



THE REPUBLIC OF THE PHILIPPINES  
MUNICIPALITY OF MALAY



NATIONAL SOLID WASTE MANAGEMENT  
COMMISSION



JAPAN INTERNATIONAL COOPERATION  
AGENCY

# THE MASTER PLAN ON SOLID WASTE MANAGEMENT

FOR BORACAY ISLAND  
AND MUNICIPALITY OF MALAY  
FINAL REPORT  
(VOLUME II: MAIN REPORT)



**March 2008**

**NIPPON KOEI CO., LTD.**

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# **THE MASTER PLAN ON SOLID WASTE MANAGEMENT**

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AND MUNICIPALITY OF MALAY  
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**NIPPON KOEI CO., LTD.**

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## **PREFACE**

In response to a request from the Government of Republic of the Philippines, the Government of Japan decided to conduct a study on "The Master Plan on Solid Waste Management for Boracay Island and Municipality of Malay" and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Toshiyuki UJIIE of NIPPON KOEI Co., Ltd. between March 2007 and February 2008. In addition, JICA set up the advisory committee supported by Mr. Shiro AMANO and Mr. Taizo YAMADA, Senior Advisor belongs to the Institute for International Cooperation, JICA, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Republic of the Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Republic of the Philippines for their close cooperation extended to the study.

March 2008

Ariyuki MATSUMOTO  
Vice President  
Japan International Cooperation Agency

March 2008

Mr. Ariyuki MATSUMOTO  
Vice President  
Japan International Cooperation Agency  
Tokyo, Japan

### **Letter of Transmittal**

Dear Sir,

We are pleased to submit herewith the final report of “The Master Plan on Solid Waste Management for Boracay Island and Municipality of Malay”.

The Government of the Republic of the Philippines established the Ecological Solid Waste Management Act, namely RA9003, in 2001 in order to tackle solid waste problems which were becoming year by year. In accordance with RA9003, the local government units (LGUs) shall prepare respective 10-year solid waste management plans. However, since no plan has been approved by the National Solid Waste Management Commission so far, it is necessary to enhance the implementation of RA9003 generating the best practice model.

With this background, the Study aimed at formulating a best practice model for 10-year solid waste management plan for the Municipality of Malay under the collaboration of communities, the LGU, the national level government and the other stakeholders. The proposed plan is expected to be utilized as a reference guide for formulation of the 10-year solid waste management plan of LGUs with similar local conditions in the Philippines.

The proposed plan covers a wide spectrum of issues related to solid waste management on Boracay Island and the Mainland of Malay such as diversion, collection and transportation, final disposal, public awareness, and organizational and institutional arrangements including the cost recovery system which is necessary to implement the plan. The continuous collaboration of the organizations concerned is essential to implement the activities proposed in the plan.

We wish to express our sincere appreciation to the officials of JICA, the Ministry of Foreign Affairs, the Ministry of Environment, the Embassy of Japan for the Philippines, and JICA Philippine Office for their continuous support throughout the Study. Also, we would like to express our great appreciation to all Philippine organizations concerned, especially the members of the Steering Committee for their active participation in the Study.

Finally, we hope that the outputs of the Study will contribute greatly to improve solid waste management not only in Municipality of Malay but also in the local government units of the Philippines, and to foster a long lasting partnership and friendship between the two nations of Japan and Philippines.

Yours faithfully,

Toshiyuki UJIIE  
Leader for JICA Study Team



**Location Map**

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#### **PART IV: RECOMMENDATIONS**

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## Abbreviations

### <Organizations>

ABC	Association of Barangay Chairperson
ADB	Asian Development Bank
BCCI	Boracay Chamber of Commerce and Industry
BFI	Boracay Foundation Inc.
B-pid	Boracay Private initiative for Diversion
BSWM	Bureau of Soils and Water Management
BSWMAT	Boracay Solid Waste Management Action Team
BSWMC	Barangay Solid Waste Management Committee
BWSS	Boracay Water Supply and Sewerage Service
CENRO	City Environmental and Natural Resources Office
CIDA	Canadian Institute for Development Assistance
DA	Department of Agriculture
DBP	Development Bank of the Philippines
DENR	Department of Environment and Natural Resources
DENR-EMB	Department of Environment and Natural Resources-Environmental Management Bureau
DOE	Department of Education
DOH	Department of Health
DOILG	Department of Interior and Local Government
DOST	Department of Science and Technology
DOT	Department of Tourism
DTI	Department of Trade and Industry
EEDD	Economic Enterprise Development Department of Caticlan Jetty Port and Passenger Terminal
EIARC	Environmental Impact Assessment Review Committee
EMB	Environmental Management Bureau
EPG	Eminent Persons' Group
FMB	Forest Management Bureau
FPA	Fertilizer and Pesticide Authority
JICA	Japan International Cooperation Agency
KFFDA	Kabulihan Farmers and Forest Developers Association
LBP	Land Bank of the Philippines
LCFMC	Local Common Fund Management Committee
LGU	Local Government Unit
MGB	Mines and Geosciences Bureau
MOB	Municipality of Buruanga
MOM	Municipality of Malay
MSWMAT	Mainland Solid Waste Management Action Team
MSWMB	Municipal Solid Waste Management Board
MSWMU	Municipal Solid Waste Management Unit
MTO	Municipal Tourism Office
NEPC	National Environmental Protection Council
NGAs	National Government Agencies
NSO	National Statistical Office
NSWMC	National Solid Waste Management Commission
OECD	Organization for Economic Co-Operation and Development

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PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAMB	Protected Area Management Board
PAWB	Protected Areas and Wildlife Bureau
PCG	Philippine Coast Guard
PEMO	Provincial Environment Office
PENRO	Provincial Environment and Natural Resources Office
PMRB	Provincial Mines Regulatory Board
PTA	Philippines Tourism Authority
SLFMU	Sanitary Landfill Management Unit

**<Metric Units>**

cc	Cubic centimeter
cm	Centimeter
dB(A)	Decibel
g	Gram
GT	Gross Tonnage
ha	Hectare
hr(s)	Hour(s)
kg	Kilogram
km	Kilometre
km <sup>2</sup>	Square kilometer
L	Liter
m	Meter
mg	Milligram
min	Minute
mm	Millimeter
m <sup>3</sup>	Cubic meter
sec	Meter per second
t or ton(s)	Ton(s)
°C	Centigrade
%	Percentage

**<Currency>**

JPY	Japanese Yen
PhP	Philippine Peso
USD	U.S. Dollar

**<Others>**

3Rs	Reduce, Reuse, Recycle
A&D	Alienable and Disposable
ATC	Authority to Close
ASL	Above Seaside Level
BH	Borehole

BHC	Boracay Health Center
BOD	Biochemical Oxygen Demand
C/P	Counterpart Personnel
CBR	California Bearing Ratio
CDP	Comprehensive Development Plan
CH <sub>4</sub>	Methane
CIP	Capital Investment Plan
CLUP	Comprehensive Land Use Plan
CMVR	Compliance Monitoring and Validation Report
CNC	Certificate of Non-Coverage
CO <sub>2</sub> ,	Carbon Dioxide
COD	Chemical Oxygen Demand
DAO	Department Administrative Order
DBO	Design Built Operation
DO	Dissolved Oxygen
DWT	Dead Weight Tonnage
EAF	Environmental and Admission Fee
EC	Employer's Contribution
ECA	Environmentally Critical Areas
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMMP	Environmental Management and Monitoring Plan
EMF	Environmental Monitoring Fund
EMS	Environmental Management System
EOI	Expression Of Interest
E/S	Engineering Service
ESWM	Ecological Solid Waste Management
ESWMP	Ecological Solid Waste Management Plan
F/R	Final Report
F/S	Feasibility Study
GAR	Geologic Assessment Report
GCF	Garbage Collection Fee
GCL	Geocomposite Clay Liner
GIR	Geologic Investigation Report
GOCC	Government Owned Controlled Corporation
GPS	Global Positioning System
GW	Groundwater
GWD	Ground Water Deep well
GWS	Ground Water Shallow well
H <sub>2</sub> S	Hydrogen Sulfide
HCW	Health Care Waste
HDPE	High Density Polyethylene
HHW	Household Hazardous Wastes
HRM	Human Resource Management
I/A	Implementing Arrangement
ICE	Interpersonal Communication and Education

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IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IRA	Internal Revenue Allotment
IRR	Implementation Rule and Regulation
LCF	Local Common Fund
LGC	Local Government Code
MCE	Mass Communication and Education
MDG	Millennium Development Goal
M/M	Minutes of Meeting
MMT	Multi-partite Monitoring Team
MO	Municipal Ordinance
MOOE	Maintenance, Operation and Other Expenses
M/P	Master Plan
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MTPDP	Medium Term Philippine Development Plan
ND	Not Detectable
NEPC	National Environmental Protection Council
NGO	Non Governmental Organization
NH <sub>3</sub>	Ammonia
NIPAS	National Protected Area Systems
NMC	Natural Moisture Content
NO <sub>2</sub> -N	Nitrite-Nitrogen
NSWMF	National Solid Waste Management Framework
O&M	Operation and Maintenance
OMC	Optimum Moisture Content
PA	Philippine Agenda
PASD	Philippine Agenda on Sustainable Development
PC	Physical Closure
PCGS	Philippine Coast and Geodetic Survey
PCM	Post Closure Management
PD	Presidential Decree
PET	Polyethylene Terephthalate
PO <sub>4</sub> -P	Phosphorous Phosphate
PP	Polypropylene
PPP	Polluters Pay Principle
PRS	Philippine Reference System
PSDW	Philippine Standard for Drinking Water
PT	Percolation Test
QWC	Quantity of Waste Collected
QWCM	Quantity of Waste Composted (by Bioreactor) at MRF
QWD	Quantity of Waste Diverted
QWG	Quantity of Waste Generated
QWLF	Quantity of Waste Landfilled
QWPM	Quantity of Waste Provided to Livestock Feeding at MRF
QWRM	Quantity of Waste Recycled or Sold to Junkshops at MRF
QWRS	Quantity of Waste Reduced at Source
QWUC	Quantity of Waste Uncollected

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RA	Republic Act
RCP	Reinforced Concrete Pipe
RIDF	Rainfall Intensity Duration Frequency
RMP	Recycling Movement of the Philippines
SB	Sangguniang Bayan
SDR	Standard Dimension Ratio
SLF	Sanitary Landfill
SMR	Self Monitoring Report (Self-monitoring Report)
SPT	Standard Penetration Test
SRR	Source Reduction Ratio
ST/C	Steering Committee
SW	Surface Water
SWM	Solid Waste Management
SWMP	Sustainable Solid Waste Management Program
TDS	Total Dissolved Solid
THW	Toxic Hazardous Waste
TOR	Terms of Reference
TP	Test Pit
TPD	Tonnage per day
TSD	Treatment, Storage and Disposal
TSS	Total Suspended Solid
UGR	Unit Generation Rate
VAT	Valuable Added Tax
WACS	Waste Analysis and Characterization Survey
WFP	Work and Financial Plan
WPT	Water Pressure Test

## SUMMARY OF THE STUDY

### 1. General

#### 1.1 Background

Boracay Island belongs to Municipality of Malay (MOM) in Aklan Province and has been developed as most popular tourist resort in the Philippines. Since the number of tourists has increased year by year, the amount of solid waste generated has rapidly increased. Consequently, the solid waste management (SWM) of the MOM has been in critical situation. Under these backgrounds, the 10-year Solid Waste Management for Municipality of Malay (10-year SWM Plan) has been formulated in order to conserve natural environment and tourism resources and to improve public sanitation for the residents based on Ecological Solid Waste Management Act (RA9003).

#### 1.2 Objectives of the Study

The overall goal of the Study is to enhance the implementation of RA9003 generating the best practice model at the MOM under the collaboration of communities, the LGU, the national level government and the other stakeholders. The proposed plan is expected to be utilized as a reference guide for formulation of the 10-year SWM plan of LGUs with similar local conditions in the Philippines. Under the above overall goal, the Study was conducted with the following objectives.

- 1) To formulate a 10-year SWM Plan for the MOM
- 2) To conduct a feasibility study (F/S) for priority projects
- 3) Through the course of the Study, to strengthen the capacity for SWM of the staffs of the MOM and the NSWMC

#### 1.3 Study Area

The study area covers the entire jurisdiction of the MOM, which has 17 barangays with total area of 6,731 ha.

#### 1.4 Target Waste

The target wastes of the study are municipal solid waste and infectious waste as defined in RA9003 which is generated from the jurisdiction of the MOM.

### 2 Approaches of the Study

The following approaches have been taken into consideration during the Study.

- Approach 1: Consistency with RA9003 and other Requirements
- Approach 2: Grasping and Consideration of Actual Solid Waste Management Condition
- Approach 3: Stakeholder Involvement
- Approach 4: Consideration of Urgent Requirements

Approach 5: Proper Social and Environmental Considerations  
Approach 6: Involvement of C/P in the Study for Capacity Development

### 3. Proposed 10-year Solid Waste Management Plan

#### 3.1 Vision

A vision of the 10-year SWM Plan has been set as **“A Sustainable Integrated Solid Waste Management System is Developed”**.

#### 3.2 Future Framework

Future solid waste generation per day (t/day) is projected as follows:

**Future Solid Waste Generation Projection (t/day)**

Area	Barangay	2007	2017
Boracay Island	Yapac	1.4	4.6
	Balabag	11.1	18.0
	Manoc-Manoc	6.5	10.1
	Sub-total	19.0	32.7
Mainland of Malay	Urban barangays	3.5	7.5
	Semi-urban barangays	2.1	3.0
	Rural barangays	0.8	1.1
	Sub-total	6.4	11.6
Total		25.4	44.3

Source: JICA Study Team

#### 3.3 Targets

Targets of the 10-year SWM Plan have been set for the target year (2017) for Boracay Island and the Mainland of Malay respectively as shown in the table below:

**Targets of the 10-year Solid Waste Management**

Category	Component	Boracay Island		Mainland of Malay	
		Present (2007)	Target Year (2017)	Present (2007)	Target Year (2017)
Diversion	Source Reduction Ratio (SRR)	23%	35%	51%	54%
	Intermediate Reduction Ratio	20%	53%	38%	40%
Collection	Service Coverage	86%	100%	78%	90%
Disposal	Sanitary Disposal	0%	100%	0%	100%
	Safe Closure of Old Dump Site	0%	100%	-	-

Note: Source Reduction Ratio (SRR) = Waste Reduced at Source / Waste Generated  
Intermediate Reduction Ratio = Waste Reduced at MRFs / Waste Collected  
Service Coverage = Waste Collected/ Waste Discharged  
Sanitary Disposal = Residual Waste Landfilled in a sanitary way/ Total Residual Waste

### 3.4 Technical System of Solid Waste Management

The proposed technical system of SWM is summarized in the table below:

#### Proposed Technical System of Solid Waste Management

Category	Technical System of Solid Waste Management
Source Reduction	<p>1) <u>Boracay Island</u>: Introduction of new source reduction programs</p> <ul style="list-style-type: none"> <li>- Introduction of 3Bs programs               <ul style="list-style-type: none"> <li>BALIK BAYONG: reduction/prohibition plastic shopping bags</li> <li>BALIK BOTE: Introduction of deposit system for returnable waste</li> <li>BALIK BIO-WASTE: Home composting promotion</li> </ul> </li> <li>- Introduction of waste avoidance program (prohibition of specific package use)</li> </ul> <p>2) <u>Mainland of Malay</u>: Introduction of new source reduction program (group collection of recyclables)</p>
Sweeping	<p>1) <u>Main road</u>: Manual sweeping except the areas cleaned by residents or business establishments</p> <p>2) <u>Beach</u>: Manual cleansing except the areas cleansed by residents or business establishments</p>
Collection and Transport	<p>1) <u>Collection Area</u></p> <ul style="list-style-type: none"> <li>- Boracay Island : almost 100% collection service</li> <li>- Mainland of Malay: collection service corresponding to development cluster MRFs</li> </ul> <p>2) <u>Collection Method</u></p> <ul style="list-style-type: none"> <li>- Segregated collection (Biodegradable, Recyclable, Residual and Special wastes)</li> <li>- In-house and in-business establishment segregation</li> <li>- Segregated discharge using by transparent plastic bags</li> </ul> <p>3) <u>Collection Frequency</u></p> <ul style="list-style-type: none"> <li>- Boracay Island: everyday for biodegradable and three times a week for other wastes</li> <li>- Mainland of Malay: everyday for biodegradable and three times a week for other wastes, or twice a week for biodegradable and once a week for other wastes</li> </ul> <p>4) <u>Collection and Transport System (Generation source to MRF)</u></p> <ul style="list-style-type: none"> <li>- Boracay Island: Curbside/door to door/primary and station</li> <li>- Mainland of Malay: Primary and station/curbside</li> </ul> <p>5) <u>Collection Vehicle</u></p> <ul style="list-style-type: none"> <li>- Boracay: Dump trucks, Push carts, Tri-cab</li> <li>- Mainland of Malay: Dump trucks, Push carts</li> </ul> <p>6) <u>Transport of Residual Waste</u></p> <ul style="list-style-type: none"> <li>- Land transportation: Dump truck</li> <li>- Marine transportation : Pump boat</li> </ul>
Material Recovery (Composting and Recycling at MRFs)	<p>1) <u>Establishment of MRFs</u></p> <ul style="list-style-type: none"> <li>- Boracay: Maonc-Manoc Centralized MRF</li> <li>- Mainland of Malay: Caticlan Cluster MRF, Kabulihan Cluster MRF</li> </ul> <p>2) <u>Methods</u></p> <ul style="list-style-type: none"> <li>- Biodegradable waste: Composting by bioreactor and charcoal production</li> <li>- Recyclable waste: Manual sorting and selling to junkshops</li> <li>- Residual waste: To be transported to sanitary landfill</li> </ul>
Disposal	<p>1) <u>Sanitary landfill</u>: leachate treatment system and other environmental measures</p> <p>2) <u>Old dump site</u>: Safe closure by rehabilitation</p>
Special Waste (Health Care Waste)	<p>1) <u>Boracay Island</u></p> <ul style="list-style-type: none"> <li>- Treatment at the centralized MRF by autoclave</li> <li>- Disposal: Sanitary landfill site</li> </ul> <p>2) <u>Mainland of Malay</u></p> <ul style="list-style-type: none"> <li>- Treatment at the Public Health Center by autoclave</li> <li>- Disposal: Sanitary landfill site</li> </ul>

Source: JICA Study Team

### 3.5 Institutional System of Solid Waste Management

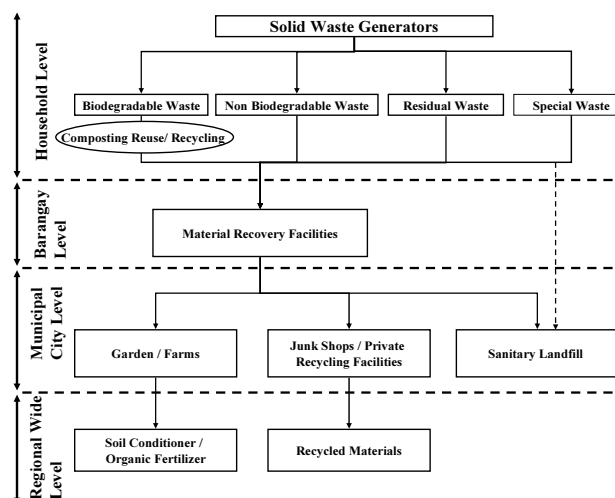
The institutional and organizational arrangements have been proposed in order to realize smooth implementation of the 10-year SWM Plan.

- Implementation of IEC programs (mass communication and education, interpersonal communication and education)
- Introduction of incentive programs (waste generators, recyclers and end user, the MOM and barangays)
- Implementation of Market Development (compost products, recyclables, etc.)
- Arrangement of legal system (amendment of the existing Municipal Ordinances and constitution of new Municipal Ordinances)
- Organizational setting up (Municipal Solid Waste Management Unit, Unit for development and operation of Kabulihan Sanitary Landfill)
- Re-organization of Boracay Solid Waste Management Action Team (BSWMAT) and establishment of Mainland Solid Waste Management Action Team (MSWMAT)

A series of training programs on SWM and its implementation, and development of administrative tools for SWM such as manuals, guidelines and database are also proposed for capacity development.

### 3.6 Implementation Framework

The implementation framework of the 10-year SWM Plan is based on the RA9003 following a SWM hierarchy. The framework covers the entire range of activities involved in SWM starting from source reduction and ending with the final disposal of waste. The hierarchy also matches the levels of governance starting from households up to the national level.



### 3.7 Cost Estimate and Financial Aspect

The proposed 10-year SWM Plan and the estimated total investment and O&M costs are summarized in the following table: In order to cover the total costs, the following financial measures including cost recovery are proposed.

- Sharing the costs among stakeholders based on the amount of waste generated in accordance with Polluters Pay Principle (PPP)
- Establishment of Local Common Fund (LCF) in order to manage various financial sources
- Revision of Garbage Collection Fee (GCF) including imposing the GCF on the residents

- Revision of Environmental and Admission Fee (EAF) including improvement of collection system
- Identification of funding sources such as the Development Bank of the Philippines

**Proposed 10-year SWM Plan and Total Project Cost (2008-2017)**

(Unit: x10<sup>3</sup> PhP)

Projects	Investment Cost	O&M Cost
<b>1. Diversion</b>		
1.1 Promotion of Source Reduction	0	1,002
1.2 Promotion of Recycling and Composting at MRFs		
1.2.1 Development of Manoc-Manoc Centralized MRF	40,786	50,362
1.2.2 Development of Caticlan Cluster MRF	1,555	3,405
1.2.3 Development of Kabulihan Cluster MRF	*	
1.2.4 Closure of Existing MRFs on Boracay Island	2,024	0
Total of 1. Diversion	44,365	54,769
<b>2. Collection and Transport</b>		
2.1 Improvement of Collection System on Boracay Island	1,948	59,697
2.2 Introduction of Collection System on the Mainland of Malay	580	5,033
Total of 2. Collection and Transport	2,528	64,730
<b>3. Disposal</b>		
3.1 Development of Kabulihan Sanitary Landfill	56,087	61,379
3.2 Rehabilitation of Old Dumping Site	8,136	900
Total of 3. Disposal	64,223	62,279
<b>4. Special Waste Management</b>		
4.1 Introduction of Health Care Waste Management System on Boracay Island	348	744
4.2 Introduction of Health Care Waste Management System on Mainland of Malay	348	536
Total of 4. Special Waste	696	1,280
<b>5. IEC Program</b>		
5.1 Implementation of Public Education and Information	0	716
Total of 5. IEC Program	0	716
<b>6. Institutional and Organizational Arrangement</b>		
6.1 Introduction of Incentive System	0	3,700
6.2 Implementation of Market Development	0	-
6.3 Arrangement of Legal System	0	-
6.4 Organization Setting Up	0	-
6.5 Introduction of Cost Recovery System	0	3,216
Total of 6. Institutional Arrangement	0	6,916
<b>7. Capacity Development</b>		
7.1 Implementation of Training Program on SWM	0	1,200
7.2 Development of Administration Tools on SWM	0	400
Total of 7. Capacity Development	-	1,600
Total of 1-7	111,812	192,290
<b>8. Price Escalation</b>		82,617
<b>Grand Total</b>		<b>386,719</b>

Note: \* Investment and O&M costs for the Kabulihan Cluster MRF are included in the costs of the Kabulihan SLF.

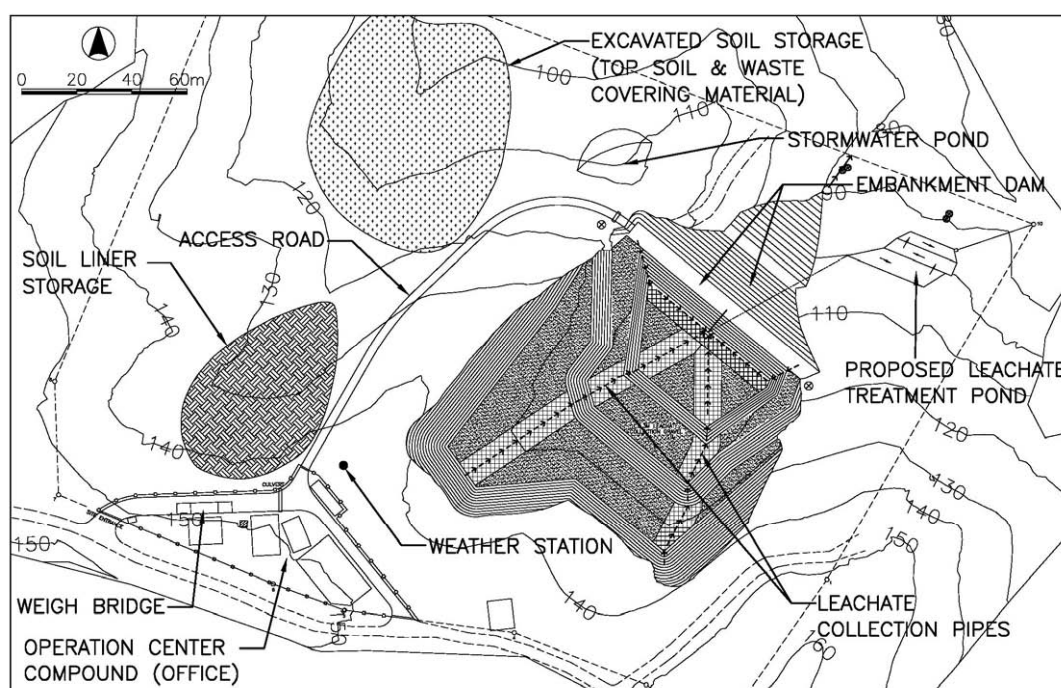
Source: JICA Study Team

## 4 Feasibility Study

### 4.1 Development of Kabulihan Sanitary Landfill

It is proposed that the landfill site be developed progressively in order to minimize the initial investment costs as well as the amount of leachate. The site will be developed in two phases. Phase 1 will be developed under the 10-year SWM Plan, while Phase 2 will be developed in the final year of filling of Phase 1 which would be after the 10-year SWM Plan period. Since the amount of residual waste received is estimated less than 15 ton/day, the SLF is proposed to be designed as Category 1 which is stipulated in DAO 10, Series of 2006.

The Phase 1 area is also developed progressively. The Sub-Phase 1B of the landfill area of Phase 1 is shown in the figure below. This area accommodates approximately eight years waste. The capacity summed up the Sub-Phase 1A (1A-1, 1A-2) and 1B is enough to receive the total waste hauled during the 10-year SWM Plan period.



**Development Plan of Sub-Phase 1B of Landfill Area**

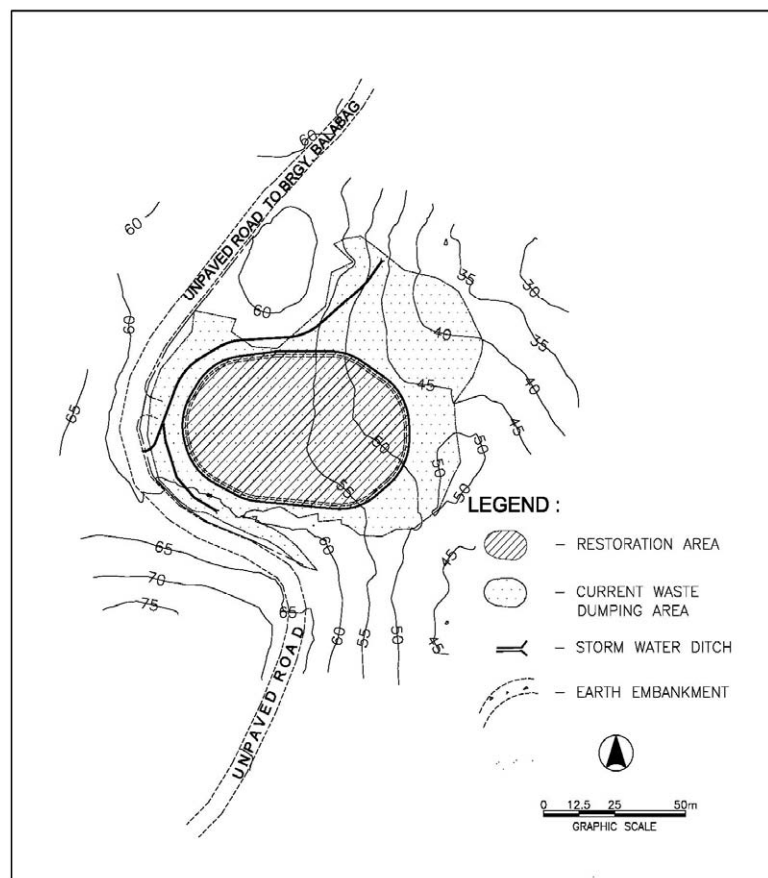
Source: JICA Study Team

Careful considerations have been given to the social and environmental impacts in development plan of the proposed SLF based on DAO 10. The SLF aims to dispose of the residual waste in a sanitary way so that the environmental degradation which has been brought about by the waste dumped other than the SLF can be minimized. As for the financial aspect, investment and O&M costs for the SLF can be recovered by the MOM including arrangement of a loan. As a result of a series of evaluations from the technical, social, environmental, financial aspects, the Development of the SLF is evaluated as viable as a whole.

#### 4.2 Rehabilitation of Old Dump Site

The planning concept for the rehabilitation of the old dump site was considered based on the results of the site condition surveys as well as DAO 09 Series 2006. One of the most critical environmental issues which should be taken into consideration is contamination of groundwater in and around the old dump site.

In the rehabilitation works, reshaping of the dumped waste and providing an earth embankment along the bottom slope of the site are proposed. The area covered by the dumped waste is to be concentrated and the eastern margin of the site is stabilized by flattening the slopes. The rehabilitation plan of the old dump site is shown in the figure below.



**Rehabilitation Plan for the Old Dump Site**

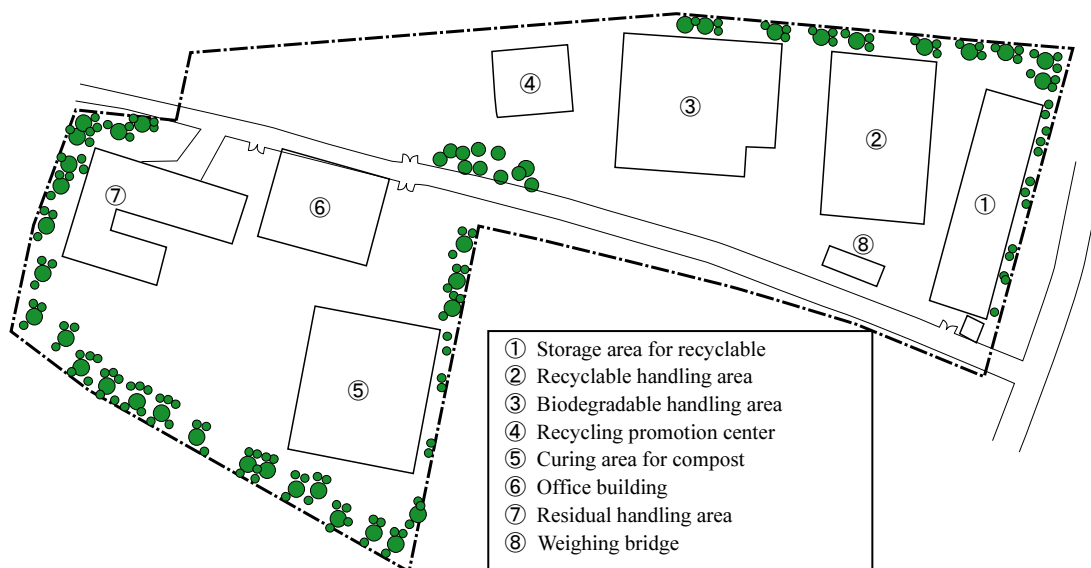
Source: JICA Study Team

The Rehabilitation of the Old Dump Site aims to mitigate the environmental degradation which has been brought about by the waste that has been dumped. As a result of series of evaluations from the technical, social, environmental, financial aspects, the Rehabilitation of the Old Dump Site is evaluated as viable as a whole.



#### 4.3 Development of Manoc-Manoc Centralized MRF

The proposed centralized MRF is to be located in Barangay Manoc-Manoc based on the aspect of transport efficiency of residual waste and land availability including the possibility of extension of the existing MRF area. The layout plan of the proposed Manoc-Manoc Centralized MRF is shown in the figure below.



**Layout Plan of Manoc-Manoc Centralized MRF**

Source: JICA Study Team

The development of the Manoc-Manoc Centralized MRF aims at producing sufficient diversion of the solid waste to be transported to the SLF. As a result of series of evaluations from the technical, social, environmental, financial aspects, the Development of the Centralized MRF is evaluated as viable as a whole.

### 5. Recommendations

As the result of the Study, the following are recommended.

