

**Japan International Cooperation Agency (JICA)**

**Waste Minimization and Recycling Promotion Project  
In the Republic of the Fiji Island**

**3R Guideline**

**November 2011**

**Department of Environment**



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## Appendix

Intermediate Treatment Technologies and Resource Recovery Method

## Abbreviation

JICA	Japan International Cooperation Agency
MSWM	Municipal Solid Waste Management
DOE	Department of Environment
LCC	Lautoka City Council
NTC	Nadi Town Council
M/P	Master Plan
JET	JICA Expert Team
LA	Local Authority <sup>1</sup>
RDF	Refuse Derived Fuel
GW	Green Waste
CDM	Clean Development Mechanism
3Rs	Reduce, Reuse, Recycle
EPR	Extended Producer Responsibility
PPP	Polluter-Pay-Principle
A/P	Action Plan
WACS	Waste Amount and Composition Survey
POS	Public Opinion Survey

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<sup>1</sup> Local Authority in this 3R Guideline means Municipal Council.

## **3R GUIDELINES (DRAFT)**

### **1 Introduction**

#### **1.1 Background**

The Government of Fiji has advocated the "coexistence of a sustainable society and the environment" as one of its basic policies. Furthermore, in June 2008, the government published its "National Solid Waste Management Strategy and Action Plan, 2008 – 2010" which aims to minimize waste, establish appropriate solid waste management (SWM) and reduce their environmental footprint. To achieve these basic policies, the Fiji Government has conducted a "Waste minimization and recycling promotion project" from October 2008, working out of the Lautoka City Council (LCC) and Nadi Town Council (NTC).

The Department of Environment (DOE) decided to move ahead with waste minimization and recycling nationwide by promoting the 3Rs while building a sustainable Solid Waste Management (SWM), as stated in the National SWM Strategy 2011 – 2014 which was revised strategy endorsed by cabinet in 15<sup>th</sup> August, 2011. Therefore, the DOE prepared this 3R Guideline as a national policy to promote 3Rs.

#### **1.2 Objective of the 3R Guidelines**

The objective of the 3R Guidelines is to exhibit the national policy on 3R promotion to the persons in charge of SWM.

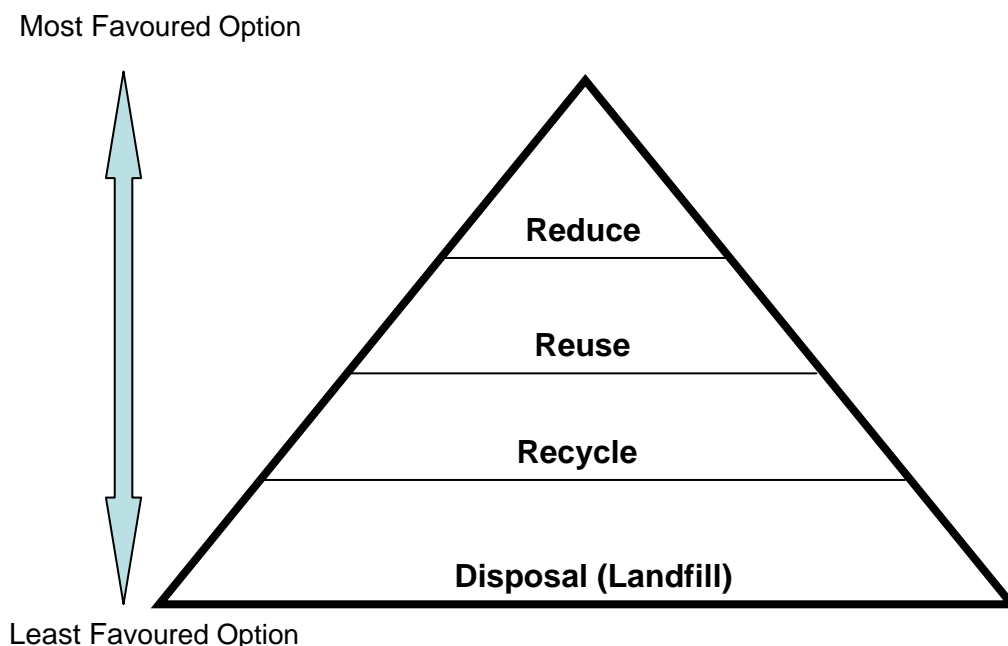
The persons in charge of SWM, especially the Local Authorities (LA), are required to take action to realize the national policy described in the guidelines within their jurisdiction.

### **2 3R Targets and Policy of Promotion**

#### **2.1 What is 3R (Reduce, Reuse and Recycle)?**

##### **2.1.1 Waste Hierarchy**

The waste hierarchy refers to the 3Rs of Reduce, Reuse and Recycle, which classify waste management strategies according to their desirability. The 3Rs are meant to be a hierarchy, in order of importance.



(Source) JICA Expert Team

Figure 1: Waste Hierarchy

### 2.1.2 Vision of Solid Waste Management (SWM) and 3R

The vision of SWM for each local authority (LA) is:

*To establish an environmentally sound SWM system, which aims at more efficient use of products and resources and reduction of adverse environmental impact by waste in the LA.*

In the environmentally sound SWM system, 3R (Reduce, Reuse and Recycle) is promoted and the following situation should be established.

- Waste reduction is encouraged at the generation source, such as households and business establishments.
- Waste generated after reduction measures have been applied is reused or recycled as much as possible.
- Only after efforts have been made to reduce, reuse or recycle waste, it is then properly collected, treated, and finally disposed of in an appropriate manner without negative environmental impacts.
- Such a SWM system will be established by requiring the governmental sector, private sector and general public to bear adequate responsibilities under a transparent and fair rule.

### 2.1.3 Policy of 3R Promotion

Each element of 3R--Reduce, Reuse, Recycle--is interrelated, and the policies to promote each can not be treated independently.

