

WASTE MINIMIZATION AND RECYCLING PROMOTION PROJECT



3R Promotion Manual



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Department of Environment

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A: Home compost	
B: Market waste compost	
C: Green waste chipping and recycling	
D: Separate collection for recyclables	
E Clean school program	

Abbreviation

SWM	Solid Waste Management
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
M/P	Master Plan
NSWMS-A/P	National Solid Waste Management Strategy and Action Plan
DOE	Department OF Environment
LA	Local Authority
JET	JICA Expert Team
LCC	Lautoka City Council
NTC	Nadi Town Council
WACS	Waste Amount Composition Survey
FDAS	Final Disposal Amount Survey
T&M	Time and Motion Survey
POS	Public Opinion Survey

1. Introduction

1.1 Background and Objectives

1.1.1. Background

The government of Fiji adopted a policy for sustainable social and environmental compatibility in its Strategic Development Plan 2007-2011 in 2006, which also recognizes the importance of appropriate waste management. As for the legal aspects, the Environmental Management Act 2005 was legislated in March 2005. The Environment Management (Waste Disposal and Recycling) Regulation 2007 which gives effect to the provisions of EMA 2005 was enacted on January 2008,. Also, the National Solid Waste Management Strategy and Action Plan 2008-2010 was launched in June 2008 with the aim of reducing environmental impact and waste through proper waste management. Department of Environment (DOE) has now adopted updating the National Solid Waste Management Strategy and Action Plan 2011-2014 in August 2011.

The Fiji government recognizes that local administrations are unlikely to possess sufficient resources to properly deal with the process of solid waste treatment--from collection to final disposal--and instead favors the promotion of regional treatment. In order to achieve this, it is critical that a soft component is also employed to strengthen the capacity of each local administration, promote waste minimization and recycling efforts, and furthermore, reduce the costs of collection and transport, extend the life of current disposal sites and improve capabilities to conduct proper landfill practices. As such, Fiji requested technical cooperation from Japan for a project on waste minimization and recycling promotion. Therefore, based on this request "**The Waste Minimization and Recycling Promotion Project in the Republic of the Fiji Islands**" (hereinafter referred to as "the 3R Project") targeting Lautoka City and Nadi Town was started with the support of JICA from October 2008.

The master plan for solid waste management has been developed for each council and the validity of home-composting, market waste composting, utilization of green waste and separate collection for recyclables to minimize the waste has been demonstrated through the pilot project conducted as part of the Project. Various attempts are now being made to expand these 3R activities to cover the entire council jurisdiction.

Based on the experiences gained in Lautoka and Nadi, DOE developed a Guideline and a manual to promote 3R activities nationwide, focusing on the Western region, with the support of JICA Experts in November 2011.

1.1.2. Objectives

This manual aims to **provide the technical and practical information which guides Local Authorities (hereinafter referred to as “LAs”)** to promote the 3Rs according to the 3R Guideline which serves as the national policy on waste minimization.

1.2 User guide

1.2.1. Target users

In order to establish Environment sustainability and the Sound Material-Cycle Society, each sector has important roles as described below.

Table 1.2.1 Sectors in charge of solid waste management and their main activity

Sector	Main activity
1. National government (Department of Environment)	<ul style="list-style-type: none"> • Develop policies and legislations for 3R Promotion (3R guideline) • Conduct public awareness and campaigns at national level • Monitor 3R activities implemented by local governments and other stakeholders • Collate and share good practices and lessons learnt among stakeholders (through workshop, seminar, website, etc)
2. Local Authorities (Municipalities)	<ul style="list-style-type: none"> • Integrate 3R practices into current SWM system • Develop 3R-related regulations • Implement, Promote and Monitor 3R activities • Conduct public awareness and environmental education
3. Private Sector (Businesses)	<ul style="list-style-type: none"> • 3R activity at hotels (composting, recycling, etc) • Beer bottle, PET bottle and Aluminum cans collection for recycling
4. Community	<ul style="list-style-type: none"> • Cooperate with LA by participating actively in 3R activities.
5. Others (NGOs, etc)	<ul style="list-style-type: none"> • Cooperate with the LA by participation in 3R activities

Among the above implementation bodies, the main users of the manual are **officials in charge of solid waste management at Local Authority (LAs) level.**

As stipulated in the National Solid Waste Management Strategy and Action Plan (NSWMS-A/P), Local Authorities are responsible for the collection, transportation, treatment and disposal of municipal waste. Therefore, the respective Solid Waste

Management (SWM) system of each Local Authorities will serve as the framework for waste minimization through 3R practices.

1.2.2. A Step-by-Step 3R Promotion

Each LA may establish its own SWM system according to regional and local conditions. It is important to remember that the two key measures for 3R in Fiji, “Reuse” and “Recycle”, are limited by the fact that, ultimately, there may not be enough “final users”. Therefore, while taking into account the situation in Fiji to promote 3R, LAs are recommended to follow the steps outlined below to achieve the desired results.

Step 1: Understanding the situation and problems on current Municipal Solid Waste Management (MSWM):

The first step is to develop a waste stream diagram based on the results of a baseline survey and understand the current situation and problems of MSWM as accurately as possible.

Step 2 Development of Action Plan for 3R Promotion:

Based on the current situation and problems concerning Municipal Solid Waste Management (MSWM), the LAs should develop an Action Plan (A/P) to solve any issues and promote the 3Rs. As a form of leverage, the LAs can refer the “3R Promotion Manual” and the master plan on MSWM for LCC and NTC, and if necessary request the support of LCC and NTC experts. Therefore, the A/P will be a plan to solve the current problems and promote 3R activities step-by-step, while referring to the waste stream for guidance.

Step 3 Step-by-step 3R Promotion:

A large amount of input is necessary to conduct 3R promotion across the board. Furthermore, the population scale of the LA may be extremely prohibitive for investment in a recycling facility and equipment. The 3R promotion should therefore reflect to the regional characteristics and be easy to understand for the citizens, who must collaborate with the program. Given these considerations, 3R promotion was conducted step-by-step in LCC and NTC. It is suggested that 3R promotion be initialized as a pilot project and then expanded through amendment of the A/P if necessary

According to the above steps, LCC and NTC implemented 3R activities following

procedure as below;

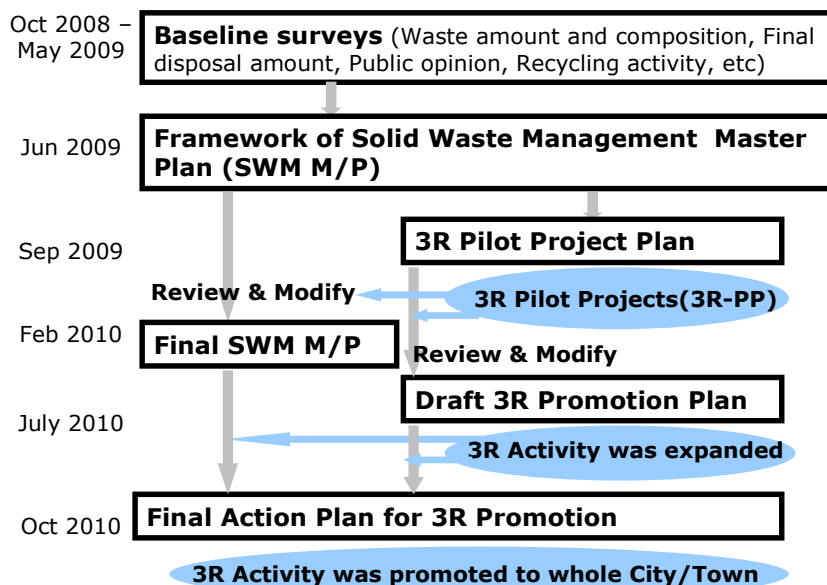


Figure 1.2.1 Implementation procedure of the 3R Project

1.2.3. Contents of the Manual

During the Project, LCC and NTC conducted various surveys and developed plans which were indispensable to the implementation of 3R promotion, given technical and financial support provided by JICA through the JICA Expert Team (JET). However, LAs which intend to initiate 3R promotions in the near future can not expect such support. Therefore, it is suggested that an LA utilize the “3R Promotion Manual” and promote the 3Rs following the steps mentioned above.

The “3R Promotion Manual” consists of the following items necessary for 3R promotion based on the information obtained through the Project in LCC and NTC.

Table 1.2.2 Contents of 3R promotion manual

Items	Contents
1.Understanding the situation and problems of current MSWM	
1.1 Baseline Survey	Introduction of the basic survey and the results obtained in LCC and NTC to grasp the situation of current SWM
1.2 Develop a Waste Stream	Introduction of an easy method to develop a waste stream diagram by using the baseline data.
1.3 Extract Problems	Introduction of a check sheet to understand the situation and extract problems concerning the current MSWM

2. 3R Promotion (based on the experience in LCC and NTC)	
2.1 Basic Policy on 3R Promotion	Explanation and introduction of the characteristics of 3R particular to island countries. Selection of sustainable 3R activities and sustainable practices for their promotion.
2.2 Measures for 3R Promotion	On-site composting, Off-site composting, Green waste recycling, Separate collection of recyclables, 3R promotion in schools
2.3 3R Promotion Activities in Schools	Activities to promote 3R in schools
3. Making a 3R Promotion Action Plan	
3.1 Components of the A/P	Index and Contents
3.2 Informing Citizens	Using workshops, seminars and bulletins
3.3 Securing a Budget	Including 3R activities in the LA annual budget plans

2. Understanding the Situation and Problems of Current MSWM

2.1 Baseline Survey

A baseline survey is a quantitative assessment of the current situation and serves as a basis to proceed with appropriate changes to current waste management. After understanding the situation and extracting any problems with current SWM, it will be possible to study countermeasures to the problems and introduce the 3Rs. In addition, it is also possible to use the key points of the baseline to monitor the progress of the 3R activities in the future.

Waste generation is estimated by calculating the total output of generation sources, such as households, business establishments, public and private offices, schools and public areas (roads, parks, drains), as well as the rate at which they are generated. The number of generation sources can be obtained through statistical data, and the generation rates are understood by measuring the amount of waste and conducting a composition survey.

A portion of the waste generated is recycled and/or disposed of at the generation source (i.e. self disposal), and then the remains are discharged. An LA collects and transports this waste to the disposal site. Waste minimization is carried out from generation and disposal to a small degree when waste pickers, who are part of the so-called informal sector, collect valuable materials. To estimate the amount of recycling and disposal

done at the generation source, as well as waste picking at the dump site, a public opinion survey is conducted.

The situation of the current SWM is understood through these steps, but the surveys listed in the table below must be conducted. As mentioned above, it would appear to be difficult for LAs to conduct these surveys by themselves, so the methodology to use data obtained in LCC and NTC to understand the situation of current SWM is introduced below.

Table 2.1.1: Items and Objectives of the Baseline Surveys

Survey items	Objectives
1. Waste Amount and Composition Survey (WACS)	Obtain data on the waste generation rate (by generation source per day) and physical composition per generation source to develop a waste stream diagram
2. Final Disposal Amount Survey (FDAS)	Confirm the number of incoming collection vehicles to the disposal site, loading weight of each vehicle, and specific gravity of the waste during transportation
3. Time & Motion Survey (T&M)	Understand the manner of discharge and collection and recognize problems with the waste collection system
4. Public Opinion Survey (POS)	Grasping customary practices, recycling practices, and self disposal at generation sources in a community
5. Compost Demand and Market Survey	Confirmation of the demand and market capacity of compost
6. Recycling Survey	The flow of recyclables from collection to exportation, grasping the scale of the recycling industry, etc.

2.2 Statistical Survey

The population present in a service area is an important factor in SWM. It is also necessary to obtain the number of households and business establishments in order to prepare an action plan for 3R promotion.

2.2.1. Population

The population is estimated based on 2007 census data. The projected populations are estimated according to the forecasted population, as shown in the table 2.2.1, given in the Census 2007 Resultsⁱⁱ which were published by the Fiji Island Bureau in 2008. This shows that the population growth rate was 0.79% per year from 2007 to 2010, and the rate of 0.92% per year is adopted to estimate 2011 to 2020.

ⁱⁱ Statistical News 2008 No. 45: Census 2007 results: Population size, growth, structure and distribution

Table 2.2.1: Population Growth Rate in Fiji

Year	Total Population	Growth rate (%)	
		Per period	Per year
2007 (Census)	837,271	-	-
2010 (Projected)	857,000	2.36	0.79
2020 (Projected)	936,000	9.22	0.92
2030 (Projected)	1,034,000	10.47	1.05

The population of each LA is tabulated in Table 2.2.2, based on the Census data in 2007

Table 2.2.2 Population of Councils in Fiji

Urban Area	Urban / Peri-Urban	Census Population		Urban Area	Urban / Peri-Urban	Census Population	
		1996 (Nr)	2007 (Nr)			1996 (Nr)	2007 (Nr)
Ba	All	14,716	18,526	Nausori	All	21,617	47,604
	Town	6,314	6,826		Town	5,744	24,919
	Peri-Urban	8,402	11,700		Peri-Urban	15,873	22,685
Labasa	All	24,095	27,949	Savusavu	All	4,970	7,034
	Town	6,491	7,706		Town	2,652	3,285
	Peri-Urban	17,604	20,243		Peri-Urban	2,318	3,749
Lami	All	18,928	20,529	Sigatoka	All	7,862	9,622
	Town	10,556	10,752		Town	1,597	1,634
	Peri-Urban	8,372	9,777		Peri-Urban	6,265	7,988
Lautoka	All	43,274	52,220	Suva	All	167,975	85,691
	City	36,083	43,473		City	77,366	74,481
	Peri-Urban	7,191	8,747		Peri-Urban	90,609	11,210
Levuka	All	3,746	4,397	Tavua	All	2,419	2,388
	Town	1,096	1,131		Town	1,283	1,079
	Peri-Urban	2,650	3,266		Peri-Urban	1,136	1,309
Nadi	All	30,884	42,284	Rakiraki	All	3,361	4952
	Town	9,170	11,685		Town	3,361	4952
	Peri-Urban	21,714	30,599		Peri-Urban	-	-
Nasinu	All	0	87,446	Total	All	343,847	399,260
	Town	0	76,064		City/Town	161,713	267,987
	Peri-Urban	0	11,382		Peri-Urban	182,134	131,273

Data source: National census in 2007

Population of peri-urban in Rakiraki has not been published in census 2007.

The future population of LAs is estimated as below formula;

- 2007-2010: (Population in 2007) x (1+0.0079)^m m: elapsed year from 2007
- 2011-2020: (Population in 2011) x (1+0.0092)ⁿ } = {Population in 2007x (1+0.0079)³ }x (1+0.0092)ⁿ n: elapsed year from 2011

The estimated populations of LCC and NTC are shown in the table 2.2.3 based on the above formula.

Table2.2.3 Estimated Population of LCC and NTC

Year	LCC		NTC		Your Council	
	Population	Households	Population	Households	Population	Households
2007	43,473	8,038	11,685	2,554		
2008	43,814	8,101	11,777	2,574		
2009	44,155	8,164	11,869	2,594		
2010	44,497	8,228	11,960	2,614		
2011	44,907	8,304	12,071	2,638		
2012	45,317	8,379	12,182	2,663		
2013	45,727	8,455	12,293	2,687		
2014	46,137	8,531	12,404	2,711		
2015	46,547	8,607	12,515	2,735		
2016	46,957	8,683	12,626	2,760		
2017	47,367	8,758	12,737	2,784		

*Average family number per household (person/household) : LCC: 5.41, NTC: 4.58

2.2.2. Other data concerning waste generation sources

The number of waste generation sources can be obtained based on the following data;

- Registration of business establishments,
- Actual performance of public area cleaning,

The examples of LCC and NTC identified in 2008 were as follows;

Table2.2.4 Number of Waste Generation Sources in 2008

Generation sources		Unit	Lautoka	Nadi	Your Council
Population		Person	43,814	11,777	
Commercial	Restaurant	Restaurant	72	223	
	Other shop	Shop	1,174	1,579	
Hotel		Room	249	1,065	
Public and Private office		Office	187	286	
School		Student	2,460	11,389	
Market		Stall	1,660	789	
Street sweeping		M	47,600	41,200	
Park		m ²	665,700	326,000	
Drain		ha or m	1,462 ha	28,300 ha	

2.3 Baseline data obtained in LCC and NTC

A selection of the results of the Waste Amount and Composition Survey (WACS), one of

the baseline surveys conducted in LCC and NTC, which will be most useful to other LAs is given below. Please refer to the survey reports attached DVD for further details.

2.3.1. Waste Amount and Composition Survey (WACS)

(1) Waste amount

The generation rate of each source, given below, was estimated in the WACS-survey, which was carried out in both the dry season in 2008 and rainy season in 2009.

Table 2.3.1 Waste Generation Rate in 2008

Generation source		Unit	Lautoka	Nadi
Household		g/person/day	432	374
Commercial	Restaurant	g/restaurant/day	17,500	9,800
	Other shop	g/shop/day	3,130	1,100
Hotel		g/room/day	165	190
Public and Private offices		g/office/day	2,480	270
School		g/student/day	25	4
Market		g/stall/day	1,988	4,820
Street sweeping		g/m/day	86	9.7
Park		g/m ² /day	4.2	12.3
Drain		g/ha/day, g/m/day	479	14.1

*Green waste is not included in household waste

The generation amounts of LCC and NTC were estimated as 48.1 ton/day and 22.4 ton/day, respectively, according to the generation rate shown in Table 2.2.5, and the number of generation sources was obtained by statistical data (see Table 2.2-4).

Table 2.3.2 Waste Generation Amount in 2008

		Unit	Lautoka	Nadi
Household		ton/day	18.9	4.4
Commercial	Restaurant	ton/day	1.3	2.2
	Other shop	ton/day	3.7	1.7
Hotel		ton/day	0.04	0.2
Public and Private offices		ton/day	0.5	0.1
School		ton/day	0.1	0.1
Market		ton/day	3.3	3.8
Street sweeping		ton/day	4.1	0.4
Park		ton/day	2.8	4.0
Drain		ton/day	0.7	0.4
Green waste		ton/day	12.7	5.1
Total		ton/day	48.1	22.4

The waste generation rate of households in LCC is 432 g/person/day, and in NTC is 374

g/person/day. Thus, there does not signify a large difference between the two in terms of households; however, the waste generation rate of Municipal Solid Waste (MSW), which is estimated by total waste generation divided by population, in LCC and NTC are 1,098 g/person/day and 1,894 g/person/day, respectively. Here we can see that the MSW generation rate of NTC is 1.7 times that of LCC.

Table2.3.3 Comparison of waste generation ratio

Distinguish	Unit	LCC	NTC
Household waste	g/person/day	432	374
Municipal waste	g/person/day	1,098	1,894

The reason for NTC to have such a large MSW generation rate is that the number of registered business establishments in NTC is 40% higher than in LCC, and the amount of waste generated by business establishments is significant. This highlights the fact that waste generation is particular to the context of each city, and therefore, each LA is requested to consider its own characteristics when it estimates its waste generation amount.

Various waste amounts are estimated when making a waste stream, as explained below, but the MSW generation rate of LCC has been adopted in this 3R Promotion Manual because it is most likely the more applicable for other LAs to use.

Table 2.3.4 Number of Business Licenses in LCC and NTC

No	Generation source	LCC in 2007	NTC in 2008
01	Restaurant	72	223
02	Shop	1,147	1,579
03	Hotel	8	54
04	Office	157	266
05	School	7	19
06	Hospital	22	60
	Factory	66	35
	Others	527	604
Total		2,006	2,840

(2) Waste Composition

Waste composition obtained by WACS in the Project is shown in the table below. Green waste makes up the largest portion at 37.4% in LCC and 36.9% in NTC. The next is kitchen waste, which is 30.1% in LCC and 36.4% in NTC. Those wastes are considered to be organic matter, for which the total portion of waste generated is 67.5% in LCC and 73.3% in NTC. This high ratio of green waste is considered to be a characteristic of Fiji.

On the other hand, the ratio of recyclables such as PET, metals, bottles and glass, which are valuable and can be sold, is only between 4 and 5%.

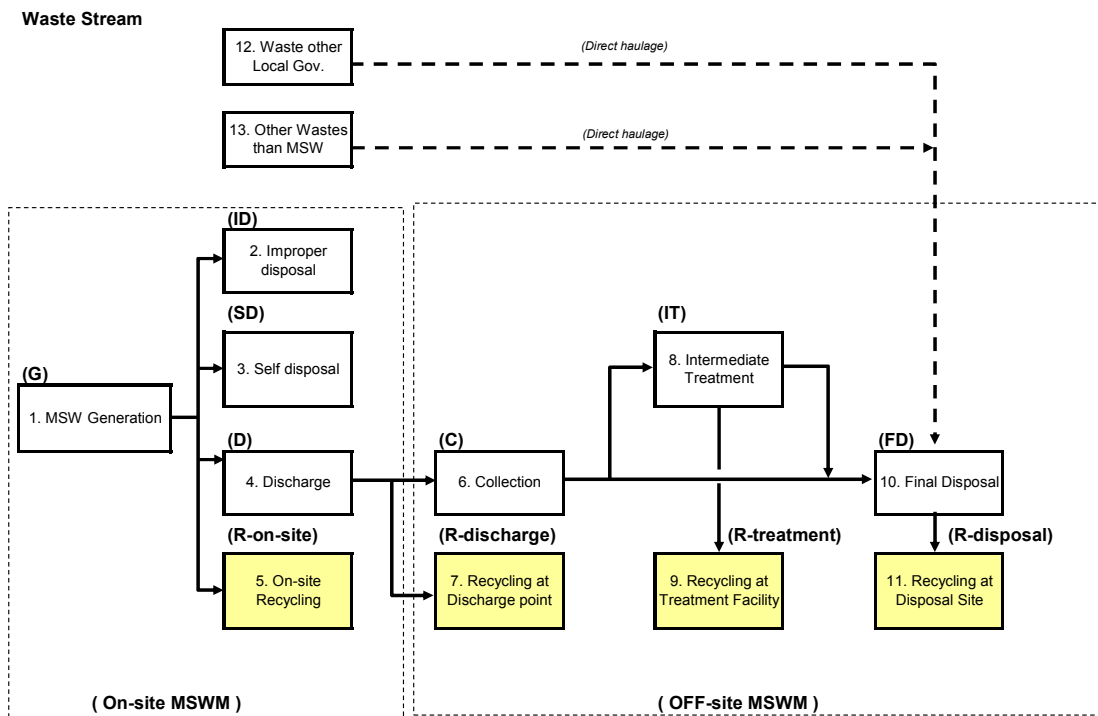
Table2.3.5 Waste Composition in 2008

Category of Waste	Lautoka (%)	Nadi (%)
Kitchen Waste	30.1	36.4
Paper	12.9	12.1
Textile	1.5	0.9
Plastic (PET)	1.2	2.2
Plastic (Film)	6.7	4.9
Grass and Wood	37.4	36.9
Rubber and Leather	0.2	0.0
Combustibles Sub-total	90.0	93.4
Metal	2.5	1.3
Bottles and Glass	1.5	0.9
Ceramic & Stone	2.7	3.1
Others	3.3	1.3
Non-Combustibles Sub-total	10.0	6.6
Total	100.0	100.0

2.4 Development of the Waste Stream

2.4.1 Basic Waste Stream

The waste stream is a visual method to understand MSW management. The basic waste stream indicates the flow of wastes from generation to disposal, as shown in the following figure.



(Source) JICA Expert Team

Figure2.4.1 Basic Waste Stream

3R promotion methods are explained below. The numbers indicate a box in the above waste stream diagram.

1. MSW Generation: The total waste generation amount is estimated through the summation of the waste generation rate and number of generation sources in the LA. This may be reduced through waste reduction activities.
2. Improper disposal: This emerges when sufficient waste collection service is not provided. Improper disposal refers to the burning of MSW in a prohibited area, illegal dumping of waste or littering. Also includes backyard accumulation of refuse where collection service is provided. The amount can be estimated through the POS-survey, the amount of illegally dumped waste that is cleaned-up, etc. Therefore, elimination of “improper disposal” should be the first priority in the improvement of MSWM.
3. Self disposal: This refers to waste treatment through techniques such as burying kitchen waste or burning garden waste in the backyard where burning is allowed, in an area without waste collection services. The amount of self disposal can be estimated based on the data obtained by POS, etc.
4. Discharge: This waste is seen to be dispensable and is discharged from the

- generation source. It does not include recyclables collected at the generation source. The discharge amount is estimated by the amount of waste generation, improper disposal, self disposal and on-site recycling, which is mentioned below.
5. On-site recycling: Recycling conducted at the generation source, such as composting of kitchen waste (using a composter), or using it as animal feed and mulching of green waste like grass and peelings.
 6. Collection: This is the amount of waste collected by the public service provided by the LA.
 7. Recycling at discharge point: This is the collection of separated recyclables at the generation source. It includes cases where the LA collects recyclables separated by the discharger as well as when the recycler and/or street waste-pickers collect recyclables directly.
 8. Intermediate treatment: This is the integrated processing of MSW at a composting facility, incineration plant, etc. The facility may be constructed in the disposal facility.
 9. Recycling at treatment facility: This is recycling conducted in the intermediate treatment facility mentioned above. Composting of organic waste at a composting facility and thermal recycling or power generation at an incineration plant is included.
 10. Final disposal: This is the final disposal amount at the disposal site owned or used by an LA. If the disposal site is used by any other LA ("12. Waste of Other Local Governments") or receives waste other than MSW ("13. Other Waste than MSW"), those amounts should be estimated in order to understand the LA's MSWM.
 11. Recycling at disposal site: This is the amount of recyclables collected by waste pickers at the disposal site.
 12. Waste of Other Local Governments: This is MSW transported by another LA which does not have a disposal site. The disposal amount can be estimated by the number of incoming collection vehicles and the loading capacity of each (FDAS-survey).
 13. Other Waste than MSW: This is the waste other than MSW, such as factory waste, other common industrial wastes and non-hazards hospital waste.

2.4.2 Development of Waste Stream by Simplified Method

The results of surveys such as the WACS, FDAS and POS are necessary to develop the waste stream.

However, the time and cost to implement these surveys likely prohibit most LAs from

conducting them. Therefore, the 3R Promotion Manual has been produced to offer a simple reference that an LA can use to develop its waste stream, based on the generation rate and several comparative ratios obtained for LCC in 2008.

Nevertheless, the waste stream developed by this simple method will clarify a general view of the current situation, which is important for an LA to prepare a 3R Action Plan.

The steps to develop a waste stream using this simplified method is explained in the basic procedures below.

Furthermore, each amount of waste in the waste stream is calculated as ton/day.

(1) MSW Generation (G)

The MSW generation amount of an LA is estimated by using the MSW generation rate obtained by the WACS-survey in LCC and the population of the LA.

Table2.4.1 MSW Generation Rate

Year	LCC Population projection	Total MSW generation amount	MSW generation rate (A)
		(ton/day)	(g/person/day)
2008	43,814	48.1	1,098
2009	44,155	48.7	1,103
2010	44,497	49.3	1,108
2011	44,907	49.9	1,112
2012	45,317	50.7	1,117
2013	45,727	51.5	1,125
2014	46,137	52.3	1,132
2015	46,547	53.1	1,139
2016	46,957	53.7	1,142
2017	47,367	54.4	1,147
2018	47,760	55.1	1,153
2019	48,179	55.8	1,158
2020	48,599	56.6	1,164

The MSW generation amount in 2010 can be estimated by multiplying 1,108 g/person/day (the MSW generation rate in 2010) and the population in 2010, estimated according to the census data and population growth rate explained in section 2.1.1, and finally adjusting to ton/day.

$$G \text{ (ton/day)} = 1,108 \text{ (g/person/day)} \times \text{Population (person)} / 1,000,000$$

[Example to estimate MSW Generation amount with population of 20,000]

- Population: 20,000 persons
- $G \text{ (ton/day)} = 1,108 \text{ (g/person/day)} \times \text{Population (person)}$
- $G = 1,108 \times 20,000 / 1,000,000 = 22.16 \text{ ton/day}$

(2) Improper Disposal (ID)

It is presumed that the Improper Disposal (ID) amount is the difference between the MSW generation amount (G) minus the sum of the self-disposal (SD), discharge (D) and on-site recycling (R-on-site) amounts.

$$ID \text{ (ton/day)} = G \text{ (ton/day)} - (SD + D + R\text{-on-site}) \text{ (ton/day)}$$

[Example to estimate Improper Disposal amount]

- $G = 22.16 \text{ ton/day}$
 - $SD = 1.11 \text{ ton/day}$
 - $D = 13.96 \text{ ton/day}$
 - $R\text{-on-site} = 1.11 \text{ ton/day}$
- $ID \text{ (ton/day)} = G \text{ (ton/day)} - (SD + D + R\text{-on-site}) \text{ (ton/day)}$
- $ID = 22.16 - (1.11 + 13.96 + 1.11) = 5.98 \text{ ton/day}$

(3) Self-Disposal (SD)

Self-disposal (SD) was calculated based on the result of POS (Public Opinion Survey) implemented by the JICA Expert Team (JET) to develop the SWM Master Plan of LCC.

In the case of LCC, the amount of SD in 2008 was 2.4 ton/day, and therefore, the SD percentage of the 48.1 ton/day of MSW generation amount is estimated as 5%.

$$SD \text{ (ton/day)} = G \text{ (ton/day)} \times 0.05$$

[Example to estimate Self-disposal amount]

- G: 22.16 ton/day
- $$SD \text{ (ton/day)} = G \text{ (ton/day)} \times 0.05$$
- $$SD = 22.16 \times 0.05 = 1.11 \text{ ton/day}$$

(4) Discharge (D)

The Discharge amount consists of waste discharged from households and business establishments to be collected and transported directly to the disposal site. This also refers to waste collected from public areas, such as road sweeping, drain and park cleaning.

