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RESCCUE

WASTE AND WASTE WATER MANAGEMENT INITIATIVES IN RA PROVINCE - DIAGNOSIS AND ACTION PLAN



The operator that is in charge of the implementation of the RESCCUE project in Fiji under the supervision of both SPC and the **University of the South Pacific** is a consortium of **four partners**:

The Institute of Applied Sciences, University of the South Pacific

(Leader: Johann Poinapen)

Contact: Johann Poinapen

e-mail: johann.poinapen@usp.ac.fj

phone: +679 323 2992



Landcare Research (Leader: Suzie Greenhalgh)

Contact: Suzie Greenhalgh

e-mail: greenhalghs@landcareresearch.co.nz

phone: +64 1 9 529 7444



Wildlife Conservation Society (Leader: Sangeeta Manguhai)

Contact: Sangeeta Manguhai

e-mail: smangubhai@wcs.org

phone: +679 331 5174



Conservation International (Leader: Susana Waqanaibete-Tuisese)

Contact: Susana Waqanaibete-Tuisese

email: swaqainabete-tuisese@conservation.org

phone: +679 331 4593



Fiji Environment Law Association (Kiji Vukikomoala)

Contact: Aliti

e-mail: kiji.vukikomoala@fela.org.fj



Main author/contributor	Date
Patrick Fong & Isoa Korovulavula, IAS, USP	23/12/2016

Overview of the objectives and components of RESCCUE project:

The *Resilience of Ecosystems and Societies to Climate Change* (RESCCUE) project is a regional project implemented by the Secretariat of the Pacific Community.

The overall goal of RESCCUE is to contribute to increasing the resilience of Pacific Island Countries and Territories (PICTs) in the context of global changes. To this end RESCCUE aims at supporting adaptation to climate change (ACC) through integrated coastal management (ICM), resorting especially to economic analysis and economic and financial mechanisms.

The RESCCUE project operates both at the regional level and in one to two pilot sites in four countries and territories: New Caledonia, Vanuatu, Fiji and French Polynesia.

RESCCUE is funded primarily by the *French Development Agency* (AFD) and the *French Global Environment Facility* (FFEM) for a duration of five years (01/01/2014 to 31/12/2018). The total project budget is 13 million Euros, including 6.5 million Euros from AFD/FFEM and about the same in co-funding.

RESCCUE Project sites in Fiji are Ra and Kadavu provinces. Ra has about 95 communities and Kadavu 73 communities. The following are the RESCCUE components that will be implemented in these two sites.

It is structured around five components:

Component 1: Integrated coastal management – supporting ICM implementation through ICM plans, ICM committees, and management activities concerning both terrestrial and marine ecosystems, capacity building and income generating activities.

Component 2: Economic analysis – using economic analysis to support coastal management and policy decisions.

Component 3: Economic and financial mechanisms – setting up economic and financial mechanisms to generate additional and sustainable funding for ICM: review of options (payment for ecosystem services, taxes, user fees, trust funds, quota markets, offsets, labels...); feasibility studies; implementation; monitoring.

Component 4: Capitalization, communication, dissemination of project outcomes in the Pacific – going beyond pilot sites activities in order to have impacts at the regional level, by fostering experience sharing between sites, cross-sectoral expertise, and communication and dissemination of the project outcomes.

Component 5: Project management – implementing and coordinating the project, by providing technical assistance, organizing local and regional steering committees, conducting audits and evaluations (mi-term and ex-post), etc.

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Executive Summary

The two key objectives of the establishment of waste and waste water management initiatives in Ra Province - Diagnosis and action plan are:

- To examine and review past and current initiatives on waste and waste water management initiatives; and
- To identify areas that RESCCUE can address, support and facilitate in strengthening waste and waste water management.

In order to understand waste management work in Ra, an in-depth analysis of the various sources suggests that community solid waste and wastewater is the key contributor to waste issues in the province. Ra province typically lacks appropriate infrastructure and formally organized solid waste management system, resulting in increasing problems relating to solid waste, including impacts on human health and decreasing aesthetic values of rural villages and their surroundings. Wastewater from households is normally disposed of via plumbing into septic systems or straight into waterways. From previous work, the majority of districts in Ra province including Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navolau have highlighted that waste management is a serious issue that needs to be addressed.

Other critical waste sources – point-source pollution

- Sugar industry: the largest industry in Ra province with the ‘inputs’ use, fertilizer weedicides and pesticides as the main waste source.
- Rakiraki Fiji Sugar Corporation Mill: Effluent from the Penang Mill is the main contributor of pollution within Rakiraki waterways with the majority of waste being directly dumped into the Rakiraki river.
- Rakiraki industrial area: there is visible evidence to confirm that this is also a serious waste management issue in Ra province with absence of specific regulations available to deal with the safe storage, transportation and disposal of this material.