To illustrate this, the table below shows the 3R promotion policy arranged into a table by JET. Here, "On-site Composting" is categorized under "3. Recycle" as item 3.1.1, but this measure also belongs under "1. Reduce" in item 1.2.4.

Table 1: 3R Promotion Methods

Item of 3R	Large Category	Detailed Method
1. Reduce	1.1 Governments establish policy and legal system	1.1.1 PPP (Polluter-Pays-Principle) 1.1.2 EPR (Extended Producer Responsibility) 1.1.3 Import tax on troublesome goods for SWM 1.1.4 Promotion of environmentally friendly products (product design for 3R at the manufacturing stage) 1.1.5 Promotion of simplified packaging 1.1.6 Green purchasing system (Eco-label system)
	1.2 Enhance public consciousness	1.2.1 Buy less and use less 1.2.2 Buy environmentally friendly products 1.2.3 “My bag” campaign (carrying reusable bags) 1.2.4 Reduction of waste discharge through reuse and recycling at waste generation sources
2. Reuse	2.1 Governments establish policy and legal system	2.1.1 Deposit system for reusable/recyclable products 2.1.2 Promotion of returnable containers and packaging
	2.2 Enhance public consciousness	2.2.1 Re-use and repair products 2.2.2 Buy goods with returnable containers and packaging 2.2.3 Sorting reusable goods at generation sources
3. Recycle	3.1 Material recycling	3.1.1 Composting (On-site and Off-site) 3.1.2 Sorting reusable/recyclable wastes (On-site and Off-site)
	3.2 Thermal recycling	3.2.1 RDF (Refuse Derived Fuel) production 3.2.2 Biomass fuel of chipped green waste (GW) 3.2.3 Incineration for power generation and heat supply 3.2.4 Biogas production

(Source) JICA Expert Team

As shown in the table above, reduce and reuse measures—most particularly, reduction--depends largely upon the central government to develop a policy (i.e. a guideline) and establish the necessary legal system to actualize policy. The National Government, through the Ministry of Local Government, Housing, Urban Development and Environment will take the necessary steps to prepare the legal system needed to strengthen the initiatives of LA’s to progressively promote and sustain 3R activities based on the 3R Guidelines.

It is also important to raise public awareness for 3R promotion, especially concerning reduce and reuse. Concerning these measures, the LA will be requested to take positive action.

The 3R Promotion Manual will be utilized by each LA to implement national policy shown in the 3R Guidelines. The manual primarily deals with recycling techniques, and it is important that LAs will promote recycling by developing policy, preparing bylaws to realize the policy and take actions to raise public awareness.

## 2.2 Municipal Solid Waste Management and 3R

### 2.2.1 Municipal Solid Waste management

3R promotion is closely linked to Municipal Solid Waste Management (MSWM). The technical system in MSWM consists of 3 main systems which are: 1) Collection System, 2) Intermediate Treatment System, and 3) Final Disposal System, as shown in the next figure.