The Discharge amount (D) is estimated by multiplying the MSW generation amount (G) by the percentage of discharged waste obtained in the LCC waste stream.

The Discharge amount (D) in the LCC waste stream is 30.1 ton/day, which is estimated to be 63% of the MSW generation amount. Therefore, the amount discharged by an LA is estimated using the following formula.

$$D \text{ (ton/day)} = G \text{ (ton/day)} \times 0.63$$

[Example to estimate Discharge amount]

- G: 22.16 ton/day
- $$D \text{ (ton/day)} = G \text{ (ton/day)} \times 0.63$$
- $$D = 22.16 \times 0.63 = 13.96 \text{ ton/day}$$

(5) On-site Recycling (R-on-site)

On-site Recycling (abbreviated 'R-on-site') includes the amount composted (traditionally by heaping organic waste into piles) and utilizing green waste as kindling material, etc. The daily amount of R-on-site was estimated as 2.4 tons based on the results of POS, etc. Therefore, the percentage of total MSW generation that was recycled on-site in LCC is 5%.

If an LA implements composting, using a composter that has been verified for effectiveness in LCC and NTC, it will be included in R-on-site. According to the results

from pilot project monitoring done in LCC and NTC, the amount of kitchen waste being recycled using a composter at households is estimated to be 107 g/person/day. The amount of on-site composting is estimated by multiplying the above amount by the average number of family members per household, and the number of composters installed, divided by 1,000,000 to adjust to tons/day.

$$\mathbf{R\text{-on-site (ton/day) = G (ton/day) \times 0.05 + (107 (g/person/day) \times (average of number of family members) \times (Number of composters installed))/1,000,000}$$

[Example to estimate R-on-site amount]

- G: 22.16 ton/day
- Number of family members: 4.5 persons
- Number of composters installed: 30

$$\text{R-on-site (ton/day) = G (ton/day) \times 0.05 + (107 (g/person/day) \times (average of number of family members) \times (Number of composters installed)) / 1,000,000}$$

$$\text{R-on-site} = 22.16 \times 0.05 + ((107 \times 4.5 \times 30) / 1,000,000) = 1.11 \text{ ton/day}$$

(6) Collection (C)

Collection (C) is calculated as the Discharge amount (D) minus the amount of Recycling at the discharge point (R-discharge). R-discharge is explained further in item 7 below.

$$\mathbf{C (ton) = D (ton) - (R\text{-discharge})}$$

[Example to estimate Collection amount]

- D: 13.96 ton/day
 - R-discharge: 0.18
- $$C = D - (R\text{-discharge})$$

$$C = 13.96 - 0.18 = 13.78 \text{ ton/day}$$

(7) Recycling at Discharge point (R-discharge)

Beer bottle collection through a deposit system is counted as Recycling at discharge

point (R-discharge). The collection amount is estimated as 0.4 ton/day according to the results of the POS-survey. This corresponds to 0.8% of the MSW generation amount.

Separate collection of recyclables is being implemented in LCC and NTC, and its effectiveness has been verified. If an LA chooses to implement separate collection of recyclables as an Off-site recycling measure, it will be counted as R-discharge. The results of monitoring of the pilot project implemented in LCC and NTC show the average discharge rate of recyclables to be estimated as 6.2 g/person/day at households and 217 g/BE/day at business establishments (BE). An LA can estimate the R-discharge value by multiplying the unit discharge rate and the population and number of business establishments, divided by 1,000,000 to adjust to tons/day. An example using the LCC and NTC average is shown below.

Table2.4.2 Discharge rate of separate collection for recyclables

	Household (g/person/day)	Business Establishment(BE) (g/BE/day)
NTC	6.7	315
LCC	5.7	118
Average	6.2	217

R-discharge (ton) = G (ton) x 0.008 + ((6.2(g/person/day) x population receiving service of separate collection for recyclables) + (217(g/BE/day) x Number of BE receiving separate collection for recyclables))/1,000,000

[Example to estimate R-discharge amount]

- G: 22.16 ton/day
- Population provided separate collection for recyclables: 0
- Number of BE provided separate collection for recyclables: 0

R-discharge (ton) = G (ton) x 0.008 + ((6.2(g/person/day) x population provided separate collection for recyclables) + (217(g/BE/day) x BE Number of BE provided separate collection for recyclables))/1,000,000

R-discharge = 22.16 x 0.008 + ((6.2 x 0) + (217 x 0)) / 1,000,000 = 0.18

(8) Intermediate Treatment (IT)

If there is a compost facility and/or incineration plant, etc. that is used between waste collection and the landfill, the amount of waste that is taken to these facilities will be counted as Intermediate Treatment (IT). In the case of LCC, IT is divided into two categories: i) market waste composting, and ii) green waste recycling.

(i) Market Waste Composting

If an LA decides to implement composting of market waste, as was conducted in LCC and effectiveness verified, then the LA must separate organic waste, such as vegetables and fruit, and divert it to the compost facility. According to the LCC waste stream, 3.3 ton/day of market waste is generated, which is 6.9% of the MSW generation amount (G). According to monitoring data, 8.0% of that market waste, i.e. 265 kg/day of organic waste, is separated and transported to the compost facility. The leftover composting residue is transported to the disposal site and landfilled.

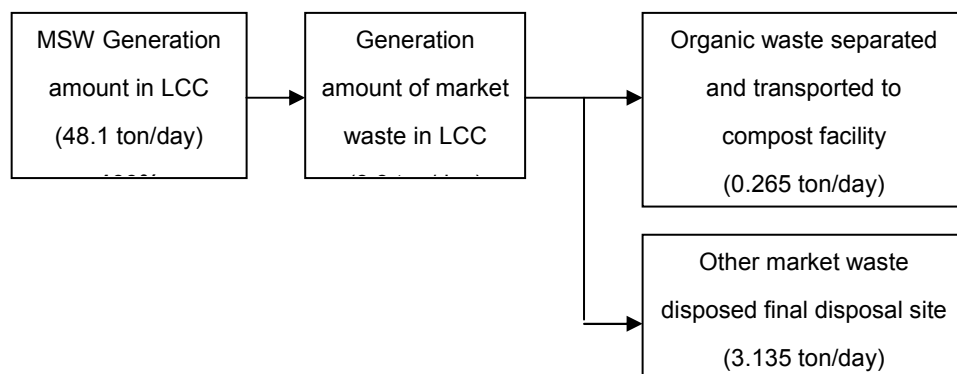


Figure2.4.2 Market waste separated and treated at compost facility

An LA can estimate the amount of market waste to be composted in the compost facility by using the percentage obtained in LCC.

IT market compost (ton) = G (ton) x 0.069 x (percentage of organic waste separated and transported to compost facility)

(ii) Recycle of Green Waste

LCC utilizes its green waste by chipping the tree-clippings generated from households, business establishments and parks to be used as mulching material or sold to the Fiji Sugar Corporation (FSC) as boiler fuel.

The generation amounts of green waste in LCC were 12.7 ton/day from households and businesses and 2.8 ton/day from parks and avenues in 2008. These correspond to 26.4% and 5.5%, respectively, of total MSW generation.

- GW generated from households and business establishments:
 - Generation amount of GW = MSW Generation (G) x 26.4%
 - Discharge amount of GW = 4.7% of generation amount of GW
 - Off-site recycling of green waste discharged from household etc. (%)
- GW generated from parks and avenues:
 - Park waste amount = 5.5% of MSW Generation amount
 - Off-site recycling of green waste discharged from parks (%)

IT green waste recycling (ton) = G x 0.26 x 0.047 x (% of off-site recycling of green waste discharged from household and business establishment) + G x 0.055 x (% of off-site recycling of green waste discharged from parks and avenues)

[Example to estimate the Intermediate Treatment amount]

- G: 22.16 ton/day
 - Off-site recycling of green waste discharged from households, etc.(%) = 0
 - Off-site recycling of green waste discharged from parks, etc. (%) = 0
- IT market compost (ton) = G (ton) x 0.069 x (percentage of organic waste separated and transported to compost facility) = 22.16 x 0.069 x 0.0 = 0.0
- IT green waste recycling (ton) G (ton) x 0.26 x 0.047 x (percentage of off-site recycling of green waste discharged from households and business establishments) + G x 0.058 x (percentage of off-site recycling of green waste discharged from parks and avenues) = 22.16 x 0.26 x 0.047 x 0 + 22.16 x 0.058 x 0.0 = 0
- IT = IT market compost + IT green waste recycling = 0.0 + 0.0 = 0.0 ton/day

(9) Recycling at Treatment Facility (R-treatment)

The amount of recycling at a treatment facility (R-treatment) refers to the portion of waste taken to an intermediate facility, such as a compost facility or incineration plant,

and recycled or reused.

However, the R-treatment amount will fluctuate due to the treatment capacity and/or input quantity, so an LA must estimate this amount taking into consideration the existing facility or action plan.

According to the monitoring results in LCC, compost was 10% of market waste (measured by weight) input to the compost facility. Of this amount, 55% was used as the final product and the remaining 45% was disposed as residue.

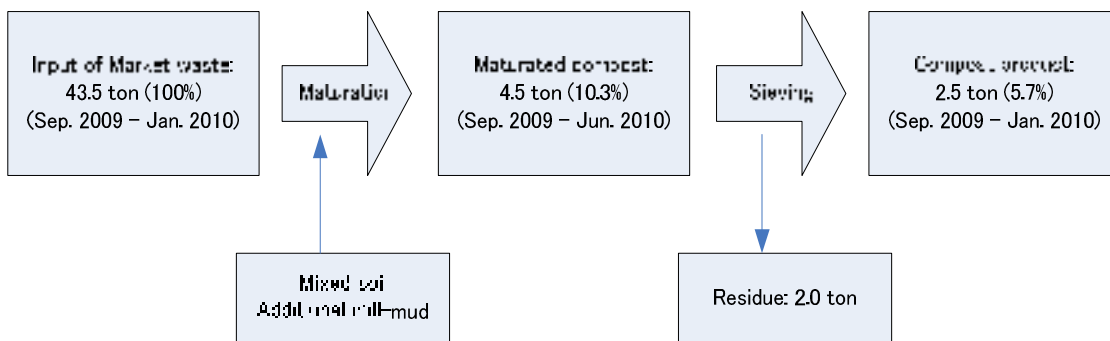


Figure2.4.3 Waste Stream of Market Waste Composting

$$R\text{-treatment (ton)} = IT \text{ market compost (ton)} \times 1/10 \times 0.55$$

+ IT green waste recycling

$$Residue \text{ of } R\text{-treatment (ton)} = IT \text{ market compost (ton)} \times 1/10 \times 0.45$$

[Example to estimate R-treatment amount]

- IT market compost: 0 ton/day
- IT green waste recycling: 0 ton/day

$$R\text{-treatment (ton)} = IT \text{ market compost (ton)} \times 1/10 \times 0.55 + IT \text{ green waste recycling}$$

$$= 0 \times 1/10 \times 0.55 + 0 = 0$$

$$Residue \text{ of } R\text{-treatment} = IT \text{ market compost (ton)} \times 1/10 \times 0.45 = 0$$

$$= 0.12 \times 1/10 \times 0.45 = 0.0054$$

(10) Final Disposal (FD)

Final Disposal amount (FD) is estimated by subtracting the amount of intermediate treatment from the total amount collected, and adding the residue of the amount recycled at a treatment facility (Residue of R-treatment).

$$FD \text{ (ton)} = C \text{ (ton)} - IT \text{ (ton)} + \text{Residue of R-treatment (ton)}$$

[Example to estimate Final disposal amount]

- C: 13.78 ton/day

- IT: 0

- Residue of R-treatment: 0

$$FD \text{ (ton)} = C \text{ (ton)} - IT \text{ (ton)} + \text{Residue of R-treatment (ton)}$$

$$FD = 13.78 - 0 + 0 = 13.78$$

(11) Recycling at Disposal site (R-disposal)

The recycling amount collected by waste pickers at the disposal site is abbreviated as R-disposal.

There are about 35 waste pickers collecting valuables at Vunato disposal site in LCC. The survey conducted in 2008 estimated the amount of R-disposal to be 1.1 ton/day, which is equivalent to 2.3% of the SWM generation amount. The amount of recyclables collected by each waste picker per day is estimated to be 30 kg.

$$R\text{-disposal (ton)} = G \text{ (ton)} \times 0.023$$

[Example to estimate R-disposal amount]

- G: 22.16 ton/day

$$R\text{-disposal (ton)} = G \text{ (ton)} \times 0.023$$

$$R\text{-disposal} = 22.16 \times 0.023 = 0.51$$

2.4.3 Result of Waste Stream

Waste Stream obtained based on the simplified method is summarized Table 2.4.3 and Figure 2.4.4

Table 2.4.3 Waste amount calculated by simplified method

Item	Adopted figure	Unit	Source and calculation method
Population	20,000	inhabitant	Sample population for calculation
average of number of family members	4.5	Person/family	Average of whole Fiji
1. MSW Generation (G)	22.16	ton/day	$G = 1,132 \text{ (g/person/day)} \times \text{Population(person)}$
2. Improper Disposal (ID)	5.98	ton/day	$ID = G - (SD + D + R\text{-on-site})$
3. Self-disposal (SD)	1.11	ton/day	$SD = G \times 0.05(\%)$
4. Discharge (D)	13.96	ton/day	$D = G \times 0.63(\%)$
5. On-site Recycling (R-on-site)	1.11	ton/day	$R\text{-on-site} = G \times 0.05 + (107 \text{ (g/person/day)} \times (\text{average of number of family members}) \times (\text{Number of composter promoted})) / 1,000,000$
6. Collection (C)	13.78	ton/day	$C = D - (R\text{-discharge})$
7. Recycling at Discharge point (R-discharge)	0.18	ton/day	$R\text{-discharge} = G \times 0.008 + ((6.2 \text{ (g/person/day)} \times \text{population provided separate collection for recyclables}) + (217 \text{ (g/BE/day)} \times \text{BE Number of BE provided separate collection for recyclables})) / 1,000,000$
8. Intermediate Treatment (IT)	0	ton/day	IT market compost = $G \times 0.069 \times 0.08$ IT green waste recycling (ton) = $G \times 0.26 \times 0.047 \times (\text{Off-site recycling of green waste discharged from household etc.}) + G \times 0.058 \times (\text{Off-site recycling of green waste discharged from park})$
9. Recycling at Treatment Facility (R-treatment)	0	ton/day	$R\text{-treatment} = IT \times 1/10 \times 0.55 + \text{IT green waste recycling}$
10. Final Disposal (FD)	13.78	ton/day	$FD = C - IT + \text{Residue of R-treatment}$
11. Recycling at Disposal site (R-disposal)	0.51	ton/day	$R\text{-disposal} = G \times 0.023$

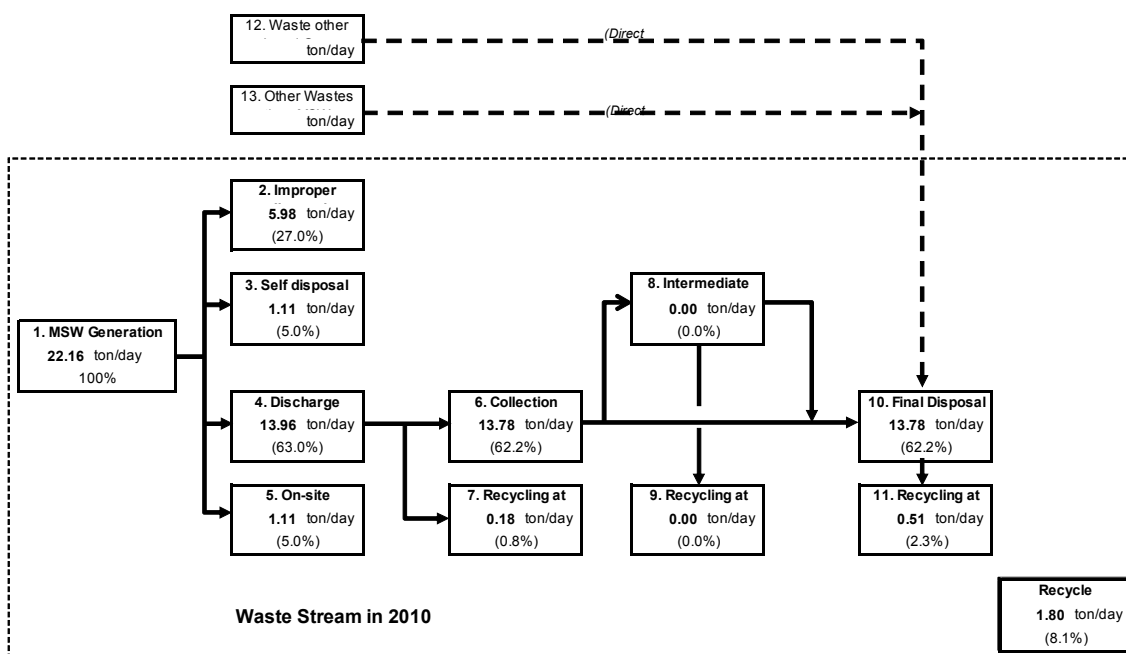


Figure 2.4.4 Present waste Stream created by simplify method

2.5 Extracting the Problems concerning Current SWM

Each LA will have to analyze its particular situation and any problems concerning its current MSW management system from the technical and institutional points of view. Guidance on how to approach this analysis is provided, based on the waste stream developed in the former section and other information that was gathered.

The situation and problems of LCC and NTC are summarized in the SWM Master Plan for each council, which are attached in the annex.

2.5.1. Technical System

The current situation concerning technical aspects of the system is summarized in the center column in the table below, composed of data from nine subsystem items outlined in the left column. The problems with the current SWM system are listed in the right column, based on those identified by sources such as the people managing the system, resident complaints and so forth.

Table 2.5.1 Summary of current situation and problem in term of technical aspect

Items	Current situation	Problems etc.
1. Waste generation		
<ul style="list-style-type: none"> ➤ Population ➤ Generation amount of MSW ➤ Generation rate of MSW ➤ Generation rate of household waste: ➤ Generation amount of household waste*ⁱⁱⁱ 	<p style="text-align: right;">Persons ton/day</p> <p>1,098 g/person/day</p> <p style="text-align: right;">ton/day</p> <p>432 g/person/day</p>	
2. Waste composition (LCC data)		
<ul style="list-style-type: none"> ➤ Household waste <ul style="list-style-type: none"> - Kitchen waste - Plastic (PET) - Plastic (film etc.) - Paper ➤ MSW <ul style="list-style-type: none"> - Green waste*^{iv} - Kitchen waste - Recyclables*^v 	<p style="text-align: right;">52.5%</p> <p style="text-align: right;">1.9%</p> <p style="text-align: right;">11.7%</p> <p style="text-align: right;">11.8%</p> <p style="text-align: right;">37.4%</p> <p style="text-align: right;">30.7%</p> <p style="text-align: right;">5.4%</p>	
3. Storage and discharge		
<ul style="list-style-type: none"> ➤ Storage (container, plastic bag etc.) ➤ Discharge (curb side, stationary, etc.) ➤ Separate discharge by waste material 		
4. Collection and haulage		
<ul style="list-style-type: none"> ➤ Collection method: (curb side, stationary, container, bell, etc.) ➤ Collection service provider: ➤ Collection frequency: ➤ Collection amount: ➤ Collection rate: ➤ Collection of green waste: ➤ Collection of bulky waste: ➤ Contract price: ➤ Unit cost for waste collection: 	<p style="text-align: right;">time/week</p> <p style="text-align: right;">ton/day</p> <p style="text-align: right;">%</p> <p style="text-align: right;">ton/day</p> <p style="text-align: right;">ton/day</p> <p style="text-align: right;">FJ\$/year</p> <p style="text-align: right;">FJ\$/ton</p>	

ⁱⁱⁱ *Since green waste is generated in large quantities, it is not included in the waste discharged in the WACS-survey. Therefore, the generation rate and composition of household waste does not include green waste.

^{iv} Measuring the volume of green waste was very difficult. It was estimated using the record of the green waste collection service in Lautoka. Therefore, the proportion of green waste to municipal waste was estimated by the ratio of green waste weight, estimated by collection records, and other municipal waste generation amount, estimated based on the results of WACS.

^v The proportion of valuable recyclables (PET, Metal, Bottles and Glass) currently collected as municipal waste in Lautoka. Paper recycling is excluded, as although some paper is collected, it only makes up a small percentage, and whether it is recycled is effected by fluctuations in international prices.

Items	Current situation	Problems etc.
5. Public area cleansing		
(1) Street sweeping ➤ Total sweeping length: ➤ Collection amount: ➤ Service provider: ➤ Contract price: ➤ Unit cost for street sweeping:	km ton/day FJ\$/year FJ\$/km	
(2) Park cleansing ➤ Total cleansing area: ➤ Collection and transport amount: ➤ Service provider: ➤ Contract price: ➤ Unit cost for park cleansing:	➤ ➤ ha ➤ ton/day ➤ ➤ FJ\$/year ➤ FJ\$/ha	➤
(3) Drain and grass cutting ➤ Total length of drain cleansing: ➤ Total area of grass cutting: ➤ Frequency of grass cutting: ➤ Collection and transport amount: ➤ Service provider: ➤ Contract price: ➤ Unit cost for drain and grass cutting:	Km ha time/month ton/day FJ\$/year FJ\$/ton	➤
6. Intermediate treatment		
➤ Existence of intermediate treatment: ➤ Existence of incinerator for medical waste		
7. 3R activities		
➤ Existence of material recovery facility (MRF) ➤ Existence of recycling factory in the jurisdiction ➤ Existence of recycler in the jurisdiction ➤ Existence of recyclable collection by informal sector: ➤ Individual composting:		
8. Final disposal		
➤ Final disposal site: ➤ Area: ➤ Land use of surrounding area: ➤ Distance from the center of the City/Town: ➤ Final disposal amount: ➤ Responsible department: ➤ Operation staff: ➤ Equipment for landfill operation: ➤ Operation cost: ➤ Income from tipping fee: ➤ Unit disposal cost:	ha km ton/day person Bulldozer: unit unit FJ\$/year FJ\$/year FJ\$/ton	
9. Maintenance		
➤ Type and number of council equipment ➤ Maintenance system of the council ➤ Maintenance facilities		

Items	Current situation	Problems etc.
<ul style="list-style-type: none"> - Area of depot: - Maintenance staff - Maintenance instrument ➤ Maintenance cost: 	ha person FJ\$/year	

2.5.2. Institutional System

The current situation on institutional aspect such as law, administration and public education so on is summarized by using below table;

Table 2.5.2 Summary of current situation and problem in term of institutional system

Items	Current situation	Problems etc.
1. Laws and regulations	(1) Central government (Examples) ➤ Environment Management Act (EMA) ➤ Environment Management (Waste management & recycling) regulations were enforced in accordance with the EMA. (2) Council (Examples) ➤ Existence of By-Laws, etc.	
2. Administration and Management System on Solid Waste	(1) Central government (Examples) ➤ Department of Environment (DOE), Ministry of Local Government & Urban Development & Housing and Environment is in charge of SWM. ➤ DOE is updating National Solid Waste Management Strategy & Action Plan 2008-2010 (NSWMSAP) in accordance with the EMA. (2) Council ➤	
3. Public education and cooperation	(1) Council (Examples) ➤ Environmental education: ➤ Other activities promoted by the council: ➤ Collaboration with the community, etc.	

2.5.3. Financial aspect

The current situation concerning financial aspect is one of useful information to recognize the MSWM in LAs. The following informations are summarized;

- Portion of SWM expenditure to the total municipal expenditure
- Source of revenue
- Breakdown of the expenditure for cleaning works

(1) Portion of SWM expenditure to the total municipal expenditure

Table 2.5.3 Ratio of SWM expenditure in total municipal expenditure

Items	unit	2009	2010
Total income	FJ\$		
Total expenditure	FJ\$		
Surplus (Deficit)	FJ\$		
SWM total income	FJ\$		
SWM total expenditure	FJ\$		
Surplus	FJ\$		
Ratio of SWM expenditure in total municipal expenditure	%		

(2) Source of revenue

Table 2.5.4 Source of revenue

Items	Unit	2009	Portion to total (%)
1. Income from SWM fee	FJ\$		
1.1 Fee from green waste collection service	FJ\$		
1.2 Tipping fee from disposal site operation	FJ\$		
1.3 Market waste collection service	FJ\$		
2. Income from municipal budget	FJ\$		
Total Income for SWM	FJ\$		

(3) Breakdown of the expenditure for cleaning works

Table 2.5.5 Breakdown of the expenditure for cleaning works

Service items	Ton/day	Cost (FJ\$/year)	Unit cost (F\$/ton)
1. MSW collection			
1.1 MSW other than 1.2 & 1.3			
1.2 Market waste			
1.3 Green waste			
2. Public area cleansing			
2.1 Road sweeping			
2.2 Park cleaning			
2.3 Drain and grass-cutting			
3. Final disposal			
Cleansing Services Total			
Administration, Education, Others			
Total			

3. Implementation of 3R Promotion Activity

3.1 Target 3R Promotion activity

3R Promotion activity through Reduce, Reuse and Recycle are generally categorized as follows;

Table 3.1.1 Target 3R Promotion activity

Category	Sub-category	
Reduce		
Public Awareness and Environmental Education	Promote to buy less and use less	
	Promote to buy environmentally friendly products	
	Promote eco-bag/re-useable bags	
Reuse		
Public Awareness and Environmental Education	Promote to Reuse and Repair products	
	Promote to buy goods with returnable containers and package	
Recycle		
Implementation of Material Recycling	Organic waste	Home composting
		Composting of market waste
		Green waste chipping and recycling
	Recyclable waste	Separate collection of recyclables
Common (Reduce/Reuse/Recycle)		
Public Awareness and Environmental Education	Promote 3R at the public, schools, hotels etc.	

Among the above 3R activities, this manual will provide necessary information for implementation of the following five (5) 3R promotion activities based on the experiences of Lautoka City Council (LCC) and Nadi Town Council (NTC) through the waste minimization and recycling promotion project (3R project).

- 1) Home composting (On-site composting)
- 2) Composting of market waste
- 3) Green waste chipping and recycling (Off-site composting)
- 4) Separate collection of recyclables
- 5) 3R Promotion at schools

During the project, 3R Promotion at schools had been implemented on Council's own initiative. NTC developed a guidebook for schools based on good practices and lessons learnt which were given through the Clean School Program with assistance of Japanese Overseas Cooperation Volunteers (JOCV) in March 2011. The guidebook also provides necessary procedure and tips for implementation.

3.2 Selection of 3R Promotion Activity to be implemented

Lastly, each 3R promotion activity which has been introduced in this manual, is evaluated from the following four (4) perspectives;

Table 3.1.2 Aspect to select 3R promotion activity

	Items to be monitored	How to do?
1	Technical aspects	Degree of difficulty to establish and introduce the system
2	Acceptability of people	Difficulty to gain people's understanding and cooperation
3	Financial aspects	Degree of difficulty to secure the necessary budget
4	Effect of waste minimization	Degree of difficulty to achieve waste reduction

Table 3.1.3 Score of difficulty

Score	Degree
+1	Easy to introduce
+2	Average to introduce
+3	Difficult to introduce
+4	Very difficult to introduce

In order to enable councils to select which activity your council can manage to deal with, four (4) 3R promotion activities are prioritized based on the above perspectives. This will be useful for selection of activity, however, it is not necessary to follow the order of priority if meet conditions.

3.2.1. Technical aspects

Table 3.2.1 Technical aspect

3R Promotion Activity	Items to be established	Degree of difficulty
Home composting	<ul style="list-style-type: none"> • Gain the basic knowledge of composting process • Understand how to use compost bin • Raise awareness of garbage separation at generation source • Establish monitoring system on the collection day 	+1
Market waste composting	<ul style="list-style-type: none"> • Raise awareness of waste separation in the market • Place separate bins for market waste • Establish separate collection system for market waste • Ensure a compost yard, human resources, necessary machinery and materials • Establish the process of market composting • Establish the market for market compost 	+3
Green waste chipping and recycling	<ul style="list-style-type: none"> • Raise awareness of waste separation at generation source • Establish the collection on request basis • Ensure a chipping and storage space, human resources, necessary machinery and materials • Establish the system to make use of chips 	+2
Separate collection of recyclables	<ul style="list-style-type: none"> • Raise awareness of garbage separation at generation source • Examine the systems for discharge, collection, transport, sort and storage • Coordinate with the current garbage collection system and recyclables collection system done by recycling companies 	+4

3.2.2. Acceptability of people

Table 3.2.2 Acceptability of people

Activity	Target area	Target people	Degree of difficulty
Home composting	Whole of City/Town boundary area	<ul style="list-style-type: none"> • Each household • Small business establishments • Some schools 	+2
Market waste composting	In the municipal markets	<ul style="list-style-type: none"> • Market master • Market vendors • Market users (incl. people from other City/Town) 	+1
Green waste chipping and recycling	Whole of City/Town boundary area	<ul style="list-style-type: none"> • Each household • Some business establishments such as hotels 	+3
Separate collection of recyclables	Whole of City/Town boundary area (*depends on the expansion plan)	<ul style="list-style-type: none"> • Each household • Business establishments • Some schools 	+4

3.2.3. Financial aspect

Table 3.2.3 Financial aspect

3R Promotion Activity	Expenditure	Saved cost	Income	Decree of difficulty
Home composting	<ul style="list-style-type: none"> Develop awareness materials(leaflet, poster, etc) Purchase the necessary number of compost bins Conduct monitoring 	Garbage collection and transport cost	Sales of compost bins	+1
Market waste composting	<ul style="list-style-type: none"> Purchase separate bins for market waste Collection and transport fee Compost manufacturing cost (personnel, machinery and materials) Develop a compost yard Processing cost of products Conduct awareness and monitoring 	Dumping fee at final disposal site Operation and Maintenance cost of dumping site	Sales of compost	+2
Green waste chipping and recycling	<ul style="list-style-type: none"> Purchase shredder Develop awareness materials (leaflet, etc) Collection and transport fee Maintenance cost of shredder 		Sales of chips	+3
Separate collection of recyclables	<ul style="list-style-type: none"> Collection and transport fee Develop awareness materials (leaflet, discharge container, etc) Conduct awareness and monitoring 		Profits from sales of recyclables	+4

Comparison of cost and benefit for 3R activities implemented in NTC is shown as a samples in Table 3.2.5. And the basis to calculate the unit cost for 3R activities attached in ANNEX 2.