- (1) Recommendations for the Municipality of Malay
  - 1) Practical Implementation of the 10-year SWM Plan
    - Necessary actions to be taken in 2008 as the first step of the 10-year SWM Plan
    - Revision and updating of the 10-year SWM Plan
    - Introduction of progress assessment system
    - Introduction of Human Resource Management (HRM)
    - Establishment of financial management system
    - Promotion of coordination between the LGU and Barangays
    - Promotion of collaboration among stakeholders

- Encouragement of collaboration with neighboring countries
- Grasping material balance inflow and outflow to/from Boracay Island
- Receiving of waste from the Municipality of Buruanga
- 2) Tourism Management for Environmental Conservation
  - Counting the number of tourists
  - Consideration of the Boracay Integrated Tourism Master Plan
  - Consideration of carrying capacity of Boracay Island
- (2) Recommendations regarding sludge treatment
  - Improvement of sludge drying procedures
  - Improvement of handling methods for dried sludge
- (3) Recommendations for the other LGUs and NSWMC
  - Structure of the 10-year Solid Waste Management Plan
  - Calculation methods of diversion
  - Careful arrangement of land for the development of SLF
  - Requirements for SLF development

# **PART I : GENERAL**

## **PART I      GENERAL**

### **1.1      Introduction**

#### **1.1.1      Background of the Study**

Environmental problems, especially those pertaining to solid waste, have caused adverse impacts on public sanitary conditions, the local economy, and tourism, and are one of the most serious social issues in the Republic of the Philippines (the Philippines). The Government of the Philippines established the Ecological Solid Waste Management Act (Republic Act (RA) 9003) in 2001 in order to tackle solid waste problems which were deteriorating year by year. The act is deemed to be a broad based and comprehensive approach for solid waste management (SWM) and covers the social, economic, technological, political and administrative dimensions of SWM. In accordance with Section 16 of RA9003, the province, city or municipality, through its local solid waste management boards, shall prepare its respective 10-year solid waste management plan (10-year SWM Plan) consistent with the National Solid Waste Management Framework. However, although many local government units (LGUs) have developed respective 10-year SWM Plan, no plan has been approved by the National Solid Waste Management Commission (NSWMC) so far. It is therefore necessary to enhance the implementation of RA9003 generating the best practice model.

Boracay Island belongs to the Municipality of Malay (MOM) in Aklan Province and has become the most popular tourist resort in the Philippines. The number of visitors has increased year by year and reached approximately 500,000 in 2006. In line with this, the amount of solid waste generated has rapidly increased and become one of the most serious problems on the Island. Following RA9003, the MOM closed the dumping site in Boracay Island and started operation of Material Recovery Facilities (MRFs) in 2006. After commencement of the new solid waste disposal system in accordance with RA9003, the SWM seems to have improved. However, because there is no sanitary landfill site in Malay Municipality, a large amount of solid waste has been stored on the proposed new landfill site in Mainland Malay and MRFs of Boracay Island since 2006 without employing suitable disposal methods. The SWM of the MOM is in a critical situation.

With this background, the Government of the Philippines requested the Government of Japan to conduct “The Master Plan on Solid Waste Management for Boracay Island and the Municipality of Malay in the Republic of the Philippines (the Study)”. The Study has been conducted since March 2007 on the basis of the scope of work described in the Implementing Arrangement (I/A) between the MOM, the NSWMC and Japan International Cooperation Agency (JICA) signed on February 14, 2007 and the Minutes of Meeting (M/M) on the I/A agreed on November 29, 2006. The implementing organizations of the Study were the MOM and NSWMC.

### 1.1.2 Objectives of the Study

The overall goal of the Study is to enhance the implementation of RA9003 generating the best practice model at the MOM under the collaboration of communities, the LGU, the national level government and the other stakeholders. The proposed plan is expected to be utilized as a reference guide for formulation of the 10-year SWM plan of LGUs with similar local conditions in the Philippines.

Under the above overall goal, the Study was conducted with the following objectives.

- 1) To formulate a 10-year SWM Plan for the MOM
- 2) To conduct a feasibility study (F/S) for priority projects
- 3) Through the course of the Study, to strengthen the capacity for SWM of the staffs of the MOM and the NSWMC

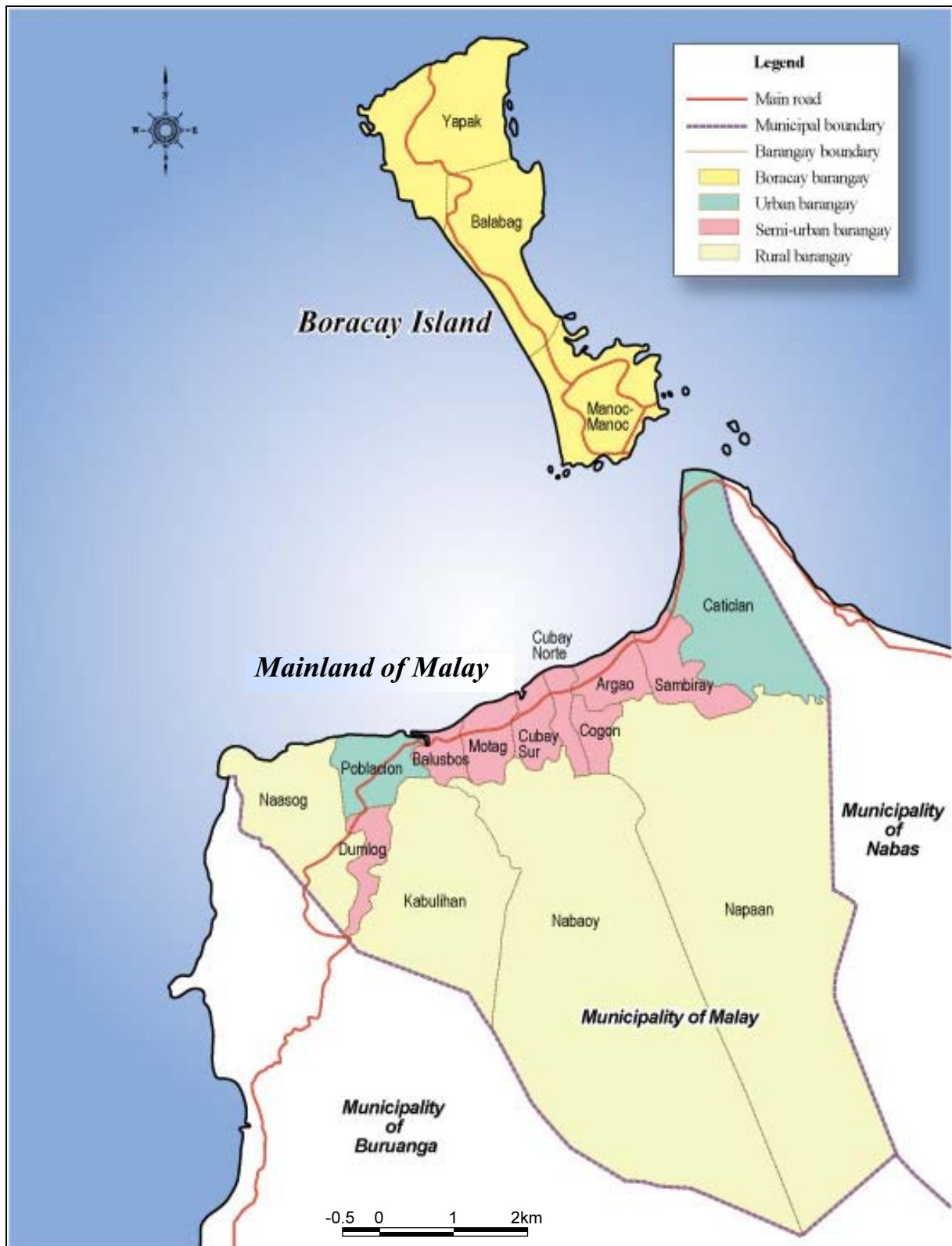
### 1.1.3 Study Area

The study area covers the entire jurisdiction of the MOM, Aklan Province. The MOM has 17 barangays with a total area of 6,731 ha (see Figure 1.1-1).

### 1.1.4 Waste Characterization of the Study Area

Municipal solid waste shall refer to wastes produced from activities within the LGU, which include domestic, commercial, institutional and industrial wastes and street/beach litter. Municipal solid waste of the study area is mainly generated from domestic and commercial sources. Food waste accounts for the largest proportion of the municipal solid waste at the generation sources. Non-recyclable plastics such as plastic shopping bags and also recyclable papers constitute a relatively large proportion of the generated waste and could be some of the possible target wastes for future diversion (see Chapter 3). Special wastes referring to household hazardous wastes such as paints, thinners, and batteries are usually handled separately from other residential and commercial wastes. Healthcare waste including infectious waste such as equipment, instruments and utensils are generated by hospitals or clinics.

The target wastes of the Study are municipal solid waste and health care waste (HCW) as defined in Section 3 of RA9003 which are generated within the jurisdiction of the MOM.



*The Master Plan on the Solid Waste Management  
for Boracay Island and Malay Municipality*

*Japan International Cooperation Agency*

**Figure 1.1-1 The Study Area**

## 1.2 Approach of the Study

The following approaches were taken into consideration for the Study.

### **Approach 1: Consistency with RA9003 and Other Requirements**

Laws such as RA9003 and its implementing rules and regulations (IRRs) have been issued, and Technical Guidebooks on Solid Waste Disposal Design and Operation and on Safe Closure of Disposal Sites by NSWMC have been formulated in the Philippines. These laws, regulations and other requirements have been taken into consideration for the Study.

### **Approach 2: Grasping and Consideration of Actual Solid Waste Management Condition**

Reliable basic data on waste characteristics have been collected through a series of surveys including a waste analysis and characteristics survey (WACS) to formulate the 10-year SWM Plan. The natural environment and geographical conditions are taken into consideration for the formulation and implementation of 10-year SWM Plan.

### **Approach 3: Stakeholder Involvement**

There are many stakeholders involved in SWM in the study area such as the MOM, 17 barangays, DENR-EMB Region Office, NSWMC, PTA, NGOs and local residents. From an early stage of the Study, these stakeholders have been involved. In addition, because commitment of the MOM is essential to ensure implementation of the SWM, the municipal council (Sangguniang Bayan: SB) as well as the Municipal Solid Waste Management Board (MSWMB) were closely involved in the Study.

### **Approach 4: Consideration of Urgent Requirements**

Since the development of a new sanitary landfill was an urgent issue, the F/S was carried out in parallel with formulation of the 10-year SWM Plan. In addition, as the previous final disposal site (old dump site), which was closed in January, 2006, is located next to a sightseeing spot and has potential environmental risks for the surroundings; its rehabilitation was urgently required. Furthermore, establishment of a centralized MRF on Boracay Island was proposed for effective waste diversion. They were selected as priority projects in the 10-year SWM Plan.

### **Approach 5: Proper Environmental and Social Considerations**

Various kinds of projects were proposed in the 10-year SWM Plan, but they should be implemented with proper environmental and social considerations. Especially, careful social environmental considerations were given to the priority projects, 1) development of a new sanitary landfill site, 2) rehabilitation of the old dump site, and 3) establishment of a centralized MRF. The study on environmental and social considerations for the projects was executed in accordance with the Presidential Decrees and DENR Administrative Orders regarding EIA/IEE of the Philippines.

### **Approach 6: Involvement of C/P in the Study for Capacity Development**

During the course of the Study, the following approach was taken to develop the capacity for SWM of the MOM personnel;

- Capacity development through cooperative works with the JICA Study Team (push-up effect), and
- Capacity (social capacity) development through cooperative works with other stakeholders (pull-up effect).

The JICA Study Team and the C/P cooperated on a person to person basis during the course of the Study. Capacity development was carried out regarding social aspects such as participation in meetings or interview surveys with the residents, communities, or business sectors in an effort to utilize some of the experience during the formulation of the 10-year SWM Plan. Local human resources were also utilized in the Study for capacity development for the bodies related to SWM.

### **1.3 Study Schedule**

The Study is composed of Phases 1 and 2 as follows. Overall work flow of the Study is shown in Figure 1.3-1.

#### **Phase 1: Formulation of the 10-year SWM Plan and F/S for the Sanitary Landfill**

The 10-year SWM Plan is formulated in parallel with the F/S for the proposed sanitary landfill. At the beginning of the Study, a Steering Committee (ST/C) was established based on the M/M on the I/A, and then an organizational structure which proceeded to formulate a 10-year SWM Plan and implement a F/S was established in cooperation with the C/P and the JICA Study Team.

#### **Phase 2: Implementation of F/S for Selected Priority Projects**

The F/S for the selected priority projects was implemented in cooperation with the C/P. The implementation program was formulated from the view-point of financial, technical and environmental aspects. Taking into consideration the results of F/S, the 10-year SWM Plan has been finalized.



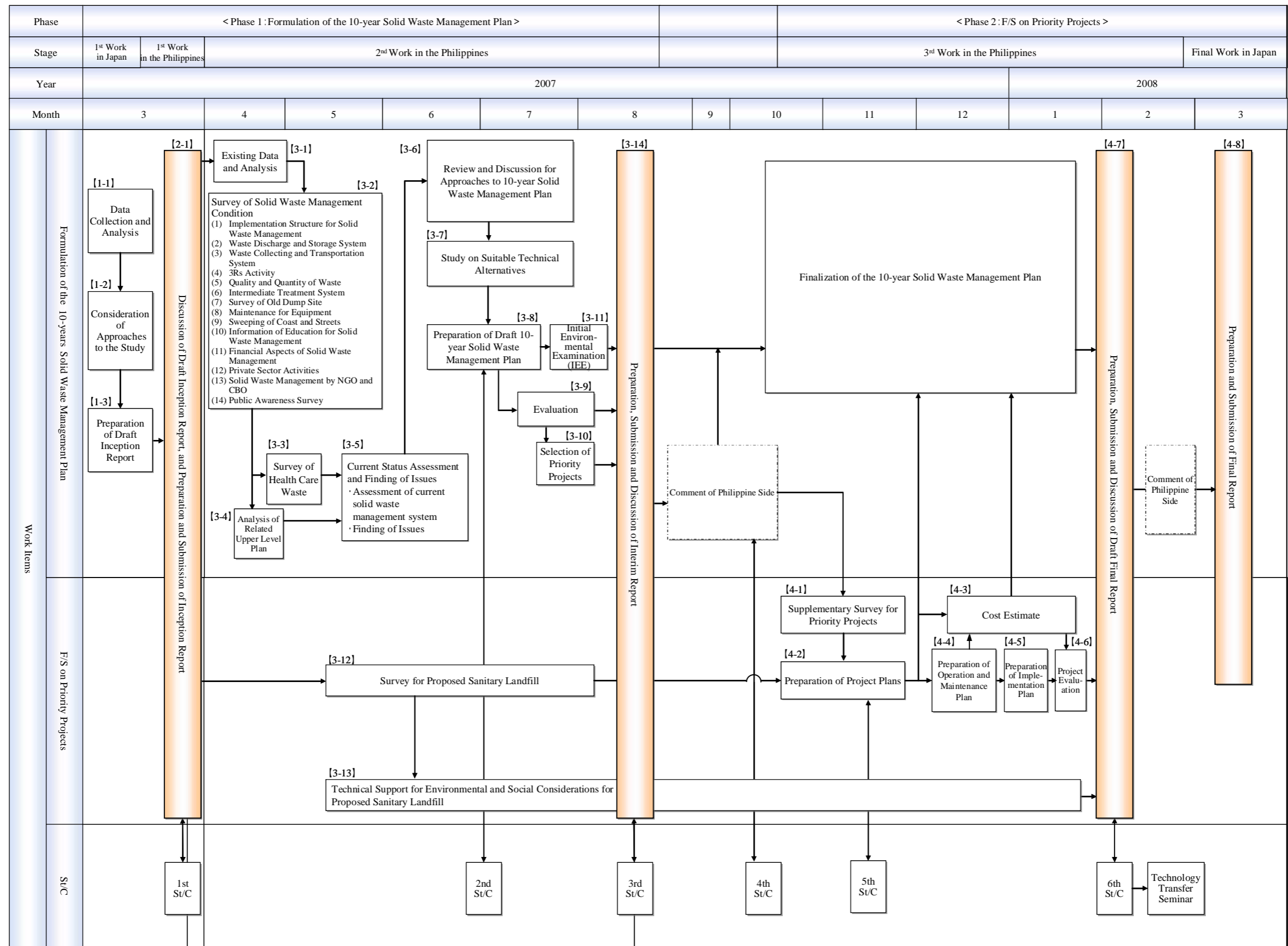


Figure 1.3-1 Overall Workflow of the Study

## 1.4 Structure of the Study Reports

In accordance with the scope of works of the Study, the following reports were prepared as shown in Table 1.4-1.

**Table 1.4-1 Structure of the Study Reports**

Report	Part	Content	Remarks
Executive Summary		Summary of the Main Report	
Main	Part I	General	
	Part II	Proposed 10-year SWM Plan for the MOM	Prepared based on the annotated outline by NSWMC. Expected to be used for approval from NSWMC and also referred by the other LGUs.
	Part III	F/S for the Priority Projects	
	Part IV	Recommendations	
	Appendix	Various information on the plan and F/S	
Supporting	Part I	Minutes of Meeting of ST/C	
	Part II	Detailed information on Proposed 10-year SWM Plan	
	Part III	Detailed information on F/S for the Priority Projects	
	Drawings	Drawings of F/S for the Priority Projects	

Source: JICA Study Team

**PART II : PROPOSED 10-YEAR SOLID  
WASTE MANAGEMENT PLAN FOR  
THE MUNICIPALITY OF MALAY**

## **PART II          PROPOSED 10-YEAR SOLID WASTE MANAGEMENT PLAN FOR THE MUNICIPALITY OF MALAY**

### **CHAPTER II-1          INTRODUCTION**

#### **1.1          Purpose**

##### **1.1.1          Background**

The Government of the Republic of the Philippines (the Philippines) established the Ecological Solid Waste Management Act (RA9003) in 2001 in order to tackle solid waste issues which were deteriorating year by year. In accordance with Sec 16 of RA9003, the province, city or municipality, through its local solid waste management boards, shall prepare its respective 10-year SWM Plan consistent with the national solid waste management framework.

Boracay Island belongs to the MOM in Aklan Province and has become the most popular tourist resort in the Philippines. The number of visitors has increased year by year and reached approximately 500,000 in 2006. In line with this, the amount of solid waste generated has rapidly increased and become one of the serious problems on the Island. Following RA9003, the MOM closed the dumping site on Boracay Island and started operation of MRFs in 2006. However, because there is no sanitary landfill site in the MOM, a large amount of solid waste that should have been disposed of has instead been stored at the proposed new landfill sites on the Mainland of Malay and the MRFs on Boracay Island without any suitable disposal method since 2006. The SWM of the MOM is in a critical situation.

On this basis, the 10-year SWM Plan for the MOM has been proposed in order to conserve the natural environment and tourism resources of the MOM as well as to improve public sanitation for the residents.

##### **1.1.2          Purpose**

As provided in RA 9003, the 10-year SWM Plan was proposed to ensure the following principal goals on SWM;

- Protection of public health and the environment
- Utilization of environmentally friendly methods in SWM
- Promotion of “diversion” of solid waste
- Retention of responsibility of SWM at the barangay level
- Development of a system for special waste management
- Encouragement of participation of private sectors and NGOs in SWM

## 1.2 Approach

The following approaches have been taken into consideration for formulation of the 10-year SWM Plan.

### **Approach 1: Consistency with RA9003 and Other Related Laws and Regulations**

Legislation such as RA9003 and its implementing rules and regulations (IRRs) have been issued, and Technical Guidebooks on Solid Waste Disposal Design and Operation and on Safe Closure of Disposal Sites by NSWMC have been formulated in the Philippines. Following RA9003 and the other requirements, the 10-year SWM Plan was formulated consisting of 1) Municipal profile, 2) SWM conditions, 3) Waste characteristics, 4) Legal/institutional framework, 5) Plan strategy, 6) SWM system, 7) Implementation strategy, 8) Institutional aspects, 9) Social and environmental aspects, 10) Cost estimate/Financial aspects, and 11) Plan implementation.

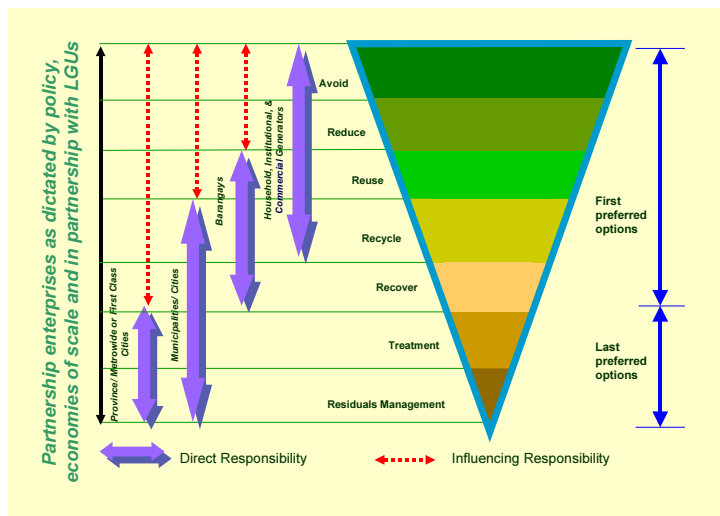
In RA9003, implementation of “diversion” activities such as source reduction and acceleration of recycling and composting by the LGU were introduced as well as introduction of sanitary landfills for the final disposal sites of solid waste. This has been taken into consideration in the formulation of the 10-year SWM Plan.

### **Approach 2: Consistency with SWM Hierarchy**

RA 9003 promotes SWM following a hierarchy of options. These options cover the entire range of activities starting from volume reduction and ending at the final disposal of waste. Correspondingly, the hierarchy also matches the levels of governance starting from households up to the LGU.

The base of the hierarchy triangle is avoidance and reduction of waste. The objective is primarily to

reduce the amount of materials entering the waste stream. The basic approach to source reduction covers avoidance, reuse and decreased consumption. The next level of the hierarchy is recycling and recovery, which differs from source reduction since it involves the recovery of products from the waste stream. A critical facility at this level of the hierarchy is MRF which separates and prepares the recyclables for marketing or segregates only the biodegradable for composting. These five levels, from volume reduction to recycling and recovery, constitute the first preferred options under the waste management hierarchy. The last two levels are treatment and disposal. Although volume reduction and recycling are



**Figure 1.2-1 Solid Waste Management Hierarchy**

Source: National Solid Waste Management Framework 2004, NSWMC

actively pursued, a considerable amount of waste, which has to be disposed of in an environmentally acceptable manner, remains.

### **Approach 3: Consistency with Suitable Technology**

The 10-year SWM Plan was formulated to establish integrated and sustainable solid waste management through self-help efforts by the LGU. Segregated collection and use of MRFs, which are currently operated in Boracay Island, could be called pilot projects (activities). The suitable technology was examined from lessons learned from these activities and from the viewpoint of technical and economic effectiveness.

### **Approach 4 : Consistency with the Boracay Development Plan**

The 10-year SWM Plan needs to reflect the future socio-economical situation of the target area, especially the tourism development plan of Boracay Island. The Boracay Island Development Plan, which is under preparation by the Philippine Tourism Authority (PTA), is to be considered for the formulation because it contains the future tourism development plan for the area on and around Boracay. The planning framework, waste stream, suitable treatment options and facilities location should be prepared in line with this development plan. Although the formulation of the development plan is still in a preliminary stage according to PTA, the 10-year SWM Plan was formulated considering feed back to and from the development plan.

### **Approach 5: Stakeholder Involvement**

There are many stakeholders involved in SWM in the target area such as the MOM, the 17 barangays, DENR-EMB Region Office, NSWMC, PTA, NGOs and local residents. From an early stage of the 10-year SWM Plan formulation, the above stakeholders were involved in the series of discussions. Furthermore, because commitment of the MOM is essential to ensure implementation of the measures to be proposed, the municipal council (Sangguniang Bayan) as well as the Municipal Solid Waste Management Board (MSWMB), are especially involved. Transparency for the formulation process of the 10-year SWM Plan was considered due to high awareness of SWM among the local people and private sectors.

## CHAPTER II-2 PROFILE OF MALAY MUNICIPALITY

### 2.1 Location

The Municipality of Malay (MOM) is located approximately 350 km south of Manila in the northwestern tip of the Province of Aklan on Panay Island. It is bounded on the north by Sibuyan and Sulu Sea, on the east by the Municipality of Nabas, on the west by the Municipality of Buruanga and on the south by the Province of Antique. It lies between 121°50'00" and 12°00'00" north latitude. The MOM is about 76 km from Kalibo and the average traveling time is around one and a half hours by car.

It is accessible by all forms of land transportation either from Iloilo via Capiz and Antique. There is a domestic airport, a terminal area and other facilities located in Barangay Caticlan, which is the jump off point to the prime tourist destination, Boracay Island. Boracay Island is located about 1 km off the northwest coast of Panay Island.

### 2.2 History

#### 2.2.1 History of Municipality of Malay

The MOM, by virtue of Republic Act No. 381, was declared the 17th municipality of Aklan Province on June 15, 1949. Prior to this, Malay was geographically and politically part of the municipality of Buruanga, about 10 kilometers on its west border.

The name Malay is said to be derived from the word *Maeay*, which is a species of tiny fish that was indigenous in the river of the first settlement during the Spanish Era. The first settlers were families with names such as Cajilig, Casidsid, Maglinte, Masangcay, Oczon, Omogtong and Taunan who were concentrated in "PAHO", the site of the present catholic cemetery, a natural refuge from the Moro pirates who frequented the area. This group was headed by a local head known as "Capitan Absoluto." The official seat shifted according to the residence of the chosen leader.

#### 2.2.2 History of Solid Waste Management in Municipality of Malay

The history of SWM of the MOM can be equated to the history of SWM campaigns and activities on Boracay Island. Before the advent of business establishments on Boracay Island, waste was disposed of by dumping in the middle of the sea during the night. As the clandestine practice continued, however, divers complained about the garbage which was beginning to destroy the marine environment. Except for Caticlan barangay, the mainland barangays still adopt traditional modes of garbage disposal such as burying, burning and feeding to animals.

From 1981 and onwards, more establishments and restaurants were set-up under the strict control of the DOT and the PTA. The Local Government Code (LGC) of 1991, however, vested local autonomy over the island. The island was opened to various investors, further increasing the building constructions and other tourism related activities.

In 1992, the local officials bought a 300 m<sup>2</sup> lot in Mt. Luho and set up a furnace measuring to burn mixed municipal garbage. This furnace was less than satisfactory and lasted only six months, after which the MOM resorted to open dumping at the same site, as approved by the provincial and city environment offices.

The advocacy on SWM on Boracay Island and the Mainland of Malay preceded the enactment of the Ecological Solid Waste Management Act of 2000. In 1992, the PTA supported the local government by providing an annual budget of PhP 1.0 million for garbage collection and sponsored information and education campaigns. The concept of “Zero Waste Management,” was introduced through orientations and seminars conducted by individual environmentalists from the Recycling Movement of the Philippines and other non-government organizations. The teachings included the practical applications of segregation-at-source, recycling and composting at home, in schools, in markets, in offices and other institutions as well as livelihood alternatives generated from recycled materials. However, this awareness campaign was not followed up by a concrete plan for enforcement at the LGU level and therefore, it failed to achieve concerted community participation.

In 1997, Boracay Island was plagued by news and issues of high coliform (E-coli) content in its coastal water. This revealed the island’s need for more aggressive environmental awareness campaigns and proper disposal of sewage and municipal solid waste. Succeeding advocacy campaigns for more environment-friendly solutions to the growing garbage problems were conducted by the government and private organizations like the DENR, DOT, Canadian Institute for Development Assistance (CIDA), Mother Earth-Philippines, Couples for Christ, Happy Soil, etc. Although the concepts and the methodology proposed simple, community-based and multi-sectoral approaches, these efforts were not able to create a critical mass that could lead to a sustained adoption of the RA9003 throughout the island. Often times, the sponsors of such educational campaigns stopped with the classroom activities, leaving the participants or the public to apply the new knowledge on their own without the support of local government authorities who were in charge of the waste management services.

With the enactment of RA9003 and the subsequent issuance of the implementing rules and regulations after one year, the DENR - Region 6 embarked on new dialogues with the business sector and created the MSWMB. A Boracay Solid Waste Management Action Team (BSWMAT) was formed to undertake the hauling and dumping of wastes, street cleaning and beach cleaning.

With the growing garbage crisis and the exposure of burning and open dumping in Mt. Luho, Boracay Island, the DENR began stricter monitoring of MOM’s implementation of the act. In 2003, the DENR ordered the closure of the open dumpsite, conversion to a controlled dump and establishment of MRFs. The DENR and the local government appointed and trained some 70 selda (cell) leaders to orient and monitor 20 or more households each for the three barangays. The grassroots were finally empowered to practice segregation and composting at the household level. Local cable-television stations promoted the SWM program and helped in awareness building. The local government posted billboards on



proper waste segregation and collection schedules along the roadsides. On August 4, 2003 a memorandum of agreement was forged between the MOM and the three barangays to enforce RA9003 and adopt the "no segregation no collection" policy. However, the initial enthusiasm for the campaign slackened and eventually died down due to poor and inconsistent enforcement of the law, lack of organizational support for the selda leaders, lack of monitoring activities by the DENR, weak local institutional set-up and insufficient technical capability.

In 2005, Boracay Chamber of Commerce Inc. (BCCI) through the CIDA-Pearl 2 Project conducted solid waste management seminars and supported Balabag MRF by providing a kitchen shredder and a multi-cab van. Although the project ran for two years, the environmental efforts were not focused solely on SWM and therefore had limited impact on community participation.

Upon the initiative of the BCCI and the Boracay Foundation Inc. (BFI), the DOT implemented the Eminent Persons Group (EPG)-Materials Recovery Project between May and November 2006 with the objectives of establishing sustainable and profitable MRFs and to strengthen the enforcement of RA 9003 by capability building for the MRF workers; general public awareness campaigns through door to door campaigns by monitors; and issuance of violation tickets. Garbage trucks, various machines like a bioreactor, shredders, plastic melting ovens, computers, handheld radios and other equipment were donated by the DOT to the MOM to an amount of PhP 4.8 million. As a result, functioning MRFs as pilot projects are now set up in each of the 3 barangays on Boracay Island. A temporary MRF has, likewise, been set up by the LGU for Barangay Caticlan on the Mainland of Malay.

### **2.3 Population**

Malay is a critically fast growing and developing Municipality in the province of Aklan. This is due to the presence of the popular tourist island of Boracay. The population recorded in 1975 was 8,770, 9,120 in 1980, 14,201 in 1990, 19,406 in 1995 and 24,519 in 2000. This translates to a growth rate of 5.1 % per year from 1995 to 2000. The rapid increase in population may be attributed to the in-migration of people from neighboring towns and provinces due to the existence of livelihood and other economic opportunities brought about by the booming tourism industry.

The latest population data available is the National Statistical Office (NSO) census 2007 in the MOM which shows a total population of 33,769 persons. Among the 17 barangays, the largest population is in Manoc-Manoc, followed by Balabag, Caticlan and Yapak. The population density is 502 person/km<sup>2</sup> as of 2007. Table 2.3-1 shows the population of each barangay and population density.

**Table 2.3-1 Population and Population Density of MOM**

Barangay	Population		Land Area (km <sup>2</sup> )	Population Density (2007) (person/km <sup>2</sup> )
	2000	2007		
Boracay Island				
Yapak	1,917	2,642	3.7	716
Balabag	4,430	6,102	3.2	1,930
Manoc-Manoc	5,656	7,790	3.2	2,457
Total of Boracay Island	12,003	16,534	10.1	1,650
Mainland of Malay				
Caticulan	3,987	5,491	4.7	1,172
Poblacion	1,117	1,538	1.0	1,559
Sub-total of urban barangays	5,104	7,029	5.7	1,239
Sambiray	700	964	1.2	790
Argao	757	1,042	0.8	1,298
Cogon	489	673	0.5	1,381
Cubay Norte	240	330	0.5	733
Cubay Sur	849	1,169	0.9	1,336
Motag	650	724	0.7	1,370
Balusbos	950	1,308	0.5	2,740
Dumlog	526	724	1.9	381
Sub-total of semi-urban barangays	5,161	7,106	6.9	1,034
Napaan	417	574	21.3	27
Nabaoy	829	1,142	16.5	69
Kabulihan	579	574	3.5	230
Naasog	426	587	3.4	172
Sub-total of rural barangays	2,251	3,100	44.7	69
Total of Mainland of Malay	12,516	17,235	57.3	264
Total	24,519	33,769	67.3	502

Source: NSO census in 2007 from the MOM

Boracay Island has a total population of 16,534 persons in 2007. This represents 49.0 % of the total population of the MOM. The land area of Boracay is about 10.1 km<sup>2</sup> with a population density of 1,650 person/ km<sup>2</sup>.

## 2.4 Economic Profile and Land Use

### 2.4.1 Tourist

The number of tourist arrivals at Boracay Island has been increasing. During the past 10 years, from 1997 to 2006, the tourist arrivals increased at an annual rate of 11-34 % to around 400,000 per year. The increase of foreign visitors for the same period was a modest 2-43%, while domestic visitors increased at a more significant rate of 8-36%. Since 2004, foreign tourists have increased drastically mainly due to the results of tourism promotion together with development of large-scale hotels and resorts.

