENVIRONMENT: Offshore tuna catch increased from 1997 to 2006, but has since decreased due to restrictions on catch to ensure sustainable tuna harvest. Unsustainable shark harvest remains a concern. Between 2002 and 2011 shark species averaged 10 to 15% of the total offshore tuna catch, and an analysis of shark fin exports reveals that there is a dedicated shark fin harvest.

Inshore Marine Environment: Monitoring of live coral cover, fish biomass and diversity suggest that the overall inshore environment is in a good state with stable trends. Inshore fishing pressure, however, remains high, particularly unregulated subsistence fishing in certain areas. Certain inshore products, such as beche-de-mere (sea cucumber) appear substantially overfished.

Marine Managed Areas: Fiji's Locally Managed Marine Areas are largely a model of success across the Pacific, and have resulted in the recovery of fish and invertebrate stocks in several areas in Fiji. Issues with external poaching and siting of the tabu areas remain a concern, but the trend is generally improving.

Biodiversity

ENVIRONMENTAL INVASIVE SPECIES: A number of invasive species exist on many Fijian islands. The spread to other areas in Fiji is happening rapidly in some places, and there is little inter-island biosecurity to prevent the spread. However, Fiji Biosecurity Authority has had success in keeping new pests out of Fiji's ports, and efforts in eradicating invasive species on some small islands have been successful.

PROTECTED TERRESTRIAL AREAS: IUCN classified protected sites only make up 2.7% of Fiji's land mass. Proposed Key Biodiversity Areas, Important Bird Areas, and Priority Forest Areas would make up a further 15% if accepted under protected area status. However, currently there is little action in establishing new protected areas.

THREATENED AND ENDEMIC SPECIES: Many of Fiji's Endangered species are endemic, and most inhabit the terrestrial environment. The general consensus is that Fiji's biodiversity is deteriorating, with the decline of the natural forest forming the biggest threat. Some recovery plans exist but are generally poorly supported, and there is a very low state of knowledge about Fijian threatened species.

Culture and Heritage

BUILT HERITAGE AND INDIGENOUS SITES: Overall, most recognized heritage sites in Fiji have some level of preservation or management, some more successful than others. There appears to be no significant difference in overall state between built and indigenous heritage sites. Continued environmental and anthropogenic pressures on these sites underline the *need for protection*.

TRADITIONAL ENVIRONMENTAL KNOWLEDGE: Like most aspects of Fijian culture, traditional knowledge is undergoing pressures from modernization, but is still widely intact across Fiji today. Some aspects of sustainable environmental practices are being replaced by modern practices, but many have been revived, or remain firmly part of the Fijian cultural landscape.

Traditional Diets: Overall, Fijians still consume a large amount of traditional, locally produced foods, particularly when compared to countries across the Pacific. A strong subsistence base remains, but there is increasing evidence that this is changing very rapidly with the decline in agriculture across Fiji, as well as cultural changes taking place.

Built Environment

ENERGY CONSUMPTION, AVAILABILITY AND RENEWABLES: Per capita energy consumption has increased substantially over the past 10 years, largely due to increased access to electricity and market demand. Much of this demand has been met by non-renewable resources. However, energy efficiency has increased and plans are in place to increase renewable sources of electricity above the current 66%.

SOLID WASTE: Waste management, recycling and collection is improving, but currently collection and recycling rates do not keep up with increasing generation rates. Only 80% of waste generated makes it to landfills. Most landfills lack segregating facilities for separation of recyclables and hazardous waste, and in many cases, waste is still burnt.

WATER AND SANITATION: Access to improved drinking water and sanitation has improved over the past 30 years. However, access to sanitation in some rural areas and informal settlements remains an issue. In addition, poor construction and maintenance of septic systems is likely leading to high faecal contamination in receiving waters.

RESPONSE AND RECOMMENDATIONS: CHALLENGES IN MOVING FROM POLICY TO ACTION

While gaps exist, Fiji has many strong laws, policies and regulations that promote sustainable use and protection of its environmental resources. In addition, since the 1992 SOE report, Fiji has had a plethora of assessment reports recommending actions on biodiversity, agriculture, water, marine management, climate change, and others. However, the national implementation and enforcement of these efforts is inconsistent and, in some cases, non-existent. They are largely dependent on external funding from NGOs and international sources, many of which are short-term and determined by current international priorities.

A good example is the case of endangered species, where the implementation (and in some cases development) of protective policies is left to NGO's, who have a limited ability to implement them. Another example is the management of invasive species. With international assistance, Biosecurity Fiji has been effective at keeping new species out of Fiji, but has limited ability or mandate to keep existing invasives from spreading to other parts of Fiji.

The best examples of environmental management in Fiji are where traditional practices have been combined within a modern legislative framework. One such example is the qoliqoli tradition of managing inshore marine areas, a model of success today.

On their own, traditional practices are not enough to protect the environment from modern day pressures, such as deep sea mining, the demand for shark fins, whole-scale resource extraction and population growth. Traditional practices of environmental management need to be integrated into, and supported by, a strong legislative framework of environmental protection for overall success.

The Fiji government has recently introduced a "Reach for Fijian Made" campaign, promoting the strengthening of the Fijian manufacturing and agricultural economy. Perhaps a "Made in Fiji" approach can be developed for the terrestrial environment, like it was for the marine environment in the mid 1990s. There are examples of sustainable traditional farming, forestry and water management practices of iTaukei Fijians and Indo-Fijians that could be utilized within a modern management framework.

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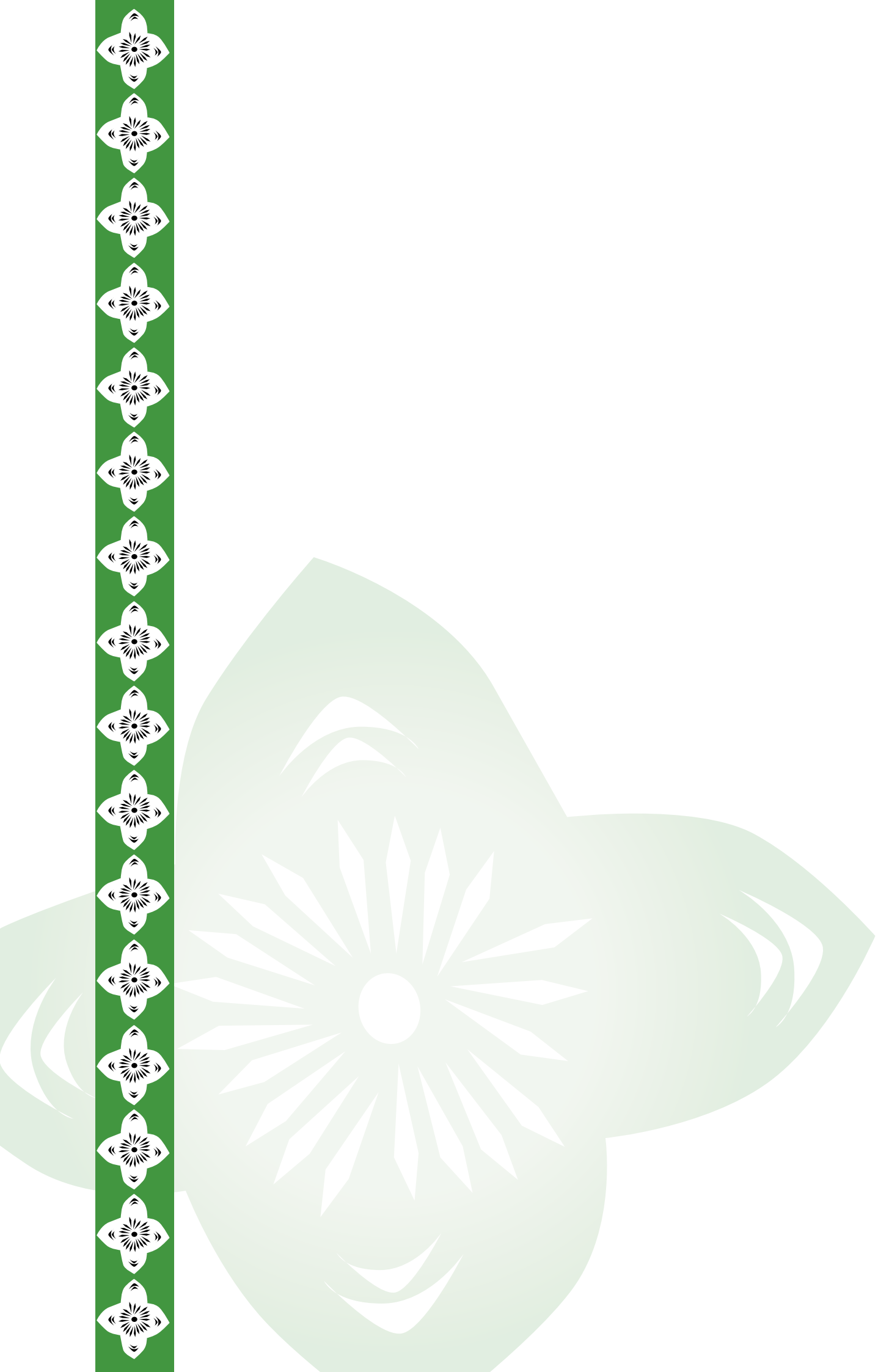


SECTION 1

INTRODUCTION AND READER'S GUIDE

Photo: Carlo Iacovino, SPREP.

INTRODUCTION AND BACKGROUND

ENVIRONMENTAL REPORTING IN FIJI

A number of planning and reporting requirements have been mandated under the Fiji Environment Management Act 2005 (Figure 1). The National Resource Inventory is intended to serve as a basis for formulating the Natural Resource Management Plan. Under Part 3, Section 23, 24, 25 Subsection (1) of the Environment Management Act 2005,The State of the Environment Report (SOE) must be published every 5 years, and the National Environment Strategy must be formulated within 12 months after the approval of the National SOE. The National Natural Resource Inventory was compiled, passed by cabinet and launched in 2010.

In relation to the National SOE, the Legislation mandates the following (Part 3:23):

1. The National State of the Environment Report must be published at least every 5 years.
2. A Ministry, department and statutory authority must provide any technical assistance and information required by the Department, in the formulation and review of the National Report.
3. The National Report must be formulated, prepared and reviewed in accordance with the prescribed procedures and must contain the prescribed matters.
4. After consideration of any submissions, the Department must develop a draft of the proposed National Report and circulate it for public review.
5. The National Report must be submitted to the Minister for tabling before each House of Parliament.

FIGURE 1. Fiji planning and reporting requirements.

PURPOSE OF THE STATE OF ENVIRONMENT REPORT

The aim in preparing the Fiji SOE is to present and consolidate information as the basis for effective environmental management and planning. The SOE looks at the major drivers of change in the environment which emerge from global, regional as well as national factors. The SOE then evaluates the main pressures that these broad forces are creating, and the ways they impact not only the environment, but also national economies, and the lifestyles and well-being of citizens.

State of the environment reporting is an internationally accepted method of assessing and analysing the condition of the ecosystems and associated natural resources of a given geographic area or jurisdiction. SOE reports bring together both quantitative and qualitative data from various local, regional, national and even international sources. These data are compiled and analysed to provide a holistic picture of the current state of the environment, and trends and patterns in relation to key aspects of the natural world, especially in relation to human activities which impact on it.

The most important aspects of the environment for the area in question are given priority with emerging issues also identified and considered. SOEs have typically included accounts of the condition of flora and fauna species, habitats such as native forests, marine and inland water bodies, soils, and vegetation cover. However, contemporary approaches also address key aspects of highly modified agricultural and built environments.

Many SOEs provide predictions about emerging issues and likely future scenarios. This aspect is particularly important with the growing concerns and need to devise strategies to mitigate and adapt to the impacts of climate change. Increasingly SOE reports can provide well-researched information for forward planning in areas such as natural resource management, town planning, tourism and resource development.

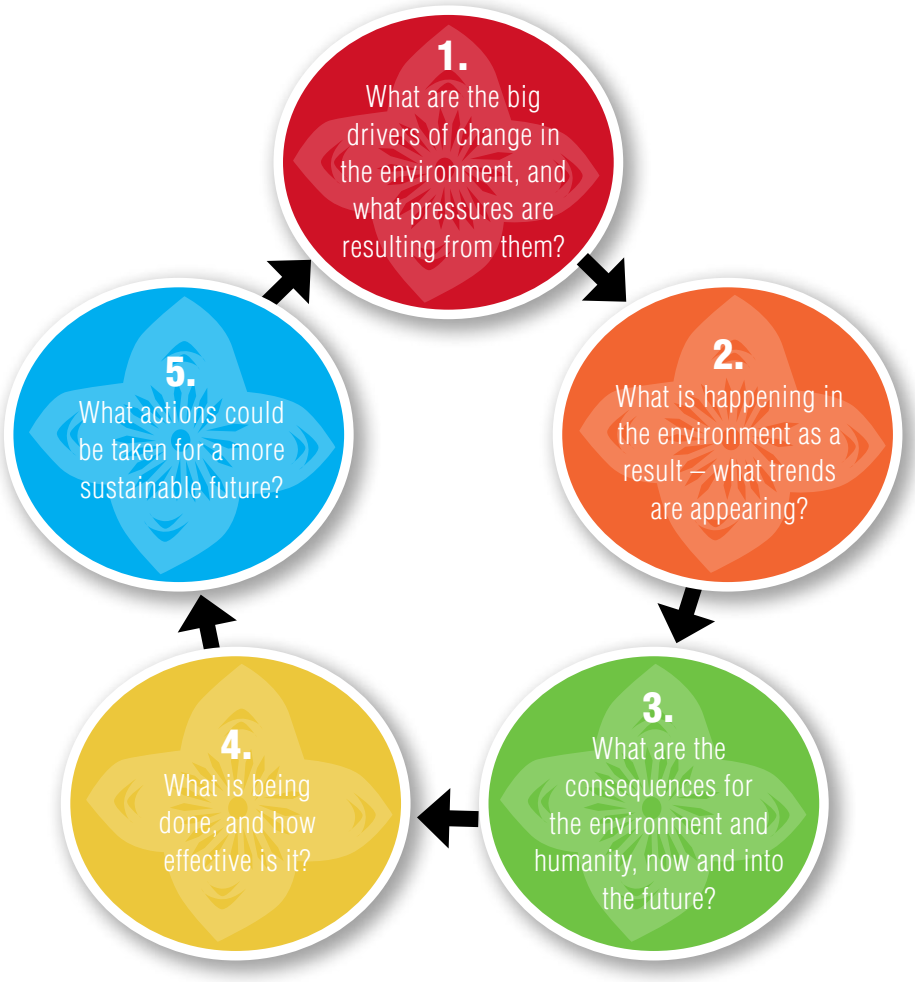


FIGURE 2: Objectives of SOE reporting.

AUDIENCES

The main audiences for the Fiji SOE are:

- Fiji Government personnel, particularly those working in areas relating to the environment, but also others such as Planning and Infrastructure, Health and Education.
- Individual citizens and community groups
- Donor organisations e.g. UNDP, GEF, MEAs, AusAID
- Non-government organisations like WWF, IUCN, the Nature Conservancy and others
- Researchers of SOE report themes
- Research institution and university personnel

Comparing the 1992 and 2013 SOE Reports:

Fiji's 1992 State of Environment of Report highlighted several environmental issues that needed addressing in Fiji. Summarized, these were:

- *Unsustainable resource use* – Poor management of cane farming, inshore invertebrate harvest, and forest and mineral exploitation were having adverse environmental impacts across Fiji.
- *Urban Environment Pollution* – The growing urban environment was under pressure, particularly in the area of waste and sanitation management and air pollution.
- *The lack of protection for biodiversity resources.* In general, Fiji's species were vastly undervalued for their genetic, cultural and tourism potential; current protection and management was inadequate.

The 2013 State of Environment Report follows up on these and other issues, and focuses on data collected in the interim between the reports. Many of the issues identified in 1992 remain today, with further escalation of the noted trends, and some new issues have emerged. The collection of better data has helped clarify some issues and discover new ones.

Beyond an observation of similar issues, it is difficult to make quantitative comparisons between the two reports. In 1992 there was little data to determine baselines or trends, so much of the assessment was done by expert opinion, some of whom who have contributed to this report. The 2013 SOE contains then, not just a summary of the state and actions required to protect the environment, but also a summary of the best available data and information on each theme. The purpose of the 2013 SOE was not to provide an exhaustive list of data or develop new research questions, but to provide a baseline and assessment for future reporting.

However, huge data gaps remain, so the 2013 SOE took a pragmatic approach to data – that is: first, find the best data available to determine state and trends. Then, if important issues contain data gaps, look for proxy data that provides a "clue" to the state. For example, for air quality, vehicle emission observation data and cane burning was taken as a proxy for urban and rural air quality. This is also why a confidence level was developed, as typically proxy data for indicators have lower confidence for the assessment.

APPROACH TO THE 2013 FIJI SOE

THE DRIVING FORCES, PRESSURE, STATE, IMPACT, RESPONSE (DPSIR) MODEL IN SOE REPORTING

The DPSIR model (Figure 3) is used in state of the environment reporting as part of a systems approach, which takes into account the social, political, economic and technological factors, as well as forces associated with the natural world, like climate variability. As with any consideration of the environment, there is inevitable overlap between these factors. Climate change is one such example, where a 'natural' driver, climate, is also closely connected with social drivers including economic, population growth and policy. Such drivers result in pressures which bring about changes in the natural environment (and in turn, impact social and environmental conditions further).

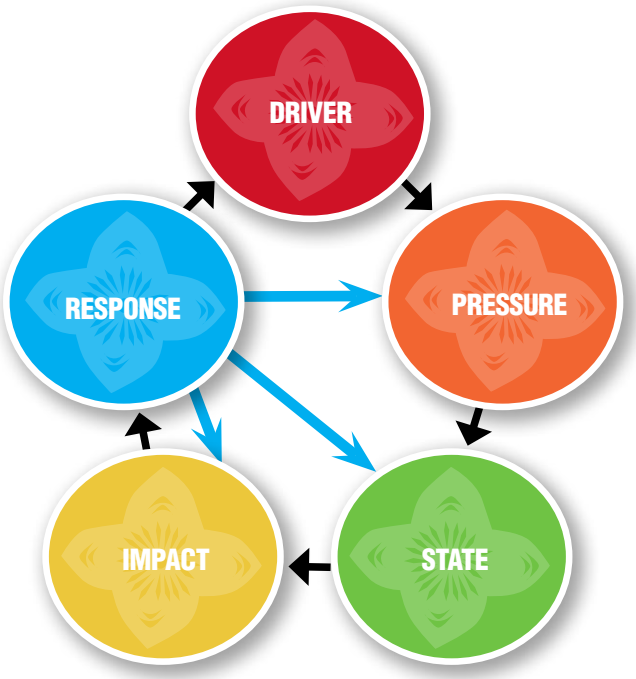


FIGURE 3: DPSIR model for SOE reporting.

THEMES FOR THE 2013 FIJI SOE

Seven themes have been adopted for the 2013 Fiji SOE covering a number of important ecosystems and issues relating to the environment as detailed below. Indicators were developed under each theme according to habitat or sub-topic. For example, the theme of the Marine Environment was broken into 3 key areas or topics: the Inshore Environment, the Offshore Environment and Marine Managed Areas. See Table 1 for a breakdown of the themes and subtopics used.

Within each sub-topic or habitat, there are indicators that are used to assess the state of that area. For example, the Inshore Environment has 4 key indicators: Inshore Fish and Invertebrate Harvest, Coral Reef Live Cover, Fish Biomass and Fish Species Diversity. All of these indicators are individually rated for state (good, fair, poor), trend (deteriorating, stable, mixed or improving) and confidence in the data (low, medium, high).

The indicators are then rolled up into the sub-topics under each theme (shown in the "highlights" section), and given a similar rating for state, trend and confidence.

For more information on how the state, trend and confidence were assessed and compiled refer to section "A Guide to Interpreting State, Trend and Confidence Symbols".

TABLE 1. Themes, sub-topics and indicators for the 2013 Fiji SOE.

THEME	SUBTOPIC OR AREA	INDICATOR (S)
Atmosphere and Climate	Air Quality (Urban)	Ground Level Ozone and Vehicle Emissions
	Air Quality (Rural)	Burnt Cane over time and household fuel use
	Ozone Depleting Substances and Greenhouse Gases	Suva Stratospheric Ozone and Fiji ODS consumption over time
		Trend in National Inventories of CO_2, CH4 and VOC's
	Physical Climate	Precipitation trends over time
		Temperature trends over time
		Flooding and Cyclone events over time
Inland Waters	Watershed Condition	Risks from land clearing, invasive species and road building to watersheds
	Surface Water Quality	Trends in DO, Nutrients, Biological and Faecal coliforms in major creeks and rivers across Viti Levu
	Groundwater	Groundwater availability, quality and withdrawals
Land	Forests	State and Trends in open, closed and plantation forests
		State and trends in area of Mangroves
	Agriculture	Land Productivity for Agricultural Commodities – Yield per hectare of Dalo and Ginger
		State and trends in soil acidity
		State and trends in areas under cultivation and ownership types
		Trends and state in traditional crops and vegetable varieties
Marine	Offshore Environment	Tuna, Sharks and Tuna-Like Species Harvested
	Inshore Environment	Fish Biomass for selected areas in Fiji
		Trends in Inshore fishery catch of Fish and Invertebrates
		Species diversity as percent of expected across selected areas in Fiji
		% Live Coral Cover
		Status and trends in Suva Harbour DO and Faecal Coliforms
	Marine Managed Areas	Effectiveness of LMMA's at meeting national marine protection goals
Biodiversity	Environmental Invasive Species	Number and spread of Environmental Invasive Species
	Endemic and Endangered Species	# of ESP listed/IUCN species in Fiji by key habitats
		Trends and state of species of special concern in Fiji (Focus on species of importance)
	Terrestrial Protected Areas	State of and trends in protected terrestrial areas
Culture and Heritage	Built and Indigenous Heritage Sites	State of listed built and indigenous heritage sites
	Traditional Knowledge and Practice	State of traditional knowledge from cultural mapping exercise
	Traditional Foods	Traditional crops and diet trends and state
Built Environment	Solid Waste	Urban solid waste collected and recycling rates
		Waste generation estimates and litter surveys
	Water and Sewerage	Access to improved drinking water
		Access to improved sanitation
	Energy Consumption	Energy Consumption, Availability and Renewables

A READER'S GUIDE TO THE 2013 STATE OF ENVIRONMENT REPORT

HOW TO READ THE REPORT

A State of the Environment Report condenses a large amount of information on various aspects of the environment into a readable and actionable report. Given the broad spectrum of topics covered, the report has been broken into themes for easier utilization. The report can be read as a whole or according to different themes, noting that most of the themes are connected to each other and to the pressures and drivers behind them.

In addition, to allow for a summary of the state, trend and confidence in the assessment, symbols have been designed for each individual indicator. Symbols were also designed for groups of indicators that described a sub-topic or habitat within a theme. For example the theme of Land is broken into Naturally Vegetated Areas and Agriculture. Symbols were not designed for each theme because the variety of states limits a meaningful summary statement.

A GUIDE TO THE SYMBOLS USED

An assessment like the SOE takes into consideration many data sources, expert opinion and other information. For the Fiji SOE, although there is more data available since 1992, there is not enough information to make quantitative assessments (e.g. an index of 1–10, or a threshold) that could be compared across themes. Therefore a good, fair, poor generic index was developed that took into account expert opinion and data.

The assessment symbols (see Figure 4) were designed to provide a quick summary, based on the data available and expert opinion on the state of each indicator. This serves two main purposes: 1) to provide an easy to understand synopsis and 2) to establish a baseline for comparing state of each indicator/topic area for future assessments, including State of Environment Reports. The symbol includes a "state" rating, "trend" rating and " confidence" rating. Table 2 below breaks down how to interpret the symbols and also how they were typically derived during the assessment process.

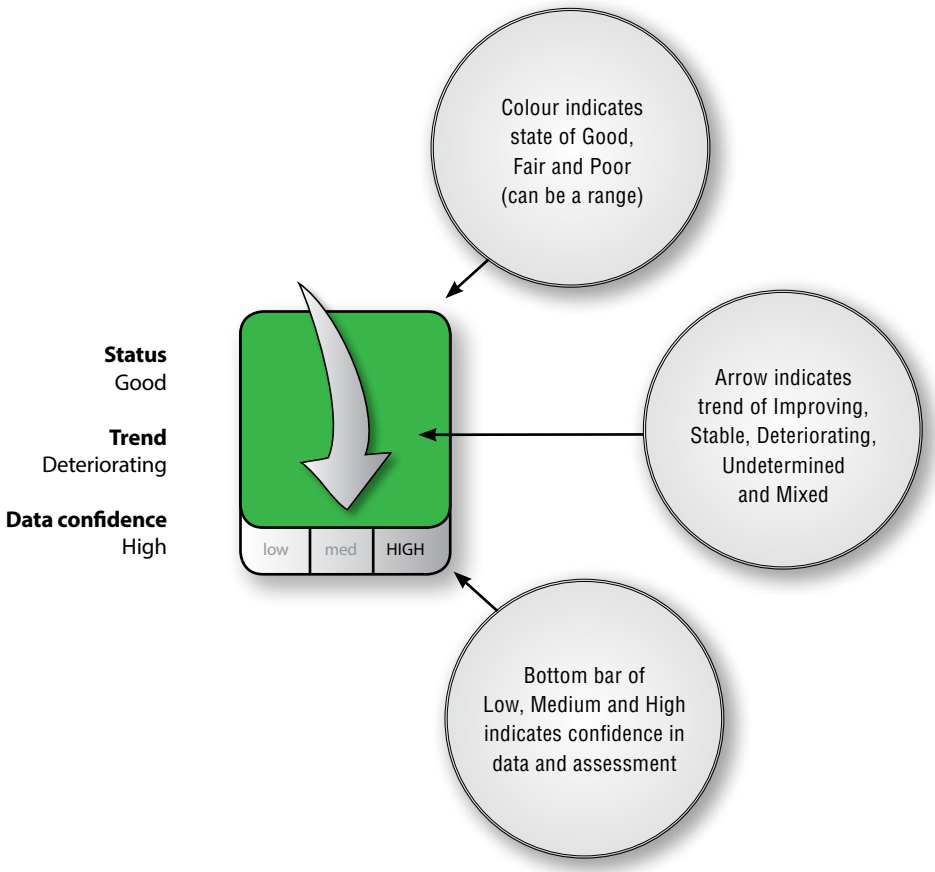
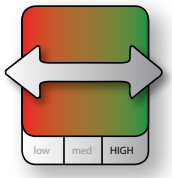
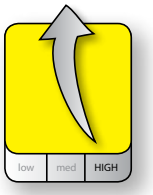
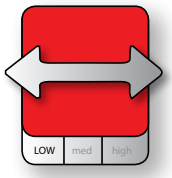
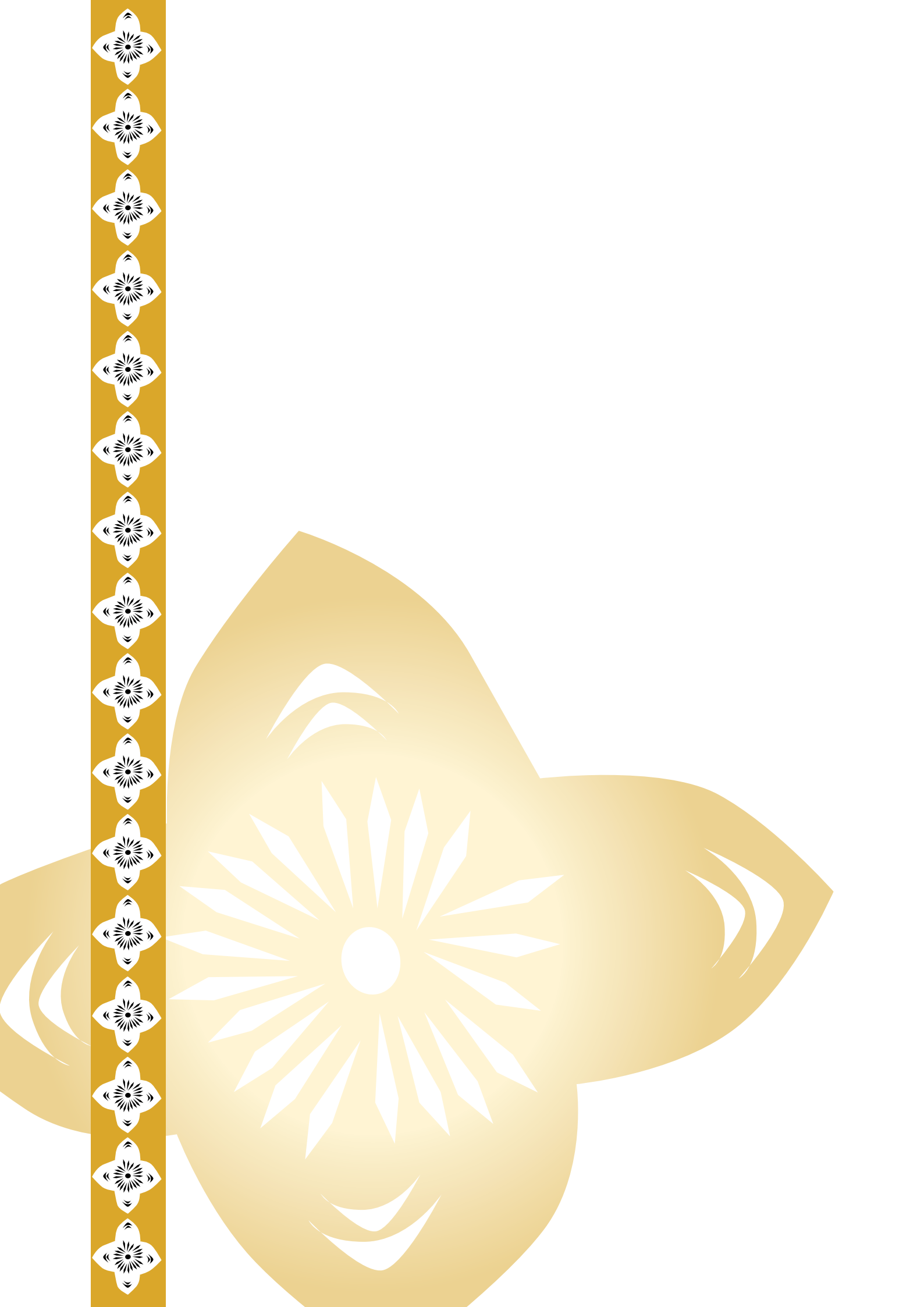


FIGURE 4: Breakdown of the Indicator symbol.

TABLE 2. A guide to interpreting the symbols.

	CATEGORY	DESCRIPTION	HOW IS IT DERIVED?	EXAMPLE
STATE (CAN BE A RANGE)	GOOD	The level to which the indicator meets or exceeds (good), is close to meeting (fair) or is well below (poor) a given standard for healthy ecosystems, habitats, species, airsheds, watersheds or an urban environment.	Assessment is based on 1) recent trends, 2) comparison with similar jurisdictions and 3) comparison with "healthy" habitats and systems. Where little data exists to make an assessment based on these criteria, expert opinion is used.	
	FAIR			
	POOR			
TREND	IMPROVING	The state of the environment related to this indicator is getting better.	Trends show a significant increase or based on weight of evidence indicators are improving.	
	DETERIORATING	The state of the environment related to this indicator is getting worse.	Trends show a significant deterioration, or based on weight of evidence that indicators are worsening.	
	STABLE	The state of the environment related to this indicator shows there is no detectable change.	Trends show no significant increase or decrease or, based on weight of evidence indicators are stable.	
	MIXED	The indicator shows that there is a mixed trend, some worse, some better and some stable.	Used primarily for sub-topics with multiple indicators, or in cases where data shows two distinct trends.	
	UNDETERMINED	Not enough data exists to determine trend.	Not enough data exists to determine trend.	
CONFIDENCE	HIGH	Data is of high quality and provides good spatial and temporal representation.	Data is of high quality and provides good spatial and temporal representation.	
	MEDIUM	Data is either lower quality, geographically sparse or limited temporally.	Data is either lower quality, geographically sparse or limited temporally.	
	LOW	Data does not meet any of the above criteria.	Data does not meet any of the above criteria.	**Status** Good **Trend** Improving **Data confidence** Low



DRIVERS AND PRESSURES ON FIJI'S ENVIRONMENT

Nadi, Fiji. Photo: Carlo Iacovino, SPREP.

WHAT ARE THE DRIVERS OF ENVIRONMENTAL CHANGE IN FIJI?

Human activities such as overfishing, and deforestation are placing pressures on the natural environment. However, these activities are driven by broader social, economic, technological and cultural forces. These drivers do not work in isolation, but interact to create pressures that produce changes in the environment that impact the lives and well-being of individuals, communities and nations. For this 2013 Fiji State of Environment Report (SOE) five broad level drivers have been identified:

- Population growth and demographic change;
- Globalisation and geography;
- Climate change and variability;
- Economic and technological development; and
- Traditional & contemporary values, attitudes, lifestyles and governance.

Table 1 outlines the broad driver themes along with related indicators for each theme:

TABLE 1. Drivers and their Key Indicators.

DRIVERS (KEY INDICATORS)				
Population and Demographic Change	Globalisation & Geography	Climate Change and Variability	Economic and Technological Development	Traditional & Contemporary Values, Attitudes, Lifestyles & Governance
Global and National Population growth	Shipping Connectivity to markets in Fiji and selected countries	Global CO_2 emissions	Global and Fijian phone and internet subscriptions	Fiji and Regional Agricultural Trade balance
Gross National Product (Global and Fiji) and household expenditure	Tourism arrivals in Fiji	Global average air temperatures and sea surface temperature	Global and Fijian Economic Sector changes	Fiji Land tenure systems
Global, regional and national urbanisation rates	Multilateral Environmental Agreements (Fiji and world)		Fijian Urban and Rural Economies	Global and Fijian access to education

Drivers can have diverse impacts on society, the environment and economy; they are not exclusively negative or positive. So they should be viewed objectively in light of how they are managed to achieve best outcomes.

DRIVER 1: POPULATION GROWTH AND DEMOGRAPHIC CHANGE

Population growth is a major driver in changes to the environment, putting further pressures on both the built and natural environment. Figure 1 shows the current and expected populations for the Pacific region from 1970 to 2050.

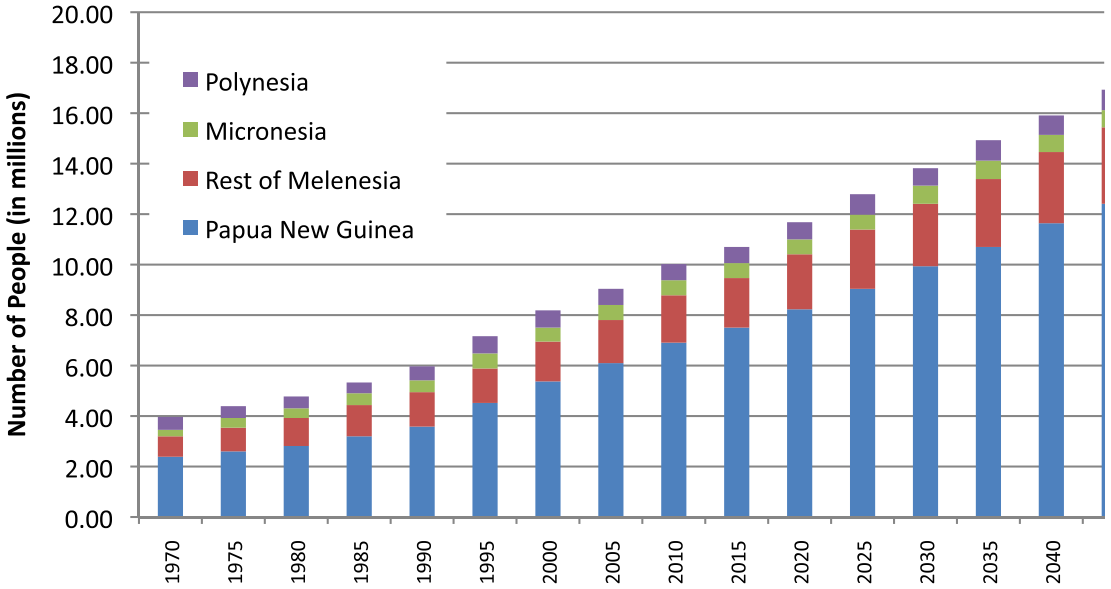


FIGURE 1. Pacific Islands Past, Current and Projected Populations.
(Adapted from the Pacific Environment and Climate Change Outlook – PECCO, 2012.

Figure 2 shows world growth rates along with Fiji's population and growth rates. Fiji's population has grown from 450,00 in 1962 to almost 900,000 in 2012. The growth rate peaked in 1966 at 3.3 and has steadily declined to 0.7 in 2012 largely due to emigration and reduced family sizes. The gradual decline in growth rates in Fiji is similar to the world wide trend but with much more variation.

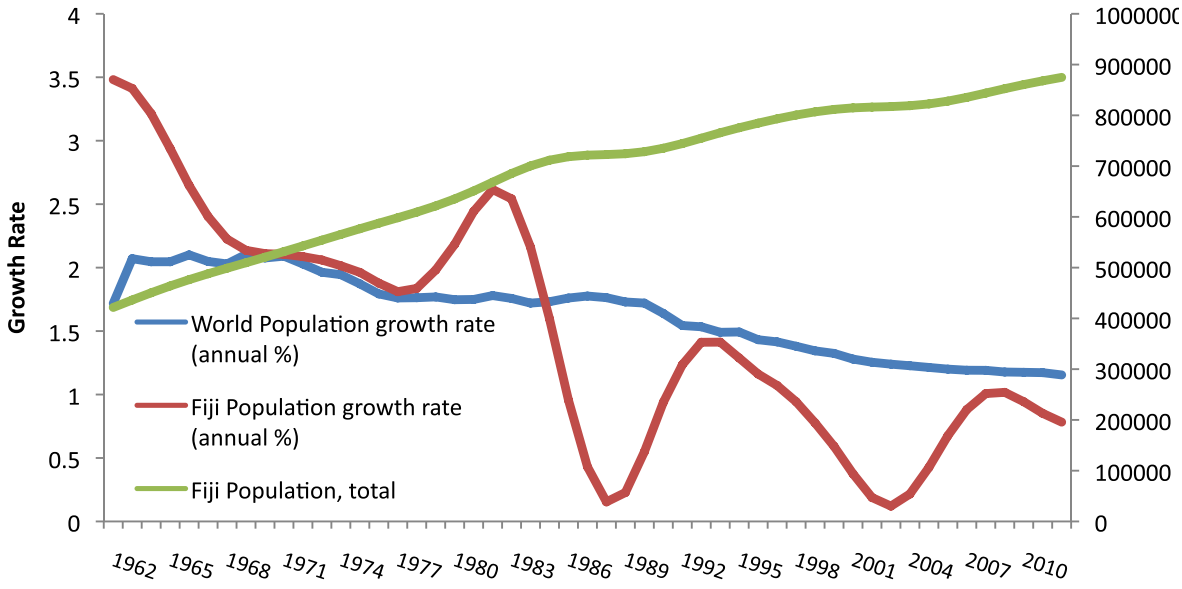


FIGURE 2. Fiji and World population and growth rates. Source: Fiji Bureau of Statistics.

A demographic driver behind environmental change throughout the world and in Fiji is the general increase in household income and access to goods. Figure 3 shows GDP per capita for the world, middle income countries and Fiji since 1960. In real dollars, GDP has risen worldwide, and although driven by the wealthiest countries, overall, low and middle income countries have also increased substantially.

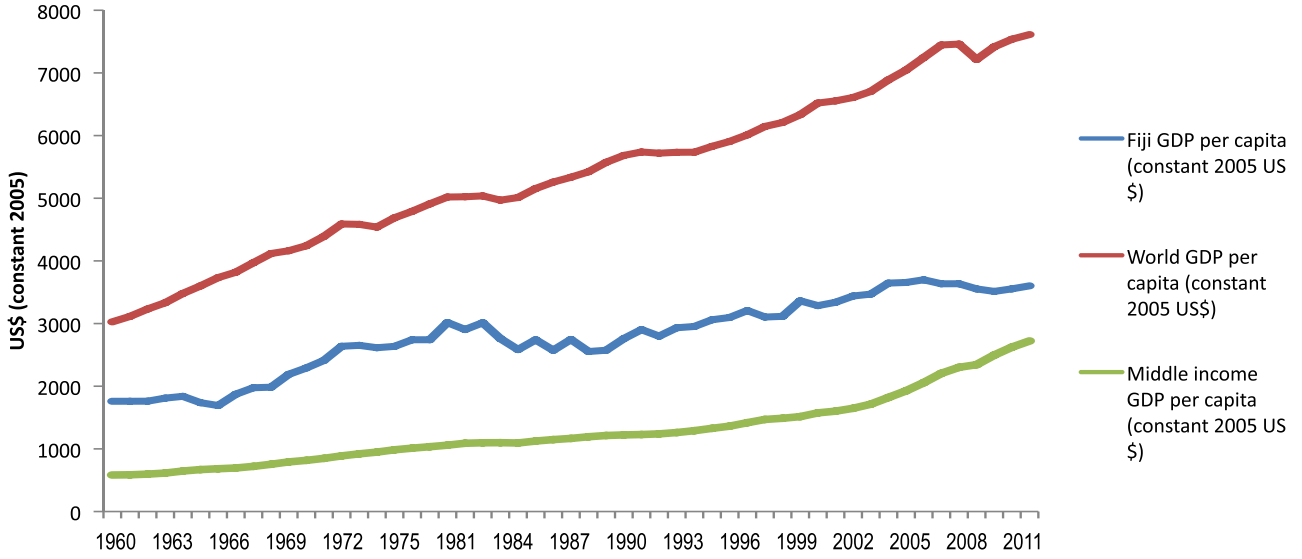


FIGURE 3. Fiji, World and Middle Income GDP per capita changes since 1960. Source: World Bank, 2013.

This global driver is reflected In Fiji, where overall income has increased dramatically in the past 50 years, from 407 FJD (220 USD) per person in 1962 to 7770 FJD (4200 USD) in 2012 based on current USD/FJD rates. In addition, as income has grown, so has average household consumption, as shown below in Figure 4. Based on current FJD/ USD currency, consumption of household goods has increased from 144,300 FJD (78,000 USD) in 1960 to almost 5,500,000 FJD (3,000,000 USD) in 2012.

While this allows for a better standard of living, increased access to education and health services, it can create pressures on the environment by increasing waste and energy demands. Increased income also results in changes to the culture through increased access to global commodities, often bringing in other influences from around the world. These are discussed later.

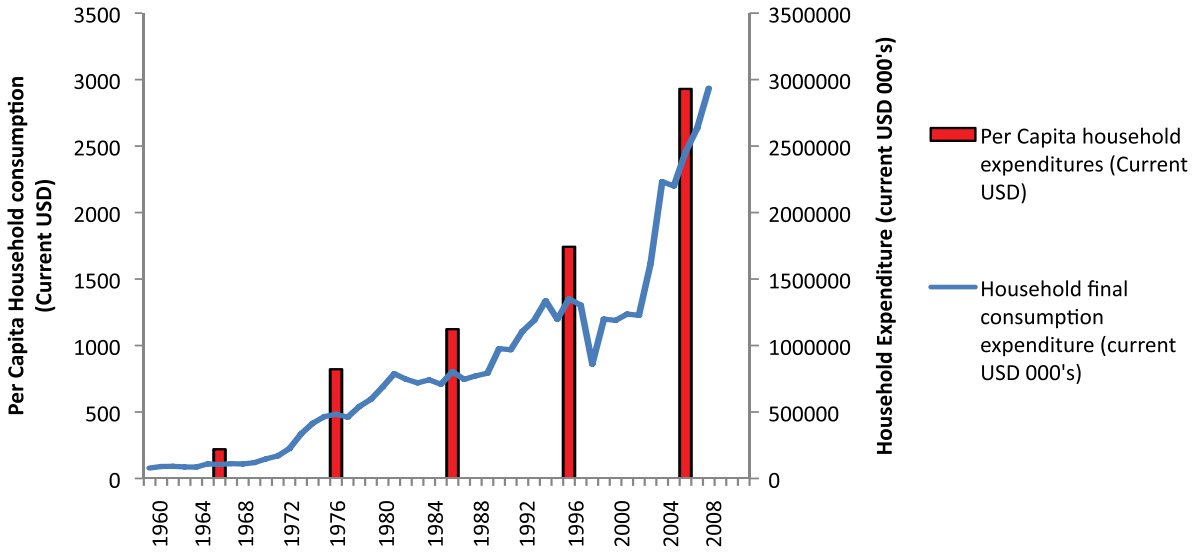


FIGURE 4. Fiji household expenditure per capita and total.
(Source: World Bank and Fiji Bureau of Statistics, 2013.

Urbanisation is a global phenomenon and Fiji is no exception. As seen in Figure 5, Fiji's urbanisation follows the trend towards urbanisation around the world with Fiji aligned well with middle income countries. Of the Pacific Island countries, Fiji has the highest urbanisation rate, with more than 50% living currently in urban centres compared to less than 30% in 1960.

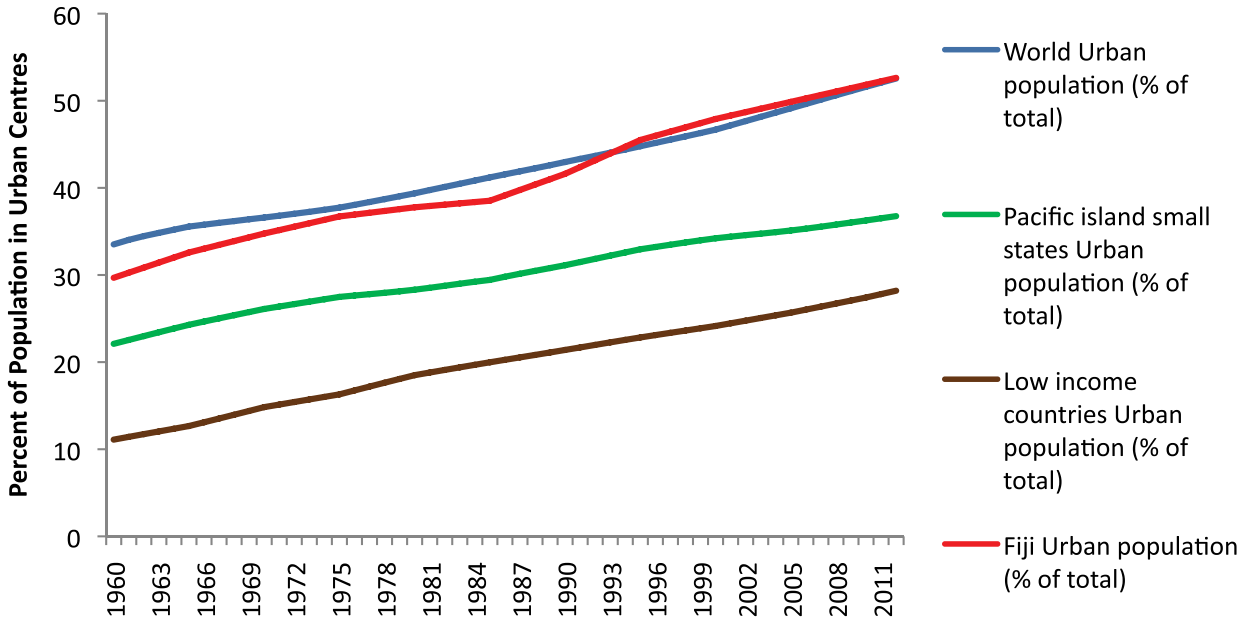


FIGURE 5. Urbanisation in Fiji compared to Pacific Island Countries as a whole, the World and Low Income Countries. Source: World Bank, 2013.

DRIVER 2: GEOGRAPHY AND GLOBALISATION

Small island countries have physical limitations on growth and infrastructure. These can create serious pressures on the environment, for example, waste management and food security. In addition, their relative isolation from other countries has traditionally meant a reduced capacity for cheaper goods and access to markets. Figure 6 shows the liner shipping connectivity for Fiji compared to other countries and the Pacific Islands in the past 7 years. This index is out of 100 and captures how well countries are connected to global shipping networks.

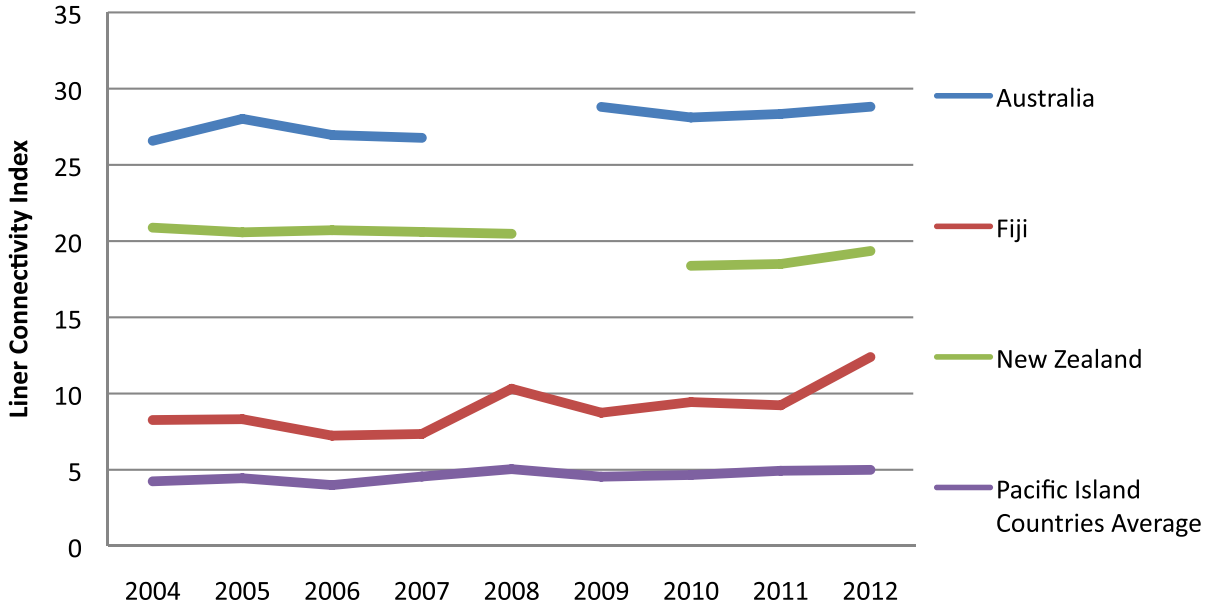


FIGURE 6. Shipping Liner Connectivity. Source: World Bank, 2013.

The figure shows that while relatively isolated compared to developed countries, Fiji is becoming more connected to the global market, with a marked increase in 2012. This, coupled with increasing tourism (shown below in Figure 7) and increased demand for imported technology all produce a pressure on Fiji's environment and its culture.

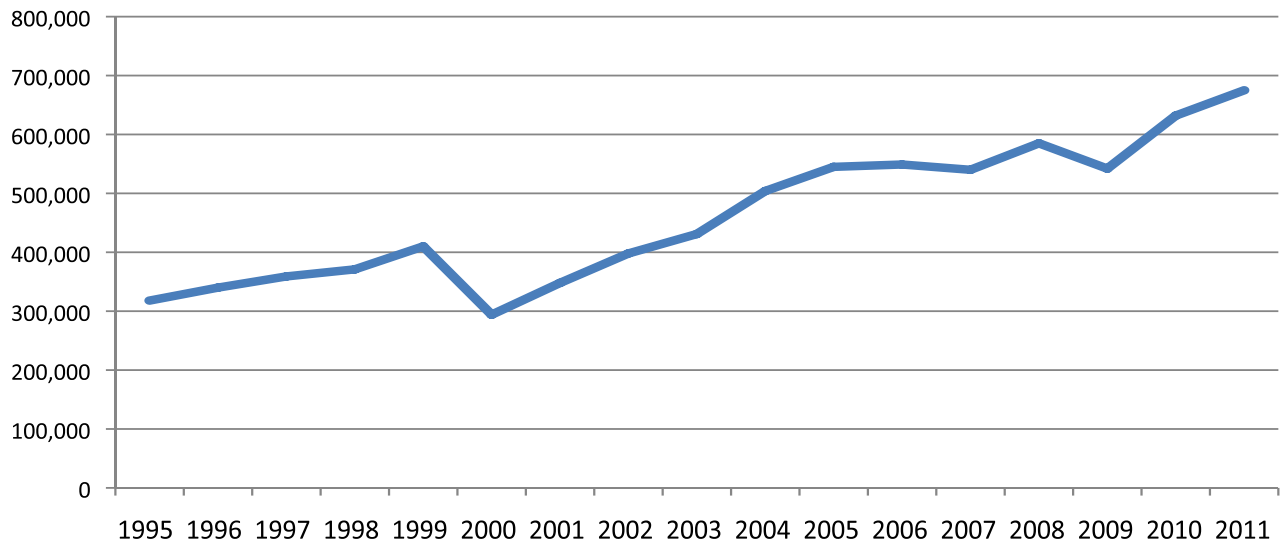


FIGURE 7. Tourism Arrivals to Fiji. Source: Fiji Statistics, 2013.

One further indicator of globalisation and its influence on Fiji is the prevalence of global multilateral agreements in the past 40 years. These indicate an increasing pattern in global influence on individual countries. Figure 8 below shows the number of Multilateral Environment Agreements (MEAs) worldwide and Fiji's signature and ratifications.

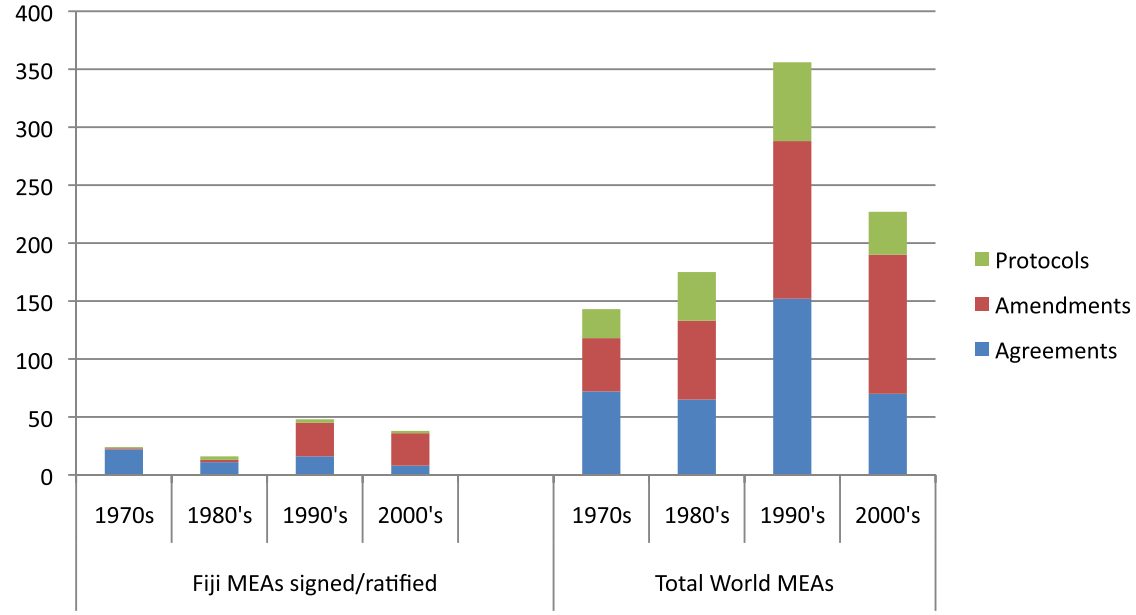


FIGURE 8. Global Multilateral Environmental Agreements and Fiji's ratifications/acceptance. (Source for world data: R. Mitchell, International Environmental Agreements Database Project, http://iea.uoregon.edu/, Fiji Source, SPREP Library, 2013.

DRIVER 3: ECONOMIC AND TECHNOLOGICAL DEVELOPMENT

Closely tied to globalisation is the driver of technological development. In Fiji, increased access to technology impacts natural resources through more efficient extraction methods. This can have both a positive and negative impact on the environment, as better technology means that we can extract more resources, but it can also mean the adoption of more environmentally sensitive and efficient extraction, shipping and processing methods. Technology also influences society, bringing access to a global technological culture, in addition to other cultures. Furthermore, technological waste or "e-waste" can increase the burden of an already challenging waste management situation in Fiji.

Figure 9 shows how access to technology has changed in Fiji and the world through the adoption of cellular phones and internet. Of particular note is how rapid the change has been, with cell phone subscriptions increasing almost 8 fold in the past 10 years alone. And in Fiji, between 2006 and 2007, in one year, subscriptions almost doubled from 34 to 63 per 100 people. Fiji's trends with internet and cell phones track well with global changes.

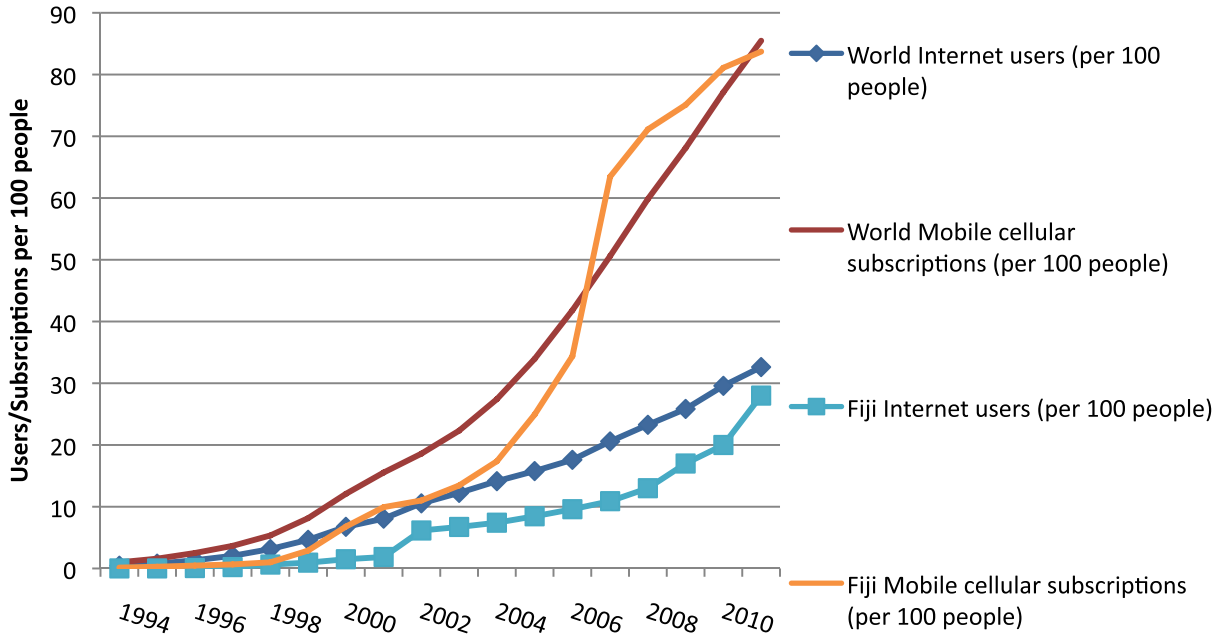


FIGURE 9. Cellular and Internet Subscription in Fiji and Worldwide (World Bank, 2013.

The economic drivers in Fiji have changed as well. As seen in Figure 10, worldwide there has been a general increase in the service industry sector and a general decrease in the predominance of industry and agriculture as a percent of GDP.

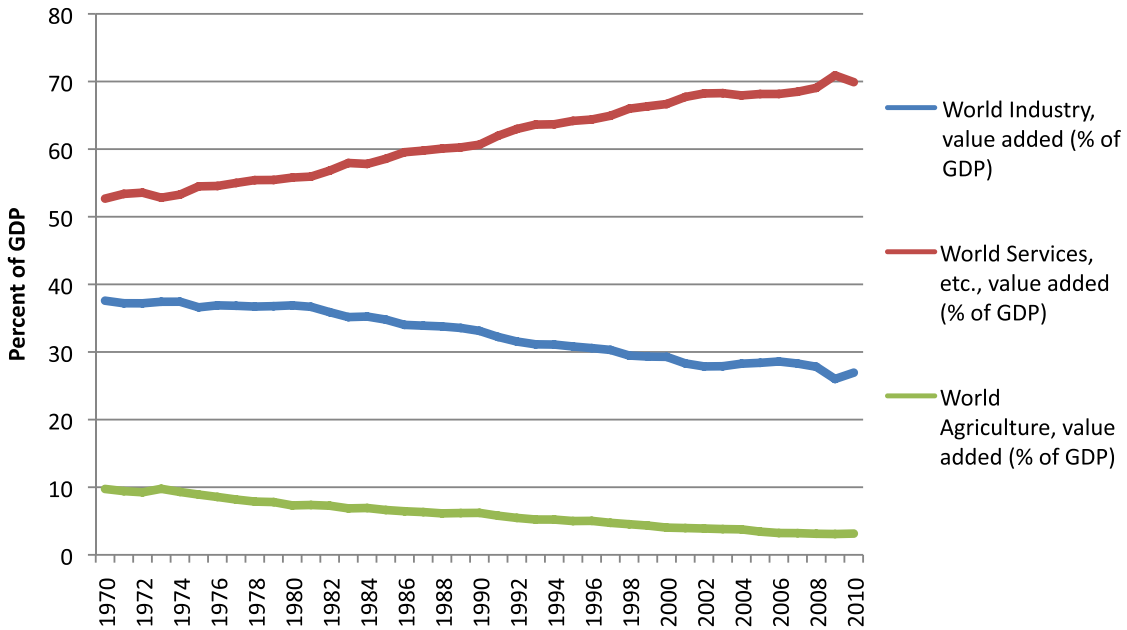


FIGURE 10. Major Global Economic Sectors as % of GDP from 1970 to 2010. (World Bank, 2013.

This same pattern is observed in Fiji with an even greater predominance of the service sector due largely to tourism. As of 2012, the service industry accounted for 68% of Fiji's GDP. The share of manufacturing in Fiji's GDP, including the production of textiles, food and beverages has also increased significantly compared to the traditionally predominant agriculture (forestry, fishery and crops), which in 1963 accounted for 41% of Fiji's GDP and now accounts for 12%.