Table 3.2.4 Basis to calculate the unit cost for 3R activities

1) Comparison of unit cost to implement 3R Promotion activities in NTC

3R Promotion Activity	Required cost (\$/ton)	Benefit (\$/ton)	
		Saved cost	
Home composting	(\$25/unit)	143.21	Collection cost, Tipping fee to Lautoka VDS
Market waste composting	22,64	13	Tipping fee to Lautoka VDS
	-	(\$5/10kg: matured compost)	Sales of matured compost
Green waste chipping and recycling	26.33	26	Tipping fee to Latuoka VDS
	-	75	Sales of chips
Separate collection of recyclables	91	26	Tipping fee to Lautoka VDS

2) Cost estimation to implement 3R Promotion activities in NTC

3R Promotion	Unit	Cost estimation in 2012				Balance	
	Condition of projection	Unit	Cost		Benefit		
Home composting	186 (year 2012) 522 (accumulation)	Unit	-4,650	(186unit)x(\$25)	13,332	(107g)x(4.58person)x(522unit)x(365days)/1,000,000x(\$143.21)	8,722
Market waste composting	0.5	t/day	04,132	(0.5t)x(365days)x(\$22.64/t)	7,574	(0.5t)x(365days)x(\$13/t)x(0.5t)x(365days)x0.054x100x((\$5/10kg)	3,442
Green waste chipping and recycling	3.09	t/day	-29,696	(3.09t)x(365days)x(\$26.33/t)	29,324	(3.09t)x(365days)x(\$26/t)	-372
Separate collection of recyclables	0.29	t/day	-9,632	(0.29t)x(365days)x(\$91/t)	2,752	(0.29t)x(365days)x(\$26/t)	-6,880
Total			-48,110	-	53,022	-	4,912

3.2.4. Effect of waste minimization

The following figure shows the composition of LCC Municipal Solid Waste (MSW).

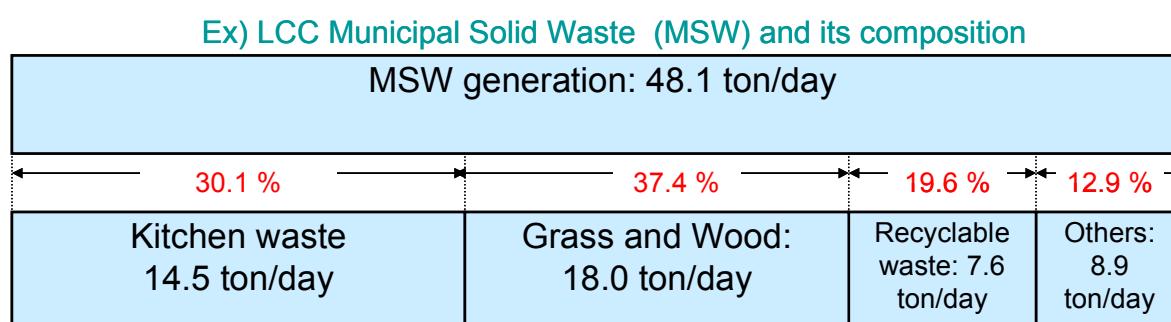


Figure 3.2.1 Municipal solid waste and its composition in LCC

Organic was like kitchen waste, grass and wood accounts for more than 60 % of total amount of MSW. If these organic wastes are reduced through implementation of 3R Promotion activities, it is expected to reduce the amount of waste dramatically. In terms of waste minimization impact, each 3R promotion can be evaluated as shown below;

Activity	Waste type to be targeted	Decree of difficulty
Home composting	Part of kitchen waste, grass and chipped wood (generated from households)	+1
Market waste composting	Part of kitchen waste (generated from municipal markets)	+2
Green waste chipping and recycling	Wood (generated from the public and households)	+3
Separate collection of recyclables	Recyclables wastes (generated from households and business establishments)	+4

Table 3.2.5 In terms of waste minimization impact

3.2.5. Overall evaluation

Taking the above perspectives into consideration, each 3R promotion activity can be evaluated;

Table 3.2.6 Overall evaluation

Activity	Technical aspect	People's acceptability	Financial aspect	Waste minimization	Total (order of priority)
Home composting	+1	+2	+1	+1	+5 (1)
Market waste composting	+3	+1	+2	+2	+8 (2)
Green waste chipping and recycling	+2	+3	+3	+3	+11 (3)
Separate collection of recyclables	+4	+4	+4	+4	+16 (4)

As a result of overall evaluation, it is recommended to initiate 3R activity one has to follow the order;

- ① Home composting
- ② Market waste composting
- ③ Green waste chipping and recycling
- ④ Separate collection of recyclables

Separate collection of recyclables will give councils big challenges, but will also be a great opportunity to approach communities through house-to-house visit and community meeting. Through these awareness activities, other 3R activities can be promoted in the most effective way.

School program won't contribute to waste minimization directly, but it will become great investment for future generation.

3.3 Implementation procedure

Each 3R Promotion Activity should be implemented according to the following steps.

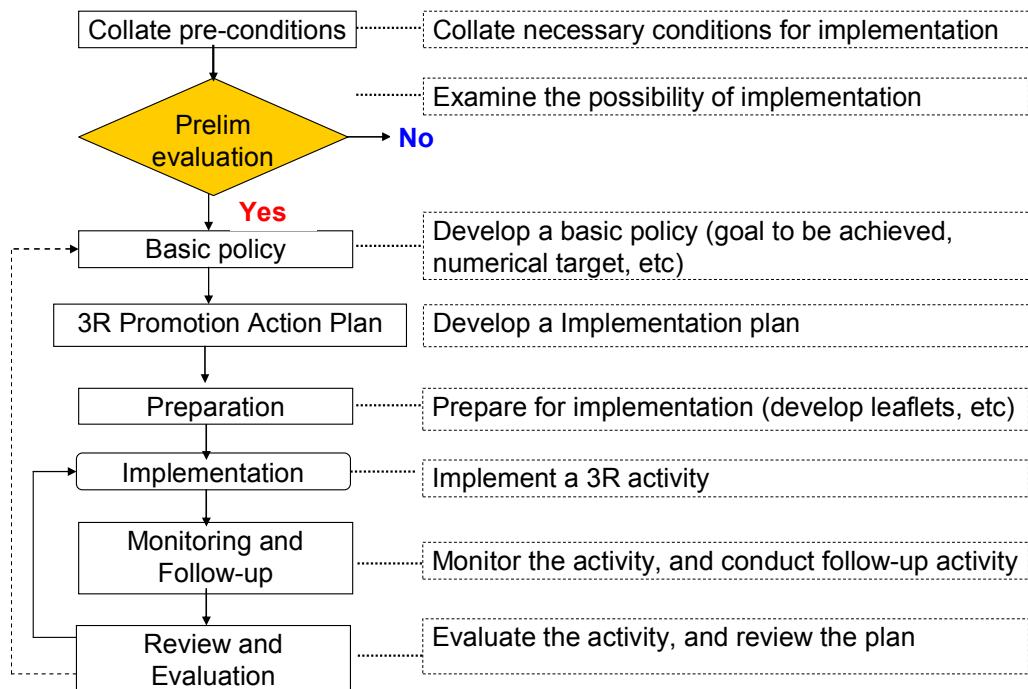


Figure 3.3.1 Implementation procedure

According to the above steps, the measure for the implementation of each 3R activity is explained from the next chapter.

4. 3R Promotion Activity



- A. Home Composting
- B. Market Waste Composting
- C. Green Waste Chipping and Recycling
- D. Separate Collection of Recyclables
- E. Clean School Program

Waste Minimization and Recycling Promotion Project in the Republic of the Fiji Island (3R Project)

Current situation

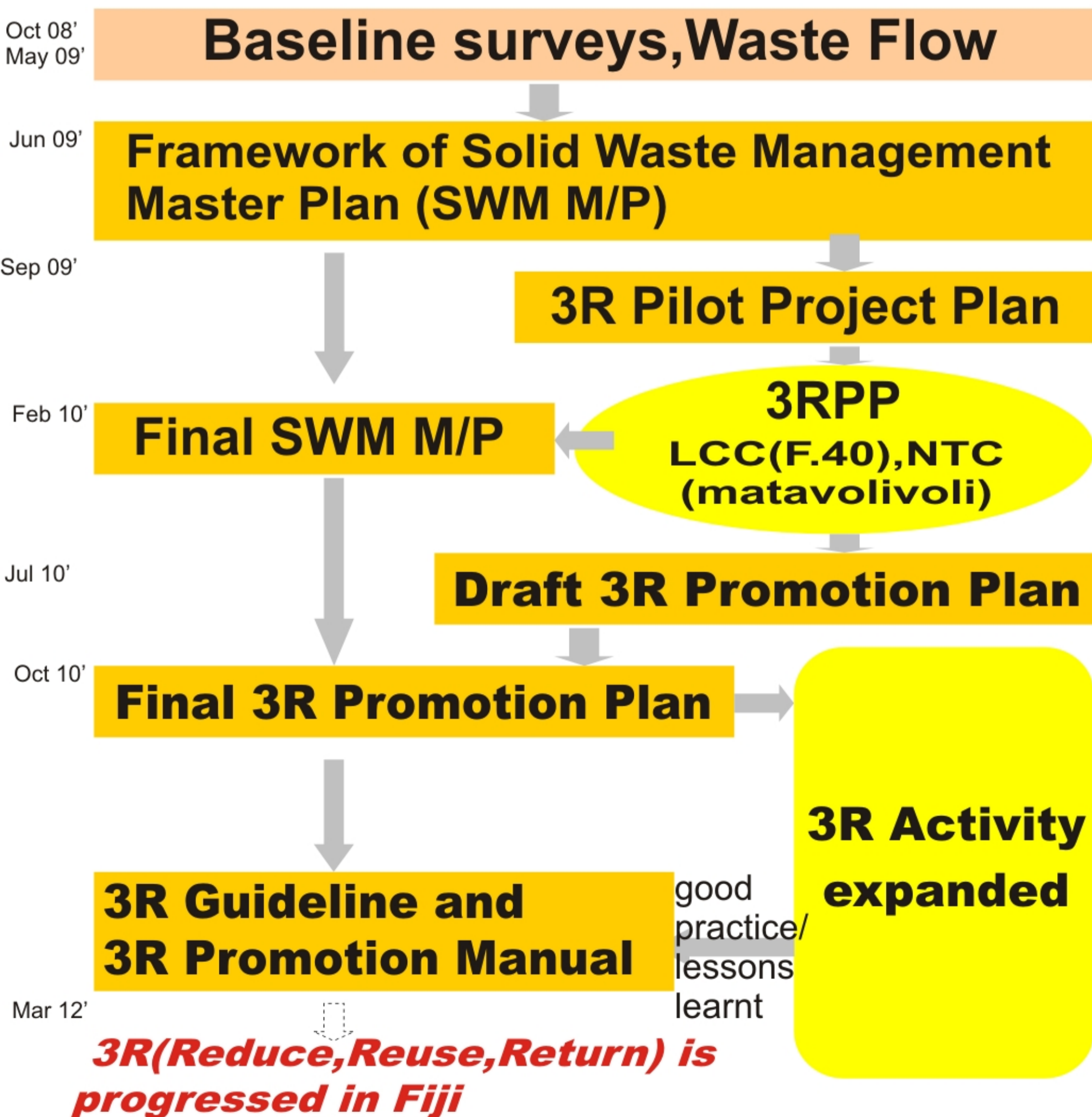
A huge amount of waste is generated everyday(2008:LCC-48.1ton/day,NTC-22.4 ton/day),and it will be increased by approx. 16% in 2017.

.NTC has no waste disposal site,so all garbage generated in nadi is taken to Lautoka dump at a considerable cost(transportation,dumping fees).

.Waste management accounts for 20-28% of the council expenditure.

Necessity to Promote 3R
 .Reduce the disposal amount,
 .Preserve and protect the environment,
 .Create awareness on the waste minimization.

Project framework



3R Promotion Activity



Home composting



Recyclables collection



Green waste chipping



Market waste composting



Clean school program



Public awareness



A: Home composting



A. Home composting

Home composting is implemented and promoted according to the following procedure.

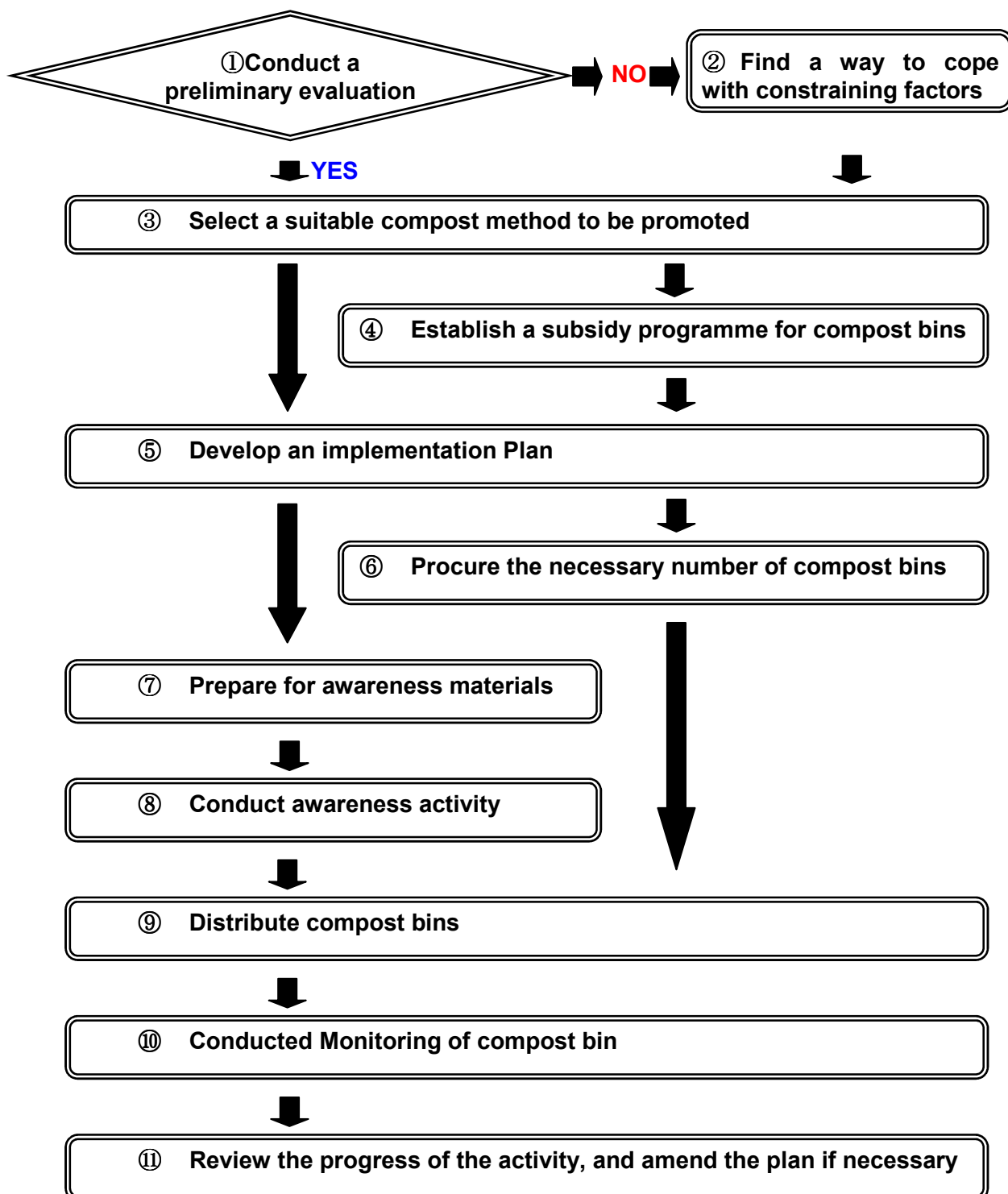


Figure A-1: Implementation procedure for home composting

1. Conduct a preliminary evaluation

Before implementation of home composting, it is recommended that your council should conduct preliminary evaluation through the following checklist to determine whether or not your organization can implement home composting.

Table A-1: Pre-conditions for home composting

	Pre-condition	Category	Checklist
1	Is in need of a minimization of organic waste (esp. kitchen waste and garden waste) as these wastes are in the majority of household waste.	Political will	
2	Has knowledge on the concept, benefits and composting process, and can explain them to residents.	Knowledge	
3	Can establish a subsidy programme for compost bins to encourage residents to buy compost bins.	Finance	
4	Can conduct monitoring for distributed compost bin	Human resources	

2. Find a way to cope with constraining factors

If your organization does not satisfy the above pre-conditions, please do not give up! The following measures will help meeting requirements.

2.1 [Pre-condition 1] Q1. I don't know the amount of organic waste generated in my area

A1) Estimate the amount of organic waste generated based on waste flow or the results of the Waste Amount and Characterization Survey (WACS)

According to the results of the Waste Amount and Characterization Survey targeting Lautoka City, the potential amount of waste to be decomposed including kitchen waste, grass and wood, accounts for 66% (747 g/person/day) to the total Municipal Solid Waste generation amount (1,132 g/person/day).

Figure 1-1 shows the result of WACS which was done in Lautoka City Council. The actual amount of composted waste was calculated as 107 g/person /day, which mean 14.3% of MSW, can be reduced if the whole households of Lautoka City practiced home composting.

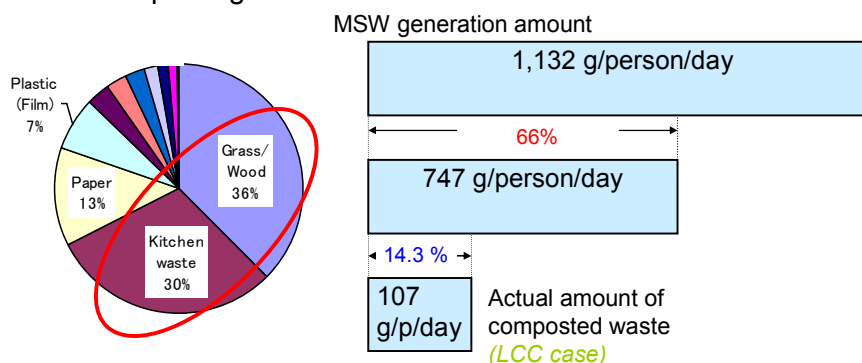


Figure A-2: Ration of organic waste to be decomposed (LCC case)

2.2 [Pre-condition 2] Q2. I need more knowledge on compost

A2) Study by developed manuals, and Practice composting!

The 3R Project developed manuals which guide how to use compost bin and tips for home composting. It also explains useful countermeasure when residents have faced some difficulties such as bad smells and insects.



Figure A-3: Manuals for home composting (see ANNEX)

You can gain basic information on composting from manuals but the most effective way to enhance your knowledge and experience in composting is to practice and experience home composting by yourself!

In cases of LCC and NTC, compost bins were distributed to all staff of Health Department and council management members before distributing to their own residents. You and your staffs may accumulate necessary knowledge of know-how by practicing the process and can apply gained knowledge to own residents as compost instructors in future.



LCC DoH staff practicing composting at their home

2.3 [Pre-condition 3] Q3. It seems difficult for our council to establish subsidy programme for compost bins.

A3) Review current financial status allocated to Solid Waste Management (SWM).

In order to secure the budget for 3R Promotion, the following measures can be examined.

- increase the allotment for cleaning services from the council budget
- raise the levy/service fee

- review the quality of service (i.e. reducing service frequency)

In case of LCC, the expense of SWM accounts for 20% of the council budget, and 53.2% of them was spent for public area cleansing. In order to secure necessary budget for 3R Promotion, LCC is trying to reduce the cost for public area cleansing.

To secure the budget, NTC also reduced the frequency of garbage collection from three times a week to once a week. Actually it was difficult to amend the contract fee as the collection service had been contracted out for a given period of time. Instead, NTC used the same garbage contractor to collect recyclable, and saved some money by minimizing the tipping fee.

2.4 [Pre-condition 4] Q4. It seems difficult for our council to release staffs for monitoring due to limited human resource.

A4) Integrate monitoring work into day-to-day work





Continuous monitoring to be conducted by council is very important to let residents use compost bins in a sustainable way.

Insufficient human resource is one of the common issues councils have faced, so it might be difficult to release staff(s) for monitoring for distributed compost bins. One of the main duties of Health Inspector is to carry out inspection of complaints received from residents. The information of compost owner, such as name and home address, must be registered in database. Hence, the monitoring work can be done when Health Inspectors visited surrounding areas for inspection.

3. Select a suitable compost method to be promoted

The basic concept of composter is familiar with people in Fiji. Some schools and villages have already introduced the wooden-made composter (as shown below (Option 1-2)). However, these methods sometimes create issues such as odor generated through decomposing process. The following table shows some general methods of home composting. Taking advantages and disadvantages into consideration, a suitable compost method for your council should be selected.

Table A-2: Methods of home composting

	Option 1	Option 2	Option 3	Option 4
Type	In-ground compost method	Open wooden box	Used drum	Plastic-made composter
Photo				
Material	Soil	Wood/ Waste timber	Waste drum	Plastic
Cost	none	FJ\$5-10	FJ\$5-30	FJ\$55
Advantage	- no cost - No need big	- can reuse waste timber	- can maintain easily	- can maintain easily and durable

	yard - Easy and quick - be familiar with Fiji people	- low cost - can cater large volume of organic waste - be familiar with Fiji people	- can reuse waste drum - low cost	- Local-made - Stable materials - Removable - More appealing
Disadvantage	- Bother odor, insects and dogs - can be affected by heavy rain	- Need to be constructed by residents - Get rot easily - Bother odor, insects and dogs	- Need to be constructed by residents - Get rust easily	- Costly relatively - Price fluctuates according to manufacturing cost
Priority	4	3	2	1 (for large city)
Notes			*See the Colum for more information	

Final users of the compost bins are mainly residents, therefore, you can also discuss with residents and other stakeholders which type of compost container to use.

4. Establish a subsidy programme for compost bins (Option 3, 4 only)

Applying option 2, 3, 4 of above-mentioned compost types will result in incurring expenses. We need to think, “Who should bear the cost to procure necessary materials like waste timber, drum and plastic-made compost bin?” It also depends on how much budget your council can allocate for promotion of home composting.

In order to encourage your residents to start composting at home, it is strongly recommended to establish a subsidy program as described below.

Colum- Home compost subsidy programme (LCC/NTC)

LCC and NTC have established a “Home compost subsidy prgramme” to encourage their ratepayers to use compost bins since July 2010. Councils have provided a \$25 subsidy when Lautoka ratepayers purchase a bin from councils. Non ratepayers are also eligible to buy bins but at the normal cost of FJ\$55.00.

In order to make it sustainable programme and secure sufficient budget allocation, it is highly recommended to develop a by-law for the home compost subsidy programme.

5. Develop an implementation plan

In order to implement strategically and secure necessary budget, an implementation plan should be developed including the following components;

Table A-3: Items to be included in the implementation plan

	Item	Remarks
1)	Goal	where we want to get to
2)	Implementation/responsible bodies (lead agency, other related organization)	by whom?
3)	Actions/Activities	by what?
4)	Timeframe	by when?
5)	Indicator	to evaluate the progress
6)	Budget	how much?

You can refer to the attached DVD for examples of implementation plans which were developed by LCC and NTC as 3R Promotion Action Plan.

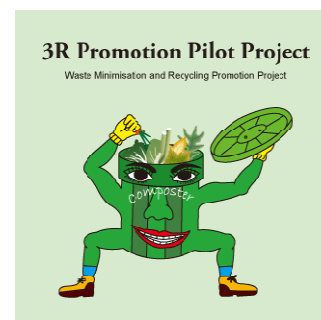
6. Procure the necessary number of compost bins

Based on the developed implementation plan, council orders the necessary number of compost bins from the manufacturing company. Delivery date to be confirmed when ordered. It is recommended to check all bins one by one to reject inferior products when delivered.

7. Prepare for awareness materials

When the total number of compost bins is determined, start preparing for the following materials for the purpose of advertising and awareness;

- ✓ Manual
- ✓ Application form
- ✓ Sticker for compost bin
- ✓ Poster for subsidy programme (to be pasted at municipal facilities)



Sticker for compost bin

Most of the above materials were developed by the 3R Project, so other councils can utilize them (these materials are attached as ANNEX). These materials shall be amended according to the situation your council has faced.

The table below shows the necessary number of each material to be prepared in case of NTC. It depends on the number of compost bins to be procured and target waste reduction rate according to the Action Plan your council developed.

Table A-4: Necessary number of awareness materials (NTC)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of compost bin to be procured	50	100	186	186	258	258	258	258	376
Leaflet with application	100	150	200	200	300	300	300	300	400
Sticker	100	150	200	200	300	300	300	300	400
Manual	100	150	200	200	300	300	300	300	400
Poster	-	50	50	50	50	50	50	50	50

8. Conduct awareness activity

Using the above materials, carry out various advertising and awareness activities for the public as follows;

- (1) Setting up the booth nearby the council's cashier desk or reception area.
- (2) House-to-house visit for separate recyclable collection when expanded
- (3) Demonstration in the community meeting
- (4) Demonstration during the council's event (Sugar festival, Open day, etc)
- (5) Demonstration at schools
- (6) Advertising through newspaper
- (7) Radio programme



Booth in the council office



House-to-house visit



Community meeting



Booth during event



Float at festival



Demonstration at schools

Some compost bins, approx.10, should be stored in the council office to be handled it to residents who visited the council office to purchase a bin. It will be also good sample for residents to show. Leftover of compost bins needs to be stored properly at the council depot or other designed spaces.

9. Distribute compost bins

Figure 1-4 shows the procedure and schedule of distribution for plastic-made compost bins (Option 4).

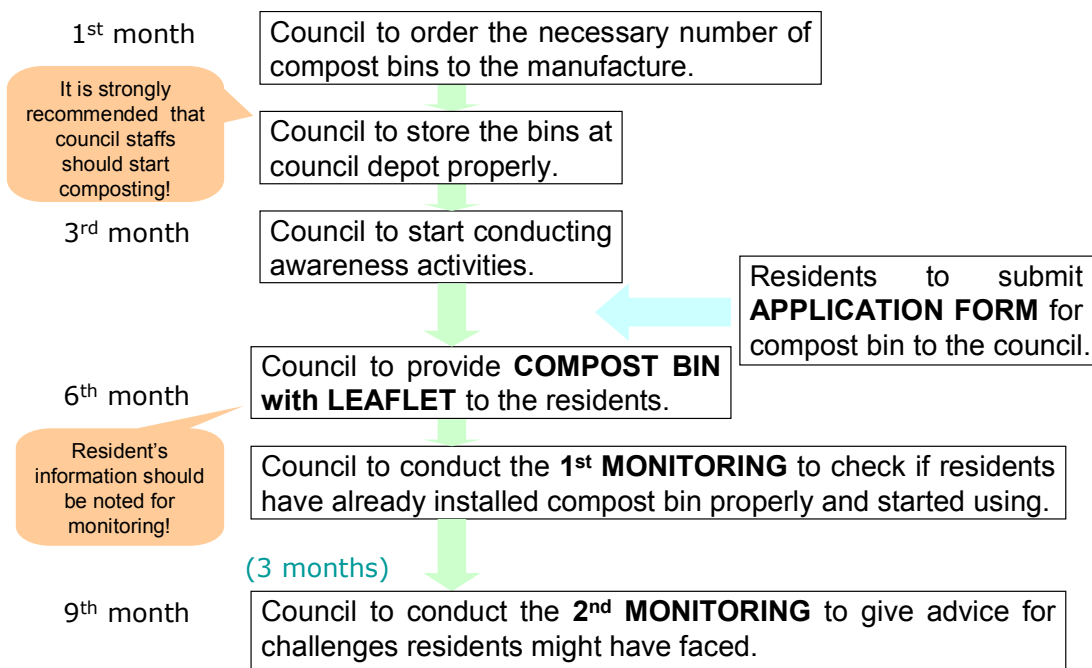


Figure A-4: Procedure and scheduled of distribution of compost bin



Ratepayers visit the council's cashier desk, and submit an application form with payment



1st monitoring done by council staff¹

10. Conduct monitoring of compost bins



Monitoring plan (staff in charge, schedule, etc) should be developed. It is preferable to check the implementation condition of compost bins two times at least after the distribution.