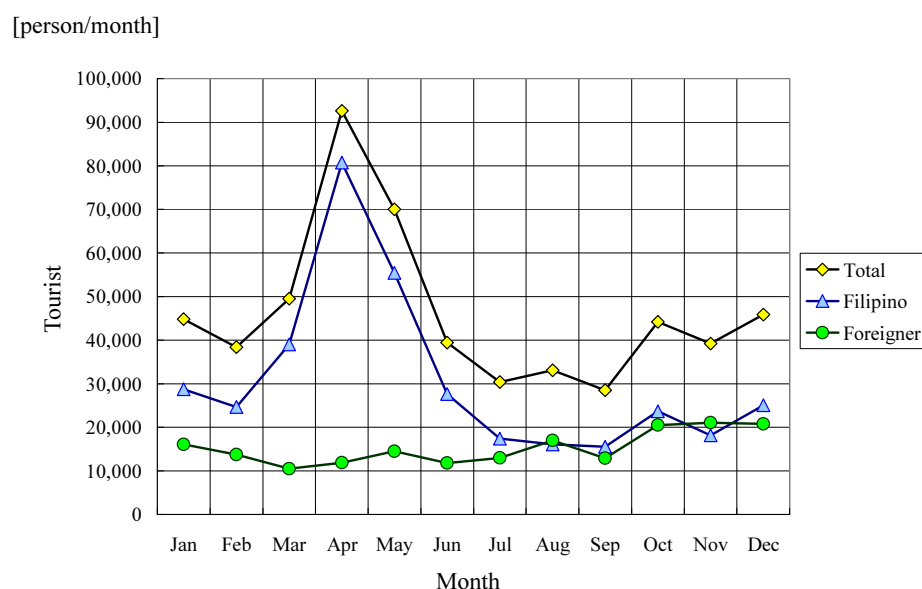
**Table 2.4-1 Annual Tourist Arrivals on Boracay Island (1997-2006)**

Year	Foreigner	Filipino	Total
1997	66,214	85,093	151,307
1998	44,358	91,586	135,944
1999	56,886	124,927	181,812
2000	72,670	157,091	229,509
2110	76,474	188,332	264,806
2002	77,892	222,900	300,792
2003	84,514	254,694	339,208
2004	121,019	307,732	428,751
2005	155,744	343,713	499,457
2006	183,835	372,249	556,084

Note: Filipino living abroad are counted as Filipino.

Source: Municipal Tourism Office (MTO)

Monthly tourist arrivals on Boracay Island in 2006 are presented in Figure 2.4-1. Domestic tourists come to Boracay Island mainly during the peak season from March to May, while foreigners come to the island almost constantly through out the year with small peaks in August and from October to December.



**Figure 2.4-1 Monthly Tourist Arrivals on Boracay Island in 2006**

Source: MTO

#### 2.4.2 Industry

The MOM is said to be an agriculturally based municipality together with tourism on Boracay Island. The primary crop is palay with a production 3,018 tons in 1999. Upland farms occupy a total of 70 ha and use “kaingin” (traditional farming or ham-ham in the dialect). Coconut is another important crop which occupies 46.6 % of the total agricultural area. Root crop farming, notably cassava, camote and gabi, is planted on an effective area of 158 ha. Other agricultural products are vegetables (16 ha), corn (12 ha) and bamboo (488 ha).

Tourism plays a very important role in economy of the MOM as well. Tourism is mainly

concentrated in the three barangays of Boracay Island and some in Barangay Caticulan. Table 2.4-2 shows the breakdown of commercial establishments in the MOM. The economic impacts of the tourism have been generated in two forms, namely revenues generated out of various tourism activities and the employment required for the services that need to be provided.

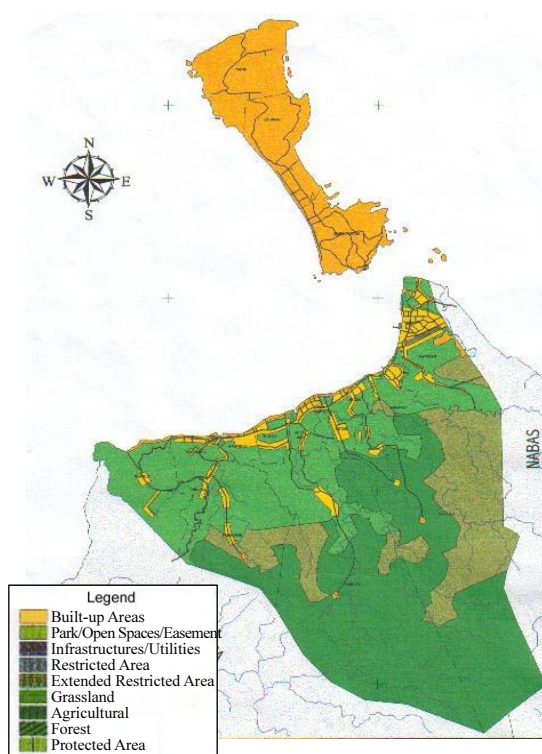
**Table 2.4-2 Number of Business Establishments in the MOM (2005)**

Business Establishments		Number	Percentage (%)
1	Tricycle	539	20.7
2	Cottages/Resorts and Hotels	205	7.9
3	Vendors	177	6.8
4	Sari Sari Store	168	6.4
5	Boutiques/Gift Shops/Souvenir/Shop/Arts	154	5.9
6	Bars and Restaurants	153	5.9
7	Motorboats/Speedboats/Sailboats/Banana Boats/Flat Boats/Paraw/Basnig and Other Fishing Boats	130	5.0
8	Boracay Island Hopping Association (BIHA)	105	4.0
9	Manicurist/Masseurs	105	4.0
10	Others	869	33.4
Total		2,605	100.0

Source :MTO

#### 2.4.3 Land Use

The land of the MOM is basically agricultural with about 2,719 ha or 40.4 % of its total Alienable and Disposable land (A&D Land), which comprises 46.5 % of the total land area being used for that purpose. More than a third (38.6 %) or about 2,600 ha is classified as forest or timberland. The built-up area is about 184ha, which covers areas being utilized for residential, commercial, institutional and infrastructure purposes. The areas utilized for tourism purposes are about 1,004 ha. This area covers Boracay Island which is expected to be fully developed before the planning period ends. Figure 2.4-2 shows the general land use of the MOM.



**Figure 2.4-2 Land Use of Malay**

Source: MOM

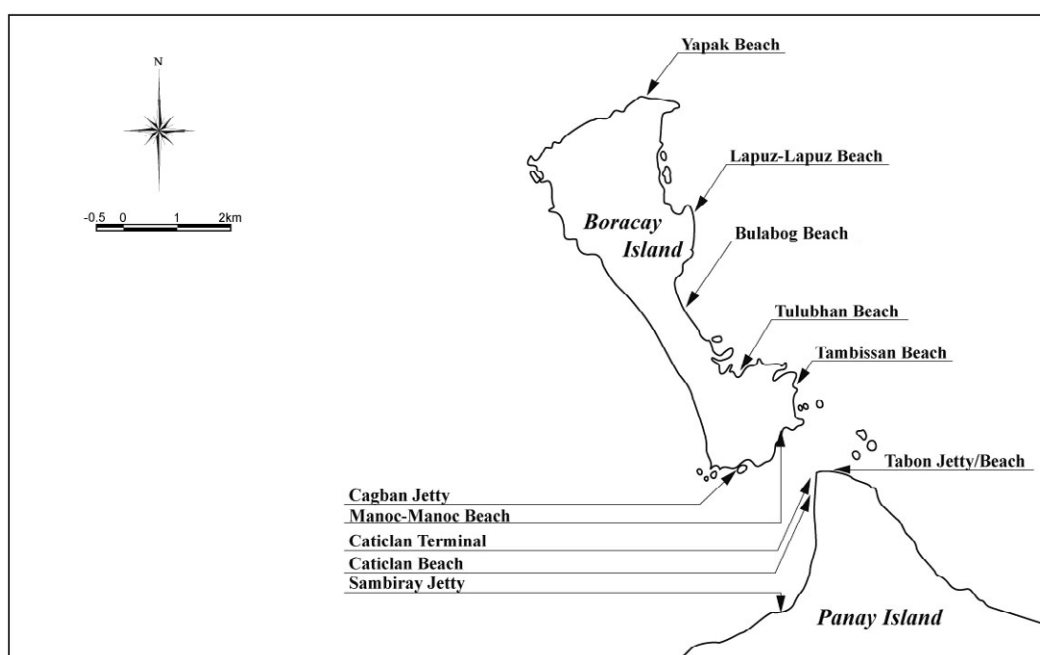
#### 2.4.4 Transportation

The total road network in the MOM is about 86 km in length, of which, 12.3 km is classified as national road, 8.2 km provincial road, 6.3 km municipal road and 58.6 km barangay road. In terms of type of pavement, 19.0 km is concrete, 1.3 km asphalt and the remaining 65.2 km is unpaved gravel, which means that

31.2% of the road is paved.

The Caticlan Airport accommodates light commercial and private planes on regular and non-scheduled flights. Its runway measures 834 m x 90 m. Other facilities include a terminal building, control tower, powerhouse, fire station, and apron that are administered by a local office of the Air Transportation Office.

On Boracay Island, there are seven cargo loading/unloading sites, while on the northwest coast of the Mainland of Malay (Panay Island), there are four cargo loading/unloading sites serving Boracay Island as shown in Figure 2.4-3. At Manoc-Manoc, Tambissan, Tulubhan, Bulabog, Caticlan and Tabon beaches, wooden motorized outrigger bancas, called pump boats, land along natural beaches for loading/unloading operations (see Appendix II-2.4.4).



**Figure 2.4-3 Locations of Cargo Loading and Unloading Sites**

Source: JICA Study Team

## 2.5 Physical Characteristics

### 2.5.1 Geography, Geology and Soil

The topography is moderately steep to mountainous (with slopes of 33 to 88%) in the central part where there are several mountain peaks such as the Taobun Mountain Ridge, Mount Guimbarogtog, Mount Tinagtocon, Mount Cumaingin, Mount Malagod and Mount Sapinitan. The highest peak at 600 meters, which is only 20.0 ha in area, is found in Kabulihan. The majority of the mountain ranges are from 200-300 meters high. Hilly areas are mostly covered with grassland and shrubs. The subsurface materials are generally weathered, silted clay with volcanic rock fragments, slight to moderate permeability for 1.2 meters deep. The bedrock is shallow, about 1.5 to 2 meters deep represented by the massive metasediments of the Buruanga Metamorphic Complex. Base on the Geological and

Physical Assessment by the Mines and Geo-science Bureau (MGB), there are no identified geo-hazard zones within the municipality or the province. Mass movement has not been witnessed within the area.

Boracay Island is about 7 km long and at its narrowest points barely 1 km wide, comprising an area of 1,083 ha. The center of the island is flat and narrow, and about two-thirds of the total land area falls between 8 and 16% slope. Lowland and gently sloping areas are found near the shoreline. Both the southern and northern ends of the island are wider and hilly, with the highest point (Mt.Luho, 100 m) located in the northeast.

## 2.5.2 Hydrology and Climate

The plan area is naturally drained by rivers, namely the Malay, Nabaoy, Napaan and Potal Rivers while creeks serve as tributaries. Marshlands and a lake are found in the eastern section near Caticlan Airfield due to influx of brackish water. Flooding hazard is concentrated along the banks of Napaan, Potal Balusbos and Nabaoy Rivers but the total area subject to flooding is negligible at 11.0 ha or 2% of total land area of the municipality.

The climate of the Philippines is tropical monsoon so that the weather condition is affected by this climate. The weather is clearly divided into two seasons of rainy and dry. The rainy season is normally recognized as the southwest monsoon period from June to November. Most annual rainfall concentrates in those months with squalls and strong western winds blowing. On the other hand, the dry season continues from January to May under the northeast monsoon period. Although there is no weather station in MOM, there are several weather stations on Panay Island which can refer the data. The rainfall data at these stations are summarized in Table 2.5-1. The average monthly rainfall amounts range from 65 to 290 mm at the Calapan station, from 48 to 311mm at the Romblon station, and 45 to 295 mm at the Roxas station.

**Table 2.5-1 Average Monthly Rainfall at the Weather Observation Stations near MOM**

(Unit: mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Calapan	73	65	77	118	178	237	221	199	246	290	232	169	2,068
Romblon	97	55	48	70	106	224	214	193	235	311	234	207	1,945
Roxas	87	45	57	72	122	254	235	217	214	295	253	177	2,028

Note : Data at Calapan station are from 1961 to 2006, at Romblon from 1971 to 2000, and at Roxas from 1971 to 2000

Source: Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

On the other hand, meteorological observation was conducted until 2000 at the Kalibo station where was the nearest station from the MOM. The rainfall intensity duration frequency (RIDF), which means the maximum rainfall amount during consecutive duration of each return period, for 21 year was calculated by the Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) as shown in Table 2.5-2.

**Table 2.5-2 Rainfall Intensity Duration Frequency at Kalibo Station**

(Unit: mm)

Return Period	Consecutive Duration															
	5 min	10 min	15 min	20 min	30 min	45 min	60 min	80 min	100 min	120 min	150 min	3 hr	6 hr	12 hr	24 hr	
2 year	8.7	13.4	17.2	20.3	25.3	30.2	33.5	39.2	44.3	48.3	53.5	58.1	75.5	92.3	104.5	
5 year	12.3	18.9	24.4	28.9	36.2	43.3	48.2	56.5	64.0	70.0	77.6	84.4	110.7	135.4	154.0	
10 year	14.8	22.6	29.2	34.6	43.4	52.1	58.0	68.0	77.1	84.3	93.6	101.8	134.0	163.9	186.7	
15 year	16.1	24.7	31.9	37.9	47.4	57.0	63.5	74.4	84.4	92.4	102.6	111.6	147.1	180.0	205.2	
20 year	17.1	26.2	33.8	40.1	50.3	60.4	67.3	79.0	89.6	98.1	108.9	118.5	156.3	191.3	218.1	
25 year	17.8	27.3	35.3	41.9	52.5	63.1	70.3	82.5	93.6	102.4	113.7	123.8	163.4	200.0	228.1	
50 year	20.1	30.8	39.7	47.2	59.2	71.2	79.4	93.2	105.8	115.9	128.7	140.1	185.2	226.7	258.8	
100 year	22.3	34.2	44.2	52.5	65.9	79.3	88.5	103.9	118.0	129.2	143.5	156.3	206.8	253.3	289.3	

Note: Each data indicates the maximum rainfall amount during consecutive duration of each return period. For example, the consecutive 30 minutes rainfall which occurs with the probability once in 100 year will cause maximum rainfall amount of 65.9mm.

Source: PAGASA (1980 to 2000)

At the Calapan station, the temperature at ground level has monthly mean values range from 25.6 to 28.5°C. At the Romblon station, the monthly mean value is 26.0 to 29.3 °C. At the Roxas station, the monthly mean values range 26.3 to 28.7°C. These three stations near the site are similar value around 25 to 28°C.

## CHAPTER II-3 CURRENT CONDITIONS OF SOLID WASTE MANAGEMENT

### 3.1 Institutional Arrangements

#### 3.1.1 Legislation

##### (1) National Legislation

The existing National Legislation, which governs SWM in the Philippines, is RA 9003: Ecological Solid Waste management Act of 2000. The implementing rules and regulations (IRRs) of RA 9003 were issued on December 20, 2001 as DENR Administrative Order No.2001-34. As a national policy, RA9003 declares the adoption of a systematic, comprehensive and ecological solid waste management program in the Philippines. A National Solid Waste Management Framework (NSWMF) was formulated by the NSWMC, with public participation, in 2004 in order to ensure that the policy is effectively carried out as per Section 15 of RA9003. The framework provides a comprehensive but practical guide on SWM planning for LGUs and other concerned sectors involved in the implementation, in part or in whole, of RA 9003 and its IRR.

Since the passage of RA 9003, the Philippines have a comprehensive and integrated SWM policy and legal framework. The next step for the Philippines has been to implement the law and ensure its sustainable impacts and the following challenges as shown in Table 3.1-1 have been addressed as goals of PA 9003.

**Table 3.1-1 Goals of Ecological Solid Waste Management in the Philippines**

Action	Goals
Generation and Collection	<ul style="list-style-type: none"> <li>- Listing of non-environmentally acceptable products within one year of the law coming into effect with a phase out period to be set by the Commission</li> <li>- Segregation of waste in all households upon effect of the law</li> </ul>
Recycling and Composting	<ul style="list-style-type: none"> <li>- At least 25 percent of waste is to be recycled and recovered within five years of the law coming into effect</li> <li>- Inventory of markets for recyclables and compost is to be completed within six months of the law coming into effect</li> </ul>
Disposal	<ul style="list-style-type: none"> <li>- All open dumps are to be converted to controlled dumps within three years of the law coming into effect</li> <li>- All controlled dumps are to be converted to sanitary landfills within five years</li> </ul>

Source: Philippine Environment Monitor 2001, The World Bank, Dec.2001

The other major environmental laws which have stipulations concerning SWM are the Presidential Decree (P.D.) 115, namely the Philippine Environmental Code of 1977, and RA 7260, namely the Local Government Code of 1991 (see Appendix II-3.1.1).



(2) Local Legislation

The Municipal Council of Malay (Sangguniang Bayan: SB) has passed the following ordinances relating to SWM.

Environmental Preservation and Protection Ordinance

1) Regulated Activities

Municipal Ordinance No.230: Environmental & Admission Fee

Municipal Ordinance No.233: Increasing Garbage Fee

2) Garbage and Sanitation

Municipal Ordinance No.56: Amending 1990 Garbage Disposal

Municipal Ordinance No.72: Prohibition of Spreading of Human Waste

Municipal Ordinance No.84: Requiring Owners to Clean their Area

Municipal Ordinance No.86: Cleaning of Rest/Comfort Rooms

Municipal Ordinance No.100: Penalizing Certain Acts/Sanitation

Municipal Ordinance No.98-116: Prohibition of Urinating & Defecating

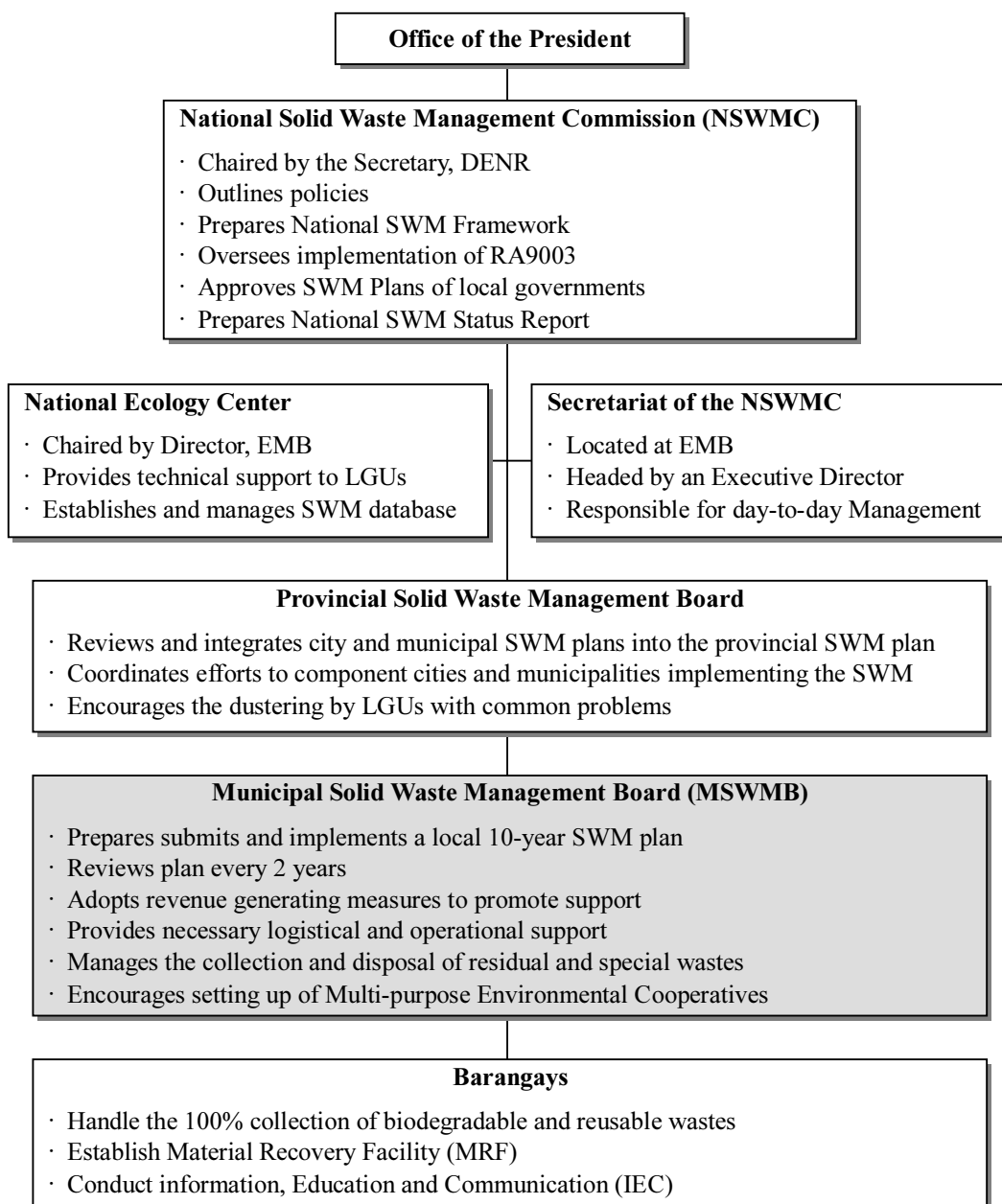
Municipal Ordinance No.185: Regulating Garbage Disposal

Municipal Ordinance No.188: Requiring Restaurants and Commercial Buildings to have Sewerage

3.1.2 Organizations

(1) Overall Organization for Solid Waste Management in the Philippines

Over the years, successive laws and issuances mandating different agencies to manage solid waste has resulted in overlapping responsibilities. The Local Government Code of 1991 (LGC) re-affirmed the primary responsibility of LGUs to plan and implement SWM programs within their localities. RA9003 reinforces this responsibility and defines the national oversight mandate of NSWMC. The current institutional arrangement of the SWM of the Philippines is illustrated in Figure 3.1-1.



**Figure 3.1-1 Institutional Arrangement of SWM in the Philippines**

Source: Philippine Environment Monitor 2001, The World Bank, Dec.2001, modified by JICA Study Team.

The current responsibilities of the different agencies concerned with SWM are explained in Table 3.1-2.

**Table 3.1-2 Organizational Aspects of SWM**

Organizations	Responsibilities
Department of Environment and Natural Resources (DENR)	Sets standards, criteria, and guidelines for all aspects of solid waste management. Performs regulatory as well as monitoring and enforcement functions with regard to air emissions and effluent of solid waste management systems. Chairs the NSWMC, which sets the overall policy, prepares the national framework, and approves local SWM plans.
Environmental Management Bureau (EMB)	EMB is a line agency of DENR. Chairs the National Ecology Center composed of multi-sectoral and multi-disciplinary experts tasked to facilitate training and education on the ESWM. Establishes and manages an information database. Provides secretarial support to the Commission.
Department of Health (DOH)	Regulates the storage of waste in food establishments with respect to construction, maintenance, and placement of storage containers within their establishments. Provides guidelines for proper management and disposal of hospital wastes, and other infectious wastes.
Department of Science and Technology (DOST)	Conducts research and develops technologies on alternative and clean technologies for the usage of non-recyclable and non-reusable materials; improves utilization of organic materials; Evaluates available technologies through the Technology Verification Program.
Department of Education (DOE)	Incorporates ESWM in the school systems at all levels, emphasizing the involvement of the school administrators, teaching and non-teaching staff, and students in school-wide and nearby community waste management actions, and in the strengthening of the waste management content in the curricula.
Department of Interior and Local Government (DOILG)	Develops a coordinative mechanism that ensures that LGUs are significantly guided in the preparation of the SWM Plans and that all SWM Plans are integrated from the provincial, municipal and barangay levels; Monitors creation of Local SWM Boards, and is active in education and public information on SWM of every LGUs, down to the barangay levels.
Department of Trade and Industry (DTI)	Formulates and implements a coding system for packaging materials and products to facilitate recycling and re-use. Publishes study on existing markets for recyclables and recommends steps to expand these markets.
Department of Agriculture (DA)	Publishes an inventory of markets and demands for compost. Assists compost producers to ensure that the compost produced conforms to standards.
Department of Tourism (DOT)	Supports the MOM, barangays and private sector on Boracay Island by providing grants through the DOT-EPG MRF Project.
Philippine Coast Guard (PCG)	Responsible for preventing ocean dumping of solid waste.

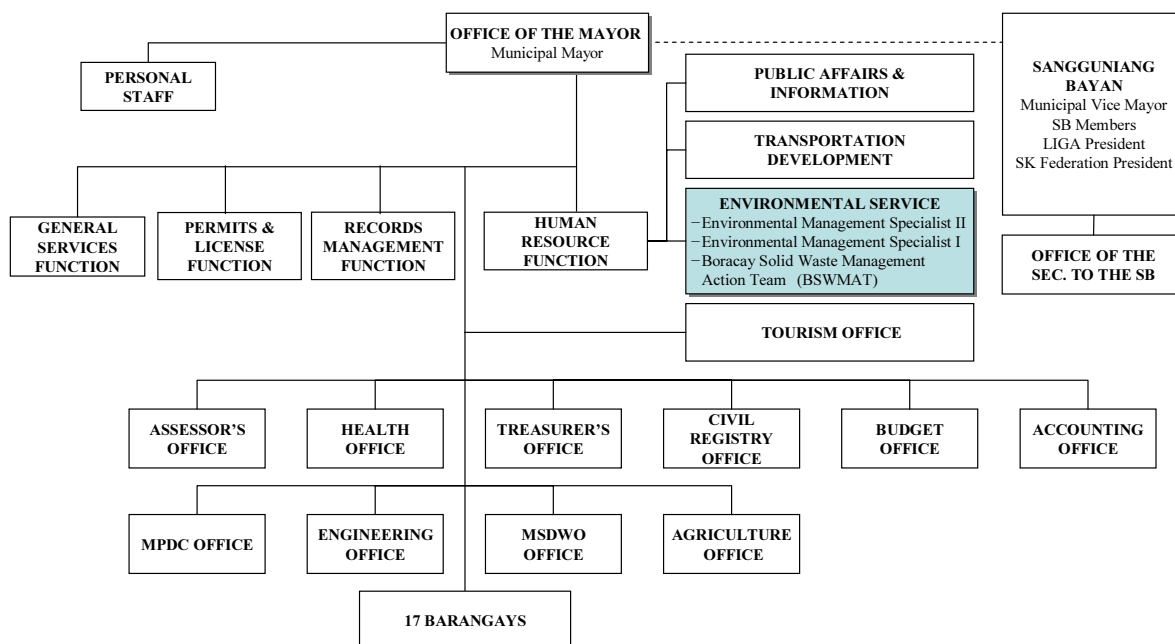
Source: Philippine Environment Monitor 2001, The World Bank, Dec.2001, modified by JICA Study Team

(2) Organization of Municipality of Malay

The MOM has a responsibility for preparation and implementation of the 10-year SWM Plan together with other stakeholders within their jurisdiction. The chief executive of the MOM is the mayor who is empowered by LGC to enforce all laws and ordinances relative to the governance of the municipality; initiate and maximize the generation of resources and revenues and apply the same to the implementation of development plans and programs, and ensure the delivery of basic services and the provision of adequate facilities (Section 444, LGC). The SB is composed of the vice-mayor as the presiding officer and the councilors as members. The head of the Association of Barangay Chairperson (ABC) and the representative of the Sangguniang Kabataan also sit as members of the SB. The SB approves ordinances and passes resolutions necessary for an efficient and effective municipal

government, among which is to protect the environment and impose appropriate penalties against activities which may result in pollution (Section 447, LGC).

The organization of the MOM is illustrated in Figure 3.1-2. Currently, the established Environmental Service consisting of 37 staff including members of the BSWMAT has responsibility for supervising the SWM. The BSWMAT has been organized to fully act on the SWM issues and concerns such as beach and street sweeping and the monitoring.



**Figure 3.1-2 Organization of Municipality of Malay**

Source: Municipality of Malay

The MOM has organized the Municipal Solid Waste Management Board (MSWMB) as per Executive Order No. 114 dated August 2, 2004 according to RA 9003 and its IRR (Rule VI, Section 4). The chairperson of the MSWMB is the Municipal Mayor while the Vice-Mayor sits as the Vice Chairperson. Various sectoral representatives are designated as members of the MSWMB. The principle functions of the MSWMB are as follows (see Appendix II-3.1.2 (2)):

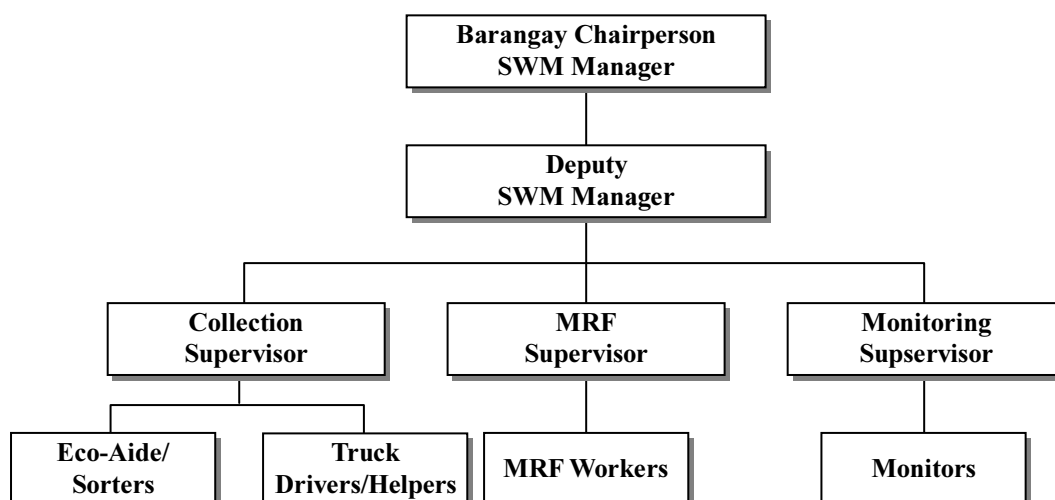
- Convene regular meetings for planning and coordinating the implementation of the SWM plan
- Review every two years, or as the need arises, the SWM Plan for ensuring its sustainability, viability, effectiveness and relevance
- Develop specific mechanisms and guidelines to implement the SWM Plan
- Recommend to local government authorities for franchise or build-operate-transfer agreements with duly recognized institutions for the collection, transfer, storage, processing, recycling or disposal of municipal solid waste
- Provide the necessary logistical and operational support to component barangays
- Recommend measures and safeguards against pollution and the preservation of the natural ecosystem

- Coordinate the efforts of component barangays in the implementation of the SWM Plan
- Call on any concerned agency or sector, as it may deem necessary, for support or other appropriation
- Develop the 10-year SWM Plan to ensure long-term SWM as well as integrate the various SWM plans and strategies of component barangays
- Adopt measures to promote and ensure the viability and effective implementation of SWM programs in all component barangays
- Monitor the implementation of the SWM Plan, through the component barangays and in cooperation with concerned NGOs
- Adopt specific revenue-generating measures to promote the viability of the SWM Plan.

(3) Organization of Barangays

A barangay is a basic political unit in the Philippines and is headed by the barangay chairperson (punong barangay) who is specifically mandated to enforce all applicable laws and ordinances including ones on pollution control and protection of the environment (Section 389, LGC).

On Boracay Island, each barangay has a SWM organization in principle. Normally the barangay chairperson works as a SWM Manager with an appointed deputy SWM Manger. Under them, supervisors for collection, MRF and monitoring are appointed who supervise workers' tasks. Under the collection supervisor, eco-aides, sorters, and truck drivers and helpers are working in their roles of daily waste collection from inaccessible areas through pushcarts, assisting of sorting, driving and maintenance of the trucks, loading and unloading of solid waste to/from the trucks, respectively. In Barangay Caticlan, only one supervisor has been appointed to supervise collection, MRF and monitoring. Typical SWM organization of barangays on Boracay Island is shown in Figure 3.1-3.



**Figure 3.1-3 Typical SWM Organization of Barangays on Boracay Island**

Source: JICA Study Team

The Barangay Solid Waste Management Committees (BSWMCs) should be created according to RA 9003 and its IRR (Rule VI, Section 6). Several BSWMCs have been organized based on Ordinance No. 2003-001, An Ordinance Creating the Barangay Solid Waste Management Committee, Providing Funds For The Operation Thereof And For Other Purposes (see Appendix II-3.1.2 (3)). As of July 23, 2007, only a few barangays, such as Balabag and Manoc-Manoc, have active BSWMCs as shown in Table 3.1-3.

**Table 3.1-3 Status of Barangay Solid Waste Management Committee**

Barangay	Year organized	Ordinance no.	Status
1. Argao	2003	004	Inactive
2. Balabag	2003	01	Active
3. Balusbos	2003	02	Inactive
4. Caticlan	2006	021	Inactive
5. Cogon	2003	01	No BSWMC but has a single ordinance on garbage disposal
6. Cubay Norte	2003	002	Inactive
7. Cubay Sur	-	Not submitted	Inactive
8. Dumlog	2003	03	Inactive
9. Kabulihan	2007	-	Newly organized
10. Manoc-Manoc	2003	07	Active through assigned MRF Supervisor
11. Motag	2003	002	Inactive
12. Naasog	-	-	No BSWMC
13. Nabaoy	2003	15	Inactive
14. Napaan	NA	03	Inactive
15. Poblacion	2005	3	Inactive
16. Sambiray	2004	005	Inactive
17. Yapak	2003	Not submitted	Inactive

Note: NA means not available.

Source: Each barangay

Memberships of the BSWMC according to Section 7 Rule VI of the IRR, are:

- The Barangay Captain as the chairperson
- One (1) Kagawad, preferably Chairperson of Committee of Environment or Health
- Sangguniang Kabataan chairperson
- President of Homeowners Association
- Public or private school principal or representative
- One (1) Parents and Teachers Association president or representative
- One (1) Religious organization representative
- One (1) Business Sector representative
- One (1) Environmental NGO representative
- President of Market Vendors Association, one representative from junkshop owners

(4) Roles of the MOM and Barangays

Principal roles of the LGUs on SMW are discussed in RA 9003 and its IRR as follows:

- Sec.2 of Rule VIII of the IRR: the LGU shall be primarily responsible for the implementation and enforcement of the ecological SWM systems within their respective jurisdictions as described in the LGC. Waste segregation and collection

shall be conducted at the barangay level, specifically for biodegradable/compostable and reusable/recyclable wastes. The collection and disposal of non-recyclable/non-recoverable materials and special wastes shall be the responsibility of the municipality.