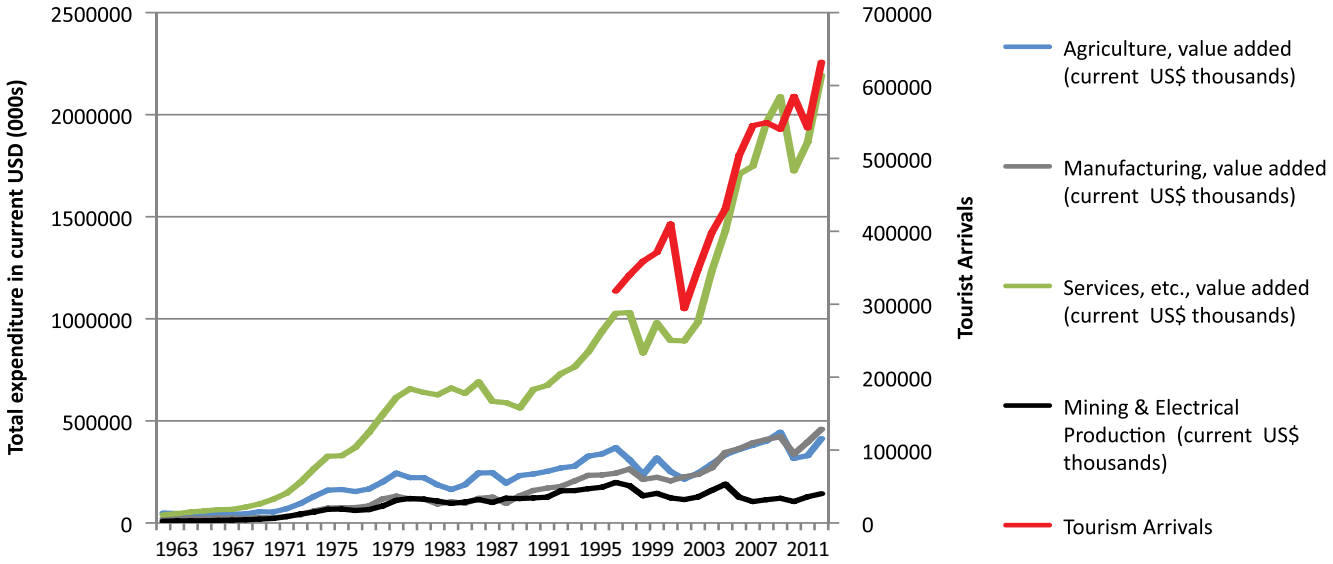


FIGURE 11. Major Economic Sectors in Fiji from 1963–2011. Source: Fiji Bureau Of Statistics and World Bank, 2013.

Figure 11 shows the relative expenditure for each sector in current USD since 1963, along with tourist arrivals since 1995. This marked change in the economic drivers of Fiji has implications for society, the economy and the environment – alleviating some pressures (e.g. poverty, access to health care and goods) while creating new ones (e.g. consumption, waste and cultural change).

As Fiji's economic drivers have shifted from resource based to service and trade oriented, this has resulted in a general increase in the urban based economy, where most services are based in cities. Conversely, the decline in the resource based economy, has led to an underperforming rural economy. Between 2002 and 2008, the average household incomes in urban areas increased (in real terms) by 24% while rural area incomes decreased by 8 %. Figure 12 shows the relative distribution of income levels between rural and urban income earners. Overall, high income earners have decreased in rural areas and increased in urban areas, while lower income earners have increased in rural areas and decreased in urban areas.

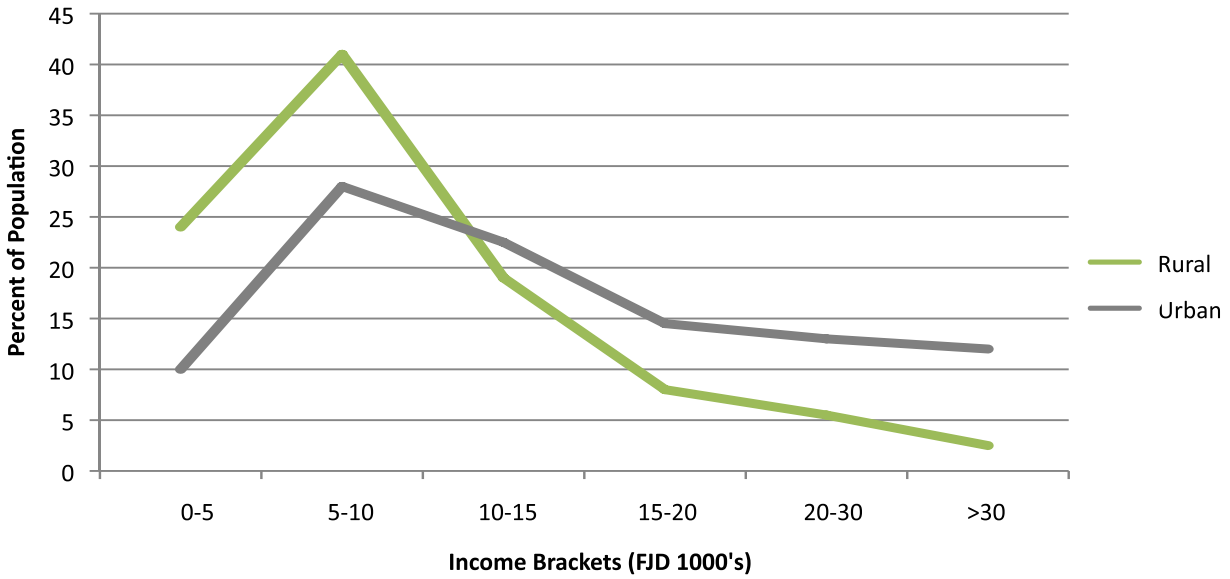


FIGURE 12. Average Household Income Distribution in Fiji between 2002 and 2008 (Rural vs Urban. Source: Fiji HIES 2011.

Underperforming rural economies and the promise of a better future in the city, are the main drivers of rapid urban growth in Fiji. Source: Fiji National Housing Policy 2010. This is discussed further in the Pressures section under Informal Urban Settlements.

DRIVER 4: TRADITIONAL AND CONTEMPORARY VALUES, ATTITUDES AND LIFESTYLES

Another driver of environmental change is lifestyle, behaviour and values. Cultural change is strongly linked to other drivers, such as globalisation and income; where traditionally more costly and unavailable items are now readily available. This changes traditional values and behaviours. One indicator of a cultural driver is the change in reliance on imports. Figure 13 compares the relative reliance on agricultural imports between Fiji and the rest of the Pacific countries. The number 0 represents an equal balance between exports and imports, while negative numbers indicates a high reliance on food imports. Across the Pacific, reliance on imports has increased, including Fiji.

Figure 14 shows this cultural change in Fiji over the past 50 years as evidenced by Fijian carbohydrate food sources. Traditional consumption of root crops (dalo, cassava and other tubers) reduced dramatically since the 1960's and began to level off in the late 90's. Copra and coconut consumption also decreased, although not as dramatically. These traditional food sources were replaced by an ever increasing diet of wheat and other refined (imported and locally produced) cereal products. Soft drink consumption has risen also, in addition to imported fruit such as apples.

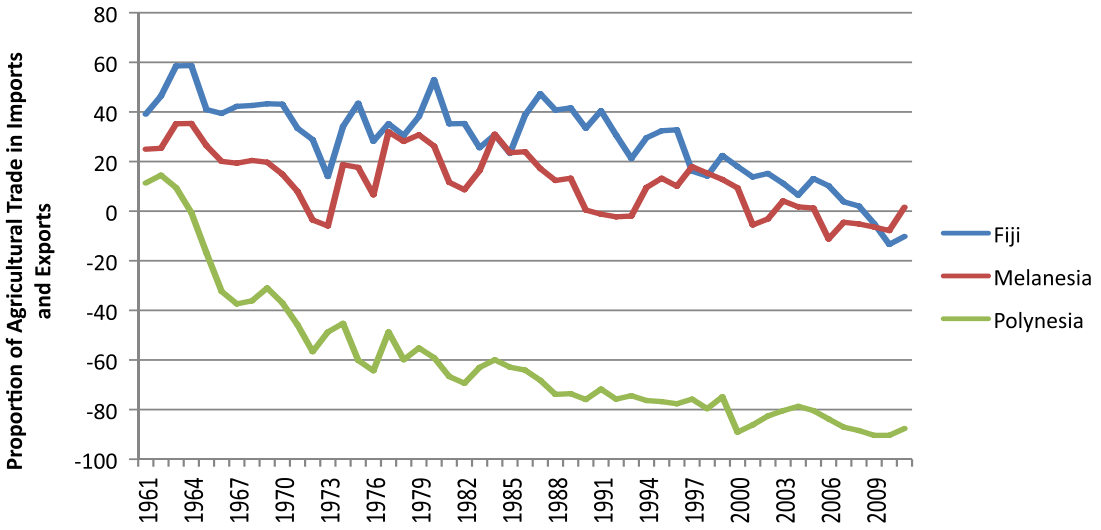


FIGURE 13. Agricultural Trade Balance in the Pacific (negative numbers represent higher imports than exports, positive numbers represent higher exports than imports. Source FAO, 2013.

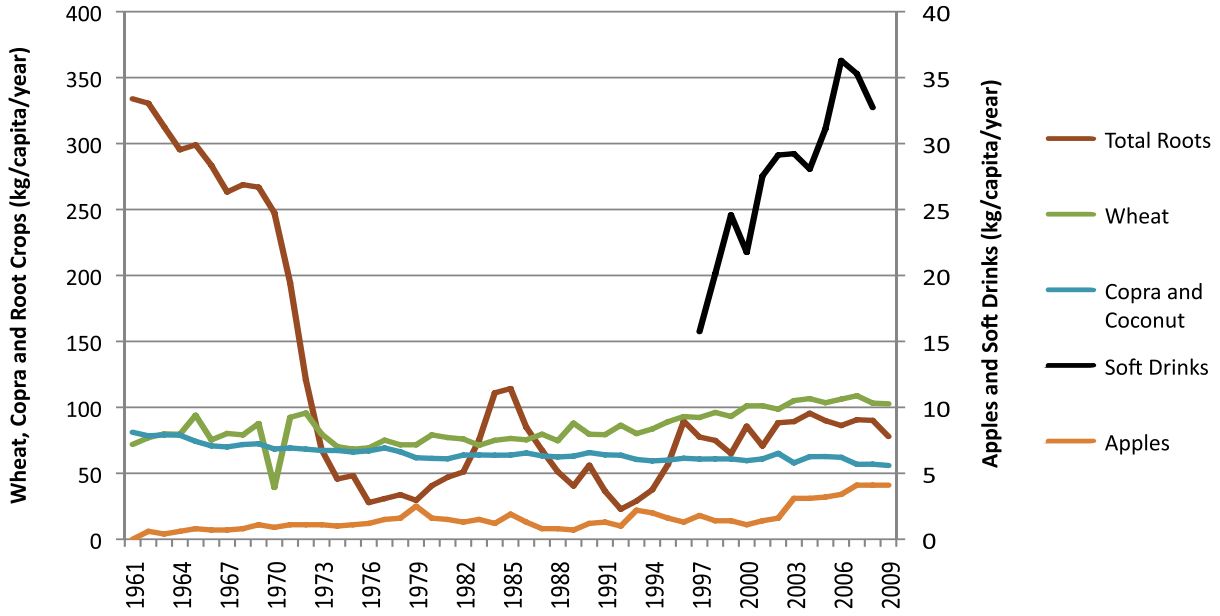


FIGURE 14. Consumed food commodities in Fiji per capita per year, 1961 to 2008. Source: FAO and Fiji Bureau of Statistics, 2013. (Note: soft drink consumption includes tourist consumption.)

Traditional communal land ownership is common across the Pacific and is part of the cultural driver for the environment in Fiji. Figure 15 below highlights the predominance of traditional or customary land tenure in Fiji. Communal ownership can both create and alleviate pressure on the environment. Well managed communal lands, including Tabu protected areas, are a good example of land managed sustainably for the benefit of all.

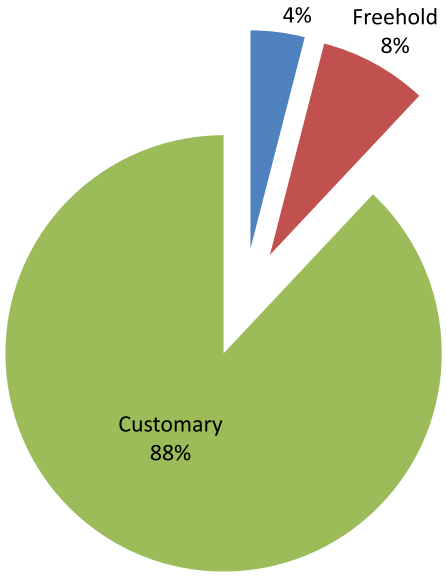


FIGURE 15. Distribution of Land Ownership in Fiji by tenure system. Source: PECCO report 2013.

Education is another indicator of a driver for cultural change. Access to education, particularly secondary and post-secondary, can have profound impacts to the environment including: a diversification of the economy from subsistence to service based, increased environmental awareness and increased adoption of contemporary values and lifestyles over traditional ones. Figure 16 shows gross percent enrolment of eligible ages to secondary school for Fiji and the world. Fiji has generally followed global trends in increasing access to education.

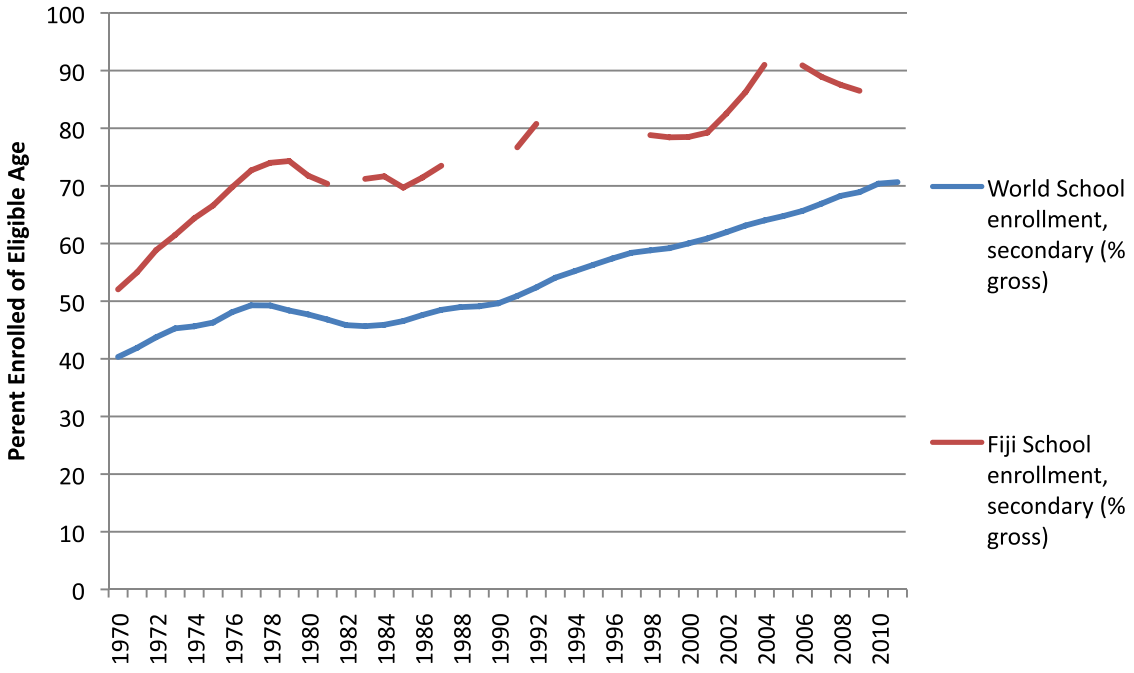


FIGURE 16. Secondary enrolment (Fiji and World) from 1970 to 2010. Source: World Bank, 2013.

DRIVER 5: CLIMATE CHANGE

Climate change refers to a change of climate which is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (Source: UNFCCC). It is now widely recognised that Climate Change is occurring globally as a result of human activity, in particular from the burning of fossil fuels. One example, Figure 17 shows the latest mean global CO_2 concentrations since 1980.

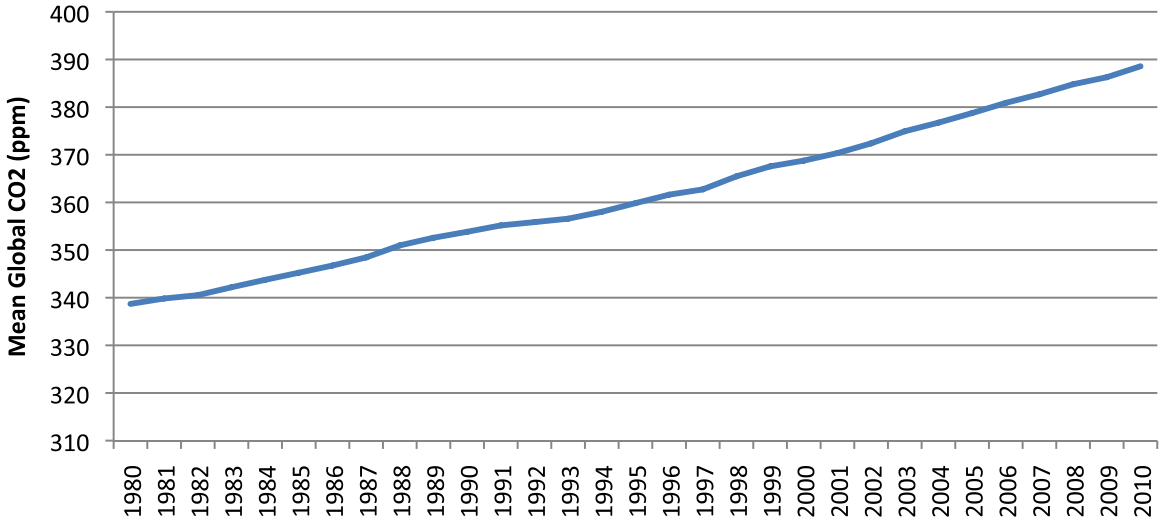


FIGURE 17. CO2 emisions worldwide. Source UNEP Live, 2013.

Climate variability refers to variations in the mean state and other climate statistics such as standard deviations, and the occurrence of extreme weather events. The effects of these variations may be experienced well beyond the timing and scale of the initial weather event. Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forces (external variability.

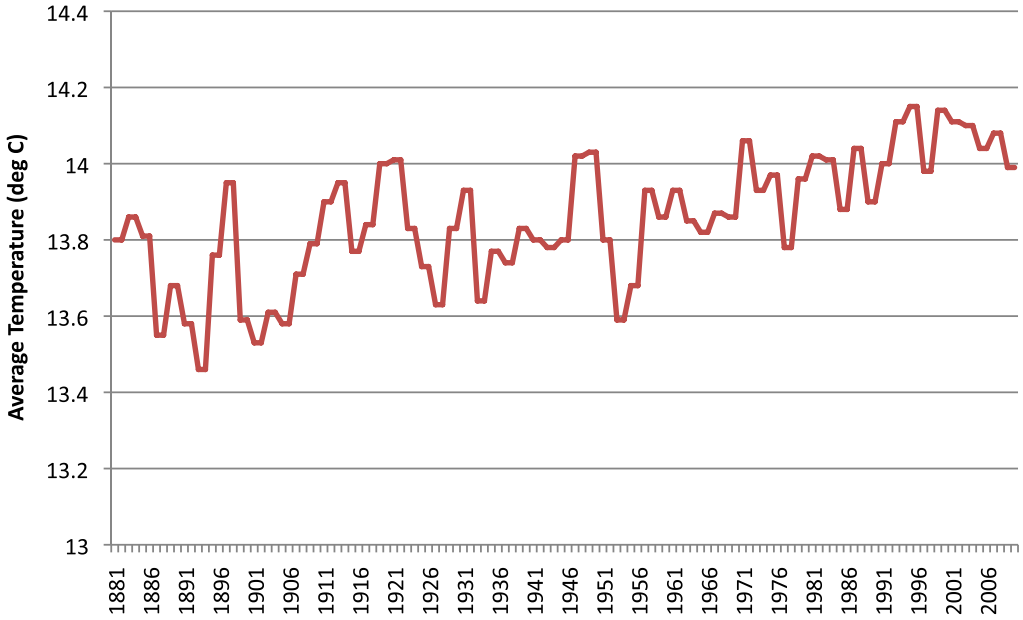


FIGURE 18. Average Global Temperatures (1881–2006). Source: UNEP Live, 2013.

The effects of climate change and climate variability are being felt in Fiji as they are globally, and in other Pacific island nations, as a key driver of environmental change. However, geographic location, topography and other factors influence the rate and intensity of the resulting changes in climatic conditions.

The impacts of both on the environment are widely documented and include:

- *Agriculture and Food Production* – Climate induced disasters such as the increased frequency and intensity of tropical cyclones has resulted in flooding in low lying and coastal areas, saline intrusion, coastal erosion and increased rates of coral bleaching. Social and economic impacts include crop losses, reduced food production capacity, and higher demand for imported staples. The capacity for communities to generate income and be self-sustaining is also impacted.
- *Water Supply and Quality* – Altered precipitation patterns is another aspect of Climate Change. On the one hand increased periods of drought impact the availability of water resources, while increased storm events can affect water quality. Sea level rise increases the possibilities of seawater intrusion into underground water aquifers, and is already being experienced by many coastal communities.
- *Biodiversity and Ecological Conservation* – The increased incidence of tropical cyclones, periods of low rainfall, temperature fluctuation and changes in precipitation patterns, all put increased pressure on sensitive ecosystems and habitats of endangered and endemic species. Coral reefs are particularly vulnerable to the effects of more intense and frequent storm events.
- *Health* – Children and the elderly are especially vulnerable to extremes in temperature, and there are predictions of changed patterns in vector water borne diseases as conditions for the occurrence and spread of these diseases are favoured by the changes in climate.
- *Forestry* – periods of drought of three months or more can severely affect the viability of forests and increase the risk of forest fires.
- *Infrastructure* – Lowland and coastal flooding and severe coastal erosion impacts coastal infrastructure, as well as the management of the coastal watershed areas especially of urban areas.
- *Energy Production* – The predicted changed and variable precipitation levels expected with climate change are likely to impact energy production in complex ways. On the one hand periods of low rainfall and even drought would drastically reduce hydro-generation capacity, leaving Fiji reliant on diesel and as yet underdeveloped renewable energy sources such as biomass and solar PV technologies. This would bring with it increased operation costs which would be likely to affect usage rate.
- *Tourism* – The impacts of climate change on the tourism sector include loss of beaches, inundation, and degradation of the coastal ecosystems, saline intrusion and damage to critical infrastructure.
- *The built environment* – Under climate change, population growth and the global phenomenon of increased urbanisation will have significant impacts on the built environment, especially along the coastal fringes. Poor drainage systems, more impervious surfaces and associated storm water run-off, inadequate strategic planning, increased road and other transport infrastructure for work and tourism-related travel will exacerbate the impacts of climate change on urban settlements.
- *Village Communities* – The livelihood of coastal and lowland communities is highly vulnerable to the impacts of climate change. Flood damage to homes, public buildings and infrastructure, unreliable water quantity and quality; loss of income and food security from damage to subsistence and commercial plantations. The location of many villages in coastal and low lying areas leaves these communities particularly exposed to the effects of coastal erosion and flooding, along with a loss of culturally valued heritage land.

WHAT ENVIRONMENTAL PRESSURES ARE THE DRIVERS CREATING?

Pressure indicators present data for the main human activities that could potentially adversely affect the condition of the environment in Fiji. They are connected with one or more drivers (e.g. climate variability and change, population growth, management and demographics, or social, technological and economic systems). The following section highlights several of the key pressures on the environment and society created by the overarching driver themes in Fiji. Some pressures will be covered in further detail in the "State" section.

For the purpose of this report, pressure indicators are broken into 3 classifications – Land development, resource extraction and consumption/waste. Each of these are linked to one or more drivers identified above.

TABLE 2. Key Pressures on the environment in Fiji.

PRESSURES (KEY INDICATORS)		
Land Development	Resource Extraction	Consumption and Waste
Formal Urban Development	Forestry	Energy consumption
Informal Urban Development	Fishing	Vehicle ownership
Agricultural Expansion	Mining and Quarrying	Solid and Liquid Waste Generation
Invasive Species		Water consumption

PRESSURE 1: LAND DEVELOPMENT

FORMAL URBAN DEVELOPMENT

Urban development puts pressures on the environment through increasing the removal and fragmentation of sensitive habitats. Also, increased development increases waste discharge to the natural environment, in particular, sewage and solid waste. A complicating factor is that even in formal developments that are built according to building codes, lack of monitoring and enforcement means that waste and sanitation infrastructure is often poorly designed and not properly maintained.

Population growth, demographics and globalisation are all key factors in land development in Fiji. First, as population grows, there is a need for more residential space per capita. This is seen in Figure 19 below where residential development (based on current value of land) peaked substantially in the early 1990's and mid 2000's. These peaks and declines follow world markets and in the case of private and government development are tied to external influences like tourism and connectivity to global markets. Note the dramatic increase in other building development, particularly hotels, in the early 2000's.

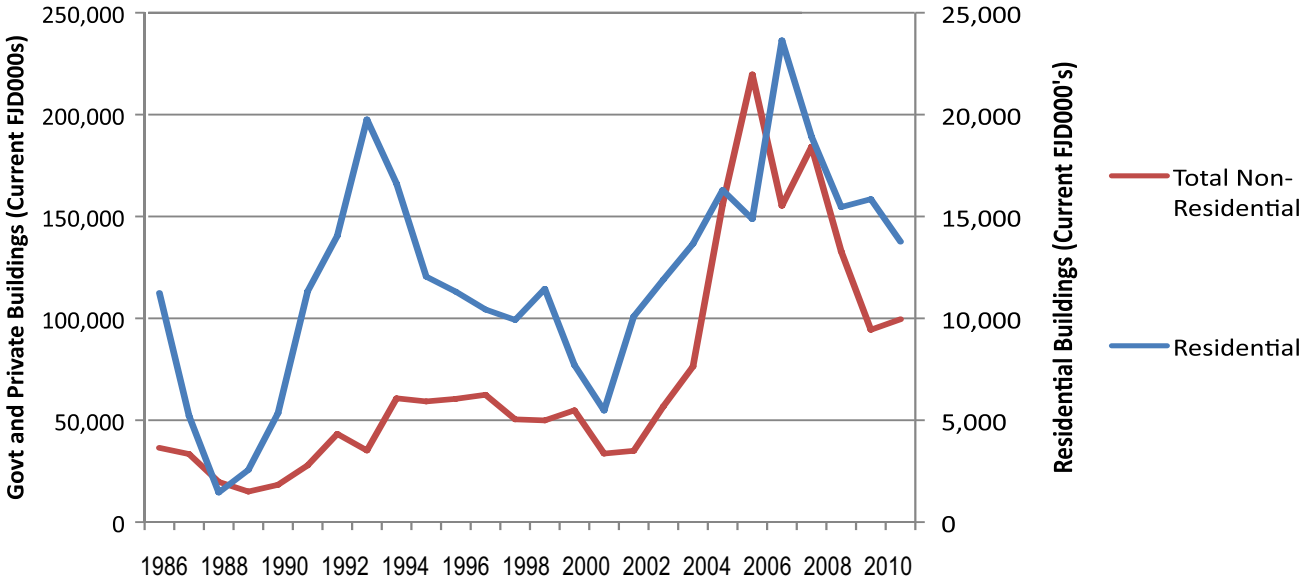


FIGURE 19. Expenditure (in 1000's FJD) on new residential and private/government buildings in Fiji. Source: Fiji Bureau of Statistics, 2013.

INFORMAL URBAN DEVELOPMENT (SQUATTERS)

As Fiji's population grows, and the economic divide between urban and rural economies widens, the appeal of a better standard of living in urban environments drives a greater proportion of the population to informal urban settlements. Many of these settlements have little to no access to appropriate sanitation and water. In many cases, the move is due to expired agricultural leases, but there is also an established pattern of residents of formal settlements moving to informal ones due to employment and, in some cases, lifestyle choice.

In general, these informal settlements put tremendous pressure on the urban environment, particularly in regards to habitat destruction, waste pollution, burning and water quality impacts. Recent data suggests that these settlements are growing and that 15% of the current urban population in Fiji lives in informal settlements. Data from a recent USP project suggest that between 1978 and 2011, six new settlements developed in Suva alone (Source: Koto 2011). Figure 21 below shows the distribution of these settlements.

AGRICULTURAL DEVELOPMENT

Agriculture is a key component of Fiji's economy, traditionally dominated by permanent crops and plantations, such as sugar cane, rice and copra, in addition to livestock. With the exception of livestock, horticulture and aquaculture, agriculture in Fiji is generally declining in both production and area used. See Figure 20.

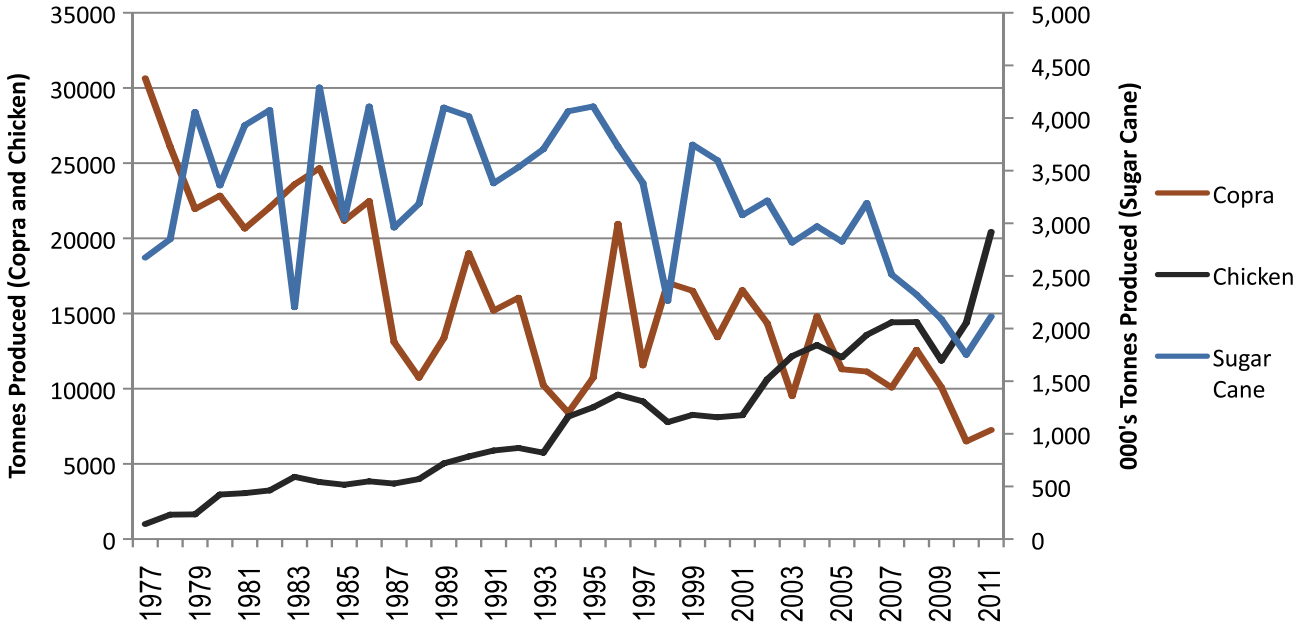


FIGURE 20. Key Agricultural production in Fiji from 1977–2011 (Tonnes. Source: Fiji Bureau of Statistics.

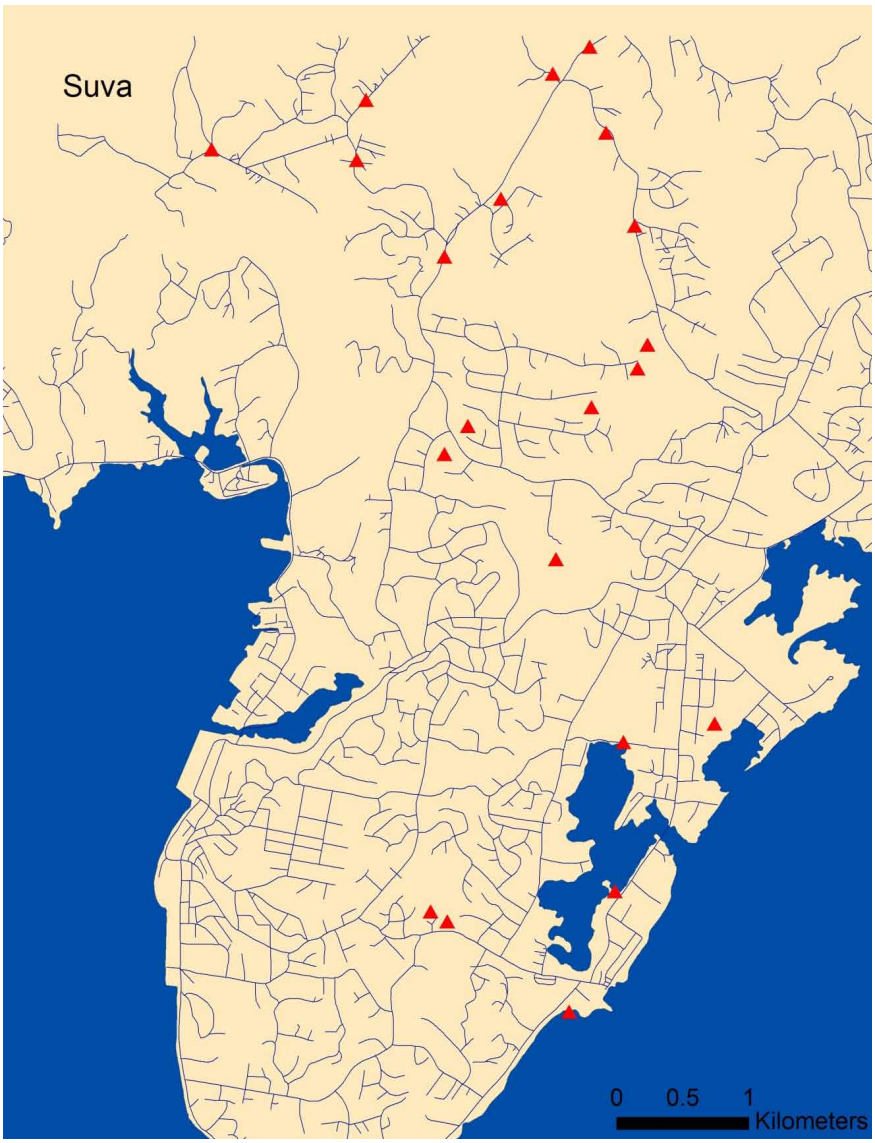


FIGURE 21. Location of urban informal settlements in Suva – 2011. Source: Koto – Exploring Informal settlements in Suva, 2011.

Unsustainable agricultural practices can put pressure on the environment through nutrient/soil loss, pesticide pollution to ground and surface water, habitat fragmentation, air quality from crop burning, diminished biodiversity and spread of invasive species.

Figure 22 shows fertilizer and pesticide use in Fiji as one example of an agricultural pressure. Fertilizer and pesticide use has generally risen over the past five decades, predominantly used for production of sugar cane and other permanent crops.

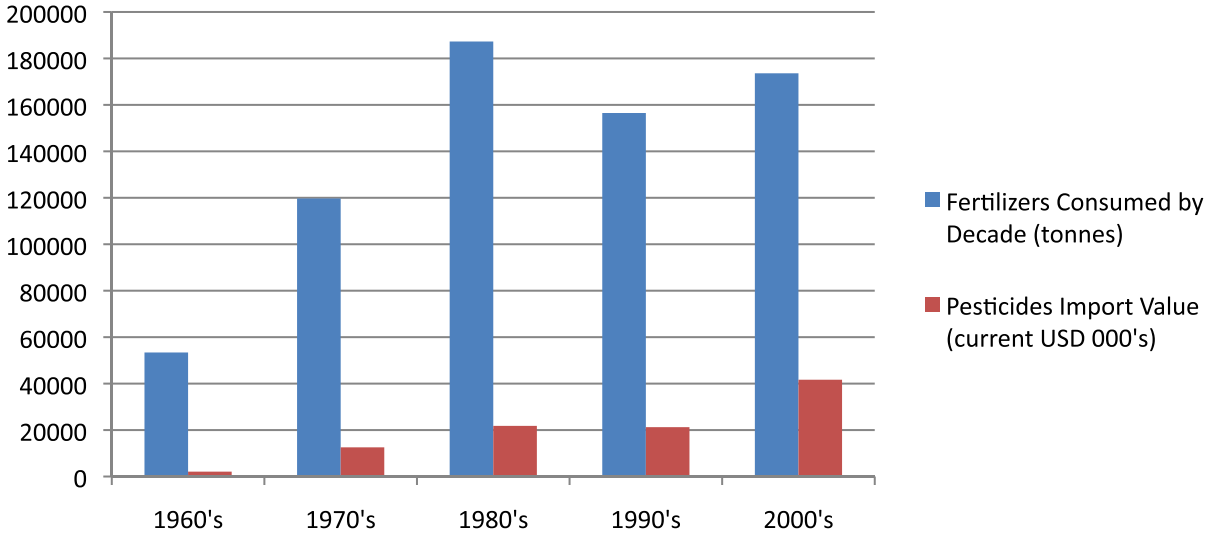


FIGURE 22. Fertilizer use and Pesticide import use by decade in Fiji. Source:FAOSTAT, 2013.

INVASIVE SPECIES

Increased globalisation and connectivity to the world bring invasive species to Fiji. However, once in-country, the primary pathway for spread is infrastructure related to development such as roads, urban expansion and agriculture.

Invasive species form a major pressure on Fiji's environment competing with indigenous species and habitats with little or no natural predation. Much of the invasives that have arrived in Fiji arrived in the last 100 plus years, and now major efforts and resources are underway to contain the spread of existing invasives and preventing new ones (such as the American Iguana and termites) into the country.

The graph below shows survey results from 30 communities in Vitu Levu on the incidence of 5 key invasive species seen currently in Fiji. Overwhelmingly, most respondents perceived that these five species were increasing in Fiji.

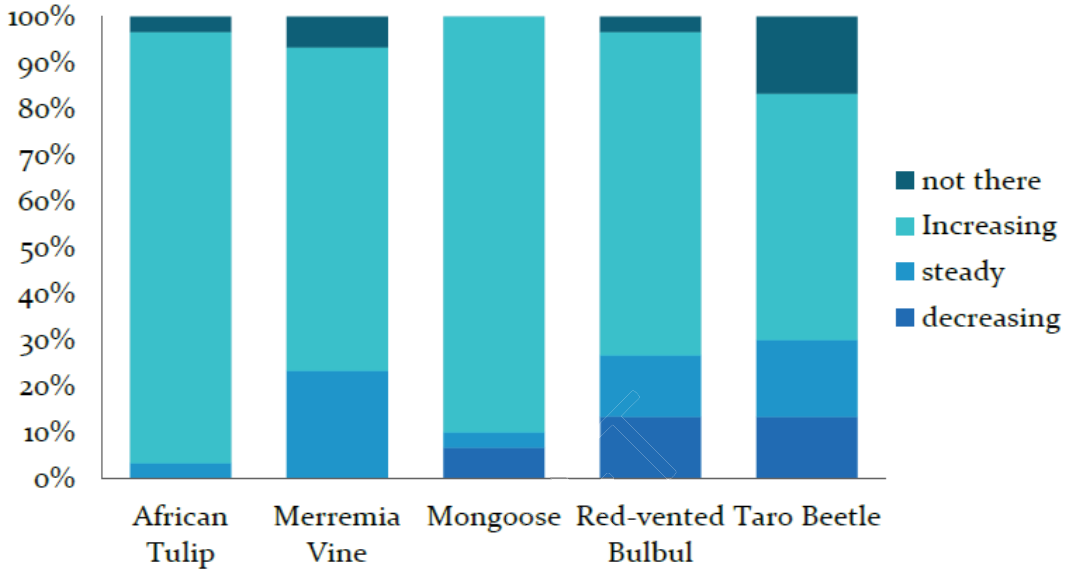


FIGURE 23. Presence of key invasives in Eastern Viti Levu. Source: Brown and Daigneault: Landcare Research, 2013.

PRESSURE 2: RESOURCE EXTRACTION

FORESTRY

Forestry is still a major industry in Fiji, particularly plantations of exotic species such as pine and mahogany, which overtook indigenous species as the principal forestry product in the late 1980's. Key pressures related to forestry include erosion and related watershed impacts, as well pressures on habitat and species biodiversity, particularly if practiced unsustainably. Although indigenous forestry production has decreased, indigenous forests are still decreasing in size due to cumulative impacts from smallholder agriculture expansion, urbanisation and plantation forestry.

A major increase has also been seen over the past 10 years in fuelwood removal, largely driven by the use of cheaper hog fuel for manufacturing and lumber processing. In addition, the wood fuel waste and treatment chemicals from lumber processing at sawmills adds an additional burden to environment. More will be discussed on forestry in the state of "land" theme later.

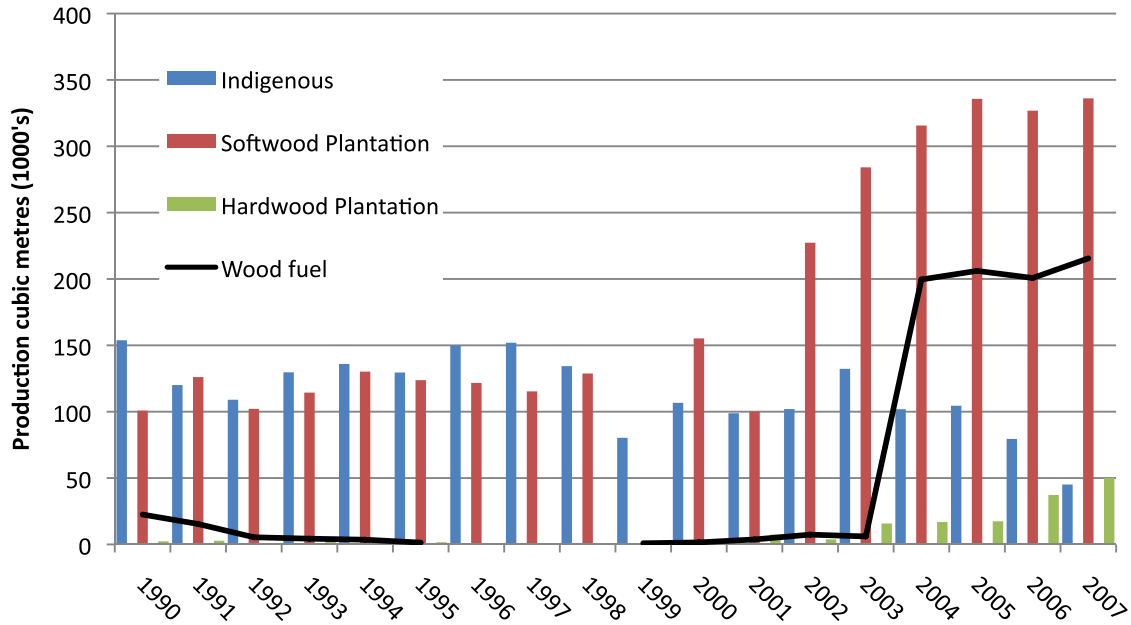


FIGURE 24. Dominant forest production numbers, Fiji 1990–2007. Source: FAO Fiji FRA reports 2005 and 2010.

FISHING

Offshore and inshore fishing create numerous pressures on the biodiversity and habitat of the marine environment, particularly if harvest levels are unsustainable or unregulated.

Figure 25 shows estimates of total fish harvesting (excluding aquaculture and freshwater fisheries) in Fiji since 1971. Commercial harvesting of pelagic fish, primarily Tuna and other open ocean species, increased substantially in the early 1970's, increased again in the 2000's and are currently steadying off. Reef and demersal fish (bottom dwelling) have seen a sharp rise in both commercial and subsistence harvest since the 1970's, and continue to increase substantially. This is largely due to improved boat access to what were formerly remote fishing areas in Fiji from major commercial centres (e.g Suva) in Fiji.

In Fiji, offshore fishing and harvesting practices are in line with global standards for commercial harvest (ADB and Gillette 2009) and is classified as fully developed, verging on over developed. There is far less control and enforcement on subsistence and artisanal fishing, which, particularly in the inshore environment, constitutes a significant amount of Fiji's fish harvest. Invertebrate harvest of marine and freshwater species constitutes a significant supply for Fijians diet, and in the case of species like Trochus and Bech-de-mere, are also a major commercial product. For a more detailed discussion of fishing in Fiji, refer to the Marine chapter.

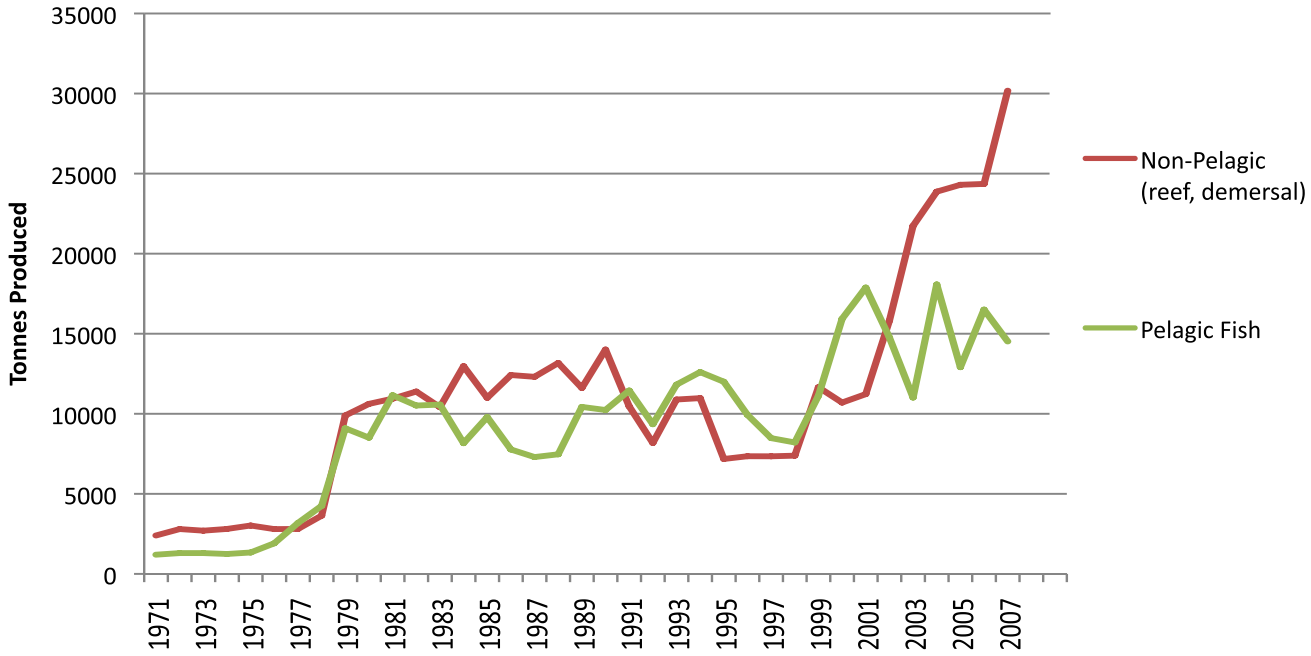


FIGURE 25. Subsistence and Commercial Fish harvest estimates excluding aquaculture, invertebrates and freshwater fish. (Source: FAO databank, 2013.

MINING AND QUARRYING

Mining and quarrying is a significant part of the economy in Fiji, likely to play an even stronger role with the proposed development of deep sea mining. Metal extraction, dominated by gold and silver, increased substantially over the 1990s and only recently decreased due to market forces and mine closures. With renewed interest from foreign exploration and mining companies, including deep sea minerals, it is likely that minerals will play an even larger part in Fiji's economy in the future. Figure 26 shows known mineral resources on Viti Levu and Vanua Levu.

Quarrying for sand and gravel has gradually increased in Fiji since the early 1990's when statistics were first made available. This is reflected in cement production, which has also gradually increased.

Key pressures on the environment from mineral extraction include: water pollution from mineral processing and acid leaching, air quality impacts from process related air pollution, habitat destruction and fragmentation and spread of invasive species. Sand and gravel quarrying, although not as intense a process, can impact beaches, riverbeds and more widespread areas.

A further issue in mitigating the pressure that mining has on the environment, is that the regulatory process in Fiji around mining requires further development. Currently, the Mining Act takes precedence over other regulations and acts, and rehabilitation requirements are not undertaken as part of any assessment. Furthermore, the approving process for mining from authorities is generally uncoordinated.

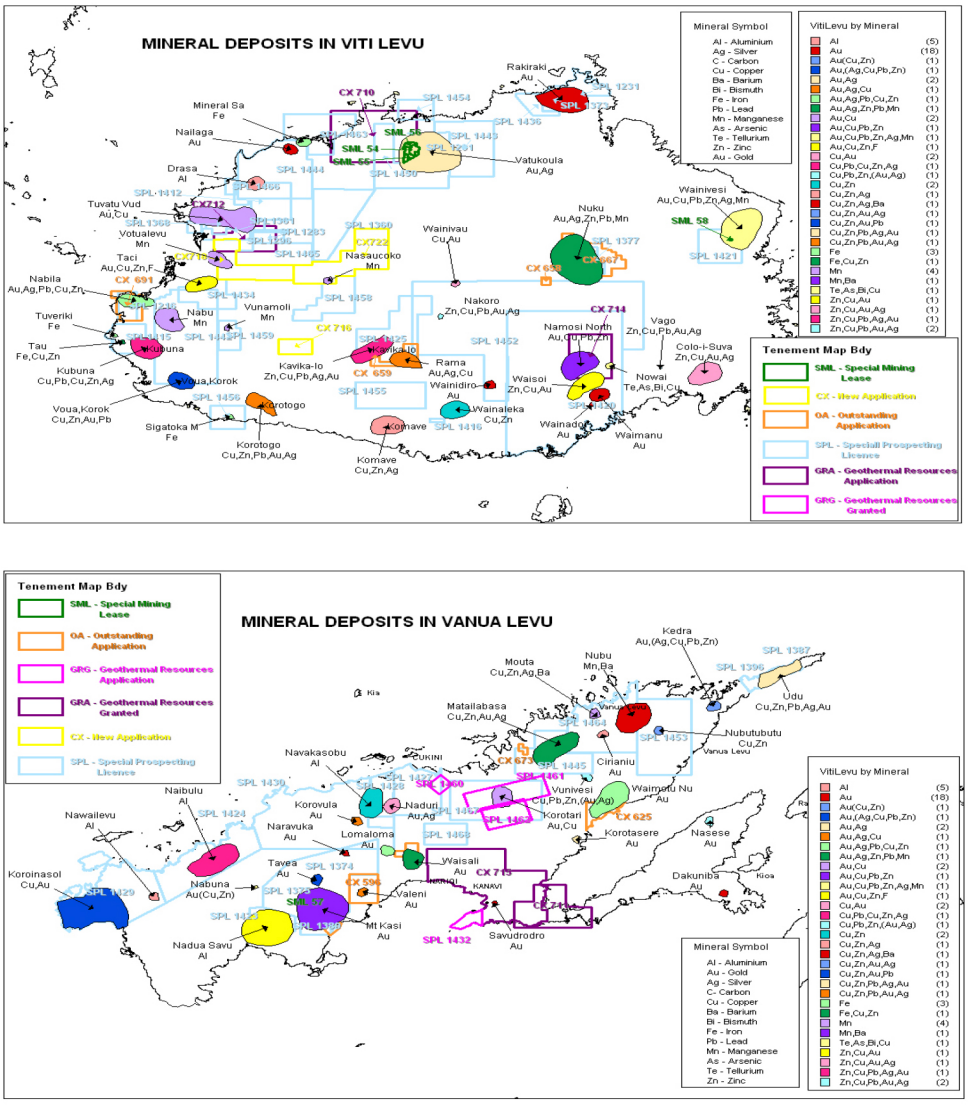


FIGURE 26. Known Mineral resources in Fiji. Source: Mineral Resources Department, 2010: cited from NRI Biman 2010.

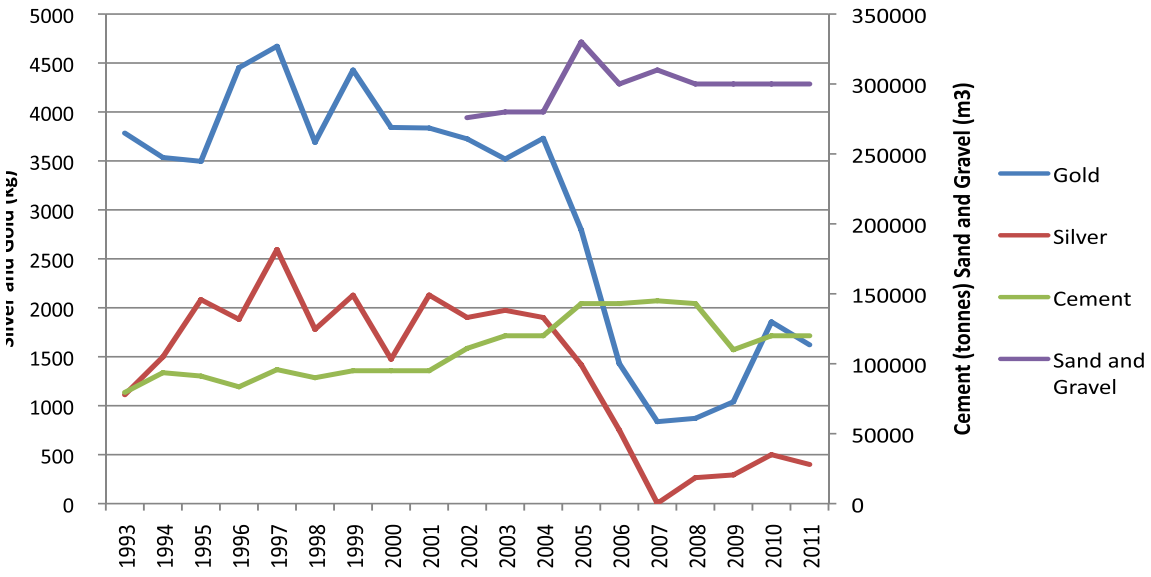


FIGURE 27. Fiji Mining and Quarrying Production. Source: USGS Mineral Yearbook reports (1997–2011) – Sharp decrease in gold and silver due to Vatukoula gold and silver mine closing in 2006. Mine reopened in 2008.

PRESSURE 3: Consumption and Waste

ENERGY

As household incomes have grown, access to overseas goods have increased and Fijian cultural expectations changed, so too have consumer goods and electrical demand. Figure 28 shows the dramatic increase in white goods and televisions owned in Fijian households.

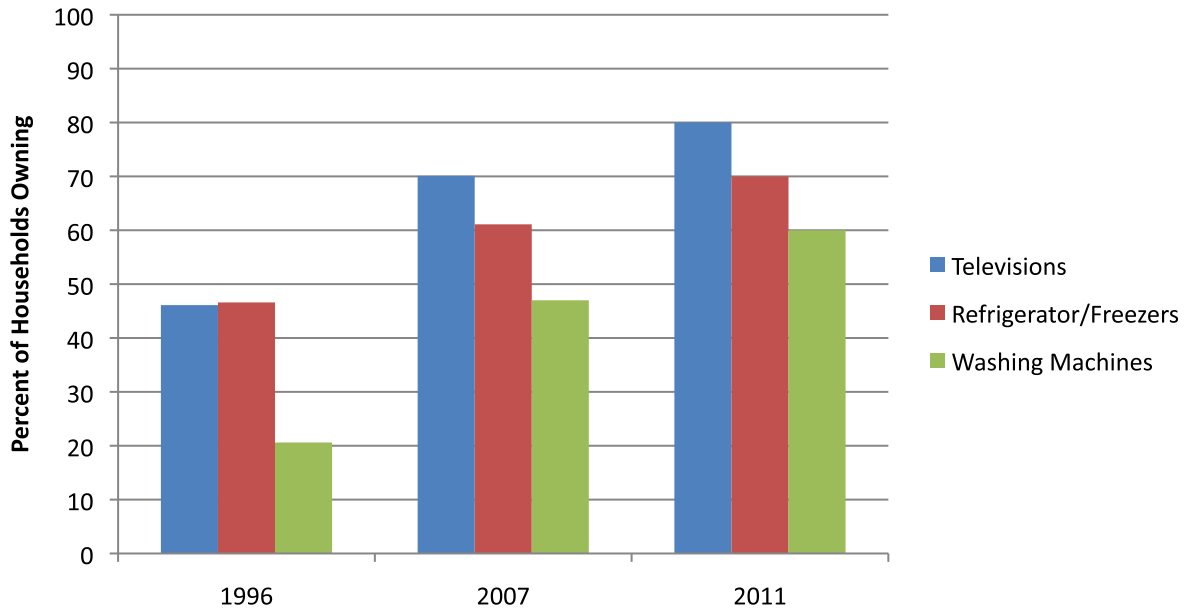


FIGURE 28. White goods and TV's owned in Fiji households. Source Fiji Bureau of Statistics, JICA.

The increase in consumer goods is reflected in electrical consumption by Fijians over the past ten years, which, as shown in Figure 29 below, has increased from 600Kw per person in 2000 to an average of 1000Kw person in 2012.

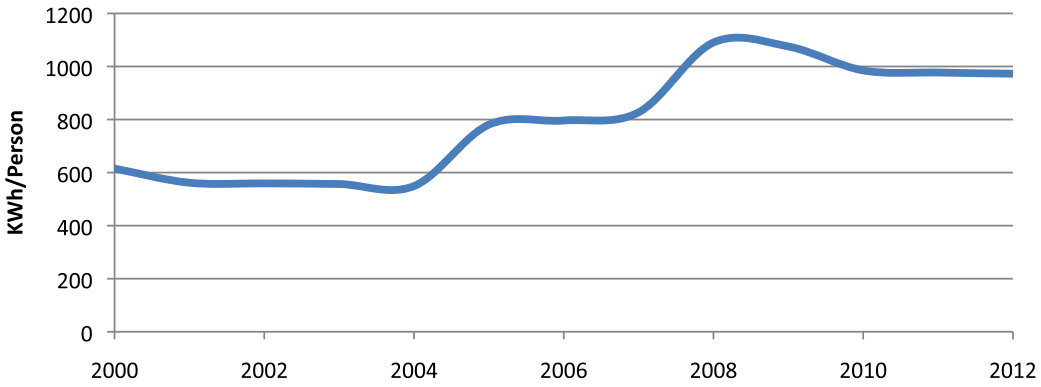


FIGURE 29. Electrical Consumption per person Fiji 2000–2012. Source Fiji Bureau of Statistics.

Almost half of Fiji's energy is derived from fossil fuels, a key pressure on Fiji, making it particularly vulnerable to external fuel price changes, as well as environmental impacts related to fossil fuel burning.

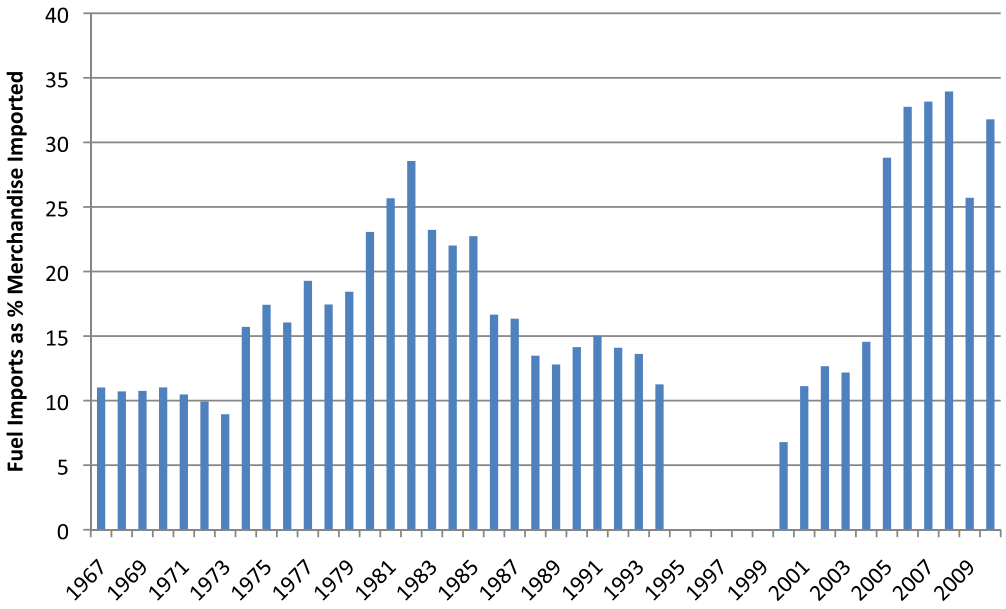


FIGURE 30. Fuel imports as percent of total merchandise imported. (World Bank datasets, 2013.

VEHICLE OWNERSHIP

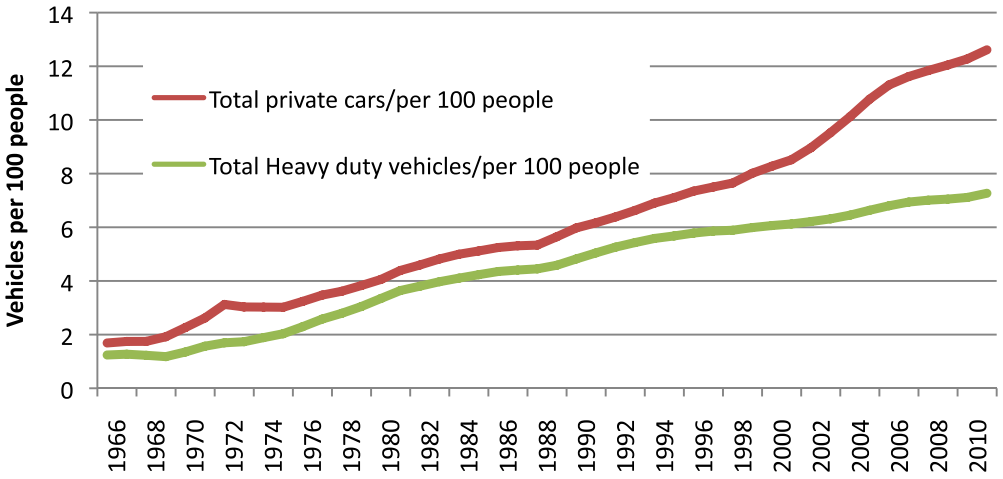


FIGURE 31. Vehicle registration in Fiji 1966 to 2010. Source Bureau of Statistics.

Vehicle ownership is another pressure on Fiji's environment, having a direct impact on air quality and waste generation through vehicle emissions and disposal of old cars. It also generates indirect impacts through the creation of roads, such as: increase of impervious surfaces leading to increased flooding, fragmentation of habitats and spread of invasive species.

Over the past 45 years vehicle ownership per capita, including personal use and heavy duty vehicles, has increased from under 4 total vehicles per 100 people in 1966 to now almost 20 total per 100.

WASTE GENERATION

SOLID WASTE

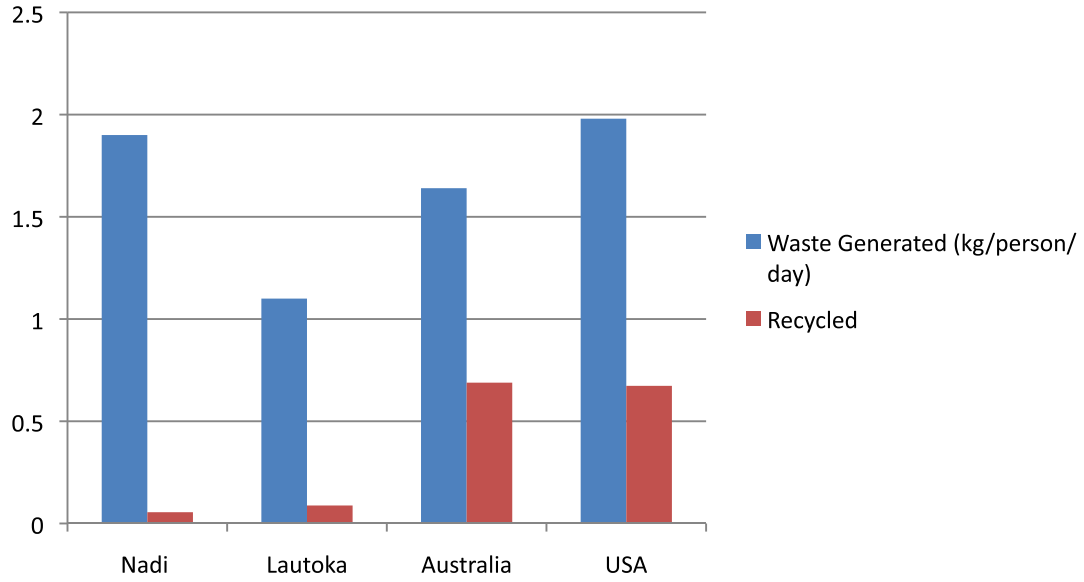


FIGURE 32. Solid Waste Generation and Recycling Estimates. (Nadi, Lautoka, USA and Australia – 2008) Source: JICA (Fiji), Australia (SOE 2011), USA (EPA Fact Sheet).