Table A-5: Monitoring schedule and matters to be monitored

	Monitoring schedule	Matters
1 st monitoring	At installation time, or within a month after distribution	- Installation condition, - location where bins placed
2 nd monitoring	After 3-6 months	- Status of composting process

¹ In order to make sure to let residents use compost bins properly, NTC and LCC deliver compost bins to resident's house and instruct them how to install and use bins on site as well as supply a bag of shredder chips as base materials for moisture control.

The following items should be checked during monitoring as shown below;

Table A-6: Items to be checked during monitoring

Items to be checked	Resident's information
<ul style="list-style-type: none"> • Condition (color, odor, moisture, insects, temperature) • What kind of waste put into bin? • How full was bin? • How often they have used bin for a week? • How much waste they put into bin at once? 	<ul style="list-style-type: none"> • Name • Household number/address • Family number • The day when bin was installed • Date of monitoring

If it seems difficult to conduct monitoring due to limited human resources, provide telephone number of the department which is in charge of promotion of home composting, so that it will make necessary instructions available to residents anytime when needed.

The pictures below show some of the results of monitoring which was conducted by LCC and NTC.

1) Location where bins placed



Easy to access



Near the garden



Difficult to access

2) What kind of waste put into bin?



Left over rice



Grass



Various kitchen waste

3) Condition



Maggots



Molds (good sign for decomposing!)



Too dry



Too much moisture



Become converted to soil!



Turning over

11. Review the progress of the activity, and amend the plan if necessary

Council should develop a database including the following information;

- Resident's information who own a bin (name, the place where they live, etc)
- The number of bins which were sold for a month (to estimate the number of bins to be sold within a year)
- Result of monitoring (status of use, difficulties resident faced, advises and suggestions council staff provided, etc)

Based on the above database, it is recommended to develop a monthly report, and submit it to the Director of the department and/or council's management members at the end of every month to share the progress and difficulties.

The implementation plan should be reviewed and re-examined if council faced the following situations;

- If not enough bins are sold, and cannot expect to achieve the target number of bins to be sold within a year.
- If the results of monitoring indicated that most of residents are using bins in an inappropriate way.

Column – Drum compost method

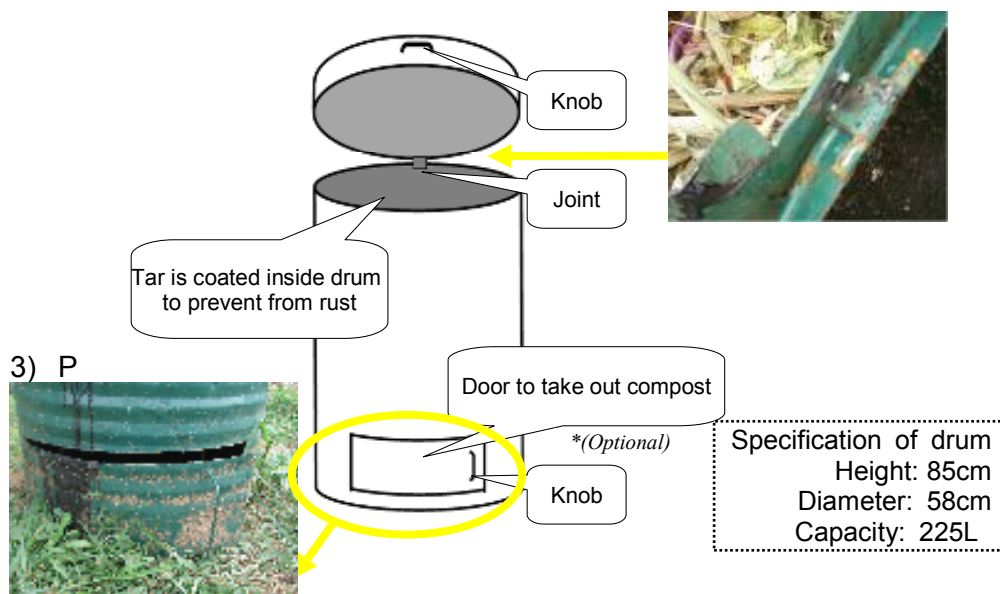
Drum compost is also very practical method and produce the same result as plastic-made composter mentioned above. As for the advantages of drum compost method, it is more affordable for the people as used-drum can be utilized.

Procedure of drum compost method is as below.

- 1) Prepare for the used –drum (55 gallon drum). You can color up as you want to make it more attractive.



2) Make a composter using the drum. Preferable structure is as below.



3) P



C

4) Place a drum at designed place.

Optimum place for the composter is as same as plastic-made composter. See the attached manual.



4) Start composting!



5) Maintain your compost pile

In order to make compost quickly, it is recommended to turn the materials over with a shovel or pitchfork to send the air into the inside of materials. It promotes the fermentation and decomposition process done by microorganisms in the soil.

6) Use compost.

Compost can be produced in as little as a couple of months. It depends on the kinds and conditions of kitchen waste you put. Take the materials out from the bottom of composter which is ready to use compost. Use compost for flower and vegetable garden.



12. Cost required

Table A-7 shows an example of the cost required.

Table A-7: Cost required for implementation of home composting (LCC)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Compost bins	-	5,500	10,230	10,230	14,190	14,190	14,190	14,190	20,680
Leaflet with application	-	-	200	200	300	300	300	300	400
Sticker	-	-	200	200	300	300	300	300	400
Manual	-	-	200	200	300	300	300	300	400
Poster	-	-	500	500	500	500	500	500	500
Total	900	5,500	11,330	11,330	15,590	15,590	15,590	15,590	22,380
Returns from sales of bins	250	3,000	5,580	5,580	7,740	7,740	7,740	7,740	11,280
Actual expenditure	-	2,500	5,750	5,750	7,850	7,850	7,850	7,850	11,100

Annex for Home composting

- a. Application form
- b. Home composting manual “How to use distributed composters”
- c. Leaflet “Home Composting”/”How to make a compost?”
- d. Leaflet “Home Composting Subsidy Programme”

Form A1

(for resident record)

APPLICATION FORM for COMPOST BIN

(dd/mm/yy)

Director of Department of Health, _____ City/Town Council

We would like to apply for a “Compost bin”. And we promise to use in proper way following the manuals.

Name of the head of family	
Family number	
Address	
Phone number	

Director, Department of Health,

(Signature)

Form A2

(for council record)

APPLICATION FORM for COMPOST BIN

(dd/mm/yy)

Director of Department of Health, _____ City/Town Council

We would like to apply for a “Compost bin”. And we promise to use in proper way following the manuals.

Name of the head of family	
Family number	
Address	
Phone number	

Director, Department of Health,

(Signature)

Home Composting



Funded by the
Japanese
International
Cooperation Agency



Health Department
Lautoka City Council
P.O.Box 124, Lautoka
Phone: 666 0433
Fax: 666 3288



Health Department
Nadi Town Council
P.O.Box 241, Nadi, Fiji Island
Phone: 670 0133, 670 0503
Fax: 670 1202, 670 0131



How to use
distributed composters

We would like to thank OISCA, a Japanese non-profit organization, for providing us with BOKASHI.

What is happening in that pile?

The kitchen scraps and yard waste in your compost contain nitrogen and carbon. There are a number of different micro organisms, worms and beneficial insects that live on a diet of nitrogen and carbon-rich materials. The microorganisms will generate a lot of heat as they do their work – a compost pile regularly heats up after new material is put into it. During the process, the materials you put in are broken down into compost, or humus.



Step 1

- Decide where to compost

The backyard is usually a good place. Find a spot on bare ground that gets a fair amount of shade, so your pile is not dried out by the sun. A tree can provide some shelter from heavy rain storms. Put your composter far enough away from your back door or a spot that seems handy, maybe just near your garden where you will use the material.



Step 2

- Place the composter

Before placing the composter, dig the ground to a depth of 30cm. Then, put your composter at a 10cm-deep under the ground. Remain the soil generated by digging around the composter for water control.

Step 3 - Let's start home composting

It's a time to put your kitchen waste into the Composter.

1. Reuse and put an empty ice cream or any container at kitchen for storing kitchen waste for a day and making only one trip to the composter instead of disposing every time a kitchen waste is generated.
2. Cut kitchen waste into smaller pieces as much as possible before adding them to the composter, you will allow the faster compost process.
3. Squeeze the moisture out of kitchen waste as much as possible. With moisture, bad smell will be issued and the fermentation and decomposition processes are getting slowly!
4. Begin with a layer of branches first, this helps air circulate in your pile and allows water to drain, – and then add kitchen waste. Finish by covering with a layer of brown waste (i.e. soil, grass, shredded chips). Always cover with some leaves or other brown wastes when you put the kitchen waste into the Composter. It helps water control, and minimizes odors that may occur, and also promotes the fermentation process.



Step 4

- Maintain your pile

1. Turn the materials over with a shovel or pitchfork to send the air into the inside of materials. It promotes the fermentation and decomposition process done by microorganisms in the soil.
2. Sprinkle BOKASHI just on the top of pile once a week. BOKASHI contains a lot of nutrients and it serves as a catalyst/booster for rapid fermentation and odor control.

What is BOKASHI?

- The general definition of the Japanese term "Bokashi" is "fermented organic matter".
- Bokashi is a byproduct of EM (Effective Micro-organisms), and is a high quality fermented compost accelerator, rich in beneficial micro organisms.

Step 5

- Use Compost

1. Compost can be produced in as little as a couple of months. It depends on the kinds and conditions of kitchen waste you put into.
2. Take the materials out from the bottom of Composter which is ready to use compost. If it is not ready, cover them by soil or plastic sheet until it gets ready.
3. Use compost for flower and vegetable garden.



TIPS FOR HOME COMPOSTING



What is the best location for your home compost site?

- In open area exposed to sun. Natural heat from the sunlight will boost the internal temperature of compost pile which will assist in decomposition. Heat will also eliminate maggots, fruit flies and other undesirable insects.
- At an elevated location to prevent surface water runoffs getting into the compost pile.

What materials should you add to a compost pile?

- Any organic matter including vegetable peelings, egg shells, partly dried grass, fallen leaves, leftover food lees in moisture content like bread, rice, root crops etc, garden trimmings/pruning's, animal manure, shredded wood chips, saw dust etc.
- Adding chipped leguminous plants like bean plant is a bonus for the compost as it is an excellent source of nitrogen.

What materials should NOT be added to the compost?

- Any plastics, paper, oil and cardboard.
- Any liquid matter – left over liquid food like soup, dhal, tea, milk etc.
- Organic matter containing lot of water – to be squeezed to get rid of excess moisture.
- Raw or cooked meat and rotten/spoilt eggs.

What should I do when I notice foul odor/smell, maggots, other insects or excess moisture in the compost?

- Do not get alarmed or disheartened (important!)
- Sprinkle a layer of soil or Bokashi if available on the surface.
- Add dry grass or fallen leaves or wood chips.
- Stir the pile at least once a week to introduce air into the compost pile.

What should I do when it rains?

- Ensure that the location has good drainage to prevent water getting into the composter.
- Cover the lid at all times.
- Add dry grass and soil or BOKASHI to control moisture and maggots.



Containers or buckets can be used as coposters. You can make a good composter from a used drum.

What can I do if my compost pile takes too long to break down?

- Compost pile needs large enough pile and enough air, so;
 - Add moisture-rich and nitrogen-rich fruit and vegetable scraps to speed up the process.
 - Add more fresh food scraps and water while stirring the pile.
 - Mix in materials that do not compact, such as green twigs and plant stems. *it will help to create more air spaces.

How can I judge when composting is finished?

- Signs of finished compost include:
 - A sufficient amount of time has passed since materials were last added to the pile.
 - The pile of compost has developed a dark brown color.
 - Odors are no longer a concern – could be earthy odor, no more ammonia or rotten odor.
 - Consistent crumbly texture except for pieces of wood, the compost shows very little evidence of the original yard trimmings and food scraps added to the pile.
 - The moist pile remains cool and does not become warmer after turning.

How long will it take to make finished compost?

- Compost can be produced in as little as 3 months or longer (in a year or more). It depends on how you maintain your heap.

What should I do with the final compost material?

- Leave in exposed area for at least a week to let dry properly. Turn pile whilst drying/storing.
- Add to your garden to improve soil fertility and act as soil conditioner.
- Can be used as base material before planting vegetables or flowers.
- Can be used as potting mix.
- Remember to keep a small portion and add to the new compost pile as the need arises to help eliminate foul odor, maggots, moisture. Compost is rich in micro organisms which help in the composting process.

Note : Organic fertilizer has good water retention capacity and can supply wide range of essential nutrients to plants for longer duration compared to costly artificial fertilizer.

How to make a compost?

Waste Minimization and Recycling Promotion Project in the Republic of the Fiji Islands

Step 1 Decide where to compost



Backyard near garden is a good place.



Step 2 Place your compost bin



Place the bin at depth of 10 cm from ground level and place back the soil.



Step 3 Put your kitchen and yard waste into the compost bin

What's In

Wet Greens

Grass chippings, vegetable peelings, yard trimmings etc

Dry Browns

Dried leaves, saw dust, shredded branches etc



Place a bin at kitchen for sorting!



Put your kitchen waste into the bin!

Don't mix with non-biodegradables such as plastic waste!

Step 4 Maintain your compost pile



Turn pile over to promote fermentation!



Fermentation process



beginning



after 3 months

Step 5 Use Compost



Ready to use as manure after 5 months.



Use compost for flower and vegetable garden!

Effect of Compost



with compost



without compost

Home Composting

Waste Minimization and Recycling Promotion Project in the Republic of the Fiji Islands

Q1. What is composting?

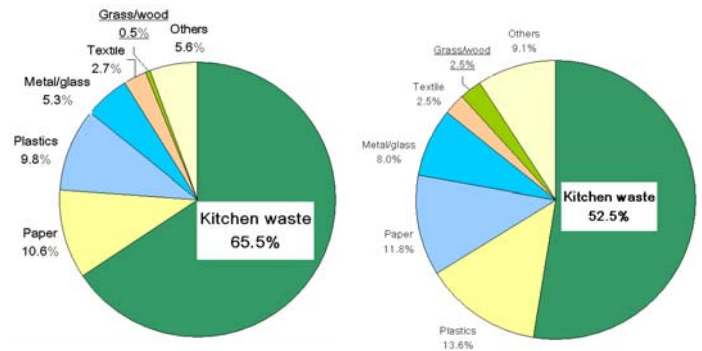
A: Composting is a natural process through which organic materials are converted into a soil-like product called compost or humus.

Organic waste (Kitchen waste, Grass) accounts for **55-66%** of total waste generated from household.



Household Waste Composition

Waste Amount and Composition Survey (2009)



Q2. What is happening in that pile?

A: The kitchen scraps and yard waste in your compost contain nitrogen and carbon. There are a number of different microorganisms, worms and beneficial insects that live on a diet of nitrogen and carbon-rich materials. The microorganisms will generate a lot of heat as they do their work – a compost pile regularly heats up after new material is put into it. During the process, the materials you put in are broken down into compost, or humus.

Q3. What are the benefits of composting?

Your benefits

- ◆ reduce 20% of waste generated from your home
- ◆ no need to worry about scattering by dogs
- ◆ easy and fun way to get the whole family to take part in an environmentally friendly solution
- ◆ produces free compost for your gardens

Environmental benefits

- ◆ recycles a valuable natural resource rather than burning or burying it in a landfill
- ◆ helps gardens and lawns become less dependent on chemicals
- ◆ adds essential nutrients to the soil
- ◆ helps soil hold water better
- ◆ discourages weeds

Council's benefits

- ◆ cuts frequency of garbage collection
- ◆ reduces leachate generated from landfill
- ◆ extends life of our landfills
- ◆ reduces greenhouse gases

So many benefits!!



Vunato Landfill Lautoka



Reduce, Reuse, & Recycle



Home Composting Subsidy Programme

Waste Minimization and Recycling Promotion Project in the Republic of the Fiji Islands

We Subsidize COMPOST BIN

Lautoka City Council (LCC) and Nadi Town Council (NTC) now established the subsidy programme to encourage ratepayers to use compost bin for organic waste composting at home.

The number of compost bins available is limited, and we provide compost bins on "first-come-first-served basis". If you consider starting home composting now, don't miss the chance!

Application forms are available at the office of Department of Health. We will accept applications from the 14th of June to the 9th of July.



compost bin : ~~\$55.00~~

(*Councils will provide a subsidy of \$25.00 per bin)



For more information,
Visit us at DoH at NTC/LCC
From Mon 14th June to Fri 9th July



Health Department
Lautoka City Council
P.O.Box 124, Lautoka
Phone: 666 0433



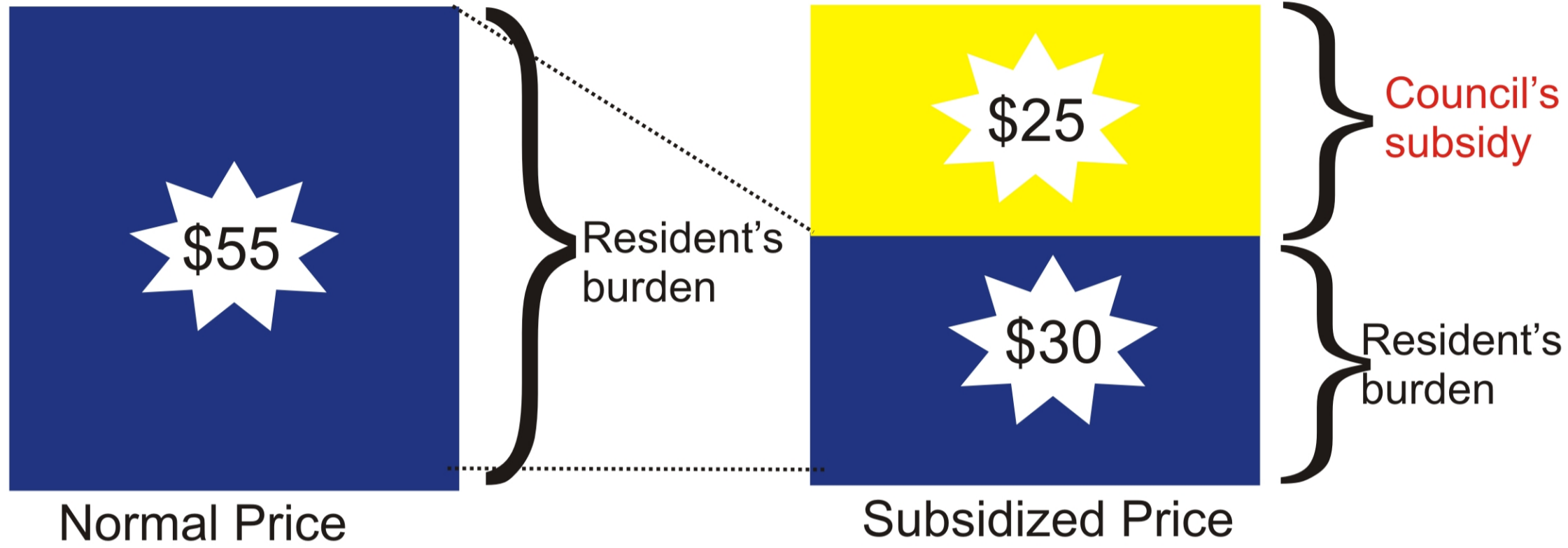
Health Department
Nadi Town Council
P.O.Box 241, Nadi
Phone: 670 0133, 670 0503



3R Promotion Activity (1)

Home composting

A Subsidy Programme to promote home composting



① CP s accumulated the necessary Knowledge and experience on home composting



(House-to-house visit)



(Community meeting area by area)



④ Guidance given when installed (Manual to be distributed)



③ Residents visit councils for application



(Promotion during the festival)



(Display of composter at festival)



⑤ Monitoring conducted by CPs(after 3 months)



(3R Campaign)

② Awareness activity



(With Prime Minister)

B: Market Waste Composting



B Market Waste Composting

Market waste composting is implemented and promoted according to the following procedure.

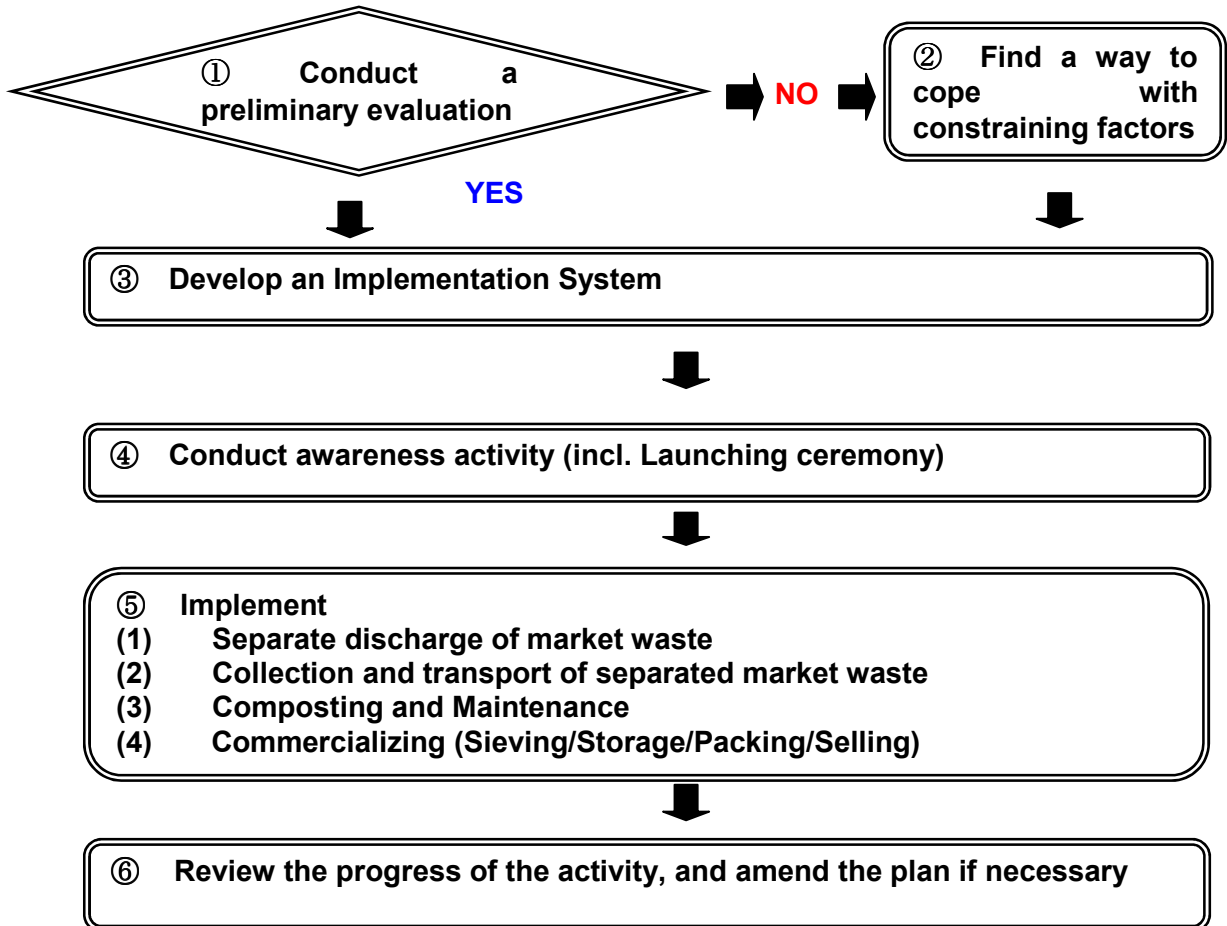


Figure B-1: Implementation procedure of market waste composting

1 Conduct a preliminary evaluation

Before implementation of market waste composting, it is recommended that your council should conduct preliminary evaluation through the following checklist to determine whether or not your organization can implement market waste composting.

Table B-1: Pre-conditions for market waste composting

	Pre-condition	Category	Checklist
1	Is in need of a reduction of amount of market waste going to dump site.	Political will	
2	Knows the quantity and quality of market waste generated.	Knowledge	
3	Has collection system of market waste.	System	
4	Can conduct regular awareness and monitoring for waste separation for market vendors and users.	Human resources	
5	Can place separate bins for market waste.	Equipments	
6	Can collect and transport market waste separately from other waste.	System	
7	Can ensure for the provision of certain space as a compost yard, human resources and necessary machineries and materials to make composting	System	
8	Has basic knowledge of composting.	Knowledge	
9	Can ensure utilizing of generated market compost.	Market	

2 Find a way to cope with constraining factors

If your organization does not satisfy the above pre-conditions, please do not give up! The following measures will help in meeting the above requirements.

2.1 [Pre-condition 1] Q1. I am not sure why there is a need for minimizing of market waste.

A1) At municipal market, the market vendors create a large amount of vegetable waste, that, in the past, was hauled to the dumpsite.

In the case of Lautoka City Council, the survey shows that vegetable waste accounts for 96.6% of total waste generated in the municipal market, therefore, it is possible to make a high-quality compost from market waste.

Most serious problem is that vermin and insanitary insects are attracted to the organic waste such as kitchen waste and so on generating foul odours and leachate and landfill gases in the process of anaerobic decomposition of the organic waste. To reduce these problems, it is important to separate the organic substances from the waste to be landfilled at source and treat it separately by composting.

Market waste is normally being collected every day apart from Sunday and holidays, so the collection and transport cost to the final disposal site becomes financial burden for councils.

Therefore, based on the following reasons, councils may consider whether to proceed with market waste composting.

- ✓ reduce the disposal amount,
- ✓ preserve and protect the environment, and
- ✓ reduce the collection and transport cost of market waste
- ✓ promote environment-friendly manure

- ✓ Educational purpose for citizens

2.2 [Pre-condition 2] Q2. I don't know the amount of market waste generated in my municipal market

A2) Estimate the amount of market waste generated based on waste flow or the results of the Waste Amount and Characterization Survey (WACS)

Waste Amount and Characterization Survey is a very useful tool to determine the amount of market waste generated. Even though weighbridge may not install at your final disposal site, you can estimate the amount based on the result of Lautoka City Council, which is 3.8 ton/day.

2.3 [Pre-condition 3] Q3. Our council has not provided separate collection service for the market waste.

A3) Most of councils may have provided waste collection services for their own municipal markets, but a few councils might not have any. If no, visit the market and observe the present situation of the market and waste generated from the market. If the small-scale markets are spread over the town/city, it will be difficult to collect market waste intensively. In that case, market waste should be collected through normal garbage collection service on regular basis.

2.4 [Pre-condition 4] Q4. Why do we need to conduct regular awareness and monitoring for waste separation for market vendors and users?

A4) In order to collect sufficient quantity and quality of market waste, separating market waste from other waste at source is the most important step.

In the case of LCC, workers had to choose some of bins which contained only vegetable waste during the initial stage of the Project (most of bins are rejected as mixed with other waste).

The following figure shows the actual amount of market waste collected for composting process (only 8% of total market waste was collected for composting!)



Rejected market waste due to mixing

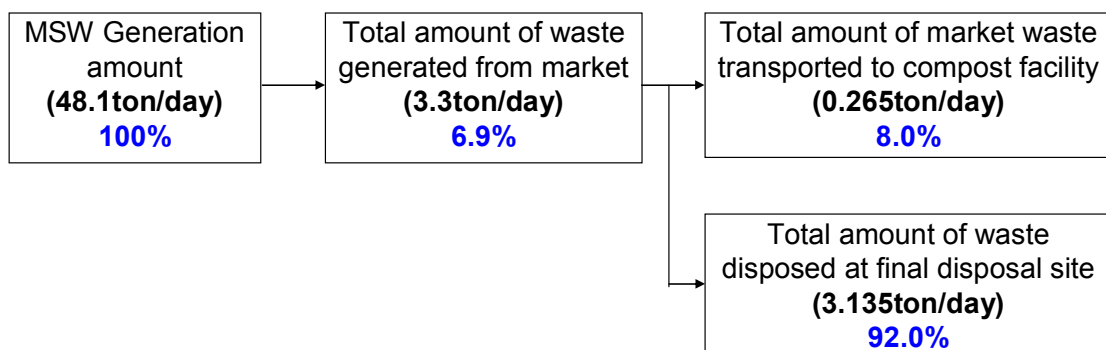


Figure B-2: The actual amount of market waste collected

To make matters worse, LCC workers had further separated other waste such as plastics from heaps of market waste after hauling collected market waste to the

composting yard. This is also time-consuming work.

Therefore, separation at source is important to make the collection and composting works quite easier.

Targets for awareness raising are mainly market vendors and the public as market users. Market vendors change continuously, and the customers also visit the market from within and outside of the city/town. Hence, awareness activity should be done regularly and consistently.



Remove undegradable item

Council Market masters and the market vendors association should be key actors to make awareness activity effective. It is recommended to build consensus to gain their understanding and continuous support before starting the activity.

2.5 [Pre-condition 5] Q5. Why do we need to place separate bins for market waste?

A5) It is highly recommended to place the necessary number of bins for market waste separation. Without separate bins, people has no options to discharge market waste



Placed separate bin
(Green bin for vegetable waste only,
Yellow half-bin for other waste)

2.6 [Pre-condition 6] Q6. We don't collect market waste separately from other waste.

Market waste is normally collected and transported to the final disposal site mixing with normal waste by council's vehicle or contractor's truck. It is quite difficult to take vegetable waste out from mixed waste. It indicates that market waste should be collected separately from other waste.

Therefore, it is recommended for councils to secure specific vehicle for market waste collection only. If you use the same vehicle used for normal garbage collection, you need to make an additional trip just for market waste collection.

2.7 [Pre-condition 7] Q7. What kind of space as a compost yard, human resources, machinery and materials do we need?