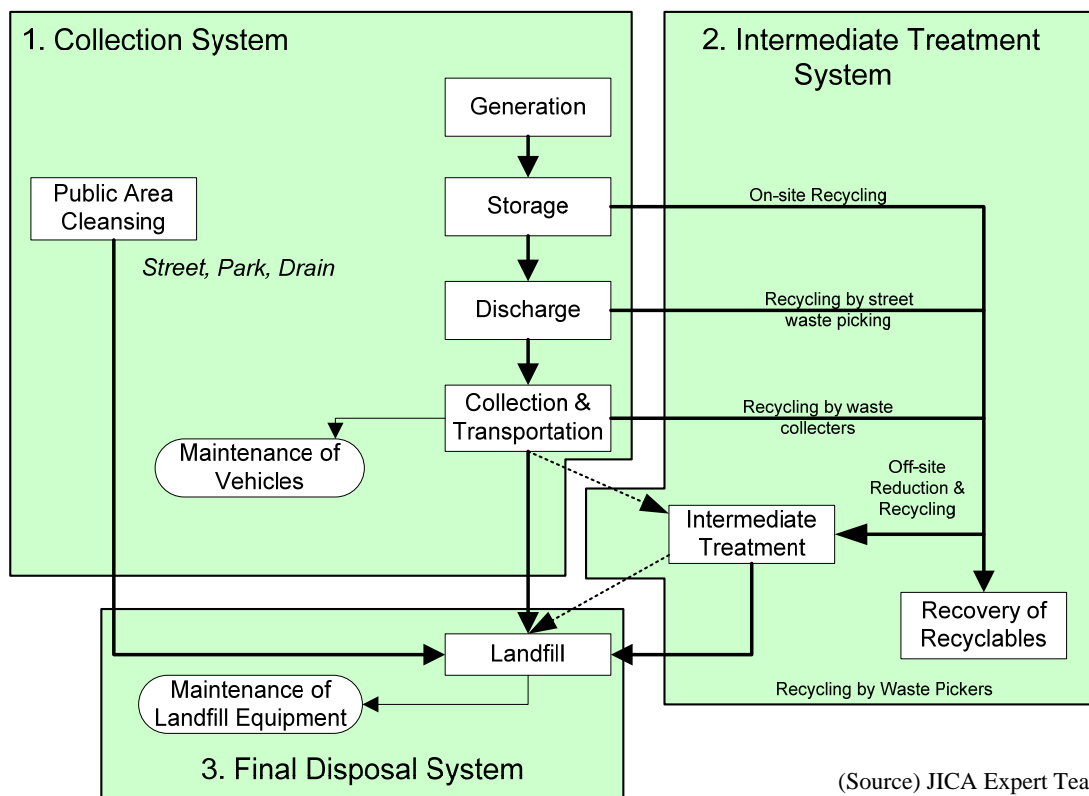


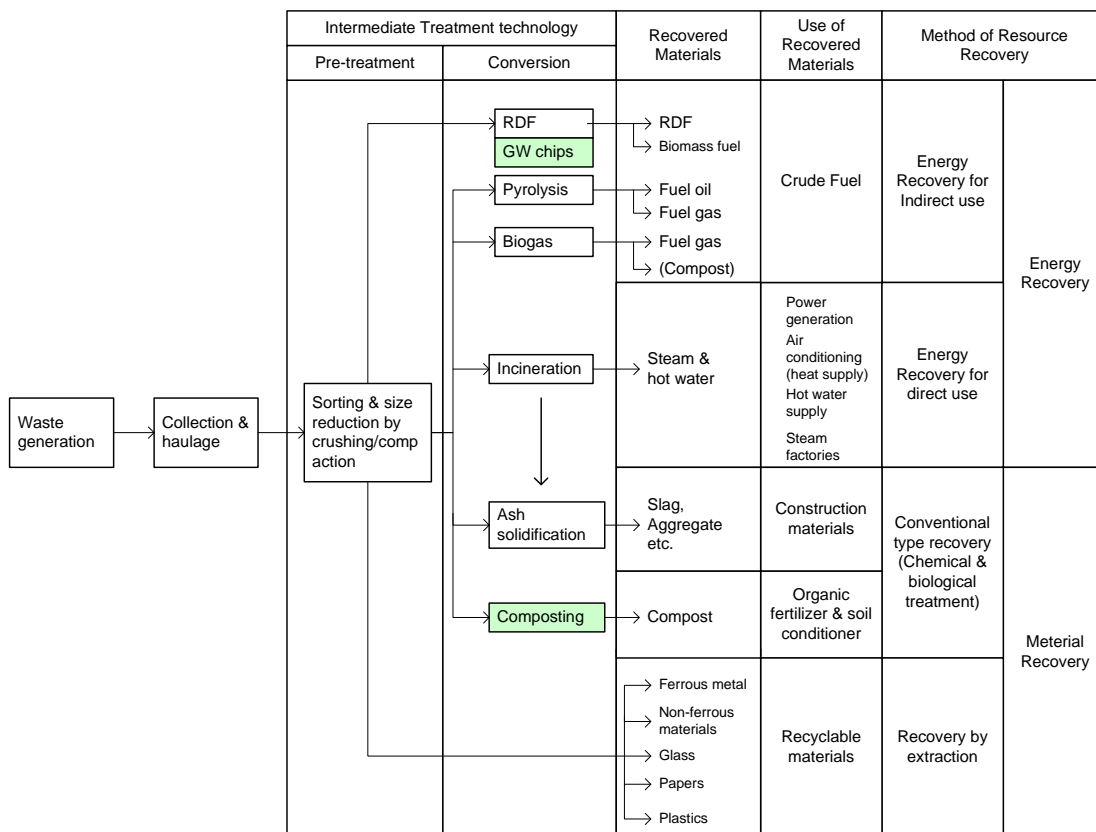
Figure 2: MSWM Technical System

### 2.2.2 Intermediate Treatment Technologies and Resource Recovery Method

Reuse and recycling of MSW are classified under the “Intermediate Treatment System” as shown in Figure 2. Intermediate treatment has a large variety of technologies and many technologies are being operated all over the world.

The following figure shows a relation between intermediate treatment technologies and methods of resource recovery.





(Source) JICA Expert Team

Figure 3: Intermediate Treatment Technologies and Resource Recovery Method

Green waste chipping can be useful for biomass fuel and composting, however typical intermediate technologies as introduced in the appendix, and explained below are alternative intermediate technologies in Fiji.

**a. Green Waste (GW) Chipping as Biomass Fuel**

GW Chipping as Biomass Fuel is a recycling system which converts green waste generated largely in the LA into chips which are then used as a biomass fuel. The combustion of these chips does not require a special facility such as an RDF incinerator, so the existing combustion system can be employed. In Lautoka, Fiji Sugar Corporation (FSC) uses the chips as fuel for the boiler at their factory. GW fuel is renewable so it can be promoted as a CDM project. In addition to utilization as a fuel, wood chips also serve as a bulky material to keep the compost heap under aerobic conditions and act as moisture control.

Therefore, GW chipping is an adoptable intermediate treatment technology. Details of wood chipping are explained in the “3R Promotion Manual”.

**b. Composting**

Waste composting is a method used to achieve microbiological degradation of organic matter (household and vegetable wastes, garden waste, etc.), to produce a recycled organic product for use in agriculture, gardens, parks, and so forth. The most important technical issue related to composting concerns the precise nature of the product. Compost is not a fertilizer but a soil conditioner. It does contain some plant nutrients, but its value lies primarily in that it improves the soil structure by introducing humus, promotes microbial activities, and can help to retain fertilizers and moisture in the soil. Most essential for achieving success when

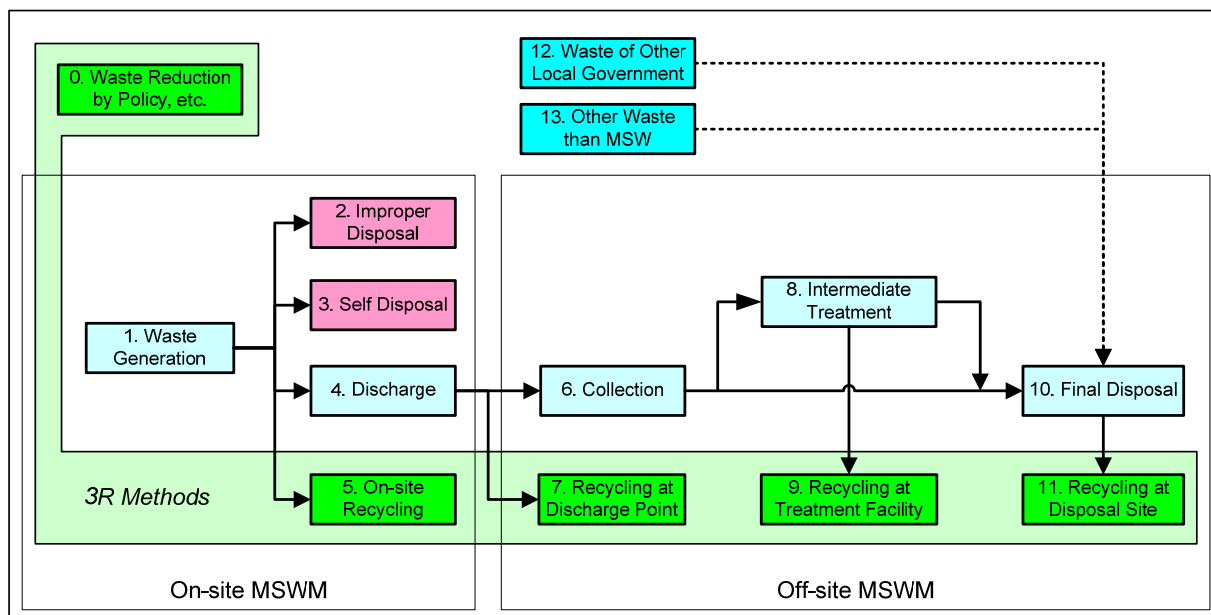
composting municipal waste is that the waste is sorted into a “green” fraction (i.e. organic waste), and a fraction that is not appropriate for composting (plastics, glass, metals, etc.). Sorting may be conducted at a central compost plant (Off-site composting) or at the source (On-site composting).