Previous waste and waste water management initiatives in Ra province

- Ra Integrated Coastal Management: implemented by ANZDEC in partnership with IAS in the province with a waste management component. This project component was identified earlier as a priority coastal management issue in the province, as it has been observed by key stakeholders that the improper disposal of waste on land and along the waterways are barriers to natural resource management. An output of this project, which paved the way for the RESCCUE project was the development of the Ra ICM Plan. Section 4 of the Ra ICM Plan highlights some of the management strategies that need to be implemented in order to address waste management in Ra province and these are intended to be part of the RESCUE project
- Ministry of Health: Basic medical services are provided through two health centres, one at each end of the province. The Sub-Divisional Health Inspector is responsible for

ensuring that villages comply with the public health regulations stated in the Fiji public health legislations.

- The Rakiraki Rural Local Authority: the Rural Local Authority was very successful in taking the initiative of hiring a private contractor to collect garbage from the businesses and residents and billed them for these services.
- Private Sector Initiatives: Several tourism operators in Ra province including *Sega Na Leqa* Retreat Backpacker, Volivoli Beach Resort, Wananavu Beach Resort and Dolphin Island have implemented waste management strategies.
- In the whole of Ra province, there are no garbage disposal services provided for the people in the rural areas such as villages; farming areas; rural squatters and settlements; and majority of island villages.
- The Pacific Community (SPC) Animal Health and Production: implemented a project funded by Taiwan/Republic of China with the main aim to raise awareness on animal waste and train participants to better manage it.

Existing policies

Unlike other developing countries, Fiji does not have comprehensive legislation committed to the management and minimisation of waste. Currently there are no provisions for waste separation and recycling; handling and disposal of difficult wastes; reduction in proliferation of non-biodegradable wastes such as packaging, waste oil, batteries, tyres, waste electric and electronic equipment (WEEE) and landfill site selection and management. Without appropriate legislation it would be difficult to support programmes and targets. Furthermore, there is a lack of comprehensive policy frameworks for solid waste management while the existing legislations lack enforcement.

RESCCUE activities

RESCCUE will be focusing on the following initiatives:

Solid waste management

- Learning workshop will be held to discuss the different types of waste and effects they can have on human health and the environment.
- Different modes of disposal will be discussed.
- An alternative use of paper is to shred and use for composting pig waste.
- Hazardous waste and non-recyclable items are typically buried but awareness of potential water body pollution needs to be considered and alternatives discussed.
- For organic waste, composting is the preferred option and different methods such as simple piling, containers and pits can be discussed (along with the benefits of composting).
- Field trips for community leaders can be arranged to existing sites as well as discussing optimal practices in compost heap management.
- For waste initiatives sites will be canvassed to determine which ones are especially interested in these issues; western Ra sites have been previous targets.

On-ground solid waste management field activities in communities:

- Workshop on solid waste management by applying practical measures such as recycling, reuse, repair and compost
- Community to construct landfills at appropriate places for non-biodegradable solid waste
- For biodegradable community will identify areas and prepare it for compost waste. Ideally to be close their household gardens

Community wastewater management

- Learning community based workshop on the effects of liquid waste.
- Management of “grey” waste water (domestic washing waste water) and sewage waste (black water) with the application of ecosystem based treatment measures such as artificial wetland (e.g. banana trench) or a perforated 44-gallon drum with coral rock and coconut husks inside can be used in crowded situations.
- For sewage waste where flush toilets are not in place and especially in the drier side of Ra, composting toilets should be considered.
- Piggery waste also makes a major contribution to coastal pollution and options such as locating piggeries away from water bodies, composting of pig waste or ponding and evaporation can be considered.

On-ground liquid wastewater management field activities in communities:

- Workshop on managing and minimizing domestic waste water
- Constructing compost toilets.
- Constructing drainages where necessary to separate black and grey wastewater from households
- Aquatic plant species used to screen or filter domestic wastewater such as *Scleria cubensis* to be planted near the outlets of the drains before the wastewater goes into creeks and other waterways.

Private sector wastewater management

- For the small tourism facilities in Ra where the sewage will likely affect coastal waterbodies there are relatively inexpensive Orelco modular systems that greatly reduce the nutrient and microbiological load of the sewage waste. The idea here is to formally engage and work with interested small resorts such as “Sega Na Leqa retreat backpacker and Volivoli resort to set up demonstration wastewater management facility model.
- The application of low-cost monitoring equipment such as hydrogen sulphide test kit. Communities can be easily trained to use it (Refer to Annex 1).

1. Introduction

1.1 Background information

Public waste management infrastructure in Ra Province is not well developed. Development projects are generally carried out on a communal basis with finances coming from government, donors and the people themselves. Examples of projects are village pipe water system, power generation, village toilets and septic tanks, village meeting halls, nursing and health stations, schools and pre-school facilities etc.

1.2 Objective

The two key objectives of the establishment of waste and waste water management initiatives in Ra Province - Diagnosis and action plan are:

- To examine and review past and current initiatives on waste and waste water management initiatives; and
- To identify areas that RESCCUE can address, support and facilitate in strengthening waste and waste water management.

2. Understanding waste and wastewater sources

2.1 Community solid waste and wastewater

Ra province is also affected by globalization and changing lifestyles and these have resulted in increased consumption of packaged and processed goods in recent years, including food and other items (Lal *et al*, 2007). As the case with all rural areas in Fiji, Ra province typically lacks appropriate infrastructure and formally organized solid waste management system, resulting in increasing problems relating to solid waste, including impacts on human health and decreasing aesthetic values of rural villages and their surroundings.