Little historical solid waste generation rates exist for Fiji until recently, however, given the increased levels of household consumption over the past 30 years it can be assumed that waste generation has also increased dramatically. Based on recent surveys, Fiji is fairly close to municipal solid waste generation rates of developed countries, however, the respective recycling rates are much lower. This puts an increased burden on Fiji to manage and dispose waste effectively and reduce the potential air, marine and freshwater impacts from landfills, garbage burning, littering and disposal of hazardous waste.

WATER CONSUMPTION

Water consumption in Fiji is growing as infrastructure improves, consumption of water consuming appliances increases, and population grows. Agriculture (irrigation and sugar refining) is still a major source of water consumption in Fiji, but as figure 33 shows, it is declining in proportion compared to built environment demands of municipal consumption. Currently, Fiji's Water Authority supplies ~322,000 m^3/day of water for municipal consumption. Of this, the majority is from surface water (69%) with the remaining proportion from groundwater.

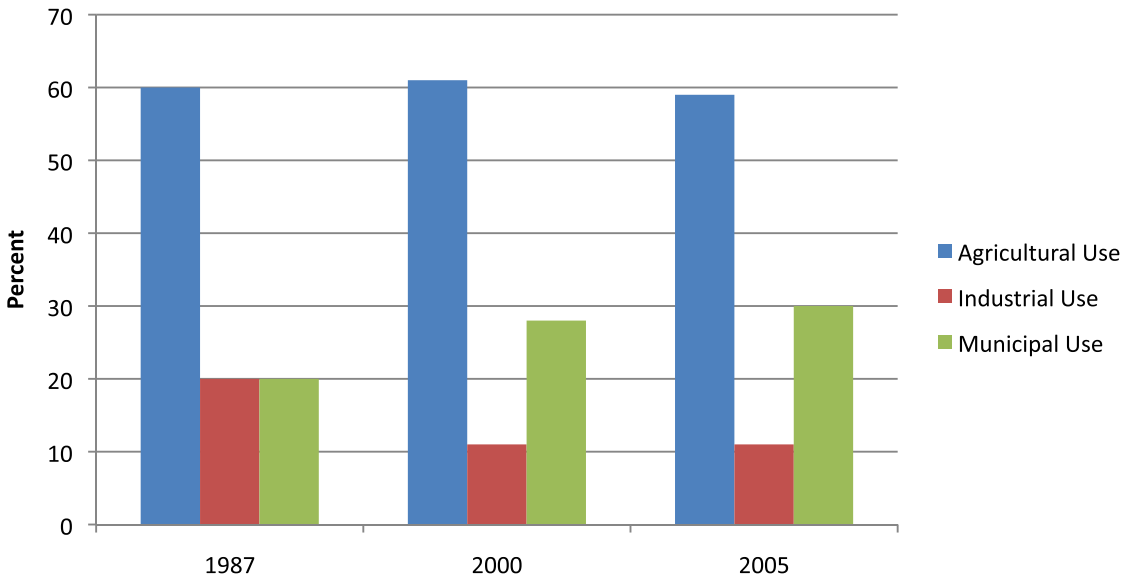
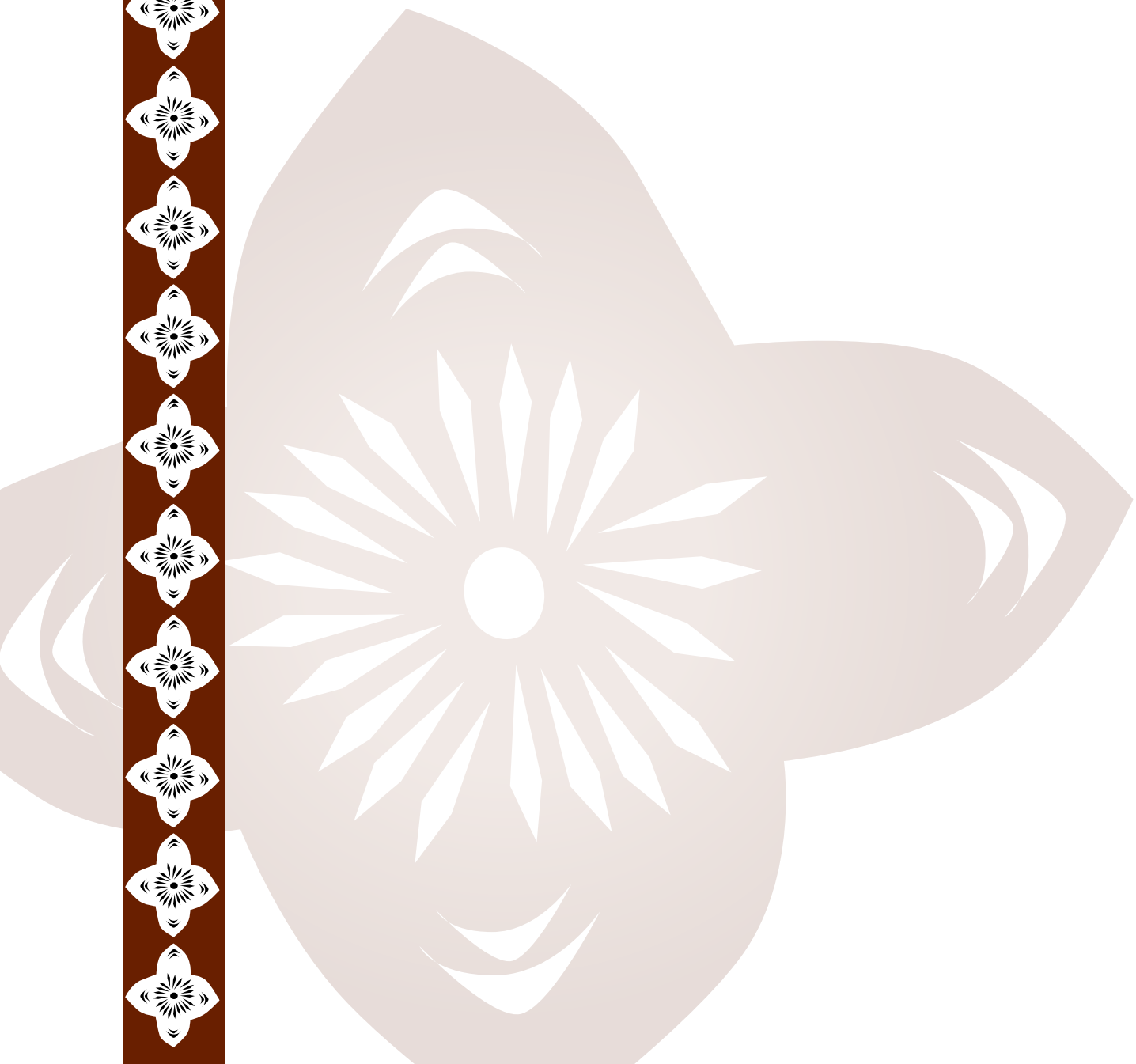


FIGURE 33. Water Withdrawals in Fiji by sector. Source FAO – Aquastat, 2013.



STATE OF FIJI'S ENVIRONMENT, THE IMPACTS, CURRENT AND RECOMMENDED RESPONSES

This chapter deals with the state of Fiji's Climate and Atmosphere and focuses on four major areas; Air Quality, Greenhouse gases (GHGs), Ozone Depleting Substances (ODS) and Climatic trends (air temperature, precipitation, and extreme climatic events).

Air Quality: A Growing Concern in Fiji

Air pollution is a concern in Fiji, especially with increased urbanisation and the growth of Suva in particular. Based on limited data, there is evidence of deteriorated air quality. Furthermore, historic open burning and the heavy reliance on indoor wood cook-stoves, have potential health impacts on human health in rural areas. See the indicator sections for Urban and Rural Air quality for more detail.

Greenhouse gases and Ozone depleting substances (ODS)

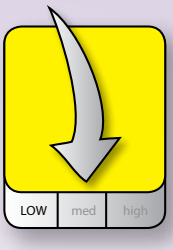
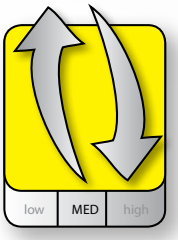
The reduction in Ozone Depleting Substances has been a success story in Fiji and throughout the world. However, greenhouse gases like methane and CO_2 continue to rise. Refer to the indicators on ODS and GHS for more detail. To see more on how Fiji is mitigating GHGs through renewable energy, refer to the Energy section in the Built Environment theme (7).

Climate variability in Fiji

Climate is naturally variable, but climate change threatens for more extreme climatic events. Fiji is seeing increased temperatures over the past 50 years. At this point in time, no discernable trend can be determined in Fiji in precipitation and cyclones, although the number flooding events appear to have increased over the last 50 years, except where mitigation efforts like dredging have taken place.

Nadi skyline on a Cane Field Burning day (October 2013). Photo: Mark Graham, SPREP.

ATMOSPHERE AND CLIMATE HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 AIR QUALITY	 **Status** Fair **Trend** Deteriorating **Data confidence** Low	Urban and rural air emissions likely have increased over the past 30 years. Ground level ozone has increased in Suva along with vehicle emissions. Cane burning has also increased in cane growing areas and household wood fuel use and open burning remains high.	Fiji has programs in place to remove smoking vehicles from the streets, ensure second hand imported cars and parts are fit and reduce cane burning. Better monitoring, as well as planning and enforcement is needed to target major air pollution sources in rural and urban areas.
 ODS AND GHGs	 **Status** Fair **Trend** Mixed **Data confidence** Medium	Ozone depleting substances (ODS) have been greatly reduced in Fiji and stratospheric ozone levels above Suva over the past 10 years indicate stability. GHGs have increased over the past 10 years, particularly in energy, industry and agriculture. Fiji's GHG removals remain substantially more than its emissions, and on average, GHG emissions are lower than its PIC counterparts.	Fiji should maintain its strong response to reducing ODS and build on its past success. Despite increasing energy use, Fiji is taking steps to reduce its dependence on fossil fuels for energy. It is expected that by 2015, almost 90% of its grid based electricity will be from renewable sources. Efforts should continue to coordinate climate change projects with national initiatives.
 CLIMATE	 **Status** Fair **Trend** Mixed **Data confidence** Medium	In Fiji, over the past 30-50 years, there are no detectable trends in precipitation, flooding and tropical cyclones. Overall maximum and minimum temperatures, have increased significantly in that same timeframe.	Fiji is making substantial investments in improving its response to extreme climate events. In addition, improvements to climate monitoring and flood warning systems are improving in large urban areas and watersheds. Focus should be given to smaller population areas and watersheds as well.

URBAN AIR QUALITY – GROUND LEVEL OZONE AND VEHICLE EMISSIONS

The main sources of air pollution in urban Fiji are from transportation (light, heavy duty vehicles and buses), incinerators, backyard burning and industry (cement, sugar refineries and steel). Under suitable meteorological conditions, emissions from agricultural and landfill open burning can impact urban areas as well.

In urban areas, four key criteria pollutants are responsible for urban smog and poor air quality; 1) ground level ozone is created at lower levels of the atmosphere through reactions of emissions (VOCs and NO_2) from urban sources, in the presence of sunlight. 2) oxides of Nitrogen, gases emitted from transportation and industry, 3) oxides of sulphur from heavy fuel combustion and industrial processes and 4) fine particulates or $PM_{2.5}$, microscopic particles created from the combustion of fossil fuels, wood and biomass.

No long term air monitoring exists for Nadi and Lautoka. Data presented below represents the best available information on ground level ozone and vehicle emissions in Suva. Ground level ozone monitoring was taken at USP Suva as part of an ozone sonde monitoring program through NOAA and Penn State University. Samples were taken at ground level 2–5 times per month since 1998.

No vehicle emission inventory exists for Fiji at this time, however, studies on polluting cars have been taken in Suva, so are used as proxy for the general state of vehicle emissions (see Table 1).

Status
Fair

Trend
Deteriorating

Data confidence
Low

Status: Fair **Trend: Deteriorating** **Confidence: Low**

Figure 1 shows that average ground level ozone at USP Suva follows a normal cyclical pattern due to changing annual meteorological conditions. Since 1998 wet season (Dec–Feb) averages are stable and remain around 10 ppb. However, dry season (Jun–Aug) values have increased on average about 5 ppb and now exceed 30 ppb during the mid-morning sample periods. Further monitoring is required to verify results.

Survey results from Campbell (2004) and LTA show a high presence of smoky vehicles in Suva. This is still a major issue in urban centres and with the growing number of vehicles in Fiji, air pollution is assumed to be increasing. More monitoring is required to confirm this.

TABLE 1: Percent of observed vehicles with some, high and gross levels of smoke observed at ill in Suva (Campbell, 2004.

Vehicle Type	Smoky	High Smoke	Gross Smoke
Cars	40%	10%	0%
4WD/Van	90%	25%	3%
Taxis	90%	60%	3%
Light Commercial Vehicles	90%+	30%	7%
Buses	95%+	70%	16%
Trucks	90%+	60%	5%

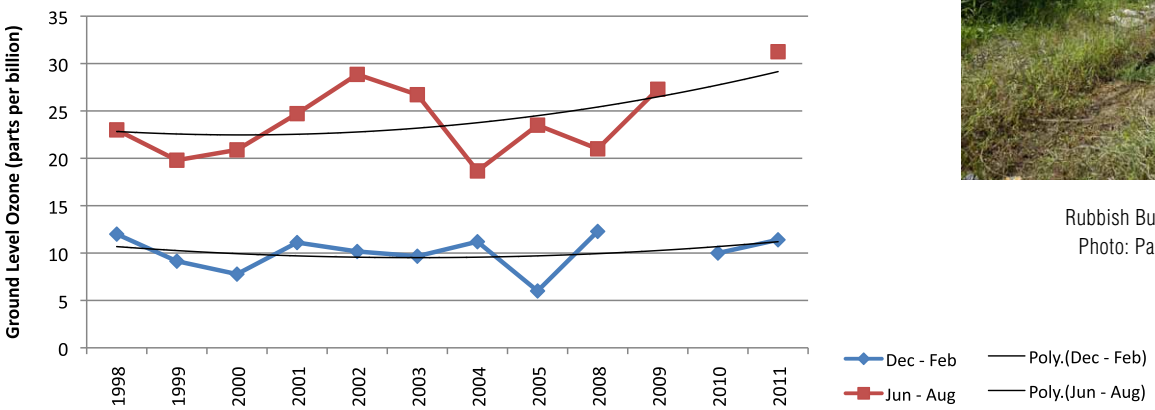


FIGURE 1: Dry and Wet Season Average Ground level ozone values at Suva USP. Source: NOAA-SHADOZ.

Rubbish Burning in Lami, 2014.
Photo: Paul Anderson, SPREP.

IMPACTS TO FIJI

The impacts of poor air quality on human health are well documented and include respiratory (e.g. asthma) and circulatory (cardiovascular) effects. Fine particulates generated from combustion of fossil fuels (especially heavier fuels such as diesel and bunker fuel), are a particular concern as they pass the body's natural defences and can be inhaled deep into the lungs and transfer into the circulatory system. Certain segments of the population, particularly the elderly, young, and those with respiratory concerns are at risk for long term health effects.

In addition to the burden it places on human health, air pollution is costly to Fiji's society and economy. Smoke represents wasted energy and inefficient burning of fuels. Also, air pollution reduces societal and tourist enjoyment of the natural and urban environment.

RESPONSE

What is Fiji doing to improve urban air quality?

Currently Fiji's Land and Transport Authority (LTA) issues curbside Traffic Infringement Notices (TINs) to drivers whose vehicles emit excessive smoke in excess of 10 seconds. Less stringent Defect Notices are also issued to drivers/vehicle owners that allow them to rectify defects causing emission before re-inspection of the vehicle by LTA. Table 2 shows TINs and Defect Notices issued by LTA between 2010 and 2012.

The National Air Strategy of Fiji, 2007, provides the direction for improving air quality in Fiji and includes strategies for public awareness via media coverage. In addition, the Offshore Motor Vehicle Inspection Agency is a joint operation between LTA and Fiji Revenue and Customs Agency (FRCA), to verify vehicle documentation, structure, removal of R12 gases, and fumigation before second hand vehicles and parts are imported into Fiji.

RECOMMENDATIONS

Improving air quality in Fiji requires significant investments in two main areas: **Monitoring and Inventory** and **Planning and Enforcement**:

Monitoring and Inventory

Proper monitoring and an inventory of air pollution emissions provides direction for planning and enforcement to focus on priority pollution sources. An emissions inventory determines major sources of air pollution (i.e. vehicles, open burning, industry) and combined with air monitoring, identifies hotspot areas that require emissions reduction and planning. At the time of publication, a monitoring and inventory study is being planned in Suva, through DOE and Macquarie University, Australia. Planning and further enforcement strategies in Suva and other urban areas of Fiji, should make effective use of the study results.

Planning and Enforcement

The National Air Pollution Control Strategy in 2007 set the course for air pollution reduction in Fiji. It should be re-vamped once further information on air quality in Fiji comes available. In addition, city based plans are an effective way of reducing pollution in urban areas. For example, the Fiji Roads Authority (FRA) is developing a Traffic Management Plan for Suva and Lautoka, as a means to minimize emissions from vehicles during peak congestion periods.

Enforcement and regulation of air pollution continues to be a challenge in Fiji, despite progress in issuing TINs (Table 2). A strong regulatory and enforcement framework is required to limit "burning blue" vehicles and open burning in the urban environment.

TABLE 2: Pollution Related Traffic Infringement and Defect Notices issued by LTA 2010–2012.

Notices by LTA	2010	2011	2012
Traffic Infringement Notices	91	197	660
Defect Notices	2807	3427	2141

Source: National Air Pollution Control Strategy, 2007.

SOURCES

Land Transport Authority, data provide by LTA on Traffic Infringement and Defect Notices.

National Air Pollution Control Strategy, Department of Environment 2007.

Campbell A., 2004. TA No. 2850-FIJ: Road Safety Reform and Safety Improvement, Department of Environment and Ministry of Transport and Civil Aviation.

NOAA- SHADOZ Study at USP SUVA 1998–2012. PENN State University, Data accessed from SHADOZ http://croc.gsfc.nasa.gov/shadoz.

RURAL AIR QUALITY – CANE BURNING AND HOUSEHOLD FUEL USE

In rural areas of Fiji, air pollution is primarily from agricultural open burning, household waste burning and indoor lighting, heating and cooking. The principal pollutant of concern is $PM_{2.5}$, microscopic particles generated from burning of fossil fuels, biomass and wood. $PM_{2.5}$ is known to have adverse respiratory and circulatory health impacts. In addition, nitrogenous gases (NO_2, NO) are emitted from crop fields treated with fertilizer.

Particulate emissions from agriculture are principally from the burning of cane crops, where in preparation for harvesting, large swaths of land are set afire. Other sources include garbage and yard waste burning. Indoors, wood cookstoves and kerosene burners are the principal sources of $PM_{2.5}$.

No viable air monitoring data exists for rural areas of Fiji, so estimates for rural air quality are based on trends around consumption of household fuels and percent of cane burnt.

Status
Fair

Trend
Deteriorating

Data confidence
Low

Status: Fair **Trend: Deteriorating** **Confidence: Low**

Figure 1 shows that burnt cane increased dramatically over the 1990's and 2000's and after 2008 has reduced somewhat. Based on emission estimates from cane burning, burnt cane air pollution from burning of fields is significant (Barbosa et al, 2012).

Figure 2 shows that in Fiji households, kerosene is increasingly being replaced by cleaner liquefied petroleum gas (LPG). However, based on figure 3, wood fuel appears dominate in rural areas. This would indicate that 77% of the rural population, and almost 20% of the urban population is exposed to higher levels of air pollutants indoors from woodsmoke.

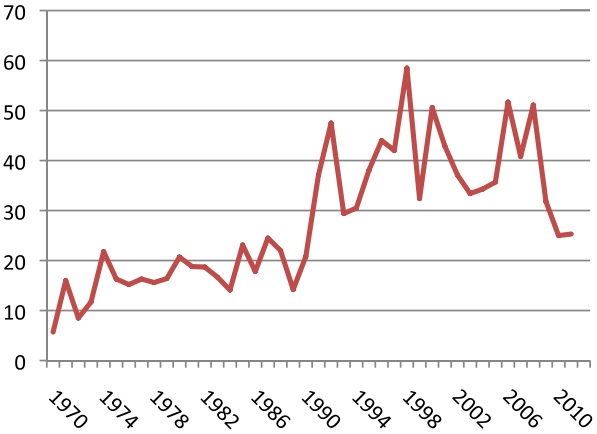


FIGURE 1: Percent of sugar cane produced in Fiji that is burnt prior to processing. Source: 2011 Sugar Research Institute of Fiji.

Cane burning in Lautoka area, 2013. Photo: Mark Graham, SPREP.

Indoor cooking with wood: Source: Fiji Times.

IMPACTS TO FIJI

Health impacts from rural air pollution are similar to urban air pollution for the general population. However, exposures can vary dramatically.

In rural households with poor ventilation and high woodfuel use, women and children typically see much higher exposure levels and can experience respiratory health impacts (Fullerton et al, 2008).

Studies from cane growing areas around the world show higher levels of cardiovascular and respiratory effects to cane farmers and people living in nearby areas where there is burning (Barbosa et al, 2012 and Cançado et al, 2006).

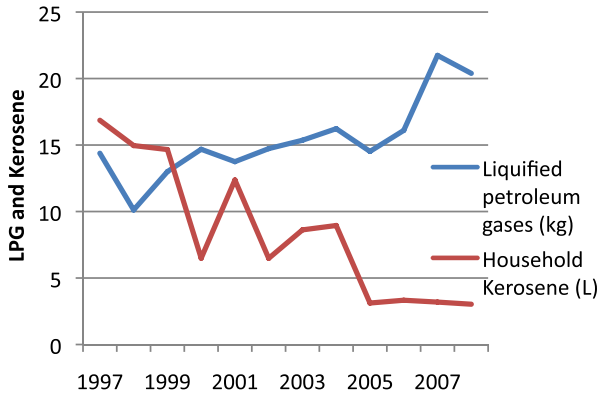


FIGURE 2: Annual consumption of Fiji fossil home fuels per capita (Data Source: Fiji Bureau of Statistics, 2013.

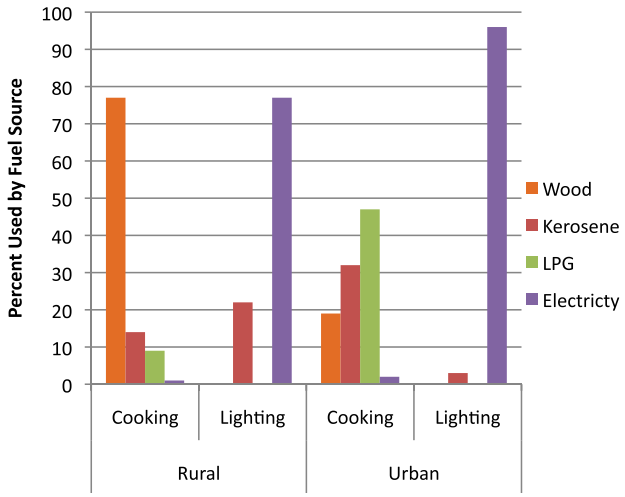


FIGURE 3: Major energy sources for Fijian Cooking and lighting. Source: Report on the 2008-09 household income and expenditure survey.

RESPONSE

The Fiji Government and the sugar refining industry (the Fiji Sugar Corporation) does discourage indiscriminate cane burning, as it can reduce the efficiency of the refining process as well as cause wildfires in forested areas. Burnt cane must be harvested and refined quickly after burning due to a rapid loss of sucrose content. In the past decade refineries have put restrictions on accepting burnt cane, and have developed programs with cane farmers on when burning is appropriate. The Fiji police force has also been used to stop the spread of indiscriminate cane fires.

RECOMMENDATIONS

Currently, cane burning is controlled in regards to its impact on sugar quality and wildfire prevention. A third impact, that of air pollution, should also be included in the consideration of when it is appropriate to burn. Cane burning (particularly close to population centres) should only be permitted under favourable meteorological conditions, when pollutants disperse and mix quickly with the atmosphere. This would involve forecasting services from the Meteorological Service of Fiji.

NGO's and government partners have promoted clean burning woodstoves or alternative cookstoves for rural areas of Fiji, but uptake has been limited due to low incomes of rural residents. A simpler approach may be to promote cleaner ways of wood burning, including how to dry wood fuel and ventilate cooking areas to reduce exposure to indoor pollution.

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Fiji Bureau of Statistics, 2013 – Table 12.1 Estimated Annual Consumption of Selected Commodities per head of Population

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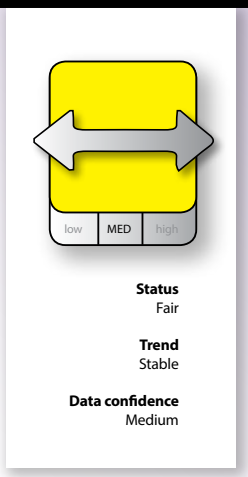
STRATOSPHERIC OZONE

Stratospheric ozone is naturally generated at high altitudes (15–50km above the earth's surface, and forms a protective layer from UV rays from the sun. CFC's and other ozone depleting substances are known to deplete stratospheric ozone by reacting with it, and breaking it down.

The Montreal Protocol is an international agreement that is designed to eliminate the production and consumption of ODS (Ozone depleting substances). Globally adopted in 1987, the Montreal Protocol has undergone several adjustments, and amendments to strengthen its control provisions. Fiji has been a member of that agreement since 23rdOctober, 1989.

Stratospheric ozone monitoring has been performed at USP Suva since 1998 using balloon sondes launched 3–5 times per month, that take ozone readings up to 30 km above the earth's surface.



Status: Fair **Trend: Stable** **Confidence: Medium**

Ozone depleting substances have been greatly reduced globally and in Fiji over past 25 years (see Figure 1). Fiji completely phased out the consumption of Annex A ODS (CFCs and Halons). HCFC's have replaced CFC usage but are also now being phased out under new protocols.

Stratospheric Ozone over Fiji (see Figure 2) in the Jun-Aug dry season is seeing little change and is stable at around 9 ppm, the warmer wetter Dec – Feb is seeing an increase of almost 1ppm at 10hpa (~ 30km elevation) over the last 13 years, suggesting that the stratospheric ozone layer remains stable over Fiji and may be improving.

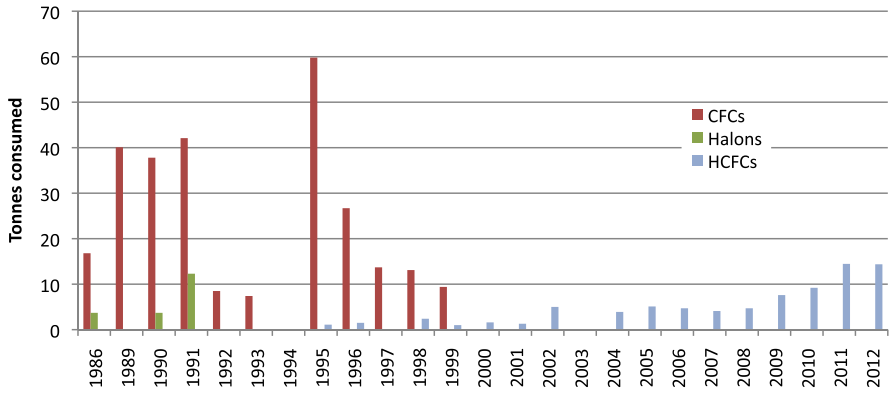


FIGURE 1: Consumption of Ozone Depleting Substances in Fiji from 1986 to 2012. Source Montreal Protocol Data.

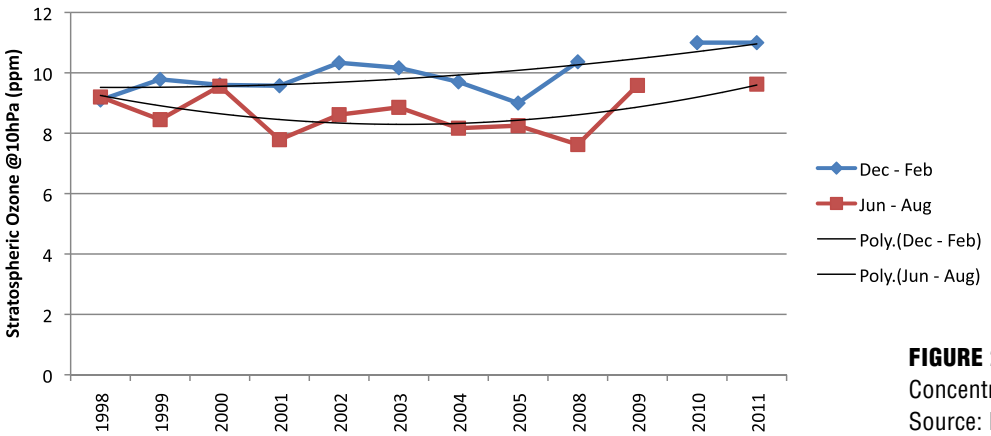


FIGURE 2: Average Stratospheric Ozone Concentrations at 10hPa, ~30km altitude. Source: NOAA-SHADOZ)

IMPACTS TO FIJI

Stratospheric ozone moderates UV radiation exposure to humans reducing the risk of UV related cancers.

Several ODS are potent greenhouse gases, contributing to global climate changes so the decline of ODSs has brought benefits not just to the ozone layer but also to the Earth's climate. For example the amount of ODS emissions (CO_2-equivalent) avoided in the year 2010 by the controls under the Montreal Protocol, is about five times larger than the emission reduction target for the Kyoto basket of gases in the first commitment period (Source UNEP Ozone Synthesis report 2010).

WHAT IS FIJI DOING ABOUT OZONE DEPLETING SUBSTANCES?

- A phase out plan for Hydrochlorofluorocarbon – HCFC (a weaker CFC used currently for air conditioning) developed for Fiji in 2010.
- Effort to phase out of methyl bromide (MBr) by reducing the import quota of MBr importers.
- Customs and Biosecurity Training to recognize and stop importation of illegal CFCs.
- Good Practices in Refrigeration Issues (GPR) training workshops, to train refrigeration technicians in efficient use of air conditioners and good maintenance practices to reduce the consumption of HFCFs.

Ozone Sonde launching at Suva USP. Source: Dr. Makakite Maata, USP.

SOURCES

NOAA–SHADOZ Study at USP SUVA 1998–2012-. PENN State University, Data accessed from SHADOZ http://croc.gsfc.nasa.gov/shadoz

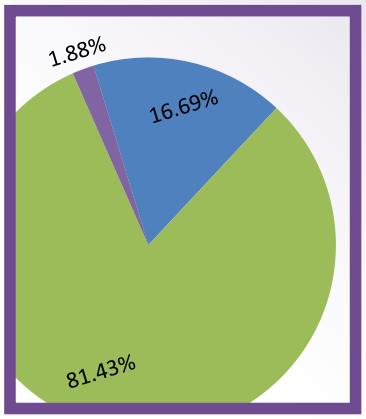
Montreal Protocol on Substances that Deplete the Ozone Layer: Data Centre (ozone.unep.org)

Fiji Department of Environment: Ozone Depleting Substances Unit.

GREENHOUSE GAS EMISSIONS

The six greenhouse gases (GHGs) under the Kyoto Protocol are: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbon and chloroflurocarbons. Through the greenhouse effect, the increase in concentration of these gases in the atmosphere causes global warming and climate change.

A Greenhouse Gas Inventory was carried out in 1994 (as part of Fiji first national communication) and 2004 to determine the source of emissions of Fiji's GHG. The 2004 inventory was prepared to fulfil the requirement of the non-Annex 1 party's decision as laid out in UNFCCC decision 17/CP.8 and the revised 1996 guideline.



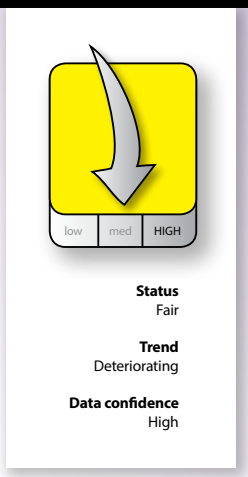


TABLE 1: CO2 Equivalent gases emitted from different sectors, compared to the 1994 inventory (carbon dioxide equivalent factors are 21 for methane & 310 for nitrous oxide – Source DOE, 1994 and 2004 GHG Inventory.

Sector	1994 CO_2 Equivalent Emissions / **Removal** (Gg)	1994 Removal (Gg)	2004 CO_2 Equivalent Emissions/ **Atmospheric Removal** (Gg)	2004 **Removal** (Gg)
Energy and Industry	821		1658.03	
Agriculture	494.1		972.43	
Land Use Change and Forestry		**7701.6**		**7987.75**
Waste	76.23		14.39	
Total	**-6310.27**		**-5342.9**	

Status: Fair **Trend: Deterioration** **Confidence: High**

Overall, greenhouse gases have increased in Fiji between 1994 and 2004 from 1391 Gg of CO_2 equivalent emissions to 2644 Gg. Much of the increase has come from fossil fuel burning in the energy, transport and agriculture sectors. However, given the large land base and relatively small population, Fiji's GHG removals remain substantially more than its emissions (see Table 1). Fiji's 2009 GHG emissions per capita are on average less than the average emissions of other PICs in 2009 (1.58 Tonnes/capita vs 3.04 tonnes/capita). See Figure 1.

The main source of CO_2 emissions are from the transport sector, which accounts for 46.53% of total emissions, and then other sectors which include commercial/ institutional, residential, agricultural/ forest/ fishing (see Figure 2).

The total methane emitted in 2004 is 20.79 Gg. The main source of methane is from the agriculture sector, which accounts for 81.4% for the total emissions (see Figure 3).

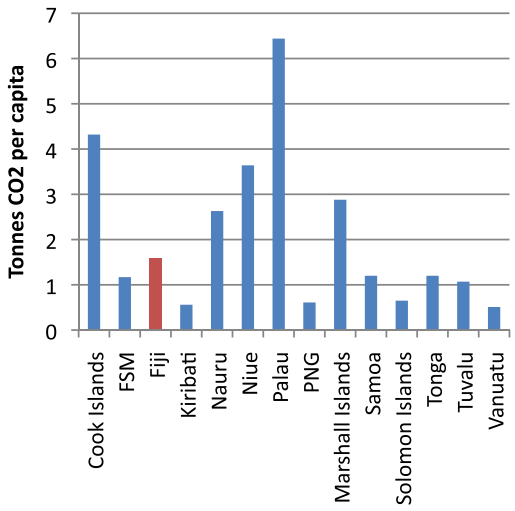


FIGURE 1: Total GHG emissions per capita (tonnes CO_2 equivalent) using embedded carbon as a measure (not UNFCCC method). Source: SPC, 2012.

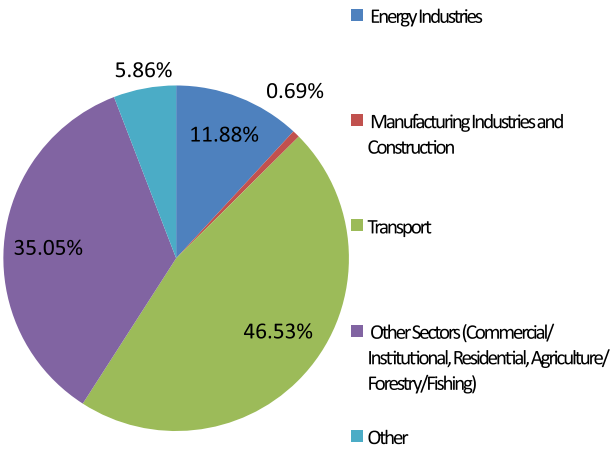


FIGURE 2: CO_2 Emissions in Fiji by Sector, 2004. Source: Fiji's Second National Communication.

The total nitrous oxide emitted from Fiji is 2.06 Gg. The main source of nitrous oxide is from the agriculture sector, which accounts for 96.24% of the total emissions (see Figure 4).

IMPACTS

Impacts to society from climate change are cross sectoral and described in the section on Climate Change in Drivers. Aside from the direct and indirect impacts of climate change, actions taken to mitigate greenhouse gas benefit the Fijian economy and society, through use of cost effective renewable energy sources reducing vulnerability from climate change.

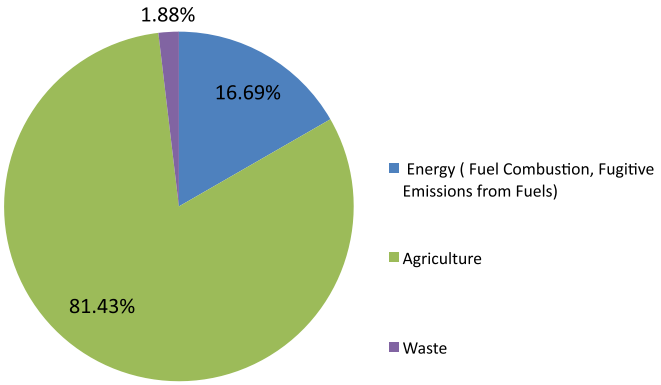


FIGURE 3: Methane emissions in Fiji by sector, 2004,. Source: 2nd National Communication.

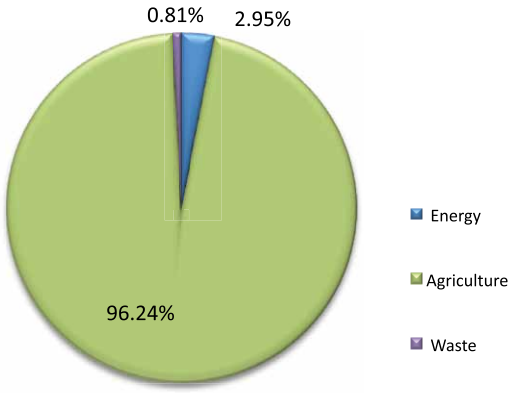


FIGURE 4: Nitrous Oxide emissions in Fiji by sector, in 2004,. Source: 2nd National Communication.

RESPONSE

What is Fiji doing to mitigate and reduce Greenhouse Gases?

Fiji's cross sectoral response to mitigation of Greenhouse gases includes:

- Fuel efficiency and emission controls. e.g. limiting second hand vehicle age imports, as well as other joint programmes between sectors to provide disincentives and incentives for more fuel efficient, cleaner burning fuels. In cooperation with WWF and IUCN, Fiji is working to improve energy efficiency in the tourism centre, including solar street lighting.
- Energy Alternatives – Wind, solar and tidal, and bio-fuel (coconut-diesel)
- Transportation Alternatives – Bike lanes, improved bus routes
- Land protection (e.g. REDD+) and planting of mangroves through the Mangrove Management Plan
- Review of the National Energy Policy undertaken by the Department of Energy to link renewable energy initiatives, and incorporate climate change policy into the plan.

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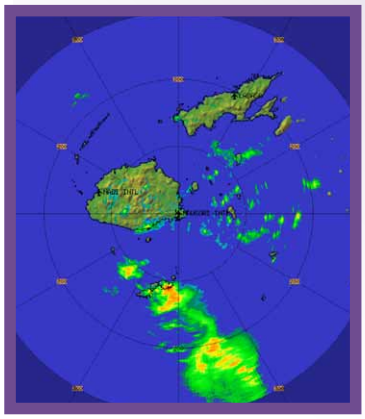
CLIMATE: PRECIPITATION TRENDS

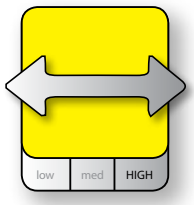
Much of Fiji's rainfall is associated with the movement of the South Pacific Convergence Zone which is closest to Fiji in the wet season. This band of heavy rainfall is caused by air rising over warm water where winds converge, resulting in thunderstorm activity. It extends across the South Pacific Ocean from the Solomon Islands, to east of the Cook Islands with its southern edge usually lying near Fiji.

Rainfall across Fiji can be highly variable. On Fiji's two main islands, Viti Levu and Vanua Levu, rainfall is strongly influenced by high mountain peaks up to 1300 m. On the southeastern slopes of VitiLevu, near Suva, the average annual rainfall is about 3000 mm. In contrast, the lowlands on the western side of VitiLevu, near Nadi, are sheltered by the mountains and have an annual average rainfall of 1800mm with a well-defined dry season favourable to crops such as sugar cane.

Additionally, year to year variation of rainfall in Fiji is heavily influenced by ENSO (the El Nino Southern Oscillation), which are periods of abnormal warm or cold sea surface temperatures that develop off the western coast of South America and cause climatic changes across the tropics.

For this indicator, national rainfall data are averaged from eight high quality stations for the last half century (52 years).





Status
Fair

Trend
Stable

Data confidence
Medium

Status: Fair Trend: No significant trend Confidence: High

Data since 1961 (Figure 1) shows no significant change in long term rainfall. The overall change over the last half century is about 7.3%. There is substantial variation in year to year rainfall and these are usually associated with ENSO events. The observed annual and seasonal rainfall trends are as follows:

- There is a very weak positive linear trend in annual rainfall over Fiji. An annual increase of about 3.39mm/year (approximately 0.14%/year) is observed from 1961 to 2012 period;
- There is a weak decreasing linear trend in the wet season rainfall with a seasonal decrease of 0.87mm/season (approximately 0.05%/season);
- There is a weak increasing linear trend in dry season rainfall with a seasonal increase of about 1.57mm/season (approximately 0.21%/season).

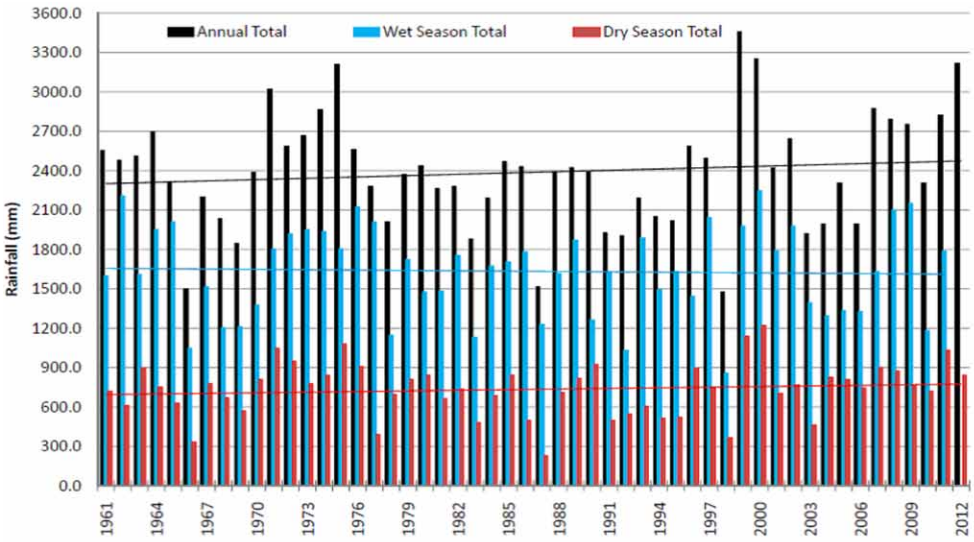


FIGURE 1: Trends in Average Annual, Wet and Dry Season Rainfall across Fiji, 1961–2012. Source: Fiji Met Service.

IMPACTS

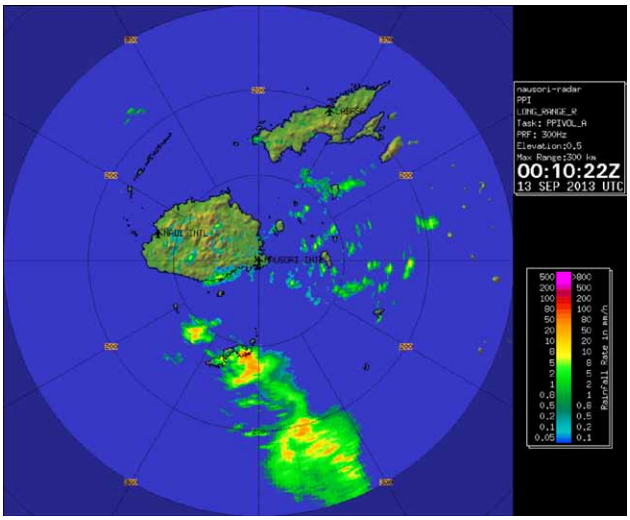
Flooding in Fiji is a common hydrological event associated with extreme precipitation events, especially during the passage of tropical cyclones, tropical depressions or an enhanced, slow moving active convergence zone. Intense rainfall and localised flash flooding in wet seasons, is very common during La Niña events

Major meteorological droughts in Fiji have been associated with El Niño events. During moderate to strong events, the annual rainfall is reduced by as much as 20% to 50% over most parts of the country as experienced during 1982/83, 1986/87, 1992/93 and 1997/98. The weak El Niño events do not have much influence on the country's total annual rainfall.

RESPONSE

The Fiji Government is making a substantial investment in improving the national capacity in the provision of early warnings to extreme weather events. This includes continuous training of staff, necessary reforms to retain staff, and investment in state of art technologies, such as, Doppler radar and monitoring technologies such as real time telemetry and climate instrumentation. In addition, the Fiji Met Service is improving web access to provide climate data products to the public.

Furthermore, the Government has implemented some vital reforms in recent times for better coordination and filtration of early warning to public, such as transfer of Hydrology Services from the Water Authority of Fiji to Fiji's Meteorological Service.



Fiji Meteorological Service Radar Image. Source: met.gov.fj, 2013.

Photo: Matt Capper.

SOURCES

All data, graphs and analysis courtesy of the Fiji Meteorological Service.

CLIMATE: TEMPERATURE TRENDS

Changes in air temperature from season to season over Fiji are relatively small and strongly tied to changes in the surrounding ocean temperature. Around the coast, the average minimum temperatures can be as low as 18°C and the average maximum temperatures can be as high as 32°C. In the central parts of the main islands, average minimum temperatures can be as low as 15°C (Fiji Met)

Temperature data are averaged for 8 representative stations across Fiji by the Fiji Meteorological Service.

Status
Fair

Trend
Deteriorating

Data confidence
High

Status: Fair **Trend: Increasing** **Confidence: High**

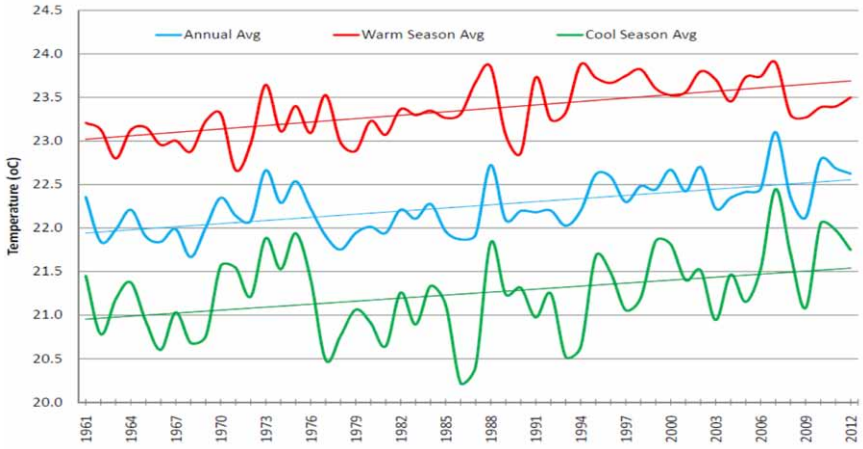


FIGURE 1: Annual Warm and Cool Season Minimum Temperatures.
Source: Fiji Meteorological Services, 2013.

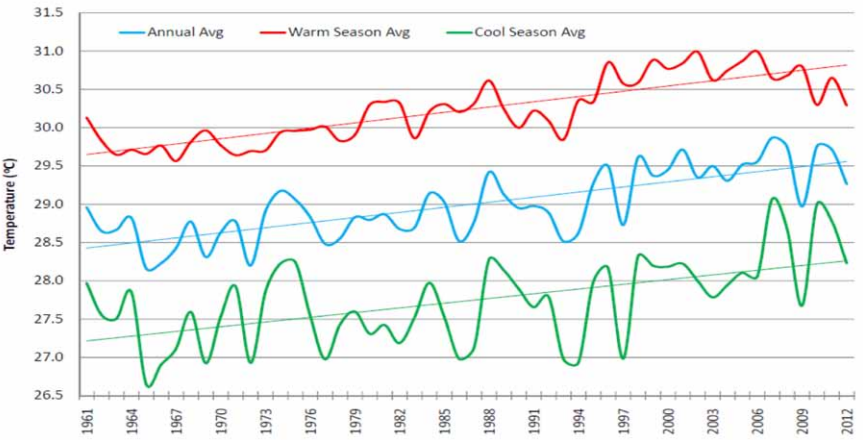


FIGURE 2: Annual Warm and Cool Season Maximum Temperatures.
Source: Fiji Meteorological Services, 2013.

Figures 1 and 2 show the trends for Maximum and Minimum Temperatures in Fiji

Maximum Temperature:

Significant warming trends are found in the maximum air temperature across Fiji over the last half century.

- The average annual maximum air temperature has increased by 1.15˚C (0.022˚C/year) over the 1961 to 2012 period;
- The average warm season maximum air temperature has increased by 1.19˚C (0.023˚C/season) over the 1961 to 2012 period;
- The average cool season maximum air temperature has increased by 1.06˚C (0.021˚C/season) over the same period.

Minimum Temperature:

- The change in average minimum air temperature is 0.62°C, over the 1961 to 2012 period.
- There is significant linear warming trend in annual minimum temperature that is consistent with global warming. The annual minimum temperature has increased by 0.012°C/year;
- There is significant increasing trend of 0.68°C (0.013°C/season) in the warm season for the same period;
- The cool season minimum air temperature has increased by 0.59°C (0.011˚C/season) over the same period.

IMPACTS TO FIJI

The increasing surface air temperature will have a compounding effect on agricultural production and may become a threat to food security, water resources, infrastructure, and human health. For instance, an increase in extreme temperatures could have negative effects on health of segments of the population such as children and elderly people.

RESPONSE

The Fiji Government is making a substantial investment in improving the national capacity in the provision of early warnings to extreme weather events. This includes continuous training of staff, investment in state of art technologies, such as Doppler radar and monitoring technologies such as real time telemetry and climate instrumentation. In addition, Fiji metrological service has invested in improving their meteorological monitoring network for temperature.

Fiji Meteorological Service: New Weather Monitoring Instrumentation.

Photo: Matt Capper.

SOURCES

All data, graphs and analysis courtesy of the Fiji Meteorological Service.

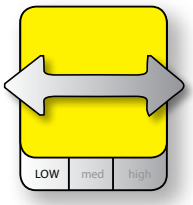
CLIMATE: FLOODING AND TROPICAL CYCLONES

Flooding in Fiji is a common hydrological event. Large scale flooding is usually associated with prolonged, intense rainfall, especially during the passage of a tropical cyclone, tropical depression or enhanced, slow moving active convergence zone.

Tropical cyclones are one of the most severe extreme events that have affected Fiji on numerous occasions in the past four decades. They usually affect Fiji from November to April, noting tropical cyclones have also affected the country in May and October.

Data provided for this indicator is based on Simon et al's report on flooding events in Fiji, that used historical records to recount reported floods. Only data from 1950 on was included as previous data had higher uncertainty, especially for rivers in remote areas. Note that flood severity is not included.

For tropical cyclones, data from the Fiji Meteorological Service was used to track cyclone numbers and frequency of "intense" hurricanes (storms at or above Category 3 Saffir Simpson and sustained winds greater than 178 km/hr.)



Status
Fair

Trend
Stable

Data confidence
Low

Status: Fair **Trend: Stable** **Confidence: Low**

Recorded floods from the 1950's in Figure 1 show an increasing trend of flooding for all rivers in Fiji. However, for the major rivers (Nadi, Rewa, Sigatouka and Ba) on Viti Levu, there was no discernable increase. Note that the Rewa River had no flooding in the previous decade, likely due to the success of dredging efforts there.

On average, 1 to 2 cyclones affect some part of Fiji every season. There have been ten seasons (1971/72, 1975/76, 1976/77, 1993/94, 1994/95, 1995/96, 2005/06, 2008/09, 2010/11 and 2011/12) when Fiji was not directly affected by cyclones. In contrast, Fiji experienced five tropical cyclones during 1992/93 season and four in 1984/85 season. A decreasing trend in the number of tropical cyclones, and a slight decreasing trend in cyclones with hurricane intensity affecting Fiji, is observed in the last 4 decades (see Figure 2).

Based on the above information, both indicators for extreme climate events are marked as fair with a stable trend. Both of these indicators require very long data sets to establish trends, and in the case of flooding, data can be skewed by flood prevention efforts (e.g. dredging, bank strengthening), therefore data confidence is currently low. Also, older reports of flooding are subject to bias for populated areas where reporting was likely more consistent.

Local Nadi residents trapped by flood waters.
Source: Bernard and Cook, 2012.

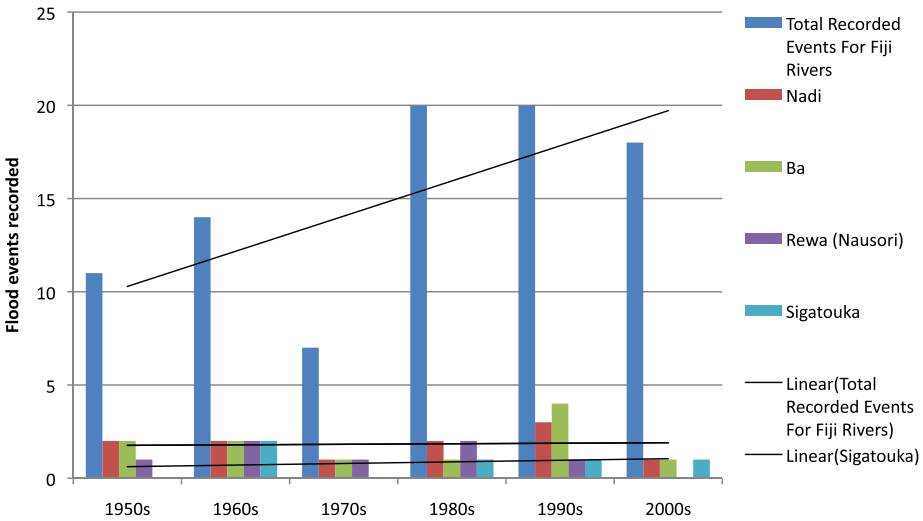


FIGURE 1: Distribution of recorded flooding events in Fiji over time, in 10 year intervals, 1951–2009.

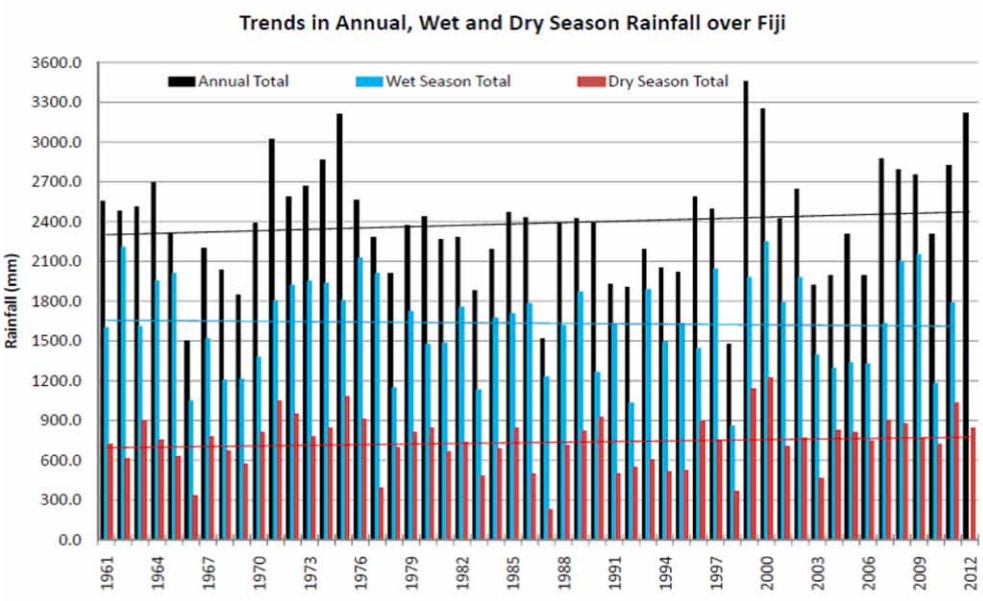


FIGURE 2: Seasonal frequency and hurricane intensity tropical cyclones affecting Fiji from 1969/70 to 2012/13 seasons. Source: Fiji Meteorological Service.

IMPACTS TO FIJI

A socio-economic assessment (Holland, 2009) prepared by SOPAC (South Pacific Applied Geoscience Commission) showed that the overall impact on small businesses by major flooding in Nadi 2009 totalled 143 million USD, with a further 7 million USD in losses to households. Two months after the March 2012 floods, the Nadi Chamber of Commerce reported that 46 small businesses (of a total of 250 registered businesses) had closed down due to damages to their premises and destruction of stock, and had consequently laid off more than 100 staff.

RESPONSE

Fiji government's flood mitigation programme includes a three-phase dredging of Nadi River, as the sedimentation in this river bed is considered to be a key aggravating factor. The objective of this dredging is to protect the population from the incidence of floods and their damaging impacts (Ministry of Information, 2010)

In the last three years, the government has spent $5 million USD dredging the Nadi River, from the mouth of the river up to 9 kilometres inland (Malo, 2010). Similar dredging programs are planned for other flood-prone areas of Fiji, such as Labasa and Wailevu Rivers and the Rewa Delta.

The Water Authority of Fiji is responsible for river flow monitoring and flood forecasting. Its Hydrology Section maintains and operates a systematic flood forecasting system for the Rewa River.

In recent years, funding provided by the European Union to the Pacific Islands Hydrological Cycle Observing System Program, managed by SOPAC, has enabled a number of river and TB3 rain gauges to be installed in the Navua and Rewa river catchments.

Instrumentation and software installed by the National Institute of Water and Atmospheric Research Ltd (New Zealand), are based on flood monitoring systems which operate in New Zealand.

A flood forecasting system for these rivers has not been developed, but will be introduced as soon as a reasonably long river discharge data record is in existence.

In addition, weather radars for the Fiji Meteorological Service have been upgraded from conventional radar, to a doppler system to improve weather forecasting.

RECOMMENDATION

Smaller population areas and watersheds, particularly squatter settlements, are often most vulnerable to disasters. Efforts should be made to prioritize vulnerable areas and ensure disaster response and climate monitoring is adequate in these areas.

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Holland, Paula, 2009. Economic Costs of January 2009 Nadi Floods. SOPAC Technical Report 426. Suva, Fiji

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Fiji Meteorological Service, Cyclone Data and Analysis, 2013.

THE INCREASING PRESSURE ON FIJI'S FRESHWATER

Fiji has an abundance of freshwater resources, including groundwater, supplying water for drinking, irrigation and livestock. In addition, Fiji's rivers and streams are an important supply of freshwater fish and invertebrates, such as Kai (clams), for Fijians.

Data collected since the 1992 SOE shows that Fiji is putting more and more pressure on its freshwater resources. Fiji's watersheds, by area, are still largely in good condition, but over 1/3 of them, primarily near populated and resource extraction areas, are heavily impacted. These impacts include:

Road and culvert building – bringing increased sediment to streams and serving as a pathway for invasive species.

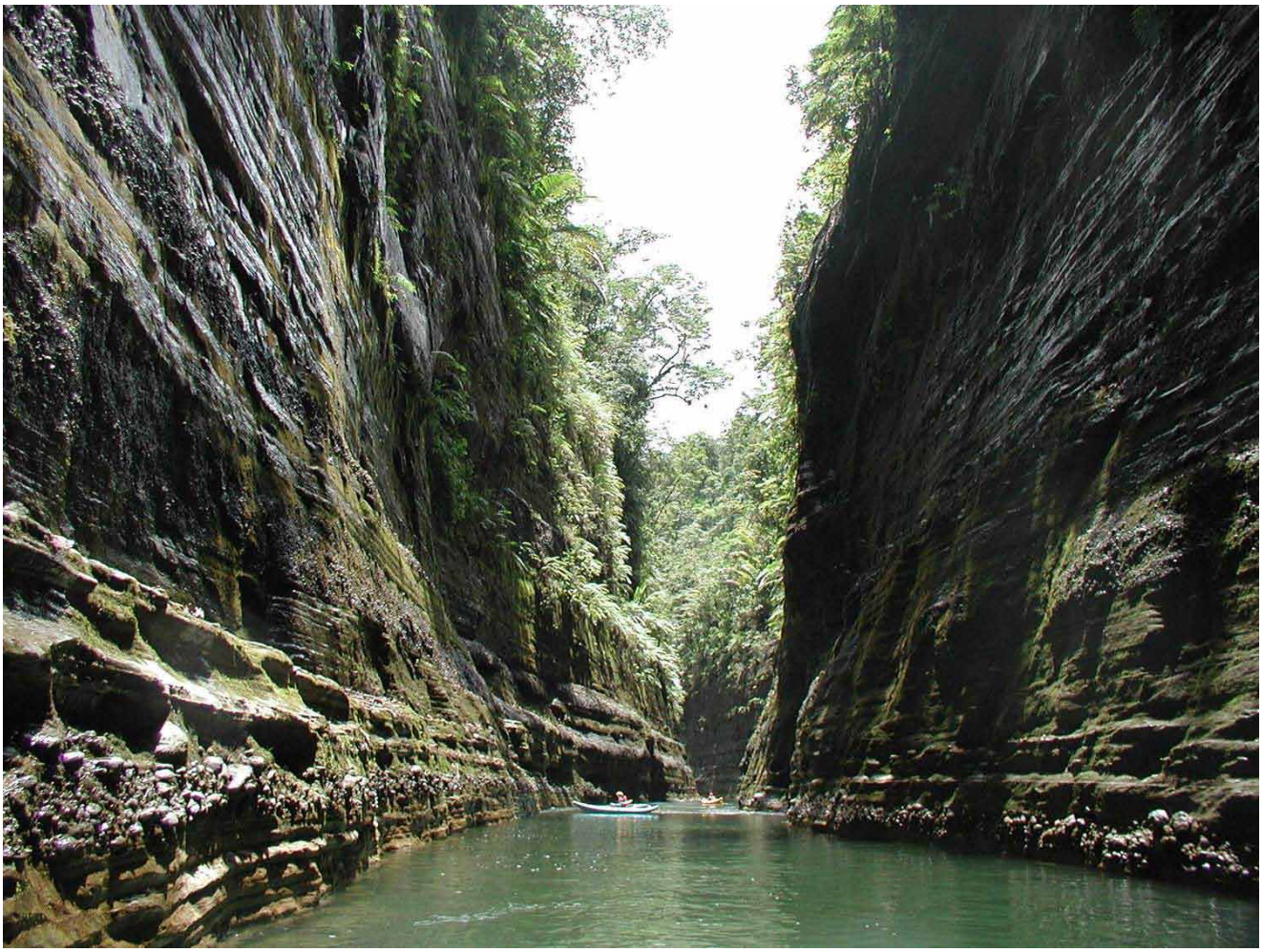
Stream-side removal of forests – reducing needed shade and oxygen for freshwater species.