Both on-site and off-site composting are applicable intermediate treatment technologies for LAs in Fiji. The details of composting technology are given in the “3R Promotion manual”.

### 2.2.3 Basic Waste Stream and 3R Promotion Methods

#### a. Basic Waste Stream

A Waste Stream is an instrument used to depict Municipal Solid Waste Management (MSWM) visually. The method to make a waste stream, using examples from the experiences in LCC and NTC, is explained in the 3R Promotion Manual. The following figure shows the waste stream (from generation to final disposal of the waste) and the relationship to 3R promotion methods.



On-site MSWM: Management of the waste treated by dischargers.

Off-site MSWM: Management of the waste discharged

(Source) JICA Expert Team

Figure 4: Basic Waste Stream and 3R Promotion Methods

An explanation is given here of the 3R Promotion Methods in reference to the waste stream sequence above.

- The Waste Reduction by Policy, etc (item 0, above) signals that MSW Generation (item 1) will be reduced through waste reduction measures. (See previous Table 1: 3R Promotion Methods, 1. “Reduce” for details)
- When waste collection services are not adequately provided, Improper Disposal (item 2) and Self-disposal (3) will take place. It also includes accumulation of refuse in backyard where collection service is provided. Improper Disposal refers to the burning of MSW within a restricted area littering or illegal dumping. Therefore, eliminating

Improper Disposal should be the top priority to improve MSW management.

- Self-disposal (3) refers to permitted burying of kitchen waste or open burning of garden waste, accumulation of refuse etc. in residential backyards in an area where collection service is unavailable.
- The amount of self-disposal and improper disposal activities can be estimated according to population information in areas without collection services, the results of a public opinion survey and the amount of waste detected when illegal dumps are cleaned up.
- When collection services are adequately provided, most of the MSW generated is (4) Discharged (4) and Collected (6).
- On-site Recycling (5) is a measure to reduce waste discharge. Examples of on-site recycling are composting using a composter, and using kitchen waste as food for livestock and pets.
- Recycling at Discharge Point (7) is the collection of recyclables separated at-source before discharge or the collection of these items at discharge points by private recyclers and street waste-pickers.
- Intermediate Treatment (8) is the centralized treatment of collected MSW by the composting facility or incineration plant. In some cases, a facility added to the disposal site.
- Recycling at a Treatment Facility (9) refers to the recycling conducted at the above-mentioned intermediate facility. This includes composting of market waste at a composting facility, heat recovery and power generation at an incineration plant and so forth.
- Final Disposal (10) means the disposal amount at a landfill site which is owned or used by the LA. It is important to note that if the disposal site receives waste from other LAs, or waste other than MSW (such as industrial waste from factories, etc.), in order to know the MSWM of the LA, the amounts for Waste of Other Local Governments (12) and/or Other Waste than MSW (13) must be measured, respectively.
- Recycling at Disposal Site (11) refers to the amount of recyclables collected at the disposal site by waste-pickers.

**b. 3R Promotion Methods**

**b.1 3R Promotion at the On-site MSWM Stage**

As shown in Figure 4: Basic Waste Stream and 3R Promotion Methods, MSWM is classified into two categories, which are On-site and Off-site. On-site MSWM is the treatment performed before discharge by the individual at the generation source. The activities for 3R promotion are listed as follows.

Table 2: On-site 3R Promotion Methods

Major key	Minor key*note1	Cost burden by Government	Benefit of Government	Notes
Reduce generation	1.1.1: PPP	<ul style="list-style-type: none"> <li>• Legal expenses</li> <li>• Cost for public awareness raising</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce expense for collection, treatment and disposal of the waste (discharger's expense)</li> </ul>	<ul style="list-style-type: none"> <li>• Paid garbage bag system</li> </ul>
	1.1.2: EPR	<ul style="list-style-type: none"> <li>• Legal expenses</li> <li>• Cost for Producer's</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce expense for recycling activities</li> </ul>	<ul style="list-style-type: none"> <li>• Biodegradable shopping bag, etc.</li> </ul>