Reliable rural statistics and general information about waste generation and waste management in Ra province or for any other parts of Fiji are generally unavailable. However, Lal *et al* (2007) estimated that rural households in Fiji produced some 405 tonnes of solid waste, much of which are believed to be discarded in the village surroundings, foreshore, along river banks and in similar areas. Poor solid waste management at the community level is a serious source of pollution in Ra province.

Table 1 Communities in the district of Burewai with waste management issues

Waste issue	Matainananu	Naveisividra	Delaiyadua	Nadogoloa
Solid waste (organic and inorganic solids)	x	x	x	x
Liquid waste (treatment of used water)	x	x	x	x

Table 2 Communities in the district of Kavula with waste management issues

Waste issue	Nabukadra
Solid waste (organic and inorganic solids)	X
Liquid waste t (treatment of used water)	X

Table 3 Communities in the district of Nakorotubu with waste management issues

Waste issue	Verevere	Saioko	Namarai	Naocobau
Solid waste (organic and inorganic solids)	x	x	x	x
Liquid waste (treatment of used water)	x	x	x	x

Table 4 Communities in the district of Navitilevu with waste management issues

Waste issue	Veidrala	Nasau	Nayavaira	Navuniivi
Solid waste management (organic and inorganic solids)	x	x	X	x
Liquid waste management (treatment of used water)	x	x	X	x

Table 5 Communities in the district of Saivou with waste management issues

Waste issue	<i>Barotu</i>	<i>Rokoroko</i>	<i>Tokio</i>	<i>Naiserelagi</i>	<i>Nanukuloa</i>
Solid waste management (organic and inorganic solids)	x	x	x	x	X
Liquid waste management (treatment of used water)	x	x	x	x	X

Table 6 Communities in the district of Navolau with waste management issues

Waste issue	<i>Namuai mada</i>	<i>Navolau 1</i>	<i>Navolau 2</i>	<i>Nakorokula</i>
Solid waste management (organic and inorganic solids)	x	x	x	
Liquid waste management (treatment of used water)	x	x	x	x

Table 7 Communities in the district of Rakiraki with waste management issues

Waste issue	Rakiraki	Malake
Solid waste management (organic and inorganic solids)	x	x
Liquid waste management (treatment of used water)	x	x

Table 8 Communities in the district of Raviravi with waste management issues

Waste issue	Narewa	Naivuvuni	Vitawa
Solid waste management (organic and inorganic solids)	x	x	x
Liquid waste management (treatment of used water)	x	x	x

Table 9 Communities in the district of with waste management issues

Waste issue	Togovere	Drauniivi	Nananu	Naseyani
Solid waste management (organic and inorganic solids)	x	x	X	x
Liquid waste management (treatment of used water)	x	x	X	x

2.2 Sugar Industry

This is the largest industry in Ra province, generating approximately \$2 million in revenue, through the production of approximately 9.2 ton of sugar. Approximately 60km² of land is used in growing sugar cane in Fiji. The main environmental hazards of these cane fields are the 'inputs' use, fertilizer weedicides and pesticides (Szmedra, 2002). There are no regulations to specifically control how they are used on farms and other work places.

Cane farming in Ra province is strictly a smallholder and labor intensive enterprise. Much of the land area in Ra province is mountainous, the eroded remnants of volcanic activity that created Viti Levu island. Sugarcane farming is mainly concentrated along the northern coast of Ra province. The soils are extremely rich in organic matter and with sufficient rainfall and appropriate levels of management expertise are capable of producing in the range of 16 tons of cane per hectare.

2.3 Rakiraki Fiji Sugar Corporation Mill

Effluent from the Penang Mill is the main contributor of pollution within Rakiraki waterways. In August, 2015, the CEO of FSC admitted that certain parts of the Penang sugar mill in Rakiraki were in a deteriorated state and there was a need for replacements. FSC cited the need to urgently repair the mill dump line and evaporator pollution pump; both have not been functioning to standard for sometimes. Hot liquid from the molasses tank outlet that is fed into the river is one of the main effluents released directly into the Rakiraki waterways, thus affecting the thermal system of the waterways and affecting aquatic resources and communities that depend on them (Mataki, 1999). The Penang *Rakiraki* Sugar Mill is now officially closed due to the damages caused by Tropical Cyclone Winston.

2.4 Rakiraki industrial area

There is no information available on the generation, storage or disposal of hazardous wastes in Rakiraki industrial area or for the whole of Fiji, however there is visible evidence to confirm that this is also a serious waste management issue in Ra province. In addition, to make matter worse there are no specific regulations available to deal with the safe storage, transportation and disposal of this material. Existing laws and regulations are quite inadequate. Hazardous wastes include materials, which are corrosive, such as strong acids, alkalis and phenols: materials, which pose fire hazard during normal handling for instance hydrocarbons, solvents; reactive

materials which are liable to explode, generate toxic fumes or react violently with air, water heat, or toxic materials, especially those that are threatening the life or health of people, plants and animals (Chandra, 2002).