Gravel extraction – increasing channel velocity of the streambed causing more intense flood events downstream

Discharge of human and animal waste – increasing faecal coliforms in Fiji's waters exposes Fijians to dangerous diseases.

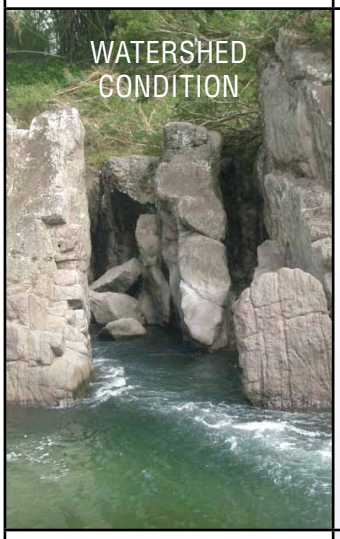
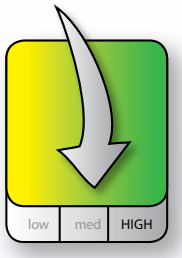
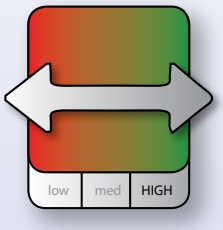
Since the 1992 SOE report, groundwater use and exploitation has greatly increased, particularly in regards to drinking water, the bottled water industry and agricultural use. However, little information is available on the sustainability of this exploitation.

The following sections describe the state of Fiji's Inland Waters in more detail.

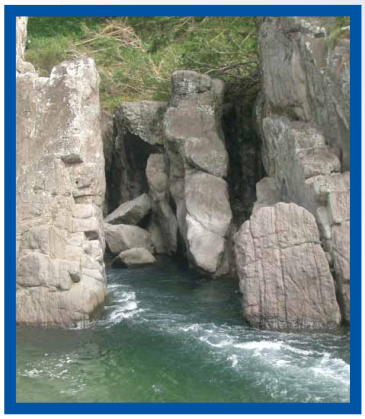


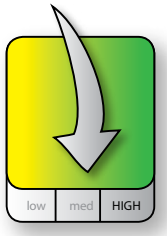
Navua Gorge. Source: Rivers Fiji.

HIGHLIGHTS

TOPIC	STATUS & TREND	JUSTIFICATION	RESPONSE & RECOMMENDATIONS
 WATERSHED CONDITION	 **Status** Good to Fair **Trend** Deteriorating **Data confidence** High	Over one third of Fiji's watershed's are classified as highly impacted by development, roads, invasives, agriculture and/or resource extraction. However, by area, most of Fiji's watersheds are in relatively good condition. Impacts such as gravel extraction remain unchecked and the trend is deteriorating.	Policies exist on stream buffers, road construction, restoration of river banks and a prohibition on introducing invasives. However, on their own they are not enough. In many places, open licences are provided for gravel extraction with no environmental or management requirements. This needs addressing.
 SURFACE WATER QUALITY	 **Status** Good to Poor **Trend** Stable **Data confidence** High	Major rivers in Fiji have fair to good water quality with moderate to high faecal coliform contamination, healthy levels of dissolved oxygen and low nutrients and metals. Urban creeks have very high faecal levels, likely from improper sanitation. Most surface waters show a stable trend.	WAF continues to increase household connection to the sewer system. An outfall testing program is in place to prioritize areas for connection. Better coordination is required between the activities impacting water quality as well as the regulatory bodies that they fall under.
 GROUNDWATER	 **Status** Fair **Trend** Unknown **Data confidence** Low	Historically, groundwater in Fiji has been pristine and abundant. Current pressures on the resources include bottled water extraction, community source water and irrigation. Some aquifers are experiencing contamination from aboveground sources. Overall, exploitation of the resource has increased significantly but the extent of the impact is unknown.	A groundwater management policy is in place to manage and protect Fiji's groundwater resource. However, limited data and lack of strenuous permitting requirements make the health and future of groundwater uncertain. Better monitoring, permitting and modelling is required to provide a confident assessment of the resource.

OVERALL WATERSHED CONDITION





Status
Good to Fair

Trend
Deteriorating

Data confidence
High

Status: Fair to Good Trend Deteriorating Confidence: High

Undeveloped watersheds in Fiji have good vegetation cover, relatively low sediment loads and high dissolved oxygen (DO). The watershed development index (WDI), developed for Fiji by Atherton et al, is a measure of the degree to which watersheds have been impacted by development and infrastructure. The higher this index, the more likely the aquatic ecosystem is degraded and impaired. The WDI covers all of Fiji's watersheds and is a factor of the total forested area, the area logged over a twelve year period, the road density and the number of stream crossings roads make. While the data used in the current WDI is in some cases over 10 years old, it represents the best national dataset for overall ambient watershed condition. Detailed conditions of selected rivers in Fiji are provided later in this chapter.

All land uses, from preserved forest areas to mining, gravel extraction, agriculture and urban development affect the condition and health of freshwater systems. These systems in turn impact the condition of the reefs at the mouths of rivers; erosion and nutrient loading has particular detrimental impacts on reefs.

Roads impact healthy rivers and watersheds as they act as pathways for exotic species, are the largest source of sediment to streams, and can block upstream and downstream movement of aquatic life. Gravel extraction increases channel velocity, causing more intense flooding downstream.

Forest cover in a watershed serves to provide shade and thus cooler more oxygen rich water to the streams, detritus with forms the base of the riverine ecosystem as well as intercepting and decreasing the impact of heavy rainfall events and holding soil erosion in check. Recently logged areas have the converse effect, more soil erosion, warmer, less oxygen rich water with an unbalanced nutrient load.

Fiji freshwater systems exhibit a range of conditions from nearly pristine to heavily impacted (see Figure 1). Over one third of all freshwater systems are ranked as "highly" impacted, (see Figure 2) however in terms of watershed area only 17% of the total area of freshwater systems are in the highly impacted category, and some larger watersheds are in good condition. (see Figure 3).

Currently the condition of Fiji's terrestrial aquatic systems is fair to good. The trend in watershed condition is declining based on in situ observations, continued gravel extraction, road construction practices and development pressure.

IMPACTS TO FIJI

In Fiji, intact riverine systems have an average of 11 more native fish species than degraded watersheds (Atherton, 2005). These native fish, which play an important role in the diet and livlehoods of inland communites, have been declining in recent years, impacting food security and income for those communities.

Degraded watersheds provide reduced sediment retention, increased peak flows and flooding, as well as a decrease in overall biodiversity. Extraction of boulders and gravel can cause extreme flooding further down the river.

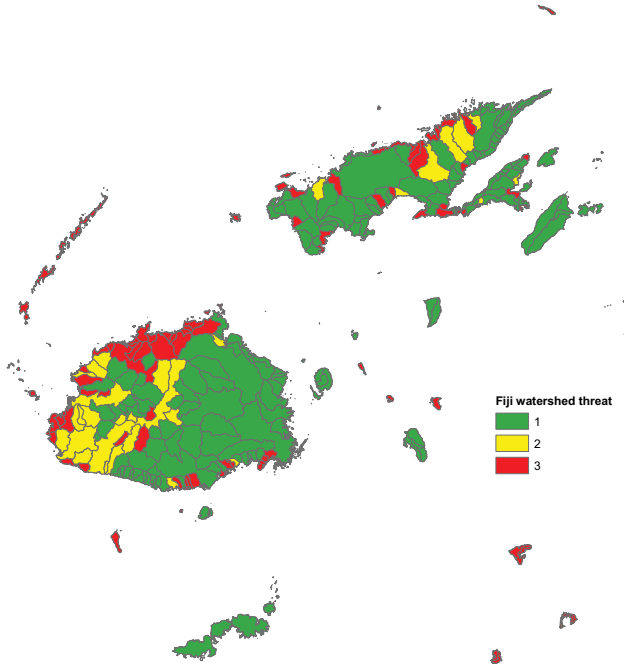


FIGURE 1: Impacted watersheds of Fiji: Adapted from Atherton, 2005. (Impact level – 1-Low,2 = Moderate and 3= High)

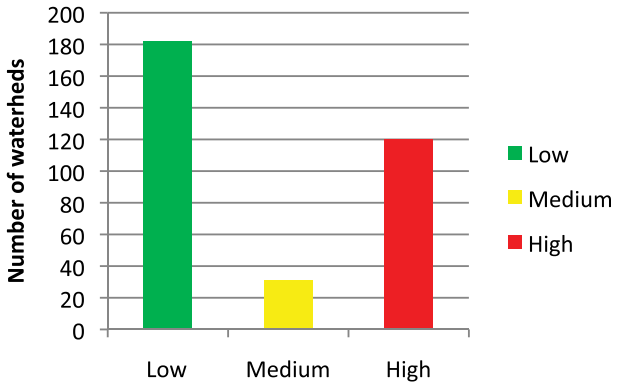


FIGURE 2: Impact level by number of watersheds.

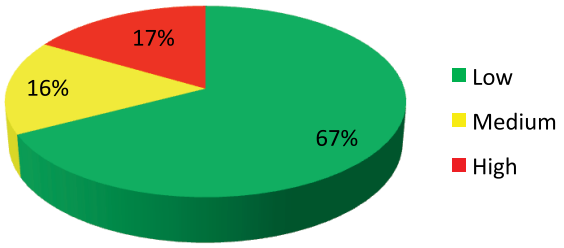


FIGURE 3: Impact level by area of Watershed (From Atherton.

HOW IS FIJI MANAGING WATERSHED CONDITIONS?

Actions are being taken by the Department of Environment/ Forestry on stream buffers, forest road construction, including proper culvert placement, maintaining and restoring forest cover along river banks, prohibiting the introduction of exotic aquatic species into pristine riverine systems. For river gravel extraction, the Native (iTaukei) Land Trust Board (NLTB) provides open licenses without any environmental or management requirements. This is a serious issue that requires addressing.

RECOMMENDATIONS

Address the rapid rate of gravel and boulder extraction from rivers, and develop alternative sources – e.g. quarrying and implement a policy on the sustainable extraction of river rock.

In Situ River Gravel Extraction: Source: Dick Watling.

Lami River. Photo: Paul Anderson, SPREP.

SOURCES

Atherton et al, Fiji Watersheds at Risk, 2005, Final Report to the United States Department of State OESI Grant # SFJ600 04 GR 004.

SURFACE WATER QUALITY: WAIMANU RIVER WATER QUALITY

The Waimanu River, located in the Nausori-Naitasiri topography is one of the three rivers draining large amounts of fresh water into the Rewa River. It drains fresh water from the upper Wainibuku, Wainimala and Waibau rivers (see Figure 1)and its water is one of the major drinking water sources in Viti Levu.

The Waila Water Treatment Plant operated by the Water Authority of Fiji, treats 100 mega liters of raw water from Waimanu River each day that serves the Suva-Nausori-Rewa Delta areas, thus serving a significant proportion of Fiji's population, industry and agriculture. The Waimanu River is also a major source for the freshwater fishery and Kai harvesting, therefore, pollution can impact both the aquatic species and people who rely on them for subsistence and diet.

Waimanu River's water quality is monitored monthly by the National Water Quality Laboratory for chemistry and changes in trends near the mouth of the river. For this report, results were averaged annually by WAF.

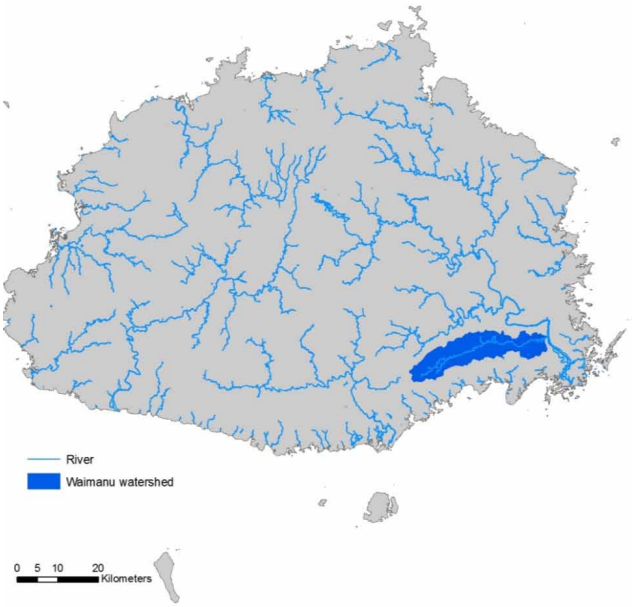
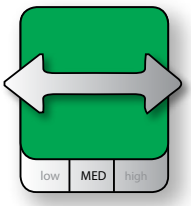


FIGURE 1: Waimanu River Catchment Area, Source: SPREP.

Waimanu River Sampling Site. Source: Google Earth Image, 2013.



Status
Good

Trend
Stable

Data confidence
Medium

Status: Good **Trend: Stable** **Confidence: Medium**

Data generated by WAF's National Water Quality Laboratory for the past seven years indicates Waimanu River being well oxygenated and low in nutrients (see Figures 2 and 3). Faecal coliforms are generally below guidelines for drinking and bathing, but concern remains for occasional exceedances which lower dissolved oxygen levels and pose risks to human health (see Figure 4)

These exceedances are likely due to a rise in populations nearby with unsafe septic systems, leaking sewage into receiving waters.

WHAT IS FIJI'S RESPONSE TO IMPROVING OR MAINTAINING CLEAN SURFACE WATERS?

The Water Authority of Fiji (WAF) continues to pursue efforts to get more households hooked up to the sewer system. Where sewer hookup is not an option, organizations such as SOPAC and NGOs are working with the Ministry of Health to educate communities on proper septic system setup.

In addition, the WAF is embarking on an outfall testing program across major rivers and creeks in Fiji to look for major sources of sewage and prioritize hookup areas to sewerage.

The *Environmental Management Act* (EMA)is in place and has a regulation in place to protect surface waters but collaborative effort needs to be coordinated at a national level to address water quality in various sectors. In addition:

- Government has developed an overarching document National Water Resources and Sanitation Policy (still yet to be passed by the Cabinet) to an efficient and effective

management system for the sustainable development of water resources (surface water and groundwater) and sanitation – Monitoring of Water Quality

- Also, existing policies such the *Rivers Act, Rural Water and Sanitation Policy, Land Water Resources Policy* need to be integrated across the freshwater sector.

WHO Max Recommended limit for Faecal coliforms in recreational waters

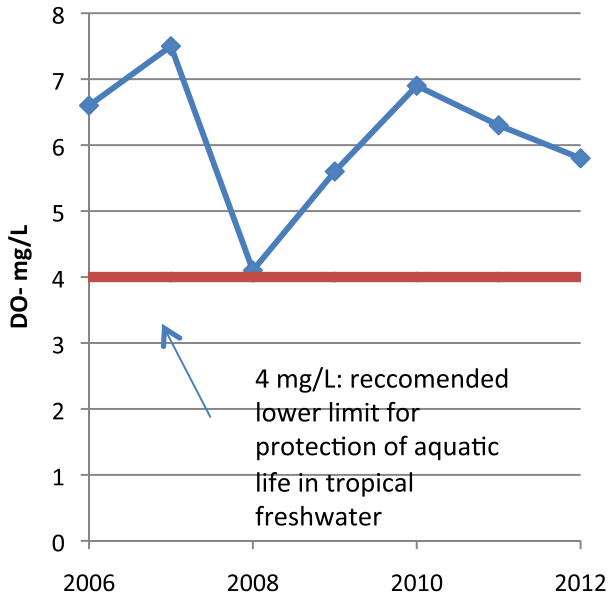


FIGURE 3: Nitrate levels in the Waimanu River. Source WAF.

IMPACT

The Waimanu River is the main drinking water source for eastern Viti Levu and almost half of Fiji's population. Protection is crucial to maintain health of the watershed and reduce costs on water treatment.

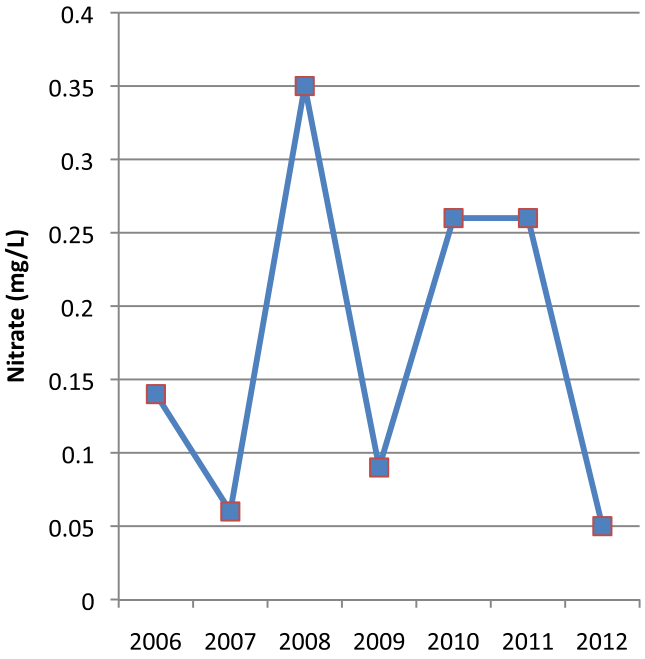


FIGURE 2: Dissolved Oxygen Levels in the Waimanu River. Source WAF.

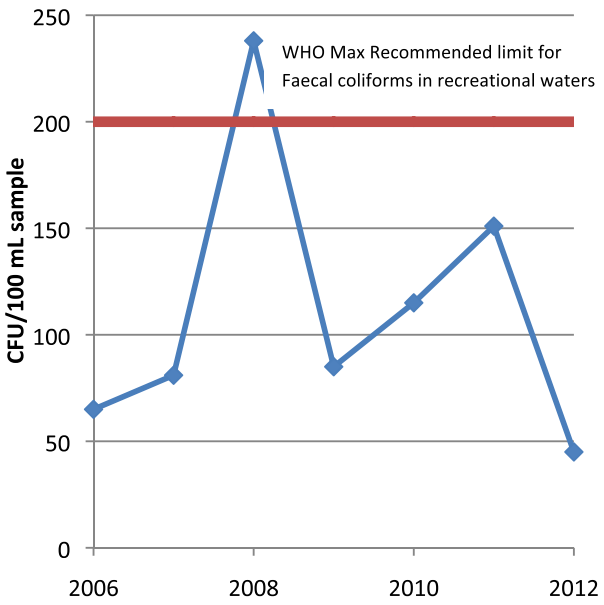


FIGURE 4: Faecal Colifoms in Waimanu R. Source: WAF.

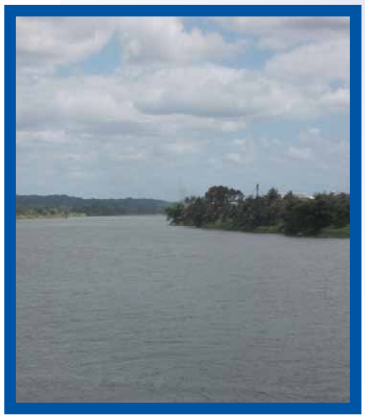
Waimanu River near mouth at Rewa: Photo: Mark Graham, SPREP.

REWA RIVER CATCHMENT AREA

The Rewa River is Fiji's largest river, 145 km long and almost 1 km wide at its mouth in Laucala Bay near Suva. It drains more than 1/3 of Vitu Levu island (see Figure 1) and its watershed provides water for a significant proportion of Fiji's population, industry and agriculture. The Rewa River is also a major source for the freshwater fishery and Kai harvesting of Fiji, so pollution can impact both the aquatic species and people who rely on them for subsistence and diet.

The Rewa also drains some of the most intact forested areas in Vitu Levu so is a good indicator of emerging trends in the aquatic environment and developing a baseline for the future.

Nutrients like nitrate and orthophosphate are found in natural levels in many creeks in Fiji, but can be increased through human sources such as sewage and agriculture. Dissolved oxygen (DO) is a measurement of available oxygen in the water for aquatic life. Nutrients and DO are useful indicators of aquatic health for fish, invertebrate and other aquatic species. Analysis for this section is based on WAF's monthly sampling near the Rewa's mouth.



Status
Good

Trend
Deteriorating

Data confidence
Medium

Status: Good Trend: Deteriorating Confidence: Medium

Overall, the condition of the Rewa River is still good with moderate levels of faecal coliforms, levels of nutrients well within guidelines and dissolved oxygen above acceptable levels. Faecal coliforms are often still above guidelines for drinking and bathing (see Figure 2, 3 and 4).

Faecal coliforms appear to have decreased in the last 5 years, but it is too early to determine if this is a true trend. DO has decreased each year from a high of 10 mg/L to approximately 7 mg/L, suggesting oxygen depletion from algal growth and nutrient loading. Over the same time period, phosphate and nitrogen have increased moderately, but are not themselves near aquatic health guidelines.

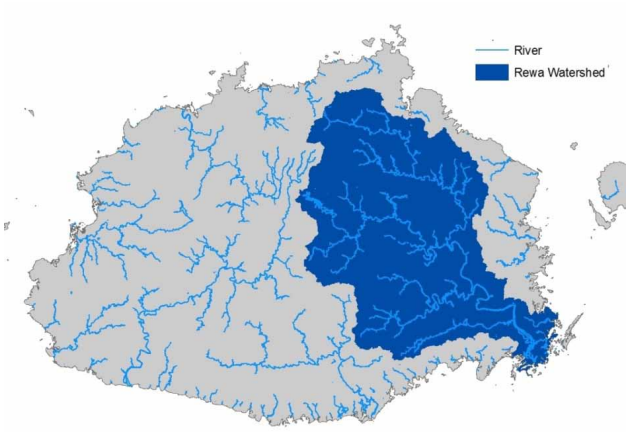


FIGURE 1: Rewa River Catchment. Source: SPREP.

Rewa River: WAF Sampling Site Area. Source: Google Earth.

Rewa River. Source: Catalogue of Rivers for Pacific Islands, SOPAC.

IMPACT

The Rewa River is a major ecosystem for a variety of fish, invertebrates and birds. It is also a substantial food source for Fijians. Habitat destruction on the Rewa, in addition to sewage pollution, impacts the health of the people who rely on the river directly.

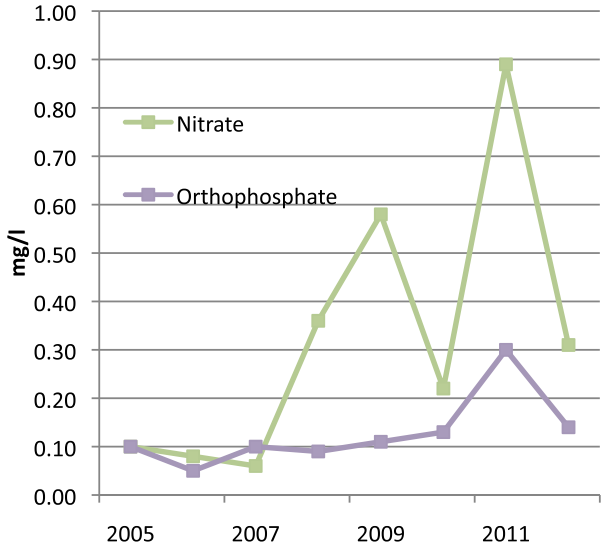


FIGURE 2: Average Annual Rewa River Nutrients (WAF)

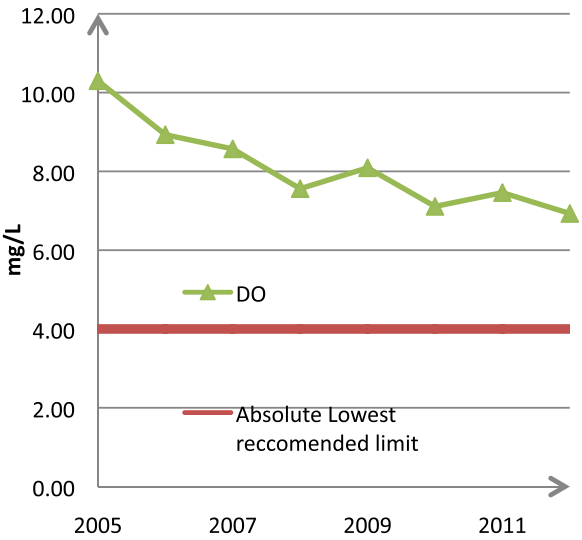


FIGURE 3: Average Annual Rewa River Dissolved O2 (WAF)

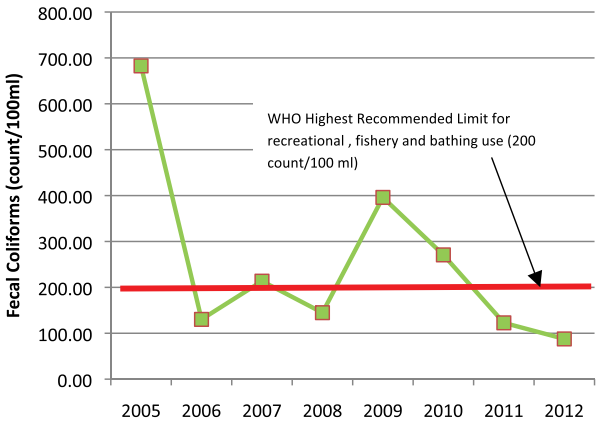


FIGURE 4: Average Annual Rewa River Faecal coliforms (WAF.

Rewa River. Photo Mark Graham, SPREP.

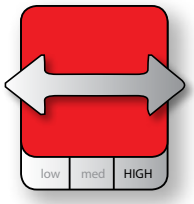
SOURCES

All data, graphs and analysis courtesy of the Water Authority of Fiji (WAF)

SURFACE WATER QUALITY: NABUKALOU CREEK WATER QUALITY

Nabukalou Creek (Figure 1) drains only a small geographic area and is highly tidally influenced, but drains one of the most built-up environments in Fiji. The creek is approximately 1 kilometre long.There has been a history of recordings of high contamination levels (nutrients and faecal colifoms) in the creek, thought to be caused by numerous broken sewage pipes and overflowing septic tanks.

Nutrients like nitrate and orthophosphate are found in natural levels in many creeks in Fiji, but can be increased through human sources such as sewage and agriculture. Dissolved oxygen (DO) is a measurement of available oxygen in the water for aquatic life. Faecal Coliforms are bacteria associated with human and animal waste.



Status
Poor

Trend
Stable

Data confidence
High

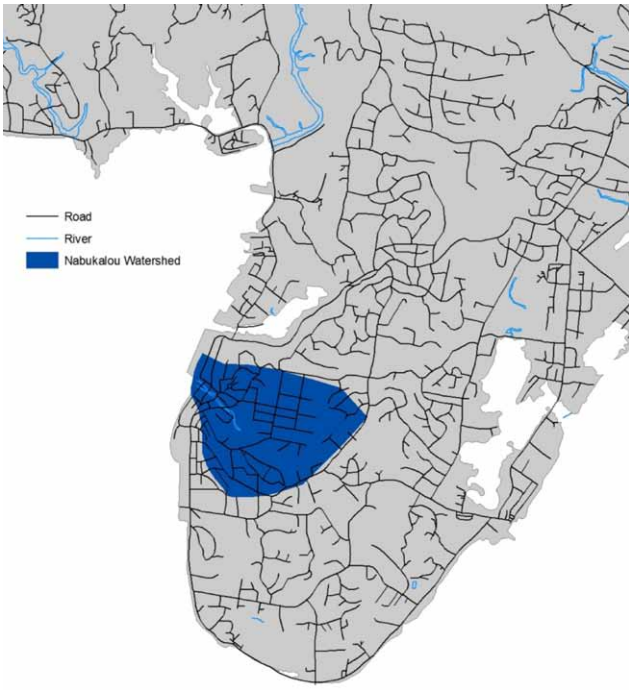


FIGURE 1: Nabukalou Creek Catchment area. Source: SPREP.

State: Poor **Trend: Stable** **Confidence: High**

Overall, the condition of the Nabukalou Creek is poor with elevated levels of faecal coliforms and nutrients (see Figures 2 and 4). Only Dissolved Oxygen levels are within acceptable levels (Figure 3).

Whilst there is large inter-annual variation between some readings, the data presented here shows that there are even greater hourly or daily fluctuations in water quality, dependent upon rainfall and tidal state. In addition, at points further upstream from the mouth, there are even higher levels (see Figure 5 and Table 1).

There appears to be no consistent trend in the water quality indicators over time, however, other creeks in Suva, such as Samabula and Vatuwaqa, although not as high as Nabukalou, are showing substantial increases (Aalbersberg, USP 2013)

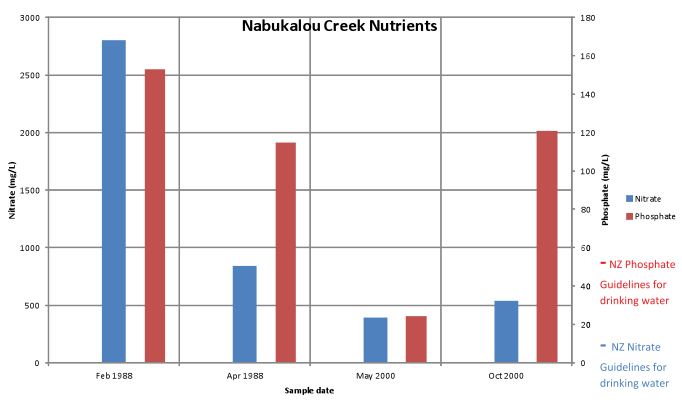


FIGURE 2: Nabukalou Creek Nutrients. Source: USP.

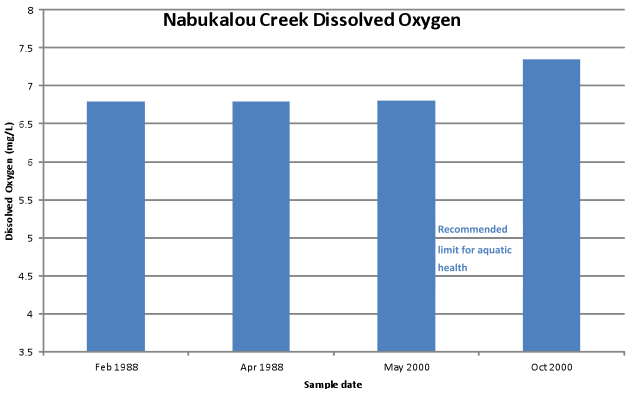


FIGURE 3: Nabukalou Creek Dissolved Oxygen. Source: USP.

IMPACT

Impacts of highly deteriorated urban streams are socioeconomic & ecological.

Poor quality urban streams can negatively impact human health, as they can be a host for a multitude of diseases such as typhoid and diphtheria. Contaminants from urban streams can enter the food chain too, especially through crustaceans and bi-valves, which has both health and economic repercussions.

Ecologically, the biggest impact from poor quality urban streams is eutrophication, making streams unliveable for aquatic life, therefore decreasing bio-diversity. They also discharge sediment and nutrients, causing algal growth and the smothering of coral reef ecosystems.

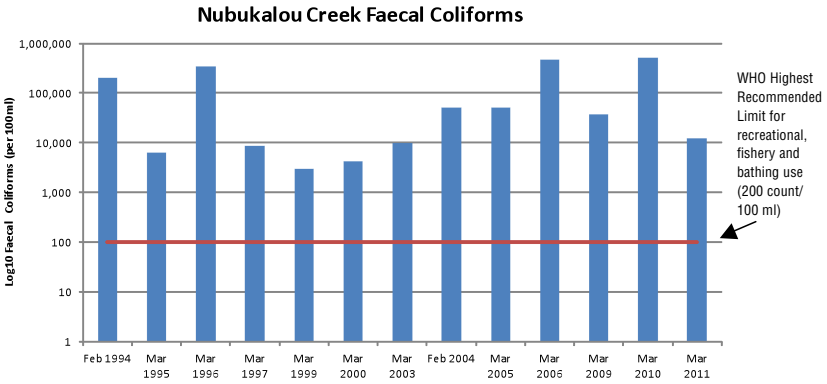


FIGURE 4: Nabukalou Creek Faecal Coliforms. Source: USP.

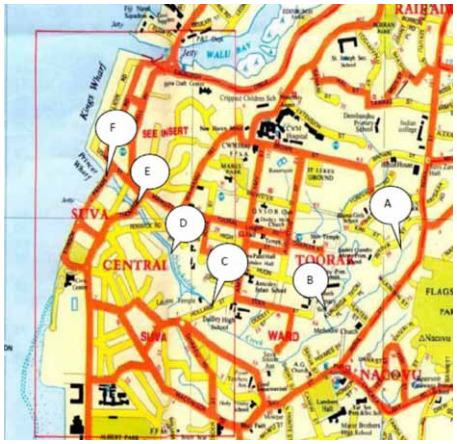


FIGURE 5: Sampling stations upstream of Nabukulou Cr. mouth

STATION	LOCATION	FC Average 2005-2011
A	Ritova Street	188,940
B	Eden Street	260,020
C	Holland Street	278,461
D	FEA	172,910
E	Thompson Street	141,418
F	Stinson Parade	122,250

TABLE 1: Average of yearly samples taken 2005–2011 in April. Source Ed Anderson and USP MS312 students.

Nabukalou Creek Sampling Site. Source: SPREP.

USP students taking water samples at Nabukalou Creek. Source: Ed Anderson, USP.

Looking upstream from MHCC Mall. Source: Mark Graham, SPREP.

GROUNDWATER GROUNDWATER QUALITY, AVAILABILITY AND EXPLOITATION

Groundwater is water located beneath the earth's surface in soil pore spaces or fractures, and crevices of rock formations. Recharge of groundwater comes largely from rainwater in addition to seepage from rivers, creeks and lakes. In Fiji, most groundwater boreholes are in the western, drier side of the main islands.

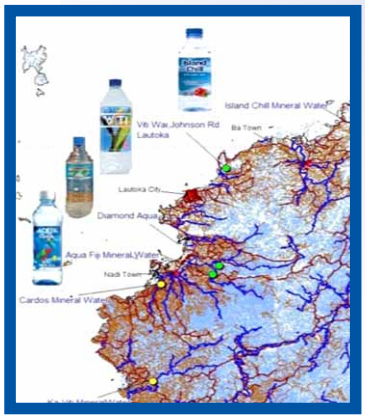
In Fiji, groundwater is an ever increasingly important source, supplying the demand for water supply in peri-urban and rural communities, on the main islands and outlying small islands. It is also important for irrigation purposes (example, Sigatoka Salad Bowl, Nadi –Lautoka and Rakiraki region), and for commercial exploitation, as the choice water source for most bottled mineral water factories in the country.

Groundwater can be accessed by drilling or digging wells. There are also some artesian wells in Fiji, wells drilled into an artesian aquifer may result in water freely flowing out of the borehole.

Groundwater can become unusable if it becomes polluted and is no longer safe to drink. As well the groundwater supply may be threatened, if more water is being discharged than recharged. However, careful use and reducing sources of pollution can ensure groundwater continues to be an important natural resource in the future.

The state of groundwater resources in Fiji can be measured by 3 indicators: 1) groundwater quality, derived by chemical measurements of nutrients, faecal coliforms and metals, 2) groundwater quantity or availability, derived by recharge rates or instances of wells going dry and 3) exploitation of groundwater resources in Fiji to date.

To date, there is little information available on these indicators, so the state is based on what data exists and expert opinion. Groundwater quality data is only available currently for the northern division (Vanua Levu and Taveuni Island) through the Water Authority of Fiji (WAF).



Groundwater drilling in Small Islands.
Source MRD.

Status
Fair

Trend
Unknown

Data confidence
High

Status: Fair **Trend: Unknown** **Confidence: Low**

Historically, the majority of Fiji's groundwater resources have been pristine and abundant. However, due to the increasing population and development in rural and peri-urban areas, groundwater resources are increasingly under pressure from physical, chemical and microbiological pollution, in addition to overuse.

Exploitation: Little is known about the extent of groundwater exploitation in Fiji, however it is likely increasing based on current MRD data and reports from private contractors. Currently the Mineral Resources Department (MRD) has ~ 800 wells drilled throughout Fiji, 200 of which were drilled in the past 10 years (see Figures 1 and 2). However, these wells make up likely less than 10% of wells drilled in Fiji and, as of 2013, there are four major private contractors drilling wells. (Dick Watling, personal communication, March 2014). Many of these wells are not licensed under legislation, so the information on them is scarce.

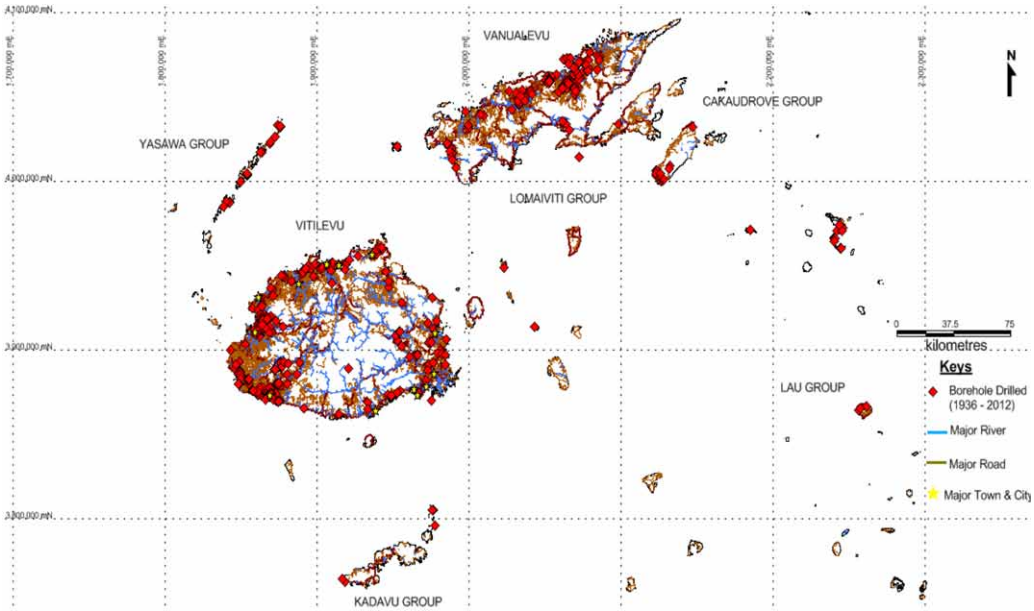
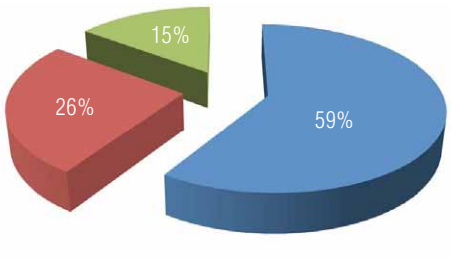


FIGURE 1: Major Boreholes drilled in Fiji by the Mineral Resources Department (MRD), 1936–2012.
Source: MRD of Fiji.



	Island Group	Capital Grant	Borehole Drilled by MRD
GW Database	Vitilevu	GRADU	483
	Vanualevu	GRADU	212
	Kadavu	Small Island	18
	Lomaiviti (Central Eastern)	Small Island	11
	Rotuma	Small Island	9
	Lau (Eastern)	Small Island	29
	Yasawa (Western)	Small Island	45
	Vatulele (Central Eastern)	Small Island	9
Total			816

FIGURE 2: Boreholes drilled by MRD 1936 to 2012. Source: MRD, 2013.

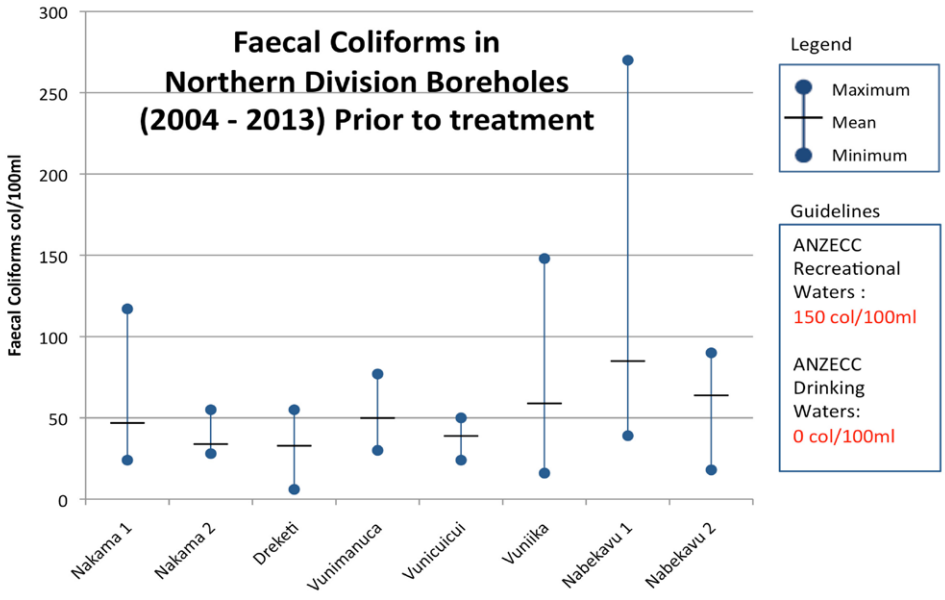


FIGURE 3: Average, Maximum and Minimum Faecal Coliform levels from Northern Division Boreholes. Source: WAF Water Quality Laboratory, 2013.

**ANZECC: The Australian and New Zealand Environment and Conservation Council*

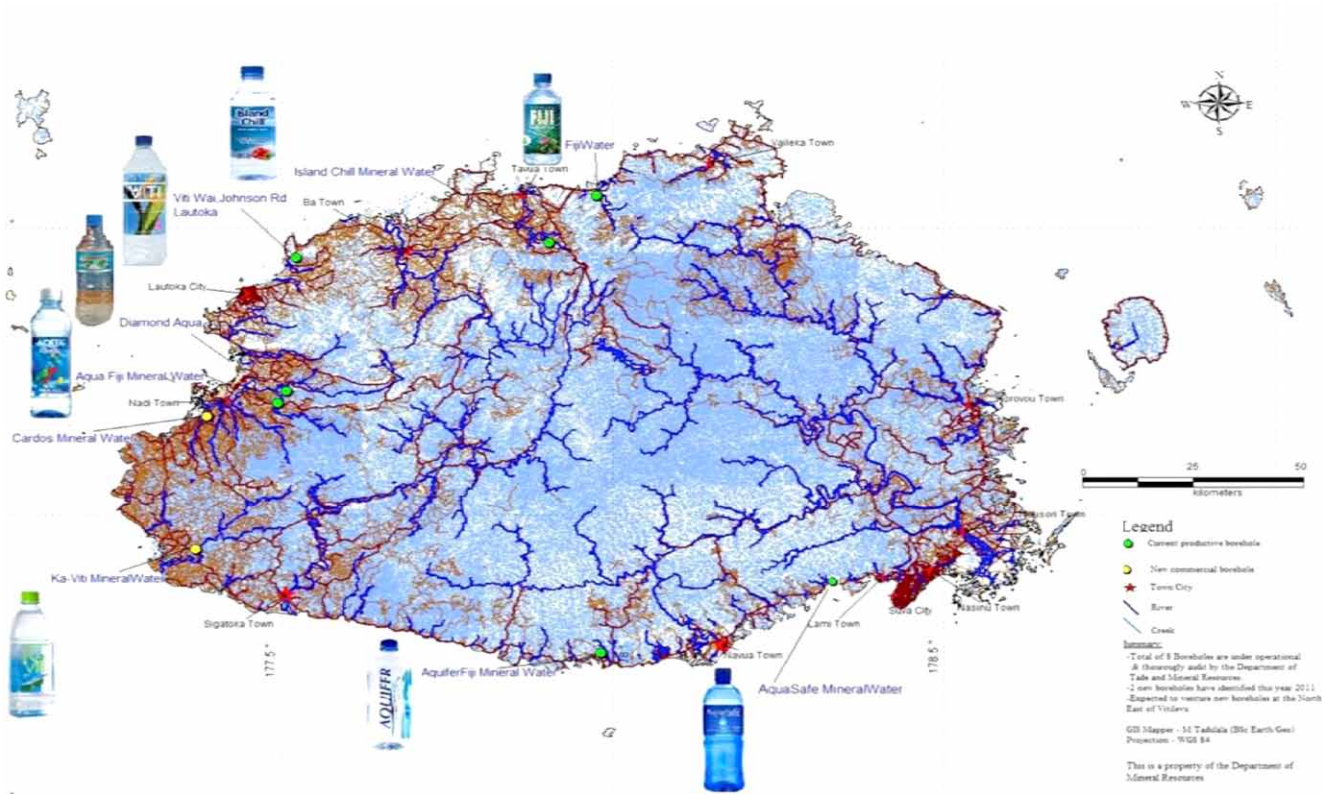


FIGURE 4: Bottling Plant Boreholes on Viti Levu Island 2012. Source, MRD.

Quality: Metals and nutrients in groundwater resources are generally low, however, in the Northern Division, some boreholes show microbial contamination (faecal coliforms) from agriculture and urban development (see Figure 3). Water from these boreholes are treated prior to human consumption. There are also a few cases of saline intrusion in the outer islands and in the coastal regions of the main islands, where the water table is close to sea level.

Quantity: In general, groundwater is still abundant throughout Fiji, particularly on the main islands of Viti Levu, Vanua Levu and Taveuini, however, this is not verified, as very little quantitative information exists on either quantity or exploitation of the groundwater resource there. Small island groundwater resources in Fiji are inevitably exhausted from time to time, due to the high demand of water to meet the needs in the villages.

In addition, the bottled water industry has grown in the past 20 years and there are now at least 8 viable commercial bottling boreholes in Viti Levu (Figure 4). These boreholes and extraction rates are licensed under legislation.

IMPACT

Overuse of groundwater can impact the availability and quality of groundwater for future generations. Poor land management can also impact groundwater quality through contamination of groundwater sources. In Fiji, these risks are higher for the small island communities that have limited water availability, and susceptibility to saltwater intrusion. Education on groundwater management is crucial in these communities, to ensure wells are protected from pollution and overuse.

Fiji's recent growth in the bottled water industry has led to increased exploitation of groundwater. Groundwater resources contribute directly to the economy through production and export of bottled mineral water through foreign earnings, taxes, employment created and other streams of revenue. It is also believed by MRD that the bottling industry has also led to an increase in public knowledge and awareness of groundwater resources, with its labelling describing groundwater and how it originates.

However, there is not a good understanding of the extent of the resource, so it is uncertain if it can be continued sustainably at the current rate.

The *Environment Management Act* is the principal law for the protection of the environment including groundwater environment and resources. There is also the requirement for Environment Impact Assessments and Environment Management Plans to be developed as part of any development that may have an impact on the groundwater resources.

RESPONSE

- Monitoring water levels and groundwater chemistry of the MRD groundwater boreholes monitoring network.
- Community awareness activities and programs to help educate locals of the need to sustainably use groundwater resources.
- Some quantity monitoring (based on rates of extraction).
- Water Quality Monitoring by the Water Authority of Fiji (WAF) in regional drinking water supply boreholes, including microbiological, metals and nutrient monitoring.
- Development of a National Groundwater Database – For groundwater resources information of Fiji
- The implementation of Fiji's *Environment Management Act* and the Environment Impact Assessment requirement for any development that would have a possible negative impact on groundwater resources.
- The development of Fiji's National Water Resources and Sanitation Policy as an overarching water resources policy.
- The development of a Groundwater Management Policy that aims to manage and protect the use of groundwater resources.

RECOMMENDATIONS

Better knowledge of the extent of the groundwater resource is required to ensure sustainable exploitation and use of the resource. The following activities are recommended.

- Expand the observation well network across major withdrawal areas to monitor the quality and availability of groundwater in Fiji.
- Improve permitting system for wells to include smaller multiple holes for agriculture and other uses.
- Make it mandatory that all drillers submit basic borehole information including well lithology and recharge rates for all holes drilled in Fiji. Data should be held centrally in the national database for future planning, study and permitting.
- Permitting system should also cover appropriate drilling practices to prevent groundwater contamination.
- Development of a groundwater modelling exercise in the regional water supply (WAF boreholes) and commercial bottling areas to ascertain the characteristics and extent of the supply aquifer (currently in development).

SOURCES

Data for wells and bottling plants supplied by the Fiji Mineral Resources Department

Data for Northern boreholes water quality supplied by the Water Authority of Fiji (WAF, 2013)

Personal Communication with Dick Watling (NatureFiji-MareqetiViti)

THE ONGOING DEPLETION OF FIJI'S NATIVE FOREST AND MANGROVES

Fiji has close to 50% of its original forest still in a natural state. Early losses of the forest were mainly from large-scale agricultural clearing and forestry. However, since 1991, Fiji's forest industry has transitioned from predominantly harvesting of indigenous species, to plantation harvesting of pine and mahogany for export and local use. In addition, with the decline of agriculture, very little large-scale forest removal is currently occurring for agriculture.

However, despite a significant decrease of commercial and agricultural logging in native forests, between 1991 and 2007 closed forest cover (closed canopy forest) still decreased by 14%. Most of the causes are small scale and include : the gradual increase of smallholder agriculture with mixed commercial and subsistence farming, fires, the spread of villages and settlements, and the continued use of the forest for fuel wood. See the section on forest for more details.

The loss of the forest is the single most destructive force destroying Fiji's biodiversity (Dick Watling, personal communication, 2013). Without adequate forest management or protected area establishment, the decline of the native forest, and its associated impacts to biodiversity will continue.

An analysis of mangrove cover between 1991, 2001 and 2007 shows the initial removal of mangroves seen in the 1990's from development and expansion, did slow somewhat between 2001 and 2007. However, destruction of mangroves in the urban areas is still extensive and ongoing. See the section on mangroves for more detail.

Wet and Dry Forest Boundary on VitiLevu. Photo: Timoci Gaunavinaka.

THE LEGACY OF AGRICULTURE

Fiji has a strong tradition of agriculture, including forestry. It is one of the most "food secure" countries in the Pacific, producing large quantities of crops, timber, vegetables, fruits and livestock for internal consumption and export.

The 1992 SOE report documented the impacts on the environment from agriculture in Fiji. These included the large scale clearing of the dry forest habitat, the movement of agriculture on to less-arable lands, and the introduction of biological control species, like the mongoose. All of these have put serious pressure on Fiji's biodiversity to this day.

Possibly the biggest difference between now and 1992 is the dominance of the service based economy in Fiji, compared to a resource based economy a generation ago. Since the last SOE, agriculture has declined significantly, and no longer dominates Fiji's economy. This is predominantly from the 40-60 percent drop in sugar cane and copra production, due to market competition and the expiration of land leases to cane farmers.

Of all the environmental issues in Fiji, the decline in agriculture has probably the furthest reaching implications on the environment including:

Food security and diversity: Most cane farms included small acreages of land set aside for the production of diverse local market fruits, vegetables and livestock, to feed farming families and communities. With these cane lands sitting fallow, these once productive micro-gardens are disappearing, along with the rich diversity of local produce and livestock.

Urbanisation: The decline of agriculture is also behind the growing urban/rural gap in incomes, which is precipitating a steady migration to the urban areas, putting pressure on urban resources. In particular, the spread of informal (squatter) settlements continues to increase. The typical poor waste and sewage management in those settlements is polluting urban creeks and rivers further.

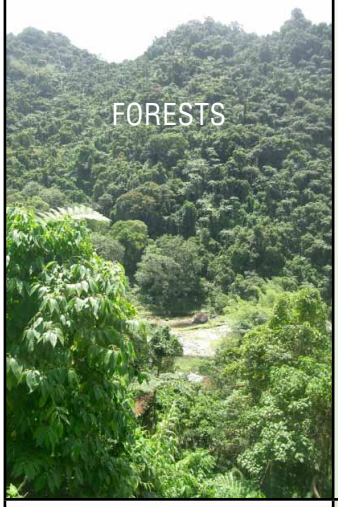
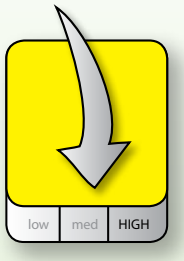
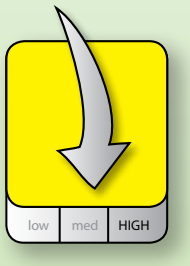
Conversion of the Natural Forest: Whole-scale clearing of the forest for agriculture on arable lands happened generations ago, but in recent decades there is evidence that small scale clearing of natural forest on steep, less arable slopes is happening at an alarming rate. Over 20% of the closed natural forest in 1991 has since been converted to open canopy forest.

Increased reliance on imported goods: As local food production declines, imports increase. This belies a wealthier Fiji, with better access to imports. However, with more imports, come more packaging and waste materials, materials that the current waste management regime in Fiji cannot adequately handle.

See the sections on agricultural cultivation, crop productivity and soil acidity, for more detail on the unique relationship between Fiji's terrestrial environment and agriculture.

Lowland Forest Canopy. Source: W. Forstreuter.

HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
	 **Status** Fair **Trend** Deteriorating **Data confidence** High	Closed natural forest has decreased by 14% between 1991 and 2007, converted into open forest through development and agricultural expansion onto steep slope natural areas. Mangrove areas declined by ~5% between 1991 and 2007, mostly in urban areas, which saw up to 40% decline in some places.	Strong, integrated forest management is key to improving the state of forests in Fiji. Despite many efforts and polices, conservation objectives are not being met due to a number of land use challenges and uncoordinated forest policies. Priority should be placed on establishing key mangrove and forested areas to ensure protection.
AGRICULTURAL LAND 	 **Status** Fair **Trend** Deteriorating **Data confidence** High	Cultivation of arable land has decreased by 60% between 1991 and 2009, largely due to the decline in cane sugar production, a traditional driver of both the agricultural economy and crop diversity. Soil acidity has also increased from fertilizer and pesticide use. Other commodities, such as dalo, livestock and fruits, are performing better. Despite the decrease in leased land agriculture, there is evidence that farmers are increasingly moving on to steep slopes not suited for agriculture. This is impacting both the natural forest, and overall soil health.	Fiji has several programs to reduce the impact of the decline of agriculture and diversify beyond cane farming. It also is investing in actions to mitigate soil erosion and acidification. Successful examples include the well-established supply of local fruit and vegetables to resorts. Farmer assistance programs are also in place to help farmers relocate and move into alternative farming (e.g. dairy). Further efforts are required to alleviate the impact of migrating farmers to squatter settlements or lands not suited for agriculture (e.g. steep slopes).

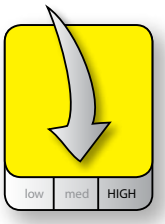
FORESTS: NATURAL (OPEN AND CLOSED) AND PLANTATION FORESTS

Fiji has a total land area of 1.827 million hectares of which 58% is covered with forests, consisting of 85.3% natural forests, 2.4% pine *(Pinus Carribaea)* plantations and 5.0% of mahogany *(Sweitenia macrophylla)* plantations (Dept of Forests, 2013)

Fiji's natural forests are dominated by lowland rainforests (78%), followed by upland rainforests (8%) with the remaining divided between mangroves, cloud forests, wetland vegetation and dry forest (Figure 1 and 2).

For this indicator, forest cover is divided into 4 general groups: Natural forests consisting of Open and Closed forests, and Plantations consisting of Pine, Hardwood and Coconut. 1991 and 2007 are the most reliable datasets for Fiji forest cover.

Open forests are defined as natural forest with crown cover by trees and / or ferns 10–40% and ground coverage by, palm and / or bamboo 50–80%. Closed forests are defined as natural forest with crown cover by trees and / or ferns 40–100% and ground coverage by, palm and / or bamboo over 20%. Closed forest includes the least impacted forest areas in Fiji in a near natural state as well as areas that have re-grown to near natural levels.



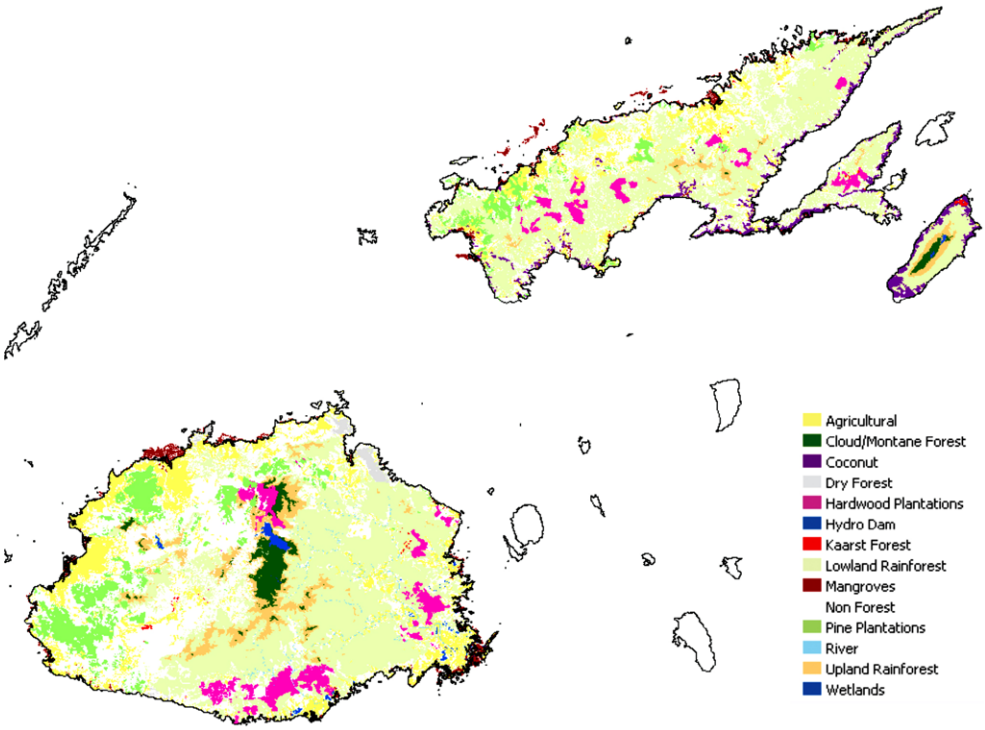
Status
Fair

Trend
Deteriorating

Data confidence
High

Status: Fair, Trend: Deteriorating, Confidence: High

Since 1991, Fiji's forest industry has transitioned from predominantly harvesting indigenous species, to plantation harvesting of pine and mahogany for export and local use (see Figure 24 in the Drivers and Pressures section). Despite a general decrease of commercial logging in native forests, between 1991 and 2007 closed forest cover still decreased ~7300 ha per year on average while open forest increased by ~8600 ha per year, as seen in Figure 3 and Table 1. Although the trend is deteriorating, the state is regarded as "fair" due to the fact that more than 50% of Fiji's land area still has natural intact forest.



Both pine (softwood) and hardwood plantations increased significantly with ~3000 ha and ~1600 ha added on average per year respectively, the major increase in the plantations being since the early 2000's. Coconut plantations decreased slightly by about 400 ha per year on average. Six principle causes of deforestation in Fiji are:

1. historical clearing of forest associated with a large-scale commercial (agriculture) rural development projects;

2. the continuing small but steady growth of smallholder agriculture involving mixed commercial and subsistence farming; 3) the continuing spread of small villages and settlements; 4) urban growth and infrastructure to service these areas (roads, dams, bridges, reservoir); 5) fire; and 6) poor logging practices followed by land clearance.

FIGURE 1: Land Use and Forest Cover Types of Fiji 2007. Source: National Trust Fiji.

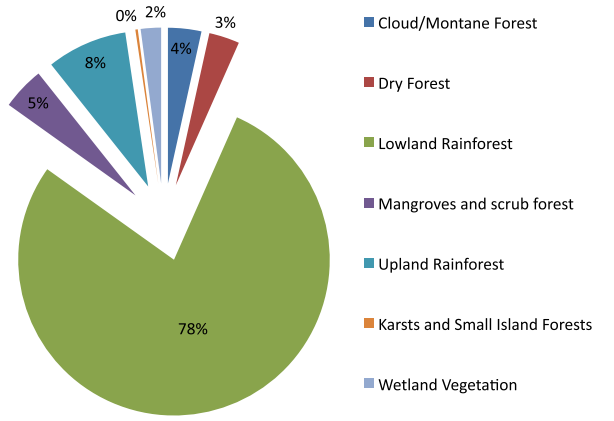


FIGURE 2: Percent of total natural forest (not plantation) in Fiji by ecosystem type, 2007. Source: National Trust Fiji, 2013.

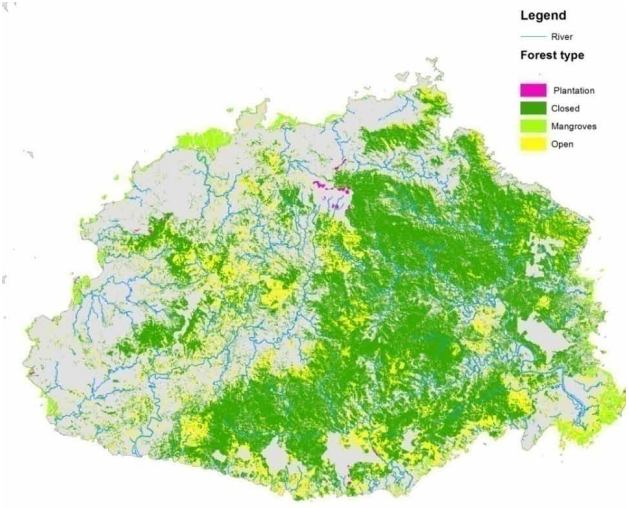


FIGURE 4: Open, Closed other forest types on Vitu Levu (1991). Source: SPREP.

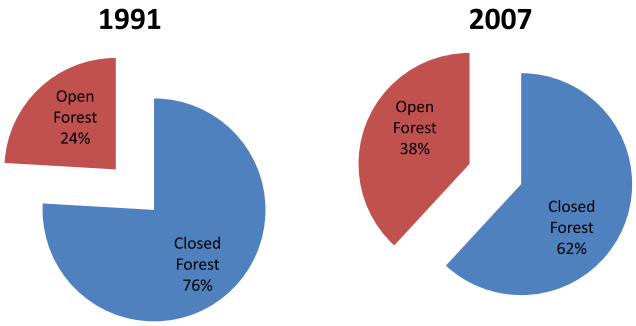


FIGURE 3: Natural forest cover types in Fiji by percent of total natural forest, 1991 and 2007. Source: FAO, 2010.

TABLE 1: Major Forest Cover types in Fiji by area, 1991 and 2007 (Source: FAO Estimation, 2010).

Forest Type	1991 Forest Hectares (1000's)	2007 Forest Hectares (1000's)
Closed Forest	704.856	587.791
Open Forest	223.53	362.198
Pine plantations	49.62	98.803
Hardwood plantations	39.22	63.860
Coconut plantations	34.56	28.669

Note: Plantation estimates are based on permit boundaries not observed growth, therefore may be smaller than estimates. Some plantation areas also may include natural forest.