Major key	Minor key*note1	Cost burden by Government	Benefit of Government	Notes
		awareness raising		
	1.1.3: Import tax on troublesome goods for SWM	<ul style="list-style-type: none"> <li>• Legal expenses</li> <li>• Cost of custom clearance work</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental protection by reducing troublesome goods for SWM</li> </ul>	
	1.1.4: Promotion of environmentally friendly products	<ul style="list-style-type: none"> <li>• Legal expenses</li> <li>• Cost for establishment of Eco-label, label system by the National Government</li> <li>• Cost of transmission and promotion of quality information</li> <li>• Cost for public awareness raising</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce cost for collection, treatment and disposal of the waste</li> </ul>	<ul style="list-style-type: none"> <li>• Eco-label</li> </ul>
	1.1.5: Promotion of simplified packaging			
	1.1.6: Green waste purchasing system (Eco-label system)			
	1.2.1: Buy less and use less	<ul style="list-style-type: none"> <li>• Cost for public awareness raising</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce cost for collection, treatment and disposal of the waste</li> </ul>	
	1.2.2: Buy environmentally friendly products	<ul style="list-style-type: none"> <li>• Cost for establishment of Eco-label, label system by the National Government</li> <li>• Cost for public awareness raising</li> </ul>		<ul style="list-style-type: none"> <li>• Eco-label</li> </ul>
	1.2.3: My bag campaign (carrying reusable bags)	<ul style="list-style-type: none"> <li>• Cost for public awareness raising</li> </ul>		<ul style="list-style-type: none"> <li>• “Furoshiki” campaign in Nadi</li> </ul>
	2.2.1: Reuse and repair products			
	2.2.2: Buy goods with returnable containers and package			<ul style="list-style-type: none"> <li>• Container Deposit Legislation Project</li> </ul>
Reduce discharge	1.2.4: On-site recycling	<ul style="list-style-type: none"> <li>• Cost for awareness raising, subsidy for purchase of composter, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce cost for collection, treatment and disposal of the waste</li> </ul>	<ul style="list-style-type: none"> <li>• Home composting (LCC, NTC)</li> </ul>
Separate discharge	3.1.2: Sorting reuse/ recyclable wastes	<ul style="list-style-type: none"> <li>• Cost for public awareness raising</li> <li>• Cost for separate collection of recyclables</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce cost for collection, treatment and disposal of the waste</li> </ul>	<ul style="list-style-type: none"> <li>• Separate collection of recyclables (LCC, NTC)</li> </ul>

note 1: Refer to the article number of “Table 1: 3R Promotion Methods”

## b.2 3R Promotion at the Off-site MSWM Stage

**Off-site MSWM** is a treatment service provided by the government and/or private company after discharge of the MSW. 3R activities carried out by those in the private sector is considered business-oriented resource recovery, and that by the government is conducted as part of their MSWM activities.

3R promotion activities carried out by the private sector reduce the government cost burden to collect and treat/dispose waste, so it should be encouraged on the condition that the

activities would not burden the government or the environment.

On the other hand, 3R promotion activities generally require additional costs for separate collection, and the construction and operation of intermediate treatment facilities. When the additional costs required are covered by the benefit gained through reduction of waste going to landfill, and less burden on the environmental, it can be said to be justified.

However, from experience, 3R promotion activities are generally not profitable. Important part is the social corporate responsibility to environment.

### **b.3 Recommendation**

It is said that promotion of the 3Rs at the On-site MSWM stage, at generation sources, is preferable to the Off-site stage in order to not only improve MSW management, but also to promote the 3Rs in general. The reasons for this are:

- **Low cost:** The additional cost burden to the government to promote On-site is less than that of Off-site.
- **Pure material for recycling:** The most difficult problem is the risk of certain substances contaminating recyclables or becoming mixed in. On-site recycling can minimize this problem. Thus, the saying, “It is *garbage* when mixed, but *resources* when separated.”
- **Raising the awareness of dischargers:** Proper MSWM is not established without the proper understanding and cooperation of waste dischargers. On-site recycling can not be promoted without raising awareness of waste dischargers. In other words, to promote “On-site Recycling” means raising the awareness of those who are discharging the waste.

## **2.3 3R Promotion by Local Authority (LA)**

### **2.3.1 Characteristics of Fiji for 3R Promotion**

A characteristic of island nation on recycling should be considered for promoting 3Rs.

#### **a. Difficulties due to island nation**

- To promote “the third R”, *recycling*, it is essential to have industries such as paper mills, electric furnace-powered factories, etc., which are the final users of recyclables. However, a large investment is necessary to establish these recycling industries, which is a real economic challenge for countries with small populations. Therefore, the recyclables collected in Fiji have to be transported thousands of kilometres to Australia, New Zealand or China. Consequently, recyclable materials which maintain profitability after deducting these significant transportation costs are extremely limited.
- Although LA in Fiji are relatively small in scale and not consolidated in any geographic location, the size and investment in an off-site recycling facility that an LA would be able to construct and operate would be limited.
- Most consumables are imported, so goods with applicable Extended Producer

Responsibility (EPR) are limited. Also, the rate of paper packaging and plastic containers are high due to the high number of imported goods.

**b. Advantages of island nation**

Despite the disadvantages outlined above, an island country carries the following advantages for 3R promotion.

- It is easy to control imported articles, which are only delivered by sea or air transport.
- Accordingly, as a countermeasure to deal with mixed-material containers and plastics which pose difficulty in applying proper treatment methods, it is easy to introduce custom controls or promote proper treatment (e.g. by imposing custom duties to promote proper treatment).
- It is easy to introduce an effective deposit system to promote Reuse/Recycle compared with other countries.

### **2.3.2 National Policy on 3R Promotion**

The National Government, through the Ministry of Local Government, Housing, Squatter Settlement, and Environment will advance the following policies on 3R promotion:

- Prepare the legal system necessary for the national government to strengthen LA's to promote the 3Rs.
- Prepare systems to assist in securing financial sources required to promote the 3Rs and proper treatment.

### **2.3.3 3R Promotion Policy of Local Authority**

Considering the characteristics of Fiji for 3R promotion mentioned above, it is recommended for an LA to promote 3R following the steps outlined below.

To develop an Action Plan for 3R Promotion, the LA is encouraged to utilize the results of surveys and experiences obtained in LCC and NTC, and request LCC/NTC experts to provide them with some support if necessary.