- Sec.1 of Rule IX of the IRR: all LGUs shall actively promote among its constituencies the reduction and minimization of wastes generated at the source; responsibility for sorting and segregation of biodegradable and non-biodegradable wastes shall be at the household level and all other sources.

Principal roles of the barangays on SMW are also discussed in RA 9003 and its IRR as follows:

- Sec.1 of Rule XI of the IRR: barangays shall be responsible for the collection, segregation, recycling of biodegradable, recyclable, compostable and reusable wastes. MRFs shall be established in every barangay or cluster of barangays.

In addition, monthly progress reports shall be submitted to the MSWMB with a copy furnished to the local DOILG. The report shall contain volume of waste according to type, for example, volume of biodegradable waste collected and composted at home or at the communal composting site, estimated volume of recyclable wastes collected and sold and volume of residual wastes for LGU collection.

(5) Other Stakeholders Related to Solid Waste Management

There are two ways of private sector participation in the RA 9003 scheme. One is through the representation of the private sector, recycling industries or NGOs in the National Solid Waste Management Board and the local government Solid Waste Management Boards or committees. Another is to participate under contractual agreements with the local SWM Boards “to provide finance, and to construct, operate and maintain a facility and, in the process, charge fees or receive compensation.”

**Table 3.1-4 Activities of Private Sector**

Private Sector	Activities
1. YT Trading	Under contract with the MOM, this company trucks out residual wastes from the MRFs on Boracay Island, transport via a flatboat and bring via another truck to the proposed SLF in Barangay Kabulihan
2. Junkshops	Buy recyclables from the households or MRFs
3. San Miguel’s Brewery Co.,Ltd.	Collecting PET bottles from MFRs in Balabag and Manoc-Manoc. They send collected PET bottles to a recycling factory in Cebu. They carry out this recycling activity under their responsibility as a producer. To involve a kind of producer that can be an end user leads to development of markets for recyclables.
4. Manila Broadcasting Company & Kalibo Cable	Promote through promotional advertising through radio and TV as sponsor or as contracted by private sector to support the information dissemination campaign.

Source: Each Organization

There are two major NGOs relating to SWM on Boracay Island which are Boracay Chamber of Commerce and Industry (BCCI) and Boracay Foundation Incorporated (BFI). Their major activities are summarized in Table 3.1-5.

**Table 3.1-5 Activities of NGOs**

Organization	Activities
Boracay Chamber of Commerce Inc. (BCCI)	<ul style="list-style-type: none"> <li>- Sits as member of the MSWMB</li> <li>- “ War on Waste” a contest among hotels/resorts to recognize good practices of ecological solid waste management</li> <li>- “Design a Trophy “ contest which promotes use of recyclable materials among students</li> </ul>
Boracay Foundation Inc. (BFI)	<ul style="list-style-type: none"> <li>- Sits as member of the MSWMB</li> </ul>

Source: Each Organization

### 3.1.3 Inventory of Equipment and Staff of the Municipality of Malay and Barangays

#### (1) Equipment

Table 3.1-6 is an inventory of equipment used by the MOM and the barangays for SWM. It is noted that most vehicles and equipment are deployed on Boracay Island, where most of the waste management activities are taking place. The bioreactors, shredders and the polystyrene melting ovens demonstrate community-based recycling efforts. It is also notable that the motor vehicles and communication equipment are used to enhance monitoring and enforcement activities. Recognizing the importance of reporting, recording, documentation and feedback mechanisms, telephone, handheld radios, computers and cameras have been installed in each MRF on Boracay.



**Table 3.1-6 Inventory of Equipment for SWM**

No.	Ownership	Equipment	Quantity (No. of units)	Purchase Price (PhP)	Type of Waste/ Usage	Operating area	Operating Conditions
1	LGU	Bulldozer	1	10,920,000	Residuals	SLF	occasional
2	LGU	Grader	1	7,382,144	Residuals	SLF	occasional
3	LGU	Payloader	1	8,000,000	Residuals	SLF	not in service
4	LGU	Mini-dump truck - 4m <sup>3</sup>	1	350,000	Hauling of Recyclables	Balabag	daily
5	Barangay Balabag	Mini-dump truck - 4m <sup>3</sup>	1	268,000	Hauling of Biodegradables	Balabag	daily
6	Barangay Balabag	Mini-cab	1	400,000	Monitoring	Balabag	occasional
7	LGU	Mini-dump truck - 4m <sup>3</sup>	1	350,000	Hauling of all waste types	Manoc-Manoc	daily
8	Barangay Manoc-Manoc	Multi-cab	1	148,000	Monitoring	Manoc-Manoc	occasional
9	LGU	Mini-dump truck - 4m <sup>3</sup>	1	350,000	Hauling of Recyclables & Residuals	Yapak	3-4 times per week
10	LGU	Truck - 6m <sup>3</sup>	1		Hauling of Residuals	LGU	daily
11	LGU	Truck - 5m <sup>3</sup>	1	280,000	Hauling of Biodegradables, Residuals or Garden wastes	Boracay Barangays	daily
12	LGU	Truck - 5m <sup>3</sup>	1		Hauling of Residuals	Balabag	daily
13	LGU	Truck - 5m <sup>3</sup>	1	490,000	Hauling of Garden Wastes	Balabag	daily
14	LGU	Truck - 5m <sup>3</sup>	1		Hauling of Mixed Wastes	Caticlan	not in service
15	LGU	Motorcycle	1	34,000	Monitoring	LGU	occasional
16	LGU	Motorcycle	1	49,500	Monitoring	Boracay	daily
17	LGU	Motorcycle	1	49,500	Monitoring	LGU	daily
18	Caticlan	Multicab -3m <sup>3</sup>	1	90,000	Hauling of mixed wastes	Caticlan	twice a week
19	LGU	Bioreactor (500kg/shift)	3	975,000	Composting of Biodegradable Wastes	Balabag & Manoc-Manoc	daily
20	LGU	Shredder (750/kg/h)	2	350,000	Biodegradable Wastes	Balabag & Manoc-Manoc	daily
21	Barangay Balabag	Shredder	1	100,000	Kitchen Wastes	Balabag	-
22	LGU	Shredder (Caticlan)	1	375,000	Biodegradable Wastes	Caticlan	under repair
23	LGU	Plastic Densifier	3	129,000	Polystyrene and used cooking oil	3 Boracay Barangays	on schedules
24	Barangays	Pushcarts	17	98,000	Collection in inaccessible areas	3 Boracay Barangays	daily
25	LGU	Handheld Radio	16	104,000	Communication, monitoring and enforcement	LGU & 3 Boracay Barangays	daily
26	LGU	Repeater & antenna	1	217,650	Communication, monitoring and enforcement	LGU	daily
27	Barangay Balabag	Radio Base	1	152,000	Communication, monitoring and enforcement	Balabag	daily
28	Boracay Barangays	Megaphones	3	4,500	Information & education campaign	3 Boracay Barangays	occasional
29	Boracay Barangays	Computer with printer	3	90,000	Documentation and communication	3 Boracay Barangays	daily
30	Boracay Barangays	Digital camera	1	7,000	Documentation and communication		-
31	Manoc-Manoc	Sorting table	2	9,800	Sorting	Manoc-Manoc	daily
32	Boracay Barangays	Plastic containers	60	16,500	Kitchen waste or cooking oil	3 Boracay Barangays	daily

Source: MOM and Barangays

(2) Staff

The list of personnel involved in SWM is tabulated in Table 3.1-7. Fifty eight (58) people are employed by the MOM for collection, transport and stockpiling of residual wastes including the preparation of the SLF, and enforcement activities. Seven two (72) are commissioned in the four barangays, namely Yapak, Balabag, Manoc-Manoc and Caticlan. The personnel of the barangays carry out SWM activities ranging from training and compliance with the monitoring at the source generation, collection of wastes, sorting, composting and trading of wastes.

**Table 3.1-7 List of Personnel Involved in SWM**

No.	Positions	No. of Personnel
<b>I. LGU Personnel</b>		
1	Solid Waste Management Action Officer	1
2	EMS Action Officer	1
3	SLF workers	8
4	EMS Staff	2
5	Over-all Deputy Supervisor	1
6	Deputy Supervisor for Street Cleaners	1
7	Street Cleaners	11
8	Deputy Supervisor for Beach Cleaners	1
9	Beach Cleaners	13
10	Truck Driver	4
11	Garbage Collector	4
12	Solid Waste Secretary	1
13	Monitoring Aide	9
14	Utility Worker	1
<b>Total</b>		58
<b>II. Barangay Yapak</b>		
1	Overall MRF Manager	1
2	Secretary/Monitor	1
3	Truck Drivers	1
4	Truck Helpers	2
5	Eco-aides/Sorters <sup>1</sup>	7
<b>Total</b>		12
<b>III. Barangay Balabag</b>		
1	Overall MRF Manager	1
2	Supervisor	1
3	Truck Drivers	2
4	Truck Helpers	6
5	Sorters/Monitors	7
6	Eco-aides/Sorters	7
7	Composting Aides <sup>2</sup>	2
8	Melting Oven Personnel	1
9	MRF Secretary	1
<b>Total</b>		28
<b>IV. Barangay Manoc-Manoc</b>		
1	Overall MRF Manager	1
2	Supervisor	1
3	Truck Drivers	2

<sup>1</sup> Eco-aides/sorters collect waste daily from inaccessible areas using pushcarts and assist in sorting.

<sup>2</sup> Composting aides work selecting biodegradable waste for shredding and loading into the bioreactor and supervising livestock feeding.

No.	Positions	No. of Personnel
4	Truck Helpers	4
5	Monitors	5
6	Sorters	5
7	Composting Aides	2
<b>Total</b>		20
<b>V. Barangay Caticlan</b>		
1	Supervisor	1
2	Truck Drivers	1
3	Street Sweeper	4
4	Eco-aides/sorters/Collectors	6
<b>Total</b>		12

Source: MOM and Barangays

### 3.1.4 Information, Education and Communication (IEC)

At present, the MOM does not have a comprehensive information, education and communication (IEC) program that covers the entire municipality. However, other national government agencies such as the DENR, the DOT and the Department of Education (DOE), through the public schools and the private sector, initiated and contributed to the IEC on ESWM, particularly on Boracay Island. Efforts towards a public awareness campaign by officials of barangays of the Mainland of Malay remain unorganized and ineffective for lack of a unified IEC program.

Table 3.1-8 shows the IEC initiatives of some national government agencies, while the IEC initiatives of public schools, and private sector entities primarily directed to Boracay Island stakeholders were conducted to promote proper waste segregation at the source (see Appendix II-3.1.4). An estimated amount of PhP 2.38 million was spent for the public awareness and training needs of Boracay Island in Year 2006.

**Table 3.1-8 Current IEC Initiatives by Government Institutions**

Agency	IEC Activities	Target	Core Message
MOM and Barangays	House-to-house campaign by LGU and barangay monitors	Boracay Island (Residents and business establishments)	<ul style="list-style-type: none"> <li>- Mandatory segregation-at-source</li> <li>- Put out garbage at designated places and designated time</li> <li>- Sanctions, penalties for violations of MO 185</li> </ul>
	Door-to-door campaign by LGU and barangay monitors		
DENR	House-to house campaign	Boracay Island	<ul style="list-style-type: none"> <li>- RA 9003</li> <li>- Segregation, anti-dumping and anti-burning</li> </ul>
	Forum on Pollution Control, Refresher Course on Solid Waste and Hazardous Waste	Hotels and the MOM	<ul style="list-style-type: none"> <li>- Role of hotels in RA 9003</li> </ul>
DOT	Training of MRF workers on materials identification, sorting, and composting	Boracay Island (MRF workers)	<ul style="list-style-type: none"> <li>- ESWM as a system</li> <li>- ESWM as a skill and profession</li> </ul>
	House-to-house campaign Door-to-door campaign	Boracay Island (Residents and business establishments)	<ul style="list-style-type: none"> <li>- Mandatory segregation-at-source</li> <li>- Put out garbage at designated places and designated time</li> <li>- Sanctions and penalties for violations of MO 185</li> </ul>
	Posting of stickers, posters in households, establishments, boats and tricycles	Public	<ul style="list-style-type: none"> <li>- Boracay Island waste segregation and collection</li> <li>- Fines and penalties</li> </ul>

Source: JICA Study Team

### 3.1.5 Public Awareness

#### (1) Methodology

This Public Awareness Survey was implemented to measure the perception of the residents – both the permanent and temporary residents - of Boracay Island and the Mainland of Malay on the current management of their solid waste.

Boracay Island was classified into three groups, namely, households/residents, business establishments, and tourists; while the Mainland of Malay was classified into the first two of those groups. A sample from each group was taken for interview using random sampling for the households and business establishments, and purposive sampling for the tourists. Table 3.1-9 shows the number of respondents surveyed from each group.

**Table 3.1-9 Numbers of Respondents of the Survey**

Target Group	Area	Respondents Per Area	Respondents Per Sector
Households/Residents	Boracay Island	132	162
	Mainland of Malay	30	
Business Establishments	Boracay Island	80	101
	Mainland of Malay	21	
Local and Foreign Tourists	Boracay Island	133	133

Source: JICA Study Team

The first portion of the survey revealed background information about the groups that demand consideration for the SWM’s design and implementation. Table 3.1-10 summarizes the relevant profiles of the three groups.

**Table 3.1-10 Profiles of Groups Surveyed**

Households/Residents	Business Establishments	Tourists
<ul style="list-style-type: none"> <li>- Annual household income ratio in Boracay to Mainland: 10:9</li> <li>- Source of income: Businesses (Boracay); Remittances from abroad (Mainland)</li> <li>- Types of houses: light materials to semi-concrete (Boracay); semi-concrete to concrete (Mainland)</li> <li>- Land ownership: 57% in Boracay; 93% in Mainland</li> <li>- House ownership: 80%</li> <li>- Ave. property area: 20sqm (Boracay); 31sqm (Mainland)</li> <li>- Ave. garden area: 9sqm (Boracay); 16.5sqm (Mainland)</li> <li>- Primary sources of information: TV, radios, neighbors</li> </ul>	<ul style="list-style-type: none"> <li>- Business size: small-scale</li> <li>- Years of existence: &lt;5 yrs (50%); 5-15 yrs (33%); &gt;15 yrs (17%)</li> <li>- Usual No. of Employees: less than 15</li> <li>- Annual Gross Income: &lt;PhP300,000 (60%); PhP300,000-PhP1M (30%); &gt;1M (10%)</li> <li>- Floor Area: &lt;25m<sup>2</sup> (40%); &gt;25m<sup>2</sup> (60%)</li> </ul>	<ul style="list-style-type: none"> <li>- Country of Origin: Philippines (34%); Other Asian countries (29%); Europe (25%); North &amp; South America (12%)</li> <li>- Koreans comprise 87% of the other Asian countries; Americans comprise 75% of North and South America; British and Germans comprise 33% of Europe.</li> <li>- Primary Reason for visiting the country: to go to Boracay to relax</li> <li>- No of Visits: 1<sup>st</sup> time – 61%; 2<sup>nd</sup> time – 22%; &gt;2<sup>nd</sup> time – 11%</li> <li>- Ave. Duration of Stay in Boracay: 5 days</li> </ul>

Source: JICA Study Team

(2) Survey Results

The major portion of the survey tackled the sectors’ perception on at least six facets of SWM. The results are presented as follows.

1) Environment and Solid Waste Concerns

The respondents were surveyed about their perceptions on cleanliness.

In the household sector, 79% of the respondents perceive their areas to be clean but not at a level that they can be proud of. The same level of perception was exhibited by the business sector in Mainland of Malay; but in Boracay, 85% of the respondents indicated that it is clean and two-thirds of them are even proud of its cleanliness. In the tourist sector, 61% of the respondents graded Boracay Island as clean. They were not asked about the level of cleanliness.

With regards to their contribution to cleanliness, 90% of the respondents claimed regular cleaning of surroundings and 87 % of those from Boracay practice waste segregation and some 64 % of the respondents discharge wastes at designated areas. The level of

participation is lower for those on the Mainland. A total of 57% of the respondents practice waste segregation and 3% of the respondents are discharging wastes at designated areas. A similar picture can be observed in the business sector. In Boracay, compliance to municipal segregation policy is at 81% of the respondents, while in the Mainland, it is only at 67%. For the tourists sector, 98% of the respondents indicated willingness to participate in municipal programs for improving cleanliness.

When it comes to how solid waste management issues are affecting cleanliness, 40% of the Boracay household respondents can not think of any way, but the top issues cited by the others are littering, scattering of wastes at collection points, and waste dumping. On the Mainland, they added burning of municipal wastes. In the business sector, the top issues cited were indiscriminate throwing of solid waste anywhere and scattering of wastes at collection points.

## 2) Knowledge on Solid Waste Management and 3R Activities

This section measured the level of the sectors' awareness on the SWM Policies and their adherence to these policies.

On Boracay Island, the level of awareness of the households and the business establishments on SWM policies are significant (at least 97%). It is different on the Mainland of Malay where 60 % of the responding households complained of the lack of waste collection in their areas. As for the tourists, 93 % indicated that they are willing to practice segregation and the 3R activities. The practice of bringing their own shopping bags, and participation in a refund system for bottle containers came to the fore. The expected amount of refund that came out of the survey was PhP 4.75. However, half of them are not aware of the SWM policies.

For those who comply with the SWM policies, the major practice mentioned was the segregation of food wastes and recyclables from the other types of wastes. For the tourists, waste segregation at discharge is the main practice.

The main sources of SWM information had been the barangays. For the households, the monitoring teams and dissemination meetings are the primary media. For the business sector, it is the government announcements. For the tourists, it is the labels on the trash bins and the posters on public transport vehicles. Radios and televisions were secondary sources.

## 3) Waste Discharge Activities

These are the components of discharging wastes that were inquired about through the survey:  
a. the manner of discharge, b. frequency, c. volume and d. capacity.

### a. Manner of Discharging Wastes

It is common practice for both households and businesses to discharge of food wastes by feeding them to animals. For recyclable items, the common manner of discharge is selling

to recyclers. For residual wastes such as construction wastes and hazardous wastes, the primary manner of discharge is segregation. For some, it is burning of construction waste and burying of hazardous waste.

b. Frequency of Discharging Waste

For all the sectors, food wastes or other biodegradable wastes are discharged on a daily basis. Recyclable wastes are discharged 3-4 times a week, while residual wastes are discharged 3-5 times a week.

c. Volume of Discharged Waste

The average volume of food wastes discharged by all sectors is 1 kg per day. For recyclables and residuals, the average volume ranges from 0.5-1 kg per discharge.

d. Capacity to Discharge Waste

The respondents can keep food wastes for only a day. For recyclable wastes, households can wait for as long as 8 days. Businesses, however, can store them for 4 days. Residual wastes can be stored for only 2-3 days.

The possibility to travel a distance to discharge of wastes varies for households and businesses. Businesses prefer to discharge wastes on-site, but if not given a choice, they are willing to travel within a 50-meter radius to discharge all types of wastes. The households are only willing to travel within a 10-meter radius for food wastes, and within a 20-meter radius for the other wastes. The tourists are only willing to bring their wastes up to their hotels or place of abode.

As for willingness to purchase trash bags, 3% responded affirmatively from the households, 26% from the businesses, and 74% from the tourists. The average amount the tourists are willing to spend for plastics is PhP3.25.

4) Opinion on Current Collection Service

The respondents' general level of satisfaction with the current waste collection is very high on Boracay Island (at least 92%), as compared to the Mainland of Malay, which is only at 48%. The main parameter of satisfaction had been the frequency of collection. Frequent collection means higher level of satisfaction.

5) Willingness to Pay for Waste Collection

Waste collection fees are required from businesses, with the exception of cottage industries, and from tourists, via the admission fees. Hence, the households are not regularly paying waste collection fees. When asked about their willingness to pay, only 1/3 responded affirmatively, and the estimated amount they are willing to pay is PhP49 per month. In contrast, businesses are spending an average of PhP373 per month for waste discharge. Tourists, on the other hand, are currently charged PhP50, and the majority of them think that is enough. When asked about

the suitability of pegging the admission fee to their duration of stay, the majority of them declined for lack of confidence on how the government uses the amount.

6) Overall Opinion on Solid Waste Management

On improving SWM, the majority of the households suggested improving the collection service, meaning increasing the frequency of collection, particularly for the Mainland of Malay, increasing public awareness, especially for tourists and on the Mainland of Malay, increasing the number of trash bins in public places, and regular monitoring of compliance.

3.1.6 Cost and Revenue

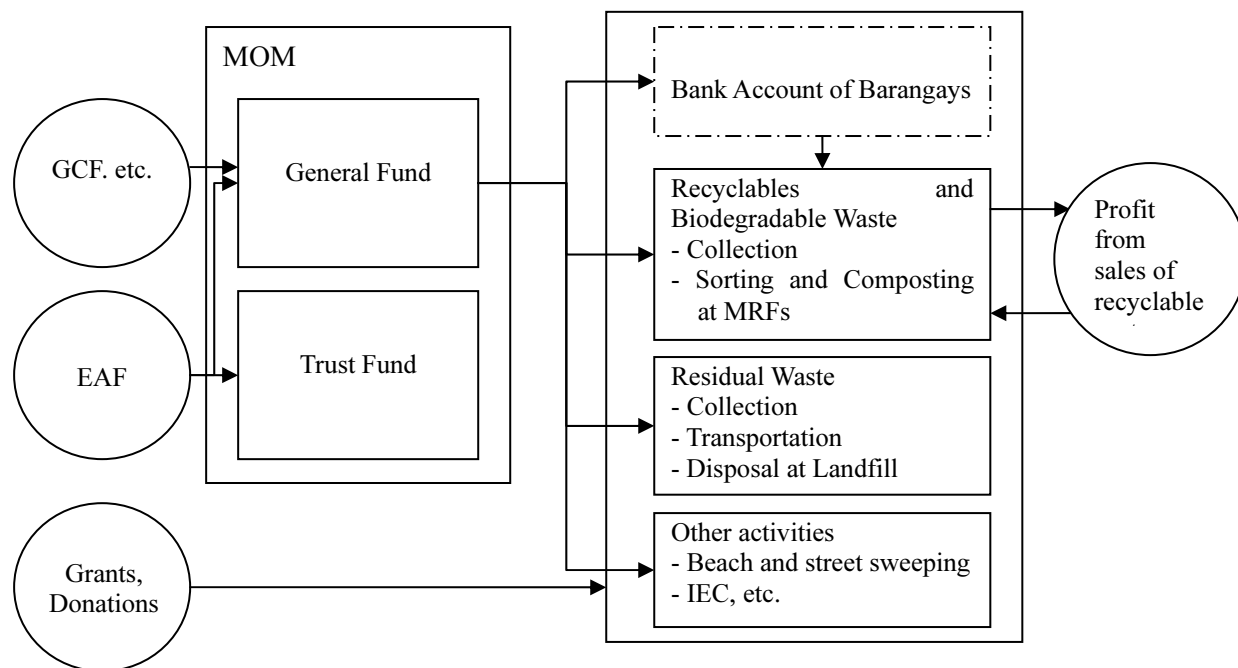
(1) Financial Structure and Flow

Main source of finance for SWM has changed from the General Fund of the MOM to the Trust Fund since introduction of the Environmental and Admission Fee (EAF) in January 2006. The EAF is basically managed as the Trust Fund, but temporarily it was managed as the General Fund until September 2006.

SWM expenses had been sourced from the General Fund until FY2005. However, the amount of SWM expenses and financial structure were drastically changed when open dump sites were closed and MRFs were established on Boracay Island in accordance with RA9003. SWM expenses were around PhP 2 million until FY2005, and then it soared to over PhP 7 million. In 2006, most of the increase in SWM expense was covered by the EAF that was introduced in that year. However, the EAF, until September 2006, was put into General Fund and appropriated for SWM. From October 2006, it was put into the Trust Fund. In FY2007, the SWM expenses were covered by the EAF through the Trust Fund.

Expenses of collection of recyclables and biodegradable waste, and costs relating to MRFs' operation by barangays have been covered by the budget of the MOM. Budget for personal expenses of MRFs and costs of collection by barangays have been provided through the bank accounts of the barangays by the MOM. The expenses for oil and lubricants, etc. for operation of MRFs and collection of biodegradable waste and recyclable are directly covered by the MOM. Consequently, the MOM has been covering all of the SWM expenses. However, grants from the DOT and donations from private sector entities support SWM in Boracay. PhP 5 million to cover costs for establishment of MRFs, including equipment and training services were granted by the DOT in FY2006. Private sector entities on Boracay Island donated a dump truck and shredder machine worth about PhP 0.77 million in 2006. These granted and donated amounts are cover 78 % of the SWM expenses of the MOM. Profits from sales of recyclables and compost, and temporarily-generated income by extra collection service for garden waste are used for operation of MRFs. The financial flow of SWM is illustrated in Figure 3.1-4.





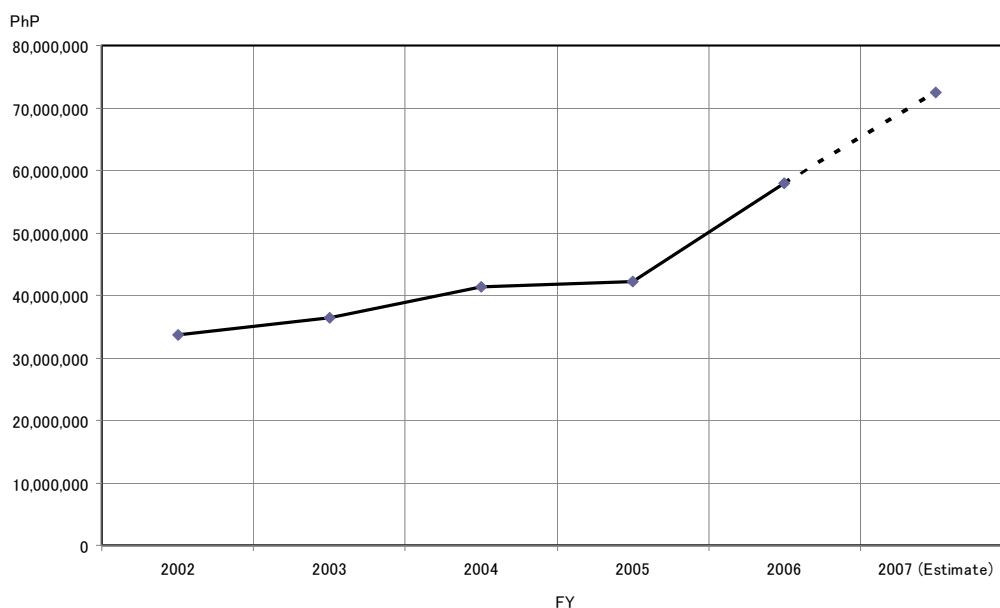
**Figure 3.1-4 Financial Flow of SWM of FY2006**

Source: JICA Study Team

(2) Budget for Solid Waste Management

1) Amount of General Fund and SWM Expenses

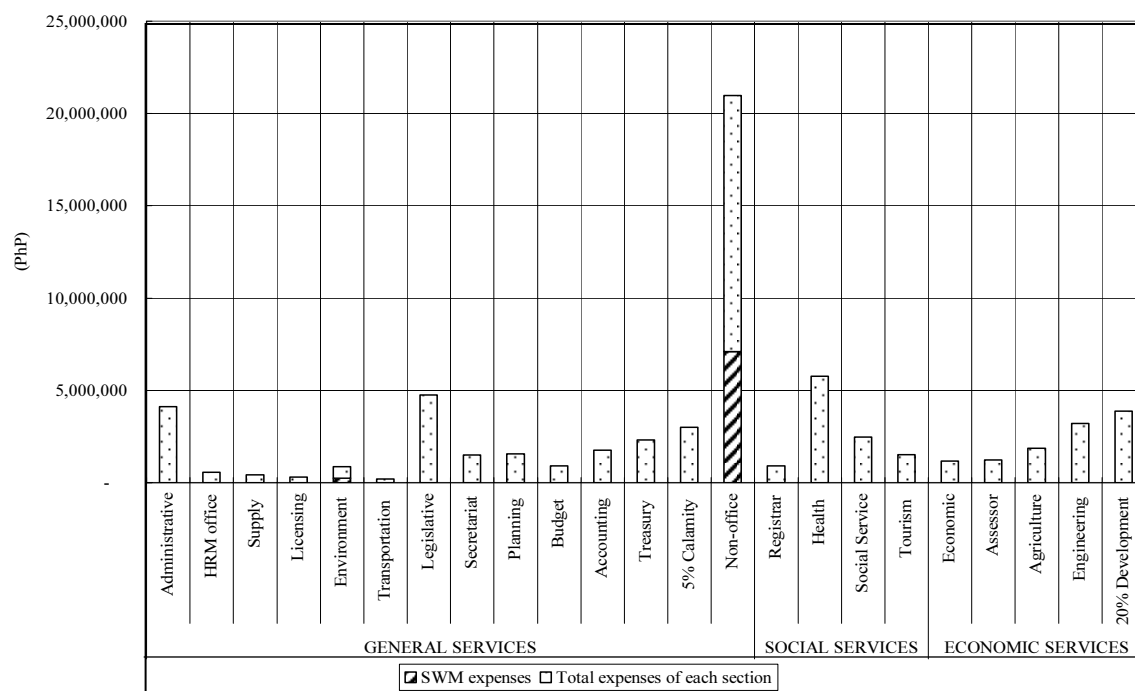
The actual amount of the General Fund demonstrates an upward trend and has increased close to PhP 60 million in FY2006 from approximately PhP 40 million in FY2005 as shown in Figure 3.1-5. Increased expenses for SWM may influence this trend. Further increase in the amount is expected in FY2007. However, it is mainly sourced from the Trust Fund and increase in the budget does not influence the amount of the General Fund.



**Figure 3.1-5 Trend of Amount of General Fund (Actual)**

Source: MOM

Details of the amount of the General Fund of FY2006 are shown in Figure 3.12-3. It is categorized based on the offices (section/department/service) of the MOM. Most SWM expenses are classified as Non-office and the SWM expenses are comparatively larger than the other categories. A part of the expenses of SWM are attributable to the Environmental Management Service.



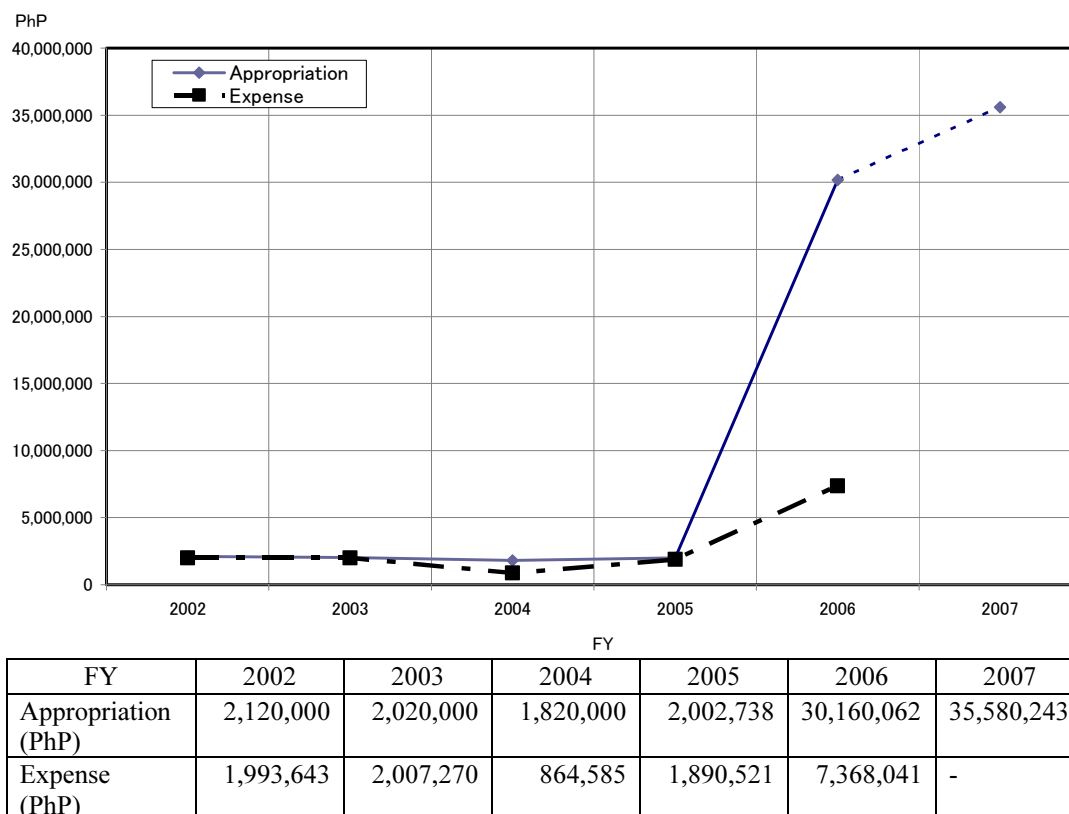
**Figure 3.1-6 Use of General Fund of FY2006 (Actual)**

Note: The sum of expenses of each item corresponds to total amount of General Fund.