IMPACTS

Fiji is losing more than the trees through land clearing. Exceeding sustainable harvesting of forest and trees leads to forest and land degradation. In addition, the "loss of forest is the single most destructive force destroying our biodiversity (Watling)". Forest loss impacts the environment through a host of pathways including: degraded water quality from poor logging practices, loss of shading, spread of freshwater invasives, marine environments, sediment deposition of coral reefs and the loss of important habitats for endemic plants and animals.

Unsustainable forest clearing impacts the economy too, short term gains from poor harvesting takes valuable resources out of the hands of future generations.

RESPONSE AND RECOMMENDATIONS

The Forestry Department addresses forest genetic conservation issues through its programs of ex-situ and in-situ conservation activities, and the establishment of forest conservation areas, in alignment with its national goals. These include Fiji's Forest Harvesting Code of Practice and Fiji's Forest Policy Statement, 2007. In addition, the Forest Decree of 1992 is currently being reviewed, to capture current business practices of the forest industry. The "Plant One Million Trees" initiative implemented from 2010 to 2011 resulted in over 1.4 million trees planted (Source, Dept of Forests)

Despite all these efforts, conservation objectives are still far from being realised due to a number of challenges; ranging from land and forest tenure systems to resources and technical capacities on the conservation of Fiji's forest genetic resources. In addition to addressing these challenges, strengthening of a number of key processes are vital which include the strengthening of necessary legal enforcement procedures, and the contribution of forest genetic resources to the broader national outcome areas such as health, food security, and poverty alleviation (Department of Forests, 2013).

SOURCES

FAO, Global Forest Resources Assessment 2010, Fiji Country Report, FRA Rome 2010

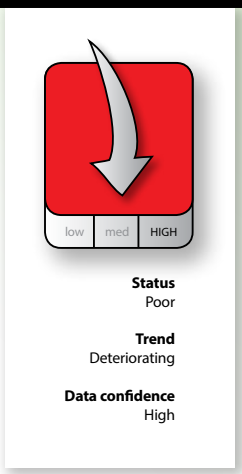
Fiji Department of Forests, Ministry of Forests and Secretariat of the Pacific Communities, *State of the Forest Genetic Resources in Fiji*, 2013.

National Trust of Fiji, 2013

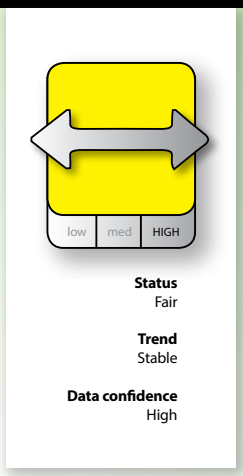
In Fiji, mangrove forests are found along estuaries, river banks and lagoons (see Figure 1) They are unique forests as they thrive in brackish water, oxygen deprived soils and can process a variety of toxins. They provide a unique biodiverse environment for many flora and fauna. They also provide valued protection and nutrients for near shore ecosystems like coral reefs and seagrass beds, and are major nursing areas for fish and birds.

Mangroves support people too, providing rich ecosystems for subsistence, materials for buildings, defending coastlines against winds and storm surges and cleaning polluted effluent from freshwater systems. In addition, they serve as large carbon sinks.

Area of mangroves over time across Fiji, was chosen as the indicator to determine the status of mangroves. Estimates were used based on remote sensing processing by SOPAC of 1991, 2001 and 2007 aerial and satellite images.



URBAN AND DEVELOPED AREAS STATE AND TREND FOR MANGROVES



RURAL AREAS STATE AND TREND FOR MANGROVES

Status: Poor to Fair **Trend: Mixed** **Confidence: High**

SOPAC (Forstreuter and Qioniwasa,2013) estimate that overall mangrove areas have decreased in size from 46,150 hectares in 1991 to 43,650 hectares in 2007 (see figure 2) a decrease of ~5%. Much of the loss was experienced between 1991 and 2001 (~2000 hectares) and slowed between 2001 and 2007.

Unlike rural areas, urban area mangroves are being reduced dramatically (see Figure 3). This is due to the expansion of urban areas (formal and informal), tourist development, creation of waste disposal sites and dredging material disposal. The analysis of satellite data suggests that between 1991 and 2007 the Suva Peninsula and Lami area (mapsheet O29) lost ~40% of its mangroves and the Korolevu/Sigatoka Coral Coast area (mapsheets L29 and M29) lost ~19% of their mangroves.

Recent developments around Suva (Jamestown and Lami) and Nadi (Denarau) suggests that the pace of mangrove destruction in urban areas is not slowing. In some instances, mangroves are cut down prior to development being approved or funded, resulting in vacant lots that have no biological or economic use. This, "cut first, plan later" policy is destroying Fiji's urban mangroves at an alarming rate.

Figure 4 shows aerial photos of one such area in Lautoka foreshore that reduced mangrove areas between 1991 and 2009.

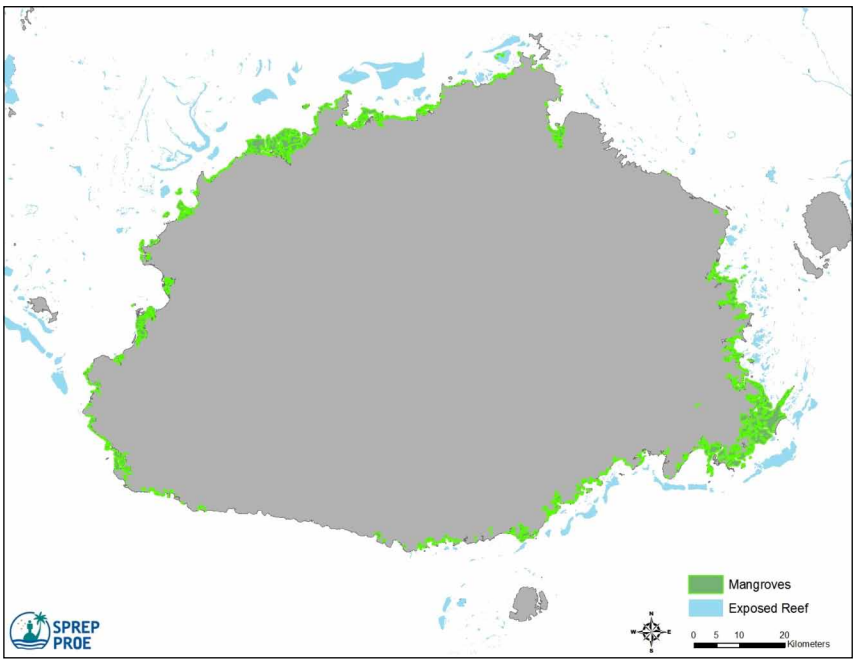


FIGURE 1: Major mangrove locations in Viti Levu Fiji, 2007. Aerial Photo Data from SOPAC.

IMPACTS

Mangroves are important ecosystems, supporting both the developed and natural world. Loss of mangroves reduces key fish and bird habitats, resulting in an economic loss to communities that rely on them. In addition, mangroves provide protection to shorelines against storm surges, and they can clean toxins from freshwater runoff.

Mangroves are a traditional source of fuel, shelter and medicines for communities in Fiji, so their destruction has cultural implications too. Additionally, the loss of mangroves is also a loss of a major carbon sequestration source for mitigating greenhouse gas emissions.

RESPONSE AND RECOMMENDATIONS

In 1985-6 a Mangrove Management Plan (MMP85) was prepared as a project of the South Pacific Commission, (now Secretariat of the Pacific Communities) with the Fiji Department of Fisheries. The Plan complemented the establishment of the Mangrove Management Committee (MMC) as an advisory committee to the Department of Lands (DoL), as the government agency responsible for foreshore as Crown/State Land (DOE, 2013)

Key findings suggest to date (DOE, 2013) that since 1993 (when the MMC was dissolved) the 1985 plan has not been used consistently to manage and protect mangrove areas, particularly in urban and peri-urban areas. The destruction of mangroves from dredge material dumping in 2011/2012 in Rewa and Labasa, highlighted in DOE/Watling 2013, provides further evidence that there is little effective management in place for protecting mangroves. The need for a review and revival in its use is recommended in numerous report,s and is incorporated in certain sectoral policies (i.e. Fiji Forest Policy Statement, 2007).

The Fiji Mangrove Management Plan (DOE 2013), is being updated and finalized based on the 1985 Mangrove Management Plan and lessons learned since then. Priority should be placed on establishing key mangrove areas in urban and peri-urban areas for protection, and ensuring that future development involving mangrove destruction is processed through a consultative advisory body.

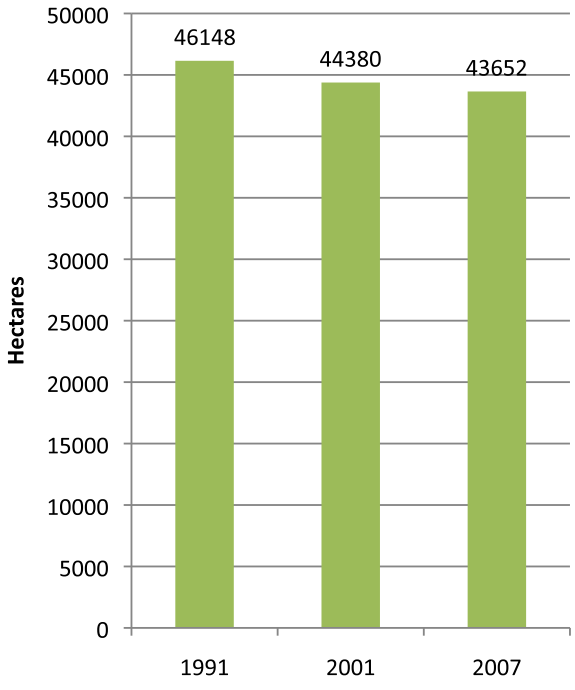


FIGURE 2: Total mangrove areas in Fiji 1991–2007. Source: SOPAC, 2013.

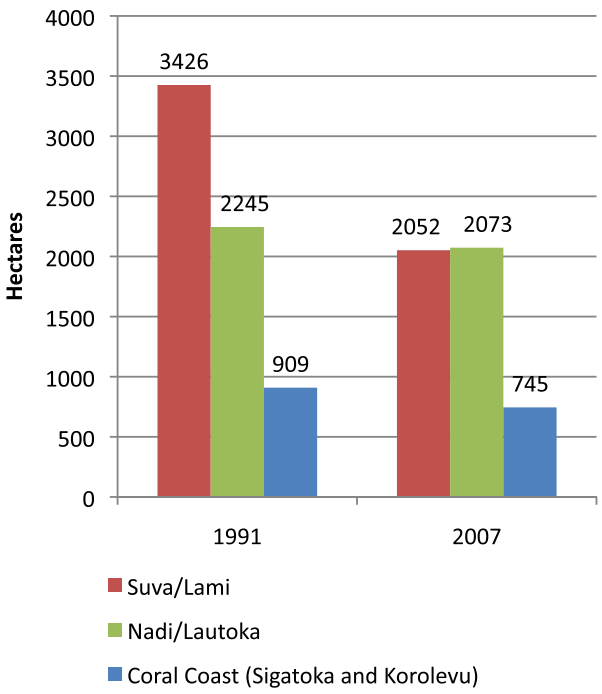


FIGURE 3: Mangrove loss in key developed areas 1991-2007 Based on SOPAC mapsheet areas. Source: SOPAC, 2013.

FIGURE 4: Lautoka Foreshore: 2009 (above) and 1991 (below). Areas of change circed in blue. Source: Department of Lands.

Mangrove destruction for the Jamestown Development, Lami. Photo: Paul Anderson, SPREP.

Mangrove fatality in the Rewa Delta following dumped dredge materials in 2011. Source: Watling/DOE 2013, Google Earth.

Mangroves at Nasoata, Rewa.
Photo: Randy Thaman.

SOURCES

Applied Geoscience and Technology Department (SOPAC) analysis of 1991, 2001 and 2007 satellite imagery data.

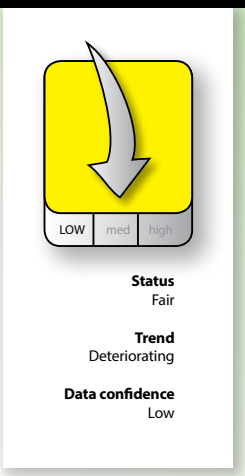
Department of Environment/ Dick Watling: Draft Mangrove Management for Fiji, 2013.

Fiji Forest Policy, 2007.

Soils in Fiji are largely volcanic and prone to high rainfall, both of which lead to naturally high acidity, affecting plant growth and reducing production. Soils in areas of high rainfall are also prone to loss of essential nutrients. These soils, in turn, require greater application of fertilizers which can increase soil acidity beyond natural levels. In addition, prolonged pesticide use also increases acidity in soils.

Soil acidity is a good indicator of overall soil health, and can determine the impacts of intensive farming practices on the health of the land.

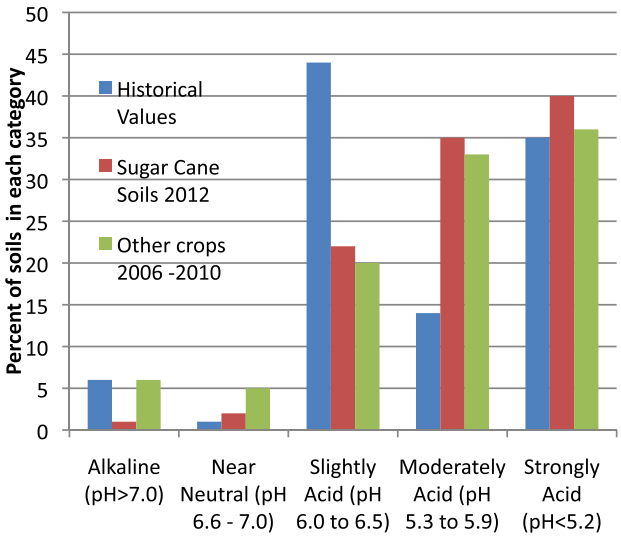
Changes in soil acidity in Fiji were analysed by the Market Development Agency for Fiji, by comparing soil pH from historical surveys performed across Fiji from 1980 to 1994, to recent soil surveys (2006 to present) from the same agricultural areas.



Status: Fair Trend: Deteriorating Confidence: Medium

Figure 2 shows soil maps created from historical (1980s) soil profile datasets, and the pH of soils based on sampling and known soil profiles. Results from successive sampling 2006–2012 on all agricultural class areas were compared to the historical pH values in Figure 1.

Results show that cropping has increased the level of soil acidity, primarily by increasing the percentage of soils from the slightly acidic category into the moderately acidic category by ~20%. The change is slightly higher for sugar cane crops compared to other crops.



	Historical Values	Sugar Cane Soils 2012	Other crops 2006–2010
Alkaline (pH>7.0)	6	1	6
Near Neutral (pH 6.6 – 7.0)	1	2	5
Slightly Acid (pH 6.0 to 6.5)	44	22	20
Moderately Acid (pH 5.3 to 5.9)	14	35	33
Strongly Acid (pH<5.2)	35	40	36

FIGURE 1: Changes in soil acidity between historical (1980–1994) soil values and current soil testing values across Fiji. Figure adapted from MDF Aglime for Fiji.

Cropping in Fiji. Source: MAFF.

IMPACTS TO FIJI

Acidic soils are costly to farmers and result in lower production, abandoning of arable land for less arable land and expensive fertilizer use. Nutrients washed out of soils from excessive fertilizer use, can impact marine and freshwater quality. Usage of fertilizer continues to increase acidity, which in turn reduces productivity, increasing the need for more fertilizer.

RESPONSE

Fiji's Response to Reducing Acidic Soils and Fertilizer Dependence

The Ministry of Agriculture, Forests and Fisheries (MAFF) has been promoting the use of agricultural lime, in addition to using organic fertilizers, blood, bone and fish meal and intercropping with nitrogen fixing plants, which reduces the need for fertilizer and decreases acidity. With the aid of the Market Development Facility of AusAid, Fiji has since launched local commercial production of agricultural lime in Fiji. MAFF is currently working with farmers to encourage use of lime as a long term cost saving tool, as lime offsets the costs of fertilizers and reduces the need for them.

The MAFF research division is working on trial sites for application of agricultural lime in the North (Taro crops), Central (Dairy), and West (Sugar cane) divisions to identify appropriate application rates for specific crops and soils.

MAFF does regulate pesticide types for farmers and the Department of Environment regulates application rates.

While there is a land use policy that guides users on cultivation on land types, it lacks compliance and enforcement. Teaching community control methods such as hedgerows and other erosion control methods is an important part of the implementation of the land use policy.

SOURCES

Aglime for Fiji, Prepared by the Market Development Agency for Fiji, 2013.

MAFF – Market Watch Newsletter – June 2012.

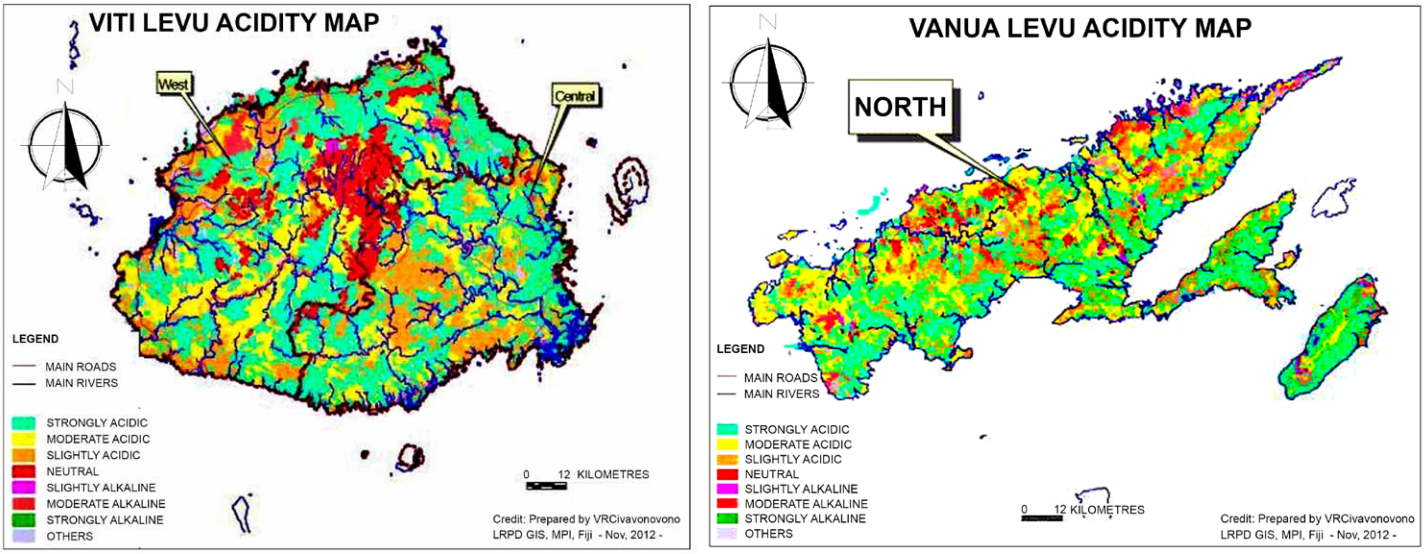


FIGURE 2: Historical soil acidity based on historical soil mapping and sampling, 1980–1984. Source: MDF, 2013.

AGRICULTURE LAND UNDER CULTIVATION

Fiji has a total area of 18,400km^2 and 16% is suitable for farming, and a further 43% could be used for tree crops and grazing. These areas are found mainly along coastal plains, river deltas and valleys of the 2 main islands of Viti Levu and Vanua Levu. The rest is found in the smaller outlying islands of the group.

Currently about 14% of Fiji's land base is used in agricultural activity (MAFF, 2009). For this report, total land area that has agricultural activity was used to measure of the prevalence of agriculture in Fiji, past and present. All data comparisons are taken by comparing results of Fiji's Agricultural Census in 1991 and 2009.

The unit of activity used in the census to determine agricultural activity was defined as the "Farm", which is any place that raises or produces any agricultural products for sale or home consumption.

Vegetable cropping near Sigatoka. Source: MDF Aglime for Fiji, 2013.

Status
Fair

Trend
Deteriorating

Data confidence
High

Status: Fair Trend: Deteriorating Confidence: Medium

The area of land under farming has declined significantly from 1991 to 2009, from ~32% of total land in 1991 to 14% in 2009. Figures 1, 2 and 3 show the data on various aspects of the decline.

Figure 1 shows that farm areas under land leases, in particular NLTB leases and Mataqali ownership, dramatically reduced from ~216,000 ha and 190,000 ha in respectively 1991 to ~ 79,000 and 89,000 in 2009 respectively. This is one key cause of the agricultural decline.

Figure 2 shows that the areas with the most decline were cane farming areas. In addition, figure 3 shows that the two prominent commodities behind the decline in agricultural land use, were copra and sugar cane. Based on area planted, sugarcane and copra production have declined from 1991 to 2009 by about 50% and 70% respectively. In 1991, sugar cane was the most dominant crop in Fiji's agriculture industry in terms of foreign exchange earnings, and number of people employed in the industry. Sugarcane decline has largely been driven by expiry of land leases. Conversely, copra was the second major traditional export earner, and based mainly around the estates in the province of Cakaudrove, but has since declined due to decreased market demand.

In addition to the expiry of land leases, the decline in agriculture can also be attributed in part to;

1) the clearing of land for residential and industrial developments, 2) high transportation costs, 3) low yield, or low profitability due to unfavourable market prices and labour costs,4) consequence of natural disasters (cyclones, flooding and droughts) and 5) a generational loss of interest in practicing agriculture.

IMPACTS TO FIJI

Cane crop areas traditionally had diverse subsistence products grown on them, so a reduction in cane farming means a reduction in the local farming market economy and diversity of products. Copra is integrated with dalo and yaqona, and rice is also heavily integrated with cane farms (1 acre per farm often set aside for rice and livestock).

In addition, a reduction in active agricutural land puts pressures on other areas lands, as farmers from expried leases move to cities or onto poor quality lands (e.g. steep slopes). Finally, a dcline in agriculture is often associated with a larger reliance on imports, reducing the overall food security of the country.

RESPONSE AND RECOMMENDATIONS

What is Fiji's response to the decline in agriculture?

The new Land and Water Resource Management Decree is expected to provide some authority for the implementation of the land use policy. This policy will ensure that land users and developers will adhere to the requirements of the respective legislation under which their activities fall, and at the same time exercise greater precaution on land degradation activities.

Fiji is also seeking to find foundational commodities that can substitute for the decline in cane sugar.

Programs to address agricultural declines in Fiji include:

1. Government and industry Farming Assistance Scheme (FAS) For existing cane farmers, where the government helps to relocate farmers to alternative crops outside of cane.
2. The Land Bank Scheme that identifies land that can be used for farming, and interested farmers apply through the Land Bank.
3. The Organization of farmers (Fiji CROP and Livestock council) and an umbrella council that address issues, and informs policy and 4) The DDA (Demand Driven Approach) program which targets micro and medium size farming enterprises where 2/3 assistance offered. It also provides import substitution programs where farmers can move to dairy production from other agricultural activities that are struggling.

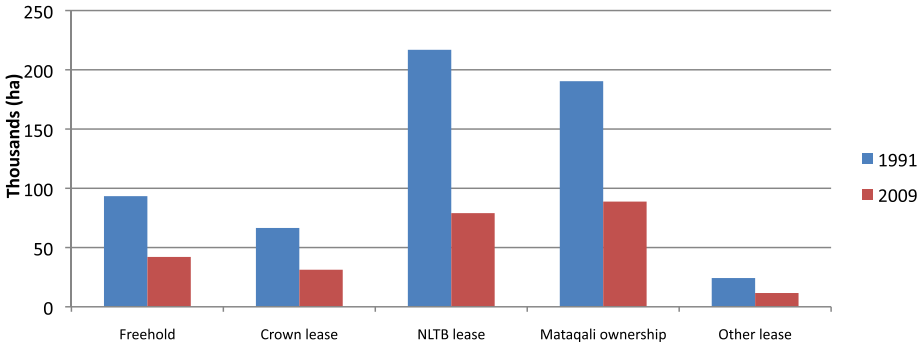


FIGURE 1: Land Tenure for Agricultural Land 1991 and 2009. Source: MAFF National Agricultural Census 1991 and 2009.

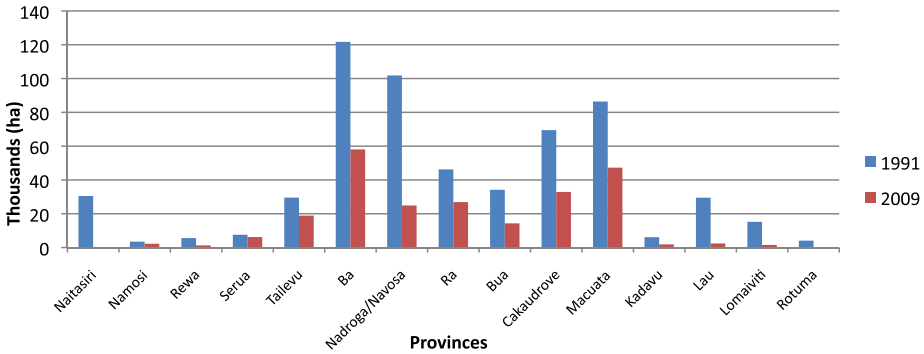


FIGURE 2: Farm areas per province in Fiji, 1991 and 2009. Source: MAFF National Agricultural Census 1991 and 2009.

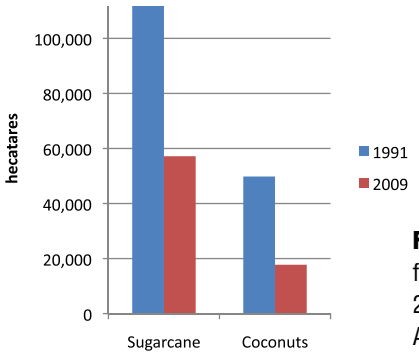


FIGURE 3: Land under cultivation for Copra and Sugarcane, 1991–2009. Source: MAFF National Agricultural Census 1991 and 2009.

SOURCES

Department of Agriculture, Economic Planning and Statistics Division. 2012. *Report on the Fiji National Agricultural Census 2009.*

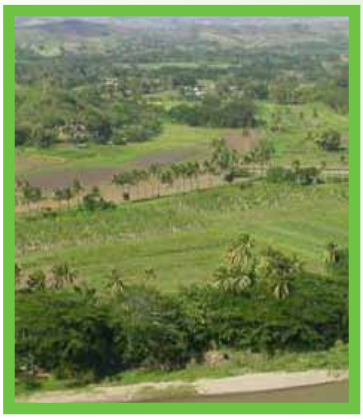
Otanez, G., Narayan, D. and Tubuna, S. Ministry of Primary Industries and Co-operatives, Agricultural Planning and Statistics Division, Statistics Unit, 1992. *Fiji National Agricultural Census 1991.*

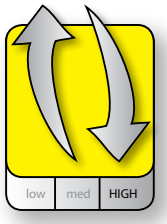
AGRICULTURE TRADITIONAL CROPS, FRUITS AND VEGETABLE VARIETIES

The variety of agricultural production reflects the condition and state of Fiji's terrestrial land resources. It also indicates society's connection to traditional culture in Fiji. Traditional crops are grown throughout Fiji and represent a "hidden strength" of the economy.

The variety of products can be determined by many variables including, soil and land characteristics, external and internal market demands and changing diets.

This indicator focuses on area cultivated for production of key traditional crops in Fiji, that have been grown for at least the past 100 years in Fiji. These crops include; cane sugar (introduced in the 1800's), coconuts, dalo, cassava, yaquona and traditional fruits like papaya and bananas.





Status
Fair

Trend
Mixed

Data confidence
High

Status: Fair Trend: Mixed Data Confidence: High

The general trend for traditional crop varieties in Fiji is that major permanent crops such as sugarcane and copra are decreasing, largely due to expiration of land leases and changing market demands/prices (see figure 1). However, fruits and vegetable areas see a mixed trend. The increasing fruit and vegetables such as watermelon, pineapple and paw-paw are likely tied to the increase in tourist demand for fresh fruit and particular vegetables (see Figure 2). Likewise, dalo and cassava, still an important part of the Fijian diet, are stable. Crops, such as rice, maize, sweet potatoes and cabbage are decreasing and may be tied to the decline gardens attached to sugarcane plantations (see Figure 3).

Sigatoka Valley (Salad Bowl of Fiji) supplies fruits and vegetables to resorts. Source: Timoci Gaunavinaka.

IMPACTS TO FIJI

A diversified agricultural industry enhances food security, provides healthier food sources, supplements cash incomes and supports livelihoods. In addition, there are clear connections to traditional culture that are lost when traditional foods disappear from the diet of a society.

RESPONSE AND RECOMMENDATIONS

What is Fiji doing to improve the production and conservation of traditional crop and vegetable varieties?

Fiji's Koronivia Research station helps to preserve traditional varieties of major crops to ensure viability of currently uncommon species.

Fiji is also putting in place a number of reform processes in agriculture that acknowledges and provides for diversity of agricultural systems, especially in developing island economies, these include:

- Seeking viable options for other commodities to replace cane (example fruits and vegetables)
- Using the Demand Driven Approach to identify specific commodities (okra, eggplant, ginger, pawpaw) for export.
- Declaring organic fruit and vegetable production in certain areas (Eastern District – e.g. Cicia Island) to meet demand for organic goods (example organic ginger in Wakaya Island).

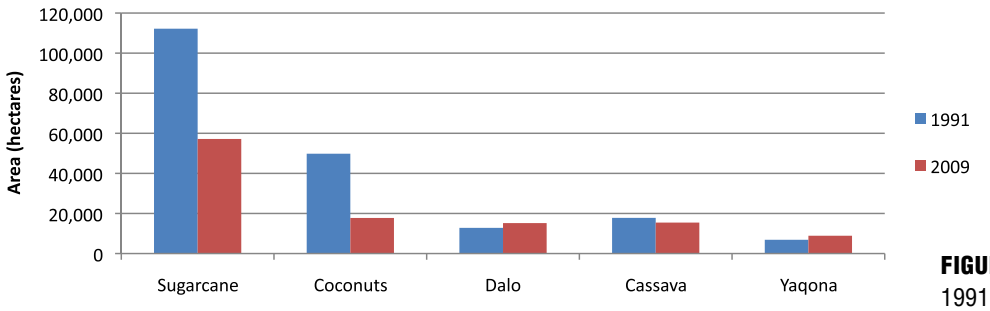


FIGURE 1: Main traditional crops planted, 1991 and 2009 for all Fiji. Source: MAFF National Agricultural Census 1991 and 2009.

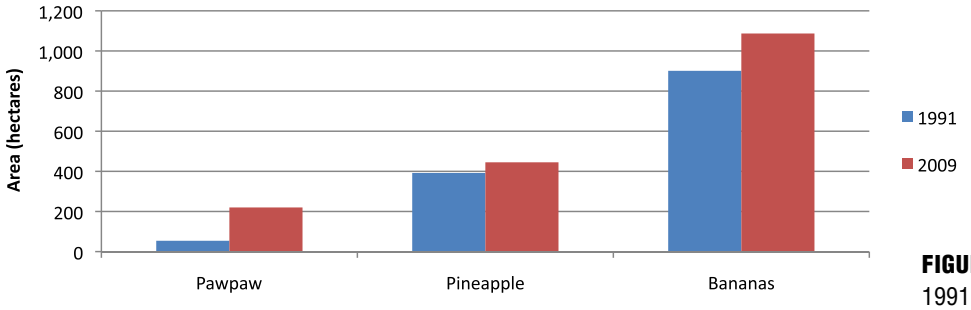


FIGURE 2: Main traditional fruits planted, 1991 and 2009 for all Fiji. Source: MAFF National Agricultural Census 1991 and 2009.

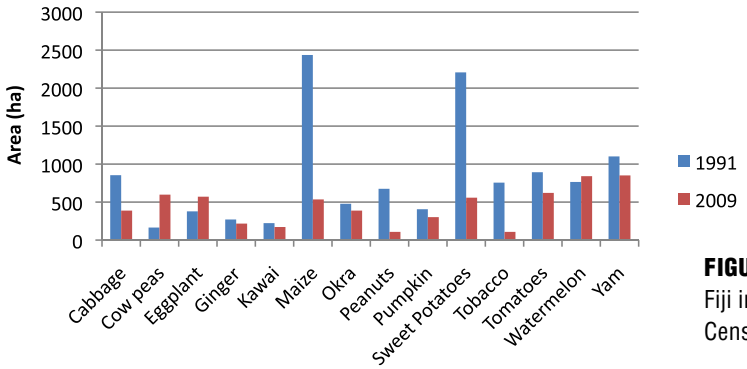
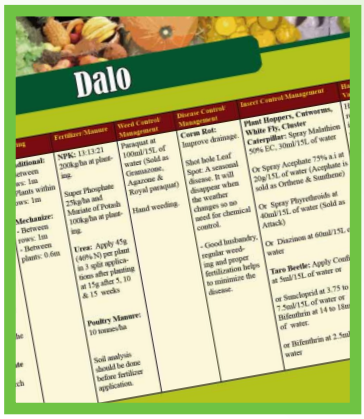
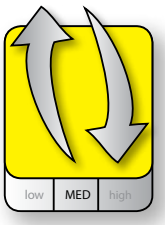


FIGURE 3: Assorted fruit and vegetable varieties planted across Fiji in 1991 and 2009. Source: MAFF National Agricultural Census 1991 and 2009.

AGRICULTURE PRODUCTIVITY – GINGER AND DALO

Land productivity indicates the health (including soil) of the land utilized by agricultural activity, as well as the quality of production (e.g. crop practices). Two key agricultural crops that highlight land productivity in Fiji are taro (dalo) and ginger. Ginger production is mainly in the Central Division of the main island Viti Levu [Naitasiri & Navua] and is slowly extending to the Ra Province. Dalo is grown throughout Fiji but is most concentrated in the Eastern, Northern and Central Divisions.





Status
Fair

Trend
Mixed

Data confidence
Medium

Status: Fair **Trend: Mixed** **Confidence: Medium**

Figure 1 shows total dalo production since 2000. The productivity for dalo increased from ~3.0 tonnes/ha in 1991 to 3.7tonnes/ha in 2009 (MAFF, 2012) This is partially the result from the Demand Driven Approach programmes set up by the government, to assist farmers in their production, as well as the local demand and the availability of the export market.

Figure 2 shows that ginger has generally declined since 2000 and productivity declined from ~11.2 tonnes/ha in 1991 to a low of 8.96ton/ha in 2009. Decline in ginger is largely due to heavy losses from nematode and bacteria wilt disease, rhizome rot disease, unfavourable topography with heavily leached acidic soil, post harvest losses due to breakage and poor quality seeds.

Ginger processing in Fiji. Source: SPC.

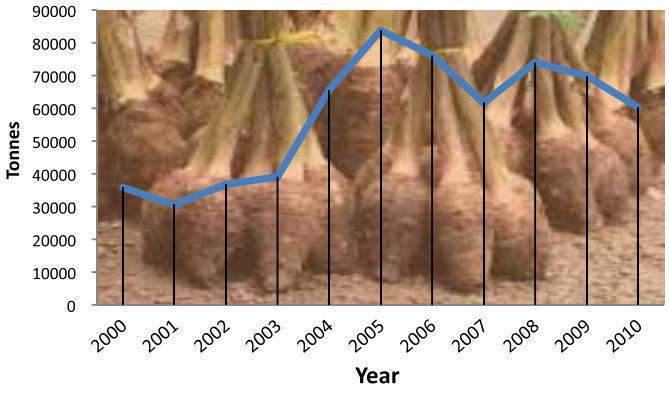


FIGURE 1: Dalo production in Fiji 2000–2010. Source: MAFF.

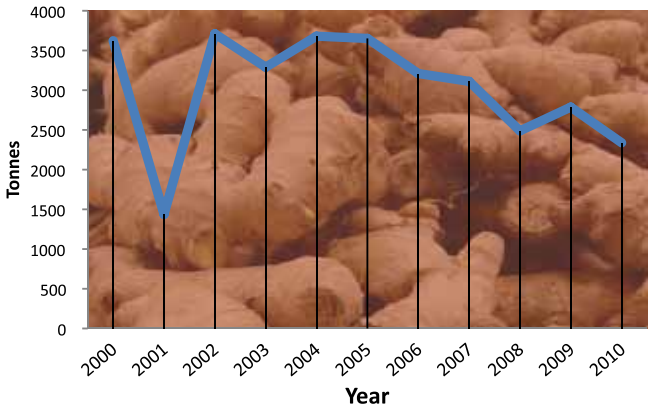


FIGURE 2: Ginger production in Fiji 2000–2010. Source: MAFF.

IMPACTS TO FIJI

Land productivity has many implications for society including impacts to food security, poverty and vulnerability to climate change. A diversified and productive agricultural sector is less vulnerable to economic, social and environmental changes.

Poor productivity can impact use of the land through the cultivation of land beyond its capability, and the expansion to less arable lands, such as steep forested slopes.

RESPONSE AND RECOMMENDATIONS

What is Fiji doing to improve the productivity of land?

Productivity can be improved by good farming practices, including crop rotations, use of organic fertilizers, and intercropping with permanent crops like copra. These and other practices are promoted through educational crop guides distributed by the Ministry of Agriculture, Fisheries and Forests (MAFF).

Through the Rural and Outer Islands Project (ROI), Alternative Livelihood Project (ALP), the United Nations Convention to Combat Desertification (UNCCD) and related rural development projects such as the Land Care Concept, Fiji is working to build the capacity of rural communities, diversify agriculture to higher value crops, increase processing opportunities and value added production of ginger and other commodities.

The Fiji government has also introduced agricultural tax incentives, improving accessibility to saving and credit facilities and developed microfinance institutions for famers. In addition, new training opportunities and infrastructure are being developed for farmers to improve on and off farm livelihoods.

Fiji has also established commodity protocols and agreements with new and existing markets (China, Australia, New Zealand, EU, USA, Japan) and promoted formation of industry councils to spearhead/coordinate commodity development.

Dalo crop guide. Source: Ministry of Ariculture, Fisheries and Forests.

SOURCES

MAFF, Department of Agriculture, Economic Planning and Statistics Division. 2012. *Report on the Fiji National Agricultural Census 2009.*

Otanez, G., Narayan, D. and Tubuna, S., Agricultural Planning and Statistics Division, Statistics Unit, 1992. *Fiji National Agricultural Census 1991.*

THE RESILIENCE (AND VULNERABILITY) OF THE MARINE ENVIRONMENT

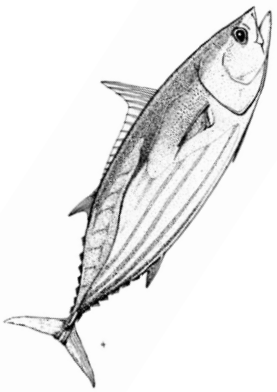
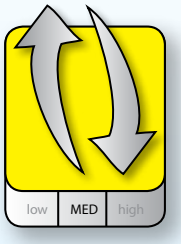
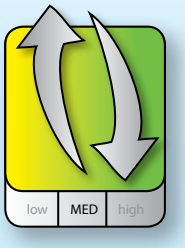
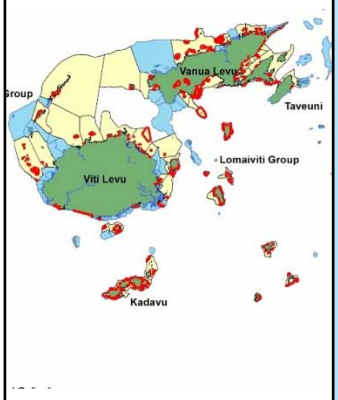
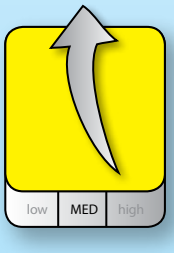
Overall, the marine environment in Fiji is faring better than the terrestrial environment. This is mainly due to Fiji's immense coastal area with a natural abundance of marine resources, that is comparable to the biodiversity of the Coral Triangle. In addition, Fiji's corals, despite having undergone bleaching and die-back in the late 1990's, have largely recovered to their original state and appear stable. Fiji's marine managed areas, underpinned by the traditional qoliqoli system, are also responsible for helping to protect and manage local fisheries to some degree.

Despite this, a number of issues remain, in particular the unchecked exploitation of inshore reef fish and invertebrates, and pelagic species like sharks. The exploitation of Beche-de-mer (sea cucumber) harvest was highlighted in the 1992 SOE report, and appears to be a having a serious impact on populations as shown by the past decade of monitoring. Furthermore, subsistence inshore fishers have increasing access to power boats, and can now fish areas that were previously inaccessible. Subsistence fishing as it stands now, unchecked and unlicensed, is likely unsustainable.

Finally, the shark fin industry is unsustainable at any level, in light of the rapid decline in shark populations worldwide. Although Fiji's tuna industry continues to catch a significant proportion of sharks as bycatch in their total harvest (10-15%), it is evident that the shark fin industry is becoming a singular commercial entity, with conservative estimates that the dedicated shark harvest is far outstripping tuna bycatch harvest numbers.

Fiji sunset: Photo: Wolf Forstreuter.

HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
OFFSHORE MARINE ENVIRONMENT 	 **Status** Fair **Trend** Mixed **Data confidence** Medium	Offshore tuna catch increased from 1997 to 2006, but has since decreased due to restrictions on catch to ensure sustainable tuna harvest. Unsustainable shark harvest remains a concern. Between 2002 and 2011 shark species averaged 10 to 15% of the total offshore tuna catch, and an analysis of shark fin exports reveals that there is a dedicated shark fin harvest.	Efforts are in place to make the offshore fishery more sustainable and protect deepwater species. These include improved monitoring, limits on tuna harvest, and the development of an Offshore Fisheries Management Decree to modernize laws. However, more oversight is required, particularly in the harvest of shark species and the subsistence pelagic fishery.
INSHORE MARINE ENVIRONMENT 	 **Status** Good to Fair **Trend** Mixed **Data confidence** High	Monitoring of live coral cover, fish biomass and diversity suggest that overall, the inshore environment is in a good state with stable trends. Inshore fishing pressure, however, remains high, particularly unregulated subsistence fishing in certain areas. Certain inshore products, such as beche-de-mere (sea cucumber) appear substantially overfished.	Major recommendations for the FLMMA network to improve and maintain the progress that has been made, include: setting optimal minimum size of Tabu areas, improving monitoring of FLMMA sites and ensuring that modernized fishing regulations incorporate and build on the FLMMA model.
MARINE MANAGED AREAS 	 **Status** Fair **Trend** Improving **Data confidence** High	Fiji's Locally Managed Marine Areas (FLMMA) are largely a model of success across the Pacific and have resulted in the recovery of fish and invertebrate stocks in several areas in Fiji. Issues with external poaching and siting of the tabu areas remain a concern but the trend is generally improving.	Fiji's response to date includes a commitment to conserve 30% of the benthic marine environment through the FLMMA network, establishing quotas on the aquarium trade and developing the Inshore Fishing Decree to modernize inshore fishing laws. Recommendations include, developing marine protected areas, regulating live rock harvest and taking action on beche-de-mere harvest.

OFFSHORE MARINE ENVIRONMENT TUNA, SHARKS AND TUNA-LIKE SPECIES HARVESTED

Offshore fisheries production, reported in metric tonnes, is an important indicator of pelagic (deepwater) fish stock health. It provides a measure of the state of fisheries and management outside of the reef. This indicator is a fundamental data type for most fisheries and is available in Fiji and the wider Pacific region.

In Fiji, offshore fisheries consist almost exclusively of long lining for tuna for both local and foreign markets. This is the main source of official revenue for Fiji's fishing industry, and it is largely dominated by domestic fleets. The main commercial species include; albacore (*Thunnus alalunga)*, skipjack (*Katsuwonus pelamis)*, yellowfin (*Thunnus albacores)* and big eye (*Thunnus obesus*). Other pelagic fish caught include sharks (for meat and the lucrative shark fin market), marlin, wahoo, barracuda, dolphin fish and mahi-mahi.

Fiji has considerable marine resources, accounting for approximately 3% of Fiji's GDP and 8% of all exports in 2012. While Fiji has 18,376 square kilometres land its Exclusive Economic Zone (EEZ) is approximately 1.3 million square kilometres (see Figure 1).

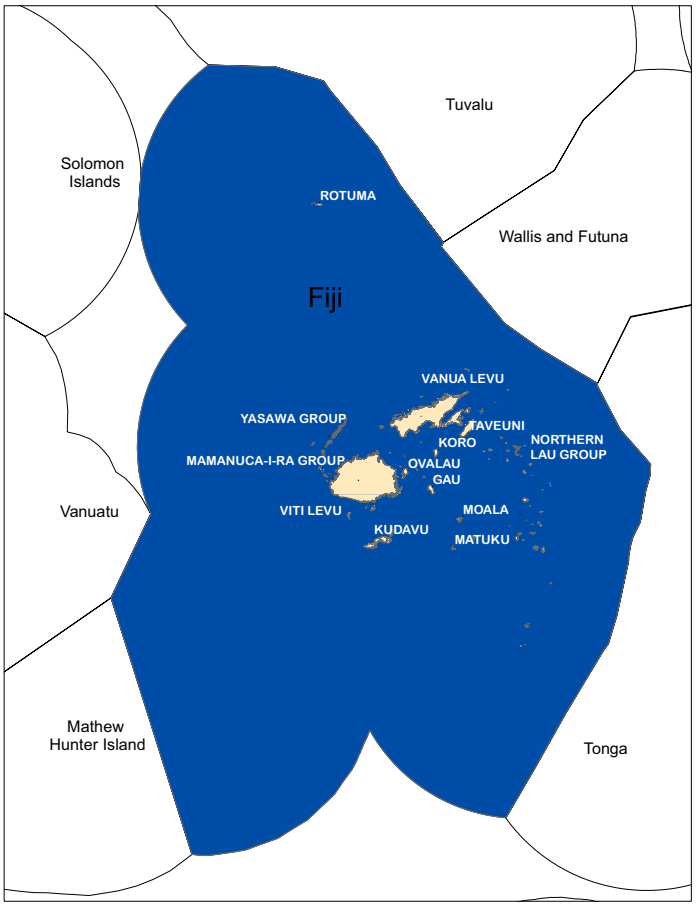
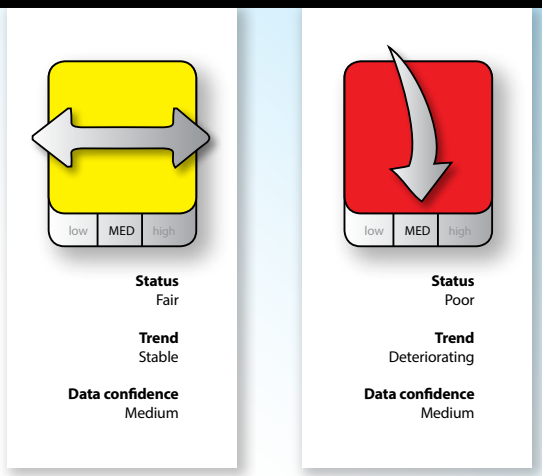


FIGURE 1: Fiji's EEZ. Source: SPREP.



Status: *Tuna and tuna like species*: Fair and stable
***Sharks*: Poor and deteriorating Confidence: Medium**

The 2012 "Status and Management of Tuna Fishes in the Western and Central Pacific Ocean" reports that Tuna fisheries in Fiji are mostly in good condition, and within maximum sustained yields. Most offshore catch in Fiji is tuna, primarily Albacore, which makes up over 70% of the total tuna catch.

Offshore catch increased from 1997 to 2006, but has since decreased due to a countrywide reduction on the maximum offshore licences cap from 110 to 70 (maximum allowable catch of 15,000 tonnes) in an effort to ensure sustainable tuna harvest. The tuna industry is likely now fully developed. There is an increased market for skipjack tuna and other species (swordfish) so the danger of unsustainable harvest still exists.

Harvest of pelagic sharks is a particular concern. Between 2002 and 2011 bycatch (non-targeted fish caught during harvest) of shark species and averaged 1300 tonnes per year, around 10–15% of the total catch of offshore fish (see Figure 3).

Fiji's export of shark fins to Hong Kong (both dry and wet) is shown in Figure 4. The price per kg of fins rose steeply in recent years, and in 2010 over 8 million FJD was earned from shark fin exports alone. The numbers also show that there is a dedicated shark harvest in Fiji, beyond incidental bycatch from Tuna fishing (see Figure 5). Based on SPC fishery observer data, data on fin to body ratios, and exported fin numbers, approximately 1/4 to 1/2 of the bycatch makes up for the sharks caught for fins (MAFF, 2011, Thomson, 2006, Biery, 2012). Over the last five years the taking of sharks, both as incidental catch and as a target catch within Fiji's archipelagic waters, territorial seas and economic exclusive zone (EEZ) is increasing to unsustainable levels, exacerbated by the recent development and introduction of mini long-line operations within inshore lagoons and barrier reef systems adjoining or in close proximity to the island groups (MAFF, 2011).

IMPACT

The predominant impacts for overfishing are both economic and biological. Unsustainable fishing leads to collapse in key stocks, so management and control is crucial to support the livelihoods of both commercial and artisanal fishers. Additionally, the removal of key biological species like sharks that maintain the trophic balance, can have wide-reaching impacts to the inshore and offshore ecosystems.

Shark harvesting in Fiji is predominantly of silky, hammerhead, white-tip and blue sharks (Thomson, 2006) all of which are classified by IUCN as near-threatened. Shark populations are extremely vulnerable to overfishing because sharks grow very slowly, and have a much lower capacity to reproduce than other bony fish species (MAFF, 2011)

RESPONSE

Fiji has undertaken several actions to improve management and protection of offshore fish stocks. These include:

- Membership of Fiji's National Albacore fishery into the Marine Stewardship Council.
- Capping of offshore fishing lisences to 70 and a yearly maximum sustainable harvest limit of 15,000 tonnes.
- Increased observer placements from 42 in 2005 to 62 in 2011 to ensure better monitoring of offshore fishing vessels (MAFF, 2011).
- International and regional regulations, treaties and policies such as CITES, CBD and CMS have helped set limits on shark bycatch.
- A new Offshore Fisheries Management Decree was promulgated in 2012 to modernize national laws and regulations governing the offshore fisheries sector.

RECOMMENDATIONS

Despite these efforts, more control and oversight is required, particularly over the harvest of shark species and management of the subsistence pelagic fishery. A full ban or strict limits to shark or shark-part harvesting should be developed soon, to manage the increasing pressure on shark populations in Fiji; especially given that shark fin prices are rising rapidly.

Offloading tuna at the Fiji fish factory outlet. Source: WWF.

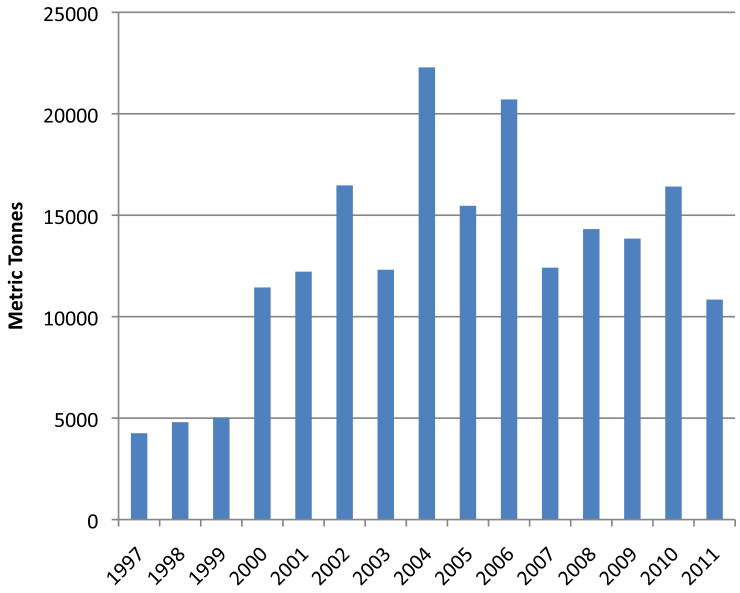


FIGURE 2: Estimates of Total Offshore Fish (Tuna, Bycatch and Other species) Caught in Fiji Waters 1997–2011. Source: ABD, 2005, Gillet, 2009 and MAFF, 2011.

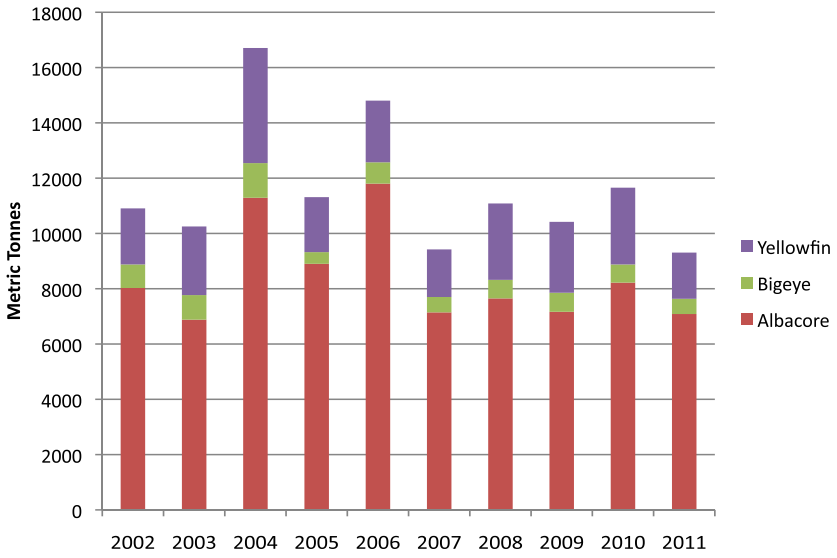


FIGURE 3: Tuna Species harvested from Fiji waters 2002–2011. Source: MAFF, 2011.

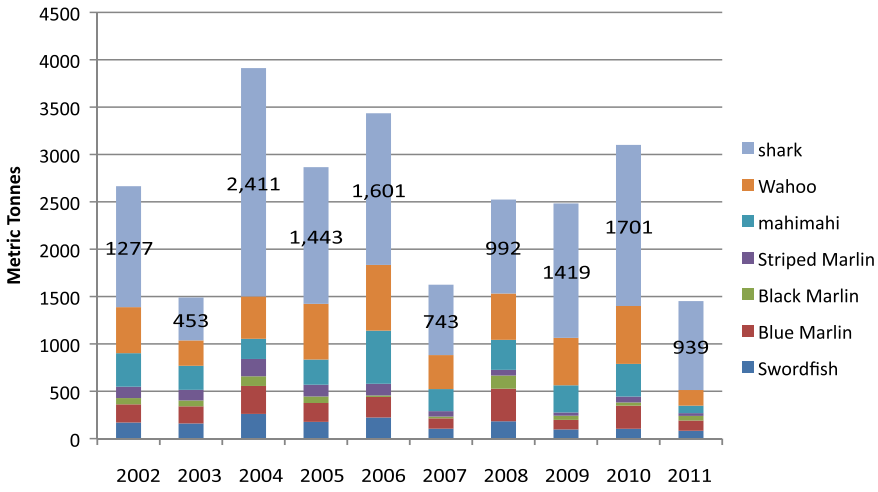


FIGURE 4: Other Offshore species harvested from Fiji waters 2002–2011, shark bycatch tonnes labelled. Source: MAFF, 2011.

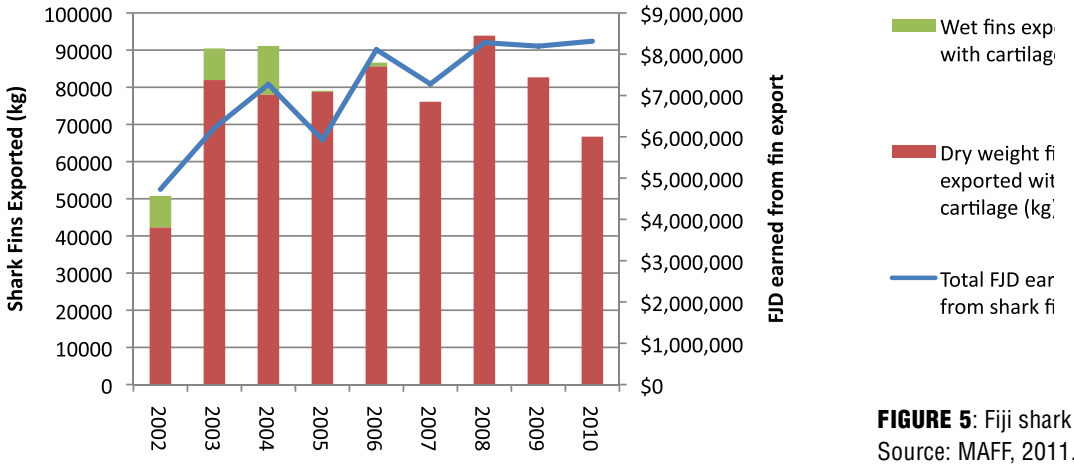


FIGURE 5: Fiji shark fin exports to Hong Kong. Source: MAFF, 2011.

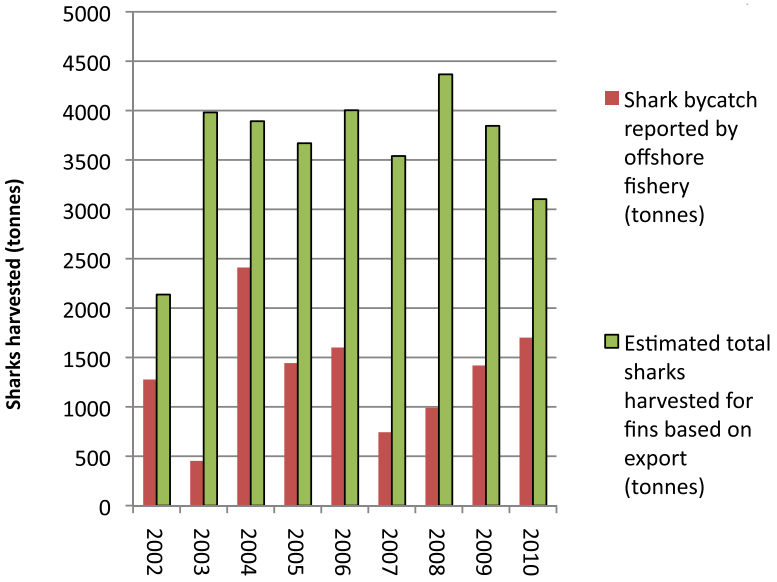


FIGURE 6: Shark bycatch reported by offshore fishers compared with reconstructed whole shark weights from fin export numbers. Average wet weight fin to whole body =5%, (based on average for blue, silky and white-tip sharks) dry weight to wet weight conversion = 0.48%. Source: MAFF, 2011 for fin exports and bycatch, Biery, 2012 for fin/body and wet dry ratios.

Black-tip shark. Photo: Helen Sykes.

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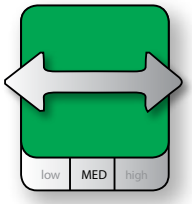
INSHORE MARINE ENVIRONMENT PERCENT LIVE CORAL COVER

Live coral reef cover is a significant indicator of the overall state of the inshore ecosystem in Fiji. For this indicator, live coral cover is defined as area covered with living hard coral, either in mono species or multi species colonies.

Coral cover provides a measure of land-use impacts and subsequent erosion, fishing pressure, relative sea surface temperature (SST), presence of disease and predators like the crown of thorns starfish, and mechanical damage from anthropogenic sources or natural phenomena like cyclones. This indicator is a fundamental data type for most surveys, and is widely available in Fiji and the wider Pacific region.

This indicator assesses live coral coverage over all depths at a series of resort, dive and marine managed areas throughout Fiji (see Figure 3) from 1999 to 2011. Although these sites do not include some of the most stressed sites in Fiji, it is the best quality and longest term dataset available for analysis.

Persistent stressors on the reef, including eutrophication, coastal development, coral and live rock harvesting, mangrove clearing, crown of thorns (COTS) and overfishing, all negatively impact live reef cover and the ability of reefs to recover from significant events.



Status
Good

Trend
Stable

Data confidence
Medium

Status: Good **Trend; Stable** **Confidence Medium**

Since 1999 Fiji's reefs have experienced a cyclic phenomena which saw the live coral cover drop from over 40% in 1999, to less than 30% in 2003, and then recovering much of the lost live coral cover by 2011; averaging over 50% live cover in the 2011 survey (Figure 3).

A mass bleaching event occurred throughout Fiji during the La Nina event of 2000. In the second quarter, over 60% of all coral colonies surveyed were bleached, and mortality on coral colonies was recorded at over 40% at most sites surveyed

This decline in live coral cover and the subsequent recovery indicates that reefs in Fiji are generally resilient, and respond to positive growing conditions in the absence of adverse conditions (see Figure 2.) However, particular locations, e.g. urban areas, and areas of intense agricultural activity, may have lower resiliency due to anthropogenic effects.

In addition to storm and pollution pressures, Crown of Thorns (COTS) remains a persistent threat and showed some increase overall in the years between 2002 – 2011 (Figure 1). Algal cover appears to be increasing as well, but is unclear whether this is part of a naturally occurring cycle or brought about by other pressures (Figure 2).

Crown of Thorns (COTS) feeding on Coral. Source: Sykes, 2007.

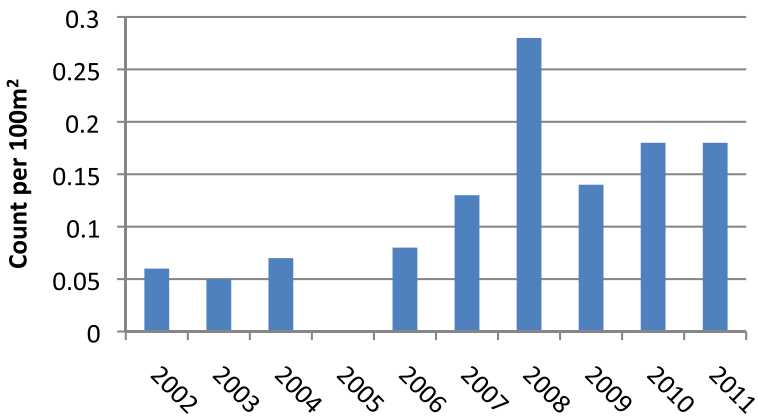


FIGURE 1: Fiji COTS counts from H. Sykes coral survey sites (see Table 1 for number of sites.

IMPACT

Degradation of the reefs has a direct economic and environmental impact to Fiji.

Firstly, tourism is the largest generator of overseas income in Fiji, and the largest non-extractive user of reef resources, with over 75% of visitors involved in marine activities. Thus the condition of Fiji reefs has a major impact on tourism enjoyment.

Reefs support a host of marine invertebrates, fish and mammals, each playing an important role in maintaining the balance of the inshore ecosystem. A loss of the reef system directly impacts sustainable livelihoods.

RESPONSE

What is Fiji doing to protect and enhance the natural resilience of coral reefs?

Due to Fiji's geographic location, it will continue to experience cyclones and bleaching events driven by global weather patterns. The ability for Fiji's reefs to withstand and recover from these periodic natural phenomena, will depend partially on the management of local anthropogenic impacts including fisheries management, land use and watershed management.