It is ideal to secure the following things;


	Space	Human resources	Machinery and materials
Item	Compost yard ¹	<ul style="list-style-type: none"> - Collection workers: 2 persons - Driver: 1 person - Maintenance of compost yard: 1 person (at least) 	<ul style="list-style-type: none"> - Collection vehicle - Sugarcane knife (for cutting into small pieces) - Shovel and fork (for turnover) - Heavy machines such as excavator (for turnover) - Container for water storage (to give moisture to compost heap) - Wheelbarrow (for carrying necessary equipments and generated compost) - Hand glove (for maintenance of compost heap) - Tarpaulin (for moisture control) - Sieve (to make compost into small pieces)  <ul style="list-style-type: none"> - Plastic bags (for bagging) - Scale (for measuring of final product for sale)
LCC case	(see Figure B-3)	<ul style="list-style-type: none"> - Collection workers: contractors (6) - Driver: 1 person - Maintenance of compost yard: 1 person 	<ul style="list-style-type: none"> - Collection vehicle (1) - Sugarcane knife (1) - Shovel (1), Fork (1) - Excavator (1) - Container for water storage (1) - Wheelbarrow (1) - Hand glove (1) - Tarpaulin (3, 5m x 5m) - Sieve (1)

Table B-3: Necessary space, human resources, machineries and materials

¹ For development of compost yard, it is recommended to consult the Department of Environment for consent to use the candidate site for composting purpose.

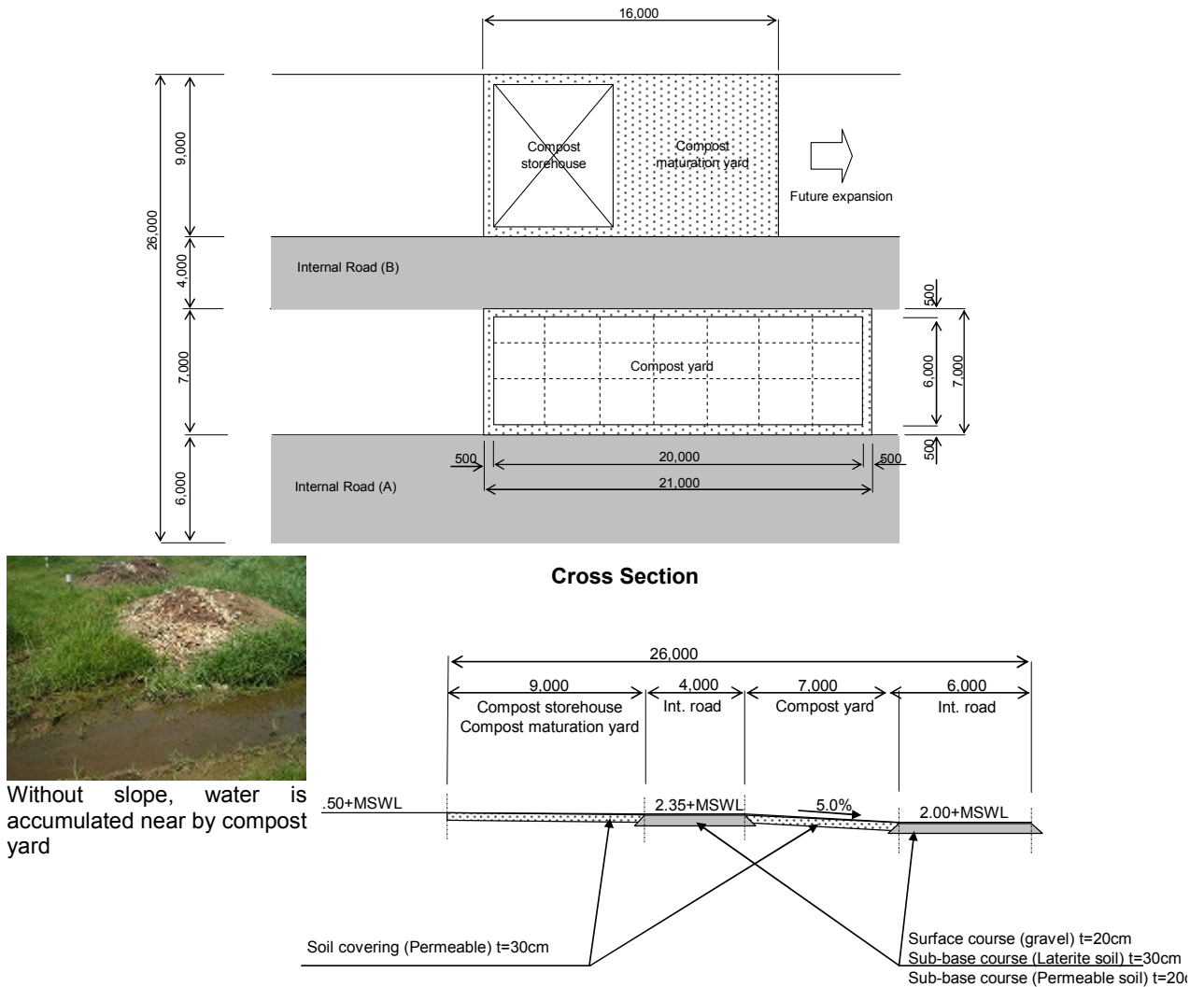


Figure B-3: Layout of compost yard (Vunato disposal site, Lautoka)

2.8 [Pre-condition 8] Q8. How to gain basic knowledge of composting?

In order to gain necessary knowledge for staff and workers engaging in market waste composting, home composting will be one of great means to understand composting concept and process (refer to the section of “Home composting”!). You can apply them for the implementation of market waste composting.

2.9 [Pre-condition 9] Q9. I have no idea to utilize generated market compost at moment.

Before starting composting, you need to determine potential markets for final products. If you have no idea where to use, just think of the places where you use fertilizers. Municipal garden and nursery will be good place to use! You can also search the potential demand of residents, market vendors and farmers through the compost demand survey (refer to the section of “Baseline survey”).

3 Develop an Implementation Plan

In order to implement strategically and secure necessary budget, an implementation plan should be developed including the following components;

Table B-4: Items to be included in the implementation plan

	Item	
1)	Goal	where we want to get to
2)	Implementation/responsible bodies (lead agency, other related organization)	by whom?
3)	Actions/Activities	by what?
4)	Timeframe	by when?
5)	Indicator	to evaluate the progress
6)	Budget	how much?

You can refer to the attached DVD for examples of implementation plans which were developed by LCC and NTC as 3R Promotion Action Plan.

In the implementation plan, the following sub-system should be included.

- (1) Awareness raising of waste separation in the market
- (2) Separate discharge system in the market
- (3) Collection and transport system of separated market waste
- (4) Composting system of market waste
- (5) Monitoring system
- (6) Commercializing (Sieving/Storage/Packing/Selling) system

The above sub-system is described in detail as below.

4 Conduct awareness activity

4.1 Awareness raising on waste separation in the market

- 1) Organize a meeting with the market management committee consisting of Market Master and Market Vendors Association to request cooperation and support for the activity.
- 2) Develop awareness materials for market waste separation as follows;
 - ① Circular (see the next page)
 - ② Poster for the market wall
 - ③ Sticker for separate bins for market waste (sticker is easily removed when bins are washed, so hand-writing is more durable)



1) Sticker (or painted directly on bin)

2) Poster

4.2 Organize launching ceremony

In order to make the project known to everyone, especially to market vendors and the public, it is recommended to organize the launching ceremony at the start of the activity. It will be an effective way as the project should be embraced and supported by the whole society.



Launching ceremony (LCC, Aug. 2009)



Demonstration during launching ceremony (NTC, Jul 2011)

At the same time, circular should be also distributed to each market vendor by council staff to request their cooperation and support for waste separation. It should be conducted on regular basis.



Distributed circular

5 Implement

5.1 Separate discharge of market waste

5.1.1 Separation

a. WHO will separate market waste from other waste?

There are the following two options.

Table B-5: Options for market waste separation

	Advantage	Disadvantage
Option1: Market vendors	- Can expect awareness raising of vendors - Cost effective as no need for further separation	- Quantity and quality of market waste collected will be unstable (depend on vendor's cooperation) - Need to conduct continuous awareness activity
Option2: Contractor	- Can secure stable amount of supply of market waste. - Will make composting work easy if contractor will be in charge of sorting and picking other waste (depends on the contract)	- Costly (contract fee will be increased) - Need to supervise and monitor contractor's work



In case of LCC, council initially collected market waste through their own vehicle. However, the amount of market waste collected was decreased since most of the bins were rejected due to mixing with other waste. Therefore, LCC has amended the contents of contract with contractor to let them do the separation work. It contributed to reduce the collection cost and improve the collection rate since June 2011.

	Until May 2011	Since June 2011
Cleaning in the market	Contractor	Contractor
Storage of market waste	Contractor	Contractor (*Market waste generated on Saturday is kept in the market during the weekend, and is hauled to the compost yard on next Monday)
Loading market waste to collection truck	Council workers (3)	Contractor (3)
Transporting and unloading to compost yard	Council workers (3)	Council workers (3)
Number of trip	Once a day	Monday, Tuesday, Wednesday: Once a day Thursday, Friday: Twice a day
Amount of market waste collected	0.2 ton/day	<u>0.8 ton/day</u>

Table B-5: Changes of market waste separation system (LCC case)

b. HOW to store sorted market waste?

There are various containers for storage of sorted market waste. It depends on the budget you can allocate. You can choose appropriate and easily available container.



Wheelie bins



Half-cut drum



plastic-made container

The number of bins to be installed depends on the scale of the market and the number of market vendors.

In LCC case, wheelie bins were utilized for market waste while half-cut drum and/or blue plastic-made containers for other waste. *Ex) In the case of LCC, 60 bins have been installed for the 4,000 m² size of the market and 327 market vendors.*

c. WHERE to place the above separate bins?

Separate bins should be placed at the spot which is easily acceptable by market vendors.

Note that suitable places of bins for vegetable waste and rubbish bins are different as shown below.

	Target	Number of bins	Location
Vegetable waste bins	Market vendors only	Limited	At unnoticeable places for shoppers but convenient places for vendors such as behind tables or between vendors
Rubbish bins	Shoppers/ Market vendors	More bins than vegetable waste bins	At eye-catching places such as near the entrances and along the main corridor

Table B-6: Target, Number and Location of separate bins



Vegetable waste bin placed between vendors



Vegetable waste bin behind a table. It is tied to a pillar with a chain.

5.2 Collection and Transport of separated market waste

a. WHO will collect market waste?



There are two options; (a) Council or (b) contractor.

In either case, the following item should be ensured.

- collection truck (*do not mix with other waste)
- 1 driver + 2 or 3 collection workers (or contractors like LCC case)

The frequency of collection:

- 5 days/week (depends on the schedule of market operation)

b. HOW MANY TIMES should market waste be collected?

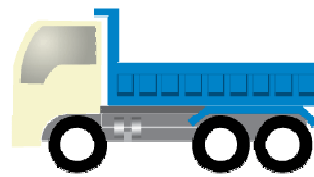
It depends on the operation schedule of your municipal market. Normally, the frequency of market waste collection is the same as garbage collection for businesses, that is, 5 days per week excluding Saturday and Sunday.

c. HOW you will transport market waste into the compost facility?

There are two options as below;



(a) vehicle with compaction



(b) open truck

If the amount of market waste generated is huge (to be generated more than 3 tons at once), option (a) seems ideal to use, but it might be necessary to make another trip just for market waste collection apart from normal garbage. If so, the involvement of garbage contractor will be crucial.

Councils rarely have own vehicles with compaction, so that option (b) must be more realistic.

d. WHAT TIME should market waste be collected a day?

It depends on who will collect market waste. If garbage contractor collects it, garbage

collection time should be taken into consideration. If council collects it, you can set the collection time when council vehicle is available. Please make sure to avoid busy time like after 4 pm.

5.3 Composting and Maintenance

a. WHERE should market composting be done?

Taking the following aspects into consideration, the location of the composting yard should be determined by;

- Distance between market and compost yard
- Space with a certain size for composting work
- Surrounding environment (should not be close to residential area)
- Well-drain ground (if not, ground condition needs to be adjusted)

b. WHERE should market waste be unloaded?

Collected market waste should be unloaded to the designed space. Driver is directed to the disposal location by the site workers. It is also desirable to put a notice which shows the date that market waste was unloaded.



Unloaded market waste at designed yard



Notice set for each compost heap
(Heap number and composting period such as "19
April 2011 – 27 May", is written on the sign)

c. WHAT SHOULD BE DONE after market waste is unloaded?

In order to make the composting process easy and quick, the following pre-treatment should be done.



1) Remove rubbish



2) Make bulky market waste into small pieces

d. HOW to make compost?

There are two methods for making compost;

[Method 1] Solar evaporation method



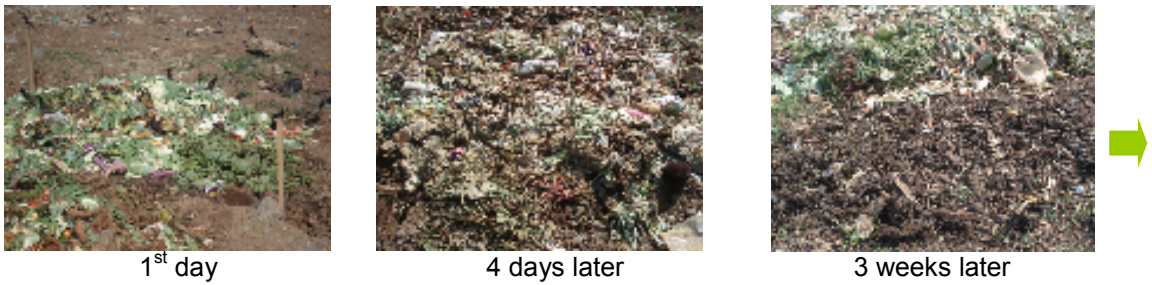
Solar evaporation method

The maturation yard shall be used for receiving fresh market green waste.

There are 21 sections with approximately 1m x 1m area of each square. Collected market waste shall be unloaded on each section everyday except for Sunday (depends on collection schedule).

Each heap of market waste shall be left for a week at least for drying up.

After one week, the heap will be moved to the next section, and then be left for a week again. These processes shall be continued for three weeks.



After three weeks of drying process, dried up vegetable waste shall form the base material at least 1 feet in height and in a round shape with approximately 2.5 metre diameter.

Then, the heap of dried up vegetable waste shall be treated as follows;



[Method 2] Heap type compost method

This method skips drying process and more easy way compared to method 1.

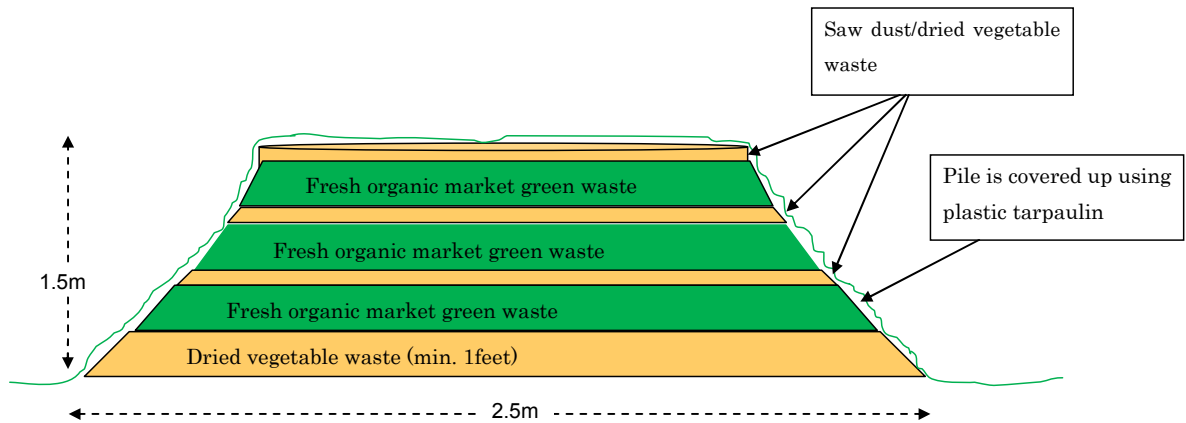
As same as the above 1) Solar evaporation process, dried up vegetable waste shall form the base material at least 1 feet in height and in a round shape with approximately 2.5 metre diameter.

Instead, it is essential to introduce other measures to retain moisture since dry weather hampers the composting by eliminating the needed moisture from the pile. It is vital that 50-60 % of moisture is required for optimum composting process. One such measure is using the fresh organic vegetable waste which is high in moisture content to supplement moisture to dried vegetable waste.

Heap type compost method



Then the fresh organic waste is spread over this pile and covered immediately with saw dust/dried vegetable waste and the fresh organic waste is again spread over this pile and covered again immediately. This process shall be continued until the pile reaches the height of 1.5 metre.



The pile is also covered with plastic sheet to retain moisture or protect from excessive moisture during heavy rain. The pile is then left to mature and turned over every fortnightly by excavator or other available heavy equipments.



Formulating base using dried vegetable waste



Unloaded fresh market waste on the base



Covering by saw dust or dried vegetable waste





turning over on regular basis



Steam noticed during the process
of turning over



Covering for moisture control
(very important!)

Once the compost is fully matured, mill mud is added approximately at ratio of approximately 20% to the volume of the pile (optional).

e. **HOW LONG will it take for compost to be matured?**

It all depends on how market waste composting is managed. Compost can be produced in as little as a couple of months or up to 6 months. You can judge when composting is finished from the following symptoms;

- ✓ The pile of compost has developed a blackish color.
- ✓ Odors are no longer a concern – could be earthy odor.
- ✓ Consistent crumbly texture
- ✓ The most pile remains cool and does not become warmer after turning.



Ready to use as compost!

5.4 Commercializing (Sieving/Storage/Packing/Selling)

The pile is then thoroughly mixed, sieved, weighed and packed in 10 kg bags for sale at cost of \$5.00, which depends on the total production cost council spent.





Considering all expenses incurred in composting process, the price of the final products should be determined. LCC is selling it for \$5.00 per 10 kg as their production cost is \$3.94 per 10 kg.

The Sales of the final products can be promoted at conspicuous place such as cashier or reception area in the council.

It is also good opportunity to display final products for selling in the public places like the municipal market. People will show big interests to 100% pure organic material and your efforts! It is preferable to organize on regular basis (monthly).



Display at council's reception



Display for market waste compost



Resident buying compost

6 Review the progress of the activity, and amend the plan if necessary

The following items should be recorded on regular basis for the review the progress of the activity.

Table B-7: Items to be monitored

Item	Frequency	Remarks
1. The place where collected market waste is unloaded	Daily	It is indicated on map.
2. Weather	Daily	By observation

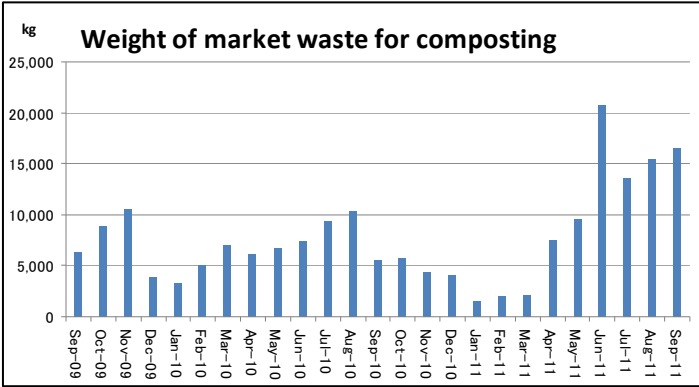

3. Amount of market waste which was transported to the compost yard	Daily	<p>It can be measured by weighbridge or be estimated by loads. The following table shows the example of LCC.</p> 
4. Report on composting process work	Weekly	It should be recorded when turning over, covering the heap with tarpaulin for moisture control are carried out.
5. Temperature	Weekly	<p>By thermometer.</p> 
6. Total amount of compost produced /packed for selling	Monthly	It is also useful to estimate the waste reduction rate.
6. Cost analysis for the total system	Monthly	To determine the product price. The cost-effectiveness of the system will be also validated.
7. Component analysis result of produced compost	1 or 2 times/year	Nutrient content analysis (Nitrogen, Phosphorus, Potassium, C:N ratio) should be conducted before selling. The result of analysis should be announced to the public to ensure the quality of final products. It is also useful information for awareness rising and promotion. Table B-8 shows the result of nutrient content analysis for various composting methods.

Table B-8: The result of nutrient content analysis for various composting methods

Material	Nitrogen (%)	Phosphorus (%)	Potassium (%)	C %
Thailand standard	>1	>0.5	>0.5	C:N <20
Shibushi Japan compost	1.3	1.1	0.75	C:N 8
OISCA compost	1.3	1.4	1.4	10.7
Market compost only	1.1	0.3	0.8	10.9
Market compost with mill mud	1.3	2.1	1.2	7.2
Plastic composter compost	0.9	0.2	1.3	5.4
Drum Compost	1.5	2.4	1.5	9.7

Grass compost	2.0	0.4	1.2	20.6
Grass + mill mud	1.3	0.9	0.7	7.3
Special compost ²	1.2	1.1	0.7	10.5
Normal Soil	0.33	0	0	3.9

*Source: The above analysis was carried out by the Koronivia Research Station in 2010.

In order to know the effectiveness of produced compost, plant testing will be one of the good methods to compare the differences between the plant with and without compost.

The result of testing should be made public and be utilized for awareness raising.



Plant testing using flower pot



Plant testing (Left: without compost, Right: with compost)

² Mixing with mill mud, chicken manure, sawdust, dried green waste

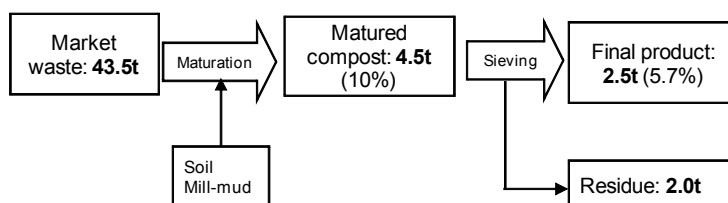
7 Unit cost estimation

Table B-9 shows an example of the unit cost estimation.

Table B-9: Unit cost estimation for implementation of market waste composting

Items	Unit	LCC			NTC
		2009 September	2010 October	2011 September	2011 September
(1) Condition					
a. Collection amount	kg/d	400.0	400.0	800.0	1340.0
b. Required working time (ba. + bb.)	hr./d	4.0	2.5	2.5	3.5
ba. Collection and transportation	hr./d	3.0	2.0	2.0	3.0
bb. Manufacturing compost.	hr./d	1.0	0.5	0.5	0.5
c. Running kilometer for MPT per collection day (Vunato-Market-Vunato)	km/d	5	5	5	10
d. Fuel consumption	km/l	5	5	5	5
e. Collection crew					
ea. Driver	person	1	1	1	1
eb. Worker	person	2	1	0	1
(2) Unit cost					
f. Labor cost					
fa. Driver:	\$/hr.	3	3	3	3
fb. Worker:	\$	3	3	3	3
g. Unit cost for Fuel	\$/l	1.97	1.97	1.97	1.97
(3) Cost estimation					
h. Labor cost (ha+hb)	\$/ton	82.5	33.75	7.5	14.55
ha. Labor cost for collection $((ea) \times (fa) + (eb) \times (fb)) \times b \times 1000 / a$	\$/ton	67.5	30	7.5	13.43
hb. Labor cost for manufacturing compost $((eb) \times (fb)) \times b \times 1000 / a$	\$/ton	15	3.75	0	1.12
i. Cost of fuel (c/dxg)	\$/ton	4.93	4.93	2.46	2.94
j. Cost of bag, seal and packing	\$/ton	5.0	5.0	5.0	5.0
k. Maintenance cost for MPT: 5% of cost of fuel $i \times 0.05$	\$/ton	0.25	0.25	0.12	0.15
l. Total cost for collection and sorting work (h+i+j+k)	\$/ton	92.7	43.9	15.1	22.6
m. Unit cost of matured compost	\$/ton	1,612.63	764.38	262.39	393.94
	\$/10kg	16.13	7.64	2.62	3.94

Market waste 1ton = Final product 57kg



Annex for Market waste Composting

a. Circular for market vendors (LCC)

LAUTOKA CITY COUNCIL



CIRCULAR TO ALL MARKET VENDORS

RE : SEPARATION AND RECYCLING OF MARKET WASTE

Lautoka City is currently working in partnership with Japan International Cooperation Agency (JICA) and Ministry of Environment with the implementation of the “Waste Minimization and Recycling Promotion Project” in Western Region of the Republic of the Fiji Islands. The overall goal of the project is to Reduce, Reuse and Recycle Waste.

The council has embarked on the “recycling campaign” at the market whereby the cooperation of all market vendors is needed in separation of all types of market wastes. The council will be providing 2 types (colors) of bins with labels and the vendors are simply requested to put the wastes in the right bin whilst cleaning your stalls.



The details are as follows:-

Green Wheelie Bins



- **Vegetable waste only** like vegetable peelings, leaves, twigs, soil, fruits etc.

Blue half cut plastic drum



- **Other waste** like Cartons, papers, plastics and others.

The council seeks support of all market vendors in actively participating in the above initiative in establishing an **environmentally friendly market** which can be seen by all as a **model market** in Fiji.

S. RAJAN

ACTING CHIEF EXECUTIVE OFFICER

February 15, 2010

3R Promotion Activity (3) Market waste composting

Composting process

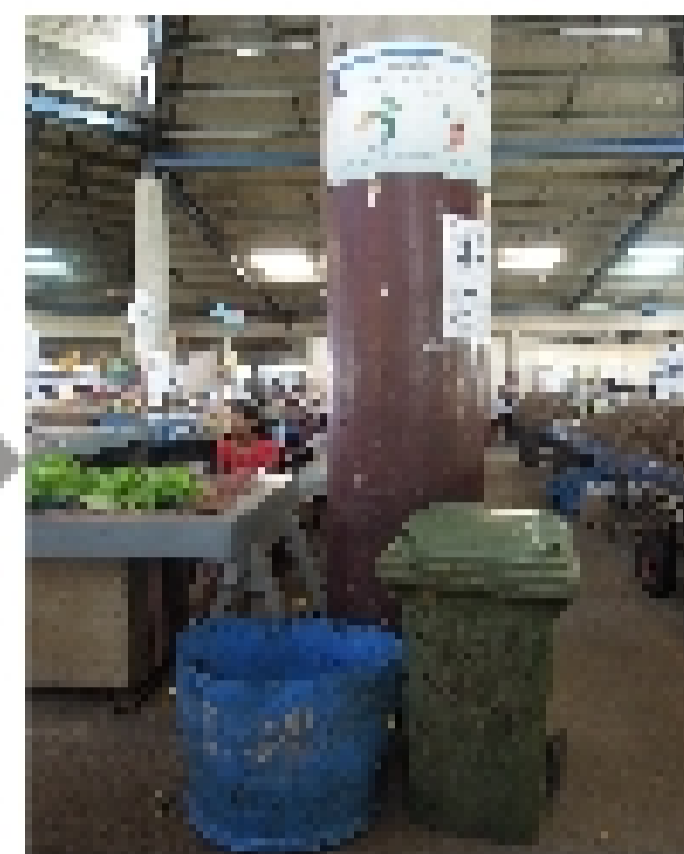


(Announcement in the market)



(Awareness for market)

① Awareness raising on market waste separation



② Place separate bins
(Green bin for vegetable waste only, Blue bin for other waste)



③ Separate discharge



④ Collection



(Turn over regularly)



(Cut finally)



(Remove undegradable item)

⑤ Pre-treatment



⑥ Haul to compost yard



(Moisture control)

⑦ Promote fermentation (for 5 months)



⑧ Sieving



⑨ Bagging



Final product

Sale \$5/10kg



C: Green Waste Chipping and Recycling



C. Green Waste Chipping and Recycling

Green waste chipping and recycling is implemented and promoted according to the following procedure.

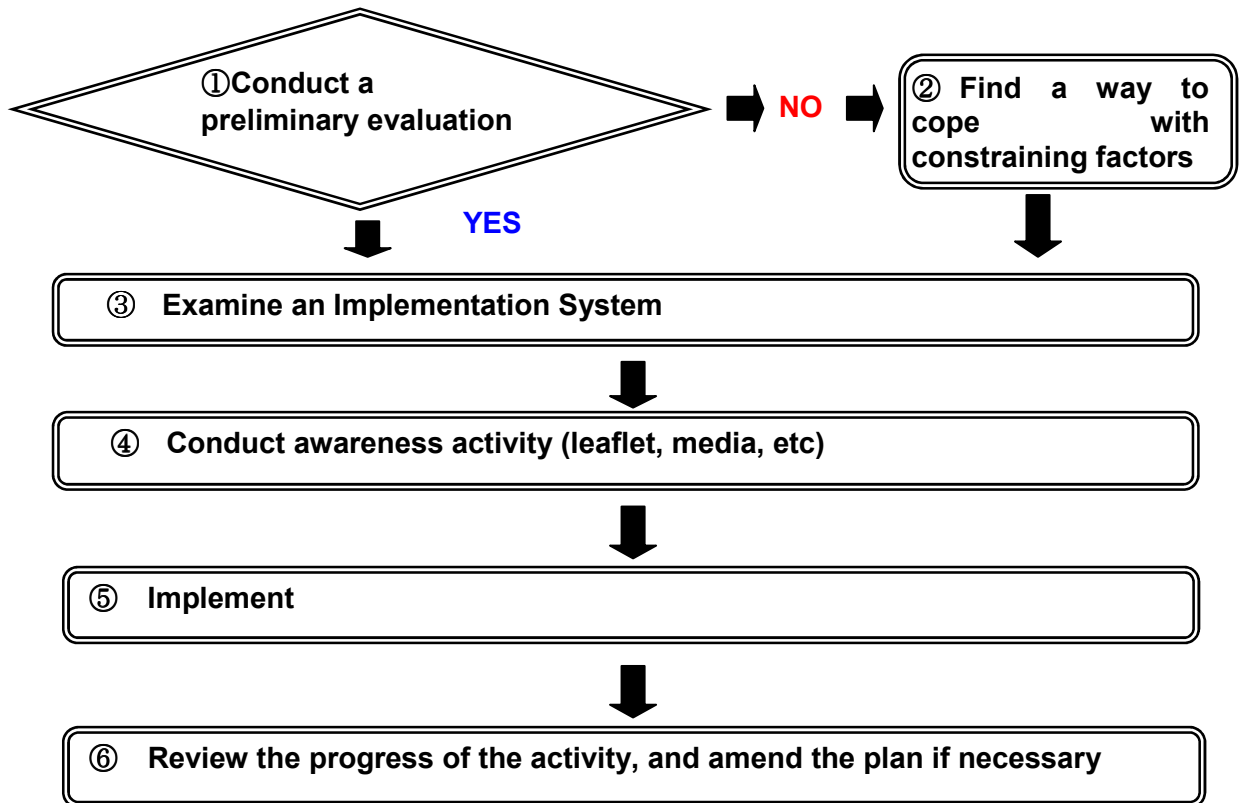


Figure C-1: Implementation procedure of green waste chipping and recycling

1 Conduct a preliminary evaluation

Before implementation of green waste chipping and recycling, it is recommended your council should conduct preliminary evaluation through the following checklist to determine whether or not your organization can implement green waste chipping and recycling.