Source: MOM

## 2) Annual Budget for Solid Waste Management

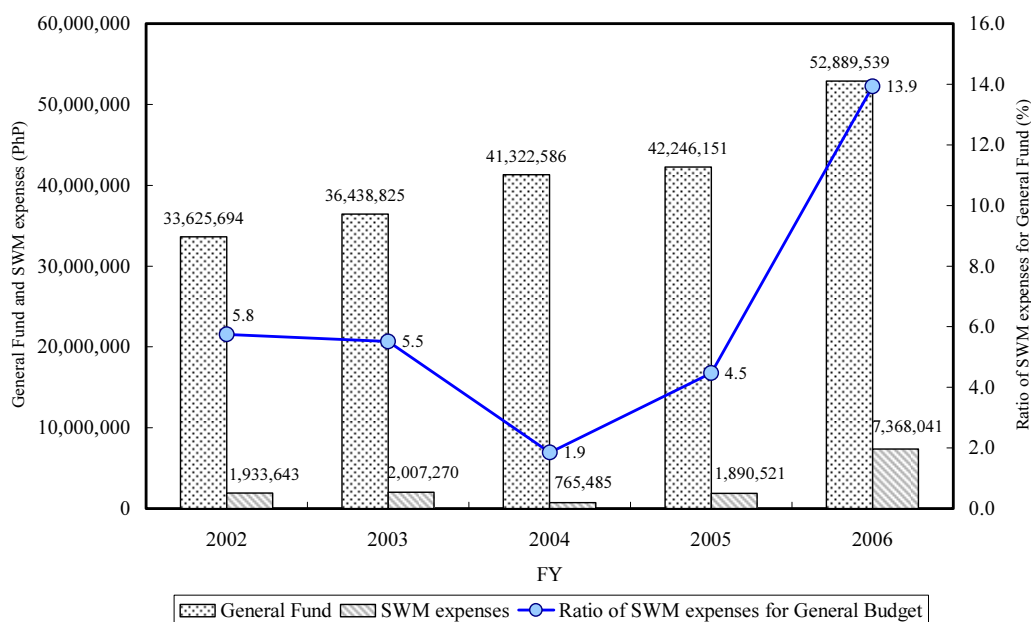
Appropriations for SWM had held at around PhP 2 million until FY 2005 when they underwent a transition as shown in Figure 3.1-7. However, the amount of appropriation drastically increased in FY2006 due to the need for transportation of residuals and development of MRFs. The amount is approximately PhP 30 million which is 15 times that of the previous year.



**Figure 3.1-7 Appropriation and Expenses of Solid Waste Management**

Source: MOM

Figure 3.1-8 shows the amount of the General Fund and SWM expenses and the ratios of SWM expenses to the General Fund. The ratios of SWM expenses to the General Fund were 2 to 6 % from FY2002 to 2005, while the ratio rose to about 14 % in FY2006.

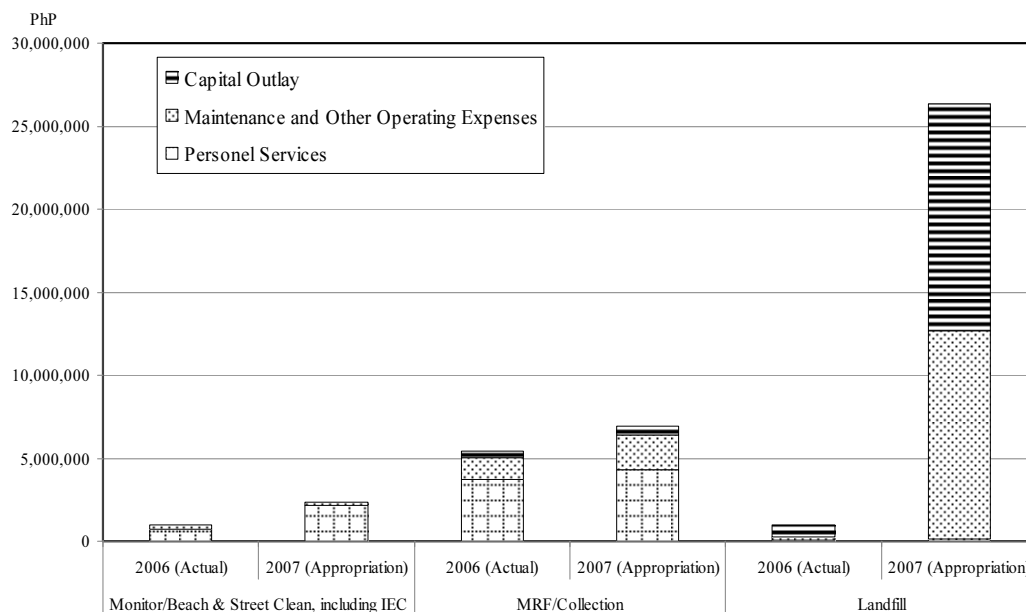


**Figure 3.1-8 Comparison between General Fund and SWM Expenses (Actual)**

Source: MOM

(3) Expenditure for Solid Waste Management

As shown in the above Figure 3.1-8, actual expense in FY2006 was approximately PhP 7 million. However, these expenses do not include management costs such as salaries of municipality officials. The expenses including the management costs are estimated at approximately PhP 8 million. Figure 3.1-9 shows the details of the expenses in FY2006 and appropriation in FY2007 for SWM including the management costs.



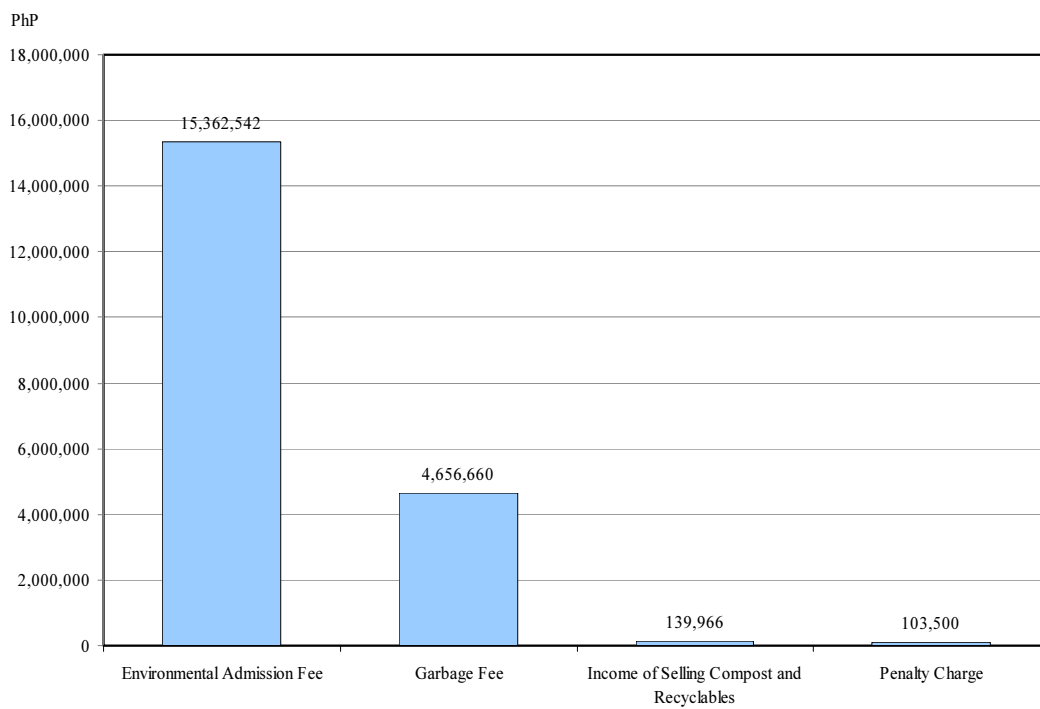
**Figure 3.1-9 Details of Appropriation of Solid Waste Management (FY2007)**

Source: MOM

(4) Revenues for Solid Waste Management

The revenues for SWM including income of the barangays should be discussed. The status of income of barangays is a key to consider how to cover the necessary costs for the 10-year SWM Plan. Figure 3.1-10 shows the amount of revenues from the EAF and GCF, income from selling compost and recyclables, and penalty charges. Although the EAF revenue is not solely for SWM, it is included as revenue for SWM.

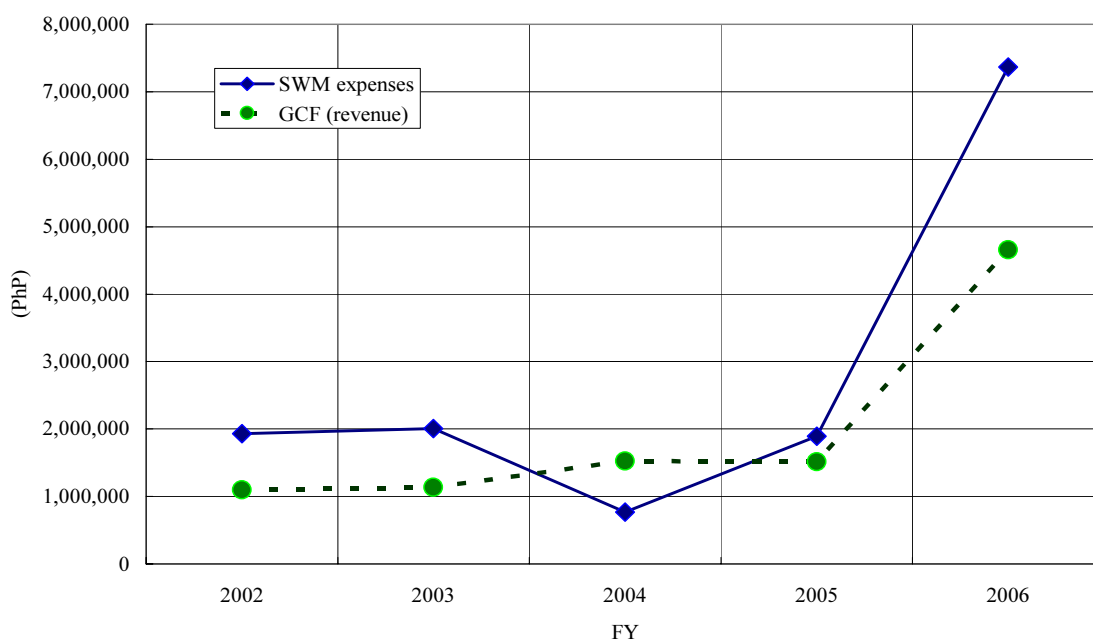
Total amount of revenues is approximately PhP 20 million when includes PhP15 million of the EAF and about PhP 5 million of the GCF. Currently, these two revenues are the main sources to cover the costs for SWM. The GCF had been only main source appropriated to SWM until FY2006. As shown in Figure 3.1-11, although more than half of SWM expenses have been covered by the GCF, the GCF could not cover the whole of SWM expenses.



Sources of Revenue	Amount (PhP)
EAF (except for 15% of total collected EAF for Province)	15,362,542
GCF	4,656,660
Income from Selling of Compost and Recyclables	139,966
Penalty Charge	103,500
<b>Total</b>	<b>20,262,668</b>

**Figure 3.1-10 Revenues related to Solid Waste Management (FY2006)**

Source: MOM



**Figure 3.1-11 Comparison between SWM Expenses and GCF (FY2006)**

Source: MOM

(5) Collection of Main Revenues

1) Collection of GCF

The GCF has been collected from business enterprises on Boracay Island. This charging system was introduced in 2002 and the fees were substantially raised in 2006. The fees that business entities should pay are decided according to type of business and floor area. Almost of them properly pay because there is a checking system by the treasurer's office of the MOM and they lose their business license if they do not pay the GCF. When the business licenses are renewed annually, they payment of the GCF of the previous year is also checked.

2) Collection of EAF

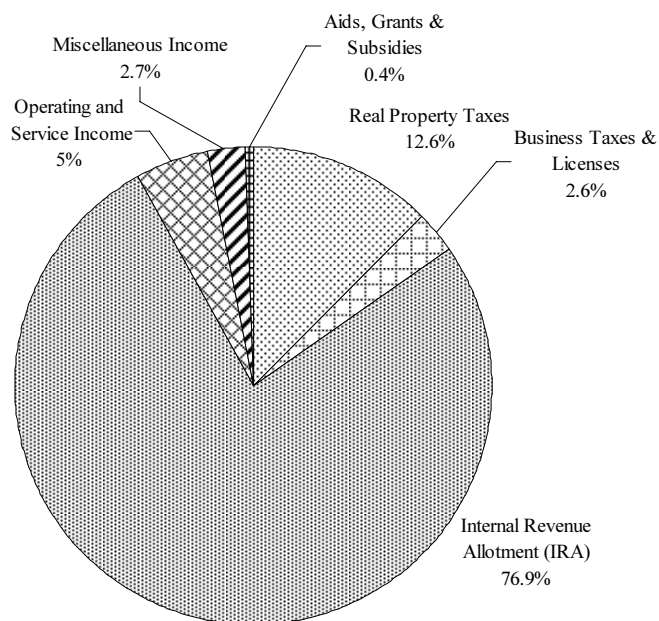
The EAF was introduced in January 2006 with aims for environmental protection as well as tourism development on Boracay Island. Until now, revenue of the EAF has been appropriated fifty-fifty for SWM and the tourism development. The EAF is collected at three ports of Mainland of Malay by the provincial government. A total of 15 % of the EAF collected goes to the provincial government, while 85 % goes to the MOM.

Tourists have to pay not only the EAF but also a terminal fee and a boat fee at an entrance to the port. However, the counters for each fee are separated and operated individually and it may make the collection system complicated, and make it difficult to collect the EAF from all the tourists. In addition, inspection of payment of the EAF at the entrance of the port is not conducted with all arrivals because it is difficult to inspect for three payments that should have been made by the tourists, especially when many tourists arrive at the port simultaneously. As a result, it is estimated that about 30 to 40 % of the tourists do not pay the EAF according to the tourism office of the MOM.

(6) Income of Barangays

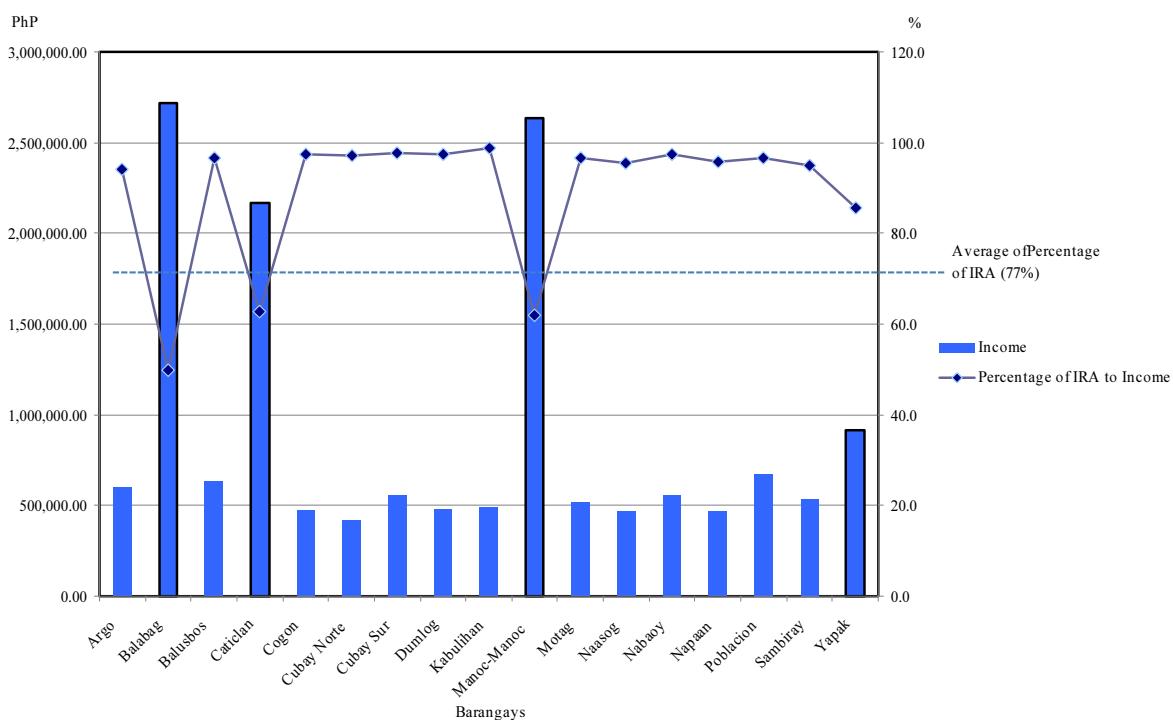
Figure 3.1-12 shows income sources of 17 barangays in FY2006. About 77% of the income of FY2006 was sourced from Internal Revenue Allotment (IRA) that the national government provides from the Development Fund. The IRA was originally a fund to be appropriated to payment for a loan. Usually the collateral requirements of a bank include securing IRA as a precondition.

Figure 3.1-13 shows the amount of income and percentage of IRA to the total income of each barangay. The amount of income of barangays on Boracay Island and Barangay Caticlan, which are the ones to operate MRFs, is comparatively bigger than the others, but the percentages of IRA to the total income are relatively small. Although the incomes are expected to be appropriated to SWM expenses, the SWM expenses have not been borne by the barangays so far.



**Figure 3.1-12 Income Sources of Barangays in FY2006**

Source: MOM

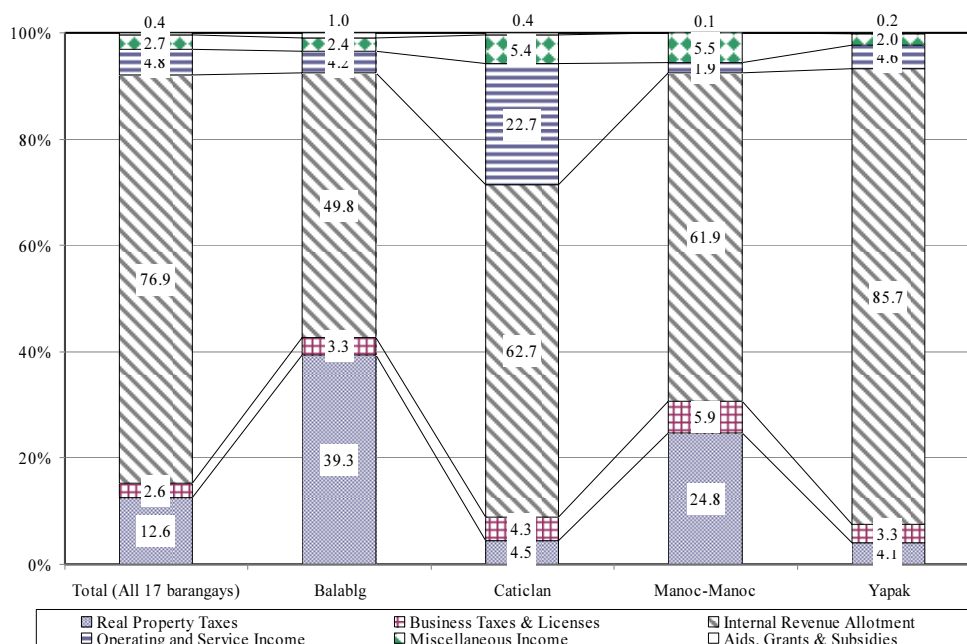


**Figure 3.1-13 Income of Each Barangay and IRA in FY2006**

Source: MOM

Figure 3.1-14 shows the details of incomes of these four barangays and total of 17 barangays. The ratios of real property taxes of barangays Balabag and Manoc-Manoc are larger and the

ratios of operating and service income (relating to operation of the ports) in Caticlan and Yapak are larger. These incomes are related to economic condition and tourism.



**Figure 3.1-14 Details of Incomes of Barangays in FY2006**

Source: MOM

### 3.2 Solid Waste Characterization

#### 3.2.1 Waste Generation

##### (1) Waste Quantity

The JICA Study Team conducted the waste analysis and characterization survey (WACS) targeting 90 households and 69 business establishments on Boracay Island and 30 households and 20 business establishments on the Mainland of Malay from May to July 2007. The quantity of solid waste from roads and beaches was estimated based on the information from the sweepers. The result of the waste quantity survey of households is shown in Table 3.2-1. The result shows that the average daily waste generation per person is 0.35 to 0.37 kg/person/day on Boracay Island while 0.30 to 0.35 kg/person/day on the Mainland of Malay. The values are more than the ones in typical rural areas in the Philippines<sup>3</sup> (0.30 kg/person/day) and less than the values in Manila Metropolitan Area except Valenzuela city<sup>4</sup> (0.53 to 0.63 kg/person/day).

<sup>3</sup> Waste Generation / Volume of Waste / Population / Classification, NSWMC (2006)

<sup>4</sup> Metro Manila Solid Waste Management Project, ADB (2003)



**Table 3.2-1 Result of Daily Waste Generation Quantity Survey of Households**

Area and type of household		Dry Season	Rainy Season	Average
		Waste Generation per Person (kg/person/day)	Waste Generation per Person (kg/person/day)	Waste Generation per Person (kg/person/day)
Boracay Island	Average	0.35	0.38	0.36
	High Income	0.34	0.41	0.37
	Middle Income	0.36	0.37	0.37
	Low Income	0.34	0.35	0.35
Mainland of Malay	Average	0.33	0.34	0.33
	High Income	0.35	0.34	0.35
	Middle Income	0.35	0.34	0.35
	Low Income	0.29	0.32	0.30

Source: JICA Study Team

The result of the waste quantity survey of business establishments is shown in Table 3.2-2. Regarding hotel, it was observed that 0.40kg/guest/day on Boracay Island and 0.41kg/guest/day on the Mainland of Malay. Based on the comparison of the result, there is no significant difference between Boracay Island and the Mainland of Malay. It was observed that the unit generation ratio of shop, restaurant and institution do not have significant differences between Boracay Island and the Mainland of Malay as well. However, the unit generation ratio of beach or street on Boracay Island is more than on the Mainland of Malay.

**Table 3.2-2 Results of Daily Waste Generation Quantity Survey of Commercial Sectors and Beaches/ Streets**

Generation Source		Unit	Dry Season	Rainy Season	Average
Boracay Island	Hotel	kg/guest/day	0.40	0.39	0.40
	Restaurant	kg/guest/day	0.21	0.20	0.21
	Shop/Market	kg/shop/day	4.66	4.33	4.40
	Institution	kg/office/day	3.08	2.92	3.00
	Beach	kg/km/day	17.50	54.00	35.80
	Street	kg/km/day	4.70	20.80	12.80
Mainland of Malay	Hotel	kg/guest/day	0.41	0.39	0.40
	Restaurant	kg/guest/day	0.21	0.20	0.21
	Shop/Market	kg/shop/day	4.44	4.36	4.40
	Institution	kg/office/day	3.03	2.92	3.00
	Beach	kg/km/day	10.50	48.60	29.60
	Street	kg/km/day	2.81	16.67	9.70

Source: JICA Study Team

Total generated waste quantity was calculated with the following assumptions.

- Household waste: the weighted average of three income levels was calculated and then the average of dry and rainy seasons was calculated.
- Hotel: Most of the generation was assumed to be from the guests (tourists).
- Restaurant: Most of the generation was assumed to be from the guests (tourists).
- Shop: Surveyed shops were assumed to be average sizes on Boracay Island and the Mainland of Malay, respectively.

- Institution: Surveyed institutions were assumed to be average sizes on Boracay Island and the Mainland of Malay, respectively
- Beaches and street: The areas considered were the main roads and beaches where sweeping activities are conducted.

Based on the above assumptions, the quantity of waste generated (QWG) of each source was estimated as shown in Table 3.2-3.

**Table 3.2-3 Estimated Quantity of Waste Generated [ton/day]**

Generation Source	Quantity of Waste Generated (QWG)		
	Boracay Island	Mainland of Malay	Total
Households	6.1	5.3	11.3
Hotels	4.9	0.3	5.2
Restaurants	2.9	0.3	3.2
Shops	4.9	0.5	5.4
Institutions	0.1	0.0	0.1
Beaches	0.2	0.0	0.2
Streets	0.1	0.0	0.1
Total	19.1	6.4	25.5

Source: JICA Study Team

## (2) Waste Quality

### 1) Physical Composition

The results of the survey executed by the JICA Study Team on Boracay Island and the Mainland of Malay are shown in Tables 3.2-4 and 3.2-5 (see Appendix II-3.2.1). On Boracay Island, the quantity of recyclables (recyclable papers and plastics, transparent and colored glass bottles, broken glass, metal cans, textiles, rubber and bulky waste such as electric appliances) and biodegradables (including kitchen waste, animal waste and garden waste, etc) constitute 72% of total waste generated. The portion of residual (non recyclable papers, diapers or ceramics, etc) is only 28%. On Mainland of Malay, the quantity of recyclables and biodegradables also constitutes a large portion of total waste generation (72%). The ratio of biodegradables (37%) on Boracay Island is slightly lower than that on the Mainland of Malay (42%).

As for the waste generated at the restaurants, the ratio of biodegradables is relatively large (56% on Boracay Island and the Mainland of Malay), and the residual is relatively small (22% on Boracay Island and the Mainland of Malay) in comparison with other generation sources. At the shops, the ratio of biodegradables on Boracay Island (44%) is smaller than on the Mainland of Malay (62%). At the institutions, the ratio of recyclables is large (45% on Boracay Island and 53% on the Mainland of Malay).

On the Mainland of Malay, the ratio of biodegradables to the total generation sources is relatively higher than on Boracay Island. No other significant differences have been identified in the WACS.

**Table 3.2-4 Physical Composition (Boracay Island)**

Type of Waste	Household	Hotel	Restaurant	Shop	Institution	Total
Biodegradable	30%	33%	56%	44%	25%	37%
Recyclable	37%	38%	23%	34%	45%	35%
Residual	33%	29%	22%	21%	29%	28%

Source: JICA Study Team

**Table 3.2-5 Physical Composition (Mainland of Malay)**

Type of Waste	Household	Hotel	Restaurant	Shop	Institution	Total
Biodegradable	39%	29%	56%	62%	25%	42%
Recyclable	31%	33%	21%	23%	53%	30%
Residual	30%	38%	22%	15%	21%	28%

Source: JICA Study Team

## 2) Bulk Density

The bulk density of the collected waste from each generation source on Boracay Island and the Mainland of Malay is described in Table 3.2-6. The bulk density of Boracay Island is larger than of the Mainland of Malay. On the Boracay Island, the food waste including shell or bone contribute to the increase the bulk density of Boracay Island.

**Table 3.2-6 Bulk Density [kg/L]**

Barangay	Dry Season	Rainy Season	Average
Yapak	0.19	0.16	0.18
Balabag	0.28	0.28	0.28
Manoc-Manoc	0.27	0.26	0.27
Boracay Island (Average)	0.25	0.23	0.24
Caticlan	0.10	0.10	0.10
Mainland of Malay	0.10	0.10	0.10

Source: JICA Study Team

## 3) Moisture Content

The moisture content of biodegradable waste from each generation source on Boracay Island and the Mainland of Malay was measured as shown in Table 3.2-7. According to the data, the moisture content on Boracay Island is slightly higher than of the Mainland of Malay. In addition, the moisture content of rainy season is higher than of dry season as usual.

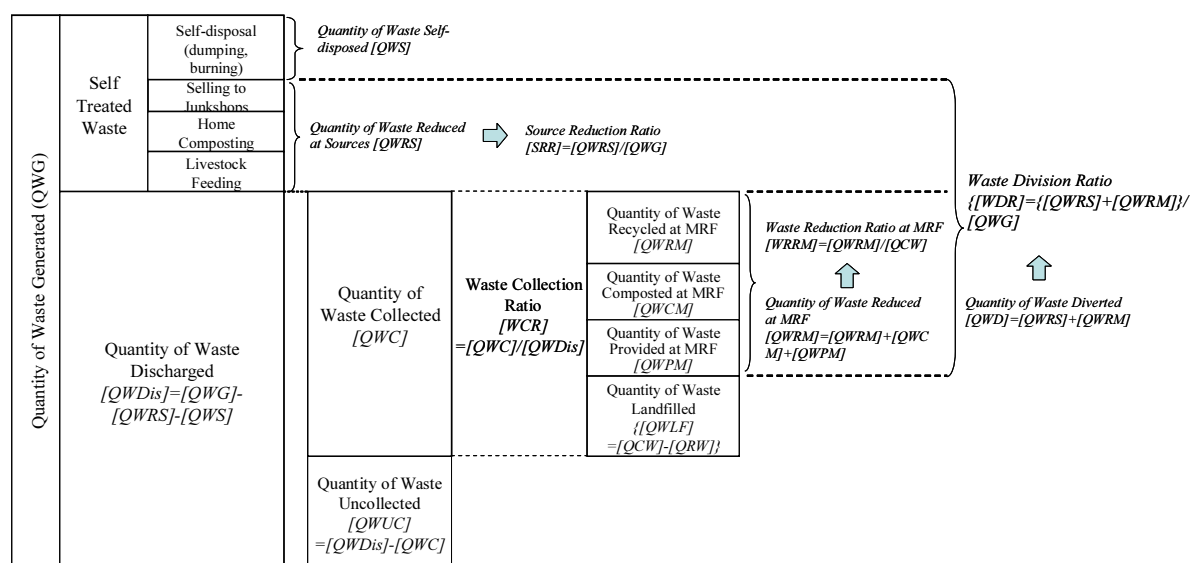
**Table 3.2-7 Moisture Content of Biodegradable Waste [wt. %]**

Barangay	Dry Season	Rainy Season	Average
Yapak	67.4	79.0	73.2
Balabag	73.5	84.5	79.0
Manoc-Manoc	62.1	80.8	71.5
Boracaly Island (Average)	67.7	81.4	74.6
Caticlan	64.9	75.5	70.2
Mainland of Malay	64.9	75.5	70.2

Source: JICA Study Team

### 3.2.2 Waste Diversion

According to RA 9003, the necessity of diversion of solid waste from waste disposal facilities through re-use, recycling and composting activities. The diversion of solid waste from waste disposal facilities is mainly categorized as diversion at the generation sources (source reduction) and diversion at MRFs (intermediate reduction). Basic concept for calculation of waste diversion is illustrated in Figure 3.2-1.



**Figure 3.2-1 Adopted Definition of Waste Diversion**

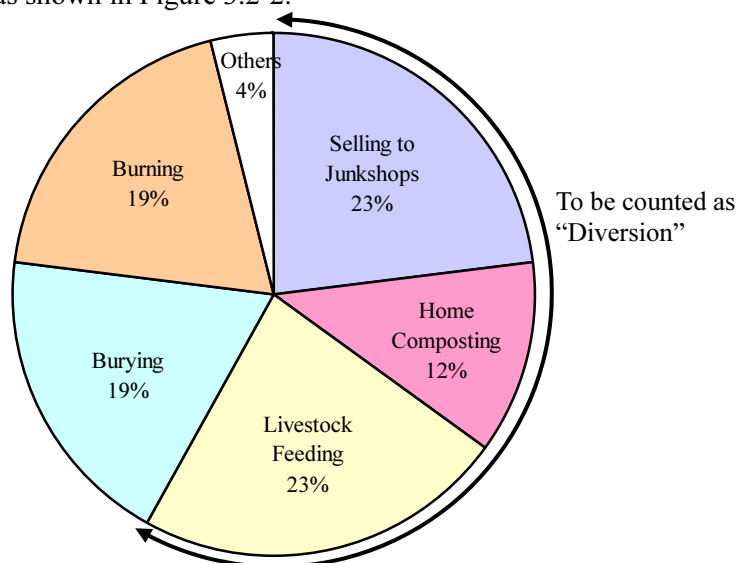
Source: JICA Study Team

#### (1) Waste Reduction at the Source (Source Reduction)

In the MOM, home composting, the provision of livestock feed and selling recyclable waste to junkshops are carried out for source reduction of solid waste. As part of the WACS by the JICA Study Team, the attribution survey to grasp the basic information such as source segregation or self-disposal<sup>5</sup> practices as well as the number of families for households, and the number of guest at the hotels and restaurants was conducted for the sampling targets.

<sup>5</sup> Self-disposal is defined as burying or burning within the owner's territory.

Based on the attribution survey, the ratio of self-treatment methods in the total self-treated waste<sup>6</sup> is revealed as shown in Figure 3.2-2.



**Figure 3.2-2 Self-Treatment and Disposal Methods**

Source: JICA Study Team

The quantity of generated waste and collected waste were measured in the WACS. Based on the result of the WACS, the amount of self-disposed of waste at sources including burying and burning was estimated as shown in Table 3.2.8. Hotels and restaurants contribute to source reduction by the provision of livestock feeding, while shops and households contribute to source reduction by selling the recyclables to junkshops or composting.

**Table 3.2-8 Solid Waste Treated and Disposed of at the Source [ton/day]**

Generation Source	Sold to Junkshops	Composted at Home	Used for Livestock Feeding	Buried	Burned	Others
Households	1.3	0.6	0.9	1.6	1.3	0.2
Hotels	0.2	0.7	1.8	0.0	0.0	0.0
Restaurants	0.4	0.0	1.1	0.1	0.1	0.0
Shops	1.1	0.5	0.1	0.0	0.8	0.3
Institutions	0.0	0.0	0.0	0.0	0.0	0.0
Total	3.0	1.9	4.0	1.7	2.2	0.5

Source: JICA Study Team

The source reduction ratio (SRR) was calculated as the rate of the amount of waste properly reduced at the source, i.e. the amounts of solid wastes sold to junkshops, composted at home and used for livestock feeding against the generation amount as shown in Table 3.2-9.

<sup>6</sup> Self-treated waste is defined as the part of generated waste that is treated, disposed or utilized within the owner’s territory.

**Table 3.2-9 Source Reduction Ratio**

Area	Source Reduction Ratio (SRR)
Boracay Island	23%
Mainland of Malay	51%

Source: JICA Study Team

(2) Waste Reduction at MRF (Intermediate Reduction)

Main activities of MRF which can be considered as waste diversion activities are recycling, composting and providing to farmers for livestock feeding. Recycling activities include sorting of recyclables and selling them to junkshops, and small scale recycling activities such as making tile from polystyrene foam. According to the results of the WACS by the JICA Study Team including interviews with the MRF workers, the amount of solid waste brought to each MRF and the amounts of recycled waste, composted waste, the waste provided to the farmers for livestock feeding, stored waste as residuals and other wastes including buried at each MRF are identified as shown in Table 3.2-10.