To date Fiji's response to protect the inshore reefs has been to:

- commit to conserve 30% conservation of the benthic marine environment through the implementation of the FLMMA network /tabu sites and other management tools.
- Prepare the Inshore Fishing Decree for review and promulgation, to conserve, manage and sustainably develop Fiji's fisheries in a manner that ensures their long-term use for the benefit of the people of Fiji.

In addition, live coral trade for the international aquarium trade is also be undertaken in a sustainable manner giving quota allocation on a yearly basis.

RECOMMENDATIONS

Further recommendations include:

- Promote further development of inshore Marine protected areas, and expansion into offshore marine protected areas including the great sea reef and isolated island systems.
- require full and high quality Environment Impact Assessments for any foreshore development, and improve policy and legislative framework so that this is implemented effectively.
- in addition, harvest of live rock needs to be regulated.

TABLE 1: Coral survey sites on Viti Levu and surrounding islands, all depths n= number of sites. Source: Sykes, 2011.

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
n	5	5	5	18	20	25	7	33	29	23	7	6	19

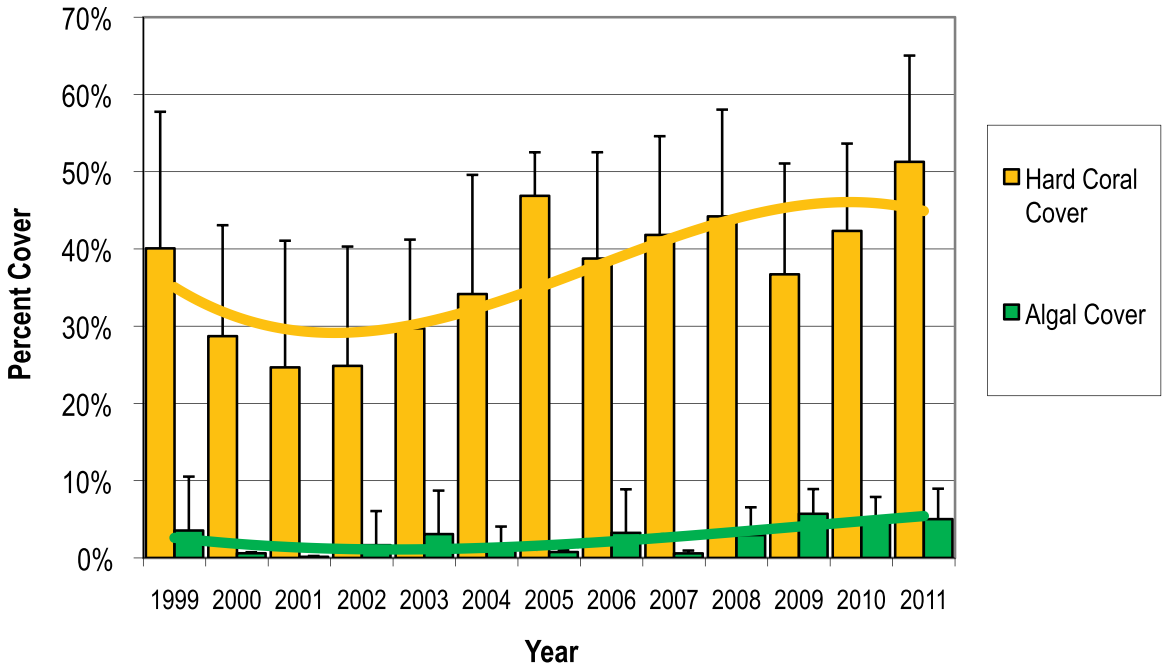


FIGURE 2: Average hard coral and algal cover across Fiji 1999-2011 (Sykes, 2013) +1 Stn Deviation; Polynomial Trendlines order 3.

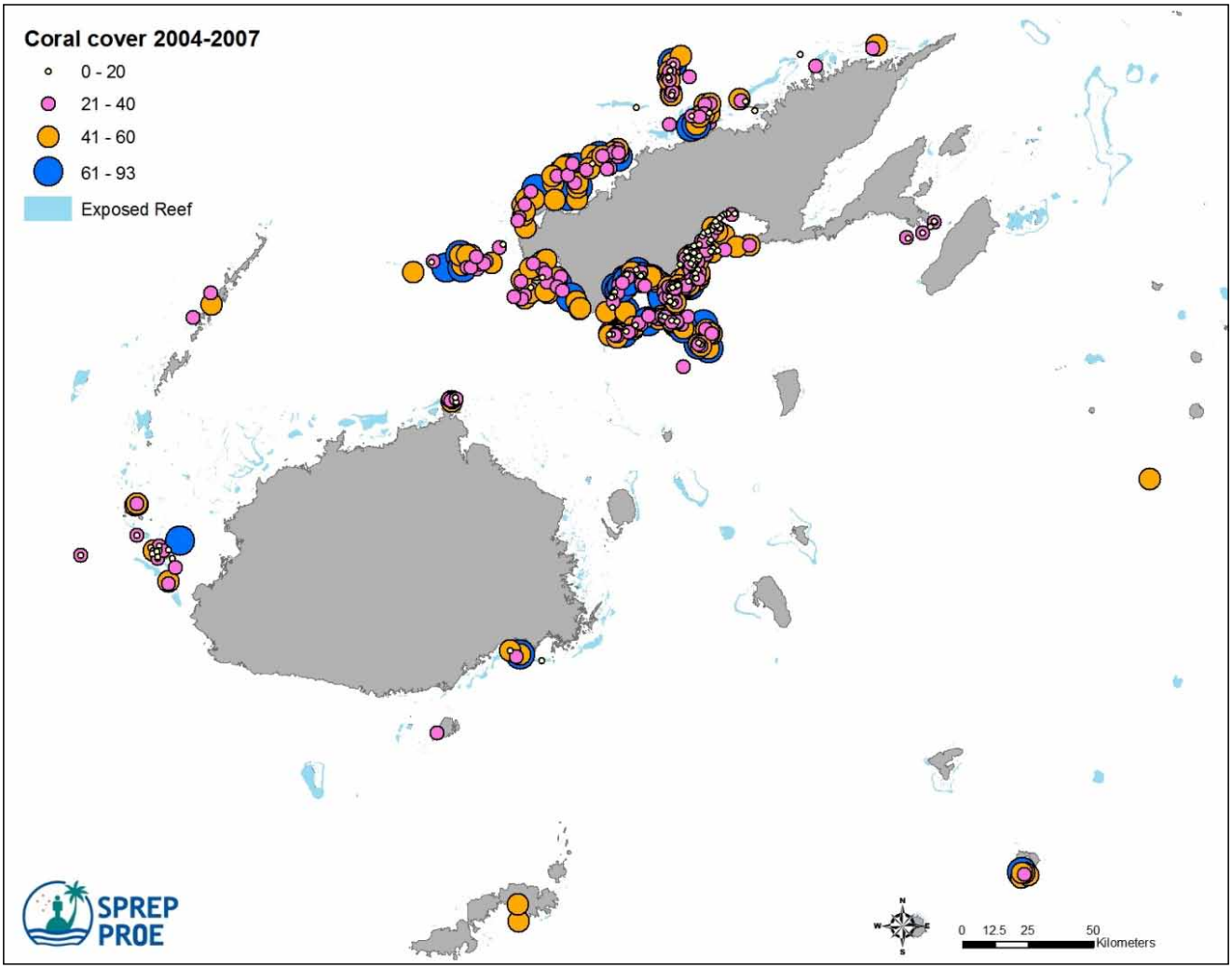


FIGURE 3: Coral Cover Surveys from Sykes (2004–2006) and Jupiter (2007).

Coral reef damage from a strong storm in 2004.

Same reef in 2006 after coral regeneration. Source: Sykes, 2007.

Coral cover at one of the shallow survey sites.
Source: H. Sykes, 2008.

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Assessment of hard coral cover from 1999-2007

R.L. Cumming, M.A. Toscano, E.R. Lovell, B.A. Carlson, N.K. Dulvy, A. Hughes, J.F. Koven, N.J. Quinn, H.R Sykes, O.J.S. Taylor, D. Vaughan, *Mass coral bleaching in the Fiji Islands, 2000*

Sykes, H. 2006 *Status of the coral reefs in the Fiji Islands.*

Sykes, H. *Recent coral survey data (1999–2011) from Helen Sykes 2013.*

Inshore fish products in Fiji are widely varied and include reef fish, ornamental live fish for aquariums, beche de mere (sea cucumbers), trochus and other invertebrates. Pelagic fish are also caught by the inshore fishery (see Figure 1). In addition, live coral, coral base and live rock, are also harvested for the aquarium industry.

For statistical purposes, inshore or near shore fisheries are categorized into 1) commercial or artisanal fishing and 2) subsistence fishing. Commercial fishing includes domestic harvesting for sale in local and international markets, and is generally regulated by the Fiji government.

Subsistence fishing is primarily for consumption by family and/or village. However, the distinction between subsistence and commercial fishing in the larger, less isolated islands is often indistinguishable as the fishing activity is becoming increasingly monetized in these areas. Determining levels of subsistence fishing has been historically difficult (PROCFISH, 2010).

For this section the primary dataset comparing commercial and subsistence fishing is from Gillett's 2009 reconstruction of 2007 data, based on surveys estimating fish consumption per capita (PROCFISH, 2010), however, reliable annual trend data is not available and not presented for subsistence fishing.

Trends for commercial inshore fishing do exist, and are useful indicators for determining the management effectiveness of the inshore fishery, as well as the overall health of the inshore marine ecosystem. These are largely sourced from national annual reports and fisheries statistics.

Status
Fair

Trend
Deteriorating

Data confidence
Medium

Status: Fair Trend: Deteriorating Confidence: Medium

The 2007 estimate for subsistence fisheries is 17400 tonnes (Figure 2), almost 65% of inshore fishery products and 43% of the total marine products (offshore and inshore ~ 41,000 tonnes) produced in Fiji (Gillett, 2009). Subsistence products are predominantly reef fish, followed by invertebrates (Figure 3). The volume generated by the subsistence fishery is a significant concern given that it is largely un-regulated.

The inshore commercial fishery is around 9500 tonnes per year and is dominated by reef and pelagic fish, followed by invertebrates and aquarium products, such as ornamental fish and coral rock (Figure 4). Trends in invertebrates and fish from inshore commercial fishery production show stable levels over the past 15 years (see Figure 5), however, certain products, such as Sea Cucumbers (Beche de Mere) are believed to be over-exploited and require further management in order to sustain populations. Surveys from Sykes (2002 – 2011) show drastic declines in Beche de Mere numbers in the last decade, as fishers harvest from deeper waters (see Figure 7).

Based on recent studies (Teh et al, 2009), over 70% of Fiji's reef fisheries, which are divided into traditional management units called qoliqoli areas, are either fully exploited or over exploited, while the remaining percent of the qoliqoli areas could sustain more fishing pressure (see Figure 6). However, the qoliqoli areas that have remaining healthy fish populations are uneconomical to exploit due to distances to market. The intensive SPC ProcFish survey at four sites in Fiji (Dromuna, Muaivuso, Mali, and Lakeba, 2002–2009) found that particular niche fisheries were so over exploited that a full ban on fishing is necessary, and in some cases restocking is recommended to recover stocks. In all cases, ProcFish recommended increase finfish management, community involvement and conservation efforts to address current levels of extraction.

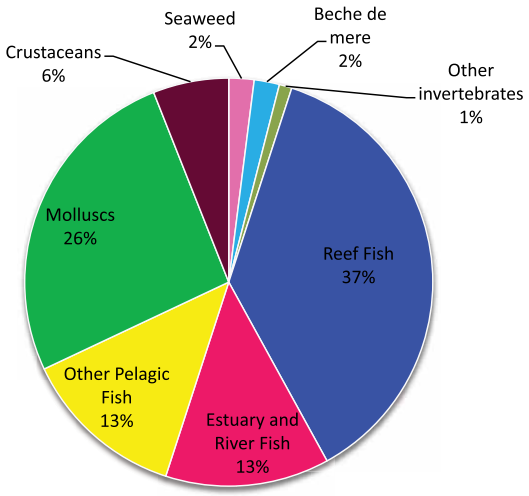


FIGURE 1: Estimated proportion (by income) of fish and invertebrate products from the commercial inshore fishery in 2005, including freshwater. Source: Kitolelei, 2010.

Given that the subsistence fishery is largely unregulated, and based on the weight of evidence from the above data, it would appear that current production in the inshore fishery is not sustainable and requires further management action, particularly for reef fish and invertebrates. A further complicating factor is the general lack of monitoring of subsistence fishing, and its potential impact on the inshore marine environment.

IMPACT

Unsustainable harvest of inshore species of fish and invertebrates has far reaching consequences for Fiji's marine environment, and the communities that depend on it. Drastic changes in herbivorous fish and invertebrates can cause deterioration in coral reefs, which has further reaching consequences on other species.

CURRENT REPONSES FROM FIJI TO ADDRESS INSHORE FISHING PRESSURES INCLUDE:

1) Designating marine protected areas with management plans, 2)Conducting biological surveys which in turn helps to design management plans for qoliqoli's, 3) Placing bans during spawning aggregation season at spawning sites, of species such as Epinepheleus polyphekadion and plectroporus jeopardus during the months of August, 4) Empowering fish wardens and building capacity of local communities to monitor their traditional fishing grounds and adhere to fisheries regulations, 5) the design of a new Inshore Fisheries Decree, developed to modernize laws and regulation of the inshore fishing sector, 6) Intensive surveying of all qoliqoli areas (180 surveyed to date) to develop reccomendeations and assess problems in each management areas and 7)Moratoriums in place for endangered species such as the Humphead Wrasse and revising and updating size limits on other species.

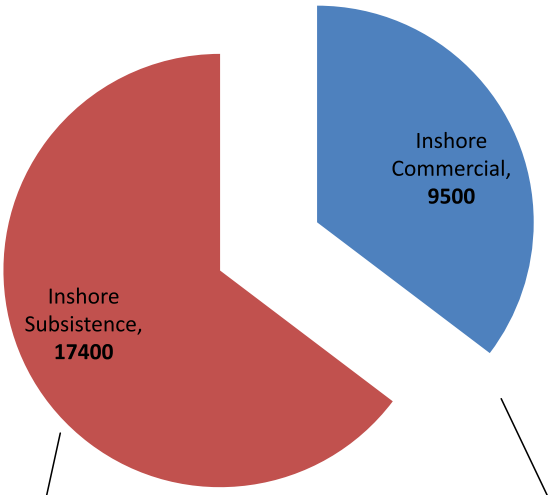
RECOMMENDATIONS

Recommendations for Fiji's inshore fisheries are centred around improving management plans for key invertebrate and fish species that provide significant services to the economy and the inshore ecosystem. Specific recommendations for sea cucumbers have been made by the Wildlife Conservation Society for Lau Province and could be expanded to other areas of Fiji. These include:

1) Halt issuance of exemptions for harvest with underwater breathing apparatus to allow for persistence of deeper populations to replenish stocks. 2) Establish minimum wet and dry size limits to enable reproduction 3) Introduce a harvesting ban that is triggered when stocks have fallen below minimum recommended sizes. 4) Establish new no-take areas (tabu) in areas that are easily enforceable. 5) Move wild-caught or hatchery-reared individuals into new or existing tabu areas and 6) Introduce mari-culture species for restocking such as Giant clams, trochus. (Cultured at Makogai Research Station and restocked on reefs around Fiji).

Surf Redfish (a type of Beche de Mere). Photo: Stacy Jupiter.

FIGURE 2: Estimated Subsistence and Commercial Fishing harvest of all products (tonnes) from 2007 across Fiji. Not including freshwater. Source: Gillett, 2009 and Kitolelei, 2010.



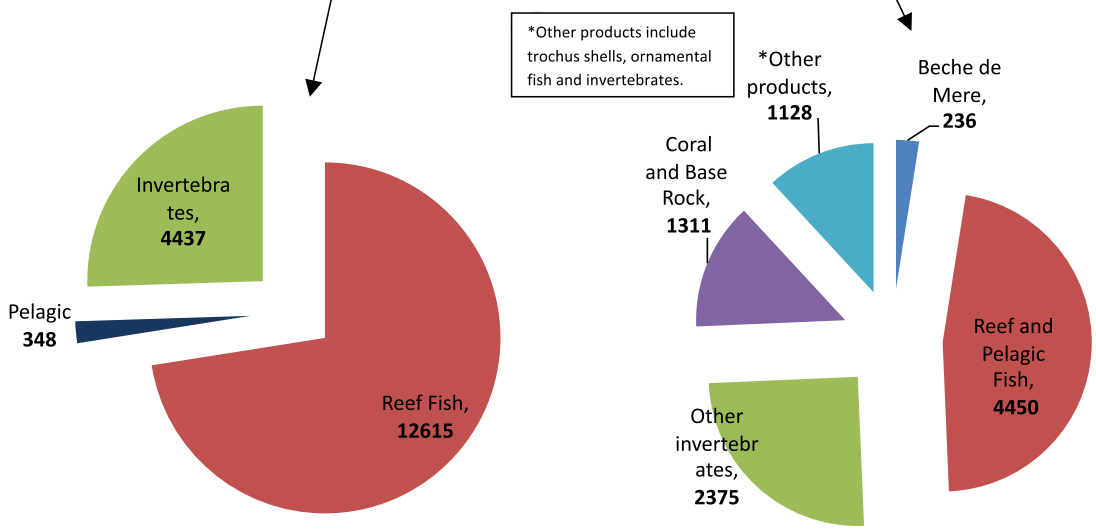


FIGURE 3: Estimated subsistence products harvested (tonnes)from across Fiji in 2007. Source: Gillett, 2009 and Kitolelei, 2010.

FIGURE 4: Reported commercial inshore fishery products harvested (tonnes)from across Fiji in 2007. Source: Gillett, 2009, Kitolelei, 2010 and MAFF, 2011.

Typical fish preparation in Fiji subsistence communities. Photo: Paul Anderson, SPREP.

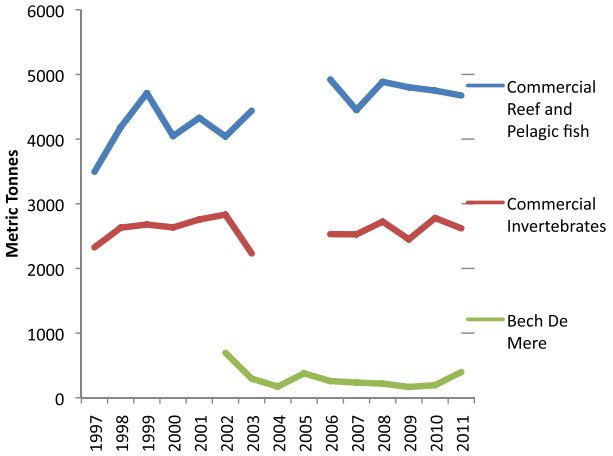


FIGURE 5: Fiji's Commercial Inshore Harvest – Data gaps in 2004 and 2005 from missing reports. Source: MAFF, 2011.

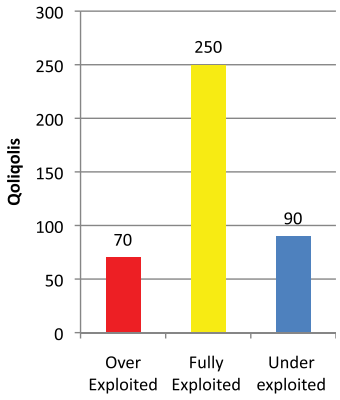


FIGURE 6: Exploitation status of 410 surveyed qoliqolis 2007. Source: Teh et al, 2009.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
# of sites	11	15	19	6	28	30	20	7	6	9

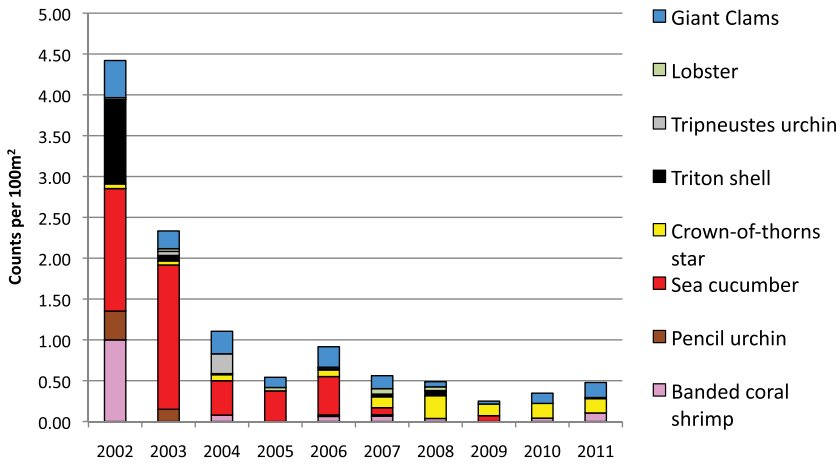


FIGURE 7: Density of invertebrates without Diadema at all depths from coral reef survey sites across Fiji (Count over 100m² reef). Source: Sykes, 2013 – number of sites surveyed shown in table above.

SOURCES

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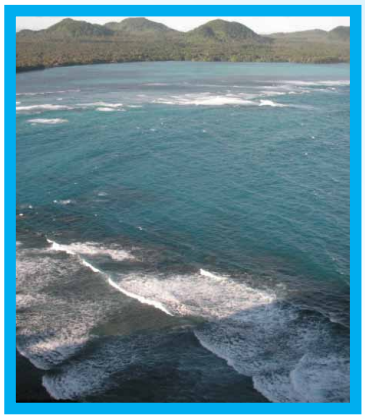
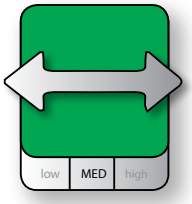
INSHORE MARINE ENVIRONMENT FISH BIOMASS (KG/HA)

Fish biomass, measured in kilograms per hectare, is a broad level indicator of general inshore fish populations and is influenced by fish sizes and numbers. For this indicator, Underwater Visual Census (UVC) was used to calculate biomass in several open and protected areas around Vanua Levu, particularly the Kubulau qoliqoli as it has the longest reliable dataset. This method uses survey dives to measure fish size and abundance along five replicate 5m by 50m transects at deep and shallow depths. An average density or weight per unit area is calculated from this data.

Biomass data for all of Fiji's inshore ecosystems is generally scarce. However, recent data collected since 2007 by WCS at Vanua Levu provides insight into the state of reef fish populations in Fiji, in addition to the effectiveness of existing marine management tools. These results were compared to the 4 fishing community sites surveyed by PROCFISH in 2003/2004.





Status
Good

Trend
Stable

Data confidence
Medium

State: Good **Trend: Stable** **Confidence: Medium**

> 1000 kg/ha is considered a very healthy fish biomass level (Jupiter, 2011) and levels at the Kubulau qoliqoli range from 40 to 1750 kg/ha in "open" areas and 119 to 2600 kg/ha in "closed" areas (see Figures 1 and 2). This is considerably higher than other documented marine managed areas in the Indo-Pacific, including protected areas.

Trends from 2007 to 2011 show a stable level of biomass density in both closed and open fishing areas in Kubulau (see Figure 2 and 3) and across all WCS sites on Vanua Levu (see Figure 4). Average levels of "open" sites are consistent with values from fishing sites surveyed by the PROCFISH study in 2003/2004 (See Figure 5). It is evident that sites closer to major populations (like Dromuna and Muaivuso near Suva) are likely to have lower biomass values due to higher fishing pressure.

However, longer term datasets are required to get fuller confidence. In addition, more data from across Fiji's marine areas is required to develop a full sense of the state of reef fish populations in Fiji.

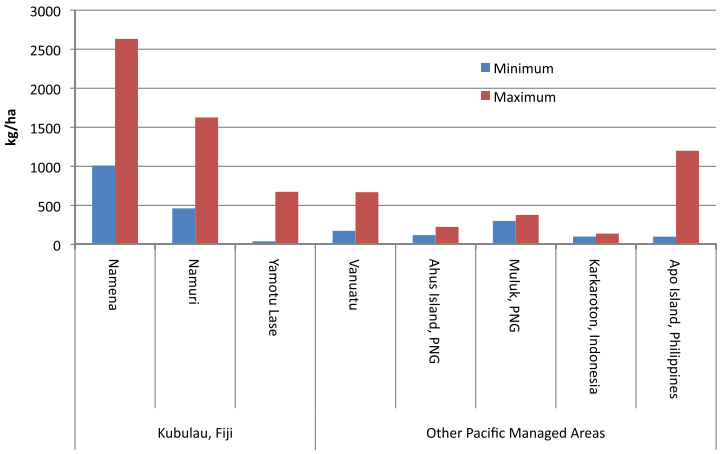


FIGURE 1: Ranges of mean fish biomass in managed areas at Kubulau, Fiji 2007-2009, compared to other managed areas in the Indo-Pacific (includes both protected and open fishing areas at each site) Source: Jupiter et al, 2011.

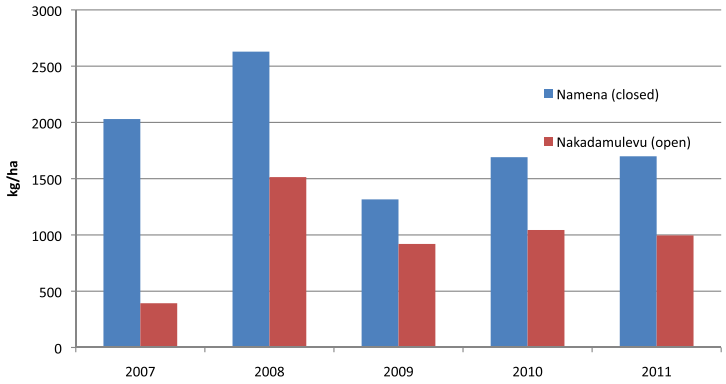


FIGURE 2: Average Inshore Fish Biomass in 2 Managed Areas of Kubulau Qoliqoli, Vanua Levu, 2007 – 2011. Source: Jupiter 2013.

School of Bigeye Trevallies: North Save a Tack Passage, Namena Lailai Island. Photo: H Sykes.

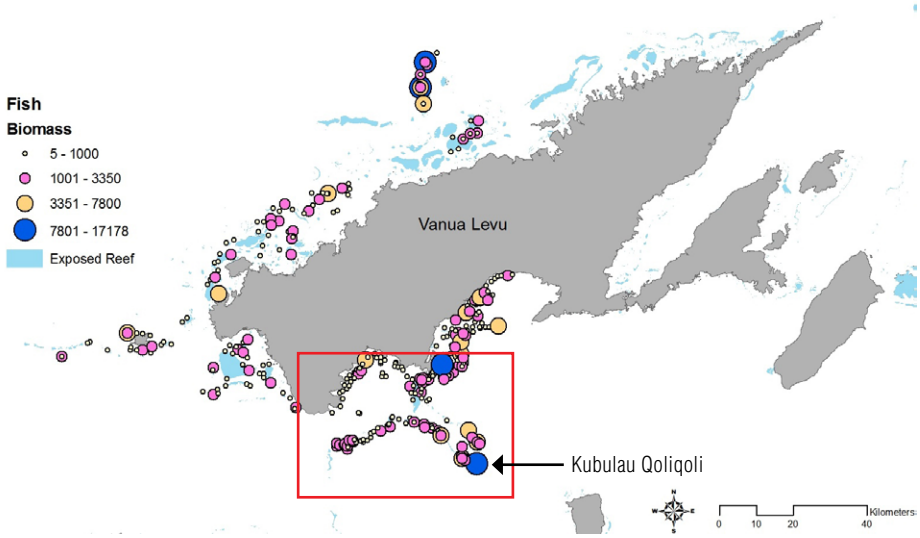


FIGURE 3: Fish Biomass (kg/ha) measured by WCS UVC surveys across Vanua Levu, 2007–2012. Source: Jupiter, WCS.

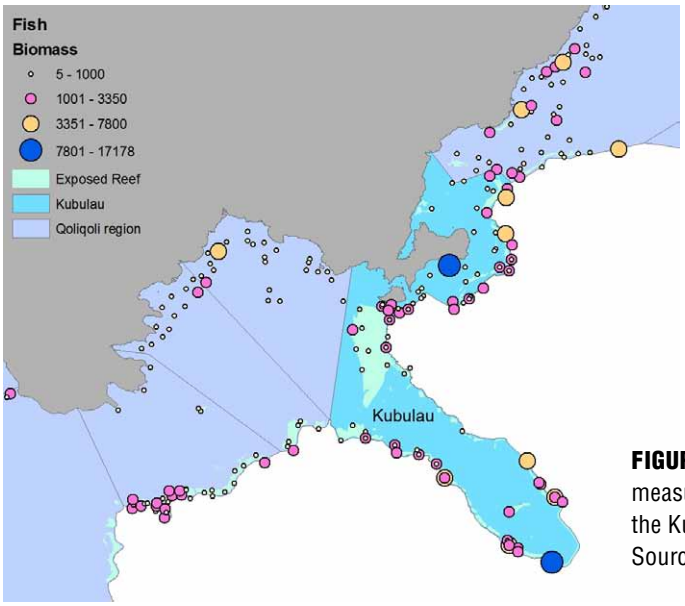


FIGURE 4: Fish Biomass (kg/ha) measured by WCS UVC surveys in the Kubulau qoliqoli 2007–2012. Source: Jupiter, WCS.

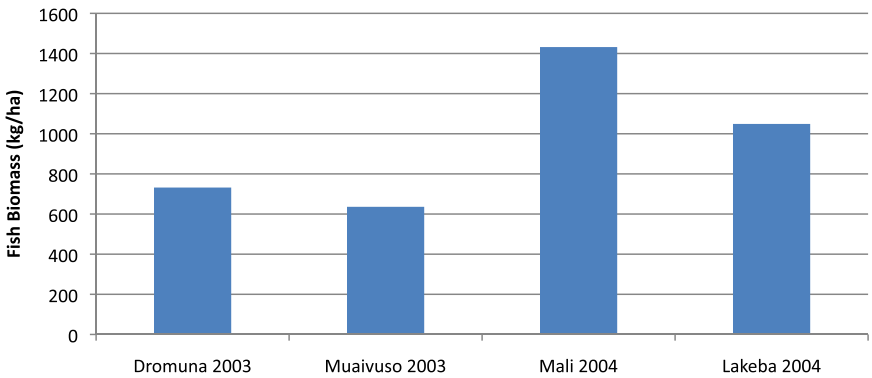


FIGURE 5: Fish Biomass at 4 PROCFISH sites surveyed in 2003/2004. Dromuna and Muaivuso are located on the southeastern tip of Viti Levu near Suva. Mali and Lakeba are near Labasa, Vanua Levu. All sites are subject to intensive fishing. Source: PROCFish 2010.

SOURCES

Biomass data used with permission from Stacy Jupiter, Wildlife Conservation Society, 2013

PROCFish, Fiji report, 2010, SPC. Kim Friedman, Mecki Kronen, Aliti Vunisea, Silvia Pinca, Kalo Pakoa, Franck Magron, Lindsay Chapman, Samasoni Sauni, Laurent Vigliola, Emmanuel Tardy, and Pierre Labrosse

The diversity of fish in any given location is largely based on the size and variety of the regional species pool and habitats. Species diversity in coral reef structures typically declines on reefs that are overfished, or where the reef has been damaged.

Total reef fish species diversity has been predicted at local and regional spatial scales using the 'coral-reef fish diversity index' (CFDI), developed by Allen (1998). The combined diversity of 6 key families (Chaetodontidae, Pomacanthidae, Pomacentridae, Labridae, Scaridae, Acanthuridae) is used to predict total diversity of the fish fauna.

The 6 families used in the CFDI are suitable for estimating total diversity within sites, and ideal for comparing diversity among sites because they are taxonomically well documented, conspicuous and relatively easy to identify, and usually comprise over 50 percent of the fish. (Reefbase.org)

Data for this indicator comes from a collaborative assessment done by Marnane et al.2003 in the Vatu-i-Ra/ Lomaiviti passage between Vanua Levu and Viti Levu (see Figure 2). An estimate of local species richness at the site was then obtained using the formula: Local species richness = ((3.39 x CFDI) – 20.595). Results were then compared with sites across the Pacific that used similar survey methods.

Status
Good

Trend
Unknown

Data confidence
Low

Status: Good **Trend: Unknown** **Confidence: Low**

Coral reef fish species diversity is high in the Vatu-i-Ra area of Fiji, in many cases similar or higher than the high biodiversity areas of the Coral Triangle (e.g. PNG and Indonesia – see Figure 2 and 3). This is likely due to low offshore fishing pressure here as well as the deep channel that brings nutrients, and cooler water conducive for coral growth.

No trend is available for this indicator as this study has not been repeated. In addition, data confidence is low due to the geographic restriction of the study to one area of Fiji.

FIGURE 1: Species richness survey points in Vatu-i-Ra by Marnane et al 2003. Map by SPREP.

SOURCES

Allen, GR (1998) Reef and shore fishes of Milne Bay Province, Papua New Guinea. In:

Werner, TB & Allen, GR (eds) A rapid biodiversity assessment of the coral reefs of

Milne Bay Province, Papua New Guinea. C.I. Washington R.A.P Working Papers II, 39–49.

Marnane, Dr. Michael, Dr. Gerry Allen, Ms. Linda Farley, Ms. Loraini Sivo, Mr. Didi Dulunaquio; 2003. *Scientific Report on an Expedition to the Vatu-I-Ra/Lomaiviti Passage*. Wildlife Conservation Society, Conservation International, The Namena Reef Conservation Group and Nai'a Diving Expeditions.

Reefbase: Summary on Papua New Guinea http://www.reefbase.org/global_database/dbr3,60,PNG,1.aspx

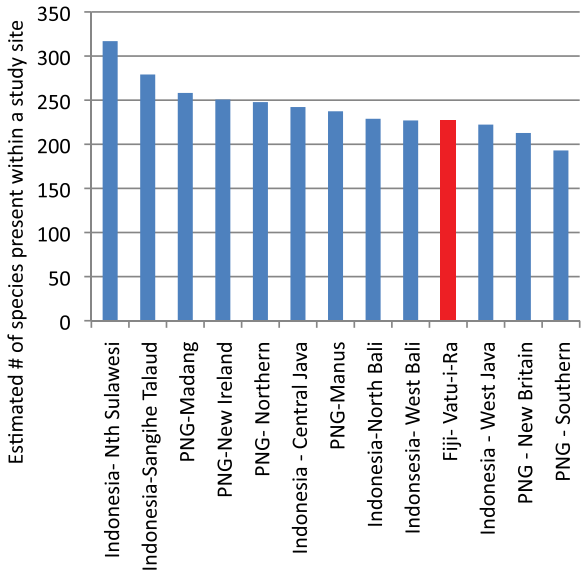


FIGURE 2: Average local species richness of reef fishes within the Vatu-i-Ra/Lomaiviti area compared with WCS study sites in Papua New Guinea and Indonesia. Local species richness = (3.39 x CFDI) – 20.595. Source: Marnane et al, 2003.

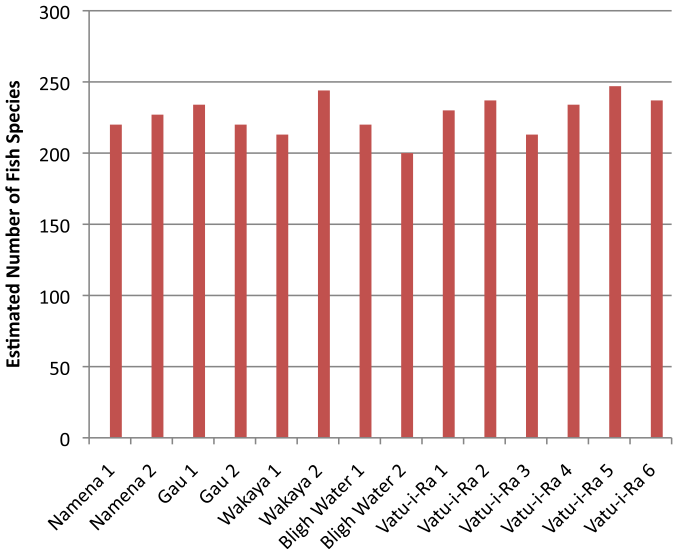


FIGURE 3: Reef fish local species richness at all Vatu-i-Ra sites surveyed by Marnane et al, 2003.

Fish at Namena Fantasea, 2008. Photo: H. Sykes.

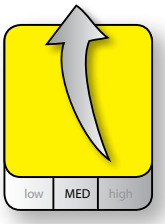
INSHORE MARINE ENVIRONMENT MARINE MANAGED AREAS

Fiji's inshore waters are divided into 410 traditional fishing grounds, known as qoliqoli or formally as 'Customary Fishing Rights Areas', and are legally demarcated by the Native Lands and Fisheries Commission. 385 of these qoliqoli are marine waters and 25 are freshwater (see Figure 1).

Since the mid 1990s, Locally Marine Managed Areas (LMMAs) have been developed in Fiji based on the traditional qoliqoli system. These areas use resource management tools that are supported by the local community, landowners and government. Some of the qoliqoli are now included as part of the FLMMA (Fiji Locally Managed Marine Areas) network that coordinates efforts by government and non-government stakeholders to preserve and protect marine areas.

A significant feature of Fiji's marine managed areas is the use of traditional 'tabu' or closed zones. These are fishing areas closed off temporarily or permanently that serve to re-stock depleted fish and invertebrate stocks near and within the tabu closure. Within each managed area, community members use a range of options, including permanent and conditional closures, reduction of harvest on certain species and bans on fishing gear to manage the resource.

This indicator is based on a gap-analysis study, to assess how effective Fiji's marine managed areas are in meeting Fiji's national goals to protect 30% of its inshore water areas and 10% of benthic ecosystems.



Status
Fair

Trend
Improving

Data confidence
Medium

Status: Fair **Trend: Improving** **Confidence: Medium**

Fiji's active LMMAs have grown from only 1 in 1997, to 135 in 2013 for a total area of ~2,000,000 hectares. This was in response to local perceptions that fish populations had declined. Overall, the Fijian model of marine managed areas has been successful, and is now replicated in other areas of the Pacific. Some areas, such as the Ucunivanua MMA, greatly benefited from the introduction of resource management, and showed a substantial increase in clam populations in areas adjacent to an established tabu site (Aalbersberg, 2005). In 2013 there were over 425 tabu sites in Fiji, which doubled in the previous 3 years (Mills, 2011). Of the 425 sites, 52 are permanently closed, 287 controlled, and 71 are unknown or uncontrolled (See Figure 2).

A gap analysis done by experts in 2011 (Mills, 2011) rated the ability of Fiji's marine managed areas to meet Fiji's national conservation objectives to effectively manage 1) 30% of Fiji's fringing, non-fringing reefs, mangroves and intertidal ecosystems and 2) 10% of other coastal benthic ecosystems. The analysis compared permanent closed areas, conditional closures with controlled harvesting and conditional closures with uncontrolled harvesting. It compared 2 extreme assumptions; 1). that all LMMA's protect ecosystems effectively and 2.) that only controlled closures protect ecosystems) with an expert opinion (assumption 3) that management areas vary in their effectiveness.

Based on the 2011 study and 2012 updated data from WCS (Figure 3), expert opinion (assumption 3) showed that as a best guess Fiji does meet its objectives to protect 10% of coastal benthic ecosystems (currently averaged at 17%, ranging from 13–48%). However, it does not meet the 30% protection objective for reefs, mangroves and

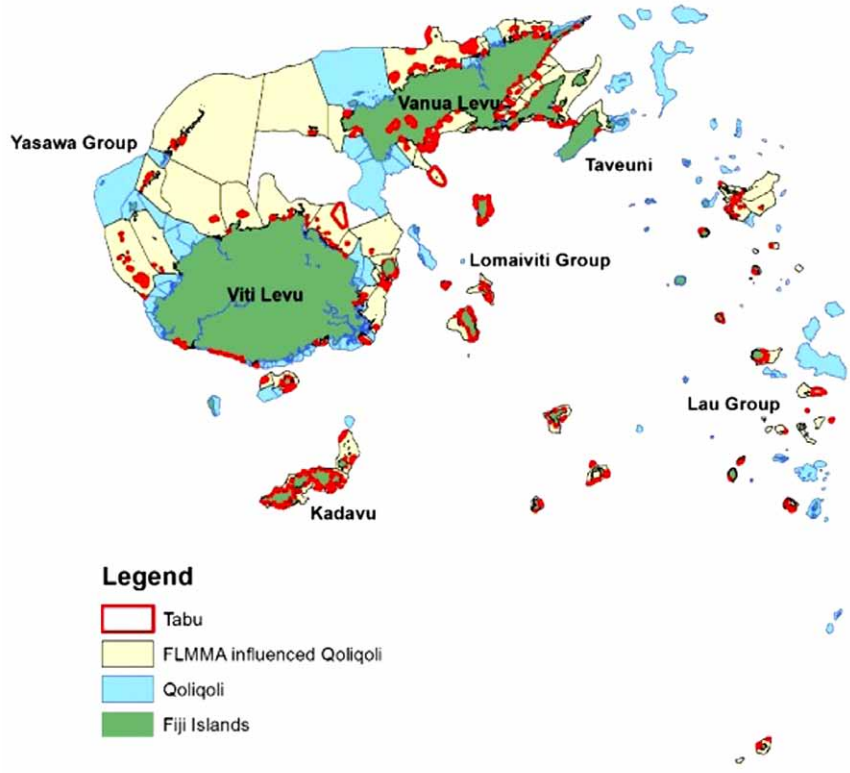


FIGURE 1: 2013 map of qoloqoli boundaries and tabu sites. Source: National Trust of Fiji.

intertidal ecosystems. On average, LMMA's protect about 15% of these areas (ranging from 10 – 28%). However this has increased substantially even in the last 3 years, primarily because of the increase in tabu sites. (WCS, 2013).

IMPACT

Successfully managed LMMAs benefit both communities and the ecosystems that support them. Firstly, fish and invertebrates populations in areas that are closed or have conditional closures, serve as a population source to re-populate adjacent areas that are being harvested.

Secondly, increased fishery resources due to better management, is both nutritionally and financially better for qoliqoli communities. Customary practice allows qoliqoli owners to permit and charge outsiders to enter for a specific purpose such as fishing or live-rock harvest.This serves as an outside source of income for the community.

Challenges in managing marine areas include: poaching from outside fishers; inequitable decision making responsibilities between women and men and limitations on size, location and extent of tabu sites. Most tabu sites are not large enough (median size is 0.73 km^2) to sustain fish and invertebrate populations in areas adjacent to the closure. In addition, tabu sites are not distributed across fishing areas and tend to be located close to where communities can monitor for compliance.

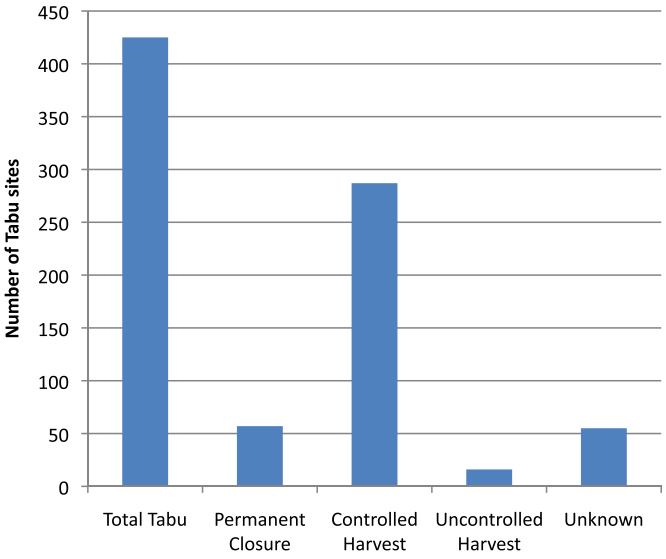


FIGURE 2: Status of Tabu sites in 2012, "unknown" refers to Tabu sites that have not been fully inventoried or verified. Source: Mills, 2011 and WCS, 2013)

RESPONSE AND RECOMMENDATIONS

The FLMMA network has largely been a successful model of community-based fisheries management. Major recommendations include actions to improve and maintain the progress that has been made. These include:

- Develop recommended size of Tabu areas to provide maximum protection to meet the 30% benthic protection target by 2020.
- Invest in and improve monitoring of FLMMA sites to establish effectiveness and address challenges as they arise.
- Perform gap analysis on tourism based MPAs and other private industries.
- Ensure that modern fishing regulations (i.e. the Inshore Fishing Decree) incorporate and build on the community-based management model.

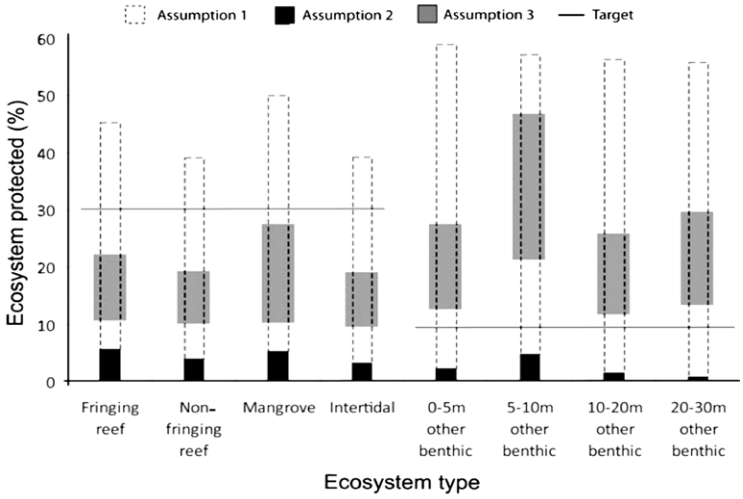


FIGURE 3: Effectiveness of Fiji's Marine Managed Areas to protect marine ecosystems based on 3 scenarios (assumptions), Assumption 1 assumes all marine managed areas protect ecosystems effectively, assumption 2 assumes only closed (tabu) systems manage marine ecosystems effectively and assumption 3 is based on expert opinion that different management actions protect ecosystems to a varying degree. Assumption 3 is experts best guess for effectiveness of marine managed areas to protect ecosystems. Targets are Fiji national objectives for ecosystem protection. Source: Mills, 2011.

SOURCES

Aalbersberg, B., Tawake, A. and Parra, T. 2005. *Village by Village: Recovering Fiji's Coastal Fisheries.* The World Resources 2005 – The Wealth of the Poor.

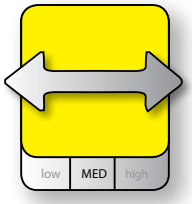
Mills, M., Jupiter, S., Pressy, R., Ban, N. and Comley, J. 2011. *Incorporating Effectiveness of Community-Based Management in a National Marine Gap Analysis for Fiji.* Conservation Biology.

INSHORE MARINE ENVIRONMENT SUVA HARBOUR WATER QUALITY

The Suva Harbour area as defined in Figure 1, covers some 30km^2 area of shallow reef and open water. The periphery of the Harbour borders the coastline of Suva Peninsula to the east, Lami Bay to the north and Navakavu Peninsular to the west. The perimeter of the harbor is 50km. Average water depths on the outer reefs are shallow; with large sections of the reef being exposed at low tide. The average water depth inside the harbour is around 15 metres.

Bordering the main urban centre of Suva, Suva Harbour receives numerous anthropogenic inputs including nutrients, faecal coliforms and, from industrial point sources including the ship maintenance facilities, a suite of other contaminants.

There exists numerous historic dataset for water quality in Suva Harbour. However, in many instances these data were not recorded at the same geographic locations. Whilst there is variation in water quality between the sites studied, for this scorecard, a site adjacent to the Royal Suva Yacht Club has been used to represent Suva Harbour. Spot samples taken from other marine areas in the Suva harbour show that the Royal Suva Yacht Club is at the lower end of the water quality recordings for Suva Harbour and a conservative estimate of Suva Harbour water quality.



Status
Fair

Trend
Stable

Data confidence
Medium

Status: Fair **Trend: Stable** **Confidence: Medium**

The large water body and tidal flushing of Suva Harbour, likely prevents a massive build-up of high levels of nutrients and faecal coliforms carried by many of the urban creeks and rivers.

It is clear from the nutrient data that there is considerable variability in nutrient levels. This likely links to rainfall patterns flushing nutrients from land into the Harbour environment. Twenty five percent of both the nitrate and phosphate levels presented fall below the acceptable standards for coastal waters (Figure 2).

Dissolved oxygen levels are within recommended limits for coastal waters (Figure 3). Faecal coliforms also vary at the Yacht Club and fluctuate above and below guidelines from year to year. There appears to be no longitudinal trend on any of the water quality parameters presented, suggesting that for water quality there is no trend (Figure 4). Faecal coliform results from other points on Suva Peninsula (Figure 5) show that the Yacht Club site is likely a conservative representation for the Suva Harbour.

Suva Harbour. Source: SOPAC Miscellaneous Report 606.

IMPACT

Shoreline water quality primarily affects the marine ecology and the humans that rely on it for food and recreation. Faecal coliforms present currently in the shoreline prevent full enjoyment of the harbour, and pose a risk to those who depend on it as a food source and interact with it on a daily basis. This has further reaching impacts on tourism and the enjoyment of the waterfront by all.

RESPONSE AND RECOMMENDATIONS

What is Fiji doing to improve and protect marine water quality?

The Environmental Management Act (EMA) is in place and a collaborative effort is imminent with appropriate streamline mechanisms. However, relevant stakeholder needs assessment should be coordinated at a National level to address water quality in various sectors.

- Government has developed an overarching document, the National Water Resources and Sanitation Policy (still yet to be passed by the Cabinet) to provide an efficient and effective management system for the sustainable development of water resources (surface water & groundwater) and sanitation – and Monitoring of Water Quality.
- Also, existing policies such Rivers Act, Rural Water and Sanitation Policy, Land Water Resources Policy address these issues.
- Watershed management.
- Demarcation of Roles Water Resources Management.

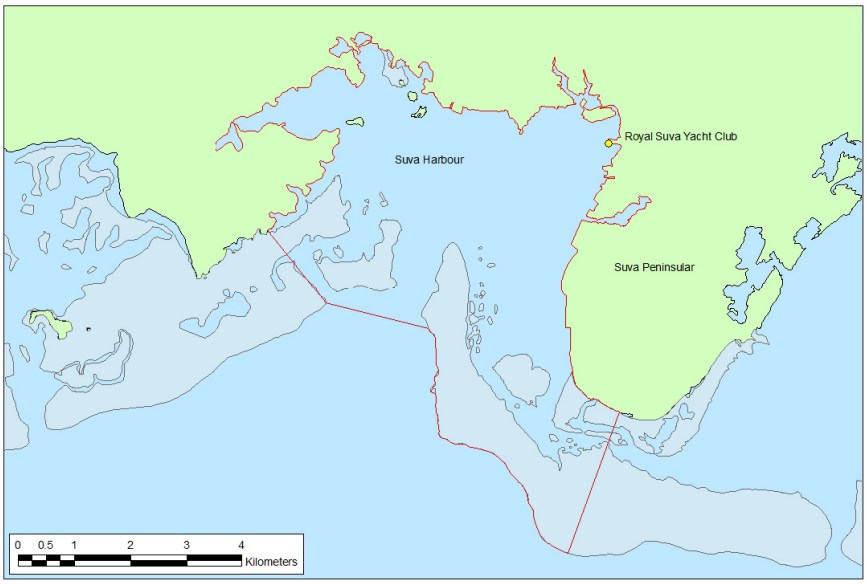


FIGURE 1: Suva Harbour extent and historical USP sampling sites, Royal Suva Yacht Club (A), Narain Jetty (B), King's Wharf Centre (C), Bowling Club (D), Ratu Sakuna (E), Suva Point (F), Children's' Park (G), Marine Studies Jetty (H), Beach Rd Park (I) and Vatuwaga Industrial Estate (J). Source: USP.

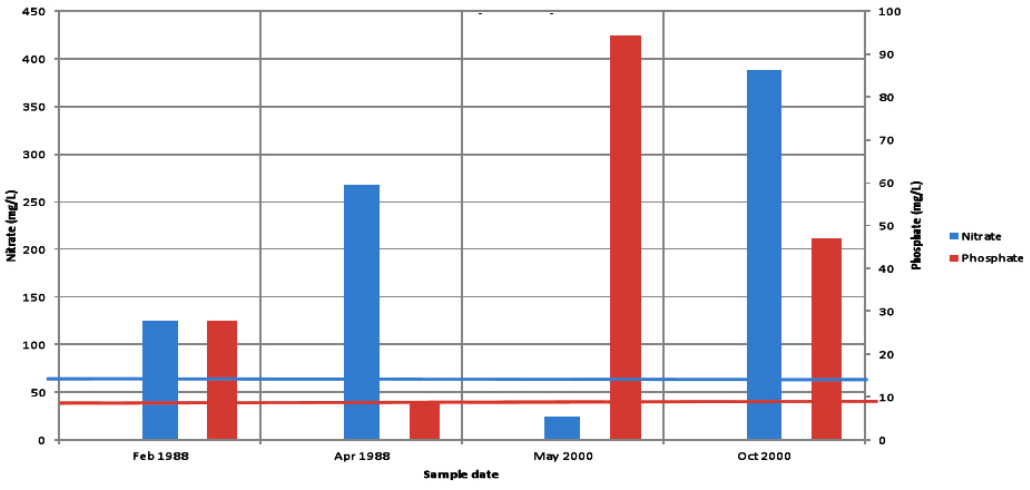


FIGURE 2: Nitrate and phosphate concentrations from Royal Suva Yacht Club – (mg/L) 1988-–2000. Red and blue lines represent Fiji 's recommended marine water quality guidelines. Source: USP.

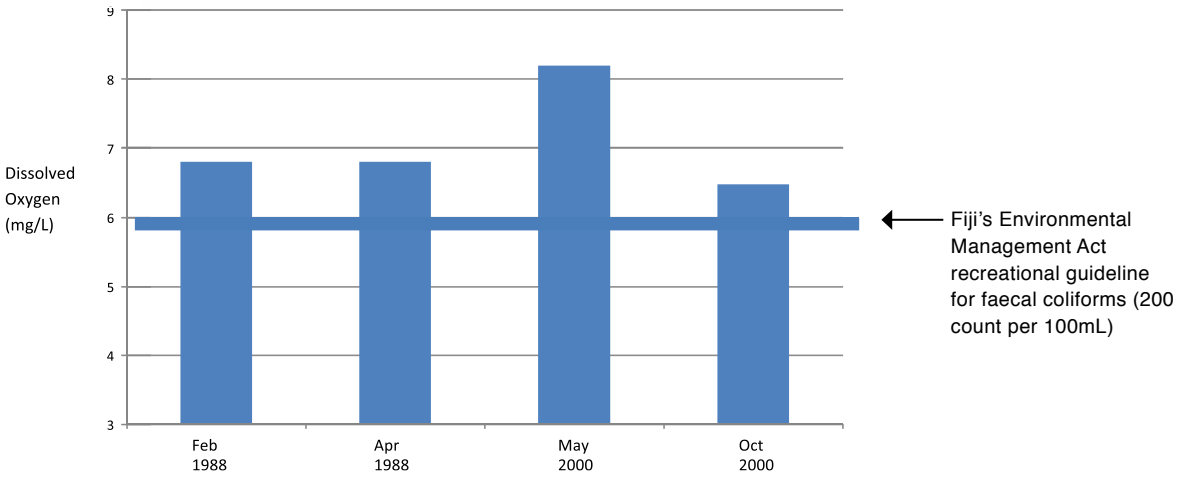


FIGURE 3: Royal Suva Yacht Club Dissolved Oxygen results 1988–2000. Source: USP.

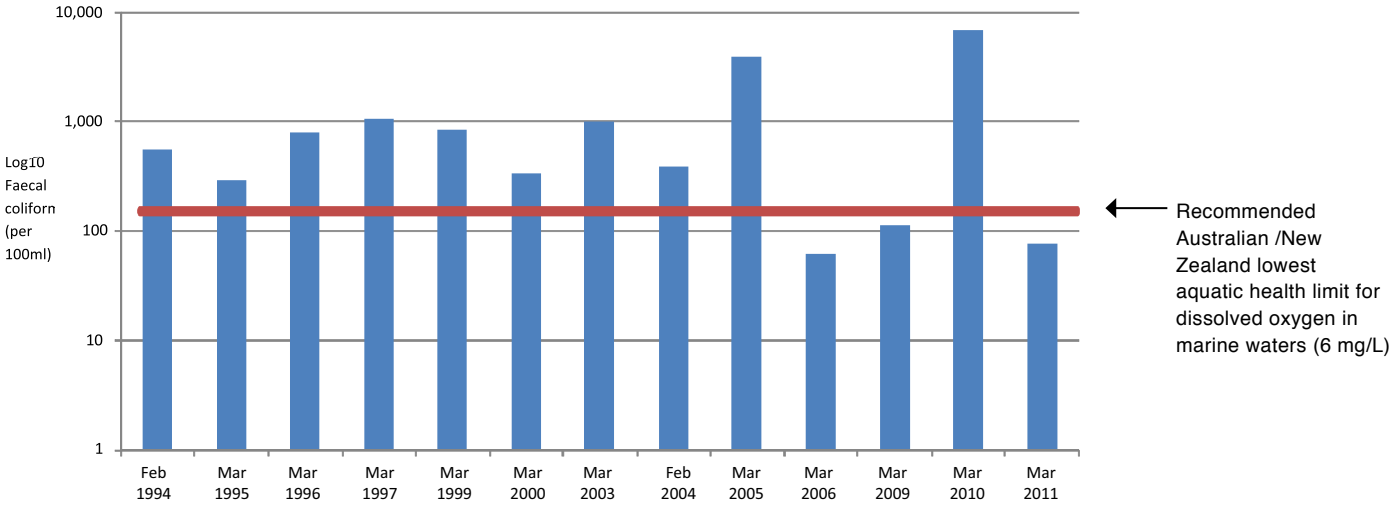


FIGURE 4: Royal Suva Yacht Club Faecal Coliform results 1994–2011. Source: USP.

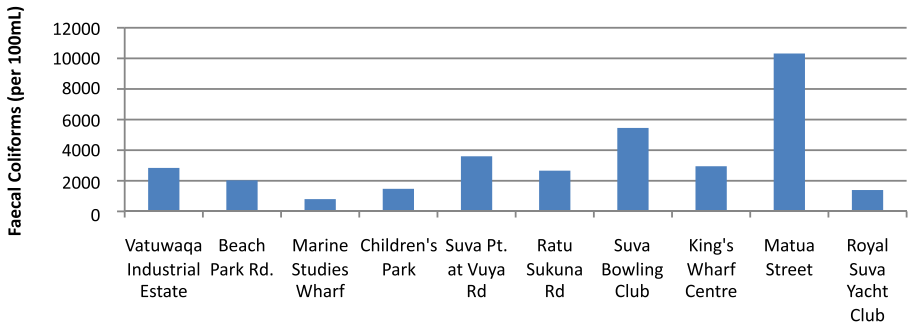


FIGURE 5: Average Faecal Coliform results for all Suva harbour sampling sites, 1994–2011. Source: USP.

SOURCES

All data and analysis provided by USP (School of Marine Studies, Institute of Applied Science and Institute of Marine Resources, 2013)

Biodiversity: A coordinated national approach needed to protect ecosystems from further degradation.

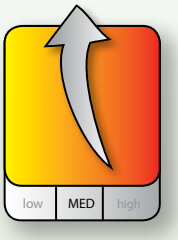
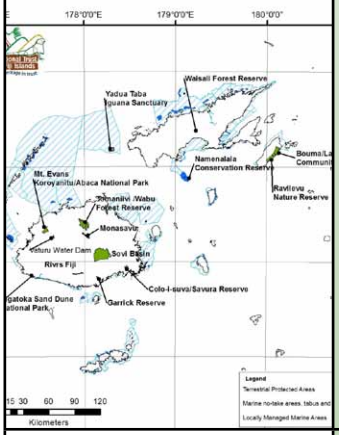
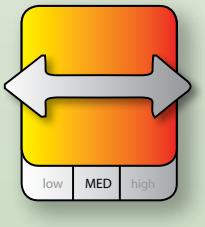
This chapter covers the theme of Biodiversity, reviewing the state of invasive species, protected areas and threatened and endemic species. It also describes what Fiji currently is doing, and needs to do to protect its unique species and ecosystems from further degradation. Results from the Land, Marine and Inland Waters chapters reveal that continuing pressures from forest removal, targeted exploitation of marine species, watershed disturbance and small-scale agricultural clearing are having a profound impact on the health of Fiji's ecosystems. In particular, it is Fiji's terrestrial environment that is seeing the biggest change, and the clearing of forests is having the most dramatic impact.

In general results show that environmental invasive species are likely spreading through Fiji. Recent efforts have been relatively successful in preventing new invasive species into Fiji's ports, but the continued spread throughout the larger islands, and onto previously "un-invaded" smaller inlands is troubling, and poses serious threats to endemic species there.

More effort is required in Fiji to both understand the state of Fiji's endemic species, as well as develop and implement protection plans. Currently there is a poor state of knowledge around Fiji's terrestrial endemics, and most effort to protect species and ecosystems is poorly coordinated and relies on the initiative of NGO's. This effort is also needed to establish and maintain protected areas. Although there has been progress made in identifying important ecosystem sites, efforts to develop and implement protection plans for them have been lackluster at best.

Sovi Basin (Protected Terrestrial Site) from air. Photo: Timoci Gaunavinaka.

HIGHLIGHTS

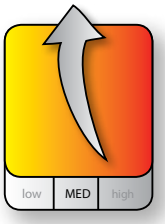
TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 ENVIRONMENTAL INVASIVE SPECIES	 **Status** Fair to Poor **Trend** Improving **Data confidence** Medium	A number of invasive species exist on many Fijian islands often with serious impacts on the environment. The spread to other areas in Fiji is happening rapidly in some places, and there is little inter-island biosecurity to prevent the spread. However, Fiji Biosecurity has had success in keeping new pests out of Fiji (e.g. the Giant African Snail).	Numerous programs aimed at eradicating certain invasives in vulnerable areas have been moderately successful. Biosecurity measures at ports have also had success. Fiji should ensure that biodiversity values are considered in the setting of internal quarantine requirements between islands.
TERRESTRIAL PROTECTED AREAS 	 **Status** Fair to Poor **Trend** Stable **Data confidence** Medium	IUCN classified protected sites only make up 2.7% of Fiji's land mass. Proposed Key Biodiversity Areas, Important Bird Areas, and Priority Forest Areas would make up a further 15% if accepted under protected area status. However, currently there is little action in establishing new protected areas.	Through the National Protected Areas Committee, Fiji has identified key biodiversity sites for protection and has a sound understanding of what areas require further protection. Dedicated action should be taken by Fiji to establish and develop suitable and attainable management plans for priority areas.
THREATENED AND ENDEMIC SPECIES 	 **Status** Poor **Trend** Unknown **Data confidence** Low	Many of Fiji's endangered species are endemic and inhabit the terrestrial environment. The general consensus is that Fiji's biodiversity is deteriorating, with the decline of the natural forest forming the biggest threat. Some recovery plans exist but are generally poorly supported, and there is a very low state of knowledge about Fijian threatened species.	Fiji needs to take a more responsive role in protecting its endemic species. Recommendations include: establish list of priority species that require further protection, increase research and data collection on priority species, develop and enforce recovery plans for priority species and establish and enforce protected areas for these species.

ENVIRONMENTAL INVASIVE SPECIES ESTABLISHED AND NEW INVASIVES

Invasive species are introduced plants, animals and other organisms that can cause harm to the environment or human livelihoods. They are mostly spread through human activity, deliberately or unintentionally. Many of these organisms are present in Pacific Island Countries and Territories.