Table C-1: Pre-conditions for market waste composting

	Pre-condition	Category	Checklist
1	Wants to reduce the amount of green waste going to dump site.	Political will	
2	Knows the quantity and quality of green waste generated from the boundary area.	Knowledge	
3	Has a shredder machine or is planning to procure it.	Equipment	
4	Has already provided green waste collection service or is planning to provide the service for the public area and/or households.	System	
5	Can work together with another department which is being in charge of public area cleansing.	System	
6	Can collect and transport green waste separately from other waste.	System	
7	Can ensure the space for chipping, human resources and necessary machineries and materials	System	
8	Can ensure how to utilize generated chips.	System	

2 Find a way to cope with constraining factors

If your organization does not satisfy the above pre-conditions, please do not give up! The following measures will help meeting requirements.

2.1 [Pre-condition 1] Q1. I don't know why we need to reduce the amount of green waste going to dump site.

Garden waste is not allowed to be discharged with the regular household garbage collection. Therefore, most residents have few options to deal with their own green waste. There is a growing concern about open burning and littering throughout the country.



Open burning

Some councils prune and collect green waste from the public spaces such as park and streets. Collected green waste is normally being disposed to the final disposal site. For instance, green waste is being generated in Lautoka and Nadi which accounts for more than 20.0 % of total Municipal Solid Waste.

Green waste is bulky and has occupies space of the dump site. It also causes negative impact to the environment such as leachate.

Furthermore, collection and transport work is costly. In case of LCC, the cost for public area cleaning service including green waste collection in 2008 was F\$563,277 which accounts for 53.2% of total cleaning service cost.

From the above situation, councils can decide whether or not they need to implement garden waste chipping and recycling considering the following reasons.

- ✓ prevent open burning,
- ✓ prevent littering in creeks/drains/parks/footpaths
- ✓ reduce the disposal amount,
- ✓ reduce the collection and transport cost of green waste
- ✓ prevent accumulation of refuse in backyard

2.2 [Pre-condition 2] Q2. I don't know the amount of organic waste generated in my area

The amount of organic waste generated will be also calculated based on the waste flow or the results of the Waste Amount and Characterization Survey (WACS)

You can estimate the quantity and quality of green waste generated from your council jurisdiction referring to the following example.

Table C-2: The amount of green waste generated from Nadi Town

Names of target park and street (location) Area (m2),	Total length (m)	Estimated amount of GW (m3)	Schedule (Frequency, season, etc)
Koroivolu Park (Town ward)	1.77 ha	3 ton/year	Twice a year (June)
Nair Dais and council car park (Town)	0.6 ha	2 ton/year	Twice a year
Street tree within the town (Queen's road)	Approximately 2km (Martintar ward – Namaka ward)	-----	Once a year
Total		-----	

2.3 [Pre-condition 3] Q3. We don't have a shredder machine.

Without shredder machine, it is difficult to carry out chipping of green waste. There are some options to procure a shredder as shown below.

Table C-3: Options to procure a shredder machine

	Options
1	Purchase a brand-new shredder machine
2	Purchase a second-hand shredder machine
3	Rent a shredder from neighboring councils (LCC, NTC)
4	Request aid agencies (such as Japanese embassy)



NTC shredder was donated by the Japanese Embassy

2.4 [Pre-condition 4] Q4. We haven't provided green waste collection service at moment.

If you have already provided the collection service to ratepayer, it will be easier to integrate 3R concept into the present system as your residents already knows the service.

The service shall be provided on “**user pay**” concept, so residents who need the service are requested to pay necessary fee for the service.

If you are planning to provide the collection service newly, it is recommended to know the needs of residents for the service before starting by conducting questionnaire survey.

For the green waste collection from public areas such as park and streets, it depends on the amount of green waste to be collected whether green waste should be chipped using shredder or not.

2.5 [Pre-condition 5] Q5. Which department do we need to work together?

Public areas cleansing works including pruning trees are being undertaken by different department such as Department of Engineering while Health inspectors who belong to Health Department are being in charge of waste management.

Staffs of Engineering Department have already necessary technique and know-how to conduct pruning trees and to maintain collection vehicles and equipments.

Health Department has normally has limited capacity such as human resources, so it is recommended to involve Engineering Department in implementation.

2.6 [Pre-condition 6] Q6. Why do we need to collect and transport green waste separately from other waste?

To get a purely green waste from households and public areas, green waste should be collected separately. Special trip for green waste only shall be carried out apart from other waste. There should be some discount on collection rates to encourage residents to discharge a purely green waste.

In terms of a collection vehicle, open truck can be utilized. Truck should be covered to avoid any green waste or shredded chips from falling whilst being transported.

2.7 [Pre-condition 7] Q7. What kind of space, human resources and machinery and materials do we need?

It is ideal to secure the following things;

Table C-4: Necessary Items for green waste chipping and recycling

	Space	Human resources	Machinery and materials
Item	- Space for shredding work (*Shredding work for public area is normally conducted at site. For residential area, certain space shall be secured to prevent from noise and dust) - Storage space for storage of chips	- Pruning workers: 2 - 5 persons - Driver: 1 person	- Shredder - Collection vehicle - Chain saw (for cutting thick trunks to make pruning work easy) - Hiring cherry picker (for public areas)
LCC case	-Space for shredding work: Vunato Dump Site and on site - Storage space for storage of chips: Vunato Dump Site / Botanical garden	- Pruning workers: 2 - 5 persons - Driver: 1 person	- Shredder - Collection vehicle with cover - Chain saw (1) - Hiring cherry picker

2.8 [Pre-condition 8] Q8. WHAT can the produced chips be utilized for?

Before implementation, your council needs to determine potential markets for produced chips as final products. It is open to utilization in various ways as follows;

- Fuel materials for boiler as renewable energy
- Municipal garden and nursery as excellent mulching materials (These helps (1) retains moisture, (2) eliminates weeds (3) conditions the soil)
- Moisture adjustment materials for composting and home garden
- Covering material for final disposal site (alternative covering material)

3 Examine an implementation system

3.1 Target green waste

There are two sources of green waste;



(a) Green waste discharged at household or business levels



(b) Green waste discharged from public areas like parks and streets.

3.2 Overall procedures

Each source of green waste has different overall procedure.

a. Green waste generated from households

Collection system shall be newly established. Awareness raising and advertising of the system are important to inform residents of the system. Generated chips can be returned to residents if they want, or be sold for others.

b. Green waste generated from public spaces

Chipping process can be integrated into present public area cleansing.

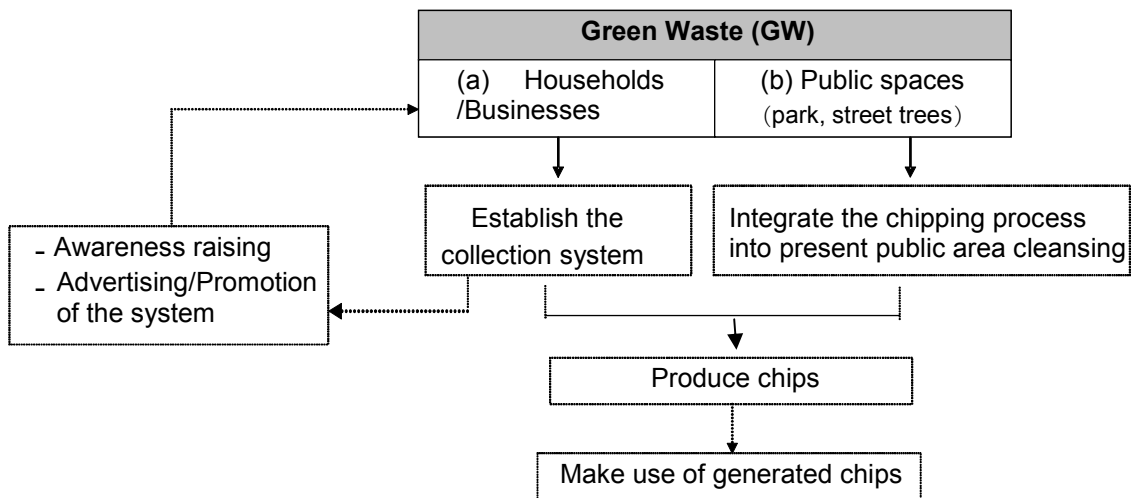


Figure C-2: Overall procedure for green waste chipping and recycling

3.3 Implementation system

a. Green waste generated from households

The service is provided on “user pay” concept, so residents who need the service are requested to pay necessary fee to the council in advance.

All money council received from residents is utilized for operation and maintenance cost for green waste shredding such as payment for collection contractor.

3.3.1 Collection body

There are two options; (a) council or (2) private contractor.

In LCC case, the collection service is basically contracted out to private contractor. It enables to provide service which caters for four (4) categories other than garden refuses (see Table C-5).

3.3.2 Collection fee

Considering the total expenses for implementation such as transport and shredding cost, collection fee shall be determined. Even a tender could be called for use pay concept.

The following tables show examples of two councils; LCC and NTC. To promote separation of garden waste at source, both councils put discounted price for category A, that is, garden refuses. A demand for GW collection service may be increased by reducing the service fee.

Table C-5: Category and Collection fee (LCC case)

Category	Target refuse	Collection fee
A) Garden refuses	<u>Only</u> garden refuse inclusive of grass, trunks, branches, roots, leaves, pruning and any other green waste.	\$22.50 (per load)
B) Commercial refuse	All refuse such as cartons, plastics, packages, wrappers, cloth pieces, leather pieces etc (may include mixture of garden refuse)	\$24.55 (per load)
C) Trade/Industrial /Construction refuse	All refuse including tyres, machine parts such as vehicle body parts, metals, building material, stones, gravel, rubble, bolders, bricks, white goods and others (may include green waste)	\$24.55 (per load)
D) Motor body shell	Motor body shell without engine	\$25.60 (per piece)

Table C-6: Category and Collection fee (NTC case)

Category	Target refuse	Collection fee
A) Garden refuses	<u>Only</u> branches and trunks of trees (please do NOT discharge grass together)	\$35.00 (per load)
Note: Any special request of target refuse on days other than schedule		\$115.00 (per load)

In either case, resident needs to inform council of which category of the waste they wish to discharge, the total amount of refuse, and home address and contact information in advance. Also residents are requested to pay the relevant fee.

3.3.3 Collection schedule

It depends on who will collect garden waste.

In LCC case, the collection is provided as per request. It also leads to effective service delivery.

In case of NTC, the collection service has provided by ward as shown Table C-6 in order to save the transport cost by reducing the number of trips. Resident who needs the service needs to pay to the council by Friday of the previous week of the collection day.

Table C-7: Collection schedule (NTC case)

Ward	Schedule
Town	Every month first (1 st) Monday
Martintar	Every month second (2 nd) Monday
Namaka	Every month third (3 rd) Monday

3.3.4 Location for shredding work

It depends on the amount of green waste to be collected from the site.

In order to save the transport cost by reducing the number of trips, it is preferable that shredder machine is brought up to the site if there is a sufficient space at site or large amount of green waste discharged.

However, chipping works using shredder machine will create a noise and dust. It might also result in traffic jams by blocking the road.

Taking the above matters into consideration, the place for chipping work should be determined.

In case of LCC, contractor hauls green waste generated from households to the Vunato Disposal Site or their botanical garden, and is chipped using shredder there.

In NTC case, they use the council depot as NTC has no final disposal site. Engineering Department of NTC sometimes conducts site inspection before carrying out GW collection in order to determine whether or not shredder should be brought to the site. At the same time, council request residents to separate garden waste from other waste. Shredding work is undertaken on site if the amount of GW discharged is more than 1 load.

Residents are requested to inform councils of the amount of green waste to be collected in advance, and to separate green waste from other waste to make chipping work efficient.



Shredding work on site
(GW from households)



Shredding work on site
(GW from public areas)



Shredding work at final
disposal site (LCC)

4 Conduct awareness activity (Leaflet, media, etc)

a. Green waste generated from households

Based on the system examined, council shall develop a leaflet which includes the following information.

- ✓ Backgrounds
- ✓ Outline of the collection system
- ✓ Collection fee for each category.
- ✓ Usage of produced chips (if produced chips is returned to the residents)

The developed leaflet is attached as ANNEX C-1. Using the leaflet, the system can be promoted through door-to-door visit and media such as community newspaper.

5 Implement

5.1 Collection and Chipping

a. Green waste generated from households

Implementation procedure for green waste generated from households is as follows;

- ① Based on the requests given by residents, (1) Health Department (HD) or (2) council cashier (Administration Department) to make a list which includes;
 - ✓ Resident information such as name and household number
 - ✓ Category resident applied for
 - ✓ Collection date
 - ✓ Confirmation of payment
 - ✓ Expected amount of green waste
- ② (1) HD or (2) council cashier to submit the above list to (1) the Contractor or (2) Engineer Department (ED) and request for provision of the collection service according to the specified collection day.
- ③ (1) Contractor or (2) ED to collect and remove all refuse from footpath/reserves and other specified areas by way of loading manually/machine, raking, sweeping. The area to be left in a clean and tidy condition to the satisfaction of the council. HD to monitor and supervise their works.
- ④ (1) Contractor or (2) ED to haul collected garden refuse to the designed place (such as final disposal site or council Depot).
- ⑤ (1) HD or (2) ED to carry out shredding work.
- ⑥ (1) HD or (2) ED to record operation hours and the amount of chips produced, and reported them to HD.
- ⑦ (1) HD or (2) ED to maintain all machineries properly.

b. Green waste generated from public spaces such as municipal parks and streets

Council carries out pruning green waste such as tree branches at parks and streets based on the schedule.

In order to save the transport cost, pruned green waste shall be chipped using shredder on site if there is a sufficient space for the work. Noise, dust and traffic related issues should be considered.

ED needs to record operation hours and the amount of chips produced, and forwards a report to HD.

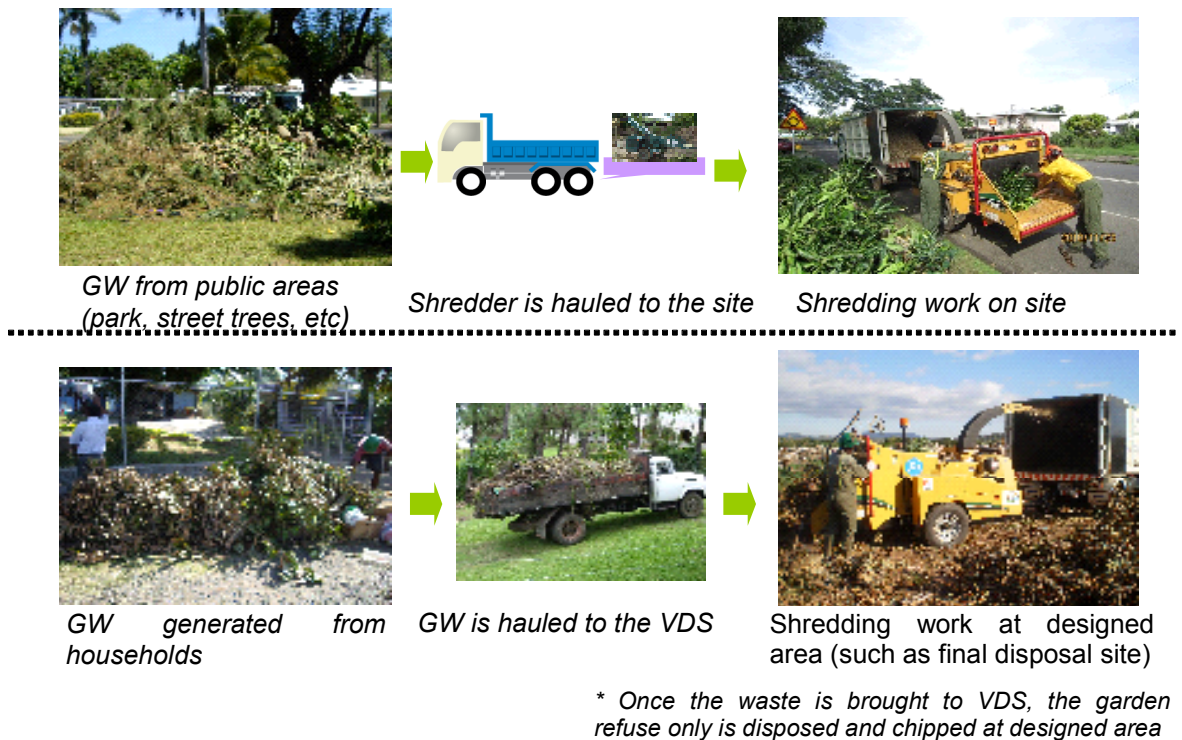


Figure C-3: Outline of green waste chipping and recycling system

5.2 Use of generated chips

Chipped materials should be stored properly to maintain the quality with necessary facilities for storage.

Chipped materials will be utilized for various ways;

- Mulching materials for council’s nursery, garden, parks and hotel compounds (to be sold)
- Base materials for home composting.
- Examine the possibility to supply the chipped materials to Fiji Sugar Cooperation (FSC). The chipped materials can be recycled for fuel for boiler in accordance with the contract with FSC. ((b) Green waste generated from public spaces such as municipal parks and streets



Chips produced from garden waste



Mulching at botanical garden



Mulching at hotel garden



Base materials for home composting



Sugar mill factory

Column - Other matters to be examined

- In the case of big amount of green waste, the members of public can request for hire of chipper at fee of \$75.00/hour and they can retain the chips. This also applies to commercial sector and other municipalities as not all municipalities can afford to pay for the purchase of shredder machine.
- The other aspect is the need for stringent enforcement of relevant legislations like open fire bylaw, litter decree to control the inappropriate self disposal of green waste via burning, littering and accumulation in backyards.

6 Unit cost estimation

Table C-8 shows an example of the unit cost estimation.

Table C-8: Unit cost estimation for implementation of green waste chipping and recycling

	Items	unit	Figure	Calculation
a	Volume of GW	m ³	40	
b	Capacity of MPT	m ³	13	4mx2mx1.6m
c	Loading ratio		0.5	
d	Volume decrease ratio		0.16	(bxc)/a
e	Working hours for shredding	hr.	1.5	
f	Working efficiency for shredding	m³/hr.	26.67	a/e
g	Unit cost of diesel	\$/l	1.97	
h	Fuel consumption of shredder machine	l/hr.	11.25	90l/8hr.
i	Cost of fuel for shredder machine	\$	33.24	exhgxg
j	Maintenance cost for Shredding machine	\$	3.32	10% of fuel cost
k	Fuel consumption of MPT	km/l	5	
l	Running kilometers from VDS to site	km	3	
m	Cost of fuel for MPT	\$	2.36	(lx2)/kxg
n	Maintenance cost for MPT	\$	0.24	10% of fuel cost
o	wage of workers	\$/hr.	3.00	
p	Number of worker	person	3	
q	Labor cost for 40m ³ of GW	\$	13.5	oxpxe
r	Cost required for shredding	\$	52.66	i+j+m+n+q
s	Cost required for shredding per 1m ³	\$/m ³	1.3165	
t	Cost required for shredding per 1 ton	\$/ton	26.33	ASG of chip: 0.05

Note; Above data was observed from the actual shredding work in LCC.

Annex for Green waste chipping and Recycling

- a. Leaflet "Garden Waste Collection and Recycling Service" (LCC)



Nadi Town Council promotes 3Rs!!

Garden Waste Collection and Recycling Service

March 2011



Do you have problems of garden waste?

Background

- Garden waste should not go in your regular household collection of garbage. There is growing concern about open burning throughout Nadi Town.
- 5.1 ton/day of Green Waste is being generated in Nadi which accounts for 22.7 % of total Municipal Solid Waste. The cost for public area cleaning service including GW collection in 2008 was F\$525,000 which accounts for 45.6% of total cleaning service cost.
- Nadi Town Council used to provide green waste collection service once every three (3) months for free until 2008. However, it was stopped due to unavailability of suitable site.
- In October 2010, with the procurement of the shredder machine through aid by the Embassy of Japan, Nadi Town Council has decided to introduce the new green waste collection and recycling services to be provided to the public and the community within the town boundary area from March 2011.
- The service will be provided on “user pay” concept, so that residents who need a service are requested to pay necessary fee for the service.



Open burning creates big problems



Chipping work of garden refuses

Target waste, and Collection fee:

The collection service caters for the following two categories of waste.

Target refuse		Collection fee
Garden refuses	<u>Only</u> branches and trunks of trees (please don't discharge grass/leaves)	\$ 35.00 (per load)
Note: Any special request of target refuse on days other than schedule		\$115.00 (per load)

Collection schedule:

Collection service will be provided once a month by area as follows.

Area	Schedule
Town	Every month first (1 st) Monday
Martintar	Every month second (2 nd) Monday
Namaka	Every month Third (3 rd) Monday

Note: No collection will be done on public holidays.
Discharge of garden refuse upon payment shall be done one day prior to the day of collection.

How you can apply for the service?



Garden refuses to be chipped.



Mulching using chips



Composting using chips

- Resident who needs the collection service, shall pay for the service to the Nadi Town Council **by Friday of the previous week of collection day.**
- This is the pre-paid collection service, so please visit the Health Department of NTC, and pay fee to the NTC cashier. You need to inform us of which category you apply, the total amount of your refuse, your home address and contact information.

How recycle Green Waste?

Garden refuses will be chipped by shredder machine. It is very useful as mulching and composting materials!

For more details:

Contact the Garden Waste Recycling Team at Health Department of Nadi Town Council on 670 8180 / 670 0133.

3R Promotion Activity (4) Recycling of Green Waste

Green Waste Chipping

Why Green Waste?

- Green Waste accounts for 32.2% of municipal waste generated, and its treatment cost is huge burden for councils.
- Self-disposal such as open burning is one of the serious issues in Fiji.



1) GW generated from public area (Parks, Street trees, etc)



(Chipping at site)



Generated chips

How to use chips?



(Mulching materials for parks)



(Base materials for composting)

2) GW generated from households



(Collection, Transport)



(Chipping at recycling yard in VDS)



(Fuel for Fiji Sugar Cooperation boiler)

D: Separate Collection of Recyclables



D. Separate collection of recyclables

Separate collection of recyclables is implemented and promoted according to the following procedure.

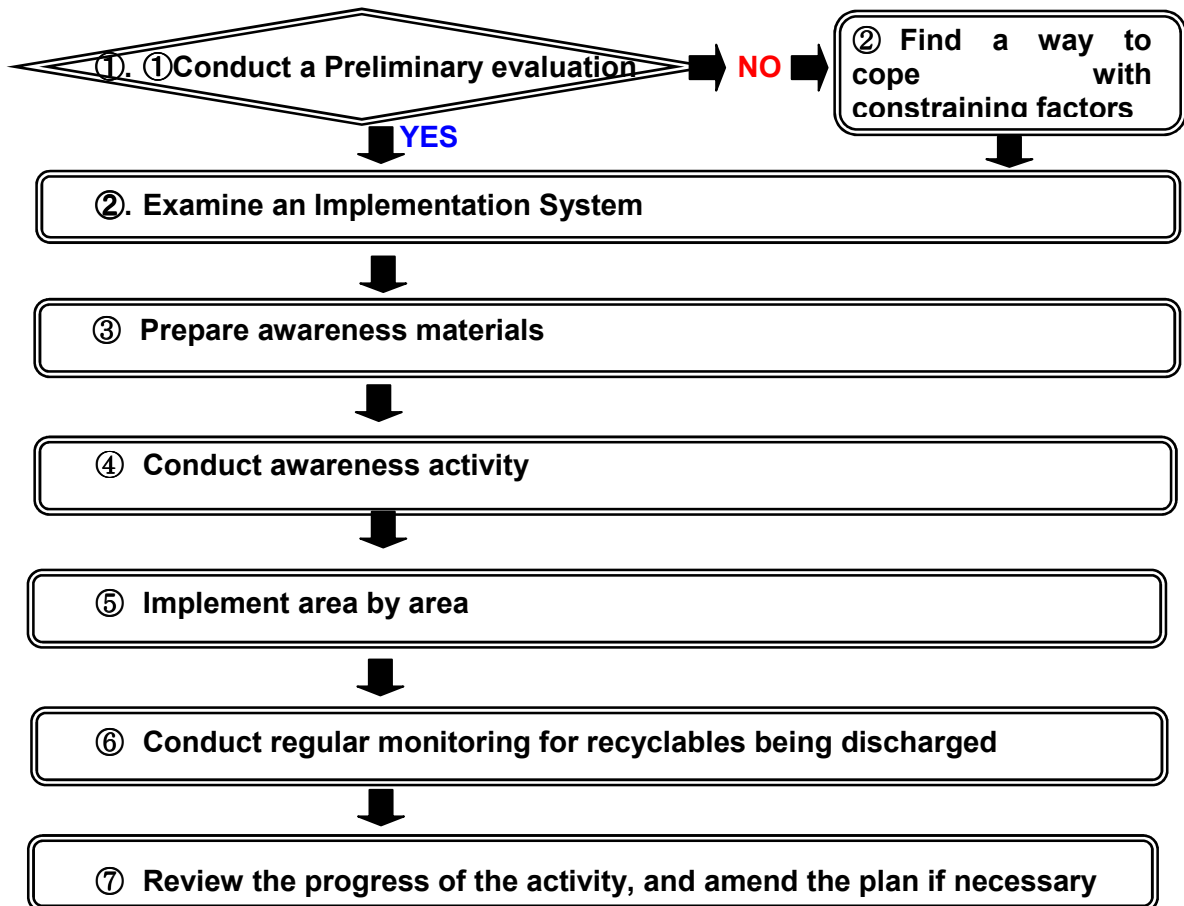


Figure D-1: Implementation procedure of separate collection of recyclables

1 Conduct a Preliminary evaluation

Before implementation of separate collection of recyclables, it is recommended for your council to conduct preliminary evaluation through the following checklist to determine whether or not your organization can implement separate collection of recyclables.

Table D-1: Pre-conditions for separate collection of recyclables

	Pre-condition	Category	Checklist
1	Provides the garbage collection service regularly.	System	
2	Wants to reduce the waste which can be recycled going to the dump site.	Political will	
3	Has a company who collect recyclables within the boundary area or surroundings.	System	
4	Has a truck to collect recyclables separately.	Equipments	
5	Can ensure the space for storage and sorting of the collected recyclables at recycler's depot or council's depot tentatively.	System	
6	Can conduct the regular monitoring.	Human resources	

2 Find a way to cope with constraining factors

If your organization does not satisfy the above pre-conditions, please do not give up! The following measures will help meeting the requirements.

③. [Pre-condition 1] Q1. We have not provided garbage collection service in our area.

You need to start providing garbage collection as residents' demand for garbage collection must be high. If recyclables collection commences in certain places where garbage collection has not been provided, all the waste with recyclables might be discharge together.

Column – Recyclable collection system in the village

For the places where garbage collection service is not provided such as villages located in the rural area, recycle stations shown in right picture, can be established. Recycling companies will come and collect recyclables when sacks are full.



Useful tips to make it a success;

- Establish a committee to look after the sacks for recyclables collection and profits on sale of recyclables.
- Talk together with recycling company about target recyclable items, collection schedule, conditions of recyclable items, etc.
- Involve all community members in the recycling activity.

④. [Pre-condition 2] Q2. We don't know whether or not we should reduce the waste which can be recycled.

The rate of recyclables to total amount of municipal solid waste must be small percentage (less than 1.0 % on a weight basis). However, it will contribute to minimize the waste at the dump site in terms of volume as most of recyclables are bulky.

In addition, separate collection of recyclables will also give a great opportunity to approach communities through house-to-house visit and community meeting. Through these awareness activities, other 3R activities can be also promoted in the area. It is also good means to educate our children to care for our environment.

⑤. [Pre-condition 3] Q3. We don't know any companies who can collect recyclables within the boundary or surroundings.

Absence of recycling company will be crucial challenge to implement recycling activity. If recyclables are collected with effort and no one accepts them, it will cause lack of motivation of the people.