Step 1: **Understanding current problems on MSWM:** The first step for adopting a policy on 3R promotion is to understand its current problems of MSWM as accurately as possible. It is desirable to conduct a baseline survey as in the case of Lautoka and Nadi. However, considerable funds and personnel are necessary for the baseline survey, LA is requested to conduct this by using available personnel and materials as much as possible to develop human resource in charge of waste management. In cases where it is hard for LA to carry out the survey by itself, it is suggested for an LA to utilize the "3R Promotion Manual" and Survey report of MSWM in LCC and NTC and understand their current problems on MSWM with minimum input.

- Step 2 **Development of Action Plan for 3R Promotion:** Considering the current situation and problems on MSWM, the LA should develop an Action Plan (A/P) to solve the current problems and promote 3Rs. The LA will leverage the “3R Promotion Manual” and the master plan on MSWM for LCC and NTC. Therefore, the A/P will be a plan to solve the current problems and promote 3R activities step by step referring to the guidance for waste stream.
- Step 3 **Step-by-step 3R Promotion:** A large amount of input is necessary to conduct 3R promotion. Considering the scale of population of the LA, investment for recycling facility and equipment may be small. The 3R promotion should reflect the regional characteristics and be understandable for the citizens who must be collaborators. Therefore, 3R promotion was proceeded step by step in LCC an NTC considering these points of views. It is suggested that 3R promotion should be initialized as a pilot project and be expanded with amendment of A/P if necessary

## 2.4 Target of 3Rs

### 2.4.1 3R Output Indicators

#### a. Output of 3R

It is exceedingly difficult to obtain a quantitative measure for the output of 3R. The waste generation changes depending on several factors, mainly lifestyle changes, a rise in income, an increase in population, and an increase in business activity. Nevertheless, in general, waste generation shows a tendency to increase. Therefore, It is recommended that the “Final Disposal Amount” and “Recovery Rate”, outlined below, are to be used as the indicators to confirm the output of 3R promotion.

#### b. Final Disposal Amount

A reduction of *10. Final Disposal Amount* in Figure 4: *Basic Waste Stream and 3R Promotion Methods* is the most easily understandable and obtainable indicator.

However, the following events may arise so the evaluation of this indicator should be taken carefully.

- An LA that does not provide collection service for all of its citizens should make it a priority to expand and strengthen its waste collection service, however, it is also possible to simultaneously promote the 3Rs. Nevertheless, expanding the collection service will likely increase *10. Final Disposal Amount* so, even if 3R is promoted, there may not be a noticeable reduction in the final disposal amount.
- Generally, the amount of MSW generated shows a tendency to increase as the living standard rises. Therefore, it is supposed that the *10. Final Disposal Amount* will not decrease, even if the 3Rs are promoted.

#### c. Recovery Rate

The following amounts, as shown in Figure 4: *Waste Stream and 3R Promotion Methods*, should be estimated based on the waste stream developed as outlined in the 3R Promotion Manual.

- 5. On-site Recycling
- 7. Recycling at Discharge Point
- 9. Recycling at Treatment Facility
- 11. Recycling at Disposal Site

Estimate the sum of the above recycling amounts, and then calculate this in juxtaposition to item 1. *MSW Generation* to obtain the recovery rate. The increase of this recovery rate is used as an indicator.

## 2.4.2 Current Situation concerning SWM

There are 13 municipal councils in the Fiji islands and the Department of Health at each council is responsible for waste management. The table below gives a summary of the current situation concerning SWM in these LAs in terms of population, the waste generation amount estimated according to the 3R Promotion Manual, collection system, and final disposal.

Therefore, the waste generation rate of LCC is adopted for estimation of the waste generation. As it is explained in the 3R Promotion Manual, the MSW generation rate of NTC obtained in the Project is 1.894kg/person/day, which is considerably high due to the large portion of the business establishments as a tourist town. This rate is so high compared with that of the other cities in foreign countries that JET determined it is not suitable to use as an average rate for estimation of the MSW generation amount of the other LAs.

Table 3: Current SWM in the Municipal Councils

Councils		Population* <sup>1</sup>	Generation* <sup>2</sup> (ton/year)	Collection		Final Disposal				Recovery rate
		2010 (Nr)		System* <sup>3</sup>	Rate * <sup>4</sup>	Site	(ton/year)	Type* <sup>5</sup>	System	
1	Ba	14,868	6,013	CO	100%	Magruru	2,652	SL	DO	
2	Labasa	7,638	3,089	CO	100%	Namara	2,243	OD	DO	
3	Lami	20,045	8,107	DO	100%	Naboro	5,433	SL	CO	
4	Lautoka	43,838	17,729	CO	100%	Vunato	19,037* <sup>6</sup>	CT	DO	8.1%
5	Levuka	1,121	453	DO	100%	Natokalau	1,280	OD	DO	
6	Nadi	11,895	8,432	CO	100%	Vunato	5,166	CT	DO	2.9%
7	Nasinu	86,678	35,054	CO	100%	Naboro	23,494	SL	CO	
8	Nausori	24,169	9,774	DO	100%	Naboro	6,551	SL	CO	
9	Savusavu	5,947	2,405	DO	100%	Savusavu	956	OD	DO	
10	Sigatoka	5,947	2,405	CO	100%	Kulukulu	7,300	OD	DO	
11	Suva	84,939	34,351	DO/CO	100%	Naboro	23,022	SL	CO	
12	Tavua	1,390	562	CO	100%	Magruru	248	SL	DO	
13	Rakiraki	4,909	1,985	DO	100%	Naria	1,442	OD	DO	
Total		313,384	130,359				98,824			3-8%
Disposal rate			100%				76%			

\*<sup>1</sup>: Population in 2010 is estimated based on that in Table 4 shown in the National Solid Waste Management Strategy 2011-2014 except Sigatoka's population confirmed by hearing from the council.

\*<sup>3</sup>: Waste generation amount estimated by population and MSW generation rate (1,108kg/person/day in 2010) which was projected for LCC in the Waste Reduction and Recycling Promotion Project.