Toxic materials include asbestos, heavy metals, cyanide, chlorinated hydrocarbons such as the organochlorine pesticides and PCB's; organophosphorus and carbamate insecticides are widely used in agriculture and even in the home, it also includes infectious hospital wastes and many other chemicals and wastes (Tabudravu, 1995).

3. Previous waste and waste water management initiatives

There has been a few waste management initiatives in Ra in the past years and this include:

Ra Integrated Coastal Management

- The Ra ICM project was implemented by ANZDEC in partnership with IAS in the province for the period 2013- 2015, with funding from the Asian Development Bank. The main approach and purpose of the project were using an integrated approach that connects policy makers and resource owners (people of Ra) in maintaining and preserving natural resources so as to help improve the livelihood and health of the people across the whole province. An output of this project was the development of the Ra ICM Plan and the main purposes of this plan are:
- To establish integrated coastal management arrangements for the Ra Province with 9 coastal districts and their stakeholders;
- • To develop integrated sustainable development policies that connect the national government, provincial government and communities; and
- • To sustainably manage the natural resources of the Ra Province for current and future generations.

Section 4 of the Ra ICM Plan highlights some of the management strategies that need to be implemented in order to address waste management in Ra province and these include:

- Situational analysis of coastal pollution along the Ra coast.
- The Fiji Sugar Cooperation to work with the sugar mills on wastewater discharge.
- The use of composting toilet is highly recommended for dry coastal areas if they are culturally acceptable.
- FSC, Water Authority and DOE to follow up with all FSC Mills on the increased levels of nitrogen and phosphorous levels found in the mouth of the Rakiraki River and 18 other locations around Ra.

These strategies together with community awareness and follow-up on existing community waste management action plan will be part of the RESCCUE waste management work

A component of this project was implementing a waste management program in one of the districts, hence Naiyalayala was identified. This project component was identified earlier as a priority coastal management issue in the province, as it has been observed by key stakeholders

that the improper disposal of waste on land and along the waterways are barriers to natural resource management (Fong, 2015).

In mid-2015, a village waste management workshop was conducted by the Institute of Applied Science at Togovere Village, Naiyalayala district. Participants included representatives (village leaders, elders, women and youths) of four villages in the district as well as the provincial Conservation Officer. The workshop was facilitated in an approach that encouraged participants to develop management action plans to be implemented in their respective village (Fong, 2015).

The following were the objectives of the workshop:

- To present about Integrated Coastal Management (ICM) - its community engagement in resource management in Ra Province
- Participants will be able to gain new knowledge and skills in the various processes and sessions leading to the development of their solid waste management plan
- Community members will be able to learn about the consequences of some of their existing waste threats and discuss measures to reduce them
- Participants are able to link traditional knowledge and practices merging with science to better understand the environment, its associated threats and to improve their relationship
- Communities will be able to know the various stakeholders who can directly or indirectly assist them in their natural resource management efforts
- Development of village based solid waste management action plan with the implementation steps defined

Below are village waste management action plans for the four villages which highlighted the various waste management issues faced in each village. The issues were prioritized and proposed solutions were agreed upon by reps from each village together with the identification of individuals or village committees to oversee the successful implementation of the solutions.

Table 10: Waste management action plan for Naseyani village.

Root Cause	Resolution	Who to lead?	Time Frame	Current status
Animal Welfare	Cover the pits with a proper lid	Men's Village group	Third week of every month	It is currently followed
Diaper	Encourage the women to bury the used diapers properly Encourage the use of cloth napkins.	Village Council	Third week of every month	It has been practiced however, Tropical Cyclone Winston have exposed most of this landfills. Villagers are currently constructing new solid waste landfill.
Solid waste from supermarkets -Cartons and plastics	Proper storage of plastics for recycling or reuse in future	Women's group	Third week of every month	It is currently practiced. Women reuse plastic bags for the commercial agricultural produce such as fruits or vegetables that they sell along roadside or at the market.
Separation of waste	Several pits to be dug for the different types of waste	Village youths	Third week of every month	Currently this is nonexistence because community members are rebuilding the live

Root Cause	Resolution	Who to lead?	Time Frame	Current status
				and proper houses.

Table 11: Waste management action plan for Nananu village.

Root Cause	Resolution	Who to lead?	Time Frame	Current status
Slothfulness	Discuss within household, clan and villages that children should not be tasked to take rubbish to the rubbish pits	Parents Village Headman Health Committee Women's Committee Resource Committee	During household church services Clan Meetings Village Meeting (Sept. 2015)	This is still on-going
Septic Tank Spillage	Request the Ministry of Health in Ra to help clean the septic tanks and for Fiji Water to financially help improve it	Village Headman	Sept- Dec 2015	Currently department of Health has yet to revisit this health and environmental issue. It was deliberated at the recent district meeting.

Table 12: Waste management action plan for Drauniivi village.