Why don't you start by contacting some major recycle company? They might be able to stop over your area for recyclables collection.

⑥. [Pre-condition 4] Q4. We have no truck and sufficient budget to provide separate collection of recyclables.

If it seems difficult to conduct separate collection due to budgetary restrictions, the following options can be considered;

- Reduce the frequency of garbage collection with the introduction of recyclables collection day (NTC case) (*Preferable frequency of garbage collection is 2 times/week)
- In the case of LCC, 3 workers were employed for collection of recyclables and council utilized its budget for fuel for collection truck. Though additional cost is incurred, council carried out the collection as part of its social corporate responsibility to the environment.
- Request recycling company to collect recyclables (may be possible for business establishments).

⑦. [Pre-condition 5] Q5. Why do we need a space for storage of the collected recyclables?

If the depot of the recycling company is not located in your area, your council need to secure a storage space of the collected recyclables until recycling company come to collect them.

Council depot is the most ideal space but need sufficient space as recyclable items are mostly bulky. The roof for the storage space is necessary as recyclables such as paper and cartons should be kept dry.

⑧. [Pre-condition 6] Q6. We don't have sufficient number of staff for conducting regular monitoring.

Health Inspectors will be ideal persons to conduct monitoring as they have an authority to give guidance for proper discharge way to residents and businesses. However, health inspectors have no time to spare for monitoring.

As an alternative solution, health inspectors should take part in the monitoring work during the first month or two of recyclables collection at newly-expanded area. Then, collection workers or garbage contractors can be trained by health inspectors and they can take over the monitoring work.

3 Examine an Implementation System

The basic procedure of separate collection for recyclables is shown as below,

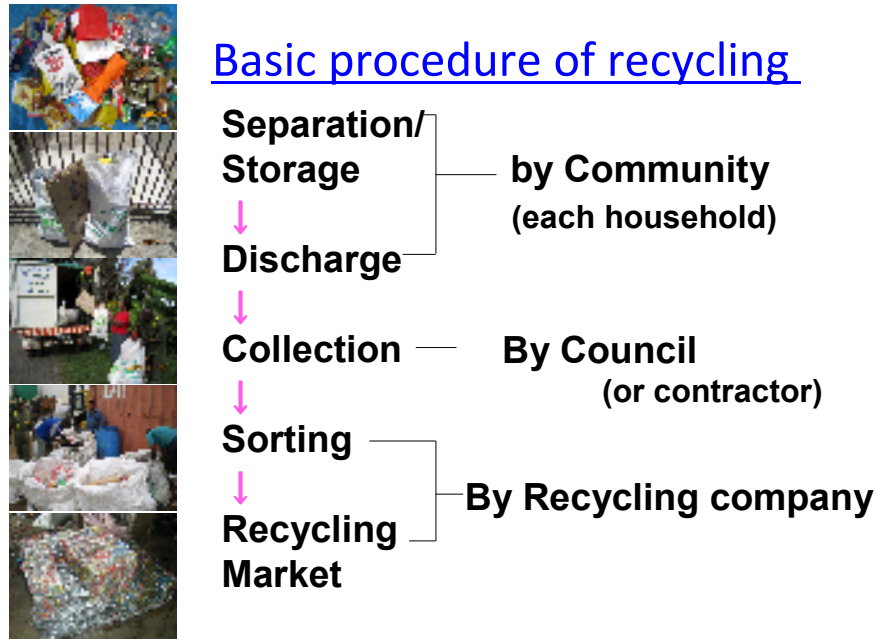


Figure D-1: Basic procedure of separate collection for recyclables

For the implementation plan, you need to examine the each system above.

⑨. Separate / Storage / Discharge

This part need to get residents/businesses involved. Your council needs to request residents/businesses for cooperation, and guide them what to do. The system to be developed for separation, storage and discharge, should be simple and systematic to make the people follow easily.

Points to be determined for the system for separation, storage and discharge are as follows;

- Target recyclables and discharge rules
- Discharge container
- Discharge time
- Discharge place



3.1.1 Target recyclables and discharge rules

These will be determined based on the acceptability of recyclables by recycling company, and the resident’s capability of separation.

*LCC and NTC cases – Waste Recycler Fiji. Ltd;

PET bottle (for beverage), Plastic shopping bag, Hard plastic, Metal, Paper (newspaper, magazines, office paper), Cardboard, Cloths, Glass bottle

Column – Recycling activity survey – to determine items to be targeted

The presence of recycling company is crucial to implement separate collection of recyclables as it is difficult for councils to carry out a series of recycling process from collection, cutting, compressing, bailing, packing and exporting to overseas market.

In order to determine which items to be collected for recycling, it is highly recommended to conduct recycling activity survey in your area and surrounding area as a part of baseline survey. During the survey, the following matters should be identified.

- Recyclable items to be accepted.
- Discharge conditions
- Purchase price
- Shipping destination
- Current recycling activity (businesses, school, etc)
- Future plan



List of major companies who collect recyclables items:

Name of company	Type of business	Items for recycling
Waste Recyclers Fiji Ltd	Recycling company	Metals (Aluminum, Steel, Copper, etc), Glass bottles, Plastics, PET bottles, Papers, Carton
Coca-cola Amatil (Fiji) Ltd	Soft drink manufacturing company	Aluminum cans, PET bottles
Foster's Group Pacific Ltd	Beer manufacturing company	Glass bottles (own products only)
Natural Waters of Viti Ltd.	Water bottling	PET bottles, Carton (own products only)

3.1.2 Discharge container

It is preferable to provide or specify certain discharge containers. Reusable and low-priced container shown as below can be options.



Plastic bags



Nylon sack



Carton box



Plastic-made bucket



Wheelie bins (businesses)

Wheelie bins will be useful for large recyclable dischargers such as hotels and restraints.

In case of sack, it should be provided once but residents can buy it at 50c each from council's collection truck on the collection day if they lost it.

Provision of special container such as "3R"-printed sack, will be useful with the following functions;

- ✓ Reminder to people of the service
- ✓ Separate bin
- ✓ Keeping/Storage of recyclables until the collection day
- ✓ Discharge container
- ✓ Indicator that makes collectors distinguish recyclables from garbage



Discharged recyclables beside garbage

3.1.3 Discharge time

Recyclable collection is very new concept for the people in Fiji. In order to avoid resident's confusion between recyclable collection and garbage collection, it is preferable to fix the discharge time as same as the garbage collection time (to be noted in the leaflet)

Ex) LCC, NTC

Discharge time: from 7:00 am

(same as garbage collection)

If you schedule recyclables collection day on the same day with garbage collection, the discharge time should be set before or after the garbage collection.

The discharge time should not be around the same time with the garbage collection as separated recyclables will be mixed with other garbage, and there is possibility that the workers of garbage collection will collect recyclables with garbage.



Recyclables discharged with
garbage

3.1.4 Discharge place

In order to avoid resident's confusion, it is preferable to fix the discharge place as same as the garbage collection time (to be noted in the leaflet)

Ex) LCC, NTC

Curb side

(same as garbage collection)



Recyclables discharged on curb side

⑩. Collection

For the collection system, you need to examine the following items.

- Frequency of collection / Collection day
- Collection time
- Implementation body
- Expansion plan
- Collection workers
- Collection truck

3.1.5 Frequency of collection / Collection day

Frequency is determined based on the amount of recyclables collected and the efficiency of collection work. Taking the schedule of garbage collection into consideration, collection day and time should be determined. The following tables shows examples of LCC and NTC.

Table D-2: Collection day for garbage and recyclables (LCC case)

	Garbage collection day		Recyclables collection day	Weekly schedule					
	Mon	Thu	Wed	Mon	Tue	Wed	Thu	Fri	Sat
Household (A)	Mon	Thu	Wed	Mon	Tue	Wed	Thu	Fri	Sat
Household (B)	Tue	Fri	Mon	Mon	Tue	Wed	Thu	Fri	Sat
Household (C)	Wed	Sat	Fri	Mon	Tue	Wed	Thu	Fri	Sat
Businesses	Daily		Mon	Mon	Tue	Wed	Thu	Fri	Sat






 Recyclables collection day
 Garbage collection day

Table D-3: Collection day for garbage and recyclables (NTC case)

	Garbage collection day			Recyclables collection day	Weekly schedule					
	Mon	Wed	Fri	Wed	Mon	Tue	Wed	Thu	Fri	Sat
Household (A)	Mon	Wed	Fri	Wed	Mon	Tue	Wed	Thu	Fri	Sat
Household (B)	Tue	Thu	Sat	Thu	Mon	Tue	Wed	Thu	Fri	Sat
Businesses (A)	Daily (except Wed)			Wed	Mon	Tue	Wed	Thu	Fri	Sat
Businesses (B)	Daily (except Thu)			Thu	Mon	Tue	Wed	Thu	Fri	Sat

 The day which is no longer garbage collection day due to introduction of recyclables collection
 Recyclables collection day
 Garbage collection day

3.1.6 Collection time

It is preferable to fix the collection time as same as the garbage collection time (to be noted in the leaflet)

Ex) LCC, NTC




Collection time: 7:00 am to 1:00pm

(same as garbage collection)

3.1.7 Implementation body

There are three (3) options;

Table D-4: Implementation body for collection work

Option	(1) Garbage contractor	(2) Council's truck	(3) Recycling company
			
Example	Introduced by NTC	Introduced by LCC	Introduced by NTC and LCC during 3R pilot project
Cost	High (It can be saved by reducing of the frequency of garbage collection)	Middle (Maintenance cost for collection truck should be considered)	Low (Need continuous negotiation with recycling company)
Reliability	High (Implemented according to the agreement /contract)	Low (Need allocation of specific staffs and truck for collection at the fixed time)	Middle (It seems difficult to implement on the fixed schedule as the companies prioritize their own business)

3.1.8 Expansion plan

It will take time for residents to become accustomed to waste separation, so council needs to conduct continuous awareness activities steadily. Capacity of council such as available human resources should be also taken into consideration.

For this reason, the target area for separate collection of recyclables shall be expanded gradually. The table below shows the expansion plan for example.



House-to-house explanation by council staff

Stage	Period	Target area	Target resident population
Stage 1	Apr. 2009 -	3R pilot project area (Matavolivoli, Namaka)	914 (10%)
Stage 2	Jul. 2010 -	Matavolivoli, Savunawai, Waqadra Cooperative, All schools, All commercial area	2,000 (20%)
Stage 3	Dec. 2010 -	Whole Namaka Ward	7,000 (60%)
Stage 4	Mar. 2011 -	Whole Martintar Ward	11,580 (90.9%)
Stage 5	Sep. 2011 -	Town Ward (residential only)	12,080 (95%)

Table D-5: Expansion plan (NTC)

3.1.9 Collection workers

One (1) driver and Two (2) workers for collection are needed at least.



Collection work

3.1.10 Collection truck

Recyclables items have large density and are bulky relatively.

Compacter truck is one of options to use for the efficient collection, however, some recyclables like metals and glasses are not suitable for compaction device.

Open truck with multi-purpose use as shown below is the most appropriate as collection truck for recyclable items. Recyclables can be also sorted out on the truck.

Truck may have built in melody or music which can be played via sound system to remind or signal to residents of recyclable collection day.



Multi-purpose truck
(attached with speaker)



Pick-up truck



Sorting on the truck

①. Sorting

Collected recyclables should be segregated by waste type. You need to examine the following items.

- Implementation body

- Estimated amount of recyclables to be collected
- Sorting place
- Sales of recyclables

3.1.11 Implementation body

Sorting will take time and be costly. Therefore, it is preferable to let recycling company do sorting as much as possible. It saves council from sorting work, and will be much quicker as they have technical know-how for sorting.

However, sorting work will become time-consuming more and more according to the target area expanded as the amount of collected recyclables will be increased. In case of NTC and LCC, councils were requested to dispatch a worker to assist in sorting work after recyclables collection upon the request from recycling company, which is Waste Recycler (Fiji) Ltd.



Sorting work by recycling company staff and council worker

3.1.12 Estimated amount of recyclables to be collected

In order to secure necessary capacity of collection truck, space for storage of recyclables and human resources, it is necessary to estimate the amount of recyclables to be collected based on the developed expansion plan. For estimation, participation rate within the target residential area can be expected to exceed 30%, which is calculated based on experiences of LCC and NTC.

	Pilot project	Stage 2	Stage 3	Stage 5
Target area (population)	Matavolivoli (914)	Matavolivoli, Savunawai, Waqadra Cooperative, All schools, All commercial area (3,000)	Whole Namaka Ward (6,500)	Whole Town Ward (12,700)
Average amount of recyclables per collection day	-	0.46 ton/2weeks	1.00 ton /2weeks	1.96 ton /2weeks
	72.71kg/week	230 kg/week	500 kg/week	1,000 kg/week
Average amount of recyclables per day (kg/day)	10.39 kg/day	32.86 kg/day	71.43 kg/day	140 kg/day

Table D-6: Estimated amount of recyclable to be collected (NTC)

* The above figures are estimated based on the actual amount of recyclable discharged which was gained during the pilot project: 154 g/2weeks/person.

3.1.13 Sorting place

It should be considered depending on the capacity of sorting facility and the estimated amount of recyclables to be collected.



Sorting work at recycler's depot

3.1.14 Sales of recyclables

Sales of recyclables are basically paid from the recycling company to councils directly (should be negotiated)

In order to motivate community initiative in implementing recycling activity, profits can be paid to the community. In this case, the amount of collected recyclables should be recorded separately with other area.



Profit was paid to the Matavolivoli 3R Promotion Committee

4 Prepare for awareness materials

The following awareness materials will be needed.

① Leaflet

Based on the above designed system, a leaflet needs to be prepared to guide people by showing the details of the separate collection system of recyclables.

Illustrations and photos should be used as much as possible, so that leaflets could clearly show the target item for recycling and instructions on how to sort, store and discharge.

Frequency of collection, Discharge manner, etc

Process of recycling

Target recyclable items

Calendar shows collection day by area

② Discharge container (in case of nylon sack)

The following nylon sack is prepared for recyclable collection. The household number will be written on the sack manually when distributed.



Original nylon sack



Printing
using frame



Printed nylon sack

③ Sticker (showing collection day, will be useful for businesses)



5 Conduct awareness activity

⑫. Door-to-door visits

A door-to-door visit is very effective way to deliver council's message to the people. Preferable implementation bodies for a door-to-door visit for residential and commercial areas are as follows;

- Residential area: "3R Promoters" (see the next page) under the supervision of the council staff
- Commercial area: Council staffs



Household visit by council staff



Business visit by council staff



Training for 3R promoters



Household visit by 3R promoter

⑬. Community meeting

Community meeting should be organized just after the door-to-door visits. Invitation leaflet can be distributed during the door-to-door visits. The date and venue of the meeting should be decided by organizing the preliminary meeting with community representatives.

- Residential area: to be conducted by area unit
- Commercial area: to be discussed with the Chamber of Commerce



Meeting with community representatives



Community meeting for residential area



Community meeting for commercial area

Column – 3R Promotion committee and 3R Promoter

It is recommended to promote community to establish 3R Promotion committee on the community's initiative. 3R activities in the area can be monitored by the committee members.

Ex) Matavolivoli 3R Promotion Committee

In case of NTC, the 3R Promotion Committee was voluntarily established by Matavolivoli community representatives to promote 3R in the community through the

community meeting which was held in Aug 2009.

Committee has been working actively. 3R activities like recyclables collection and home composting were monitored by the committee members on site, and the monitoring results were shared with the council during the regular committee meeting which was organized on weekly basis, and they discussed for further improvement.

Selected by community



Community meeting



3R Committee



ID card



Recyclables collection



Regular Committee meeting



Home composting

Furthermore, as a part of wrap-up activity of the pilot project, a clean-up campaign was conducted several times on the Matavolivoli 3R Committee's initiative. More than 50 kids turned up for the clean-up, and picked up rubbish under the committee's supervision.



Clean up activity organized by the Matavolivoli 3R Committee

Committee also assisted the council as 3R Promoter for door-to-door visits and community meetings to share their experiences among communities.



Door-to-door visits by 3R Committee



Sharing 3R experiences through community meeting

As mentioned above, 3R Committee and Promoter have performed essential functions for 3R promotion in the area. They are also very useful to make up for the limited human resources most council has faced.

6 Implement area by area

⑭. Announcement

Announcement conducted during collection work is very useful to remind people to discharge recyclables on the collection day. Message for announcement should be modified based on the system changed.

[Example of announcement]

Attention please. This is a special announcement from ○○○ Council. Today is the recyclables collection day. We are collecting metal, glass bottles, plastics, PET bottles, papers and cartons (*Target items*). These items should be clean and dry. So please put all in nylon sack which was distributed by council or any container and discharge on the curb side by 9 am.

It is preferable to make an agreement on the installation of sound system when collection work is contracted out to the private company.



Announcement by council staff using hailer



Installed sound system on collection truck

⑮. Collection

Collection work should be started on designated time. The sufficient number of bag (1mx1mx1m) for storage of recyclables should be taken in on the truck. Announcement should be started just after the collection truck arrived at target area. Truck should be driven as slow as possible as most of residents may discharge their recyclables when the collection truck is approaching to their house.



Sacks for storage of recyclables



A resident discharging recyclables when the collection truck arrived at her home.

7 Conduct regular monitoring for recyclables being discharged

Monitoring is the most important process for successful recyclables collection. It should be conducted during the collection work for the first two months at least after the introduction of recyclables collection system. It will take time for people to adjust to the new system, so need to remind them the proper discharge manner. Council staff or community representatives (ideally, 3R Promoters) need to accompany the collection work, and monitor the following points;

	Items	How to do?
1	Participation rate	The number of households by division area to be counted using hand counter by council staff or collection worker.
2	Discharge manner	Collection worker refuses the mixed non recyclables and dirty recyclables. Necessary advice to be given for residents or businesses who discharged in inappropriate manner on site directly. If they are not on site, notice to be given instead. Do encourage them to keep discharging at the same time.
3	Issues	Issues related to the current discharge and collection system should be recorded for further improvement
4	Amount of recyclables collected by type	To be recorded at recycler's depot.

Table D-6: Items to be monitored

Examples of monitoring results are as shown below.

1) Participation rate

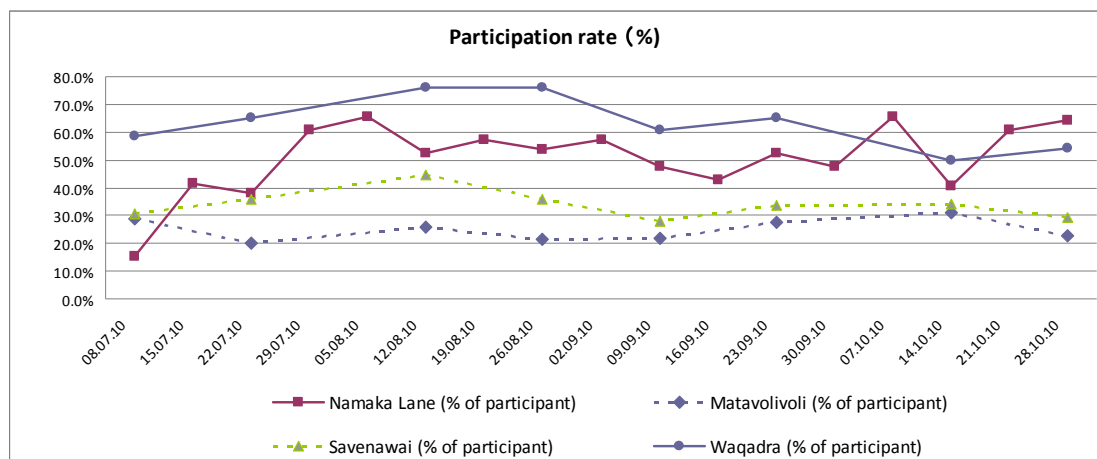


Figure D-2: Participation rate (NTC)

2) Discharge manner and Issues



Discharged recyclables
(household)



Discharged recyclables (businesses)



Recyclables discharged in
proper manner



Recyclables discharged in improper manner
(these are not collected)



Checking the quality of
recyclables



Advise given by council staff



Recording on monitorin sheet



Recording the amount of
recyclables collected by type

3) Composition of recyclables collected

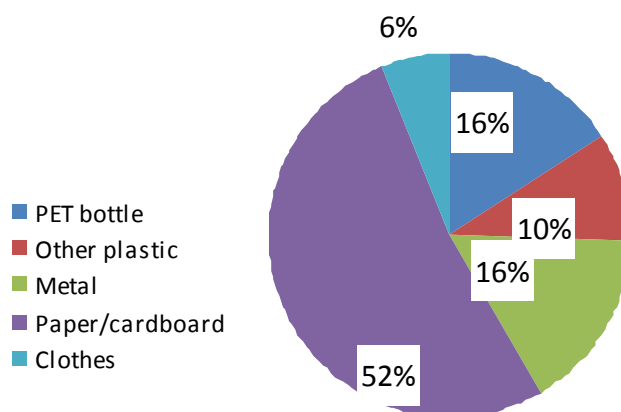


Figure D-2: Composition of recyclables collected

8 Unit cost estimation

Table D-7 shows an example of the cost required for separate collection for recyclables.

Table D-7: Cost required for separate collection for recyclables (LCC)

Items	Unit	Step1 2009 September	Step2 2010 Jul.-Dec.	Step3 2011 Mar-Sep
(1) Working Condition				
a. Collection amount	kg	66.0	3651.0	8298.0
b. Collection time include traveling time etc.	hr.	1.47	33.7	115
c. Running kilometer of collection truck (depot-collection area+collection area+collection area-recycler-depot)	km	10	290	780
d. Fuel consumption	km/l	5	5	5
e. Collection crew				
ea. Driver	person	1	1	1
eb. Worker	person	2	2	2
(2) Unit cost				
f. Labor cost				
fa. Driver:	\$/hr.	3	3	3
fb. Worker:	\$	3	3	3
g. Unit cost for Fuel	\$/l	1.97	1.97	1.97
(3) Cost estimation				
h. Labor cost ((ea)x(fa)+(eb)x(fb))xbx1000/a	\$/ton	200.45	83.07	124.73
i. Fuel cost (c/dxg)	\$/ton	59.7	31.3	37.04
j. Maintenance cost for MPT: 5% of cost of fuel ix0.05	\$/ton	2.99	1.57	1.85
k. Total cost for collection and sorting work (h+i+j)	\$/ton	263.14	115.94	163.62
Note;				
- Unit cost of garbage collection (174,000/(16x 365)	29.79			
- Original collection work was done not only collection also sorting of recyclables discharged from households on the collection truck.				
- However, collection and sorting work have been divided to improve the working efficiency from 2010.				
- Running kilometer of collection truck				
Depot-Field 40-Recycler-Depot	31km			
Depot-CDB-Recycler-Depot	6km			
Depot-Namoli-Recycler-Depot	5km			
Monday collection rout	20km			
Wednesday collection rout	25km			
Friday collection rout	30km			

Annex for Separate collection for recyclables

- a. Leaflet “Separate Collection Service for Recyclables”
- b. Poster (excluded in the manual)



Health Department
Lautoka City Council
P.O.Box 124, Lautoka
Phone: 666 0433, 702 8553, 702 8559

Notice from Lautoka City Council

Separate Collection Service of Recyclables

Lautoka City Council will start separate collection service of recyclables for the whole of Veitari Ward from February 28, 2011. Please separate recyclables shown in the yellow box and discharge them according to the instructions summarized below.

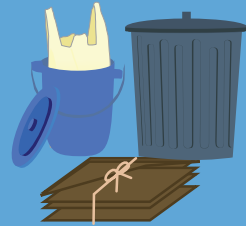
Frequency: Twice a month

Please refer to calendar below

AREA	DAY
Namoli, Natabua Seaside, Navutu, CBD Residential	: 2nd and 4th Monday
New Field 40, Field 40, Rifle Range	: 2nd and 4th Friday
Natabua, FSC, Balawa	: 2nd and 4th Wednesday

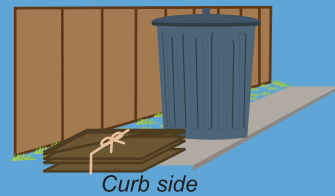
How to store

Please keep recyclables **in a nylon bag** distributed to your house or any type of **plastic bags** or containers. Bulky cardboards should be **flattened and tied**.



How to discharge

Place your container on the curb side by 7 a.m. **Do not discharge cartons on a rainy day.**



Curb side



Why separate collection?



Because ...

We can decrease the amount of waste which is disposed of at the Vunato landfill site.

We can improve our environment.



Stop Open Burning!



Flow of Separate Collection of Recyclables

Recyclable Items

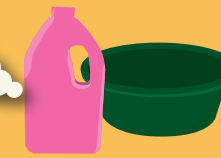
PET Bottles Plastic Bags

Rinse with water. Remove caps.



Hard Plastics

Must be washed. Remove caps & lids.



Glass Bottles & Jars

Rinse with water. Remove caps.



Metal: Any kinds of metal such as brass, copper and iron, but small size items



Food Cans must be washed and free from food residue!

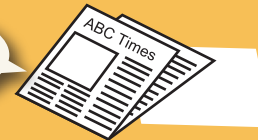
Old Clothes

Must be dry and clean.



Paper: Newspaper, Office Paper, Magazines

No dirty paper. Pack papers in plastic bags



Cardboard

Unfold and flatten. If it's bulky, tie with a string.

Must be dry and clean. Fish/meat cartons are not accepted.



All the items should be clean! If they are too dirty to clean like oil bottles etc, **please discharge them with your normal garbage.**

NON RECYCLABLES

Note: Liquid Milk packets, egg crates, noodle packets, snack packets for (Bongo, Twisties, UFOs), styrofoam, shoes and bags, cigarette packets etc **cannot be recycled**, so please discharge these items with your normal garbage.

Calendar 2011

February	March	April	May	June	July	August
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
September	October	November	December	Collection day of recyclables		
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	<p>■ : Namoli, Natabua Seaside, Navutu (inclusive of Navutu, Nasoata, Nasinu), Navutu Heights, CBD Residential Area.</p> <p>■ : Natabua (Stage 1 & 2), Balawa Area, FSC Compound</p> <p>■ : Field 40, New Field 40 Subdivision, Rifle Range Area</p>		



3R Promotion Project



What can we recycle?

yes



No X

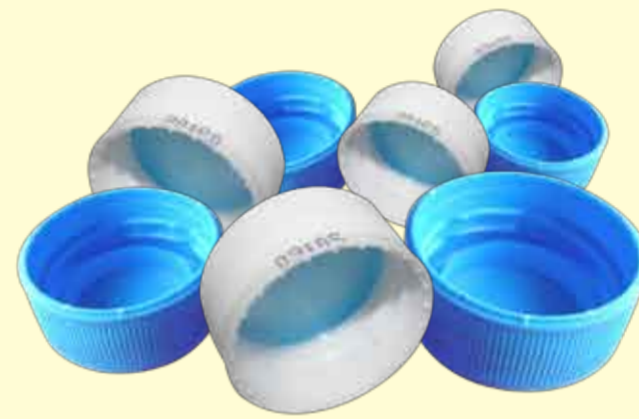


PET and plastic bottles



Paper newspaper, office paper, magazines)

Caps of bottles



Liquid milk cartons

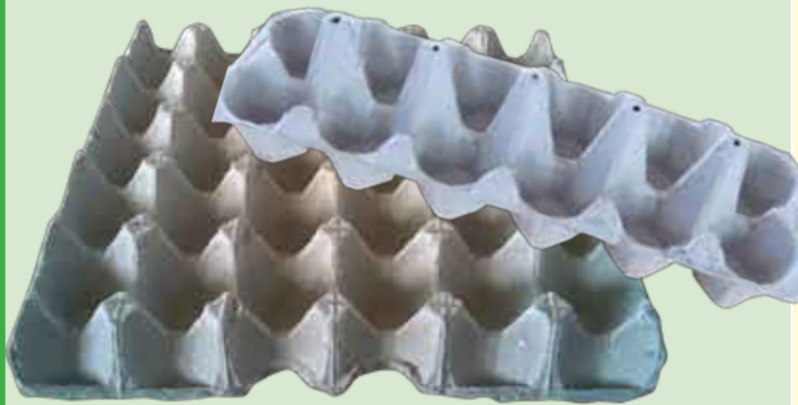


Cardboard



Metal and food tins

Egg crates



Dirty boxes/ cartons with meat residue



Brass, copper, iron



Old clothes

Noodles, snack packets



Oily plastics



Hard plastics e.g ice-cream containers)



Glass bottles



Ceramic ware



Styrofoams



Clean oil and ghee bottles



Plastic bags

Shoes and Bags



Cigarette packets



3R Promotion Activity (2)

Separate Collection of Recyclables



3R Promotion Activity (Common) **Community -based 3R Promotion** Mataivolivoli 3R Promotion Committee/3R Promoter

Outline of Mataivolivoli settlement

- **Location:** located in the north of nadi
- **Population:** 155 households(2009), 100% Fiji community
- **History:** Came in the boundary of the Nadi Town Council in 2001
- **Project:** Selected as a 3R Pilot Project site for Nadi Town Council



community meeting during
3R Pilot Project



3R Committee was established
on the community's initiative



Main activities done by 3R Committee



3RPP Launching organized by NTC
in cooperation with Committee



(Recyclables collection)

3R activities monitored by NTC in cooperation with Committee



(Home composting)



Regular committee meeting
(sharing the result of monitoring,
Discussion for counter-measures)



Clean-up organized by Committee



(House to house visit)

Sharing their experiences among other communities



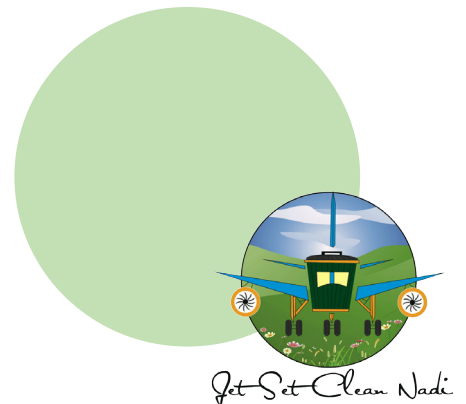
(Community meeting area by area)

Guide for

CLEAN SCHOOL PROGRAM

[3rd edition]

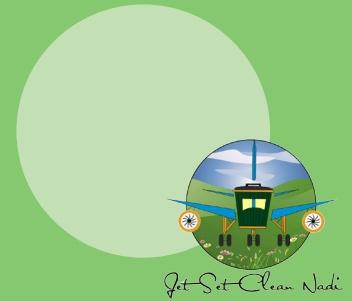
Nadi Town Council



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Background information



As the development proceeds and our life style becomes modern and convenient, natural environment has been threatened with air pollution, water pollution, dead corals, deforestation and clearing of mangroves, which are the issues of whole country and the world. Nadi, developed as a tourism town, also has big impacts of the issues since tourism is based on natural and clean environment as an important resource to attract tourists.