\*<sup>3</sup>: CO=Contract out, DO=Direct operation

\*<sup>4</sup>: Rate of waste amount collected on discharged

\*<sup>5</sup>: SL: Sanitary Landfill, CT: Control Tipping, OD: Open Dump

\*<sup>6</sup>: Disposal amount is bigger than the generation amount why the waste from surrounding area other than Nadi is disposed to Vunato DS



The sum total waste generation amount for all LAs is estimated as 296 ton/day. Almost 70% of total generation is concentrated at the Naboro disposal site where waste collected in the eastern metropolitan area of Suva is disposed of. On the other hand, in the western part of Fiji, the total generation amount from Lautoka and Nadi is 61 ton/day, and collected waste is disposed of at Vunato disposal site. The total generation amount of the municipal councils using Naboro or Vunato disposal sites exceeds 90% of the total amount of waste generated in Fiji.

The recovery rate obtained in Lautoka and Nadi in 2008 was 8.1% and 2.9%, respectively. These are the recovery rates prior to 3R promotion. There are no undertakings being carried out by other LAs referred to as 3R activities, however, beer bottles are collected nationally and, thanks to generally spacious properties, traditional backyard composting is popular. Considering the above, confirmed in the baseline survey conducted in LCC and NTC, a Recovery Rate in Fiji may be in the range from 3% to 8% as of 2010.

### 2.4.3 Numerical Target

Considering the current situation of SWM in Fiji, and the results obtained through the Waste Minimization and Recycling Promotion Project conducted in LCC and NTC, the target year and numerical targets are provided as follows:

- Target year:

The target year for waste minimization is set as 2020.

- Numerical Target for 3Rs:

The numerical target for waste minimization through 3R promotion is given below.

Table 4: Numerical Target for Waste Minimization

	2010 (Present)	2015 (mid term)	2020
MSW generation	130,359 ton/yr	140,671 ton/yr	149,979 ton/yr
Collection rate* <sup>2</sup>	100%	100%	100%
Recovery rate* <sup>3</sup>	3.0 – 8.0 %	10%	15%
Disposal amount	98,824 ton/yr* <sup>1</sup>	100,600 ton/yr	103,500 ton/yr
Disposal rate* <sup>3</sup>	76%	72%	69%

\*<sup>1</sup>: Quantities of waste disposed to landfill at dumps in 2010 is shown in Table 13 of the National Solid Waste Management Strategy 2011 – 2014

\*<sup>2</sup>: Collection rate is the ratio of waste amount collected to the waste amount discharged.

\*<sup>3</sup>: Recovery rate and disposal rate are the ratio of the waste recycled and disposed at the landfill site to the waste generation amount respectively.

### **3 Basic Accord for 3R promotion**

#### **3.1 Framework of national policies**

To realize the waste minimization target given above, 3R activities must be carried out by individuals, business establishments, local authorities and the central government according to their various roles under laws and regulations such as:

- Environmental Management Act 2005
- National Solid Waste Management Strategy and Action Plan 2008-2010
- Litter Decree Amendment 2010

#### **3.2 Role of individuals, business establishments, local authorities and central government**

National government, LAs, people and business establishment need to build proper SWM system with emphasis on 3Rs, whilst playing each role as mentioned below. Furthermore, Fiji may consider supporting 3R initiatives of neighboring Pacific countries.

##### **3.2.1 Individuals**

When selecting a purchase, individuals should give priority to less packing, and reusable, durable and/or reprocessed goods. Consumers should strive to use products as long as possible by repairing damaged goods to reduce the amount of waste they themselves discharge. Also, citizens are requested to cooperate by properly separating their waste according to the categories set by the LA for collection in order to encourage appropriate recycling.

##### **3.2.2 Business establishments**

Business establishments are responsible for the disposal of waste generated in the process of their activities. Businesses should give consideration to waste discharge reduction and appropriate recycling and reuse when selecting raw materials and/or, if necessary, by reconfiguring their manufacturing process. Then, once efforts have been made for waste reduction, reuse or recycling, businesses should secure appropriate treatment methods for the remaining waste to be disposed.

Also, concerning the manufacture, processing and sale of products, businesses should strive to simplify products and their containers and packaging, produce and sell reusable, durable products, improve product repair services and provide information needed to reduce discharge and readily implement recycling, reuse and treatment.

##### **3.2.3 Local authorities**

A LA should promote citizen's voluntary activities within its jurisdiction for discharge-reduction of MSW through proper awareness raising, information services, environmental education, etc. LA must also make efforts to recycle general waste by promoting separate collection and recycling activities.

To implement disposal management of MSW, the LA should consider the necessity to promote proper recycling and disposal, and attempt to establish broad-based management through cooperation with the other local authorities. The LA is requested to conduct cost

analysis on waste management and information services and strive to make waste management effective according to the socio-economic aspects revealed through its analysis. It is recommended for a LA to promote discharge-reduction and recycling, charging a fair rate according to the discharge amount and encourage greater consciousness amount the citizenry by utilizing economic incentives.

When the LA introduces a new, or changes the existing, waste management system through measures such as changing the categories for separate collection and/or disposal methods, it will strive to clearly explain the necessity and environmental and economical merits of the new or revised system to individuals and business establishments.

### **3.2.4 National Government**

National government measures to enhance the base for implementing the method to promote 3R in Table 1.

To promote reduction of waste generation and reuse, it is essential to change people's lifestyle which means that the people are interested in the garbage problem, select the products and services with less environmental impact and cooperates more separate collection for waste minimization and recycling. For this reason, the national government serves for promotion, providing various information and environmental education to change the people's lifestyle with LA.

The National Solid Waste Management Strategy 2011-2014 emphasize financial sustainability for establishment of a proper SWM system. Therefore, DOE will analyse and evaluate the cost for SWM and provide its results, which are the basic information to study the concrete measures adopted for 3R promotion and the optimization of the SWM system including facility development, to be a bases to optimize the system.

The National Government supports each LA to smoothly establish a proper MSW management system and promote 3R activities for the waste minimization.