Root Cause	Resolution	Who to lead?	Time Frame	Current status
Coastal Erosion	Reforestation along coastal areas	Villagers	As soon as possible during the village meeting on the 25 th of August, 2015	Work on coastal reforestation will begin towards the end of the first quarter next year 2017.
Destruction of agriculture by animals (cows from Yaqara)	Report about the incident to Ministry of Agriculture and Police	Village headman	When the incident occurs, pictures should be taken to prove the extent of damages done.	This is on-going.
Plastic Bottles	Fiji Water needs to provide recycling bags so that the bottles are proper disposed off	Villagers	A letter will be written tomorrow (21/08/2015) to request the company to provide bags for recycling bottles	Fiji Water has provided the recycling bags and will continue to do so in the future.
Littering	Share the information gathered from the workshop and the lessons learnt during the village meeting	Each individual should start from their own households	As soon as we return to our respective villages	The community cleanup process after Tropical Cyclone Winston has been a powerful educational

Root Cause	Resolution	Who to lead?	Time Frame	Current status
				motivation for communities to continue and highly value the importance of village regular cleanup.

Table 13: Waste management action plan for Togovere village.

Root Cause	Resolution	Who to lead?	Time Frame	
Littering/ Careless disposal of rubbish	<p>Hold a meeting to discuss the issue – Children should not be tasked with the disposal of rubbish because they are not able to dispose of rubbish carefully and or educate children on how waste is properly disposed</p> <p>-a pit should be dug with a lid to prevent animals from scavenging the rubbish from the pits</p>	<p>-All households</p> <p>-Individuals in village</p> <p>-Different Committees</p>	As soon as a village meeting is held	The community cleanup process after Tropical Cyclone Winston has been a powerful educational motivation for communities to continue and highly value the importance of village regular cleanup.

Root Cause	Resolution	Who to lead?	Time Frame	
Pig pen	Relocation of current pig sty with proper fencing	The caretakers of the animals and those responsible for healthy living	As soon as possible	Currently caretakers are aware of this and they are having holding a number of discussions with the other village sub-clans for the best location of their pig pens.
Other animals (Cows, Horses, Dogs and Chicken)	To encourage animal owners to better manage their animals	Animal Owners Village Headman	To be done as soon as the village meeting is carried out.	This has been sorted out in the regular village meetings
Food Peelings/ Organic Waste Materials	Proper allocation for disposal	Every individual in the village	When it is necessary	This has been carried out by some household in the villages but needs to have a 100% active support by those households who have not constructed a

Root Cause	Resolution	Who to lead?	Time Frame	
				compost pit.

Ministry of Health

The Ministry of Health services in Ra Province are coordinated by the Sub-Divisional Medical Officer and the Sub-Divisional Health Sister. Community nursing services are provided through six nursing stations located around the island (increased from five in 1996). Basic medical services are provided through two health centers, one at each end of the island. In Rakiraki, the 30-bed hospital (reduced to 22 beds in 1996) provides a basic secondary level medical service and refers patients to Lautoka for further investigation or treatment.

The Sub-Divisional Health Inspector is responsible for ensuring that villages comply with the public health regulations stated in the Fiji public health legislations. The Ra Hospital and the Ra Maternity Hospital are governed by Boards of Visitors. These community-based boards and the Ra Rural Local Authority, whose role is to oversee public health conditions in villages and settlements, are appointed by the Minister of Health. Responsibility for most community health issues had been deferred to the staff of the Ministry of Health.

There are four health centers in Ra province namely; Rakiraki Health Centre, Nanukuloa Health Centre, Namarai Health Centre and Nasau Health Centre and four nursing stations namely Dobuilevu Nursing Station, Tokaimalo Nursing Station, Vunitogoloa N/Station and Nasavu Nursing Station

The Rakiraki Rural Local Authority

In 2010, Rakiraki was declared a town and on the same year, the Rakiraki Town Council was established to administer the affairs of the town. Prior to this, Rakiraki town had a Rural Local Authority. Hence, residences and industries were not paying rates for any services including the collection of waste. However, the Rural Local Authority was very successful in taking the initiative of hiring a private contractor to collect garbage from the businesses and residents and billed them for these services. In this exercise, the Rural Local Authority ensured that the amount charged was to cover for waste collection and disposal only without making any profit.

This was an excellent example of how communities and businesses were involved in waste management in an area which has limited capacity and it is a system that the Fiji Health Ministry is striving to be introduced in the other Rural Local Authorities. The Rakiraki Rural Local Authority also received some financial grants from the Central Board of Health through the Government of Fiji.

Private Sector Initiatives

Several tourism operators in Ra province including Volivoli Beach Resort, Wananavu Beach Resort and Dolphin Island have implemented waste management strategies within their operation area and these include;

- All rubbish is sorted and disposed of accordingly. Food waste is fed to local pigs. The resort compost as much waste as possible for the organic farm. Plastic and glass bottles are recycled, as are aluminum cans.

- Batteries and empty aerosol cans are impossible for us to dispose of and we request that guests take these with them to their home country where suitable methods of disposal are available.

Waste Collection and Disposal in Rural Areas

In the whole of Ra province, there are no garbage disposal services provided for the people in the rural areas such as villages; farming areas; rural squatters and settlements; and majority of island villages, etc. The methods used to dispose garbage are:

- dumping into rivers or creeks
- dumping on vacant pieces of land
- burning and
- burying.

All the above methods have great negative environmental consequences. This does not only have environmental effects but it also causes a lot of health problems like dengue fever. Though there are provisions in the Fijian Affairs Act and Public Health Act regarding garbage disposal in rural areas and villages, these legislations have not had any significant impact on waste disposal practices in these areas.