**Table 3.2-10 Solid Waste Handled at MRF [ton/day]**

MRF	Waste Brought	Recycled	Composted	Provided to Farmers	Stored as Residual	Others (buried, etc.)
Yapak	0.62	0.05	0.04	-	0.53	-
Balabag	7.56	0.81	0.30	0.60	2.86	2.99
Manoc-Manoc	3.22	0.26	0.20	-	1.11	1.65
Caticlan	0.83	0.16	0.15	-	0.52	-

Source : JICA Study Team

The waste reduction ratio at the MRFs was calculated as the rate of the amount of reduced waste at MRF including the amounts sold to junkshops, composted and provided to farmers for livestock feeding against the generation amount. Consequently, the waste reduction ratio at MRF (WRRM) was calculated as follows and shown in Table 3.2-11.

$$[WRRM] = \{[QWRM] + [QWCM] + [QWPM]\} / [QWC]$$

where:

- WRRM : Waste Reduction Ratio at MRF
- QWC : Quantity of Waste Collected
- QWRM : Quantity of Waste Recycled or Sold to Junkshops at MRF
- QWCM : Quantity of Waste Composted (by Bioreactor) at MRF
- QWPM : Quantity of Waste Provided to Livestock Feeding at MRF

**Table 3.2-11 Waste Reduction Ratio at MRF**

Area	Waste Reduction Ratio at MRF (WRRM)
Boracay Island	20%
Mainland of Malay	38%

Source: JICA Study Team

(3) Waste Diversion Ratio

Waste diversion ratio (WDR) is calculated as follows.

$$[WDR] = \{[QWRS] + [QWRM]\} / [QWG]$$

where:

- WDR : Waste Diversion Ratio
- QWRS : Quantity of Waste Reduced at Source (sold to junkshops, home composting and livestock feeding)
- QWRM : Quantity of Waste Reduced at MRF (recycled, composted and provided to the farmers for livestock feeding)
- QWG : Quantity of Waste Generated

**Table 3.2-12 Waste Diversion Ratio**

Area	Waste Diversion Ratio (WDR)
Boracay Island	35%
Mainland of Malay	56%

Source: JICA Study Team

3.2.3 Disposed Waste

On Boracay Island, since the suspension of operation of the old dump site in January, 2006, the solid waste to be disposed of (residual waste) has been temporarily stored in each MRF. Currently, the MOM has started to transport the residual waste including waste stored at MRFs to the proposed site for the new SLF in Barangay Kabulihan on the Mainland of Malay through contracting with a private company. Because there is no accurate record of the transportation of the residual waste, the amount of residual waste which is stored in MRFs on Boracay Island and that which has been transported to the new SLF was estimated under the assumption that the daily quantity of the residual waste collected in 2006 was similar to that in 2007. The residual waste generated since the suspension of operation of the old dump site until the end of July 2007 was estimated at approximately 2,500 ton in total.

3.2.4 Current Waste Flow

According to the results of the WACS, including the attribution survey and interviews at each MRF, the current waste flow of the MOM in 2007 is summarized as shown in Figure 3.2-3.

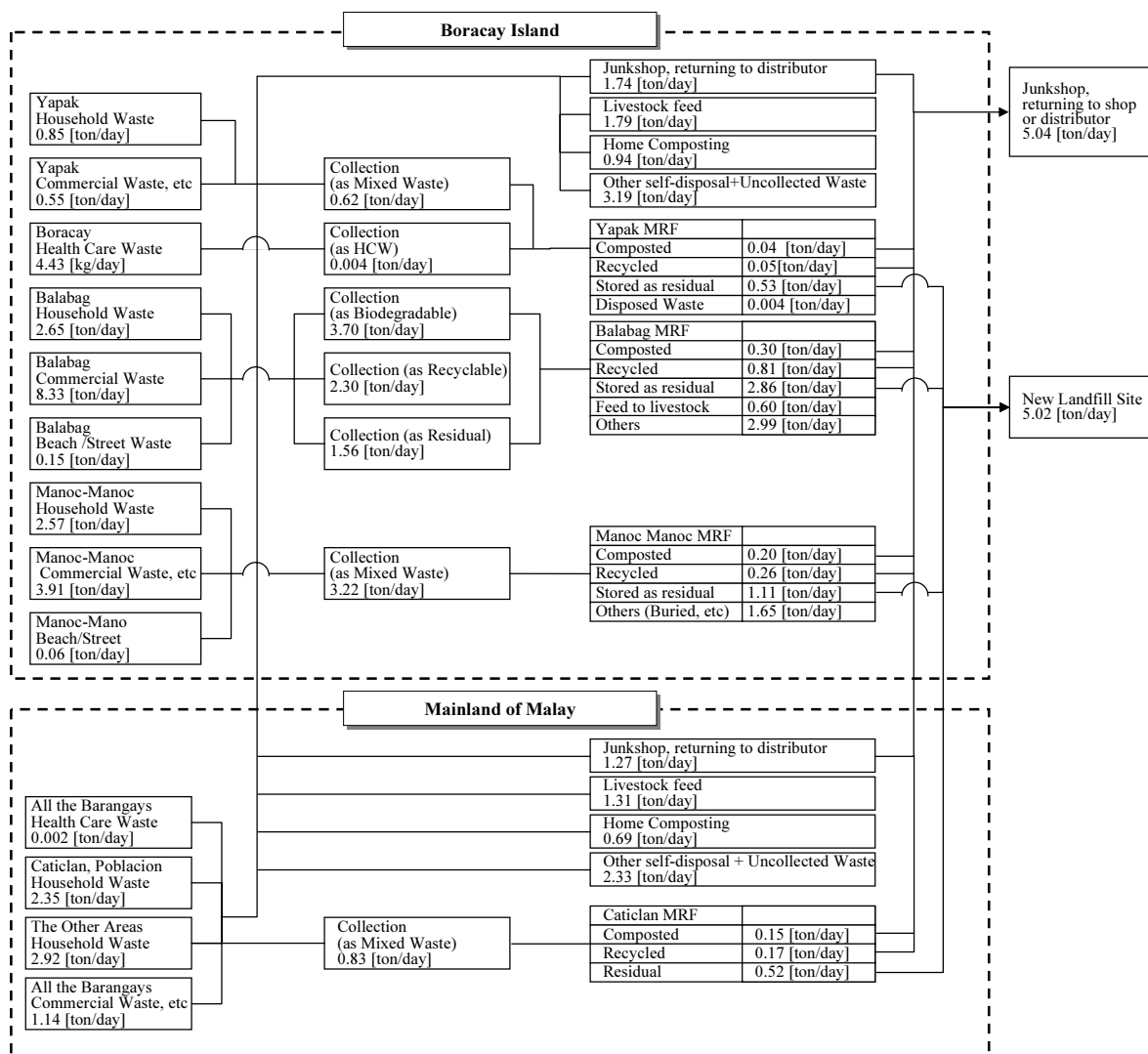


Figure 3.2-3 Solid Waste Flow of the Municipality of Malay in 2007

Source: JICA Study Team

### 3.3 Technical Aspects

#### 3.3.1 Source Reduction

On Boracay Island, hotels and restaurants are the main generation sources of biodegradable waste. Households are also one of the generation sources although the amount is less compared to hotels and restaurants. Non-biodegradable waste is generated in large amounts from by households and many kinds of commercial sectors. The container and packaging wastes comprise a large portion (around 50% on Boracay Island) of the non-biodegradable waste generated. The container and packaging materials are brought to Boracay Island mainly through distribution industries such as retailer shops and transportation companies.

The main source means of reduction of the biodegradable waste in on the Mainland of Malay is feeding the waste to livestock feeding. Some households carry out composting but it is not so many according to the Public Awareness Survey. Neither paper nor cardboard is not sold to junkshops but, other plastic bottles, glass bottles or metal cans are sold to junkshops



because of high economic values. Recyclable waste is sold directly to junkshops by households in some areas in on the Mainland of Malay where there are no collection services except for in the Barangay Caticlan, and a part of the area along the national road. Households are using foodstuff as much as possible during the cooking process which consequently contributes to reduction of biodegradable waste and they are also fixing and repairing broken things. There are some repair shops for electric appliances or vehicles which contribute to the waste reduction. Business sectors and households also contribute to source reduction by means such as selling non-biodegradable recyclable waste to junkshops.

### 3.3.2 Sweeping and Collection

#### (1) Sweeping

The streets and beaches are swept by sweepers of the MOM from 6:00 in the morning to 16:00 in the evening. The service coverage area of the street sweeping is currently only the main road on Boracay Island, but there is no sweeping service for any road in on the Mainland of Malay. As for the beach sweeping, only the White Beach is covered by the service. The solid waste generated at the beach is mainly beach debris in the off season (rainy season) and the littered waste may be from tourists in peak season (dry season). The quantity of waste swept up at during the street and beach sweeping are is estimated based on the sweepers' information as shown in Table 3.3-1.

**Table 3.3-1 Current Street and Beach Sweeping**

Area	Current Activities
Streets	<ul style="list-style-type: none"> <li>- The amount of the waste from the streets in the rainy season is approximately 20-30kg/sweeper/day (10kg/sack) and 4-8 kg/sweeper/day (4-5kg/sack) in the dry season.</li> <li>- In the off season, the ratio of garden waste increases, while the solid waste discharged by tourists increases in peak season.</li> <li>- Collection coverage area of A street sweeper is collects waste from approximately 1.2km/person of street each/ day.</li> </ul>
Beaches	<ul style="list-style-type: none"> <li>- The amount of the waste from the beaches in the rainy season is approximately 70 to 100kg/sweeper/day (15kg/sack) and 20-30kg/sweeper/day (7-8kg/sack) in the dry season.</li> <li>- In the off season, beach debris occupies constitutes the main part of swept waste, while in the peak season, most of the solid waste is from tourists.</li> <li>- Collection coverage area of street A single beach sweeper is collects waste from approximately 0.8km/person/ of beach each day.</li> </ul>

Source: JICA Study Team

#### (2) Collection

The coverage ratio of the waste collection service is approximately more than 80% on Boracay Island while it less than 30% in on the Mainland of Malay in terms of the amount of the waste collected against the waste discharged. The collection methods are mainly curbside collection for households and door to door collection for business establishments. The collection frequency is basically every day in Barangay Balabag, while in Barangay Manoc-Manoc it is every day for along the main road and the beach front but only once a week for the other areas. In Barangay Yapack, the discharged waste is collected 3 or 4

times a week. According to MO No.185, discharge and collection schedules are defined as shown in Table 3.3-2.

**Table 3.3-2 Discharge and Collection Schedule**

Area	Discharge Schedule	Collection Schedule
Along the beach/, paths and roads	between 4 AM to 5 AM	between 5 AM to 6 AM
Designated collection points	between 4 AM to 6 AM	between 5 AM to 8 AM
Other areas	between 5 AM to 10 AM	between 5 AM to 10 AM

Source: MO NO. 185, S. 2003

The segregated discharge with using plastic bags (e.g. plastic shopping bags provided from the stores or black plastic bags purchased in stores) or plastic buckets, especially for big hotels and restaurants, is exercised in Barangay Balabag based on the above MO. Since the segregated discharge is enforced by means such as by issue of a citation ticket, the segregation rate is approximately 70 to 80%. However, there is no detailed instructions of specifying the locations where the segregated waste is to be discharged of the segregated waste, and the opaque plastic is discharged without proper segregation. Therefore, the collectors have to check the segregated waste when they load the waste on the collection trucks. These checking activities by the collectors cause inefficient collection. The time required for the checking activity was recorded as shown in Table 3.3-3.

**Table 3.3-3 Solid Waste Collection Time of Solid Waste in Collection Points**

Barangays	Loading Time [s]			Checking Time [s]		
	Biodegradable/ Garden waste	Recyclable	Residual	Biodegradable/ Garden waste	Recyclable	Residual
Yapak	2.1			2.1		
Balabag	2.5	1.3	1.2	1.0	1.8	2.2
Manoc-Manoc	2.0			2.0		

Note: Loading time means the time to load the solid waste on to the collection truck at the collection point, and checking time means the time to find the target type of segregated waste (biodegradable, recyclable or residual) and to check the waste whether the waste includes other types of waste or not.

Source: JICA Study Team

According to the record, the checking time of each type of waste is generally almost the same or slightly shorter than the loading time of each type of waste. Especially, the checking time of residual is larger than the loading time and the checking time occupying about half portion the time of the collection.

The MOM has responsibility of for collecting residual waste and each Brangay has responsibility of for collection of biodegradable and recyclable wastes and for transport to each MRF on Boracay Island.

In Barangay Yapak, the collection area is mainly along the main road. The recyclable and residual wastes are collected by a truck for 3 to 4 times per week (alternate days). The collectors are segregating the wastes on the truck. However, since there is no partition in the truck, sometimes collected wastes are mixed, especially when a large amount of waste is loaded. On the other hand, most of the biodegradable waste is not collected because the most

of the residents handle it by themselves by composting or dumping it in their backyards.

In Barangay Balabag, segregated collection is applied and the wastes are segregated into biodegradable, recyclable and residual. In the mall areas such as d'mall, the managements of the malls have responsibility of for the collection of the solid waste generated in the area and transportation of it to station points. The MOM also implements primary collection by a push cart in Road 1, Bulabog and D'talipapa. The total trip number for the collection of biodegradable, recyclable and residual waste is approximately 8 to 12 but it is depending on the seasons.

In Barangay Manoc-Manoc, although mixed collection is adopted, the discharged waste is collected and carried in the segregated condition by truck helpers. The collection area is mainly the main road and the beach front area from the tourist center to the cross intersection of the Angol Road and the White Beach. The total number of trips number for the collection is approximately 4 to 8 but it is depending on the seasons.

In Barangay Caticlan, the waste is collected in a mixture including biodegradables. There are junkshops along the main road, and the recyclable waste is collected by them when households have a large enough amount of recyclable waste.

There are the areas where the waste collection service is not covered on both Boracay and the Mainland of Malay. The areas without regular collection service coverage area are as shown in Table 3.3-4.

**Table 3.3-4 Areas without Collection Service**

Balangay	No regular collection service coverage areas
Yapak	<ul style="list-style-type: none"> <li>- Ilig-iligan (back of DMCI, 5 households and 3 establishments)</li> <li>- Part of Hagdan</li> <li>- Kandingon Beach (6-8 households)</li> <li>- Balinghai (2-4 households)</li> <li>- Punta Bunga (8-10 households)</li> </ul>
Balabag	<ul style="list-style-type: none"> <li>- Ilaya (near Sitio Waling due to no access by truck and or Eco-aide)</li> <li>- Lapuz-lapuz</li> <li>- Villa Kaloo (inaccessible by truck , especially during high tide)</li> <li>- Bloomfield, Bulabog (extension- inaccessible by regular trucks but accessible to BCCI truck, mostly boarding houses)</li> </ul>
Manoc-Manoc	<ul style="list-style-type: none"> <li>- Angol Plaza (back of most tenants and boarding homes) practice open dumping rather than going to the drop-off point</li> <li>- Sitio Cabanbanan - narrow, steep road</li> <li>- Malabunot (accessible by pushcart but not regular vehicles)</li> <li>- Cagban looban (Due to bad road)</li> <li>- Ambulong Peak (Due to steepness, no access; recyclables sold by the residents, residuals brought down to the main road)</li> </ul>
Caticlan	<ul style="list-style-type: none"> <li>- Except along the national road, the airport, caticlan port and the old market</li> </ul>
Other barangays on the Mainland of Malay	<ul style="list-style-type: none"> <li>- Except along the national road and barangay Caticlan</li> </ul>

Source: Barangays Yapak, Balabag and Manoc-Manoc

### 3.3.3 Transport

On Boracay Island, the residual waste is transported to the Manoc-Manoc Port by a private contractor when the volume of them became sufficient for sea transportation. White sacks

crammed with residual waste are transported from MRFs to Manoc-Manoc Port by a 5 ton truck. At Manoc-Manoc Port, some laborers load the sacks into a pump boat manually. The laborers bring 2 sacks at a time. A 10 GT pump boat filled with sacks leaves for Caticlan Port. At Caticlan Port, sacks are transhipped to a 10 ton truck by laborers with the use of a shovel loader, and the truck leaves for the proposed SLF site. The result of a time & motion survey on residual waste transport is summarized in Table 3.3-5.

**Table 3.3-5 Current Cycle Time of Residual Waste Transport**

Place	Activities	Unit: Minute		
		Yapak MRF	Balabag MRF	Manoc-Manoc MRF
MRF	Loading to a 5t truck (including counting and binding)	28 (200 sacks (25min/180 sacks))		
On the road	Transportation by a 5t truck	35	25	10
Manoc-Manoc Port	Transshipment from a 5t truck to 10GT pump boat (Unloading/Loading by labors)	20 (200 sacks (6 seconds/sack))		
On the sea	Transportation by a 10GT pump boat (including barging time)	14		
Caticlan Port	Transshipment from a 10GT pump boat to 10t truck (Unloading/Loading by laborers and a shovel loader)	20 (200 sacks (6 seconds/sack))		
On the road	Transportation by a 10t truck	40		
Landfill site	Unloading from a 10t truck	15		
Total		172	162	147

Source: JICA Study Team

The MOM contracted a private company to transport residual wastes, through bidding. The contractual agreement regarding the transportation of residual wastes is from MRFs on Boracay Island to the proposed landfill site in Barangay Kabulihan on the Mainland of Malay with a charge of 400 PhP/m<sup>3</sup>.

#### 3.3.4 Processing Facilities (MRFs)

Three MRFs are have been established in each barangay on Boracay Island and a MRF is has been established in Barangay Caticlan. All the collected waste is transported into MRFs to segregate recyclable materials, prepare compost after segregation of unsuitable materials and storage of residuals to be transported to the landfill site. The features of each MRF are summarized in Table 3.3-6.

**Table 3.3-6 Features of Existing MRFs**

MRFs		Barangay Yapak	Barangay Balabag	Barangay Manoc-Manoc	Barangay Caticlan
Area		0.15ha	0.7ha	0.5 ha	0.06ha
Land owner		MOM/Public land	Private	Private	MOM
Hauled waste and handling method	Biodegradable	-Composting utilizing small compost bin	-Composting utilizing bioreactors -Providing food waste to farmers as livestock feed	-Composting utilizing bioreactors	No composting
	Recyclable	-Segregation of the waste collected as mixed waste	-Segregation of the waste collected as recyclable waste	-Segregation of the waste collected as mixed waste	-Segregation of the waste collected as mixed waste
	Residual	-Stored in residual waste storage area after sacking	-Stored in residual waste storage area after sacking	-Stored in residual waste storage area after sacking	-Stored in residual waste storage area after sacking
	Health care waste	Stored in concrete vault in the MRF	No handling	No handling	No handling
Number of workers		12	28	20	12
Equipment regarding recycling		-One plastic melting oven	-Two Bioreactors (0.5t/day*2), -One plastic melting oven - Two shredders	- One bioreactor (0.5t/day), - One plastic melting oven - One shredder	One shredder
Issues		- Area is not enough adequate for operation	-The land owner is a private owner which leases the land with a contract for only one year	-The land owner is a private owner which leases the land with a contract for only one year	-

Source: Municipality of Malay and Barangays

(1) Recyclables

The recyclable waste collected as recyclable is segregated by sorters in a sorting area. The working condition is not good and or effective. Unhealthy condition such as flies and mosquitoes pose a threat to the workers. The workers have to pick up the solid waste and carry it and bend to put the segregated recyclables into the bamboo shed. The segregation is not systematically carried out and is inefficient. The operation condition of the sorting activities in the Balabag MRF is summarized in Table 3.3-7.

**Table 3.3-7 Segregation Condition at Balabag MRF**

Type of recycled waste / residual		Hauled amount
Recycled waste	Cartons	51.6[kg/day]
	Paper	3.0[kg/day]
	PET bottle	11.5[kg/day]
	Hard plastic	7.8[kg/day]
	Other plastic	8.1[kg/day]
	Steel cans	13.2[kg/day]
	Aluminum cans	6.0[kg/day]
	Transparent bottles	192.0[kg/day]
	Colored bottles	128.5[kg/day]
	Broken bottles	8.0[kg/day]
	Polystyrene foam	0.3[kg/day]
Residual after segregation		961.7[kg/day]
Total		1,391.7[kg/day]
Handling Ratio of Sorting		0.285[kg/person/minute]

Source: JICA Study Team

The bending movement by required for picking up the solid waste and carrying the waste to be segregated by sorters will consume 20 to 30% of total hours for the sorting activity according to the survey.

(2) Composting

After unloading biodegradable waste, food waste is collected by farmers as livestock feed after removal of bones or and shells. The other biodegradable waste, including garden waste, is composted by using composting pits and bioreactors.

Bioreactors are operated in Balabag and Manoc-Manoc MRFs on Boracay Island for composting. The capacity of the bioreactors is 0.5 ton/day for 8 hours operation with addition of an inoculant. Before inputting the biodegradable waste into the bioreactors, it is stored for one or two days with sawdust. After that, the biodegradable is input into the bioreactors and kept there for one day. After the removal of the composting product from the bioreactor, it is stored in a curing area for a few days for curing and maturation before sacking.

(3) Other Activities

The waste collected as residual waste is sacked and stored in a residual waste storage area to await transport to the new SLF. When a sufficient amount of sacked residual wastes is stored, a private company collects them and transports them to the proposed new SLF. A plastic densifier with molds is used for making pots or tiles from polystyrene foams. Used tires and glass cullet are used as the ornaments material for gardens or other MRF facilities in Balabag MRF.

### 3.3.5 Final Disposal

#### (1) Old Dump Site

On Boracay Island, the open dump site was situated in Barangay Balabag at coordinates N11°58'45.4" E121°55'41.3". It was approximately 300 meters from the shoreline. The nearest place of dwelling is the Fairways and Bluewater Resort, owned and operated by Fil-Estate, Incorporated which is about 800 meters from the dumpsite. It had been leased by the MOM from Ms. Libertad S. Talapian. The dump site had been in operation since 1990 and suspended operation in January 2006. Despite closure of the open dumpsite, it still remains an eyesore and a threat to the fragile marine ecosystem and groundwater resources. The subject of complaints of the resident on Boracay Island, especially those near the open dump site in Barangay Balabag, is the incessant bad odor that emanates from the disposal area.

According to the past reports, there were approximately 13 individuals who were active waste pickers in the open dump site on Boracay Island. Among the 13 waste pickers, four (4) were employees of the disposal facility while the rest were residents of the nearby communities. The waste picking activities were supervised by the MOM to minimize or prevent scattering of litter and minimize entry into the facility. The local residents also commonly complained of the scattering of wind-blown litter and materials left over from the waste picking activities. However, these waste pickers have been employed in the Manoc-Manoc MRF.

#### (2) Others

The common practice of both the residents and business establishments in the mainland is to dump their solid waste in idle unused areas giving rise to the proliferation of illegal dumpsites in the absence of a designated SLF. Most of these dumping areas are located along waterways and near shore areas, specifically mangrove areas, which put at risk these important resources. These pockets of dumps are also situated near residential areas, which present itself as a major health hazard for the residents. It was also observed that at both ends of the runway of Caticlan Airport, pockets of illegal dump sites are in existence. Environmental degradation and pollution exacerbated by this practice, which if left uncontrolled, could result to in irreversible damage to these ecosystems.

### 3.3.6 Special Waste

According to RA 9003, special waste is defined as household hazardous wastes (HHW) such as paints, thinners, household batteries, lead-acid batteries, spray canisters and so on. These include waste from residential and commercial sources that is composed of bulky waste, consumer electronics, white goods, yard waste that is collected separately, batteries, oil, and tires. In addition, medical, biohazard and other types of waste covered by RA 6969, junk cars, waste oil recycling, scrap tires, construction and demolition debris, sewage sludge and hazardous waste generated by individual households and businesses are also categorized as

special waste. The hazardous waste from residential and commercial sources is hardly seen in the waste flow in the MOM. In terms of the sewage sludge, after dried, the sludge is discarded within the area of the sludge drying facility. There is no adequate reusing system for use of the sewage sludge. On the other hand, some hotels are under construction in the northern parts of Boracay Island. A contractor barges out the construction and demolition debris from the construction sites using a private port in or near the construction sites.

(1) Household Hazardous Waste (HHW)

Although it is a very small portion, it is yet potentially harmful if allowed to enter the general waste stream due to its inherent characteristics such as corrosiveness, flammability, reactivity or toxicity. Examples of toxic and hazardous waste generated in the household include the following but are not limited to the following:

- Alkaline batteries
- Car batteries
- Fluorescent and incandescent bulbs
- Chemicals - cleaning agents, paints, thinners, pesticides or and insecticides
- Expired medicines
- Vegetable or motor oil
- Tires
- Electronic wastes - discarded mobile phones and batteries, computer parts, appliance parts
- Occasionally, busted broken thermometers

According to the public awareness survey among 163 residents in the MOM, hazardous waste and other types of waste are either discharged or segregated. On Boracay, 60 % of HHW is discharged with segregation while one third is buried. On the Mainland of Malay, 82 % of HHW is buried. Those wastes discharged with segregation end up in the MRFs and can pose a danger on to the workers or the environment. Light bulbs are mostly stored in drums while others end up together with the residual waste.

(2) Infectious Health Care Waste

1) Health Care Waste Generators

There are a total of 18 health care waste (HCW) generators in the MOM. Twelve of these operate on Boracay Island: ten are in Barangay Balabag and two are in Barangay Manoc-Manoc. On the Mainland of Malay, there are six health care facilities: two of these are in Barangay Caticlan, one in Barangay Poblacion and one in Barangay Motag. The two funeral parlors are located in rural areas of Barangays Norte and Sambinay. Table 3.3-8 shows their types and number of institutions (see Appendix II-3.3.6).



**Table 3.3-8 Types and Number of Health Care Waste Generators**

Location	Types							Total
	Infirmatory/ Primary Health Care Facility	Clinical Diagnostic Laboratory	Health Clinic	Municipal Health Center	Veteri- -nary Clinic	Dental Clinic	Funeral Home	
Boracay Island	1	4	3	2	1	1	-	12
Mainland of Malay	2	-	-	1	-	1	2	6
Total	3	4	3	3	1	2	2	18

Source: JICA Study Team

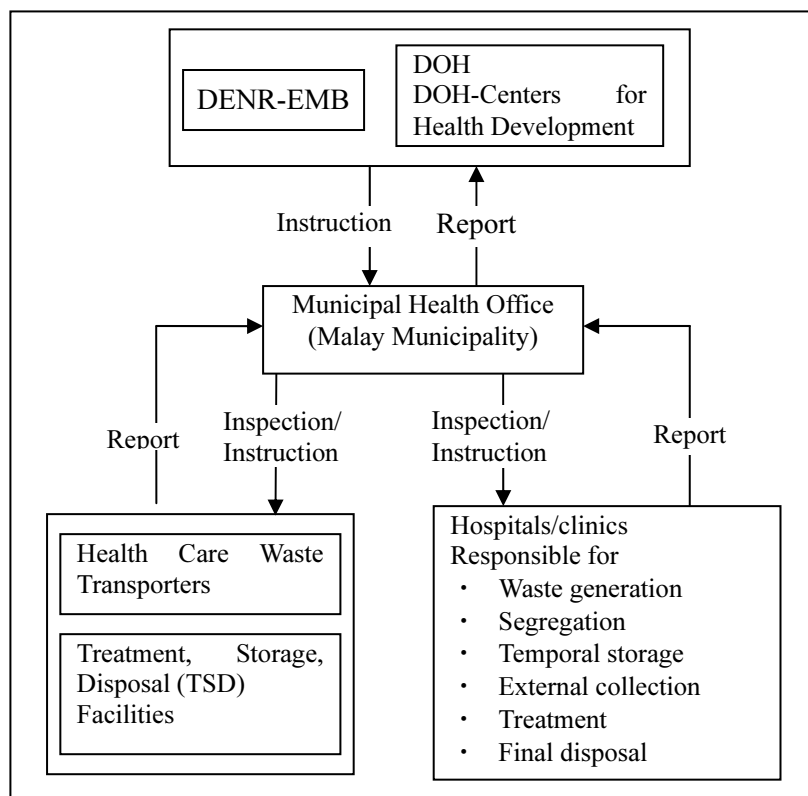
## 2) Institutional Requirements

The critical actors who promote proper HCW management are the DENR-EMB, the DOH, the MOM with the Municipal Health officer and hospitals/clinics. Figure 3.3-1 illustrates the institutional requirements for the HCW management structure.

The DENR-EMB is the primary governmental agency for implementing the rules and regulations of the HCW management. It has responsibilities for formulating policies, standards and guidelines as well as a monitoring compliance by the HCW generators, transporters, treatment, storage and disposal (TSD) facility operators and/or final disposal facility operators. In cooperation with the DENR-EMB, the DOH has a crucial role in promoting the HCW management as well. The DOH's important responsibilities include not only monitoring the hospital compliance with proper HCW management programs but also providing technical assistance and support for ensuring an effective and efficient implementation of the HCW management program.

At the LGU level, the Health Office is a key section for implementing and promoting HCW management. It periodically inspects, through the environmental monitors engaged in LGU, the HCW management at hospitals/clinics, transporters, TSD facilities, and instructs and provides them with information about the HCW management.

The DENR AO No. 29-1992 requires hospitals/clinics to notify the DENR, on a quarterly basis, of the information including the type and quantity of hazardous waste generated, produced or transported outside of the establishment. Besides, the DENR AO No. 36-2004 demands hospitals/clinics to assign a Pollution Control Officer and training its personnel and staff is also a crucial responsibility for HCW management.



**Figure 3.3-1 Institutional Requirements for HCW Management**

Source: JICA Study Team

### 3) Issues of the Institutional System

On Boracay Island, only one private clinic, Boracay Lying-in and Diagnostic Center, actually has an Environmental Compliance Certificate (ECC) from the DENR. None of the facilities, however, is registered with the DENR either as a hazardous waste generator. In addition, no institutions assign a DENR-accredited Pollution Control Officer. On the other hand, in on the Mainland of Malay, only two HCW generators, Prado's Funeral Homes and Socion Funeral Homes, have acquired an ECC. However, only Aklan Baptist Hospital assigns a DENR-accredited Pollution Control Officer.

There is only one health officer, who is a doctor as well, and a few inspectors in the MOM. Thus, the health office has a difficulty in providing technical assistance with to the hospitals/ and clinics to ensure an efficient implementation of HCW management.

In the MOM, most of the doctors work in the hospitals/ or clinics for a short period and move on to a medical facility in another region. This rotation system is one of the obstacles to transfer the knowledge of HCM management system among doctors. In order to implement proper HCW management, a person, such as an owner of the hospitals/ or clinics who can stay longer than the doctors in the MOM, should be in charge of the HCW management.

#### 4) Segregation

Practically all HCW generators practice segregation to some extent, although full compliance with the segregation rule is still wanting. It was observed during the actual collection of HCW by Yapak MRF that some sharps and syringes were occasionally mixed with other infectious waste. Some hospitals and clinics have infectious and pathological wastes mixed with general waste in garbage bins. More serious violations of segregation rules are committed on the Mainland of Malay, where only government hospitals sort their HCW while the rest mix theirs with general waste.

On Boracay Island, all hospitals and clinics invariably use empty Polyethylene Terephthalate (PET) bottles or intravenous containers for sharps. Ten out of the twelve health care facilities also use PET bottles for syringes without sharps, and vials and tubes. At times, PET bottles are also used for infectious, chemical and pathological waste. Occasionally, sharps and syringes get mixed with general waste that are placed in plastic garbage receptacles/ or bins or in black garbage bags or ordinary plastic marketing bags of any color.

On the Mainland of Malay, the most common containers for various types of HCW are plastic bags of any color. The governmental hospitals use empty PET or intravenous bottles for sharps and syringes without sharps. However, infectious waste is often put in plastic bags with common wastes.

Support personnel (janitors, sanitary inspectors, nursing aides, medical assistants and barangay health workers) are usually assigned to segregate the waste. Chemical and pharmaceutical wastes are handled by medical technologists. Labeling is not routinely practiced; if done, it is often only for sharps and syringes or sometimes for infectious waste.

#### 5) Treatment

The most commonly employed method of treatment in on the Mainland of Malay is chemical disinfection and on Boracay it is encapsulation. Most hospitals and clinics disinfect vials, slides and specimen cups with chlorine, Lysol or Cidex solutions before storing them for future re-use. Infectious and pathological wastes are also treated before disposal. Sharps, non-sharps and at times, infectious and pathological wastes are commonly encapsulated in PET or intravenous bottles to immobilize them.

The frequency of treatment varies depending on the type of HCW and the treatment method employed. On the Mainland of Malay, the governmental facilities treat their waste at least once a week. For others, treatment is done as frequently as they find necessary. On Boracay Island, one government infirmary treats their medical waste on a daily basis. Most private clinics do routine treatment at least once or twice a week.

## 6) Collection

On Boracay Island, HCW is collected and conveyed to the Yapak MRF by the personnel of the MRF. The domestic waste is collected via the regular truck collections, while the HCW is collected at least once a month.

It was observed that the waste handlers are not adequately protected, as they do not use heavy duty gloves or masks during collection and transport. Moreover, the transporters are not registered with the DENR and do not carry an approved Manifest Form to convey the hazardous wastes from the generator's premises to the final disposal facility, as required by governing guidelines.