This indicator is limited to "environmental" invasive species that have a direct impact on habitats and species, and indirectly impact humans through loss of food, disruption of trade, forestry, tourism and damage to crops and the built environment. It does not include the multitude of diseases, pests and viruses that directly affect agriculture, although many environmental invasives may have an indirect and direct impacts on agriculture.

The indicator assessment is based on three criteria: 1) the volume and spread of established invasive species within Fiji, 2) the introduction of new invasive species to Fiji in the past 10 years and 3) the level of infrastructure in place to control invasives compared to other Pacific countries.



Status
Fair to Poor

Trend
Improving

Data confidence
Medium

Status: Fair to Poor Trend: Improving Confidence: Medium

Based on IUCN Fiji's most recent assessment, Fiji has approximately 390 species listed as invasive, and approximately 40 more alien species that are regarded as uncertain as to their level of harm or ability to spread in the environment (see Figure 1). The vast majority of invasive species are terrestrial plants, trees and grasses (see Figure 2). However, the most harmful to native birds, amphibians and reptiles are rats, mongoose, feral cats, pigs and goats.

Travel within the Fiji group by locals and tourists alike is increasing, and there is a need for measures to be introduced to prevent the spread of established invasive species within Fiji's 300+ islands. Based on a recent study by Daigneault and Brown in 2013 in eastern Viti Levu, commonly known invasives, such as the Merrimia Vine (*Merremia peltata)* and the African Tulip Tree (*Spathodea campanulata*), continue to increase (see Figure 3 and 4). Furthermore, most of these common invasives have spread to the outer islands. These include invasive fish such as tilapia (*Oreochromis* spp.), that compete with native fish in Fiji's streams and rivers (see Figure 5).

Fiji has had more success preventing the introduction of new species to Fiji ports, including common Pacific invasives such as the Brown Tree Snake and the Giant African Snail, largely through strict border and quarantine controls. Some new introduced species such as the American Iguana and Termites are being aggressively managed and eradicated. Overall, compared to other Pacific countries, Fiji has a higher level of management actions and programs in place to control and manage Invasives (see Figure 6).

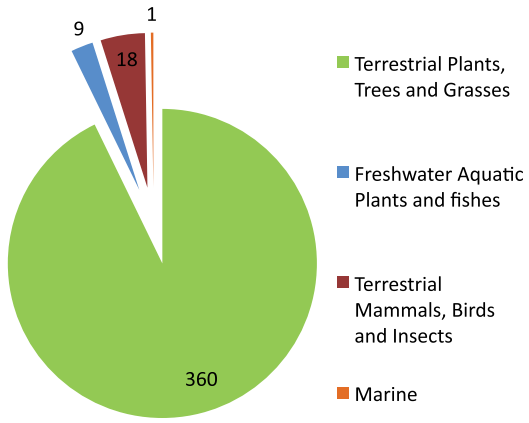


FIGURE 1: Number of recorded invasive species across Fiji. Source: IUCN Database of invasive species, Aug, 2013.

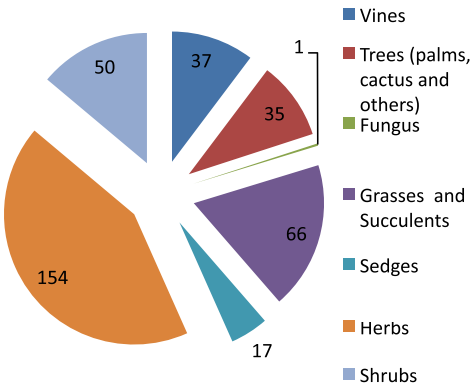


FIGURE 2: Number of recorded terrestrial plant invasive species across Fiji. Source: IUCN Database of invasive species, Aug, 2013.

IMPACT

Invasives directly and indirectly compete with native species and ecosystems, and often have an unfair advantage over vulnerable endemics. For example, the number of fish species in mid-reaches of Fiji rivers are significantly affected by loss of catchment forest cover and introductions of tilapia (*Oreochromis* spp.). On average, stream networks with *Oreochromis* spp. populations have 11 fewer species of native fish than do intact systems (Jenkins et al, 2010).

In addition, invasives can impact society and the economy through loss of food production,as well as export restrictions from other countries, infrastructural losses and other agricultural losses.

Other economic costs include losses from eradication and control programs, particularly as certain areas or species are overwhelmed by invasives.

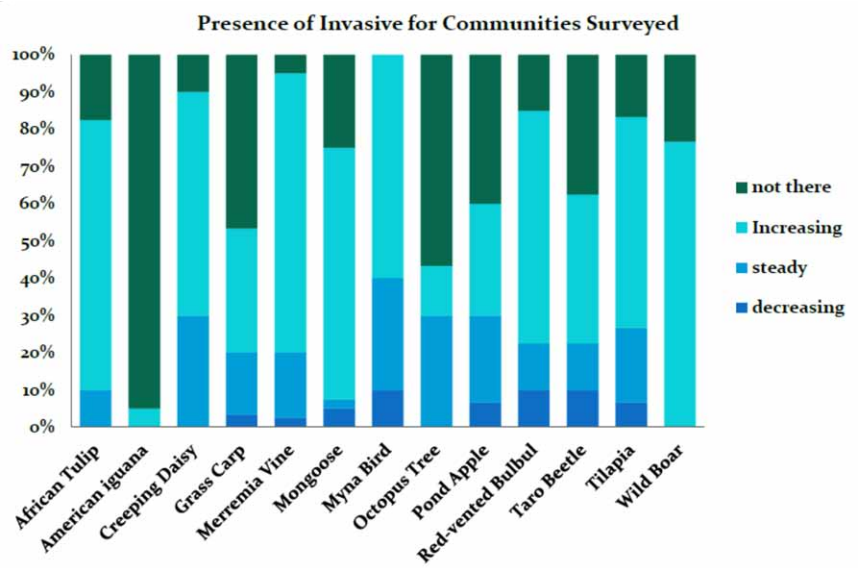


FIGURE 3: Results from communities surveyed in Eastern Viti Levu. Source: Brown and Daigneault, 2013.

RESPONSE

What is Fiji doing to prevent the spread and introduction of invasive species?

Fiji is largely concentrated on keeping new invasive species out of Fiji, managing established ones in key biodiversity sites, and eradicating them on small islands. The Biosecurity Authority of Fiji has strong quarantine programs in place to prevent new species being introduced at ports.

However, currently there is limited awareness of internal quarantine requirements, and this is confined to species of agricultural or economic significance, and often biodiversity values are not included. Efforts to reduce the spread of established invasives in Fiji include:

- Research conducted on best practices to control plant species such as the African Tulip tree, the raintree and leucocephala (lead tree).
- Goat eradication – complete eradication in 2000 from the Iguana Sanctuary.
- Weed removal for past 5–10 years. Looking at National Trust protected areas.
- Bird Life International rat eradication in small islands. (IBA sites islands).
- Biosecurity and Nature Fiji eradication and control of the American Green Iguana in Taveuni and outlying islands.
- Training efforts by the Pacific Invasives Initiative.
- Creation of the Fiji Invasive Species Task Force and involvement in the Pacific Invasives Network.

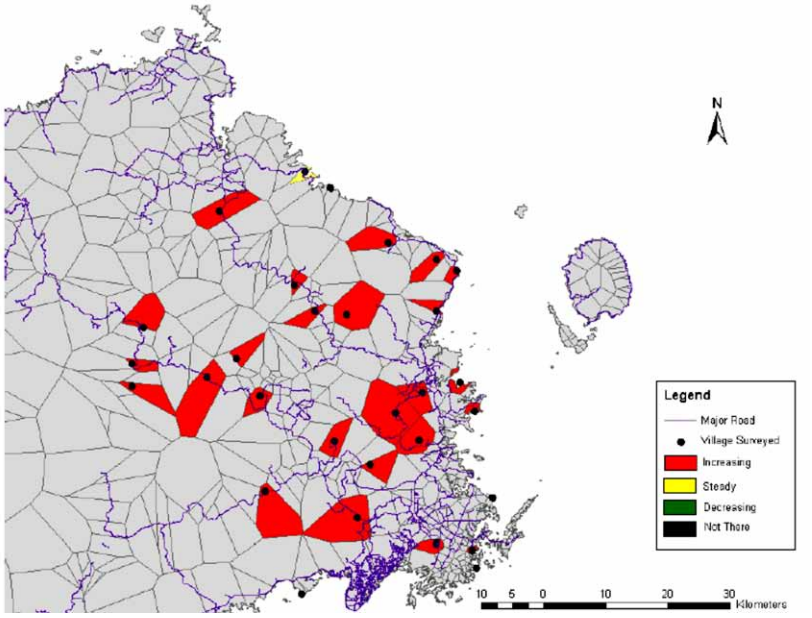


FIGURE 4: State of African Tulip Tree Surveyed in Villages in Eastern Viti Levu. Source: Brown and Daigneault, 2013.

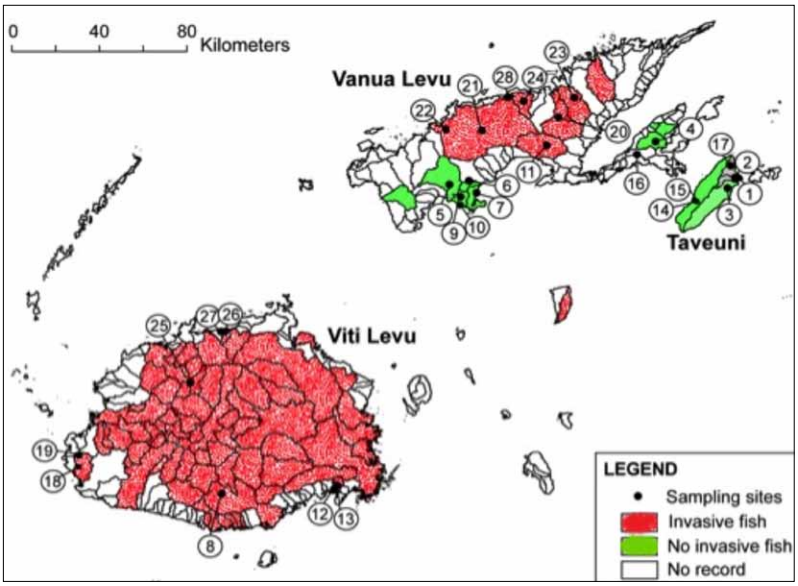
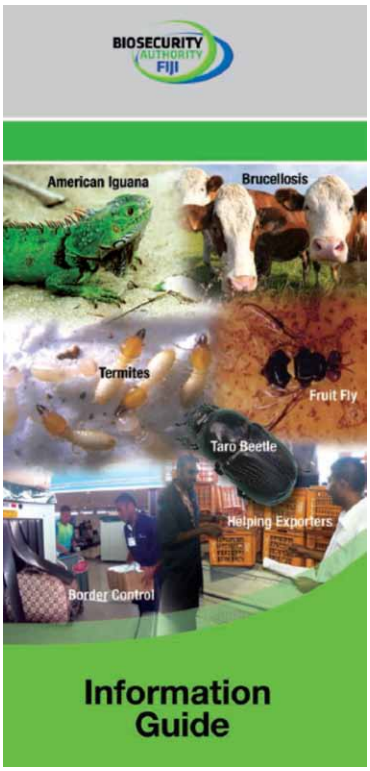


FIGURE 5: Presence and absence of invasive freshwater tilapia (*Oreochromis* spp) in Fiji. Source: Jenkins et al 2010.



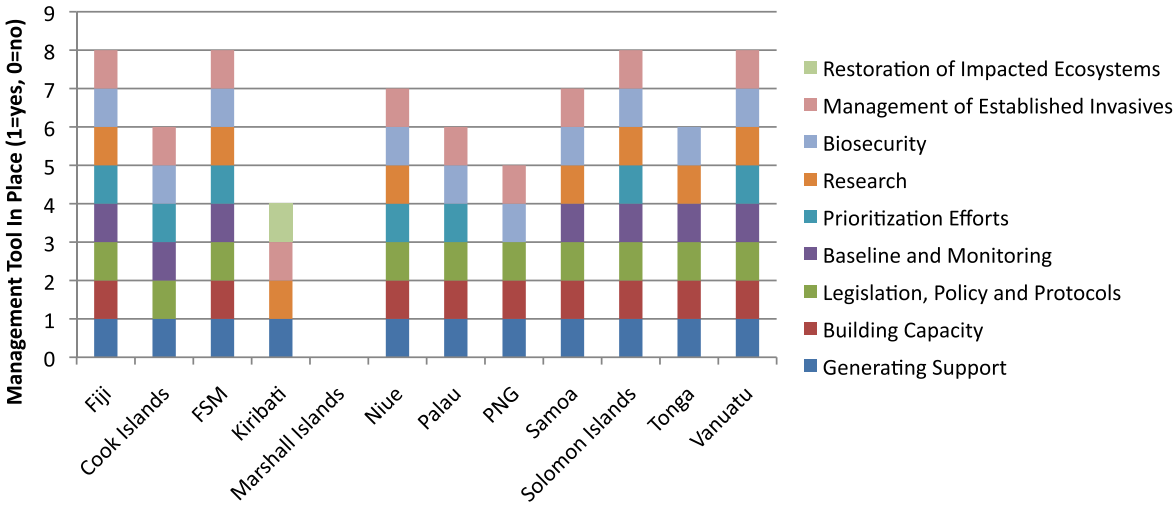


FIGURE 6: Summary of management tools and actions in place to control invasives by country. Source: Pacific Invasives Initiative, 2010.

SOURCES

Binesh Dayan (Ministry of Fisheries and Forests), Forest Health Technology & Phytosanitary Standards. Conference Presentation, Beijing 2011.

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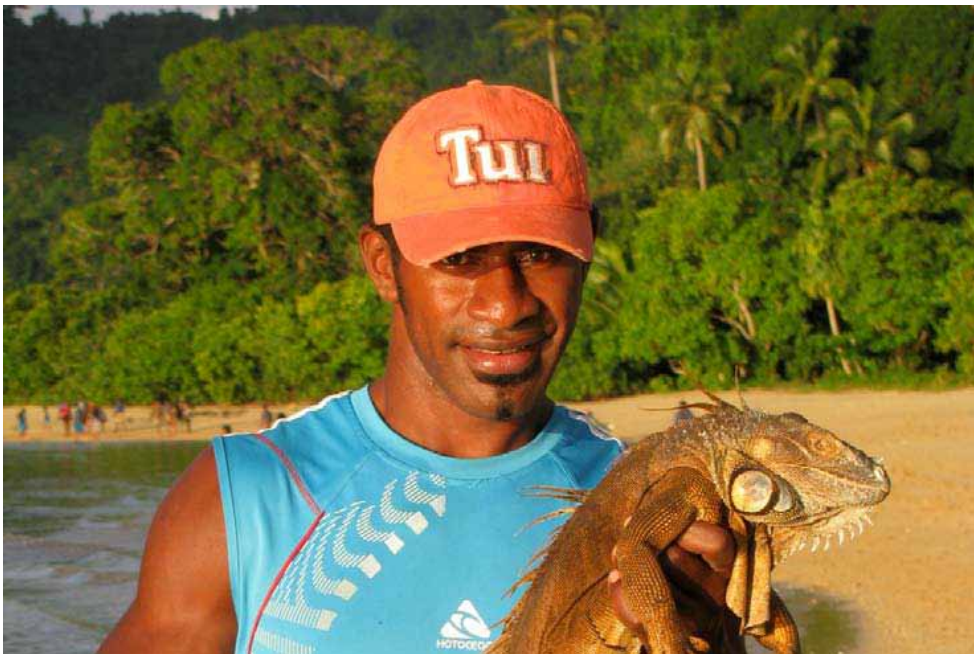
Jenkins, A. P., Jupiter, S.D., Qauqau, I., and Atherton, J. The importance of ecosystem based management for conserving aquatic migratory pathways on tropical high islands: a case study from Fiji. 2010. *Aquatic Conserv: Marine and Freshwater Ecosystems: 20: 224–238*

Pacific Invasives Initiative, 2010 Invasive Species Management in the Pacific: A Review of National Plans and Current Activities. *Produced for the Pacific Invasives Partnership.*

Van Veen, Rick. Status Report: The American iguana in Fiji – May-August 2011. Report Prepared for NatureFiji-MareqetiViti and the American Iguana Eradication Task Force, 2011.

Merrimia Vine (*Merremia peltata*). Source: Brown and Daigneault, 2013.



American Iguana (*Iguana iguana*) captured on Qamea Island. Source: Van Veen, 2011.

Static traps & sentinel plants set up at main port of entry by the Biosecurity Authority of Fiji. Source: Biosecurity Authority of Fiji.

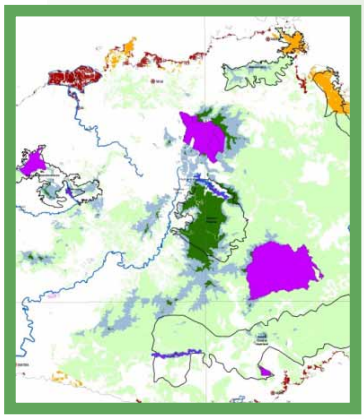
TERRESTRIAL PROTECTED AREAS STATUS OF PROTECTED ECOSYSTEMS

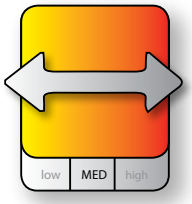
The International Union for the Conservation of Nature (IUCN) defines Protected areas as "regions set aside primarily for nature and biodiversity conservation. *They are a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (www.iucn.org/about/work/programmes/gpap_home).*

In Fiji, there are currently 23 protected terrestrial areas that meet the IUCN definition of protected areas, and are currently protected under national legislation. They include reserves, national parks, water catchments, sanctuaries and managed areas (see Figure 1)

Other terrestrial management areas in Fiji include proposed Key Biodiversity Areas, Important Bird Areas and Priority Forest Areas. These are areas that have been identified by Fijian experts as important for conservation of biodiversity of key ecosystems and species (see Figure 3).

This indicator describes the status of Fiji's current and proposed protected areas, including their management plans, achievement of biodiversity targets and percent of ecosystem types protected.





Status
Fair to Poor

Trend
Stable

Data confidence
Medium

State: Fair to Poor **Trend: Stable** **Confidence: Medium**

There are 23 existing terrestrial protected areas in Fiji (see Figure 1). They make up a total land area of ~50,000 hectares with ~35,000 ha on Viti Levu and the remaining 15,000 ha on Vanua Levu and Taveuni. In total they account for 2.7% of Fiji's land mass and protect 0 to 19% of Fiji's classified terrestrial ecosystems. This falls far short of Fiji's protection and management targets for the main vegetation types in Fiji (see Figure 2).

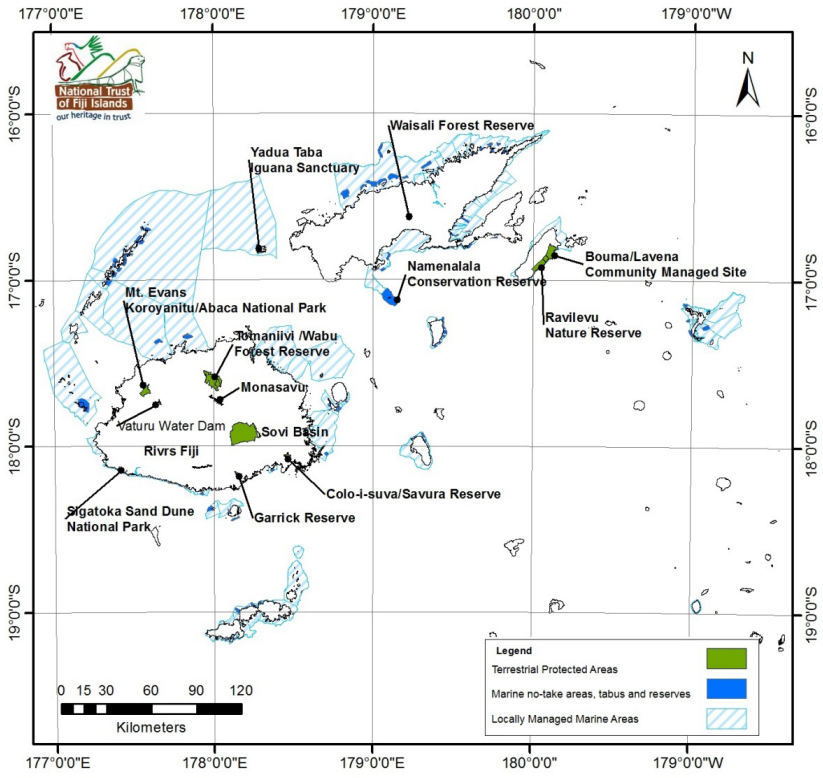


FIGURE 1: Some of Fiji's Existing Protected Areas.
Source: National Trust.

Of the existing protected areas, some are managed by National Trust, some by Forestry, and some are community or privately managed. Most do not have management plans in place. National Trust is currently piloting management plans for Sigatoka Sand Dunes National Park, and Sovi Basin Protected Area.

Classification of Key Biodiversity Areas, Important Bird Areas and Priority Forest Areas (see Figure 3) as protected areas would bring Fiji closer to achieving its protection targets, particularly in the Cloud, Lowland and Upland forests. Combined together with current PAs, the total area protected would be 18% of Fiji's land mass (National Trust, 2008,) and would go further towards reaching Fiji's protection and management targets for key ecosystems, in addition to meeting Aichi targets for protected areas under the Convention on Biological Diversity.

Some of the proposed sites currently have management arrangements through work being carried out by government and NGOs. Work is ongoing to ensure boundaries and biodiversity significance and management needs are identified. However, to date, little capacity or recognition exists to formally protect these sites.

IMPACTS

Protected areas allow ecosystems to recover relatively free from human exploitation. Protected areas directly help prevent the ongoing loss of biodiversity. Protected areas also replenish species populations, and encourage better stewardship by landowners.

Proposed sites may be vulnerable without proper protection. By including these sites into the protected areas definition it would increase the management options available for these areas.

RESPONSE AND RECOMMENDATIONS

What is Fiji doing about our Protected Terrestrial Areas?

Fiji has a National Protected Areas Committee (PAC) that was established in 2008 under section 8(2) of Fiji's *Environment Management Act* 2005, in order to advance Fiji's commitments under the Convention on Biological Diversity (CBD)'s Programme work on Protected Areas (PoWPA). Through a gap analysis the PAC established national targets for conservation and management (identified in Figure 2), collated existing and new data on species and habitats, identified current protected area boundaries, and determined how much of Fiji's biodiversity is currently protected through terrestrial and marine gap analyses. This is an important achievement for Fiji. In addition, the terrestrial working Group for the PAC is composed of representatives from the University of the South Pacific (USP) Herbarium, Conservation International (CI), National Trust Of Fiji (NTF),BirdLife International And NatureFiji/MareqetiViti.

Current priorities for protected areas include:

1. Finding sustainable financing for ongoing management of current and proposed protected areas.
2. Pursuing equitable sharing of benefits from conservation for resource owners and communities. e.g. Sovi Basin
3. Linking protected areas to alternative livelihood projects.

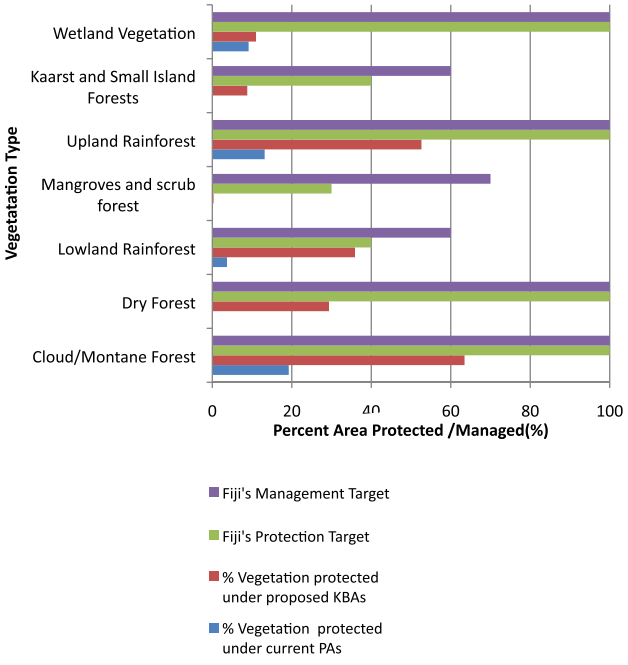


FIGURE 2: Ecosystem and vegetation types protected/managed under existing and proposed protected areas and KBA's. Source: National Trust 2008.

SOURCES

Jupiter, S and Tora, K: Filling the gaps: identifying candidate sites to expand Fiji's national protected area network, Outcomes report from provincial planning meeting, 20-21 September 2010

IUCN, *http://www.iucnredlist.org/.*

National Trust, Protected and proposed biodiversity areas – Maps and figures. 2013

National Trust, Initial PoWPA Assessment for Fiji, 2008

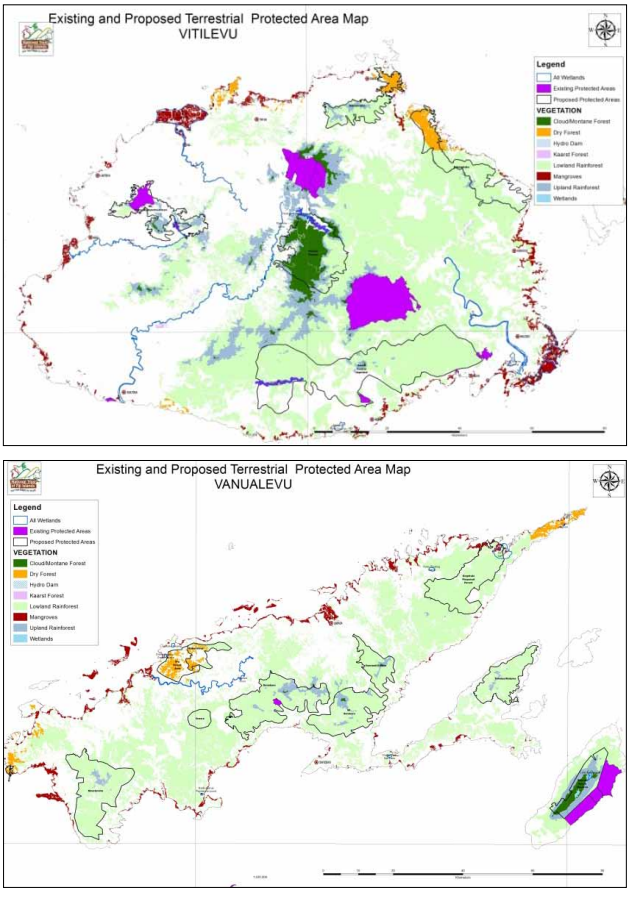


FIGURE 3: Existing and proposed protected areas for Viti Levu and Vanua Levu. Source: National Trust, 2013.

THREATENED SPECIES: NUMBER, STATE OF KNOWLEDGE AND RECOVERY PLANS

Fiji is rich with terrestrial, freshwater and marine plants and animals. Much of Fiji's marine biodiversity is shared with neighbouring countries in the Pacific. It is on the land that Fiji's endemic species (species that only exist in Fiji) dominate. Of the known endemics in Fiji, only 20 in the marine environment are currently documented, compared to almost 3000 known endemics in the terrestrial environment (see Figure 1).

Fiji tracks the status of its species through several international and national programs, these include:

- The IUCN Red List, a comprehensive inventory of the global status of plant and animal species that include 3 status categories. 3 of these categories qualify as "Threatened" status and include Critically Endangered, Endangered and Vulnerable. This list contains some of Fiji's endemics but is not exhaustive on its own for Fiji.
- Species indentified in Fiji's Biodiversity Strategy and Action Plan (NBSAP 2007)
- Species listed in Fiji's *Endangered and Protected Species Act* (2002)
- Other species (endemic, culturally important or occurring in an endangered ecosystem) identified by local experts.

For this indicator, 3 general criteria were used to assess the status and trend of threatened species in Fiji. These are:

- The estimated number of threatened species as a percentage of known species for animal and plant groups.
- The "state of knowledge" about Fiji's threatened and endemic species.
- The number of recovery plans to re-establish and/or protect endangered species.

Status
Poor

Trend
Unknown

Data confidence
Low

State: Poor **Trend: Unknown** **Confidence: Low**

The three dominant messages about the state of threatened species in Fiji are:

1. The majority of Fiji's endemic species are terrestrial and generally face a higher level of threat than their marine counterparts (refer to Table 1 and Figure 2). The greatest pressures faced by terrestrial species are clearing of the native forests, and the spread of invasive plants, insects and animals.
2. For many species in Fiji, there is not enough information to make a sound assessment on their numbers and state. While there is a general consensus that many endemic populations are declining, new information is showing that there have been both underestimates and overestimates on the state of several species. For example, recent targeted surveys of the long legged warbler (critically endangered) show higher numbers than thought previously. Without this information it is difficult to both prioritise species of concern, and develop effective protection and recovery plans.

The Fiji Flying Fox: Fiji's only endemic mammal, rare and data deficient. Source: NatureFiji-MareqetiViti.

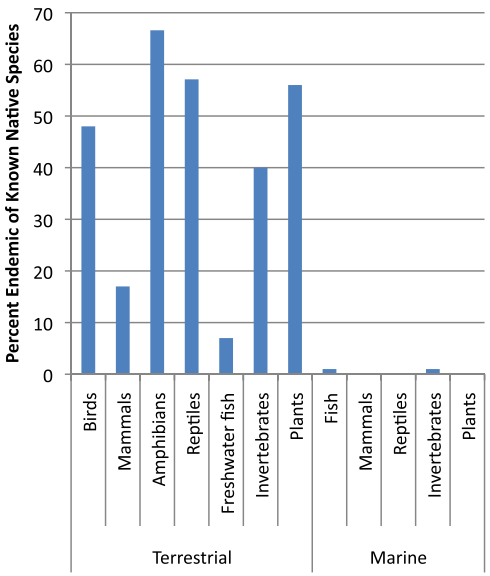


FIGURE 1: Known endemic species in Fiji. Source: NatureFiji-MareqetiViti.

3. There are recovery plans for 7 threatened species in Fiji: The Sago Palm, the Mirimiri Bat, the Crested Iguana, the Red Throated Lorikeet, Sea Turtles, the Fiji Petrel and the Collared Petrel. With the exception of turtles these plans are developed and implemented by NGO agencies in Fiji, with very little government funding for research. The efficacy of these plans is yet to be fully determined, and is discussed in the next indicator on species of concern.

IMPACTS TO FIJI

A number of threatened species in Fiji have social, economic and cultural importance. Many of these species are unique only to Fiji and are a source of national pride.

Furthermore, Fiji's native species have evolved together, and have developed interdependent relationships to help them adapt to Fiji's physical conditions. The loss of certain groups will have impacts on the ecological health of Fiji's unique ecosystems.

RESPONSE

Current efforts to protect our endangered species include:

- Ongoing research by NGOs and universities to aid in prioritization of species requiring attention and management.
- Moratorium on turtle harvesting.
- Development of recovery plans for species at risk mostly led by NGOs in consultation with government.
- Locally managed marine protected areas (LMMAs) in Fiji are playing an increasingly important role in the protection of marine threatened species.
- Identification of key biodiversity areas in Fiji by expert stakeholders and development of management plans to protect them.

TABLE 1: Status of Fiji's Biodiversity. Source: Nunia Thomas: NatureFiji-MareqetiViti, 2014.

Group	Total number of known living species	Number of introduced species	Number of known living, native species	Number (% of native species) endemic to Fiji	Number currently threatened or endangered
Terrestrial					
Birds	68	11	57	27 (48%)	17
Mammals	17	11	6	1 (17%)	2
Amphibians	3	1	2	2 (66.6%)	2
Reptiles	27	6	21	12 (57.1%)	3 (probably an underestimate, needs more research)
Invertebrates	More than 5102 – research ongoing	Research on-going	Research on-going	Estimated at 40% of known species or ~ 2000	Research on-going
Freshwater fish	161	10	151	11 (7%)	Research on-going
Plants	2543	949	1594	893 (56%)	281
Marine					
Fish	1198	15	1183?	14 (1 %)	49 – Research on-going
Mammals	12			0	8
Reptiles	10	0	10	0	3
Invertebrates	1056	Unknown	Unknown	3 (1%)	Unknown
Plants	426	Unknown	Unknown	Unknown	Unknown

RECOMMENDATIONS

- Significantly increase research and data collection on priority species.
- Prioritize and advance terrestrial protected areas to conserve remaining species.
- Advance implementation of recovery plans and improve enforcement of these plans.
- Government to take a more active role in species research, protection and implementation of recovery. plans.

The Fijian Ground Frog: One of 2 known endemic frog species in Fiji that are threatened by loss of habitat and invasive species such as the mongoose, the feral cat and the cane toad. Source: NatureFiji-MareqetiViti.

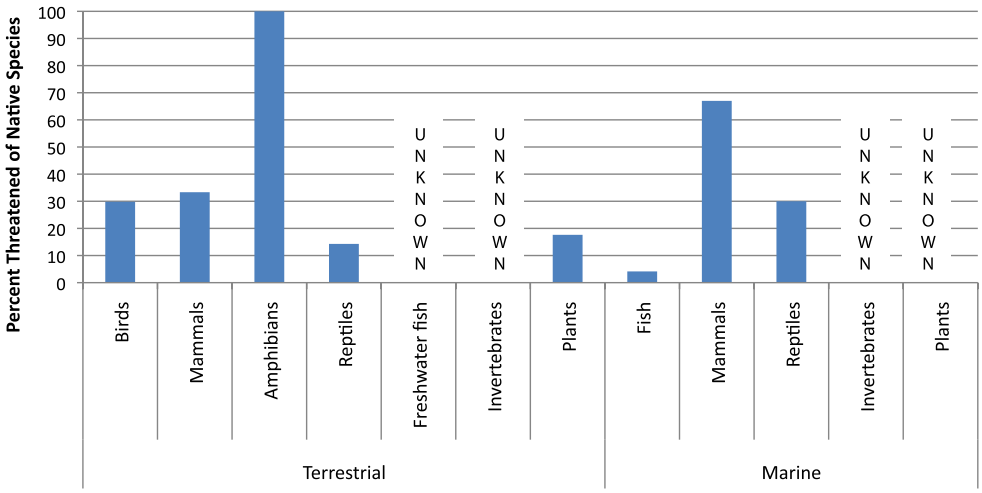
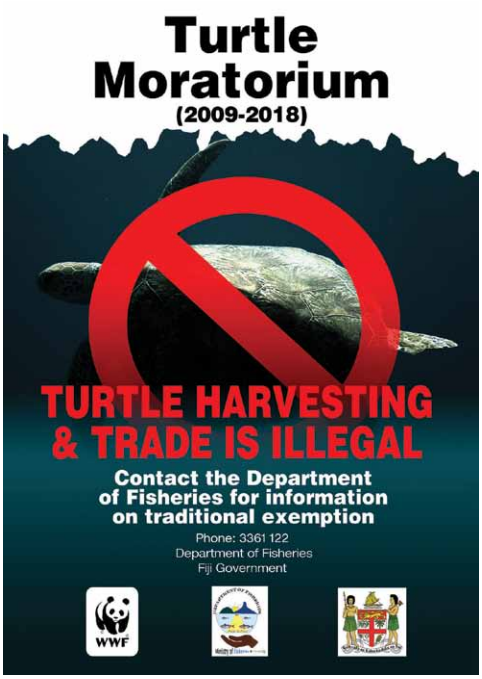


FIGURE 2: Percent of Native Species Threatened in Fiji. Source NatureFiji-MareqetiViti, 2014.

The critically endangered Hawksbill Turtle, a native of Fiji. Between 1984 and 1989, more than 5000 Hawksbill turtles were killed in Fiji for the shell. Traditional practices of anointing of chiefs included the harvesting of turtles, although this has been moderated in recent years. Source: NatureFiji-MareqetiViti, 2014.



As part of Fiji's Sea Turtle Recovery Plan, a turtle harvest and trade moratorium is in place in Fiji. Illegal harvesters face stiff fines. Source: WWF-Fiji.

SOURCES

Fiji State of Birds 2013, A Guide for Conservationists, Policymakers and Communities, NatureFiji-MareqetiViti

Thomas, Nunia. Draft Writeup on the "Endangered Species of Fiji Project", 2008. NatureFiji-MareqetiViti. www.naturefiji.org

Photos sourced from www.naturefiji.org used by permission of NatureFiji-MareqetiViti

PETREL, SAGO PALM AND CRESTED IGUANA

The number and variety of threatened species in Fiji makes it difficult to report comprehensively on the state of each species in this report. In addition, as the previous indicator noted, there is very little information available on many species to do a full assessment. So for the purpose of this report, three species were chosen that had reasonable information available, established recovery plans and were endemic to Fiji.

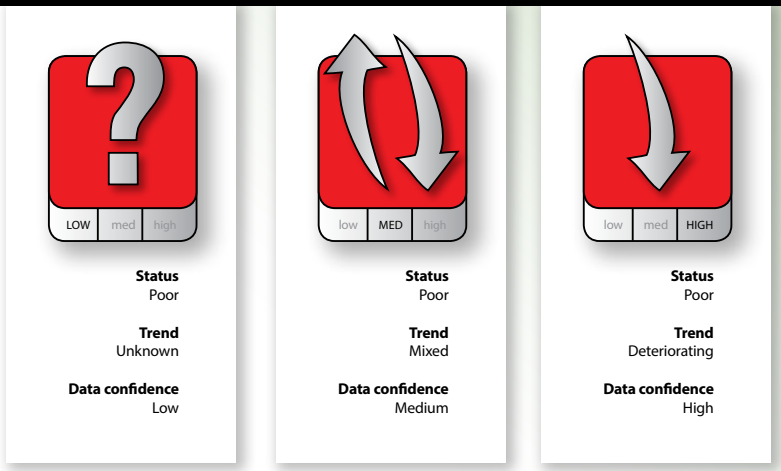
The three species chosen were:

The Fiji Petrel, an endemic seabird found only on Gau Island. The Fiji Petrel is listed as a Critically Endangered species in the IUCN Redlist of Threatened Species. For over a century it was known from a single fledgling collected from Gau in October 1855. It was presumed to be extinct until an adult was caught near the summit of Gau and subsequently released in April 1984. Since 1985, there have been 17 reports of Fiji Petrels which have landed on the roofs of village houses on Gau (from www.NatureFiji.org, 2014).

The Crested Iguana, a critically endangered endemic iguana that is now found only on a few islands and inhabits dry forests, Fiji's most endangered habitat (From www.NatureFiji.org, 2014).

The Sago Palm, an endemic palm found mainly now in Serua Province, Viti Levu. It used by communities for roof thatch and *seko* (or palm heart) but is under serious risk of extinction from overharvesting, land clearing and drainage (From www.NatureFiji.org, 2014).

The state of these species is assessed based on 2 factors; the current population trend and the efficacy of management and recovery plans.



FIJI PETREL | CRESTED IGUANA | SAGO PALM

THE FIJI PETREL

Status: Poor | **Trend: Unknown** | **Confidence: Low**

Current Population: less than 50 breeding pairs

Trend: Unknown, but likely to deteriorate if invasive rats, cats and pigs persist on Gau.

Main threats: Invasives, fishing line entanglement and other interactions with humans.

Recovery Plan: Started in 2003 and focused on invasive management, community awareness in Gau and research of breeding sites. No nests discovered to date.

Level of Management Success: Not enough data.

Grounded Fiji Petrel from 1984. Source: Watling, NatureFiji.

THE CRESTED IGUANA

Status: Poor | **Trend: Mixed** | **Confidence: Medium**

Current Population: ~13,000 individuals

Trend: Stable or increasing on Yadua Taba island due to conservation efforts, but likely declining elsewhere.

Main Threats: Invasives and loss of dry forest habitat.

Recovery Plan: Began in 2008 but preservation has been ongoing since the 1980s, with the creation of the Yadua Taba Iguana sanctuary.

Level of Management Success: Preservation efforts have staved off extinction but threats remain, particularly to the dry forest habitat.

Crested Iguana. Source: Species Recovery Plan 2008–2012.

THE SAGO PALM

Status: Poor **Trend: Deteriorating** **Confidence: High**

Current Population: Only 12 isolated populations survive, mainly on southeastern Viti Levu.

Trend: Deteriorating and at risk of extinction.

Main threats: The Sago's short life span and reproduction method make it extremely vulnerable to land-clearing. Currently the main pressures are from land drainage and clearing for agriculture and housing. Harvesting for roof thatch and seko is also a pressure and is not sustainable.

Recovery Plan: The Sago Palm recovery plan was developed in 2008 by NatureFiji-MareqetiViti and has focused on the development of sustainable harvest methods and introducing the peach palm as an alternative to the seko palm heart. One 10ha site also been restored.

Level of Management Success: Increased awareness has occurred as part of the recovery plan, but it is too early to tell if Sago populations will stabilize.

The threatened Sago Palm. Source: NatureFiji–MareqetiViti.

Sago Palm Thatch.

The critically endangered Fiji Petrel, endemic to Gau Island. Photo: Hadoram Shirihai.

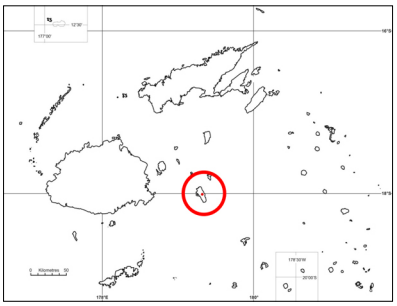


FIGURE 1: Distribution of the Fiji Petrel. Source: NatureFiji-MareqetiViti.

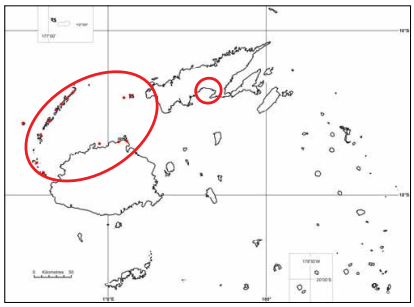


FIGURE 2: Distribution of the Crested Iguana. Source: NatureFiji-MareqetiViti.

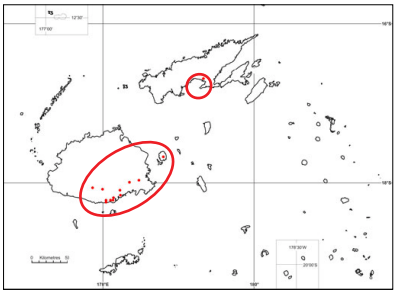


FIGURE 3: Distribution of Sago Palm. Source: NatureFiji-MareqetiViti.

ANALYSIS AND RECOMMENDATIONS

An analysis of these plans reveals three main recommendations to improve threatened species protection in Fiji:

1. **There needs to be shared leadership between government and NGOs on species management.** To date, most of the impetus and leadership on protecting threatened species has come from NGOs. NGOs have been very effective at bringing awareness to the plight of threatened species in Fiji, and developing community and science based tools to protect them. However, without leadership from government, it is very difficult to implement the plans fully. In particular, government leadership is required in the enforcement of both recovery plans and legislation, to protect species and habitats across Fiji.
2. **The local community is integral to the success of the plan.** Community awareness, training and local solutions have been successful in stabilising some species populations. The best example of this is the qoliqoli Marine Managed Areas network in Fiji.
3. **Priority should be given to Fiji's endemic species.** Often, much emphasis is placed on protecting species with international significance or familiarity, to the detriment of less recognizable endemic species. The Sago Palm is a classic example. In the 1992 Fiji SOE report, both green turtles and the palm were classified as two species requiring protection under law. Only the turtle was protected under law in the aftermath of that report, and the Sago Palm has experienced significant decline since.

SOURCES

National Trust: *Fijian Crested Iguana Species Recovery Plan 2008–2012,* 2008

NatureFiji-MareqetiViti: *The Critically Endangered Fijian Crested Iguana*, Animal Conservation Notes. 2008.

NatureFiji-MareqetiViti: *Conservation and Sustainable Management of Soga – The Fiji Sago Palm*, Nature Conservation Notes. 2008.

www.naturefiji.org for photos, maps and other information. on threatened species.

This chapter deals with the cultural and heritage elements of Fijian society as they relate to the environment; and the impact of a changing envionment on culture and heritage. An important aspect of any state of the environment report is the linkage between people, tradtions and the environment.

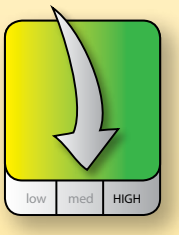
For this theme, 3 main indicators were chosen to highlight the current relationship between culture and the environment:

1. The State of Heritage and Indigenous sites, which tie directly to the environment as either a preserved environmental/heritage site such as Sigatoka Sand Dunes or a building that reflects the cultural heritage and environment of a historical period.
2. The State of Traditional Environmental Knowledge, showcasing the use of traditional managed areas, land uses and ecological products.
3. The State of Traditional Diets, highlighting the ties between diet and culture, and diet and the environment through agricultural practices, food security, and reliance on imports.

All indicators show that traditional culture is still fundamentally strong in Fiji, and forms the basis for both new and old environmental practices. However, certain areas, such as a rapidly modernizing diet of “easy to prepare” foods, is having a significant impact on the resilience of Fijians to weather economic and natural disasters. In addition, there are “overlooked” areas, such as certain historical and indigenous sites that require better management and care, further strengthening ties between Fijian culture and the environment. Fiji is modernizing rapidly, and the traditional socal structure is changing. However, much of Fiji’s success can be found in embracing both the past and future.

Mix of old and new: Sitting for a Fijian dinner. Photo: Paul Anderson, SPREP.

HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
BUILT HERITAGE AND INDIGENOUS SITES 	 **Status** Good to Fair **Trend** Mixed **Data confidence** Medium	Overall most recognized heritage sites in Fiji have some level of preservation or management, some better than others. There appears to be no significant difference in overall state between built and indigenous heritage sites. Continued environmental and anthropogenic pressures on these sites underline the *need for protection*.	Protection of culturally significant sites is aided by several agencies including the Fiji Museum, the National Trust of Fiji and the Fiji Arts Council under the *POAPI act,* the *National Trust Act* and the *Charitable Trust Act*. Focus should be given to sites (e.g. rock paintings) that are particularly vulnerable to erosion and other pressures.
TRADITIONAL ENVIRONMENTAL KNOWLEDGE 	 **Status** Fair **Trend** Mixed **Data confidence** Medium	Like most aspects of Fijian culture, traditional knowledge is undergoing pressures from modernization, but is still widely intact across Fiji today. Some aspects of sustainable environmental practices are being replaced by modern practices, but many have either been revived, or remain firmly part of the Fijian cultural landscape.	The ministry of iTaukei Affairs commenced a Cultural Mapping exercise in 2004, with the objective of safeguarding iTaukei traditions and will be completed by 2018. More research needs to be carried out on the use of traditional knowledge in preserving and interacting with ecosystems, particularly agricultural practices to protect the remaining natural forest.
TRADITIONAL DIETS 	 **Status** Good to Fair **Trend** Deteriorating **Data confidence** High	Overall Fijians still consume a large amount of traditional, locally produced foods, particularly when compared to countries across the Pacific. A strong subsistence base remains but there is increasing evidence that this is changing very rapidly with the decline in agriculture across Fiji, as well as the mass import of prepared foods.	Principle recommendations for maintaining traditional diets include: Health programs encouraging consumption of traditional foods and regulations on the import and advertising of un-healthy “snack” foods like instant noodles, soda pop and chips. Additionally, conservation of traditional crop varieties is important.

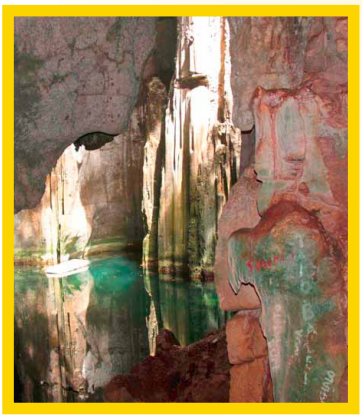
Indigenous heritage sites are conserved for their value and significance to the Fijian community. Built heritage sites are those buildings, structures and sites that contribute to our national shared heritage, and are valued for their representation of that heritage, including colonial and post colonial heritage.

The protection of national heritage is overseen via several bodies, namely the Department of Culture and National Heritage, The Fiji Museum, The National Trust of Fiji and the Fiji Arts Council.

The National Trust of Fiji protects 14 heritage sites (both indigenous and built included) throughout the islands, five of which are community conservation projects demonstrating the involvement of local Fijians in heritage preservation. These projects include: (1.) The Fiji Petrel Project in Gau Island (2.)Koroyanitu National Heritage Park on western VitiLevu (3.)Bouma National Heritage Park, Taveuni (4.)Muanakaka Bird Sanctuary, Kadavu and (5.) Levuka Town.

The National Museum is also a key place where artifacts, carvings and sketches of our rich cultural heritage are being preserved. Conservation is important to retain knowledge of the past, especially with changes in traditional society.

This indicator looks at the state of select indigenous and built heritage sites across Fiji and provides a glimpse into the value Fiji places on preserving its ethnic and national identities.



Status
Good to Fair

Trend
Mixed

Data confidence
Medium

State: Fair to Good Trend: Mixed Confidence: Medium

Overall most recognised sites in Fiji have some level of preservation or management, some better than others. There appears to be no significant difference in overall state between built and indigenous heritage sites.

Some sites are well preserved often due to scientific research values, or a unique eco-tourism value where funding is generated to assist maintenance. Some, like rock art are under pressure from environmental and human damage, and need further protection. Others, such as the first botanical garden in Lomaloma Lau have deteriorated considerably over time. However, some find funding for restoration, such as the case of the Grand Pacific Hotel.

INDIGENOUS HERITAGE SITES

Sigatoka Sand Dunes

Designated in 1989 as Fiji's first National Park, the Sigatoka sand dunes consists of an area of 650 hectares with a rich combination of geomorphological, ecological, cultural, and aesthetical attributes. It is being managed by the National Trust of Fiji, and is generally in a good state of preservation with significant national and tourist importance. Indigenous artefacts, such as Lapita Pottery are still discovered at the site. (Source: National Trust, 2014).

Top: Lapita Pattery (Sigatoka Sand Dunes). Bottom: Momi Gun Battery, Viti Levu. Source: National Trust of Fiji, 2013.

Right: Sigatoka Sand dunes National Park. Source: National Trust of Fiji, 2013.

VOLIVOLI CAVE

Volivoli Cave is located in Sigatoka on VitiLevu and contains rich archaeological deposits. It is the first site containing Quaternary terrestrial animal remains, and is considered a site of national heritage significance. Notable species recovered from the cave include an ancient crocodilian species, a tortoise, a giant iguana, a boid snake, three species of frog, several birds, a new giant megapode, and a giant pigeon (Worthy, 1999).

A conservation plan to protect the cave is now in place and was developed by the University of the South Pacific in cooperation with land-owners. Much of the maintenance work is done by local landowners using local materials.

The owners of the caves from Yadua Village have agreed to develop the site as an eco-tourism attraction as a source of income for their village. While this is positive, it is crucial that the archaeological and historical integrity of the site be preserved through good planning and management. Source: Fiji Museum).

Volivoli Cave: Source http://www.travelnewsdigest.in/

Vatulele Rock Painting: Source: Fiji Museum.

ROCK ART

Rock art, categorised as rock painting, engraving, or petroglyphs, is a medium of imparting messages that has been identified in several areas around Fiji, including Vanua Levu, Yasawa, Vatulele, Ovalau, Moala and VitiLevu.

Although 16 rock engraving sites have been documented in Fiji, Vatulele is the only rock painting site in Fiji. The Vatulele Rock Art painting is an extended gallery of at least 95 images painted on the face of low, wave cut limestone cliffs on the west coast of the island of Vatulele. Of all the rock art sites in Fiji, it is one of the most enduring and well visited by local and foreign tourists alike (Ewans, 1995).

Little research has been done on rock art in general, and little protection is provided to preserve the rock art that remains. The Vatulele painting is the best researched, and yet the site itself has very little protective barriers from the public or natural erosion. Source: Fiji Museum).

FIJI'S BOTANICAL GARDENS

Fiji has several botanical gardens originating from the colonial period. Many of these gardens, such as the Thurston Garden in Suva are well maintained and preserved for future generations.

One exception is "Senikau", Fiji's first botanical garden, located in Lomaloma, Vanua Balavu Lau. It later became known as RatuSukuna's Official Residence in Lau. The Garden was established in the 1880s after the Deed of Cession in 1874, and was looked after by Government officials stationed in Navavaoa.

However, after the Government's Office was vacated to Levuka and Suva, the garden was used for crop plantation by the school and landowner, and gradually deteriorated to the point that almost nothing of the original garden remains today. Source: Seru, 2006).

The piece of land which was once the famous garden, is now filled up with plantations of taro, yams, bananas, cassava, pineapples, water melons and many other fruit and root crops.

Suva's Thurston Gardens: Original site of the Suva Settlement. Source www.myfijiguide.com.

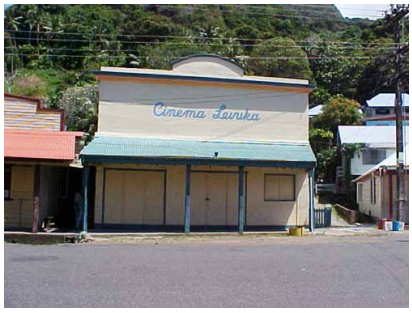
LEVUKA TOWN

Levuka is the old capital of Fiji located on the island of Ovalau. It is the town where the deed of session was signed. Its national heritage significance has long been recognised with Government officially declaring it a Historic Town in 1987 in order to secure adequate and comprehensive protection of the values of heritage places there.

Levuka still has remains of colonial buildings. The Morris Hedstrom building in Levuka is one of the sites currently protected by the *National Trust Act.*

Levuka town most recently became recognised by UNESCO as a World Heritage Site in June 2013.

MH Building, Levuka. Source: National Trust of Fiji.



Cinema Levuka. Source: National Trust of Fiji.

THE GRAND PACIFIC HOTEL

The Grand Pacific Hotel (GPH) located on the main seafront along Victoria Parade in Suva, first opened on May 23rd, 1914, just three months before the beginning of World War I. It was built by the Union Steam Ship Co. to serve the needs of passengers on its transpacific route. It was a building of splendour in the early 1900s and hosted opulent receptions, royalty made appearances on the balcony, and honeymoons in the all white bridal suite were popular events (Stephenson, 1997).

The building changed ownership several times and finally closed in 1992. This magnificent and historic colonial building remained an empty shell, falling into despair for several years until recently. It is now being restored to a 5 star hotel with the help of the Fijian government's Fijian Investment Cooperation Ltd (FICL). Restoration began in 2011 and is due for completion in 2014, which should be in time for the hotel's 100 year anniversary.

Above: The Grand Pacific Hotel in 1983. Photo: Gary Gillard .

Left: The Grand Pacific Hotel c. 2006. Photo: Alice Tamani.

IMPACTS TO FIJI

Fiji's culture and national heritage often brings interested travellers and researchers. This supports tourism as a big revenue earner in Fiji.

With globalisation, it is even more vital to conserve what has been inherited from our ancestors, so future generations as well as visitors can learn of our cultural identity.

Economic development and urban expansion leads to more clearing of old sites, hence the need to assign protective status to those of high significance for their preservation for future generations.

RESPONSE

How is Fiji Managing our Indigenous and Built Heritage Sites?

Conservation of the national heritage sites is undertaken mainly by the Department of Culture and Heritage, with three critical statutory bodies: The Fiji Museum, The National Trust of Fiji and the Fiji Arts Council.

- The Fiji Museum is mandated to oversee the preservation of national heritage under the *Preservation of Object of Archaeological and Paleontological Interest* (cap 264: POAPI). This encompasses the cultural history of the people of Fiji, and their relationship with the people of the South Pacific and the rest of the world. The Museum preserves these valuable collections for presentation to the public.
- The National Trust of Fiji operates under the *National Trust Act* cap 265; funded jointly by the Fiji Government, independent donors and multi-lateral projects. It was established in 1970 to provide for the protection of Fiji's natural, cultural and national heritage. It is the only National Trust of the South Pacific region, and specialises in both the natural and cultural aspects of heritage conservation. National Trust also runs awareness programs on some of Fiji's disappearing wildlife and cultural values.
- The Fiji Arts Council (FAC) was established in 1964, and has been engaged in various activities to encourage and promote the works of Fijian artists and craftspeople. Registered as a formal organisation under the *Charitable Trust Act,* the FAC receives a grant from government together with a service agreement annually.

RECOMMENDATIONS

The POAPI Act requires review to ensure that its mandate aligns with current pressures and activities.

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Photos used by permission of the Fiji National Trust and The Fiji Museum.

Suva's Thurston Gardens: Original site of the Suva Settlement. Source www.myfijiguide.com

Cinema Levuka. Source: National Trust of Fiji

The Grand Pacific Hotel in 1983. Photo: Gary Gillard

The Grand Pacific Hotel c. 2006. Photo: Alice Tamani

TRADITIONAL ENVIRONMENTAL KNOWLEDGE: QOLIQOLI, AGRICULTURE AND ECOLOGICAL PRODUCTS

Traditional Knowledge means the knowledge, know-how, skills and practices that are developed and sustained within a cultural community and passed on from generation to generation, forming part of its cultural identity. Traditional knowledge provides a link with our ethnic group and country. It is also a living heritage, that through interactions with the environment, can improve human responses to environmental changes. In many cases, it helps maintain a healthy and sustainable relationship between humans and the environment.

For the State of Environment Report, traditional knowledge is analysed from the perspective of its interactions with the environment. For this indicator, we look at the status of three traditional environmental practices that exist today

1. the use of traditional qoliqoli areas for management of coastal fishing areas,
2. traditional agricultural practices and
3. the traditional use of natural "products" for social and economic benefit.

Status
Fair

Trend
Mixed

Data confidence
Medium

State: Fair **Trend: Mixed** **Confidence: Medium**

Like most aspects of Fijian culture, traditional knowledge is facing pressures from modernisation and societal change, but is still widely intact across Fiji today. Some aspects (like fishing methods and mechanized agriculture) are being replaced by modern practices, but many have either been revived, or remain firmly part of the Fijian cultural landscape. The same holds true for traditional environmental practices. Three of these are discussed below:

Qoliqoli

Since the mid 1990s, Locally Marine Managed Areas (LMMAs) have been developed in Fiji based on the traditional iTaukei qoliqoli system. A significant feature of Fiji's qoliqoli is the use of traditional 'tabu' or closed zones. These are fishing areas closed off temporarily or permanently, that serve to re-stock depleted fish and invertebrate stocks near and within the tabu closure. This traditional practice, that was once abandoned, has been revived and is largely successful in providing sustainable management of the coastal fisheries. It is perhaps the best example of traditional knowledge being used to protect and manage the environment in Fiji.

Making Masi Handicrafts.
Source: Elia Nakoro, Fiji Museum.

Traditional Farming Methods

Practiced by both iTaukei and IndoFijians, traditional practices include: under planting of dalo, cassava or wild yams in permanent crop plantations, intercropping for resilience to pests, diseases and changing climate, micro-gardens planted on cane plantations and small farm husbandry of chickens, pigs and goats. Most of these practices allowed farmers to sustainably utilize the land to a fuller extent, and create small markets that provided for their families and communities. Traditional farming practices still exist today but are under increasing pressure as 1) cane farming declines and the associated micro farms disappear and 2) as less people take up farming and move to the urban service sector. Cassava is still widely planted today but less common are the wild root crops like yams (*Uvi*) or the traditional varieties of dalo. (Department of Agriculture, 2009).

Use of Traditional Ecological Products

In Fiji, traditional uses of ecological products still remain, and when done sustainably is a great example of how natural products help us value and sustain ecology. One example is the multiple uses of mangroves in Fiji. In many coastal villages, mangroves are used for multiple purposes including: animal food, preservatives, medicines, toilet paper, fans, corks and combs (Thaman, 2001) However these practices are generally deteriorating as modern products become easier to access, and younger generations no longer practice traditional methods.

Mangroves on Nasoata Island, near the outflow and delta of the Rewa River. Photo: Randy Thaman.

RESPONSE

The following responses are helping in the preservation of Traditional environmental knowledge and customs:

Government's commitment in the continuation of projects-budget allocation for the Ministry of iTaukei Affairs.

The Ministry of iTaukei Affairs commenced a Cultural Mapping exercise from 2004, with the objective of safeguarding iTaukei traditions and culture. This project is anticipated to be completed by 2018. Currently, the Ministry has completed the provinces of Namosi, Serua, Rewa, Tailevu, Lomaiviti, Bua, Ra and Macuata, consisting of 58 percent of the 1170 iTaukei villages (671 villages). Only six of the fourteen provinces are left to be completed and they are Cakaudrove, Lau, Kadavu, NadrogaNavosa and Ba.

RECOMMENDATIONS

More research needs to be carried out on the use of traditional knowledge in preserving and interacting with ecosystems. In particular, the use of traditional sustainable agricultural practices to protect the remaining natural forest. A "Traditional Knowledge and Expression of Culture Decree" is planned for development to protect community rights. Protecting traditional knowledge requires government commitment and political will.

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Department of Agriculture. *Report on the Fiji National Agricultural Census 2009.*

TRADITIONAL DIETS: CONSUMPTION AND PRODUCTION

One component of cultural identity is diet. Like many aspects of traditional culture, today's diets reflect the clash and merging of traditional patterns with modern trends.

For this indicator, traditional foods include traditional diets of iTaukeis and Indo-Fijians. These foods include foods that have formed the main part of Fijian diets for generations. These include traditional root crops, fruit, grains and vegetables such as beans, island spinach, dalo, duruka, cassava, pawpaw, rice, wheat sharps, bele, watermelon, pineapple, rourou and bananas. It also includes traditional protein sources such as fish and invertebrates from both sea and freshwater, chicken, pork, and goat.

This indicator is calculated from two sources: 1) data collected from the Fiji Household and Income Economic Survey (HIES) from 2002 and 2008, when, for the first time, the dietary behaviours of Fijians were recorded and 2) information from the Agricultural surveys of 1991 and 2009.

Status
Good to Fair

Trend
Deteriorating

Data confidence
High

Status: Fair to Good Trend: Deteriorating Confidence: High

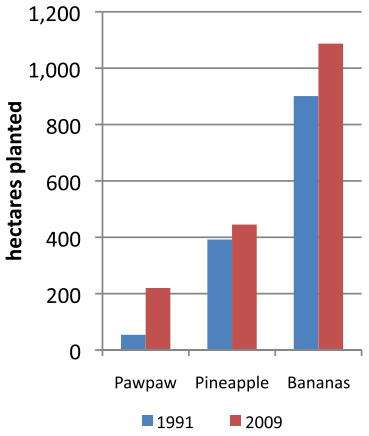
Overall Fijians still consume a large amount of traditional, locally produced foods, particularly when compared to other countries across the Pacific. A strong subsistence base remains, but there is increasing evidence that this is changing very rapidly with the decline in agriculture across Fiji, as well as cultural changes taking place.

Comparison between the 1991 and 2009 agricultural census shows that some traditional foods have declined in dominance, particularly cassava and goats, while others, such as bananas, pineapple, chicken and pawpaw have increased in production (see Figure 1). These changes are likely due to a number of factors including: the increasing demand by the tourist industry for fresh fruits and vegetables, changes in dietary preferences and agricultural market and growing limitations.