Furthermore, the Ministry of Health Rural Local Authorities have so far, not been able to provide adequate garbage disposal services to the rural dwellers, hence people in the rural areas are disposing waste into nearby natural water ways which is in some cases, their only source of drinking water. There is a need to urgently address, these problems as in the rural areas 'mini' dumps are emerging at an alarming rate. It is important to note that Ra province has a greater rural population compared to urban population (Fiji Islands Bureau of Statistics, 2007).

The Pacific Community (SPC) Animal Health and Production

In 2012, the Pacific Community (SPC) Animal Health and Production team, in collaboration with Fiji's Ministry of Primary Industries, implemented a project funded by Taiwan/Republic of China under a project titled Animal Waste Management to Improve Environmental Health in Forum Island Countries in some villages in Ra province. The main aim of the project was to raise awareness on animal waste and train participants to better manage it. Workshops were held at Rokovuaka village and were part of the follow-up to consultations on Animal Waste Assessment Survey visits that were done in these villages in 2010. The surveys found that improper animal waste disposal and management practices were posing risks to the communities and that there was an urgent need to do awareness training.

The workshops focused on raising awareness regarding the risks that animal waste poses to rural communities, and providing appropriate practical technologies to manage it such as composting piggery waste to produce organic fertilizers and using biogas digesters to produce energy for domestic use.

Improper disposal and management of animal waste in Ra province contributes to pollution of air and water and worsens existing challenges stemming from climate change, such as the challenge of providing sufficient potable water. It also contributes to transmission of zoonotic diseases from animals to humans. In addition to the training on animal waste management, the workshop provided basic training in pig and poultry husbandry, and allowed the participants to discuss what the villagers saw as major problems relating to keeping and raising livestock, apart from animal waste.

4. Existing policies

Unlike other developing countries, Fiji does not have comprehensive legislation committed to the management and minimization of waste. Currently there are no provisions for waste separation and recycling; handling and disposal of difficult wastes; reduction in proliferation of non-biodegradable wastes such as packaging, waste oil, batteries, tires, waste electric and electronic equipment (WEEE) and landfill site selection and management. Without appropriate legislation it would be difficult to support programs and targets.

Furthermore, there is a lack of comprehensive policy frameworks for solid waste management while the existing legislations lack enforcement. Some of the laws that can be enforced for improper disposal, accumulation of refuse or littering are:

- Public Health Act
- Litter Decree
- Environment Management Act
- Municipal authorities waste management by-laws
- Fijian Affairs Act

The Fiji Environment Department is the main national institution to oversee waste management work in Fiji. A unit is established within the department and responsible for waste and pollution control in Fiji Solid Waste, Liquid Waste, Air Pollution, Hazardous and Chemical Waste. The basic functions of this unit presently are to look after all waste and pollution control matters such as;

- Complaints (forward to relevant Authorities)
- Meetings and Workshops
- Projects and Complaints
- Development and Implementations of Strategies
- Education and community Awareness, Capacity building
- International Conventions
- Management of the Naboro Landfill and Rehabilitation of Lami Dump
- Enforcement of waste laws and regulation
- Waste Policy Development/Implementation/Review

- Proposal for Remediation/Waste Management Projects

Fiji was one of the first countries amongst the Pacific Islands to develop its own National Solid Waste Management Strategy and Action Plans 2006-2010

The key objectives of this Strategy are to:

- reduce the amount of waste that each community generates
- make best use of the waste that is generated
- develop and implement economic and social incentive mechanisms to change wasteful behavior
- improve and upgrade existing waste management and disposal systems and
- encourage/ provide waste management practices, which minimize the environmental risk and harm to human health
- provide a guideline template for rural or community level solid waste management practices work.

The strategy, while discussing final disposal, also expects to target the life cycle of waste and not just concentrate on the end of pipe solutions. It has usually been the case in Fiji that end of pipe solutions have been sought, perhaps because of lack of mechanisms and infrastructure to look at any other aspect of waste management. However this strategy through the action plans should remedy this problem.

The Fiji Environmental Management Act (EMA) calls for the development of a National Liquid Waste Management Strategy. The strategy sets the direction for sustainable liquid waste management in Fiji and was developed through a process of wide consultation with all stakeholders involved in the production and the management of liquid waste. The strategy developed is led by Government working in close partnership with local government and other key stakeholders (SPREP, 2015).

The strategy outlines the goal, which generally aims to minimize the negative human health and environmental effects from liquid waste. Specific objectives and activities to achieve the goal were determined, also identifying lead agencies, key contributing agencies, output indicators, indicative costs and other resources needed. In general, the objectives and activities fall into categories coherent with regional waste strategies:

- Identifying existing liquid waste management activities and their effectiveness to determine best technologies and practice,
- Developing a regulatory framework that effectively encourages adoption of best practice and monitors change,
- Creating awareness and willingness of people ready to achieve goals,
- Implementing pilot projects and up-scaling successful ones,
- Developing the needed human and capital resources to carry out the needed activities.