The National Government shall attempt to build momentum for 3R activities by providing information services regarding progressive examples at home and abroad to promote voluntary activities of individuals and business entities, and to support LAs in proceeding with the 3Rs.

The National Government supports each LA technically and financially to minimize waste and encourages LAs to organize for broad-based, divisional management.

The National Government shall subsidize 3R activities promoted by LAs for waste minimization, as needed, to encourage their smooth implementation.

The National Government considers introduction of an economic incentives in order to inhibit municipal waste generation and promote reuse.

## **3.3 Establishment of a Sound Solid Waste Management System**

Carrying out the following items is essential to establishing a sound SWM system:

- LAs promptly collect, transport and dispose MSW according to the established plan to

avoid any potential damage to the living environment within its jurisdiction.

- LAs consider the policies to achieve waste minimization when preparing a SWM Master Plan. It is necessary to take into account likely changes in the quantity and quality of MSW generated from the mid- and long-term views when preparing the management system.
- A proper collection system that takes disposal and recycling methods into consideration is established. LAs must also establish an effective transportation system considering geographical features and the distribution of their population. A transfer station shall be considered if necessary.
- Broad-based relationships beyond council boundaries are considered, as necessary, to organize collaboration on regional waste management amongst LAs.
- The management system is notified to the public in advance to obtain their support since it is essential that residents and business establishments, which discharge the MSW, are cooperative.
- LAs attempt to harmonize their SWM Master Plan with that of others so that, in cases where it is not possible for an LA to treat waste within the area it was generated, it will be treated in the facility of another LA.
- The Central Government encourages the activities carried out by the existing recyclers and strives to promote the recycling industry.

## **Appendix**

### Intermediate Treatment Technologies and Resource Recovery Method

- a. Refuse Derived Fuel (RDF)
- b. Pyrolysis
- c. Biogas Production
- d. Incineration
- e. Ash Solidification

**a. RDF**

**RDF** (Refuse Derived Fuel) utilizes plastic and paper, which are components of MSW with high calorific value. The large volume of plastic and paper-waste makes it difficult to use as a fuel, so the volume is typically reduced by processing the waste into pellets. To utilize the RDF as a fuel, however, an incinerator is necessary. However, the incinerator needs air pollution prevention equipment, particularly to prevent the release of dioxin, which is generated when plastics containing chloride are burned. Therefore, a great deal of investment is needed to develop an incinerator for the exclusive use of RDF. It is generally estimated that construction costs are about US\$100,000 per ton. It is also required to introduce continuous incineration at a temperature over 850°C to prevent the release of dioxin. Therefore, due to investment constraints for other components of MSW management, JET does not recommend introducing the technology of RDF to local administrations in Fiji where the amount of waste generated is not that great.

**b. Pyrolysis**

Pyrolysis is the thermal decomposition of organic material at elevated temperatures in the absence of oxygen. The term is derived from the Greek *pyr*, meaning “fire”, and *lysis*, meaning “to separate”. The process requires heat to produce a mixture of combustible gases (primarily methane, complex hydrocarbons, hydrogen and carbon monoxide), as well as liquid and solid residues. Extreme pyrolysis leaves mostly carbon as the residue, and is therefore called carbonization. Pyrolysis typically occurs under pressure and at operating temperatures above 430 °C.

As stated above, pyrolysis technology requires a facility that can provide high pressure conditions without oxygen and would likely require a large amount of investment. Also, there are not many waste treatment facilities that have adopted this technology. Therefore, due to investment constraints for other components of MSW management and the relatively complicated technology required, it is not recommended to introduce the pyrolysis to the LA in Fiji.

**c. Biogas Production**

Biogas is a combustible gas developed when organic matter is degraded under anaerobic conditions (i.e. without the presence of oxygen) known as anaerobic degradation. Anaerobic degradation of organic matter, resulting in biogas production, is an efficient means of degrading organic wastes, and making it hygienic. Anaerobic waste treatment is a well known process relating to the treatment of livestock manure, sewage sludge and industrial waste water and other sludge. Biogas can be utilized both for heat and power production. The residue is sludge, but can only be utilized as compost when not contaminated with non-organic matter. Therefore, introduction of this technology is not recommended due to the following reasons:

- b. The required investment for facilities is very high, similar to an incineration plant.
- c. To operate the biogas plant, a collection system preventing the interfusion of non-organic matter would have to be established.

- d. This technology is more appropriate for liquid waste rather than for heterogeneous waste such as MSW due to the high demands to keep organic waste free of non-organic matter.

**d. Incineration**

Incineration of MSW is one of the most popular methods recently adopted for processing wastes in developed countries. Waste is mainly converted into stable oxidized gases and partly into stable inorganic matters by high temperature combustion. Of the various intermediate treatment technologies, incineration generally reduces waste volume to a large degree. It also stabilizes putrescible organic wastes. Energy from waste incineration can be utilized for the production of electricity and/or district heating, and the income from the sale of energy may contribute to the economics of the plant.

A general observation would indicate that incinerators may be feasible where land for land filling is scarce, expensive or very remote from the center of actual solid waste generation. Modern incineration and flue gas treatment technology makes waste incineration an environmentally acceptable form of waste treatment; it is, therefore, possible to locate such plants even in densely populated areas.

On the other hand, the construction cost of an MSW incineration plant requires more than US\$100,000 per ton and also has very high operation costs. High temperature combustion (above 850°C) should be maintained as a measure against dioxin. Due to investment constraints for other components of MSW management and the relatively small amount of MSW generated, it is not recommended to introduce the incineration system to the LA, except for medical waste and hazardous waste.

**e. Ash Solidification**

This technology solidifies the ash generated after combustion. Solidified ash becomes slag and may be used as road construction material. Thus, this technology generates no residue that must be disposed of at a landfill site. Many local governments in Japan have adopted this technology because of very expensive disposal costs (more than US\$300/ton). However, it is not recommended to introduce this technology due to high construction and operation costs for solidification.