On the Mainland of Malay, there are no collectors especially designated to collect and transport the HCW. The staff assigned to handle these wastes delivers these to the final disposal areas. Based on interviews results, the HCW is usually collected and transported as segregated. The sanitary inspector of the MOM's Health Center also says she delivers the sharps, non-sharps and infectious wastes personally to the Yapak MRF on Boracay Island for final disposal. Actual observations revealed, however, that in some instances the HCW were disposed of at the backyard lumped altogether. This is the case of the private hospital and the two funeral homes.

## 7) Disposal

On Boracay Island, all collected HCW ends up in the Yapak MRF. In one clinic, expired pharmaceutical products and chemicals used in x-ray procedures are generally collected by the suppliers. In the case of the governmental hospital, pathological wastes consisting of sizeable body parts such as fetuses and placenta are usually retrieved and disposed of by the patient's family; otherwise these are either buried or flushed into septic tanks. Chemical wastes are normally flushed into drains or into septic tanks. Aerosol and pressurized containers are sold to junkshops.

In the Yapak MRF, the HCW are finally disposed of in a concrete vault sized 1m x 2m x 8ft. The MRF only started operating only in 2005, thus the concrete vault has enough room left to accommodate additional HCW, perhaps until for the next five years or so. The Yapak MRF supervisor handles final disposal at least once a month after waiting for accumulation of enough collection of the HCW. The MRF's concrete vault has a signage to identify the disposal site for the HCW. However, it is neither fenced off nor free from unauthorized access.

On the Mainland of Malay, the Aklan Baptist Hospital normally practices on-site burial of their HCW, but sometimes infectious waste is burned as well together with general waste. The governmental hospital and the dental clinic bring their HCW for final disposal to Kalibo. Sharps and syringes without sharps from the Municipal Health Center are delivered to the Yapak MRF on Boracay Island, while infectious waste is buried in the backyard. The funeral homes use an open pit for disposing of infectious waste along with all other refuse

(which they normally burn). Funeral parlors also have large septic tanks where blood and body fluids are directly discharged in the course of embalming dead bodies.

#### 8) Amount of Health Care Waste

The quantity and quality survey revealed the amount of discharged HCW on Boracay Island and the Mainland of Malay. The survey was done targeting 12 major 12 health care facilities out of the 18 of those in the project area. Table 3.3-9 shows the result of the survey.

**Table 3.3-9 Quantity of Discharged Health Care Waste**

Hospital/Clinic	Health Care Waste (Ave. kg/day)	Number of Employees	Number of Patient/day
<i>Boracay Island</i>			
Boracay Lying-in and Diagnostic Centreo	0.40	9	17
Bysshe Medical Clinic	<0.01	2	3
Bysshe Medical Clinic & Diagnostic Laboratory	<0.01	2	7
The Island Clinic Boracay	0.51	8	6
Boracay Health Center (Annex)	0.34	7	21
Don Ciriaco Senares Tirol Sr. Memorial Hospital	1.79	16	45
Metropolitan Doctors & Booth Fairy Dental Clinic	0.94	6	8
Metropolitan Doctors Medical Clinic	0.28	4	15
Phil Home Medical Clinic	0.17	3	16
<i>Mainland of Malay</i>			
Aklan Baptist Hospital	1.30	12	36
Alcobendas Garcia (Tolosa) Dental Clinic	0.11	2	2
Malay Municipal Health Center	0.95	5	30

Source: JICA Study Team

#### (3) Other Waste

There is yet no regulation on proper disposal or designation for construction wastes or debris. The current practice is to use construction wastes as fillers, or to dump them in vacant lots. A few big construction companies barge them out.

#### 3.3.7 Market for Recyclables

There are two key points to consider regarding the market for recyclables. First is the existence of “Recyclers” who receive and reprocess recyclables and transfer them to end users. Especially, they transfer recyclables outside Boracay Island and the Mainland of Malay through their networks. They are key bodies to promote recycling smoothly and stably. Second is the existence of “End Users” on Boracay Island and the Mainland of Malay. End users mean industries or business establishments that use recycled materials,

including products made of recyclables and compost. It is preferable for people in on Boracay and Mainland of Malay to use them and contribute to environmental protection as much as possible. The current status of markets for recyclables is summarized from the above mentioned view points, recyclers and end users.

(1) Recyclers in on Boracay and the Mainland of Malay

1) Profile of Recyclers

There are four recyclers (junkshops) exist on Boracay Island and the Mainland of Malay (DECO Junkshop has a branch shop in Barangay Sambiray of on the Mainland of Malay). Three recyclers are working at three MRFs on Boracay Island, and the other is working at the Caticlan MRF in on the Mainland of Malay. MP Junkshop basically works in on the Mainland of Malay basically but they also deal with recyclables in MRFs on Boracay Island. They collect recyclables not only from MRFs but also from the generation sources such as households and hotels. Collected recyclables on Boracay Island are transferred to Cebu or Manila via Caticlan. One of them treats many types of recyclables, two of them focus on metals, glasses and plastics, while tin cans, aluminum cans and transparent bottles are treated handled by all recyclers. On the other hand, polystyrene foam is not handled. The profiles of the recyclers are summarized in Table 3.3-10. The MOM and barangays should continuously watch the trading condition of each item because some items might be not treated according to changes in market conditions.

**Table 3.3-10 Profile of Recyclers**

Name	Salfer Junkshop	DECO Junkshop	NN Junkshop	MP Junkshop
Location	Brgy. Manoc-Manoc	Brgy. Manoc-Manoc Brgy. Sambiray	Brgy. Balabag	Brgy. Caticlan
Coverage Area to Collect Recyclables	MRF Site of : Brgy. Yapak Brgy. Balabag Brgy. Manoc-Manoc Mainland of Malay: Households within the said area	Garbage agent from: Brgy. Manoc-Manoc Brgy. Balabag Brgy. Yapak Brgy. Sambiray Individual households	House to House Brgy. Balabag Brgy. Manoc-Manoc Brgy. Yapak	MRF Site of Caticlan
Transportation Area after processing	Manila and Cebu	NA	NA	NA
Type of Recyclables Accepted by Junkshops				
Carton	●	●	N	●
Paper	●	●	N	N
PET	●	●	N	●
PP (Polypropylene)	●	●	N	N
PVC	●	●	●	N
Hard Plastic	●	●	N	●
Other Plastic	●	●	N	●
Polystyrene Foam	N	N	N	N
Tin cans	●	●	●	●
Aluminum Cans	●	●	●	●
Other Metal	●	●	●	●
Transparent Bottles	●	●	●	●
Colored Bottles	●	●	●	N
Broken Bottles	●	●	N	N
Used Oil	●	N	N	N
Rubber Tires	●	N	N	N
Old Appliances	●	N	N	N
Vinyl Sheets	●	N	N	N
Copper	●	●	●	●

Legend: ●- received recyclables, N- not received recyclables

Note: NA-Transportation area after processing was not revealed because of business secrets at three recyclers.

Source: Interview by JICA Study Team (July 2007)

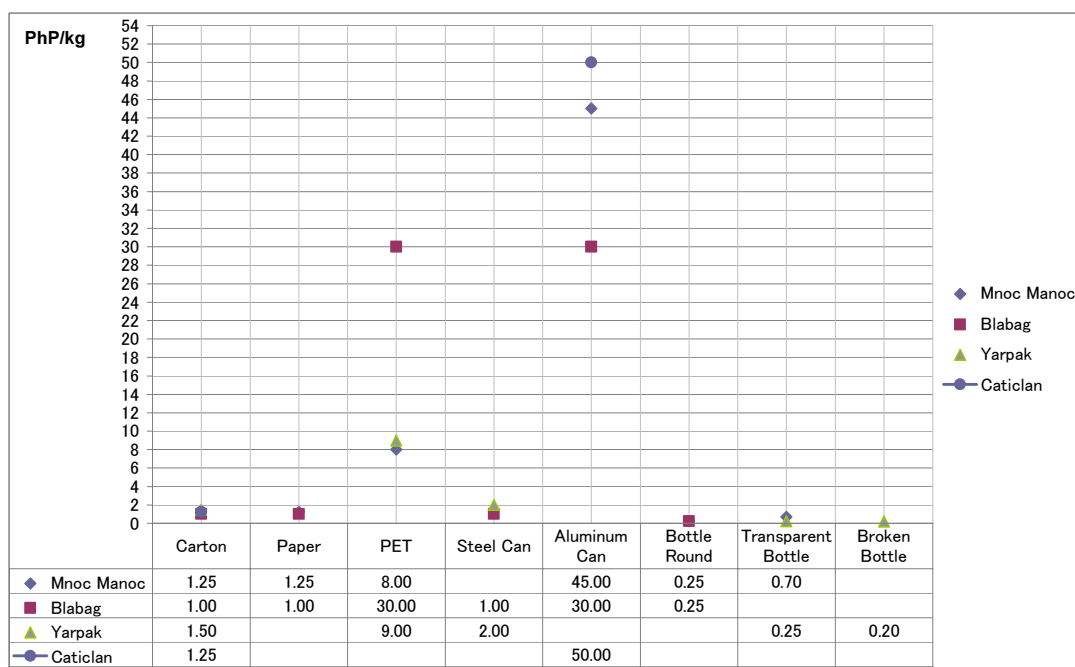
## 2) Purchase Price of Recyclables

Purchase prices of recyclables are shown in the Table 3.3-11. These data were collected through the survey for each recycler. Selling prices of recyclables at MRFs are shown in the Figure 3.3-2. These data were collected through the survey for each MRF. Purchase prices and selling prices of each item are different among recyclers and MRFs because the prices are influenced by conditions of the delivery or quality of recyclables. It is difficult to simplify it to compare the prices of respective recyclers and MRFs because of differences of each condition. However, it is necessary to know this kind of information on prices on a regular basis to consider and maximize the profit of MRFs.

**Table 3.3-11 Purchase Prices of Recyclables**

Items	Salfer Junkshop		DECO Junkshop		NN Junkshop		MP Junkshop	
	Unit	Price (PhP)	Unit	Price (PhP)	Unit	Price (PhP)	Unit	Price (PhP)
Carton	1kg	1.0	1kg	0.3			1kg	1.25
Paper	1kg	1.0	1kg	0.3				
PET	1kg	27.0	1kg	0.3			1kg	10.0
PP (Polypropylene)	1kg	9.0						
PVC	1kg	1.0	1kg	0.4	1kg	2.0		
Hard Plastic	1kg	10.0	1kg	2.5			1kg	1.0
Other Plastic	1kg		1kg	1.0			1kg	8.0
Polystyrene Foam								
Tin cans	1kg	3.0	1kg	20.0	1kg	1.5	1kg	45.0
Aluminum Cans	1kg	50.0	1kg	30.0	1kg	40.0	1kg	50.0
Other Metal			1kg	35.0	1kg	8.0	1kg	8.5
Transparent Bottles	1kg	1.8	1kg	0.5	1kg	0.25	1kg	0.25
Colored Bottles					1kg	0.35		
Broken Bottles	1kg	1.8	1kg	0.2				
Used Oil	per gal.	12.5						
Rubber Tires	1kg	180.0						
Old Appliances								
Vinyl Sheets								
Copper	1kg	200.0			1kg	180.0	1kg	200.0

Source: Interview by JICA Study Team (July 2007)



**Figure 3.3-2 Selling Price of Main Recyclable Items of Recyclables at MRFs**

Source: Interview by JICA Study Team (July 2007)



According to information from recyclers, transportation cost of recyclable is as follows:

- Boracay Island to Caticlan (Main Land): 30,000 PhP/ton or 400 PhP/kl
- Caticlan to Manila: 7,500 PhP/ton

(2) Potential End Users of Recycled Materials

There are number of accommodation facilities such as cottages, resorts and hotels and gift or souvenir shops on Boracay Island. Normally, accommodation facilities have a garden and they need flowers for decoration. This means that they have a potential to use compost to maintain the gardens and recycled products such as flower pots made of polystyrene foam. They could also buy flowers cultivated by compost from biodegradable. On the other hand, gift or souvenir shops are not direct end users for recycled materials, but they could sell recycled products as souvenirs to tourists. A golf link can be considered as a big consumer of compost. The number of potential end users of recycled material is shown in Table 3.3-12.

**Table 3.3-12 Number of Potential End Users of Recyclables**

Business Establishments	Number	Percentage (%)
Cottages/Resorts and Hotels	205	7.9
Boutiques/Gift Shops/Souvenir/Shop/Arts	154	5.9
Total	359	13.8

Note: Percentages are ratios to number of all kinds of business establishments, 2,605, on Boracay Island and the Mainland of Malay in 2005.

Source: MTO

There are two key points to consider regarding the market for recyclables. First is the existence of “Recyclers” who receive and reprocess recyclables and transfer them to end users. Especially, they transfer recyclables outside Boracay Island and the Mainland of Malay through their networks. They are key bodies to promote recycling smoothly and stably. Second is the existence of “End Users” within Boracay Island and the Mainland of Malay. End users mean industries or business establishments who use recycled materials, contained products made of recyclables and compost. It is preferable for people on Boracay Island and the Mainland of Malay to use them and contribute to environmental protection as much as possible.

### 3.4 Identified Key Issues on Solid Waste Management

#### 3.4.1 Requirements of RA9003 on Solid Waste Management

According to Section 20 of RA9003, the LGU shall divert at least 25% of all solid waste from waste disposal facilities: Provided, that the waste diversion goals shall be increased every three (3) years thereafter; Provided, further, that nothing in this Section prohibits a local government unit from implementing re-use, recycling, and composting activities designed to exceed the goal. In order to promote diversion, establishment of MRFs in every barangay or cluster of barangays is stipulated in Section 32 of RA 9003. In Section 3, Rule

XI, Part III of the IRRs, the barangays shall be responsible for ensuring that a 100% collection efficiency for biodegradable and recyclable wastes. RA9003 also stipulates the necessity of sanitary landfill sites and prohibition of open dump sites.

All LGUs including the MOM have been requested to fulfill these requirements together with barangays within their jurisdiction. However, the most of the requirements have not been fulfilled by the MOM so far and the pressing problems on SMW especially on Boracay Island are getting serious. It is necessary for the MOM and barangays to try to fulfill the requirements of RA 9003.

#### 3.4.2 Identified Key Issues on Solid Waste Management

The amount of solid waste has been increasing mainly because of the increasing economic activity, growing population and rapidly growing influx of tourists especially on Boracay Island, and has been a serious problem of the MOM, not only as due to the impacts on the environment and public health but also as a financial burden for its treatment.

On Boracay Island, diversion of biodegradable waste has been conducted through composting and providing it to nearby farmers for livestock feeding at the generation sources and the existing MRFs. However, composting at household levels has not been fully implemented as per stipulated in MO No.185. The Public Awareness Surveys revealed that although a limited number of households had been tried to conduct composting activities, the promotions as well as enforcement of the MO is required to promote biodegradable waste diversion. As for diversion of non-biodegradable waste by recycling, it has also been also conducted at the generation sources and the existing MRFs. There are still some recyclables which have not been recycled yet, even it is though they are categorized as recyclables in the MO, mainly due to lack of a fully developed recycling system. Even waste materials such as paper and colored bottles, which are traditionally considered as recyclables, are even contributing to the volume of waste for lack of buyers within the MOM. Although the diversion ratio within the MOM has archived more that 25%, diversion should be promoted so that the financial and human resource burdens on the MOM would be reduced because development and operation of a SLF is not so an easy task for the MOM.

A waste collection system has been developed on Boracay Island including source-segregated collection in Barangay Balabag. For effective diversion at the MRFs (intermediate reduction) on Boracay Island, the current source-segregated collection should be extended to the other barangays (Yapac, Manoc-Manoc) together with extension of the collection service areas toward the end discussed in RA 9003 that the barangays shall be responsible for ensuring the a 100% collection efficiency for biodegradable and recyclable wastes. On the other hand, the limited collection service areas exist on the Mainland of Malay. Actually, in 13 barangays located on the Mainland of Malay, the common problems include absence of waste collection and rampant burning of domestic waste.

The existing four MRFs are functioning and playing an important role on in waste reduction. However, against to combat the increasing waste that is being brought to the MRFs, more

effective and sophisticated operation of the MRF is required in order to improve the financial burden and unhealthy working conditions. Currently, the MRFs have been operated by the respective barangays, but all operational costs have been born by the MOM even though the responsibilities are lying on with the barangays. A sizeable portion of the MRFs' money is being spent on the collection and transport of wastes. This situation should be improved for sustainable operation. From the technical point of view, there are recyclable materials that still end up as residual waste because segregation is not maximized at the sources. Bioreactors installed at Balabag and Manoc-Manoc MRFs are not being used optimally. Some biodegradable wastes which are not loaded into the bioreactor are still buried and cause risk of methane gas formation and environmental problems.

Since January 2006, the utilization of the old dump site on Boracay Island has been suspended except for emergency cases such as disposing of the amount of yard waste or beach debris after the typhoons. However, the proper closure and rehabilitation has not been conducted and the site has been left unattended. Even under the above situation, the sanitary landfill has not been developed yet. Nonetheless, the MRFs on Boracay Island are still having difficulty in coping up with the daily accumulations of residual wastes estimated at about 10 tons per day.<sup>7</sup>

HCW in the entire municipality is not properly managed as prescribed in the Department of Health's guidelines anywhere in the entire municipality. While segregation of the general waste is espoused by the MOM, there has been no formal campaign on HCW management.

According to the Section 2, Rule XXI of the IRR of RA9003, the LGUs, down to the barangays levels, shall allocate a portion of their funds to public education and information activities on ESWM. Currently, various IEC activities have been conducted on Boracay Island mainly by private sector entities and NGOs. However, as they were conducted on an ad hoc basis, and strategic activities are needed for effective IEC.

A series of MOs relating to SWM have been passed by the SB of the MOM. However, institutional arrangements on SWM are still not adequate such as lack of stipulations on incentives and market development. On the other hand, the EAF has been collected since 2006 as per the recommended by the PTA. Although the EAF has been contributing to the environmental conservation as well as tourism development of Boracay Island, it has not been collected enough and no basic rules for its utilization have not been put in place. Although the GCF has been collected from the business establishments, no fee is collected from the residents.

The Environmental Service of the MOM has the responsibility of for SWM in addition to each barangay and a number of staffs have been attached including the members of BSWMAT. However, in order to tackle the increasing solid waste including the construction and operation of the planned facilities, institutional capacity on for SWM of the MOM is still not enough adequate such as absence of administrative tools as well as human resources.

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<sup>7</sup> Taken from Waste Characterization Survey, May and June, 2007.

### 3.4.3 Gap Analysis of Solid Waste Management Issues

The gaps between the requirements of RA 9003 and the current conditions of SWM have been analyzed in order to establish the strategies for the 10-year SWM Plan. The analyzed gaps between them are summarized in Table 3.4-1.

**Table 3.4-1 Gap Analysis of Solid Waste Management**

Requirements of RA9003	Gaps and Issues	Strategies	Remarks
<b>1. Diversion</b>			
Volume reduction at the source shall be the first priority of the ESWM system.  The LGU source reduction shall include ...to reduce and the use of non-recyclable materials, replace disposable materials and products with reusable materials and products, reduce packaging, and increase the efficiency of the use of paper, cardboard, glass, metal, and other materials.	Measures against increasing waste have been taken only for promotion of household level composting, but there have been no measures for to reduce other wastes. Even household level composting, it is not fully encouraged.	Promotion of Source Reduction 1) Introduction of new source reduction program 2) Introduction of waste avoidance program	Sec.1, Rule IX, Part III, IRRs  Sec.1 Rule XI, Part III, IRRs
MRFs shall be established in every barangay or cluster of barangays.	1) Three MRFs on Boracay Island and only one in Caticlan 2) Unhealthy and inefficient working and operational conditions.	Promotion of Intermediate Reduction at MRFs 1) Improvement of existing MRFs 2) Development of Cluster MRFs	Sec.1 Rule XI, Part III, IRRs
<b>2. Collection</b>			
The barangay shall be responsible for ensuring that a 100% collection efficiency.  Waste segregation and collection shall be conducted at the barangay level specifically for biodegradable/compostable and reusable/recyclable waste.	1) There are areas where collection service is not provided. 2) No collection service on the Mainland of Malay except for Barangay Caticlan and along the main road. 3) Compliance rate of segregation in Barangay Balabag is 70-80%, while other barangays are do not (fully) conducted segregated collection.	Improvement or Introduction of Collection System 1) Extension and/or introduction of collection service areas 2) Improvement/extension of segregated collection	Sec.3, Rule VII, Part III, IRRs  Sec.2, Rule VIII, Part III, IRRs
<b>3. Disposal</b>			
...sanitary landfill sites shall be developed and operated as a final disposal site for solid and, eventually, residual wastes of ....	There is no SLF.	Development of a SLF	Sec.3, Rule VII, Part III, IRRs
Open dumpsites shall not be allowed....the plan shall make provisions for its closure or eventual phase out	There is an old dump site on Boracay Island without that hasn't had any remedial measures implemented.	Safe Closure of Old Dump Site	Sec.3, Rule VII, Part III, IRRs

Requirements of RA9003	Gaps and Issues	Strategies	Remarks
<b>4. Special Waste Management</b>			
(Required under RA6969)	No proper treatment and or disposal of HCW	Introduction of Infectious Waste Management System	
<b>5. IEC Program</b>			
The education and public information components shall describe how the LGU will educate and inform its citizens ..... The LGUs, down to the barangay level, shall allocate a portion of their funds, to public education and information activities on ESWM....	Some IEC programs have been implemented an ad hoc basis, but they were not effective.	Strategic implementation of Public Education and Information.	Sec.3, Rule VII, Part III, IRRs  Sec.3, Rule VI, Part V, IRRs
<b>6. Institutional and Organizational Arrangements</b>			
A program providing for incentives, cash or other wise, which shall encourage the participation of concerned sectors....  Incentives shall be provided for the purpose of encouraging LGUs, enterprises, private sector, ...	No incentive programs are provided.	Introduction of Incentive System	Sec.3, Rule VII, Part III, IRRs  Rule XVI, Part IV, IRRs
The barangay may impose fees for collection and segregation of biodegradable, compostable and reusable wastes from households, commerce ,and businesses	1) The GCF is not collected from Households. 2) Utilization and revision of the rules of the regarding EAF are not established.	Introduction of a Cost Recovery System 1) Revision of the GCF System 2) Improvement of the EAF System	Sec.3, Rule XVII, Part IV, IRRs
-	1) There is no individual section for SWM 2) No SWMAT is established on the Mainland of Malay.	Organizational Setting up for SWM	
<b>Capacity Development</b>			
-	1) There is no systematic training program on SWM 2) There is no administrative tool for SWM.	1) Implementation of Training program on SWM 2) Development of administrative tools for SWM	

Source: JICA Study Team

## CHAPTER II-4 FUTURE FRAMEWORK

### 4.1 Socio-Economic Framework

#### 4.1.1 Population

The future population during the 10-year SWM Plan period from 2008 to 2017 has been projected by referring to the annual growth rates of the past available data. The NSO census data in 2000 and provisional NSO census data in 2007 are available for the Municipality of Malay.

Normally the degree of development of the area depends on its characteristics. The barangays in MOM have been categorized into i) barangays on Boracay Island (which are also categorized as urban barangays), ii) urban barangays on the Mainland of Malay, iii) semi-urban barangays on the Mainland of Malay which are mainly located along the main road, and iv) Rural barangays on the Mainland of Malay. The growth rates were applied to each category.

On Boracay Island, though the housing and infrastructure development is proceeding, the growth rate of the population is considered to be gradually reducing due to the unavailability of land for development on Boracay Island in the future. On the other hand, the growth rate on the Mainland of Malay will be similar to or gradually more than Boracay Island toward the future because of the potential of future development, especially in urban barangays. The rural area is expected to be developed after the development of urban areas or semi-urban areas and the ratio could be less than the semi-urban areas due to the lack of appropriate infrastructure. In this context, based on the tendency of previous annual growth rates of 1995 to 2000 and 2000 to 2007, the annual growth rates of 2008-2012 and 2013-2017 are set as shown in Table 4.1-1.

**Table 4.1-1 Population Growth Rate**

Barangay	1995-2000 (Annual growth rate)	2000-2007 (Annual growth rate)	2008-2012	2013-2017
Boracay	5.9%	4.7%	3.4%	2.2%
Urban	5.4%	4.7%	4.7%	4.7%
Semi-urban	2.9%	2.7%*	2.7%	2.7%
Rural	2.3%	2.3%*	2.3%	2.3%
Total	4.8%	4.4%	3.6%	2.9%

Note: Because no reliable data of Semi-urban rural barangays in 2007 regarding annual growth ratio is available, the annual growth ratio of 2000 to 2006 is described.

Source: NSO census, JICA Study Team

Based on the annual growth rate and provisional NSO census data<sup>1</sup> in 2007, the population in each year from 2008 to 2017 was projected. The projected population of each barangay is tabulated in Table 4.1-2.

<sup>1</sup> The NSO census data is approved for the provincial level. In the national level, the data might be reviewed and revised later.

**Table 4.1-2 Projected Population of Malay**

Barangay	Population		Adopted Growth Rate (%)		Remarks
	2007	2017 (projected)	2008-2012	2013-2017	
<b>Boracay Island</b>					
Yapak	2,642	3,529	3.4%	2.2%	Boracay barangay
Balabag	6,102	8,150	3.4%	2.2%	
Manoc-Manoc	7,790	10,405	3.4%	2.2%	
Sub-total	16,534	22,084		-	
<b>Mainland of Malay</b>					
Caticulan	5,491	8,701	4.7%	4.7%	Urban barangay
Poblacion	1,538	2,435	4.7%	4.7%	
Sambiray	964	1,257	2.7%	2.7%	Semi-urban barangay
Argao	1,042	1,358	2.7%	2.7%	
Cogon	673	877	2.7%	2.7%	
Cubay Norte	330	430	2.7%	2.7%	
Cubay Sur	1,169	1,524	2.7%	2.7%	
Motag	896	1,168	2.7%	2.7%	
Balusbos	1,308	1,705	2.7%	2.7%	
Dumlog	724	944	2.7%	2.7%	
Napaan	574	722	2.3%	2.3%	
Nabaoy	1,142	1,437	2.3%	2.3%	
Kabulihan	797	1,003	2.3%	2.3%	Rural barangay
Naasog	587	738	2.3%	2.3%	
Sub-total	17,235	24,299	-	-	
<b>Total</b>	<b>33,769</b>	<b>46,383</b>	<b>-</b>	<b>-</b>	

Source: JICA Study Team, NSO census

#### 4.1.2 Tourist Arrivals

The Boracay Integrated Tourism Mater Plan is being developed by the PTA covering Carabao Island where the new international airport is planned to be developed. This Tourism Master Plan is aiming at inviting more tourists to the region including Boracay Island. Presently, several large-scale hotels are being developed on Boracay Island. Therefore, it is reasonable to assume that the number of tourist arrivals on Boracay Island will increase continuously. Since this tourism master plan has not been prepared yet, the following scenarios have been considered for projection of future tourist arrivals on Boracay Island as summarized in Table 4.1-3.

**Table 4.1-3 Scenarios for Projection of Annual Tourist Arrival on Boracay Island**

Category	Scenario	Assumption	Tourist Increase
Foreigner	F-1	Increasing with average increasing number of the last 3 years	Increasing annually 33,107 tourists
	F-2	Increasing with increasing rates set based on the rates of the last 3 years	Annual increasing rates: 0.13-0.0 %
	F-3	Increasing with increasing rates which are half of scenario F-2 (due to some measures)	Annual increasing rates: 0.07-0.0 %
Filipino	P-1	Increasing with average increasing number of the last 5 years	Increasing annually 30,744 tourists
	P-2	Increasing with increasing rates set based on the increasing rates of the last 5 years	Annual increasing rates: 0.08-0.03 %
	P-3	Increasing with increasing rates which are half of scenario P-2 (due to some measures)	Annual increasing rates: 0.04-0.02 %

Note: \* adopted rates differ in years.

Source: JICA Study Team

The projected tourist arrivals on Boracay Island are summarized in Table 4.1-4 by scenarios. In the case of Scenario 1, total projected tourist arrival in 2017 is about 1.3 million, while it is 0.6 million in the case of Scenario 3.

**Table 4.1-4 Projection of Annual Tourist Arrival on Boracay Island**

Category	Scenario	Projected Tourists Arrival	
		2007	2017*
Foreigner	F-1	216,942	550,000
	F-2	207,519	280,000
	F-3	192,112	220,000
Filipino	P-1	409,032	780,000
	P-2	400,345	630,000
	P-3	381,445	420,000

Note: \* Projected tourist arrivals are rounded to the nearest thousand.

Source: JICA Study Team

Discussions have been made among stakeholders for the projection of future tourist arrivals on Boracay Island. The important factor regarding the possibility to receive the tourists is the accommodation capacity on Boracay Island. Currently, around 100,000 tourists arrived on Boracay Island in the month of April. If this situation continues during the whole year, around 1.2 million tourists could be accommodated on the island each year. Realistically, however, such number of tourists may not be coming during the off-season even if tourism promotions are carried out. On the other hand, if some measures such as land use restrictions are rectified, more high-rise hotels could be developed to accommodate more tourists. Consequently, the 10-year SWM Plan adopted Scenario 2 for projections of the number of future tourist arrivals on Boracay Island, i.e. the total projected tourist arrivals on Boracay Island is around 910,000 persons/year in 2017.



### 4.1.3 Other Socio Economic Situations

In accordance with population and tourist increases as well as socio-economic growth, the number of commercial sector entities (hotels, restaurants, and shops) and institutions are expected to increase. The estimated numbers of each sector are summarized in Table 4.1-5.

**Table 4.1-5 Future Commercial Sector Projection**

Island	Category	Unit	2007	2017
Boracay	Hotels	guest	12,377	18,536
	Restaurants	guest	14,070	19,902
	Shops	shop	1,114	3,512
Mainland of Malay	Hotels	guest	651	976
	Restaurants	guest	1,563	3,512
	Shops	shop	124	278

Source: JICA Study Team

## 4.2 Projected Solid Waste Generation

### 4.2.1 Municipal Solid Waste

Based on the existing data from the various past surveys and the result of the WACS by the JICA Study Team, the waste unit generation rate (UGR) of the year of 2007 has been set. The UGR is generally increased in accordance with the economic growth or change of life styles from the experiences of other countries. The annual growth ratio of resident UGR is assumed as 1 to 3%. As for the commercial sector, the UGR of shops is assumed to increase due to changes of tourists' behaviors and residents' life styles. At the hotels and restaurants, it can be assumed that the waste is generated mainly from guests (tourists). As the behaviors of tourists are expected to change based on the economic development, the UGR of tourists is also assumed to increase. The annual growth ratio of the waste from shops, hotels and restaurants was assumed at 2%. As for the institutions, beaches and streets, their UGRs are assumed to remain static. The UGRs of solid waste are summarized in Table 4.2-1.

**Table 4.2-1 Unit Generation Rate (UGR) of Solid Waste**

Generation Source		Area	Unit	2007	2017
Resident	Boracay	Yapak	kg/cap./day	0.32	0.43
		Balabag		0.44	0.53
		Manoc-Manoc		0.33	0.40
	Mainland of Malay	Urban		0.34	0.41
		Semi-urban		0.30	0.33
		Rural		0.27	0.29
Hotel		kg/guest/day	0.40	0.48	
Restaurant		kg/guest/day	0.21	0.25	
Shop		kg/shop/day	4.40	5.36	
Institution		kg/office/day	3.00	3.00	
Hospital		kg/hospital/day	1.33	1.33	
Beache	Boracay	Yapak	kg/km/day	29.6	29.6
		Balabag, Manoc-Manoc	kg/km/day	35.8	35.8
Street	Boracay	Yapak	kg/km/day	9.7	9.7
		Balabag, Manoc-Manoc	kg/km/day	12.8	12.8

Note: The amount of waste from hospitals in the table does not include HCW.

Source: JICA Study Team (see Appendix II-4.2.1).

Based on the UGRs in each sector, solid waste generation per day (t/day) is projected as shown in Table 4.2-2.

**Table 4.2-2 Future Solid Waste Generation Projection (t/day)**

Island	Barangay	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Boracay	Yapac	1.4	1.9	2.1	2.5	2.7	3.1	3.3	3.7	2.9	4.4	4.5
	Balabag	11.1	11.8	12.6	13.3	14.2	14.8	15.6	16.1	16.8	17.3	18.1
	Manoc-Manoc	6.6	6.9	7.4	7.7	8.1	8.5	8.8	9.1	9.5	9.7	10.1
	Sub-total	19.1	20.6	22.1	23.5	25.0	26.4	27.7	28.9	30.2	31.4	32.7
Mainland of Malay	Urban	3.5	3.9	4.1	4.6	4.9	5.3	5.6	6.1	6.5	7.0	7.4
	Semi-urban	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
	Rural	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2
	Sub-total	6.4	6.9	7.3	7.8	8.2	8.8	9.2	9.9	10.4	11.0	11.6
Total		25.5	27.5	29.4	31.3	33.2	35.2	36.9	38.8	40.6	42.4	44.3

Source: JICA Study Team (see Appendix II-4.2.1)

#### 4.2.2 Health Care Waste

The UGR of HCW is estimated based on the following. One is calculated by dividing the waste amount by the number of beds taking account of bed occupancy, i.e. kg/bed/day, and the other is by the total number of medical staff, all patients (in-patients and out-patients), i.e. kg/person/day. Because there are not sufficient data of bed occupancy, the latter formula was selected as a calculation for the UGR of HCW. The UGRs of HCW were estimated as shown in Table 4.2-3.