The Fiji Environment Management Act's Waste Disposal Regulations came in to force in 2008. The regulations introduce strict requirements in relation to the environmental management of business operations in Fiji. Operators that discharge wastes, pollutants or hazardous substances into the environment are required to secure a Waste Disposal Permit from the Department of Environment.

ECF works with operators to enable them to meet the requirements of the permit. This often includes water testing and developing an environmental management plan for their operation. ECF also liaises with Department of Environment on behalf of the client so as to secure a permit with a minimum of delay.

In rural areas outside of city or local municipal boundaries, management of waste is under the authority of the Rural Local Authorities; wastes from designated Fijian villages are under the jurisdiction of the local health officers under village health bylaws. These are considered to be "not ... particularly effective" (Fiji National Solid Waste Management Strategy, 2006). Rural areas generally have little systematic waste management, and on the whole, Fiji lacks a specific strategy to handle rural solid waste.

Rural areas have benefited from aspects of the National Solid Waste Management Strategy, particularly measures relating to Thematic Area 3: Communication/Information Management. Education and community awareness campaigns, conducted primarily by IWP, have produced some spillover impact on rural waste management. For example, in response to general waste management awareness programs on TV and radio (in English, Fijian and Hindustani), a number of villages around Viti Levu including Namuaimada village in Ra province, have sought assistance from the Ministry of Environment to establish recycling centres for plastic bottles, tins and other metals, and other recyclable materials such as aluminum cans. The income generated by the villages is not yet known, but different recycling firms visit the villages to collect and pay cash for the recyclable materials.

5. Opportunities for RESCCUE implementation

Build-on existing waste management work

Waste management work in Ra province are already implemented at some levels through past initiatives such as the ADB ICM project and this include community awareness and action planning and industrial waste management discussions with the Fiji Sugar Corporation Penang Mill. These efforts together with others implemented by NGOs and government provide an opportunity for RESCCUE to compliment and consolidate waste management work in Ra.

Waste management capacity

RESCCUE through capacity in the project management and technical team, will contribute to finding innovative means of improving waste management options for Ra province. The technical team members have good skills and knowledge in waste management project implementation.

Existence of community-based structures

The community-based structures such as the Ra YMST and a more inclusive stakeholder committee such as the Ra ICM Committee would ensure harmonization and synergies of various waste management and development initiatives. Thus, this would lead to a better communication and constructive dialogue between developers, government and the resource owners.

6. Existing threats to be considered in RESCCUE implementation

In terms of waste management in Ra with specific focus on implementing waste management facilities and strategies the problem of maintaining these systems is one of the challenges that need to be also addressed by RESCUE.

Other specific key waste management issues in communities in Ra province are as follows:

- Poor solid waste disposal especially along the coastal areas, waterways and village surroundings.
- The current rubbish pits in some villages are dug quite close to important areas such as waters dams that are constructed to be used for washing and bathing.
- Poor wastewater management practices in most villages
- Poor design of septic tank which can allow seepage of wastewater into the ground.

7. Proposed Next Steps

Solid waste management

Typically a workshop will be held to discuss the different types of waste and effects they can have on human health and the environment. Different modes of disposal will be discussed. There is recycling of plastic, metals and paper in Fiji but discussions will have to be held with the recycling agencies about conditions under which they would be willing/ able to collect materials in a rural area. At other sites large containers made of thick and durable material are placed near the roadside for the community to place the plastic and metal to be picked up by the company. The paper must be kept dry. An alternative use of paper is to shred and use for composting pig waste. Hazardous waste and non-recyclable items are typically buried but awareness of potential water body pollution needs to be considered and alternatives discussed.

For organic waste composting is the preferred option and different methods such as simple piling, containers and pits can be discussed (along with the benefits of composting). Field trips for community leaders can be arranged to existing sites as well as discussing optimal practices in compost heap management.

For waste initiatives sites will be canvassed to determine which ones are especially interested in these issues; western Ra sites have been previous targets.

On-ground solid waste management field activities in communities:

- Community to construct landfills at appropriate places for non-biodegradable solid waste; and
- For biodegradable community will identify areas and prepare it for compost waste. Ideally to be close their household gardens.

Community wastewater management

For community wastewater management again a starting point is for the community to understand the components of liquid waste that can have negative effects and the fate of these things when various types of wastewater disposal are undertaken. Grey water should be considered separately from sewage waste and can go into a natural or artificial wetland (e.g. banana trench) or a perforated 44-gallon drum with coral rock and coconut husks inside can be used in crowded situations.

For sewage waste where flush toilets are not in place and especially in the drier side of Ra, composting toilets should be considered. A manual on best practice in Fiji is available and typically a community will be asked if they might be interested and, if so, taken to see existing systems in operation and choose their preferred option. For communities with septic systems in place a simple improvement is adding an exit filter which prevents solids from leaving the septic tank and thus considerably increases the residence time of solids and lowers carbonaceous organics, nutrients and bacterial outflow. Small wetlands for the outflow can be

used to further clean the septic tank output and reduce nutrient loads into the receiving environment.

Piggery waste also makes a major contribution to coastal pollution and options such as locating piggeries away from water bodies, composting of pig waste or ponding and evaporation can be considered.