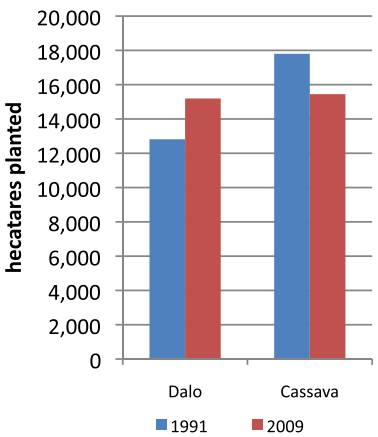
While the agricultural census would suggest that overall, the country still relies heavily on traditional foods, the results of the 2008 HIES suggest that this is changing rapidly. Between 2002 and 2008 consumption of dalo, sweet potatoes, cassava and fresh fish decreased an average of 17% while flour, tin fish, instant noodles and bread increased by 60% on average (see Figure 2).

Suva Fruit and Vegetable Market: Source. Narsey, 2011.

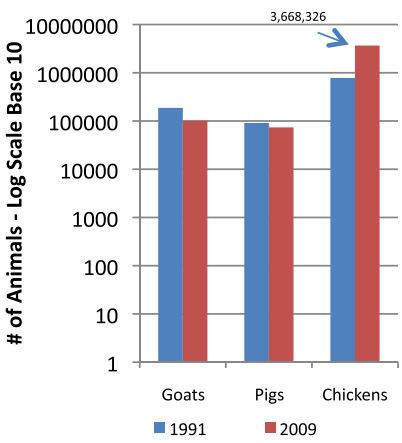
FIGURE 1: Areas in Fiji planted with traditional fruits and crops and traditional livestock numbers 1991 vs 2009. Source: Department of Agriculture Census, 1991 and 2009.



Areas Planted with Select Traditional Fruits (1991 and 2009)



Areas Planted with Select Traditional Root Crops (1991 and 2009)



Select Traditional Livestock Food Sources (1991 and 2009)

IMPACTS TO FIJI

Fiji's exposure to the global market brings many influences to traditional culture, not the least of which is food. The two major impacts seen by a decline in traditional foods are:

1. A reliance on imported "easy to prepare" foods decreases the the resilience of an island nation like Fiji to weather economic and natural crises. Additionally, most prepared foods put further pressure on the waste stream due to intensive packaging.
2. Most locally produced traditional foods are nutritionally better than their imported counterparts. For example, yellow fruits like paw paw are much more nutritritious than imported apples. Furthermore the increasing supplementation of cheap,high sodium starches, such as instant noodles for traditional root crops, has serious implications for Fijian health.

RESPONSE AND RECOMMENDATIONS

Principle recommendations for maintaining traditional diets include:

- Develop health programs and policies on encouraging consumption of traditional foods
- Regulate the import and advertising of un-healthy "snack" foods like instant noodles, soda pop and chips.
- Conserve traditional varieties of crops (currently ongoing at the Koronvia Research Station)
- Develop reform processes in agriculture that provide for a diversity of agricultural products.

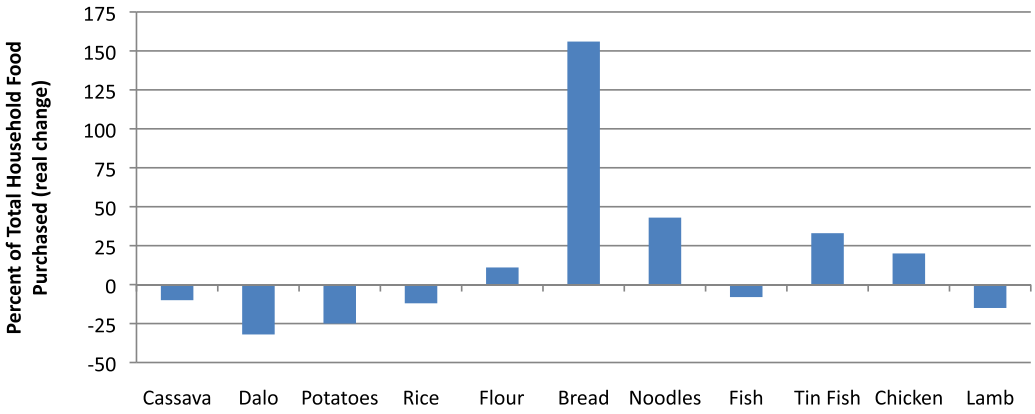


FIGURE 2: Selected Foods Average Consumption of all Fijians – Percent Change between 2002 and 2008. Adapted from Narsey, 2011.

Seafood sold at Suva Market. Source: Timoci Gaunavinaka.

SOURCES

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Narsey, Wadan. *Food Consumption Trends in the Pacific: With Implications for Health and the Economy,* Lecture to Visiting JICA Fellows from the Pacific, October 2011.

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THE RISE OF THE URBAN ENVIRONMENT

Like most countries in the world, Fiji is urbanizing. In Fiji, 52% of today's population lives in an urban environment, compared to 43% in 1992, at the writing of the last SOE. In addition, Fijians have more access to imported goods, including white goods like washing machines and fridges and other products like vehicles.

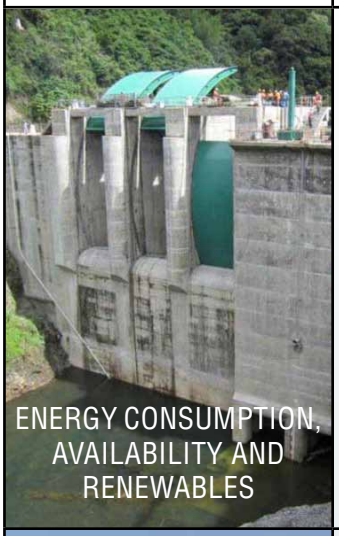
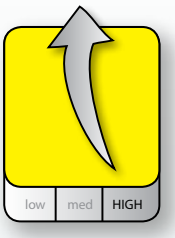
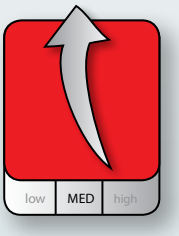
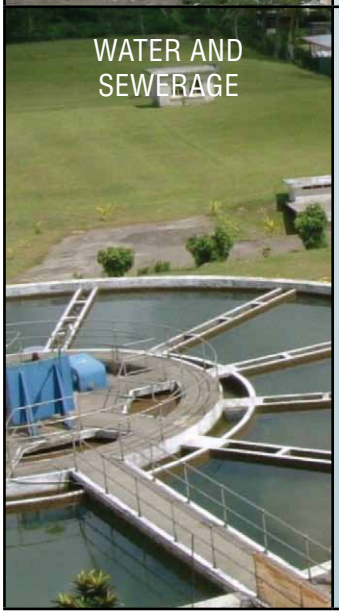
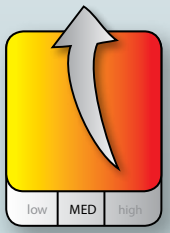
The main environmental impact of urbanisation is that Fiji's urban population continues to outpace the ability of urban services to "keep up" to the demand. There are mixed results on urban services in Fiji. Overall, drinking water and access to electrification have improved substantially over the past 30 years. Although per capita consumption of energy is increasing, new renewable energies such as hydro and bio-fuel plants and improvements to water and energy infrastructure are improving efficiencies dramatically.

Conversely, solid (household waste) and liquid (sewage) are two main waste streams that are having a huge impact on the environment in Fiji. Only 1 of the 8 waste management facilities in Fiji manages solid waste to an acceptable environmental standard (many waste sites burn as a regular practice), and recycling rates, although relatively high for Pacific countries, are still not adequate. Poor functioning septic systems are a legacy issue in Fiji, and much of Fiji's urban creeks and foreshore areas are polluted by excessive nutrients and faecal coliforms from human sewage. In addition, the growing squatter settlements have virtually no sewage treatment.

Suva is now a significantly sized city (approximately 100,000 in the urban area and 200,000 in the greater Suva area), and with the continued burning of waste as well as inefficient motor vehicles, fine particulate pollution is a concern and requires addressing and monitoring.

Boy fishing amidst rubbish in Quaia, near Suva. Photo: Paul Anderson, SPREP.

HIGHLIGHTS

TOPIC	STATUS & TREND	KEY FINDINGS	RESPONSE & RECOMMENDATIONS
 ENERGY CONSUMPTION, AVAILABILITY AND RENEWABLES	 **Status** Fair **Trend** Improving **Data confidence** High	Per capita energy consumption has increased substantially over the past 10 years, largely due to increased access to electricity and market demand. Much of this recent demand has been met by non-renewable resources. Energy efficiency has increased and plans are in place to increase renewable sources of electricity above the current 66%.	Fiji is exploring renewable energy sources to decrease its dependence on oil based imports. These include new hydroelectric projects, bio-fuel plants, investments in solar and wind energy, mini-grid systems, including solar home systems and increasing the role of IPPs in providing renewable power. In addition, the National Energy Policy has been reviewed and includes new policies on clean fuels.
 SOLID WASTE	 **Status** Poor **Trend** Improving **Data confidence** Medium	Waste management, recycling and collection is improving but is generally worse in rural and informal settlements. Overall, collection and recycling rates are not keeping pace with increasing waste generation rates. Only 80% of waste generated makes it to landfills. Most landfills lack segregating facilities for separation of recyclables and hazardous waste, and in many cases, waste is still burnt.	Fiji has piloted the 3R policy in Nadi and Lautoka and made improvements to waste management infrastructure. Further action is required to reduce littering, regulate packaging, manage hazardous waste and stimulate the recycling industry, in particular e-waste. Waste collection in squatter settlements is an immediate priority to reduce litter's impact on the environment.
 WATER AND SEWERAGE	 **Status** Fair to Poor **Trend** Improving **Data confidence** Medium	Access to improved drinking water and sanitation have improved over the past 30 years. However, access to sanitation in some rural areas and informal settlements remains an issue. In addition, poor construction and maintenance of septic systems is likely leading to high faecal coliforms in receiving waters.	Efforts are in place to provide clean water to informal settlements and there is continued investment in water treatment facilities and reticulated systems. Fiji also continues to get more households connected to the sewer system. Focus should be on neighbourhoods that are the biggest sources of pollution. sewage and prioritize hook-up areas to sewerage. This effort needs full support and substantial funding to ensure that priority areas are connected.

ENERGY CONSUMPTION, AVAILABILITY AND RENEWABLES

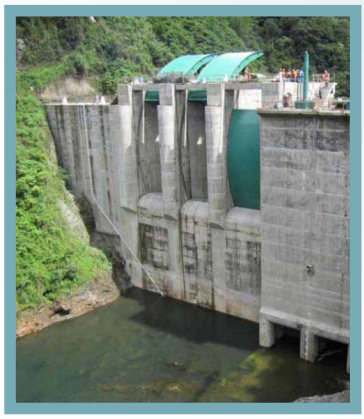
Nadrivatu Hydroelectric plant: Commissioned in 2012 is expected to save FEA 42 million FJD/year in diesel imports. (http://www.hydroworld.com)

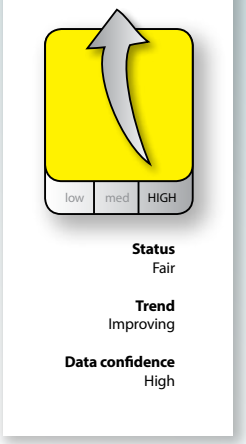
For this indicator, energy is defined as total energy demand and supply for Fiji. These include both electricity production and consumption (the power grid) and petrol, diesel, biofuel and Liquefied Petroleum Gas (LPG) for household and commercial energy needs, including the transportation sector.

This indicator is based on total energy and electricity consumption, energy and electricity availability, energy and electrical efficiency, as well as the percent of renewable energy and electricity in Fiji compared across independent Pacific islands.

Data for this indicator is supplied from the Fiji Bureau of Statistics and the FEA (Fiji Electricity Authority). In addition, baseline data was taken from SPC's Framework for Action on Energy Security in the Pacific (FAESP) country energy security profile surveys, that were completed throughout the Pacific Island Countries (PICs) in 2009.

One of 16 meteorological stations established by the Fiji Dept of Energy to monitor for appropriate wind energy sites. Source, Ministry of FA, 2013.





Status: Fair **Trend: Improving** **Confidence: High**

Total energy consumption in Fiji, like the rest of Pacific islands is substantially dependent on petroleum fuels, which account for ~ 91% of the country's total energy consumption (SPC, 2012). Renewable energy is largely supplied by hydroelectric power, in addition to a small proportion derived from wind, solar, and bagasse (a sugar cane byproduct.

Fiji's electrification rate (as supplied by the Fiji Electricity Authority, FEA) is one of the highest in the Pacific region at 72% of the total Fijian population compared to 23% for the rest of the PICs. Access to energy is generally higher in Fiji in both urban (96% vs 77%) and rural (86% vs 36%) compared to PICs (see Figure 1)

Due to high rates of access, as well as increasing access to electrical goods, Fijians generally consume more energy than their Pacific counterparts. 25% of Fijian household income is spent on energy related needs compared to an average of 19% for all PICs (see Figure 1).

Trends since 2000 show that petrol, electricity and LPG have increased in consumption, while kerosene (a traditional cooking and lighting fuel) has declined, likely because it is replaced by cleaner LPG (see Figure 2). Per-capita electrical consumption has increased approximately 4.7% annually since 2000.

However, despite the increase in energy consumption, Fiji 's energy infrastructure is one of the most efficient amongst PICs with an estimated 11% distribution loss from power plants, well below the average for PICs at 19.4% (see Figure 3).

In addition, Fiji's energy sector has a higher proportion of renewable sources than most other PICs (9% compared to an average of 1.74%). In 2009, Fiji had 61% of its electrical production sourced from renewables (see Figure 4), compared to an average of 13% for PICs (SPC, 2012).

Trends in electrical production show that as energy demand has increased in Fiji, much of the additional electricity supplied for this demand between 2002 and 2012, has come from non-renewable resources. Of the electricity generated in 2012, 67% was sourced from renewable energy (see Figure 5). This is lower than the 75% renewables seen in 2002. Prior to 2002, the % of renewables was even higher, ranging from 80-95% (Dept of Foreign Affairs, 2013).

IMPACTS TO FIJI

There are several economic, social and environmental implications for Fiji in energy consumption and efficiency. Firstly, expanding into more renewable resources for energy production decreases the vulnerability to world market volatility of fuel prices. Also, diversifing energy sources helps reduce vulnerability during disasters.

In addition, the transition to more renewable and/or efficient energy sources reduces greenhouse gases emitted.

RESPONSE AND RECOMMENDATIONS

Fiji is exploring both traditional and non-traditional renewable energy sources to decrease dependence on oil based imports. These include new hydroelectric projects, such as the Nadarivatu Hydro dam commissioned in 2012, the establishment of 4 bio-fuel plants established in Rotuma, Koro, Cicia, and Gau and new investments in solar and wind energy. In addition, FEA and the Dept of Energy are exploring min-grid systems, including solar home systems for households off the traditional grid. In 2009,over 20,000 households in Fiji have been identified that have access to small scale power.

The FEA predicts that by 2015, close to 90% of the electricity produced will be sourced from renewable sources (see Figure 6). The majority of renewable power will be from hydroelectricity and the remaining from independent power producers (IPPs) using biomass, solar and wind energy. Source: Min of FA, 2013.

In addition, the National Energy Policy has been reviewed and is waiting endorsement by cabinet, this includes new policies on cleaner burning fuels.

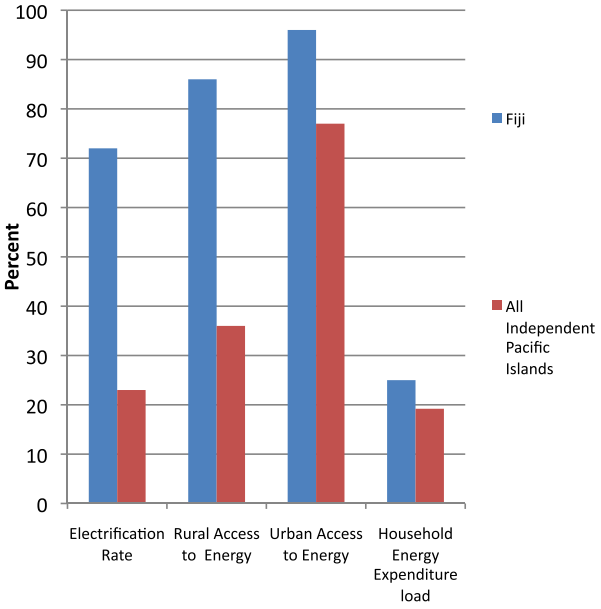


FIGURE 1: Electrification rate, energy access and household energy expenditure (as % of total expenditure) in Fiji, 2009. Source: SPC-FAESP, 2012.

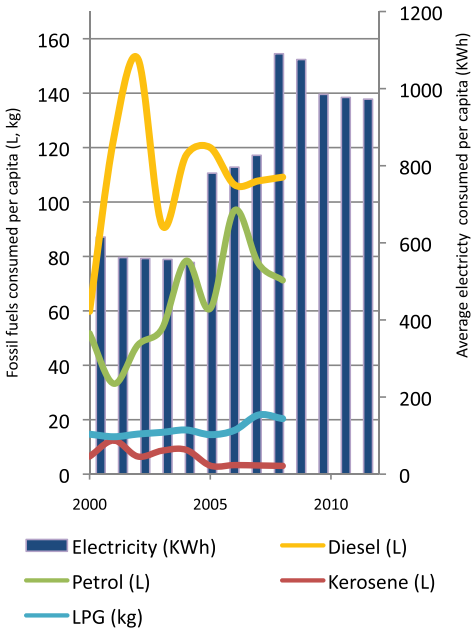


FIGURE 2: Electricity and fossil fuel consumption per capita from 2000 – 2012, not including exports. Fuel data is not available past 2008. Source: Index Mundi and Fiji Bureau of Statistics, 2013.

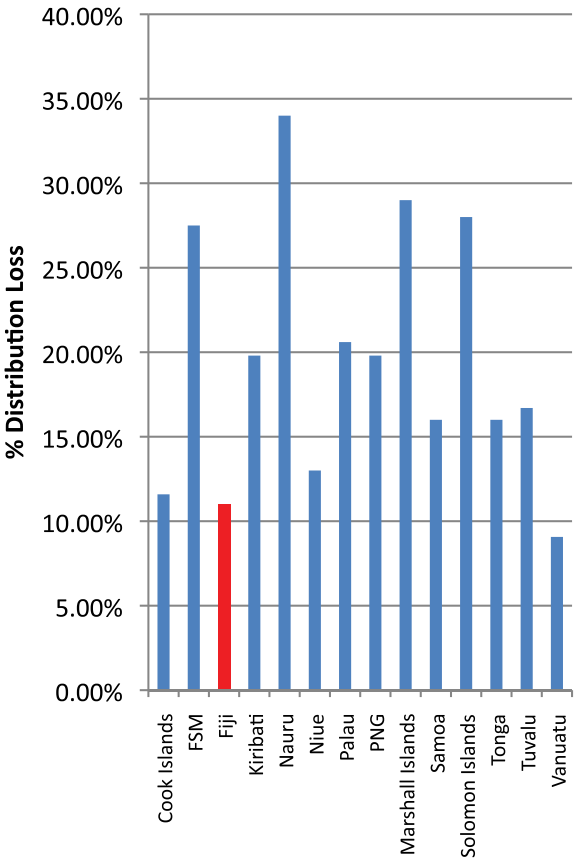


FIGURE 3: Distribution losses for all PICs in 2009. Losses are calculated comparing the amount of kWh sold with the amount of kWh sent out from the power station. Source: SPC, 2012.

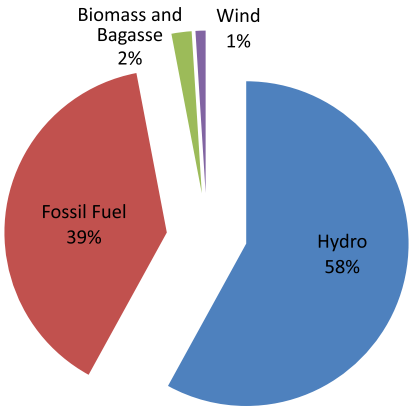


FIGURE 4: Sources of grid-based electricity in Fiji, 2009. Source: Dornan. et al, 2011.

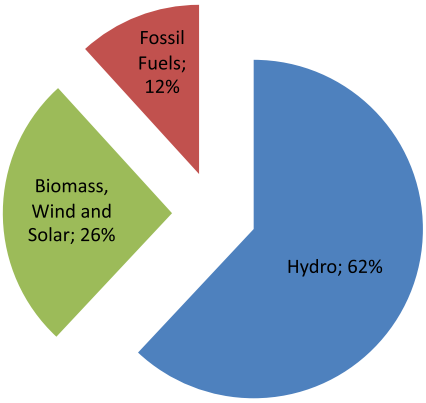


FIGURE 6: FEA estimates for power production sources in 2015. Source: Ministry of FA, 2013.

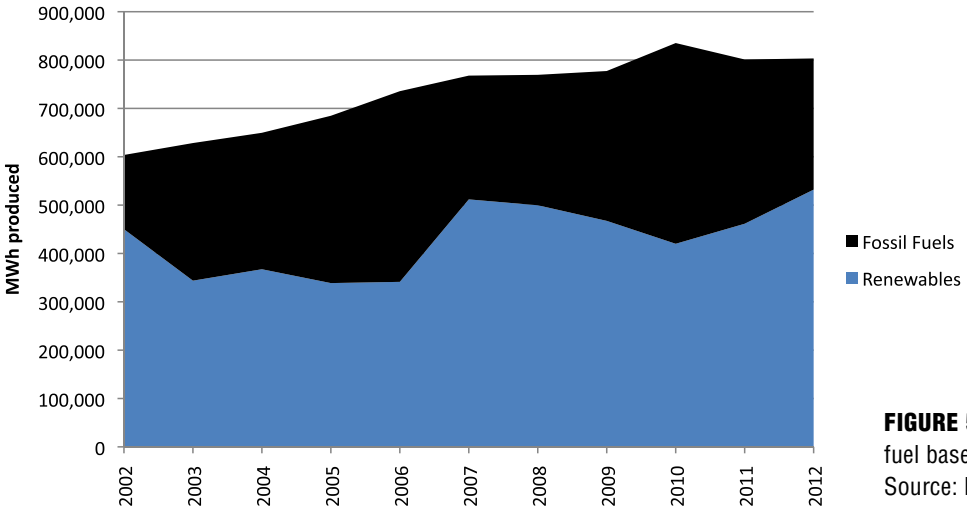


FIGURE 5: Proportion of renewables vs. fossil fuel based power production, 2002–2012. Source: Ministry of FA,2013.

SOURCES

Dornan, M. and Jotzo, F. Electricity Generation in Fiji: Assessing the Impact of Renewable Technologies on Costs and Financial Risk. Australian Agricultural and Resource Economics Society 55th Annual National Conference, Melbourne, 8-11 February, 2011

Ministry of Foreign Affairs, Government of Fiji. Second National Communication to the United Nations Framework Convention on Climate Change, 2013

SPC Energy Programme, Economic Development Division. 2012. Fiji Country Energy Security Indicator Profile 2009

SOLID WASTE COLLECTED, MANAGED AND RECYCLED

Solid waste is one of the biggest environmental issues in Fiji, largely due to physical, technical and social factors. Firstly, the relatively small landbase in Fiji makes siting and proper management of waste sites a challenge. Secondly, access and resources for appropriate collection, management and recycling are limited. Thirdly, the increase in consumption of waste producing goods seen in Fijian society, is not matched by an equivalent increase in recycling or litter reduction.

In Fiji, waste collection data is in the process of being mainstreamed and better coordinated throughout the country. There have been two concerted efforts to gather waste collection data for major population centres in Fiji, one in 2004 and one in 2011. Data from these efforts are used to indicate the state of waste collection and management.

There is very little information on recycling in Fiji, however JICA's recent "Waste Minimization and Recycling Project in the Republic of the Fiji Islands" has provided the best available information on the current state of recycling in Fiji.

Naboro Landfill. Photo: Timoci Gaunavinaka.

Status
Poor

Trend
Improving

Data confidence
Medium

Status: Poor **Trend: Improving** **Confidence: Medium**

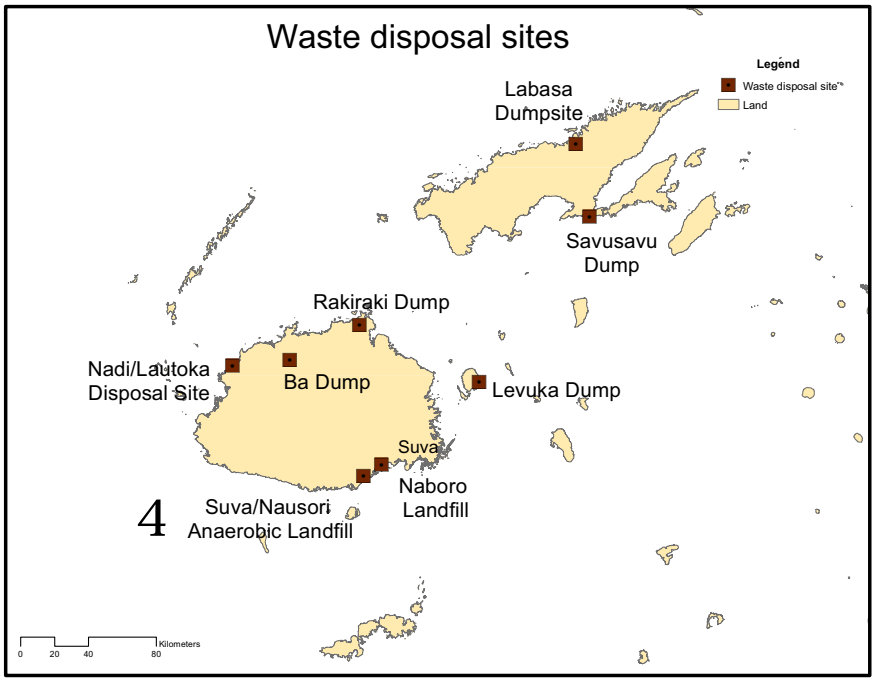


FIGURE 1: Waste Disposal sites in Fiji.
Source: Fiji National Solid Waste Management Strategy.

In 2010, the eight major waste disposal sites (Figure 1) collectively received an estimated 98,824 tonnes of solid waste. Eighty three (83%) percent of the waste was received from by Naboro landfill and Lautoka Dump (serving greater Suva, Nadi and Lautoka). Waste included all sources and was assessed based on the weigh bridges installed at both sites. The other 17% of the waste was produced primarily in the urban environment and was assessed by surveys and population alone.

Based on average waste generation rates per capita in urban (~0.4 kg/person/day) and rural areas (~0.3 kg/person/day), about 80% of waste generated (~122,000 tonnes) in Fiji is collected and disposed of at the 8 major sites (see Figure 2). The remaining waste is not collected and assumed to be handled at the household level through burying, dumping or burning.

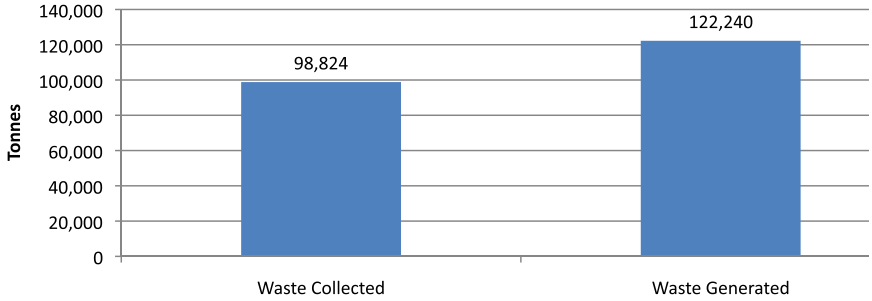


FIGURE 2: Waste collection at the 8 major disposal centres vs estimated waste generated for all of Fiji in 2010. Waste generation rates based on 2008 waste surveys across Fiji. Source: Source: Fiji National Solid Waste Management Strategy.

Of the 80% that does make it to a disposal site, dumping with little or no waste management is a major issue in several areas of Fiji. The Naboro Sanitary landfill is the only landfill that meets environmental waste management standards in Fiji, and while there have been some improvements on some dumpsites, most sites lack data recording and segregation procedures for recycling and hazardous waste. In many cases, waste is still burned.

Table 1 provides estimated recycling rates for major waste items. Figure 3 shows recycling rates for municipal solid waste have been calculated for Nadi and Lautoka based on a 2008 survey performed by JICA (no other cities have been surveyed to date). Relative to developed countries, rates are generally low and range from 3% to 8% for Nadi and Lautoka respectively, compared to other developed countries that typically recycle 30 to 45% of MSW. Recycling services are improving but still require major development (Figure 3).

TABLE 1: Estimated recycling rates for major waste materials in Fiji. Source: JICA, 2013.

Waste Material	Estimated Recycling Rate
Vehicles	65%
White Goods (washers, dryers, computers etc.)	20%
Steel Cans	40%
Aluminum Cans	40%
PET bottles	30%
Paper and Cardboard	10%
Other scrap metal	85%
Construction waste	0%
Gas and Oil containers	0%

IMPACT

The impacts of solid waste on the environment, society and economy are varied and include:

- The discharge of toxins to sensitive environments and interactions with sensitive species.
- The spread of diseases through unsanitary waste management methods, in addition to health impacts from burning of plastics.
- Wasted economic resources (e.g. land space and recyclables) and the growing expense to clean up unplanned dumping.
- Impact to tourist enjoyment of the landscape.

Responses are provided in the next section on waste generation and littering.

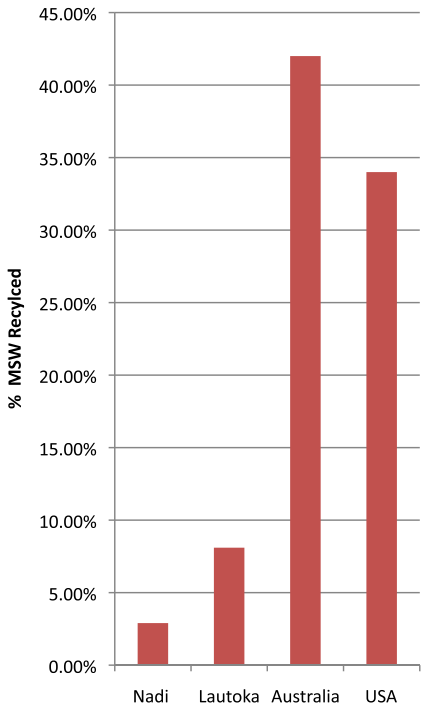


FIGURE 3: Estimated recycling rates for all MSW. Sources: Fiji – JICA, USA: EPA, Australia: 2011 State of Environment.

SOURCES

Ministry of Urban Development, Housing and Environment. Fiji's National Solid Waste Management Strategy 2011-2014, 2010.

EPA, Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2011.

Japan International Cooperation Agency (JICA),

Data Collection Survey on Reverse Logistics in the Pacific Islands, 2013

Waste burning at a dumpsite near Sigatoka. Photo: Mark Graham, SPREP.

SOLID WASTE GENERATION AND LITTERING

In the past 20 years consumption of goods has increased dramatically in Fiji. One example is the dramatic increase in household white goods (computers, TV's, washers, dryer and fridges) seen since 1990 (Figure 1).

As consumption rates and populations increase, so too does waste generation, particularly of products requiring more complex waste management such as e-waste (cell phones and computers). In addition, the potential is higher for littering, which has been an issue for several decades in Fiji.

Data for waste generation is taken from the JICA "Waste Minimization and Recycling Promotion Project" in Nadi and Lautoka as well as Fiji's National Waste Management Strategy. Littering data is taken from a 2004 study in Suva.

Litter along Lami Seawall, 2014.
Photo: Paul Anderson, SPREP.

Status
Poor

Trend
Unknown

Data confidence
Low

Status: Poor **Trend: Unknown** **Confidence: Low**

Overall waste generation is increasing in Fiji, and although waste management and recycling appear to be improving, they are not keeping up with the rate of waste generation.

Using waste composition data from Nadi and Lautoka, kitchen wastes make up almost 60% of municipal solid wastes generated in Fiji (Figure 2). Little is known as to how much kitchen waste is composted and it likely varies between rural and urban areas. The remaining 40% of waste is dominated by plastics (bags and bottles), metals and paper.

Waste generation rates for Fiji are varied and are generally higher for urban areas than rural areas. Figure 3 shows the estimated rates of waste generation for Municipal Solid Waste in 2008 and 2011.

No data exists on trends in littering, although efforts have been made to reduce littering in Fiji. Figure 4 shows the results of a litter survey done in 2004 in Suva. The data suggests that the major components of litter are plastic wrappers, bags and bottles(Figure 4). It is unclear whether littering is increasing or decreasing.

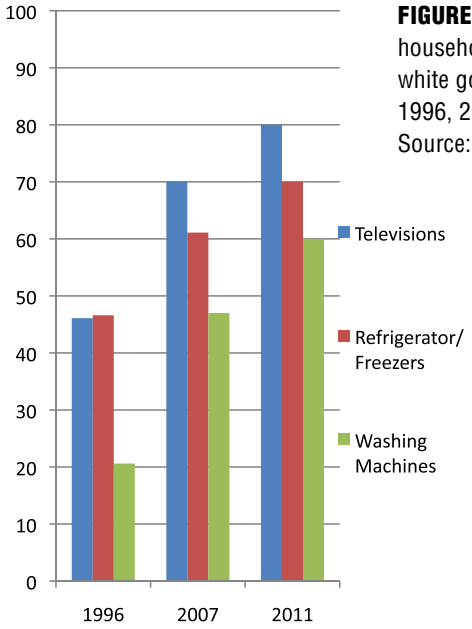


FIGURE 1: Percent of households owning white goods in Fiji 1996, 2007 and 2009. Source: JICA, 2013.

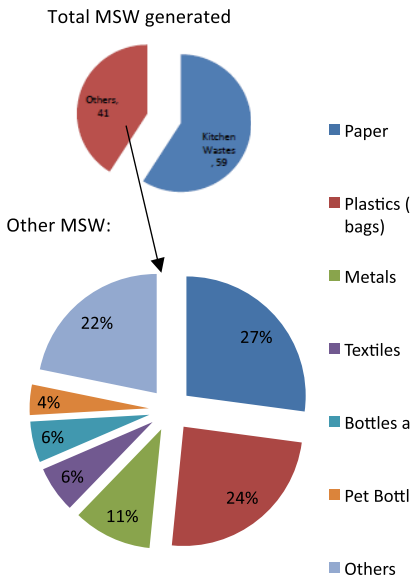


FIGURE 2: Municipal Solid Waste composition for Nadi and Lautoka, 2008. Top pie chart is total MSW, bottom pie chart is the breakdown of 41% "other". Source: JICA, 2013.

IMPACTS

As Fiji's waste stream grows, the impacts to the environment, society and economy also increase. These include impacts to the environment through suffocation of reefs or digestion by animals, to society through health impacts and to the economy through decreased tourism dollars.

RESPONSE

Fiji's current responses to improve waste collection, management and recycling and reduce littering and waste generation include:

- The development of a Green Growth Framework which includes waste management considerations for communities and to improve and development waste bylaws.
- The finalization of the 3R (Reduce, Re-use and Recycle) policy piloted in Nadi and Lautoka, the review of the National Solid Waste Management Plan and the finalization of the National Health Care Waste Management Policy.
- Improvements to waste management infrastructure, including: improving dumpsite management like the Lami dump, purchase of garbage trucks for municipalities, establishing a Rural Garbage Services Scheme and establishment of waste transfer stations.
- Establishment of a Fiji Anti-littering Decree.
- The development of a Plastic Bag Regulation (in progress) to reduce the consumption and disposal of Non-Biodegradable (Single Use Plastic Checkout Bags) in Fiji.
- Awareness programs (e.g. DOE's 3R website – http://www.environment.gov.fj/3rproject/index.html)

RECOMMENDATIONS

Direct disposal of waste into streams, mangroves and oceans is still ongoing, particularly in squatter settlements. Garbage collection is a priority for these sites.

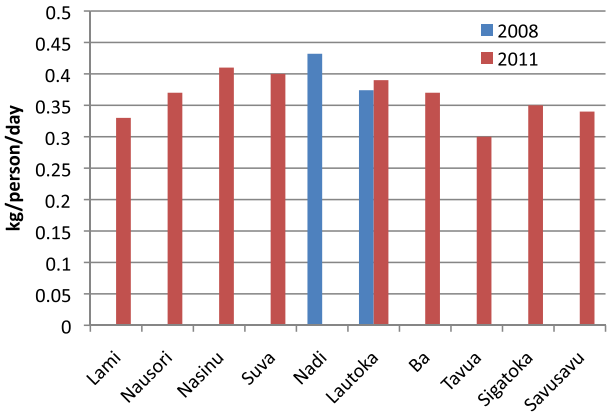


FIGURE 3. Waste generation rates across Fiji municipalities. Only Nadi and Lautoka were surveyed in 2008 by JICA, Nadi results not included for 2011 as they included all resorts for waste but did not account for tourist population in the waste generation calculation. Source: 2008–JICA, 2011 – National Waste Management Plan.

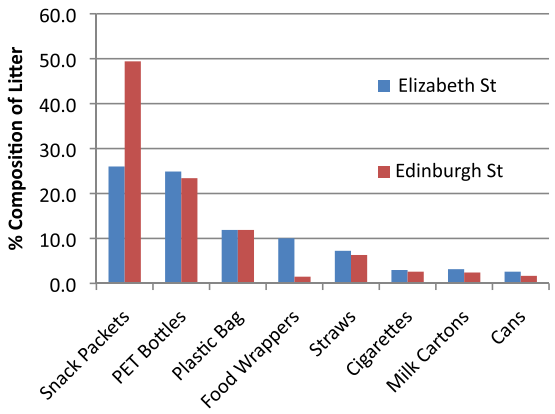


FIGURE 4: Litter survey results in Suva. Source: Dept of Environment, 2006.

The Clean School Program in Nadi: This 3R program was organized to introduce 3R's to schools and educate children about waste reduction and recycling at home. Source: DOE, 2014.

Fiji's 3R mascot. Source DOE, 2014.

SOURCES

Dept of Environment, National Soild Waste Management Strategy and Action Plan – 2006-2010

Ministry of Urban Development, Housing and Environment. Fiji's National Solid Waste Management Strategy 2011-2014, 2010.

EPA, Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2011.

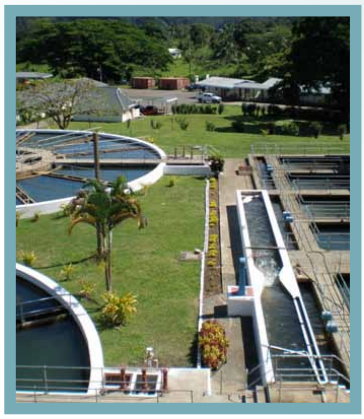
Japan International Cooperation Agency (JICA), Data Collection Survey on Reverse Logistics in the Pacific Islands, 2013

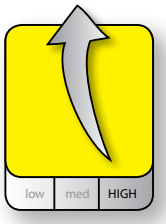
ACCESS TO IMPROVED DRINKING WATER

Access to clean drinking water is one of the Millennium Development Goals under MDG7 “Ensure Environmental Sustainability”. The indicator “access to improved drinking water” provides an overall picture of Fiji’s ability to meet the basic needs of its inhabitants. Improved drinking water access does not necessarily mean clean drinking water, but means that some improvement has been made to the drinking water system that reduces exposure to waterborne diseases. Improvements could include directly piped treated water, deep aquifer groundwater access or closed system rainwater catchment.

The majority of Fiji’s water supply is from surface water reservoirs (69%) and on the larger islands, groundwater(22%) is also used to supply rural populations. Other manmade dams account for the remaining 9% (WAF, 2013).

Treatment pools at Wailoku Water Treatment Plant.
Source: Fiji Water Authority brochure.





Status
Fair

Trend
Improving

Data confidence
High

Status: Moderate Trend: Improving Confidence: High

Overall, the status of access to clean drinking water is moderate and improving in Fiji (Figure 1). Between 1990 and 2010, access to improved drinking water in Fiji improved from 85% to 96% (69% directly piped and 27% other improved). As of 2013, almost 608,000 people (72% of the 2013 population) are served directly by water treatment plants from surface water or groundwater sources (WAF, 2013). There are currently 18 water treatment plants in Fiji (Figure 3).

Considerable differences between rural and urban areas remain, (rural areas have 92% improved drinking water while urban areas have 100%) but overall access to clean drinking water in rural areas is improving. One sign of this improvement is the predominance of municipal water withdrawals which has steadily increased since 1990 and now overtakes industrial use for percent of water allocated (Figure 2).

Other issues do remain in supplying drinking water. In 2003 the Asian Development Bank estimated that “water losses from leaking pipes or inaccurate or missing meters approached 55% of water supplied’, and according to its latest report), this reached 70% in 2007. In addition, informal urban settlements remain an area of poor access to clean water (Asian Development Bank, 2007).

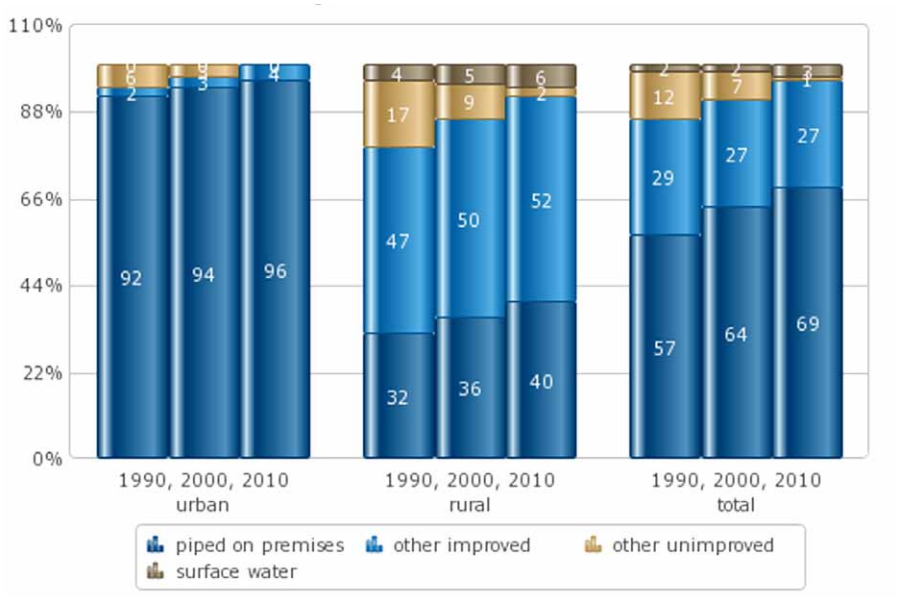


FIGURE 1: Percentage of population with access to drinking water in urban, rural and all areas of Fiji in 1990 – 2000–2010. Source: FAO. 2013. AQUASTAT database – Food and Agriculture Organization of the United Nations (FAO. Website accessed on 08/08/2013.)

IMPACTS

Poor drinking water impacts society in 3 major ways. Firstly, waterborne diseases can impact vulnerable populations causing sickness and even death. Secondly, sickness from waterborne diseases impacts the ability of a society to thrive through loss of work and school days. Finally, the cost of treating waterborne diseases and outbreaks can be substantial.

RESPONSE AND RECOMMENDATIONS

Major responses by the Fiji government to improve both access to and quality of drinking water include:

- Desalinization in rural areas,
- WAF's continued efforts to provide clean water access to urban informal settlements.
- Continued investment in water treatment facilities and reticulated systems, including purchase of chlorine feeders for small systems.
- Development of a Drinking Water Safety Planning Strategy for Village Management Plans, 2011, awaiting endorsement.
- The development of a Rural Water Supply Management Plan.

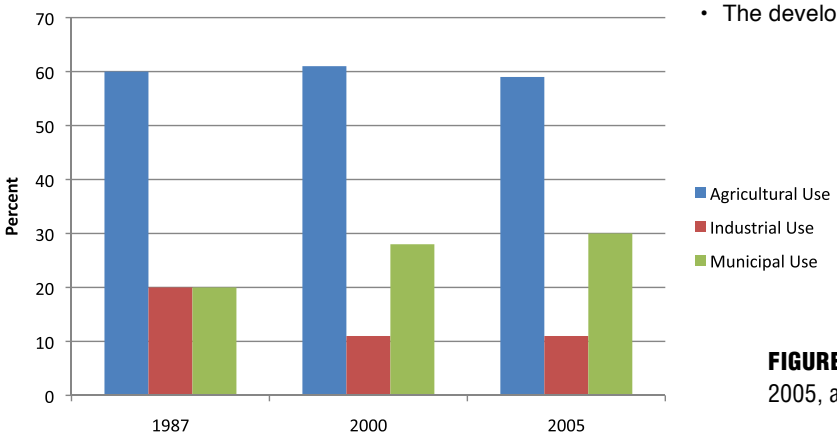


FIGURE 2: Water withdrawals by sector across Fiji 1987–2005, as % of total withdrawal. Source: FAO Aquastat.

FIGURE 3: Locations of major water treatment plants in Fiji. Source: WAF.

SOURCES

FAO Aquatstat Database

WAF Database on 2013 Water Treatment Plants

Water and Wastewater Treatment Services in Fiji, WAF 2013

Asian Development Bank (2002) Fiji case study—Suva-Nausori, in: Water Supply Fiji Islands, pp. 11–16 (Suva: Asian Development Bank).

Asian Development Bank (2007) Asian Water Development Outlook (Manila: Asian Development Bank).

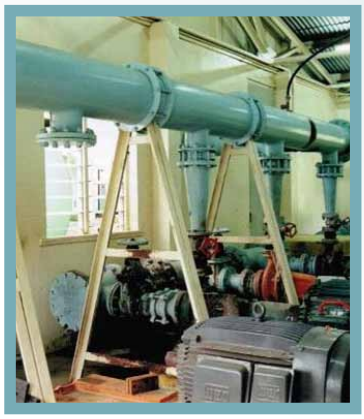
SOPAC Misc Report: Sustainable Integrated Water Resources and Wastewater Management in Pacific Island Countries, National Integrated Water Resource Management Diagnostic Report, FIJI Islands. 2007

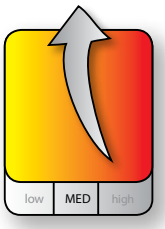
ACCESS TO IMPROVED SANITATION

Along with access to improved drinking water, access to "improved" sanitation (or sewage management) provides an overall picture of the state of the Built Environment, and Fiji's ability to meet the basic needs of its inhabitants. "Improved" sanitation means some mode of improvement including septic systems, direct sewage treatment or other treatment type which decreases exposure of the population to sewage effluent. This indicator also provides an overview of the vulnerability of the population to gastrointestinal diseases, which are highly correlated with improved sanitation.

Primary data for this indicator is based on the WHO/JMP study from the FAO Aquastat database. Supplementary data is from the Fiji Water Authority monitoring and the Ministry of Health.

Sludge thickener at Matovo sewage treatment plant.
Source: Matovo water safety plan.





Status
Fair to Poor

Trend
Improving

Data confidence
Medium

Status: Poor to Fair Trend: Improving Confidence Medium

Overall, the state of sanitation in Fiji is poor to fair and improving across many areas of Fiji. Between 1990 and 2010, access to improved sanitation increased from 57% to 87% overall (Figure 1). In 2013, almost 243,000 people were served by direct sewer lines (~28% of the population).

There are considerable differences between urban and rural access. Urban access in 2010 was estimated at 92% while rural was estimated at 82%. However, the gap has been narrowing over the past 20 years. The single largest increase in access was to rural sanitation, which increased from 37% of the population in 1990 to 82% in 2010. (source Aquastat, 2013). Most of these improvements are septic systems and most importantly, open defecation appears to have been greatly reduced.

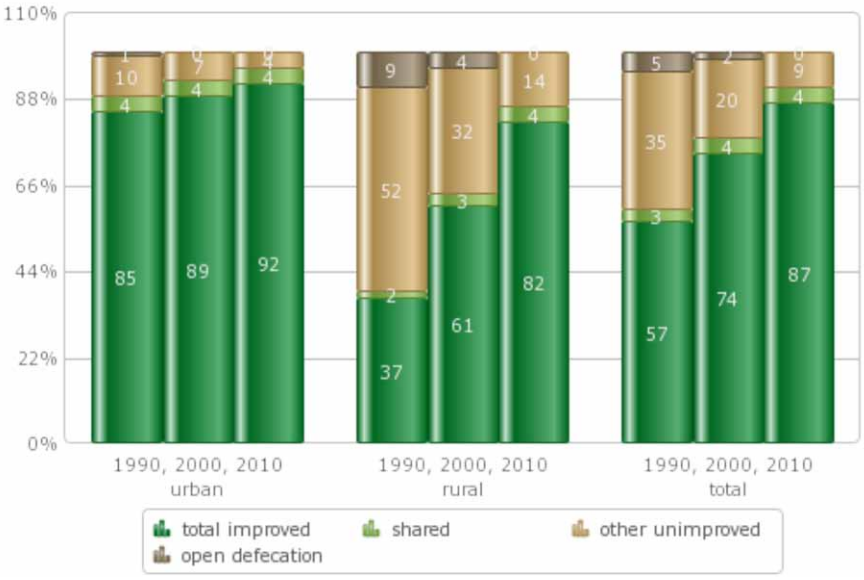


FIGURE 1: Percentage of population with access to sanitation in Fiji 1990-2000-2010. Source: FAO. 2013. AQUASTAT database – Food and Agriculture Organization of the United Nations. Source: FAO. Website accessed on 08/08/2013.

The indicator on marine receiving environments in Suva shows that faecal coliforms are still a major concern in these small urban watersheds, as well as the surrounding beach and marine habitats. Reports from the Ministry of Health also show that diseases often associated with (but not exclusively,) poor sanitation rose between 2003 to 2010 (Figure 2).

Improved sanitation appears to be contributing to reduced faecal coliform counts in surface waters, a major indicator of human sewage (Figure 3). For example, since the early 2000's, faecal coliform counts in the Rewa river (a river that drains more than 1/3rd of Vitu Levu) have dropped considerably and although still high, appear to be improving, reducing the risk to humans using the river and consuming aquatic products (e.g. Kai, fishes and invertebrates).

However, although access to improved sanitation has improved in Fiji over the past 30 years, the increase of informal urban settlements with no access to sanitation is a concern. Furthermore, poor (or old) construction and maintenance of septic systems is an ongoing issue.

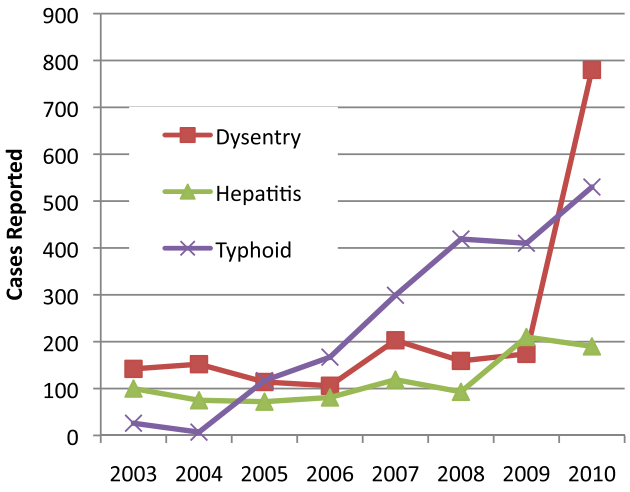


FIGURE 2: Sanitation related diseases reported annually in Fiji. Source Ministry of Heath Reports.

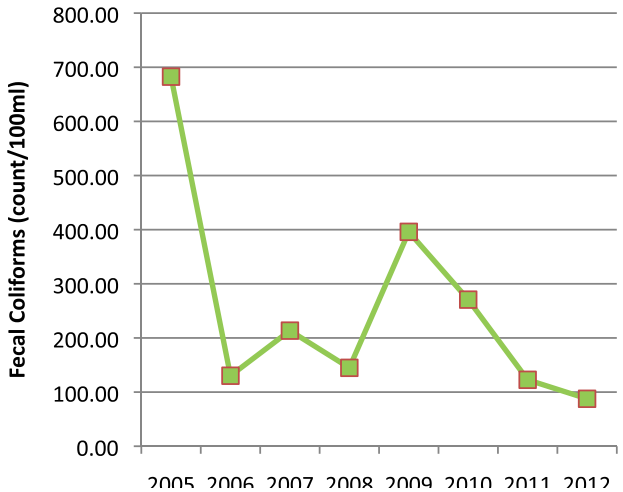


FIGURE 3: Average annual Faecal Coliforms in the lower Rewa River. Source: WAF.

SOURCES

FAO Aquastat Database, 2013

Ministry of Health Annual Reports 2003 – 2010

Water and Wastewater Treatment Services in Fiji, WAF 2013

International Water's Program: Fiji's national liquid waste management strategy and action plan, 2006

IMPACTS

The primary impacts from poor access to sanitation are health related, and include gastrointestinal diseases and associated serious diseases such as typhoid, dysentry and hepatitis. These have profound impacts on societal development and the economy. In addition, environmental impacts include eutrophication of rivers and marine receiving waters, increasing algal growth, smothering coral reefs and reducing visibility.

RESPONSE

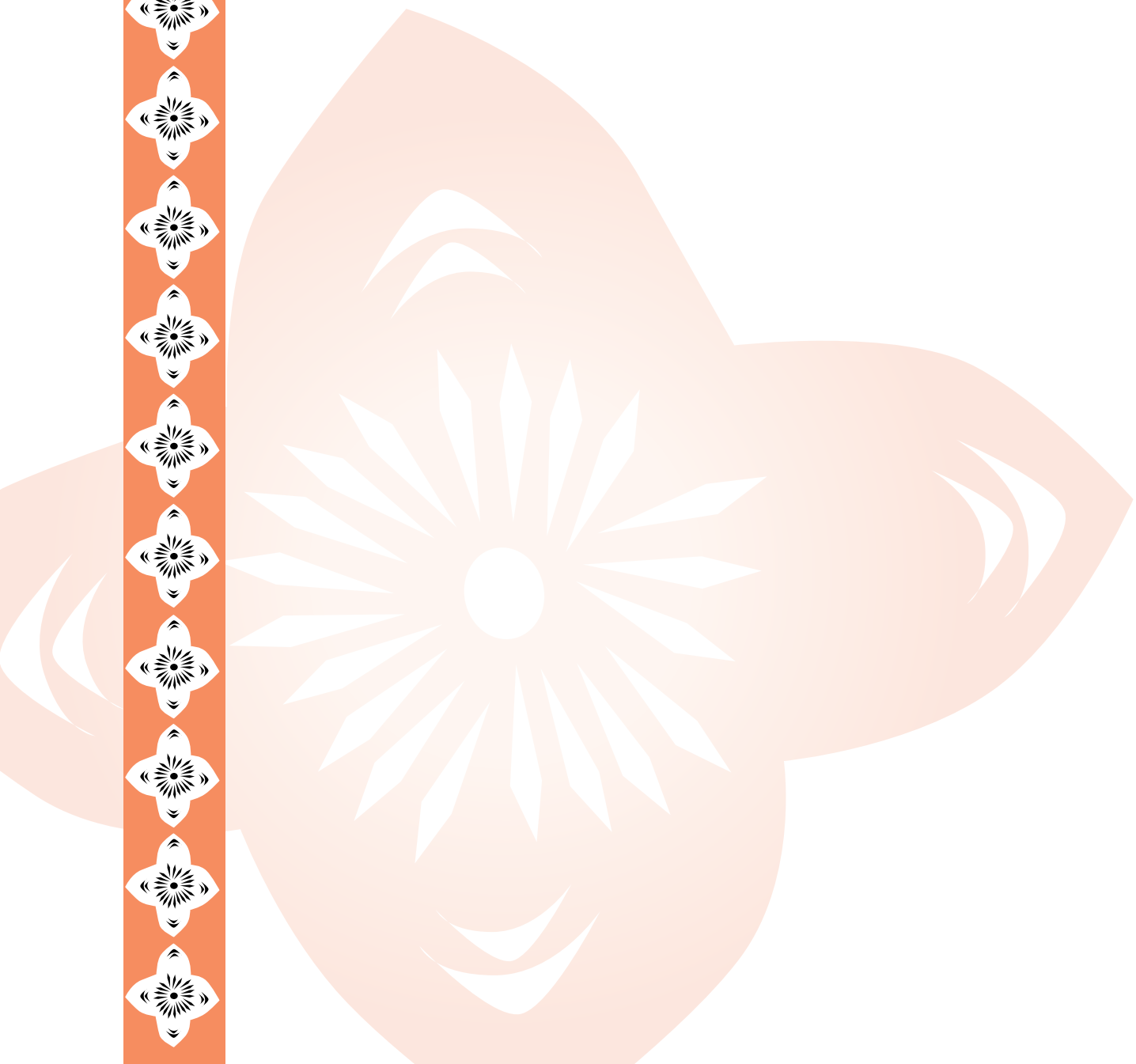
The Water Authority of Fiji (WAF) continues to pursue efforts to get more households connected to the sewer system. Where sewer hook-up is not an option, organizations such as SOPAC are working with the Ministry of Health to educate communities on proper septic system setup.

In 2006, a Sustainable Liquid Waste Management strategy was developed, through a process of wide consultation with all stakeholders involved in the production and the management of liquid waste.

RECOMMENDATIONS

Resources should be put into monitoring and prioritizing for areas that are major sources for septic pollution. WAF is currently embarking on an outfall testing program across major rivers and creeks in Fiji to look for major sources of sewage and prioritize hook-up areas to sewerage. This effort needs full support and substantial funding to ensure that priority areas are connected.

Informal Settlement in Suva. Photo: Ed Anderson, USP.



SUMMARY AND RECOMMENDATIONS

CONCLUSION AND RECOMMENDATIONS

In Fiji there are several global and regional drivers that are creating changes in the environment. They include globalisation and exposure of Fiji to world markets, rising incomes and population, urbanisation, rapid expansion and growth of technologies, new and existing cultural norms and global climate change. In turn, these drivers are creating pressures on the land, marine, freshwater, atmosphere and built up ecosystems. These pressures include land development, informal settlements, waste generation and energy consumption and resource extraction.

These pressures are, in varying degree, affecting the environment. This effect is measured by evaluating the state of key habitats, ecosystems, climates, and species. Overall the state of the environment is mixed news, some good, some fair and some poor, and the level of response to these issues is also varied.

While gaps exist, Fiji has many strong laws, policies and regulations that promote sustainable use and protection of its environmental resources. In addition, since the 1992 SOE report, Fiji has had a plethora of assessment reports recommending actions on biodiversity, agriculture, water, marine management, climate change, and others. However, the national implementation and enforcement of these efforts is inconsistent and, in some cases, non-existent. They are largely dependent on external funding from NGOs and international sources, most of which are short-term and determined by the current international priorities and agendas.

A good example is the case of endangered species, where the implementation (and in some cases development) of protective policies is left to NGO's, who have limited ability to carry them out. Another example is the management of invasive species. With international assistance, Biosecurity Fiji has been effective at keeping new species out of Fiji, but has limited ability or mandate to keep existing invasive species from spreading rapidly to other parts of Fiji.

The best examples of environmental management in Fiji are where traditional practices have been combined within a modern legislative framework. One such example is the qoliqoli tradition of managing inshore marine areas, a model of success today.

On their own, traditional practices are not enough to protect the environment from modern day pressures such as deep sea mining, whole-scale resource extraction and population growth. Another example is the decline of the Fijian forest today, which is not from large scale commercial activities but from the gradual encroachment on the land with population growth and the decline in agriculture. Traditional practices of environmental management need to be integrated into, and supported by, a strong legislative framework of environmental protection for overall success.

The Fiji government has recently introduced a "Reach for Fijian Made" campaign, promoting the strengthening of the Fijian manufacturing and agricultural economy. Perhaps a "Made in Fiji" approach can be developed for the terrestrial environment like it was for marine environment in the mid 1990s. There are examples of sustainable traditional farming, forestry and water management practices of iTaukei Fijians and Indo-Fijians, that could be utilized within a modern management framework.

KEY SUCCESSES TO BUILD ON

Some examples of key successes to improve on follow:

- WAF's Water Monitoring Program should be expanded and maintained to continue trend monitoring of Fiji's major rivers.
- Meteorological monitoring is strong and getting better.
- The Locally Managed Marine Area Network has been largely successful, but not without challenges. The FLMMA could be used as model for managing other areas, such as terrestrial key biodiversity areas.
- Fiji's efforts to prevent the introduction of new invasive species are substantial, and a good example of a targeted and funded program with clear objectives. This success should be built on to prevent the spread of existing species to outer islands.
- Coral Reef monitoring is some of the best in the region, and has both extensive spatial and temporal range. Efforts should be made to ensure this continues with additional fish biomass density.
- WAF's efforts to hook up more customers to sewage treatment (including those in informal settlements) are commendable, and should be continued to reduce the sewage contamination to creeks and rivers.
- Efforts to reduce ODS in line with the Montreal Protocol have been very successful and should be used as model in efforts to reduce other atmospheric emissions.
- Management of the offshore fishing industry has been successful in recent years in establishing sustainable harvest limits, increasing observers and auditing and developing sustainable status. Factors in success here could be used to strengthen management of the inshore fishery.

KEY CHALLENGES TO ADDRESS

Some examples of key challenges to address follow:

- The decline of the agricultural sector, in particular the reduction of the cane sugar sector is placing a tremendous pressure on the environment and society – creating a variety of social and environmental issues including:
  1. the reduction of forest cover due to cultivation of steep slopes and other non-arable areas.
  2. the increasing gap between rural and urban incomes and the resultant move to informal settlements in urban areas, putting tremendous pressure on the built environment and mangrove areas.
  3. reduction in food security due to the loss of associated micro-farming with larger cane plantations.
  4. an enormous pressure on waste management due to increasing urban populations.

Efforts are in place to replace the foundational cane sector with reliable alternatives, but given that this is an essential issue more effort is required to stabilize the agriculture sector.

- Unsustainable fishing pressure in the inshore and offshore environment. Strengthen enforcement and compliance and monitoring of fish, in particular highly harvested species (e.g. beche-de-mere and sharks). Fish diversity and density should be regularly monitored throughout the region.
- Strengthen monitoring, enforce standards of septic systems to reduce sewage effluent.
- Waste generation rates are likely to increase, so considerable effort is needed to both improve waste management at current landfill facilities and recycling options for residents and businesses.
- Air quality in both urban and rural areas needs further attention including:
  1. Air Monitoring of urban areas and adjacent rural areas (e.g. Nadi and Suva).
  2. Emission inventories of pollution sources in Fiji.
  3. Targeted policies and regulations to limit emissions (e.g. waste burning, polluting vehicles and establishing burn days during ideal meteorological mixing to limit particulate pollution).
- Protection of threatened species and habitats in the terrestrial environment needs further effort and action from government.

RECOMMENDATIONS AND NEXT STEPS

To come.

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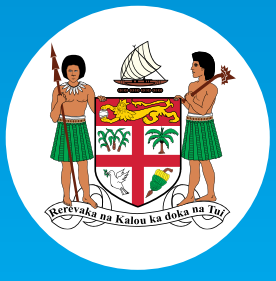

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