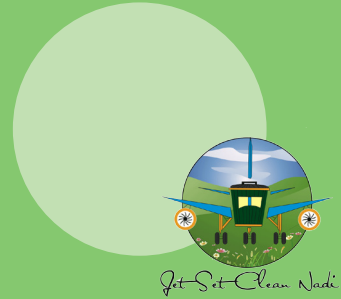
Among various environmental issues the main problem our town is now facing is the big amount of waste discharged from business and households every day. It is said that the amount of waste will soon exceed the limit of our dumpsite. The cost for waste management also bears severely on the council budget, which accounts for 30% of all budget including all cleansing services.

Under this situation, Nadi Town Council started Waste Minimization and Recycling Promotion Project in October 2008 in partnership with JICA, Lautoka City Council and Department of Environment. According to the survey conducted in the project, each person in Nadi generates 1.9kg of waste every day, and the amount is expected to increase in future. The dump site that takes the waste as a final disposal site will overflow if we continue to discharge the same amount, but it is difficult to find suitable place for a dump and it costs a lot to construct a new disposal site with necessary facilities and management system. It is very important especially for Nadi which does not have its own dump site and depend on Vunato Dump in Lautoka, to decrease the volume of waste to tackle the issue. The pilot project for separate collection of recyclables, home composting and green waste collection was conducted in Matavolivoli of Namaka Ward from September 2009, and the project has been expanded to whole area of Nadi Town Boundary.

With establishment of effective system for waste minimization, we need to promote education and awareness raising for the people at the same time. Schools will take a core role on this point since the children, who develop our future based on their learning at school, can also pass on these ideas from schools to home and communities.

The guide of the first edition was developed for Clean School Program 2010-2011 to help schools start the first step for 3R practices, and revised this time with good experiences and lessons learnt from 2010 program within Nadi town and Lautoka city schools as the key points shown in the guide. The guide is expected to be a reference book for the schools in Nadi/ Lautoka for better practices and improvement, and also for other schools interested in implementing this program using the experience of Nadi and Lautoka.

Aim



Clean School Program was organized to introduce **3R centric system to schools** with the following objectives.

- 1) To give the opportunity for schools to start proper waste management
- 2) To target children in creating awareness on the concept of waste minimization at schools, home and communities

What is 3R?

3R - standing for Reduce, Reuse and Recycle, is the concept for the actions to minimize waste.

Reduce:

To prevent or reduce waste generation at source by buying fewer items or longer lasting products etc.

Reuse:

To extend the life cycle of an item by using it again or in another way

Recycle:

To reprocess used materials in order to produce new products

Priority
of
3R

**REDUCE, REUSE, and
lastly RECYCLE**

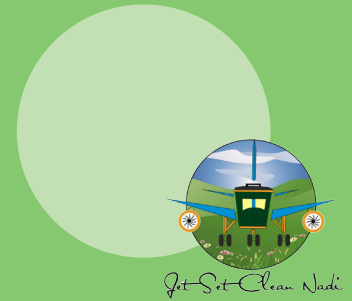
Among 3R, it is most important to “Reduce” the items we consume, not to generate waste. Then we can think of “Reuse” before throwing waste. Last means will be “Recycle” to reduce the waste going to landfill. We should remember that the process of recycling still needs energy and cost.

Concept of 3R centric system at school

There should be a well constructed system and mind to practice 3R at school as shown below.

- There are rules and opportunities to minimize waste discharged from school
- Proper way of waste disposal is known and practiced
- Teachers, students, board members and ideally parents and communities are working together
- Both theoretical and practical education is carried out

Management methods: “3R Committee”



For smooth waste management at school, the very first step could be to establish a “3R Committee” (The name of the committee may vary in each school). This will encourage schools to participate and claim ownership of waste problems. Schools are advised to elect the committee if one does not already exist.

To keep broad debate and democratic decision-making, the committee should include equality in numbers in the following areas:

- Teachers and students
- Women, men, boys and girls
- Representation of all ethnic groups

In order to make the committee work effectively, it will be important to:

- Develop and share overall goals to be achieved.
- Have regular meetings
- Have good communication between the committee and the rest of the school
- Involve parents and communities in the activities
- Ensure all committee members take specific tasks

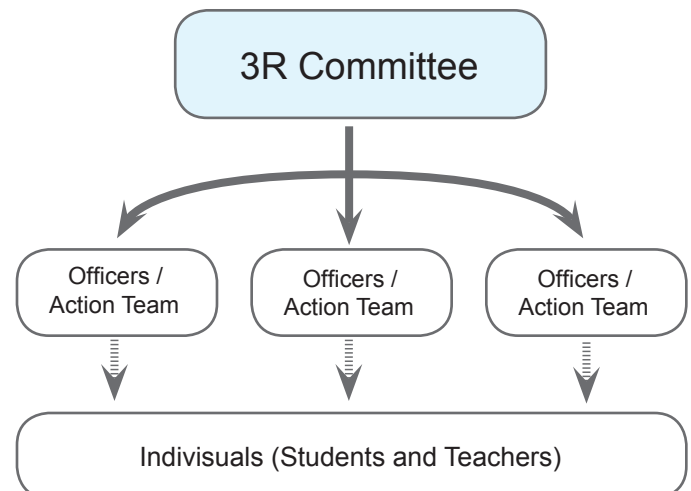
Then schools will need to select officers / form action teams to carry out the activities at classroom level. The officers / action teams might be developed in all classes to make the rules and activities known to everybody in the school. They can be also combined with existing student groups.

Role of Committee (School Level):

- Decision making
- Communication to the rest of the school
- Communication to outside of the school (parents, communities, recyclers etc.)

Role of Officers / Action teams (Classroom Level):

- Communication to all the students and the teachers
- Carrying out the activities



Reference: Live & Learn “GREEN SCHOOLS Guide”

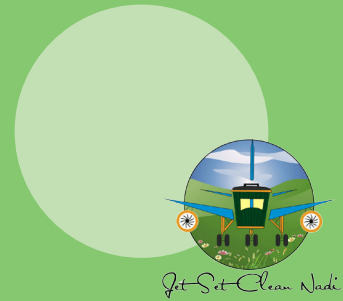
Key points

Some ways to let students feel proud of being committee members.

- Badges / ID cards
- Induction ceremony



Management methods: PDCA cycle



Why do we need to plan and monitor the activities?

In order to get from “problem-faced” to “problem-solved”, it is very important for you to manage the activity towards the problem and keep improving it.

PDCA Cycle is a useful check list of the four stages you can go through.

Plan: Find out the problems faced and make a plan for solving these problems

Do: Carry out the activities based on the plan

Check: Evaluate the result of the activities for solving the problems

Act: Improve the points which are not successful for achieving the goals

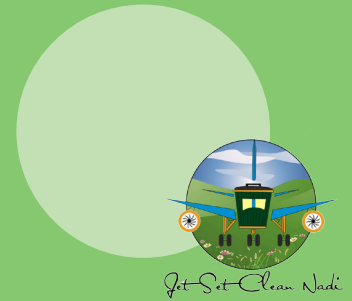


Importance of regular monitoring and supervision

It takes time to grasp and implement new practices. Teachers and 3R committee members need to give proper and clear instructions especially at early stage and monitor regularly. As one tries, the practices improve and become better.

If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. You can use what you learned to plan new improvements, beginning the cycle again.

Management methods: **Action plan**



As a start of the program schools can develop “Action plan” of the year since written and clear plan will help schools to proceed the activities smoothly. You can make the action plan with the following steps.

1. Brainstorm the problems about waste issues the school is now facing. (Check sheet in Annex of this guide can be used to help the school grasp the present situation)



2. Discuss and identify the main problems of the school.



3. Set the goals to achieve, which will be the situation to realize the solution of the main problems.



4. Plan the activities to achieve the goals. The plan should include the content (What), the process (How), the person or group in charge (Who), the time frame (When) and the cost (How much).



5. Fill in “Action plan” sheet (Annex of this guide).

Action plan should be renewed regularly according to the results and lessons of the practices carried out, which is a part of “PDCA cycle”.

Practices:

[Component 1]

Environmental Awareness Raising



Introduction

Schools have an important role of educating children with right concept of achieving healthy and sustainable environment. Component 1 shows the examples of what schools can plan and carry out for educational activities, which will contribute to raising awareness.

Practice examples

“Reduce” in 3R

- Promotion of cloth bags instead of plastic bags
- Practice of both side printing and writing
- Discussion on what we can do in shops to reduce waste (buying only necessary items, choosing less wrapped products, getting long lasting items etc.)



FUROSHIKI -Cloth bag

“Reuse” in 3R

- Reuse of pet bottles, cans, containers and cardboard boxes for another purpose
- Introduce reusable cups and plates at canteen
- Letting students and parents bring their own cups and plates in school functions to avoid the use of disposable paper plates and plastic cups
- Reuse of envelopes
- Rubbish art and craft



Rubbish art & craft

Compound beautification

- Clean-up activities
- Nurseries and gardening



Reused PET bottle for pot plant

Classroom programs

- Learning about danger of waste
- Drawing pictures about environment
- Playing dramas / songs related to environment

Outside programs

- Site visit of dump site
- Survey of littering in town
- Participation in other organization's programs
- Social activities

Whole school programs

- Poster competition
- Speech competition
- Environmental practices competition among classes

Key points

- Activities to give “experience”

For environmental education, it is important for students to actually see, do and experience something rather than just to listen for deep understanding. Choose the activities that involve some practical actions, which can build their interest and is fun as well.

- Showing outcome of activities

Students will be happy and motivated if their results of activities are shown to others. There are many ways such as displaying rubbish crafts on corridor or presenting in school assemblies.

- Background knowledge

When you carry out activities, it is advisable to introduce relevant waste issues together for better understanding and further interest of students.



PET bottles Christmas tree
(Photo: Atsuki Takeda & Yasuko Onoue in Samoa)



Dump visit by school

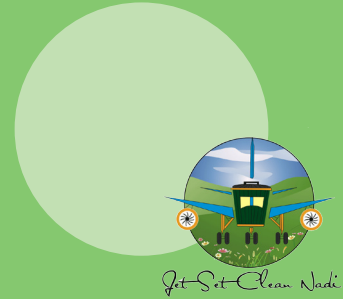


PET bottle chains for fencing in compound



Rubbish art displayed for visitors

[Component 2] School Composting



Introduction

What is composting?

Composting is a natural process through which organic materials are converted into a soil like product called humus.

Benefits of composting at school

Composting at schools:

- Is a fun way to learn about nature while also reducing the amount of organic waste. An added bonus is that students can actually get to see the end result of their finished compost being used to beautify their school's compound.
- Supplies needed nutrients and improves the soil structure of your school gardening etc. which is better than using chemical fertilizers and pesticides.
- Reduces the need for landfill disposal and cut down on garbage collection, decreasing municipality's waste management cost.
- Eliminates the need for burning in incinerators.

Steps to follow

STEP1: Decide which (if any) compost containers to use

There are some ways you can go.

1) Wooden timbers

By using wooden timbers, make a square frame for compost.
(Try to get waste timbers if possible)

GOOD

- Keeps compost moist (retains moisture)
- Easy to compact the compost to make it hard for fermentation
- Looks presentable as a compost

BAD

- May rot / decay overtime
- Turning can be difficult if height is high



2) Open Ground

Dig a hole for a few inches and pile organics to make compost.
(Do not dig deep since it might retain water)

GOOD - Easy to pile the greens and maintain

BAD - Tends to be too dry
- Can be easily mixed with other waste



3) Compost Bins

Use a plastic or drum composter to make.

GOOD

- Faster decomposition / fermentation
- Easy to use and maintain
- Reusable

BAD

- Costly
- Small for the greens discharged from schools
(Suitable for kitchen waste composting)



STEP 2: Locate compost

Decide where to compost, ideally on soil or grass to allow worms and minibeasts to get in.

- Preferably a site which receives good share of shade and sun. Site exposed directly to the sun may result in loss of much needed moisture and decomposition might not progress well.
- Also think about the issues of access to the compost by the members of school.
- Good to have it near to the garden.

STEP 3: Build the pile

Prepare organic materials and start piling up.

**Wet greens
(high in nitrogen)**

Fruit and vegetable
peelings / Grass cuttings /
Plants and flowers



**Dry browns
(high in carbon)**

Leaves, straw and
woody materials / Soil

- 1) Begin with a layer of brown - a base of leaves and woody materials (help circulate air.)
- 2) Then add a layer of greens.
- 3) Always finish with a layer of brown on top

Top Tip

- Organic materials (tree / flower pruning, vegetables and fruits) to be cut into smaller pieces for faster and better results
- No leftover food (cooked food) to be put in compost

STEP 4 : Keep adding materials**STEP 5 : Maintain your pile**

- For your compost pile to work efficiently, it must be damp and aerated (for micro-organisms to do their work of decomposition)
- Your pile should be damp, about as wet as a wrung-out sponge.
- If it's too dry add water to it.
- You can cover compost with plastic sheet to keep moisture (if it is open compost).
- Compaction by students pressing with the foot will help for quick fermentation.
- If it's too wet or it smells, add browns (browns will soak up the excess liquid).
- Mixing or turning the compost pile every 2 to 3 weeks will add air to the pile.



Do you have problems to maintain compost pile?
Check the solutions below.

Problems	Solutions
? What should I do if I notice foul odor/smell, maggots, other insects or excess moisture in the compost?	<ul style="list-style-type: none"> - Sprinkle a layer of soil or Bokashi if available on the surface. - Add dry grass or fallen leaves or wood chips. - Stir the pile to introduce air into the compost pile.
? What should I do when it rains?	<ul style="list-style-type: none"> - Ensure that the location has good drainage to prevent water getting into the composter. - Cover with plastic sheet / the lid at all times. - Add dry grass and soil to control moisture and maggots.
? How can I judge composting is finished?	<ul style="list-style-type: none"> - Pile has developed a dark brown color. - Earthly smell. - Very little evidence of original yard trimmings or organic waste that was added to the pile. - Moist pile remains cool and does not become warmer after turning.



Compost ready for use

NOTE : Compost can be produced in as little as 3 months however it can take longer depending on how you maintain your heap

STEP 6 : Use compost

- Leave in exposed area for at least a week to let dry properly. Turn pile whilst drying/storing.
- Add to your school's garden to improve soil fertility and act as soil conditioner.
- Can be used as base material before planting vegetables or flowers.
- Can be used as potting mix.
- Remember to keep a small portion and add to the new compost pile as the need arises to help eliminate foul odor, maggots, moisture.



Garden with compost near classrooms

Key points

- Accessible location

Compost should be installed at the place where the students and teachers can easily go and see. If not, the compost might not be looked after well or be misused as a dump.

- Attractive sign and look

It is important to make the compost look nice and neat to get students' interest and cooperation.

- Minimum two composts

While one compost is on the process of fermentation to be ready for use, new organic materials should not be added. It is best to have two or more composts so the school can keep making compost for sustainable practice.



Compost with a big signboard



Compost of each class



Introduction

Why do we need to separate and recycle rubbish?

All the things we produce and use are made from natural resources, which are limited on the earth. We should make full use of the resources, from sustainable point of view, by using the items again and again (Reuse) and by using them as materials for other products (Recycle). It is important to reduce the amount of waste going to the landfill as well, in order to lengthen the lifespan of the landfill and reduce the financial burden for municipalities.

Benefits of rubbish separation and recycling at school

Rubbish separation and recycling activities at school will :

- Contribute to sustainable waste management and healthy environment.
- Promote practical learning and experience for students on waste issues.
- Help disseminate the idea of 3R to homes and communities

Steps to follow

Step1: Survey

Identify the types of waste discharged from your school.

- Check sheet in Annex of this guide can be used to find the type of waste.

Step 2: Decide recycling items and the number of separation

Decide the items to be recycled and find the types of waste to be separated.

Recycling items can be:

PET bottles / Hard plastics / Food tin cans / Aluminum & steel cans, spray cans / Metals (brass, copper, iron) / Office papers / Newspapers, magazines and books / Cardboards / Cloths
=The items Waste Recyclers can collect



Points
for
Recycling

Establish the way that is simple and effective

- Start with easy number of recyclables (ex. pet bottles and office papers)
- Consider the amount of waste (Major type of waste can be effectively recycled)

Points
for
Separation

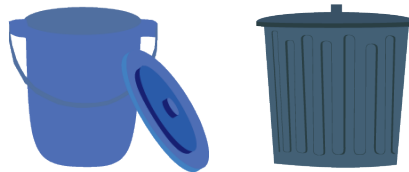
The number of recyclables is not always the number of separation

- Other rubbish than recyclables can still be separated to be disposed properly (ex. metals and papers should be separated and not burned together to avoid release of harmful toxins into the air)

Step 3: Prepare separate bins and raise awareness

Enforce separate bins in each classroom and in the compound, and announce the rules of separation to whole school so that everybody knows the discharging manner.

- Old cardboard boxes or containers can be used for bins (means REUSE in 3Rs)
- Bins can be decorated and marked with signs or pictures of items to be thrown (can be a good classroom activity)
- Chart or posters about discharging rules will be effective



Step 4: Storage and recycling (recyclables)

Choose suitable discharging area for storing recyclables and store them in a big sack until they are collected by recyclers. Contact recyclers for the items to be collected.

- Bulk or yard for storage
- Better to be protected from rain (ex. under the big tree, roof)
- Easy access by students (for proper management by students)
- Easy access by recyclers to load recyclables to their truck
- Form the action teams in charge of carrying rubbish to storage / disposal area
- Large nylon sacks can be provided by recyclers
- Discuss with recyclers to decide the frequency and date to collect recyclables (ex. once a month)

Recyclables should be kept dry and clean

Contact
of
Recyclers

Waste Recyclers Fiji Ltd. : 6668795

Coca-Cola Amatil Fiji Ltd. (Lautoka) : 6661188

Fiji Water : 6681364

Step 5: Proper disposal (non-recyclables)

Have proper storage and disposal ways for all non-recyclables.

- Green waste and kitchen waste (organics) to be composted
- Other waste than recyclables to be collected by the council
- No burning of rubbish
- No burying of rubbish

Why is burning rubbish not encouraged?

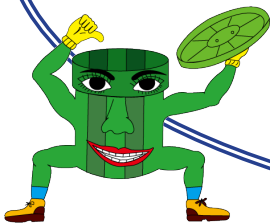
If you burn rubbish in your compound, it may

- Release harmful toxins.
- Cause emission of black smoke spreading ash around the area.
- Destroy beautification.
- Contribute to diseases.



Closed incinerator

**Let's try to achieve
"zero burning"**



Step 6: Monitoring

Form monitoring teams and check the proper operation of the system.

- Monitoring sheets are available in Annex.
- Identify ways to inform the students the result of monitoring (ex. morning assembly, classroom discussion)
- Amount of recyclables to be recorded when recyclers collect and weigh the items
- Cash to be properly managed if school gets it
- Use monitoring data in the notice or classroom discussion for further improvement and awareness raising

Monitoring is the key to keep the system working well

Key points

- Clear labels for separate bins

The biggest challenge for rubbish separation is to avoid mixing with other rubbish. Big clear labels that shows everybody the separation rules are helpful for implementation.

- Centralized storage area

The location of storage area for recyclables decides smooth recycling activity. It should be at a centralized place where prefects can easily access to empty the bins. That also helps appealing activity to whole school.

- Cost management

You may have a new cost for proper waste management such as rubbish bins or garbage bags for rubbish collection. Try to use old cardboard boxes for classroom bins, which will not cost any. Prepare some proper bins or nylon sacks for discharging rubbish rather than plastic bags, which needs only initial cost. School committee or local companies might support for those items.



Bins with big labels



Storage for recyclables

Advice for “Recyclables Collection Day” with parents and communities

It will be hard to collect many items for recycling at school, since schools have few types of waste and too many separation rules will confuse students. But you can think of having “Special Collection Day” for recycling - the occasion where parents and communities can get together at school.

Ask parents to keep the recyclables such as old cloths, newspapers, books, magazines and metals at home, not discharging them on garbage collection days. Then they can bring those recyclables to school on the day of parents day or some functions, and they can be collected by recyclers. Money made from recyclables is small but “Little and often fills the purse” - the gain may support to buy a ball or a book for students!



Annex

The following annex to the guide are available to help your school carry out the program. You can make use of them according to your necessity.

- Check sheet
- Action plan
- Monitoring sheet for Component 2: School Composting
- Monitoring sheet for Component 3: Rubbish Separation
- Monitoring sheet for Component 3: Recycling
- Photo showcase of good lessons and practices.

Cooperating schools:

(Pioneer Schools in 2010)

- Andrews Primary School
- Mount Saint Mary's Primary School
- Nadi Airport School
- Nadi Arya Samaj Primary School
- Nadi Centre for Special Education
- Nadi Christian Academy
- Nadi District School
- Nadi Muslim Primary School
- Nadi Primary School
- Nadi Sangam Primary School
- Namaka Public School
- Nadi College
- Nadi Muslim College
- Sangam Sadhu Kuppuswamy Memorial College (SSKMC)
- Ratu Navula College

Supporters:

- Ministry of Education
- Department of Environment
- JICA (Japan International Cooperation Agency)
- Lautoka City Council

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With contributions from:

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Kayo Sasaoka (JOCV 2011 - 2013 revised)

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Check sheet



Waste

- The school discharges waste
What type of waste are generated from your school?
 - Green waste (Leaves and branches)
 - Kitchen waste (Food, fruit skin, vegetable peelings)
 - Office papers
 - Other papers (books, magazines, newspapers, cardboards)
 - Plastic bottles
 - Other plastics (Containers, plastic bags, wrappings)
 - Aluminum cans
 - Steel cans and spray cans
 - Other metals (Food tin cans, brass, copper, iron)
 - Clothes
 - Bulky waste

- The waste discharged from the school is NOT collected by the council
How does your school deal with the waste?
 - Burned in incinerator / compound
 - Buried in compound
 - Piled up in compound

- Rubbish are NOT separated by type at the school
What is the problem on rubbish separation at your school?
 - Insufficient rubbish bins in classroom and compound
 - Mixed with the other type of waste
 - No recycling system
 - Not all recyclables are recycled

- The school can find littering with rubbish in compound
Which situation : applies to your school ?
 - Insufficient rubbish bins in classroom and compound
 - No clean-up time by students

Management

- The school does NOT manage waste issues well
Which situation : applies to your school ?
 - No environmental committee
 - Not involving students, teachers, cleaning staff, parents or communities
 - No regular meetings about waste issue
 - No effective way to transmit the issues to students

Education

- The school does NOT have effective ways to educate students about waste issues
Which situation : applies to your school?
 - No notice by principal or head teacher
 - No talk by teachers in classroom
 - No educational program in and out of classroom



Action plan

(Year _____)



School	
Contact person	
TEL	

Main problems in our school

--

Plan for 3R Committee

Role, number and structure of committee members, frequency of regular meeting etc.
--

Component 1: Environmental Awareness Raising

Goals to achieve
Actions

Component 2: School Composting

Goals to achieve
Actions

Component 3: Rubbish Separation & Recycling

Goals to achieve
Actions

Budget (If necessary)

Division	Items	Price
Total		



Monitoring Sheet for School Composting (EXAMPLE OF MONITORING SHEET)



Name of the School
Date composting started
Monitoring Date / Time
Weather condition
Person in charge : Teachers
Students

Points to be monitored		
1	Frequency of disposal of organic waste	
2	Volume of organic waste	
3	Turning of the pile (How often)	
4	Moisture level	
5	Temperature	
6	Smell	
7	Presence of maggots	
8	Presence of insects and flies	
9	Mixing with other waste	
10	General appearance of compost	

Any other comments / remarks



Monitoring Sheet for Rubbish Separation (EXAMPLE OF MONITORING SHEET)



Name of the School	
Classroom	
Monitoring Day	Date / Time
Person in charge :	

Mixing

PET bottle	Good (Not Mixing)	1	2	3	Bad (Mixing)
Other plastic	Good (Not Mixing)	1	2	3	Bad (Mixing)
Metal	Good (Not Mixing)	1	2	3	Bad (Mixing)
Paper	Good (Not Mixing)	1	2	3	Bad (Mixing)
Cardboard	Good (Not Mixing)	1	2	3	Bad (Mixing)
Clothes	Good (Not Mixing)	1	2	3	Bad (Mixing)

Cleanliness

PET bottle	Good (clean)	1	2	3	Bad (Dirty)
Other plastic	Good (clean)	1	2	3	Bad (Dirty)
Metal	Good (clean)	1	2	3	Bad (Dirty)
Paper	Good (clean and dry)	1	2	3	Bad (dirty and wet)
Cardboard	Good (clean and dry)	1	2	3	Bad (dirty and wet)
Clothes	Good (clean and dry)	1	2	3	Bad (dirty and wet)

*Change the name of items according to your school's rule for rubbish separation



Monitoring Sheet for Recycling (EXAMPLE OF MONITORING SHEET)



Name of the School	
Collection Day	Date / Time
Person in charge : Recycling Company	
Teachers	
Students	

Recyclables		Amount (Kg)	Profit (F\$)
Plastic	PET bottle		
	PPP		
	sub-total		
Metal	Aluminium Cans		
	Steel		
	Copper		
	Brass		
	Stainless		
	Others		
	sub-total		
Paper	Office paper		
	Newspaper		
	Book, magazine,		
	sub-total		
Cardboard			
Clothes			
Recyclables Total			

*Change the name of items according to your school's rule for recycling

Division 1: Environmental Awareness Raising



Flower-like arrangement using egg shells



Display of rubbish arts & crafts



A bird made using scrap clothes



Classroom sign made of egg cartons



Picture of flower made with pencil sharpening



Musical instruments made from waste materials



Rubbish craft for decoration



Environmental awareness through fruit carving



Use of "my bag" for waste disposal



"Say 'No' to plastic bags and use cloth bags"



How to prepare - compost poster



Environmental awareness board



Pet bottle flower in the school yard



Garden decoration using pet bottles and mulching



Garden lined with pet bottles



Ex-incinerator used for farming vegetables



Colored pet bottle fencing



Planting in a pet bottle

Division 2: School Composting



Collection of organic waste at classrooms



Ex-incinerator used as a compost frame



Open compost with a clear sign



Timber frame compost arranged for easy turning



Signage ("Compost used in the garden")



Composter made of a used drum

Division 3: Rubbish Separation and Recycling



Rubbish separation – decoration of rubbish bins



Rubbish separation – labeling with examples



Rubbish separation – attractive labeling



Rubbish separation - attractive bins



Rubbish separation – Use of used oil containers



Color painting of the rubbish bin



Decorated storage box for waste paper



Recyclable storage supplied by Fiji Water



Recyclable storage with attractive signage



Closed incinerator- "Zero Burning"

Give us your ideas

Environmental Symbol & Slogan / Character

For NADI

NADI aims to be a clean and environmentally friendly town, starting with Waste Minimization and Recycling Promotion Project in cooperation with JICA (Japan International Cooperation Agency). We will make our environmental symbol and slogan / character to be used for raising environmental awareness from local people's ideas. Please give us your nice and cool designs!

1) Participants

Students and residents in NADI can participate.

2) Division

Choose one of two divisions below to participate. (Participation in both divisions is welcome by giving one idea on one paper.)

1. Environmental Symbol and Slogan
2. Environmental Character

3) Way

Please draw Symbol and Slogan or Character with Character's Name on A4 or A3 paper or the format printed at the back. Bring or send it to Health Department, Nadi Town Council addressed below.

4) Criteria for Selection

- * The idea which is simple and easy to be remembered
- * The idea which attracts people of all ages
- * The idea which shows the image of NADI and reminds of environmental actions

Example (Symbol & Slogan)



5) Closing Date

31st July, 2009

6) Announcement

It will be announced in late August with an awards ceremony. The symbol and slogan / character will be used on anything related environment such as posters, leaflets, composts, rubbish bins, garbage collection trucks etc.

7) Notice

Selected work might be adapted for use.

Nadi Town Council Health Department

Nadi Town Council Arcade, Main Street
P. O. Box 241 Nadi
Phone: +679 6700133
Fax: +679 6700131
E-mail: naditowncouncil@connect.com.fj
(Contact person: Nafiza, Yumi)

1. Symbol & Slogan / 2. Character (Please circle the division you participate)

Explanation about the design above

Name	Age	Sex M / F
Address		
School / Work place	Phone	