On-ground liquid wastewater management field activities in communities:

- Construction of compost toilets at least in two villagers (this initiative will be discussed in the village meetings followed by a half-day community workshop and the idea is to run through with the communities the pros and cons of the current toilet system and having compost toilets);
- Constructing drainages where necessary to separate black and grey wastewater from households; and
- Aquatic plant species used to screen or filter domestic wastewater such as *Scleria cubensis* to be planted near the outlets of the drains before the wastewater goes into creeks and other waterways which is the same ecosystem based approach mentioned earlier.

Private sector wastewater management

For the small tourism facilities in Ra where the sewage will likely affect coastal waterbodies there are relatively inexpensive Orelco modular systems that greatly reduce the nutrient and microbiological load of the sewage waste.

Only one sugar refinery mill is now operating in Viti Levu and that is the Lautoka Sugar Mill. The mill based in Lautoka City in the Ba Province. Hence the current wastewater issues faced by the communities in Ra from their sugar mill is no longer an environmental or health problem since its closure in February 2017 because of major damages in its infrastructure caused by Tropical Cyclone Winston.

In all of the above it is important to test the effectiveness of the systems being used so monitoring will be undertaken of the effectiveness of the systems introduced. The hydrogen sulphide test kit will be employed by the communities in the following villages: Naseyani; Nananu; Daruniivi; and Togovere. This monitoring test will be conducted from their water source as well as from their home taps at least once a month. Report of the findings will be reported in their monthly village meetings. The Health department through the Ra Provincial office will be notified immediately if there is serious contamination or people getting water-borne illness symptoms.

Budget and Activities

Activity	Target Group (Districts representative)	Cost (F\$)	2017		
			April	May	Jun
Workshop on solid waste management by applying practical measures such as recycling, reuse, repair and compost	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navola</i>	4,000			
Community to construct landfills at appropriate places for non-biodegradable solid waste	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navola u</i>	2,000			
For biodegradable solid waste compost pits will be constructed close household food gardens	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navola u</i>	2,000			
Constructing two compost toilets in at least two villages as demonstration models.	<i>Navitilevu and Navola u</i>	5,000			
Workshop on managing and minimizing domestic waste water	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navolau</i>	4,000			
Constructing drainages where necessary to separate black and grey wastewater from households	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navolau</i>	2,000			

Activity	Target Group (Districts representative)	Cost (F\$)	2017		
			April	May	Jun
Plant aquatic plant species such as <i>Scleria cubensis</i> to screen and filter wastewater before it is goes into creeks and other waterways	<i>Burewai, Kavula, Nakorotubu, Navitilevu, Saivou, Navolau, Rakiraki, Raviravi and Navola u</i>	1,000			
Workshop and Seminar on potential on the economic viability of waste water treatment system such as Orelco modular systems.	<i>Fiji Sugar Corporation Resorts in the Ra Province Ra ICM/ iyaubula Committee</i>	3,000			
Training on legal and enforcement processes in taking polluters to task.	<i>Fiji Sugar Corporation Resorts in the Ra Province Ra ICM/ iyaubula Committee</i>	3,000			
Examining low-cost potential financial mechanisms that would be meaningful for community members to enable them to pay for solid waste village collection in-conjunction with the <i>Rakiraki</i> municipal solid waste collection system. The Ra ICM committee to facilitate this initiative with all relevant stakeholders.	<i>Fiji Sugar Corporation Resorts in the Ra Province Ra ICM/ iyaubula Committee</i>	3,000			
Total		29,000			

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Annex 1

H₂S Paper Strip Test

The H₂S Paper Strip Test is a very simple and low-technology drinking water quality test to find out if the water is contaminated. It was first used in India to test for bacterial contamination in drinking water, and is now used by many isolated and rural communities. The advantage of such a test is that it does not require highly trained technicians or advanced laboratories to test the water (Live and Learn Environmental Education Community Tool Kit).

At each rain water tank, samples were collected in specially prepared tubes containing paper strips previously treated with certain chemicals. The tubes were prepared in the IAS laboratory. The chemicals on the paper strips react with bacteria in the water samples, and turn the paper grey or black.

The water is filled up to a mark on the tube and then the tube is placed in a dark place, or wrapped in black cloth to prevent light from affecting the bacteria. Direct sunlight kills bacteria, and may produce inaccurate results. The time and date of sampling is noted. After 24, 48 and 72 hours at around the same time as the first sampling, the tubes are checked for any color change, and these are recorded. No color change from pale yellow means water is free of bacteria.

'False positives'

One of the criticisms or disadvantage of the H₂S test for Pacific Islands is the occurrence of what is termed 'false positive' result, i.e. a positive result (H₂S paper strip color turning grey or black) but not necessarily due to faecal coliform bacteria. While the sulphide reducing bacteria (responsible for production of H₂S and subsequent color change) are common in the intestinal tracts of most animals (thus making them good indicators for faecal contamination), there are also some bacteria that produce H₂S, but occur naturally in vegetation undergoing bacterial decomposition etc. and are not intestinal in origin (Mosley and Sharp, 2004). Nevertheless, the production of H₂S and color change is enough

warning that bacterial contamination is present in the water source, and that corrective actions such as cleaning out the tanks and boiling drinking water were necessary. .