**Table 4.2-3 Unit Generation Rate of HCW (Base: Number of Staff and Patients)**

Total Number of Persons at 12 Hospitals/clinics	Generation of HCW from 12 Hospitals/clinics (kg/day)	Unit Generation Rate of HCW (kg/person/day)
195	4.43	0.023

Source: JICA Study Team

Table 4.2-4 shows the projected future generation of the HCW. It is assumed that local patients may increase in proportion with population increase, and tourist patient numbers are also expected to increase in proportion with tourist arrival increase. It is also assumed that the ratios of the employees in hospitals and clinics and patients will not be changed during 2007 to 2017.

**Table 4.2-4 Projection of Future Generation of HCW**

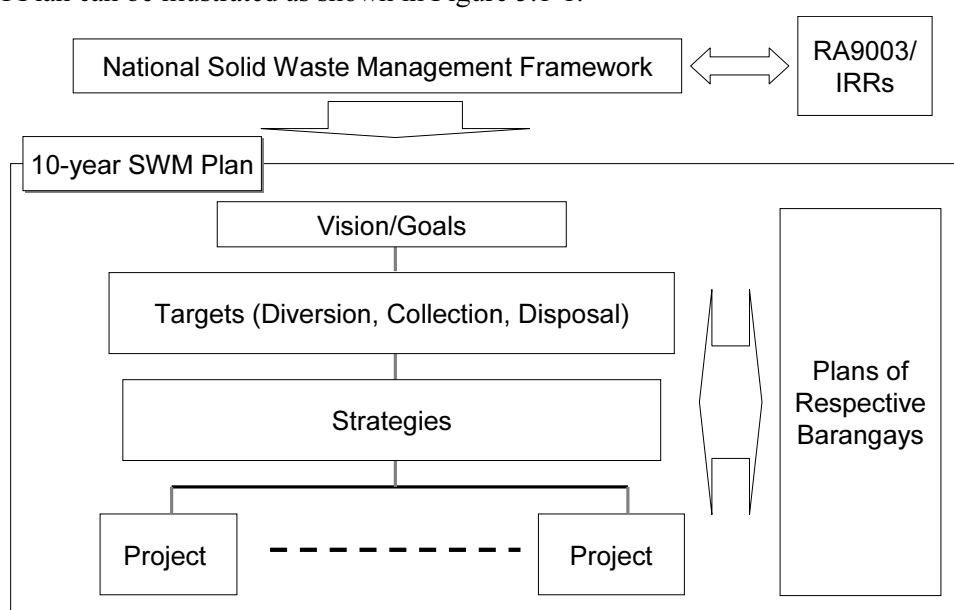
Year	Boracay Island			Mainland of Malay			Total Number of Persons	Total HCW (kg/day)
	Number of Employee	Number of Patients		Number of Employees	Number of Patients			
		Local	Tourists		Local	Tourists		
2007	57	83	55	19	62	6	282	6.4
2008	58	84	59	21	63	6	292	6.6
2009	60	84	63	21	64	7	300	6.8
2010	62	85	66	22	65	7	307	7.0
2011	63	85	69	22	66	8	314	7.1
2012	65	86	72	23	67	8	321	7.3
2013	66	87	74	23	69	8	327	7.4
2014	67	87	76	23	70	8	333	7.6
2015	68	88	79	23	71	9	339	7.7
2016	69	89	80	23	72	9	344	7.8
2017	70	89	82	24	74	9	349	7.9

Source: JICA Study Team

## CHAPTER II-5 PLAN STRATEGY

### 5.1 Structure of the 10-Year SWM Plan

According to Section 16 of RA9003, the MOM shall prepare its 10-year SWM Plan consistent with the national solid waste management framework which has been prepared by the NSWMC. Section 4 of Rule VI of the IRRs says that the municipal SWM plan shall integrate the various solid waste management plans and strategies of the barangays in its management plan. In addition the NSWMC has issued the annotated outlines as a guideline for the LGUs, which explains the structure and contents of the 10-year SWM Plan, in accordance with Section 17 of RA9003. Considering the above, the structure of the 10-year SWM Plan can be illustrated as shown in Figure 5.1-1.



**Figure 5.1-1 Structure of the 10-year Solid Waste Management Plan**

Source: JICA Study Team

### 5.2 Vision and Goals

#### 5.2.1 Vision

A vision, which is a picture of the desired future situation of solid waste management, should be set by discussions among the stakeholders and decided by a decision-maker (Mayor, MSWMB). In the Ecological Solid Waste Management Plan for 2002-2013, which was prepared by the MOM, the vision was set as “To establish a sustainable integrated solid waste management system by adopting various approaches and technologies coupled with active community participation.” Based on this, the MSWMB held a meeting on July 29, 2007 and has decided the vision of this 10-year SWM Plan as follows:

**“A Sustainable and Integrated Solid Waste Management System is Developed.**

**- Toward Clean Boracay Island and Malay Municipality through Active Stakeholders’ Participation -”**

### 5.2.2 Goals

In RA9003, establishing mandatory solid waste diversion is stipulated, LGUs shall divert solid waste from waste disposal facilities through reuse, recycling and composting and other resource recovery activities. Promotion of waste diversion could contribute to conserve the environment as well as reduce SWM financial burdens on LGUs. In order to develop a sustainable SWM system, the MOM has set the goals of the 10-year SWM Plan referring the challenges discussed as goals of RA 9003 and the NSWMF as shown in Table 5.2-1

**Table 5.2-1 Goals of the 10-year SWM Plan**

Action	Goals
Diversion	<ul style="list-style-type: none"> <li>- Source reduction such as at households and businesses is promoted as much as possible</li> <li>- After the above source reduction, discharged waste is reused and/or recycled as much as possible</li> </ul>
Collection	<ul style="list-style-type: none"> <li>- After the above source reduction, discharged waste is collected properly</li> </ul>
Disposal	<ul style="list-style-type: none"> <li>- Sanitary landfill is operated properly</li> <li>- Open dump is to be converted to a safe site</li> </ul>

Source: JICA Study Team

### 5.3 Targets

To actualize the vision and goals, the targets should be quantitatively stated for achievement toward the target year of 2017. The targets are set for Boracay Island and the Mainland of Malay, respectively because their respective solid waste management conditions are quite different. The quantitative targets have been set as shown in Tables 5.3-1 and -2 for the following reasons.

The diversion targets are set separately for the sources and at MRFs because deferent approaches are needed to archive an increase of the diversion rates and the time necessary to realize the increase is also different between them. Enforcement of diversion at source (source reduction) to the target persons may take time, while the diversion rate at the MRF can be increased by the improvement of the facility. Basically, the targets of diversion rates are set as follows:

#### Boracay Island

Since the proposed new SLF is located on the Mainland of Malay and is planned to receive the residual waste only, wastes other than residual wastes, i.e. biodegradable and recyclable wastes, are planned to be treated within Boracay Island. As a result, 72% of waste generated should be diverted in 2017 and this is set as the target.

### Mainland of Malay

Self-treatment and-disposal of biodegradable wastes at the sources, which can be counted as diversion, is active on the Mainland of Malay and these activities are expected to be continued in the future. Among the non-biodegradable wastes, reuse and/or recycle of most of the reusable and recyclable wastes are expected to be promoted at sources or at MRFs. Considering these conditions, 68% of the waste generated could be diverted in 2017 on the Mainland of Malay and this is set as the target.

As for the targets of collection, the present service coverage on Boracay Island is already 86% of the waste discharged. In order to keep Boracay Island clean for attracting the tourists and to protect the environment, the collection service area should cover the island as much as possible. Because this is also a requirement of RA 9003, collection service coverage on Boracay Island is targeted at almost 100% of the discharged waste. On the other hand, it is rather difficult to fulfill the requirement of RA 9003 on the Mainland of Malay considering the relatively low population density and limited infrastructure such as access roads. Therefore, the service coverage is planned to be limited to only urban barangays and semi-urban barangays along the main road during this 10-year SWM Plan for the Mainland of Malay. Consequently, the target of collection on the Mainland of Malay is set as 90% of the waste discharged as a realistic target.

The target for disposal was set as the amount of residual waste disposed of in a sanitary way against the total amount of residual waste. As required in RA 9003, when the residual wastes are disposed of, 100% of them should be disposed of in a sanitary way. As a necessity, the old dump site should be closed safely.

**Table 5.3-1 Targets of the 10-year SWM Plan for Boracay Island**

Category	Component	Present (2007)	Target Year (2017)
Diversion	Source Reduction Ratio (SRR)	23%	35%
	Intermediate Reduction Ratio (by composting and recycling at MRFs)	20%	53%
	Total	35%	76%
Collection	Service Coverage	86%	100%
Disposal	Sanitary Disposal	0%	100%
	Safe Closure of Old Dump Site	0%	100%

Note: Source Reduction Ratio (SRR) = Waste Reduced at Source / Waste Generated

Intermediate Reduction Ratio = Waste Reduced at MRFs / Waste Collected

Service Coverage = Waste Collected/ Waste Discharged

Sanitary Disposal = Residual Waste Landfilled in a sanitary way/ Total Residual Waste

Source: JICA Study Team

**Table 5.3-2 Targets of the 10-year SWM Plan for Mainland of Malay**

Category	Component	Present (2007)	Target Year (2017)
Diversion	Source Reduction Ratio (SSR)	51%	54%
	Intermediate Reduction Ratio (by composting and recycling at MRFs)	38%	40%
	Total	56%	68%
Collection	Service coverage	78%	90%
Disposal	Sanitary disposal	0%	100%

Note: Source Reduction Ratio (SRR) = Waste Reduced at Source / Waste Generated  
Intermediate Reduction Ratio = Waste Reduced at MRFs / Waste Collected  
Service Coverage = Waste Collected/ Waste Discharged  
Sanitary Disposal = Residual Waste Landfilled in a sanitary way/ Total Residual Waste  
Source: JICA Study Team

## 5.4 Strategies

### 5.4.1 Fundamental Strategies

In order to achieve the targets of the 10-year SWM Plan, the following fundamental strategies shall be adopted:

#### (1) Diversion Strategy

##### 1) Source Reduction

According to RA 9003, source reduction is crucial and necessary for effective procedure of solid waste management. The waste handling difficulties of large generation volume is to be minimized at the generation sources as much as possible, considering the treatment and disposal at downstream side of waste.

To adapt the concept of the source reduction for 10-year SWM Plan, the area characteristics of the Municipality of Malay should be considered as well as type of the target waste for of source reduction.

Regarding biodegradable waste, promotion and extension of current source reduction system such as home composting or livestock will be applicable. Section 3 of MO 185, states that it shall be mandatory for households, business entities with a backyard open space of more than 50 m<sup>2</sup> to maintain a modest composting bin or pit for their respective biodegradable waste. Considering the area of each household and business establishment, especially on Boracay Island, a more stringent ordinance is needed to promote this exercise for further reduction of biodegradable waste at the source, in addition to stringent law enforcement with promotion of home composting procedures for household or business establishment which have only such small areas.

Regarding recyclable waste, the utilization of current recycling market flow or the cooperation by the producers or distributors will be necessary for effective implementation of source reduction of recyclable waste in Boracay Island. On the other hand, there are some junkshops on the Mainland of Malay to collect the recyclable from each generation source. In that situation, group recycling system should be mainly introduced on the

Mainland of Malay.

Regarding residual waste, the replacement from or the restriction of the utilization of material which generates residual waste should be considered. Measures targeting the upstream of the waste flow should be taken for effective waste reduction at the sources, namely measures for “avoidance”. The concept of avoidance should be tackled. Since this concept should be applied taking into consideration the characteristics as the island, introduction of prohibitions against using specific types of packages which may become residual waste after use on the island is a conceivable strategy for waste avoidance.

The source reduction strategies for Boracay Island and the Mainland of Malay are shown as Table 5.4-1.

**Table 5.4-1 Source Reduction Strategies**

Target Waste to be Reduced	Main Target Area		Target Generation Source
	Boracay Island	Mainland of Malay	
Biodegradable Waste	- Promotion of home compost	- Promotion of home compost - Promotion of livestock feeding	Households and business establishments
Reusable or Recyclable Wastes	- Introduction of deposit system	- Introduction of group recycling	Households and business establishments
Residual Waste	- Prohibition of using specific packages - Waste avoidance	-	Households and tourists

Source: JICA Study Team

## 2) Intermediate Reduction

According to RA9003, 3Rs is mandatory for SWM of the LGU and a MRF should be installed in each barangay as an individual MRF or to cover some clustered barangays with a single MRF to segregate recyclable waste and to implement recovery and recycling such as composting. In the MOM as well, establishment of MRFs is an important strategy for intermediate waste reduction.

Although there are one MRF for each barangay being operated at present in three barangays on Boracay Island, MRFs should be centralized for effective operation due to such small area of each barangay. On the Mainland of Malay, one MRF should cover a few Barangays because the areas and generation amount of each Baranagay is small to be handled by one MRF. In addition, operational improvement is strategically planned for more efficient intermediate reduction of the waste. Therefore, centralized or cluster MRF should be taken into account.



(2) Collection Strategy

The collection system should be developed taking into account the geographic subdivisions and administrative boundaries such as barangays to define the service coverage of the area. In order to archive the targets set for the 10-year SWM Plan, a step-by-step arrangement of the collection service is planned starting from Boracay Island to the Mainland of Malay.

One of the essential strategies to be considered is to establish effective collection systems in terms of collection service coverage and necessary costs. Effective segregated collection is also considered for more practical diversion practices by composting and recycling to be conducted at MRFs. For this, especially on Boracay Island, the existing collection system is to be strategically improved without consideration of the administrative boundaries of the barangays or the demarcation of the responsibilities as previously required by RA9003, i.e. the requirement for collection of residual waste solely by the LGU while the other wastes are collected solely by the barangays should no longer be imposed. The collection system should be improved or introduced in accordance with the development schedule of the MRFs because the contents of the system are closely related with the systems and locations of the MRFs.

(3) Disposal Strategy

After a series of efforts for solid waste diversion, “only” residual waste should be properly handled and finally disposed of in a proper manner without negative environmental impacts. For this, a sanitary landfill with adequate environmental and engineering safeguards is to be developed in accordance with DENR ADMINISTRATIVE ORDER No. 10, Series of 2006 (DAO 10) as well as the Guidelines on the Categorized Final Disposal Facilities (Sanitary Landfills) by the NSWMC.

The old dump site on Boracay Island, which stopped operation in January 2006, should be closed with necessary rehabilitation engineering works in accordance with DENR ADMINISTRATIVE ORDER No. 9, Series of 2006 (DAO 9) as well as the Guidelines on the Safety Closure of Final Disposal Facilities (Sanitary Landfills) by the NSWMC.

5.4.2 Supporting Strategies

In order to support the fundamental strategies, the following supporting strategies which support and supplement the realization, shall be taken.

(1) Special Waste Management Strategy

Special waste shall refer to household hazardous wastes such as paints, thinners, household batteries, lead-acid batteries, spray containers and the like. These wastes must be handled carefully in a proper manner without negative environmental impacts. In this 10-year SWM Plan, the HCW, which is generated mainly by hospitals and clinics, such as decommissioned equipment, instruments, dressings, gloves and utensils are to be managed. For this, HCW management systems should be developed on both Boracay Island and the Mainland of Malay, which cover from the upstream to downstream ends of the waste. In

these systems the HCW should be isolated and then sterilized as required by the health office of the MOM. The sterilized infectious waste is to be collected and transported properly and then disposed of in isolated cells at the SLF.

(2) IEC Strategy

In order to support and accelerate the realization and implementation of the activities for diversion, collection and disposal, education and public information should be implemented strategically through various IEC activities as informal education. For this, IEC programs shall be developed and implemented to educate and inform each target group, such as the residents, tourists and business sectors, about source reduction, recycling and composting, etc. Information disclosure on SWM through such means as newsletters, web-site, posters, and bulletin boards, is also to be considered as a communication tool among stakeholders. The IEC program should make provisions to ensure that information on waste collection services, SWM and related health and environmental concerns are widely disseminated among the public.

(3) Funding Arrangement Strategy

Requirements not only for human resources but also of funds should be fulfilled to archive the targets thought the implementation of the 10-year SWM Plan. The funding includes identification and description of project costs, revenues, and revenue sources which the MOM will use to implement the plan. In order to ensure the necessary funds, a cost recovery mechanism is to be established using the existing systems as much as possible such as the EAF and GCF. Since grants, donations and other means may be expected, the local common fund is to be strategically established for effective utilization of them targeting self-financed sustainable implementation of the plan.

(4) Capacity Development Strategy

Institutional and organizational arrangements as well as human resources development are essential to archive the targets of the 10-year SWM Plan. Various plans and programs should be strategically institutionalized by MO for ensuring its realization. Although privatization of implementation of SWM projects, such as through Public Private Partnership, is planned to realize specific project(s), there still will be a need for capacity development of the MOM together with other stakeholders such as barangay staffs in charge of SMW. Particularly, collection and MRFs are expected to be operated mainly by the barangays, their capacity development through LGU is considered essential in the 10-year SWM Plan. For this, a series of training as well as development of the SWM administrative tools should be conducted.

## 5.5 Comparison of Technical Options for Collection Systems and Establishment of MRFs

One of the important technical options to be examined is the collection system together with locations of the MRFs because the selection of the option would affect future waste flow which is essential to formulate the 10-year SWM Plan. In particular, the options, whether the MRFs should be established by improving the existing MRFs or as a cluster MRF (centralized one) on Boracay Island, should be examined together with the collection system in order to select the most cost effective option.

### 5.5.1 Transport Route and Facilities (MRF and Port) on Boracay Island

The site selection for the SWM facilities is important to establish an effective and stable “waste flow” from generation source to final destination. Between generation sources (collection coverage area) and final disposal site, there are possibilities to select the locations of MRF(s) and the port to be used for marine transportation. In order to determine the optimum location of the MRFs and the transportation route, the following conditions were assumed.

- The target generation source of solid waste is mainly Boracay Island and a part of the Mainland of Malay Island such as Caticlan or Poblacion.
- Final destination of the residual is the proposed new landfill site in Barangay Kabulihan on the Mainland of Malay.
- From Boracay Island to the Mainland of Malay, marine transportation is required and two ports on Boracay Island, i.e. Barangay Balabag and Manoc-Manoc are considered as options.

In this context, optimal locations of MRF(s) on Boracay Island and the transportation port were compared in the following five options.

Option 1: The current three individual MRFs on Boracay Island are used with improvements. The residual wastes from the three MRFs are transported to the Mainland of Malay through the Manoc Manoc Port.

Option 2: A centralized MRF for covering the areas of Balabag and Yapak Barangays is established and the current Manoc-Manoc MRF is retained for Barangay Manoc-Manoc. The residual wastes from the two MRFs are transported to the Mainland of Malay through the Manoc-Manoc Port.

Option 3: A Centralized MRF is established in Barangay Manoc-Manoc for covering the whole area of Boracay Island. The residual wastes from the MRF are transported to the Mainland of Malay through the Manoc-Manoc Port.

Option 4: A Centralized MRF is established in Barangay Balabag for covering the whole area of Boracay Island. The residual wastes from the MRF are transported to the Mainland of Malay through the Manoc-Manoc Port.

Option 5: A Centralized MRF is established in Barangay Balabag for covering the whole area of Boracay Island. All the residual wastes from the MRF are transported to the Mainland of Malay through the Bulabog Port.

In the comparison of the options, the collection costs from the sources to the MRFs in the cases of individual MRFs are estimated to be lower than that of the centralized MRF, while transport cost of the residual wastes from the MRFs to the SLF on the Mainland of Malay for the centralized MRF is lower than the individual MRFs if the centralized MRF is located in Barangay Balabag. As for the operation cost of the MRF(s), the option with individual MRFs is higher than that of the centralized MRF. Regarding the establishment of organization structure or management, the centralized MRF is considered to be suitable to keep the same level of service for all the barangays although the establishment of a new organization would be needed. Regarding social acceptance, if land for the centralized MRF is available, it is easier to obtain social acceptance and to establish a stable operation of the MRF. As a result, Option 3 was selected as shown in Table 5.5-1.

**Table 5.5-1 Comparison of Transport Route and Site of MRF(s) on Boracay Island**

Options	Collection and Transport Costs	Operation Cost of MRF	Social Acceptance and Land Condition	Management/ Organization	Evaluation
Option 1	Low	High	Not stable	Different level at each MRF	×
	The distance to the MRF from collection area is not so long. Transport cost is low because only the residual waste is transported to the mainland.	The operation of a small size facility is not efficient.	Balabag MRF is located on short-term leased land.	Management levels are different depending on the capability of the workers in MRF and the conditions of facility and equipment	
Option 2	Slightly Low	Slightly high	Not stable	Different level at each MRF.	×
	Transport cost is low because only the residual waste is transported	The operation of small size facility is not efficient.	Balabag MRF is located on short-term leased land.	The same as Option 1, deferent MRFs are at levels.	
Option 3	Slightly High	Low	Stable	Common management	○
	Though collection cost is higher than individual MRFs, transport cost of the residual waste is lower because the MRF is located near the port for shipping.	The operation of a large size facility is more efficient.	Can be located on long-term leased land.	MRF should be managed by a new organization consisting of representatives from the barangays	
Option 4	High	Low	Not stable	Common management	△
	Though the collection cost is lower than option3, transport cost is higher than Option 3.	Same as Option 3	Long-term leased land is not guaranteed.	Same as Option 3	
Option 5	High	Low	Not stable	Common management	△
	Though collection and inland transport costs are the same as Option 3, the marine transport cost is higher than Option 3.	Same as Option 3	Long-term leased land is not guaranteed.	Same as Option 3	

Note : ○ : Suitable, △ : Applicable, × : Not Suitable

Source: JICA Study Team

5.5.2 Marine Transport

The residual waste from the MRF on Boracay Island is to be transported to the proposed new SLF by inland transportation on Boracay Island, then by marine transportation to the Mainland and then inland transportation on the Mainland of Malay. Considering projected future volume of the residual waste and transportation frequency, suitable transportation routes were examined from the view point of general cargo flow. Optimum combinations of shipping routes and vessel types are examined based on existing port facilities and natural conditions as shown in Table 5.5-2.

**Table 5.5-2 Comparison of Shipping Route and Vessel Type**

Route	Vessel Type	Caticlan Beach	Caticlan Terminal	Tabon Jetty/Beach
Manoc-Manoc beach	Pump boat	○ Its present regular route is viable during NE winds. It is not serviceable during SW winds, so it needs an alternate route.	△ EEDD restricts berthing hours of cargo vessels and boat because passenger transportation takes precedent over cargo transportation. A tariff is charged by EEDD for berthing at the Caticlan jetty.	△ During NE winds, Manoc-Manoc beach and Cagban jetty can be used but Tabon jetty and beach are not serviceable. During SW winds, Tabon jetty and beach can be used but Manoc-Manoc beach and Cagban jetty are not serviceable. This shipping route is not affected by wind direction.
	Cargo vessel	△ It is not convenient for cargo vessels to land on the beach because water in front of Caticlan beach is shallow and the seabed slope is gentle		
Cagban jetty	Pump boat	△ EEDD restricts berthing hours of cargo vessels and boats because passenger transportation takes precedent over cargo transportation. A tariff is charged by EEDD for berthing at the Cagban jetty.		
	Cargo vessel			
Tambissan beach (Main) Tulubhan beach Bulabog beach	Pump boat	△ During NE winds, Caticlan beach and terminal can be used but Tambissan, Tulubhan and Bulabog beaches are not serviceable. During SW winds, Tambissan, Tulubhan and Bulabog beaches can be used but Caticlan beach and terminal are not serviceable. This shipping route is not affected by wind direction.		○ This is an alternate route during SW winds. Tambissan beach is the most appropriate for beach landing among the three beaches and most cargo is loaded and unloaded there.
	Cargo vessel	× Water in front of Tambissan, Tulubhan and Bulabog beaches is shallow and rocks exist in many places, thus it is impossible for cargo vessels to land on the beach.		

Note: ○ : Suitable, △ : Applicable, × : Not Suitable

EEDC means Economic Enterprise Development Department of Caticlan Jetty Port and Passenger Terminal

Source: JICA Study Team

As a result, the present sea transportation system is considered to be the optimum, i.e., the Manoc-Manoc Port to and from the Caticlan Port by a pump boat during NE winds and the Tambissan Port to and from the Tabon Jetty by a pump boat during SW winds. Considering the amount of the residual waste and the capability of the inland and marine transport cycle, a pump boat with a capacity of 30 to 40m<sup>3</sup> is adequate for the marine transport.

### 5.5.3 Facilities on the Mainland of Malay

On the Mainland of Malay, only one MRF has been established in Barangay Caticlan which covers Barangay Caticlan. In addition, a MRF is planned to be established inside proposed SLF in Barangay Kabulihan. Clustering of adjoining barangay MRFs could be one of the strategic components that the municipality plans to adopt. The advantages of clustering MRFs include, but are not limited to the following: a) harmonizing the MRF management and operations; b) sharing of resources; c) maximization of economies of scale; and d) reduction of development and operational cost. Under the conditions, the following optimal options of MRF on the Mainland of Malay were proposed:

Option 1: Each barangay has individual MRFs

Option 2: The Cluster MRF in Caticlan covering some barangays (Barangays Caticulan, Sambiray and Argao) and the other barangays have individual MRFs

Option 3: The Cluster MRF in Caticlan covering Barangays Caticulan, Sambiray and Argao and the Cluster MRF in Kabulihan covers the other semi-urban and urban barangays

In the comparison of the options, the collection and transport costs from the sources to the MRF(s) and from the MRF(s) to the SLF in the cases of Option 3 are estimated to be lower than other two options. As for the operation cost of the MRF(s), the total cost for the individual MRFs (Options 1 and 2) is higher than that of Option 3. Regarding social acceptance, Option 3 is easier than the others because the MRFs can be set up at the lands which the MOM has already secured. Regarding the establishment of organization structure or management, Option 3 is considered to be suitable if a new organization would be established. As a result, Option 3 was selected as shown in Table 5.5-3.

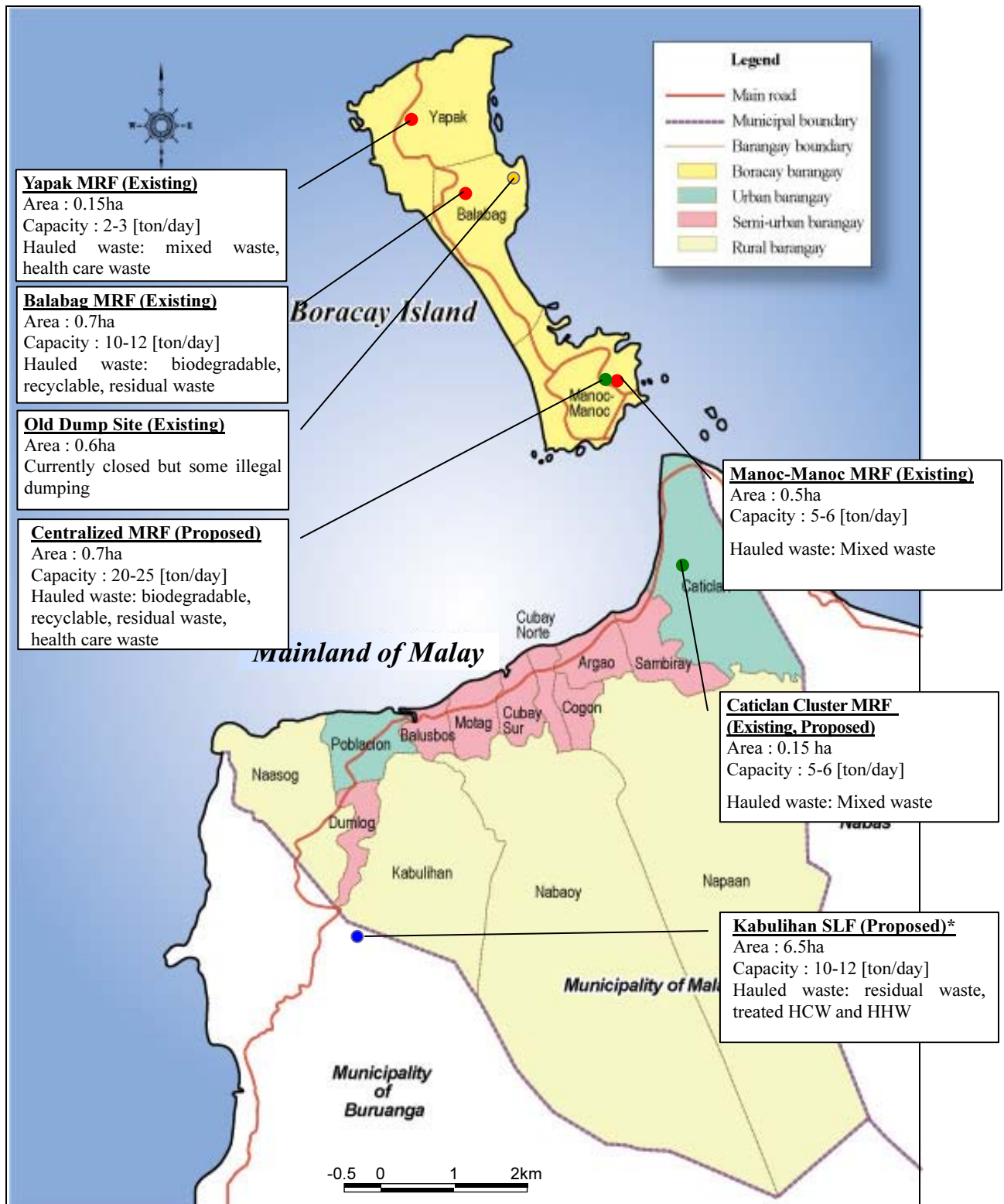
**Table 5.5-3 Comparison of Options of MRF on the Mainland of Malay**

Options	Collection and Transport Costs	Operation Cost of MRF	Social Acceptance and Land Condition	Management/ Organization	Evaluation
Option 1	High	High	Difficult	Different level at each MRF	×
	The amount of waste collected is too small for effective collection.	The operation of small size facility is not efficient.	Land acquisition is required.	Management levels are different depend on the capability of barangays.	
Option 2	Slightly high	Slightly high	Slightly difficult	Different level at each MRF	△
	The amount of waste collected is too small for effective collection.	Almost same as Option 1	Land acquisition is required.	Almost same as Option 1.	
Option 3	Slightly low	Slightly Low	Easy	Common management	○
	The collection areas can be divided by two cluster MRFs for effective collection.	The operation of a large size facility is more efficient.	Can be located at the lands already acquired	MRF(s) are expected to be managed by a newly set up organization.	

Note : ○ : Suitable, △ : Applicable, × : Not Suitable  
Source: JICA Study Team

5.5.4 Overall Facilities Plan for Solid Waste Management

As the results of the above discussion, the overall facilities for sold waste management is proposed as shown in Figure 5.5-1 (the details are discussed in the following chapters).



**Figure 5.5-1 Location of Solid Waste Management Facilities**

Note: \*Kabulihan Cluster MRF is located inside Kabulihan SLF.  
Source: JICA Study Team

## 5.6 Future Solid Waste Flow

### 5.6.1 Diversion Projections

Currently, there are some source reduction activities conducted such as home composting, selling to junkshops and the provision of feed to livestock. To achieve the diversion targets, a series of diversion programs consisting of source reduction as well as for intermediate reduction at MRFs should be conducted as well as continuation of current source reduction activities (the details are discussed in the following chapters).

As for source reduction, if current source reduction activities continue in the future, source reduction ratio is expected to be same ratio as in 2007. The balance of source reduction ratio on current source reduction activities from the target source reduction ratio in 2017 should be covered by new source reduction program. As for intermediate reduction, the size of intermediate treatment system including composting by bioreactor or carbonization of biodegradable waste, sorting to assist selling to junkshops and implementation of small scale recycling at the proposed Centralized Manoc-Manoc MRF is designated based on the target diversion ratio. As a result, the proposed activities together with target diversion ratio are summarized in Tables 5.6-1 and 5.6-2.

**Table 5.6-1 Waste to be Diverted by Each Activity on Boracay Island**

Activities		Material to be Addressed	Quantity of Waste Diverted [ton/day]	Diversion Ratio [%]
Source Reduction	Waste Diversion by "BALIK BIO-WASTE" Program	Food waste and garden waste	2.1	7
	Waste Diversion by "BALIK BAYONG" Program	Container and packaging waste	0.4	1
	Waste Diversion by "BALIK BOTE" Program	Container and packaging waste	1.3	4
	Waste Diversion by the Introduction of Prohibition of Using Specific Packages on Boracay	Container and packaging waste (Polystyrene foam)	0.1	0
	Waste Diversion by Continuation of Current Source Reduction Activities	-	7.5	23
	Subtotal			11.4
Intermediate Reduction	Composting by Bioreactor	Food waste and garden waste	4.5	14
	Carbonization	Garden waste	2.3	7
	Selling to Junkshops, Small Scale Recycling	Recyclable waste	4.5	14
	Pulverizing and Preparing Concrete of Residual Waste	Non recyclable plastic or paper	2.0	6
	Subtotal			13.3
Total			24.7	76

Source: JICA Study Team



**Table 5.6-2 Waste to be Diverted by Each Activity on the Mainland of Malay**

Activities		Material to be Addressed	Quantity of Waste Diverted [ton/day]	Diversion Ratio [%]
Source Reduction	Waste Diversion by "BALIK BIO-WASTE" Program	Food waste and garden waste	0.3	2
	Waste Diversion by the Introduction of Group Recycling	Recyclable waste	0.1	1
	Waste Diversion by Continuation of Current Source Reduction Activities	-	5.9	51
	Subtotal			6.2
Intermediate Reduction	Composting by Bioreactor	Food waste and garden waste	0.6	5
	Selling to Junkshops	Recyclable waste	1.0	9
	Subtotal			1.7
Total			7.9	68

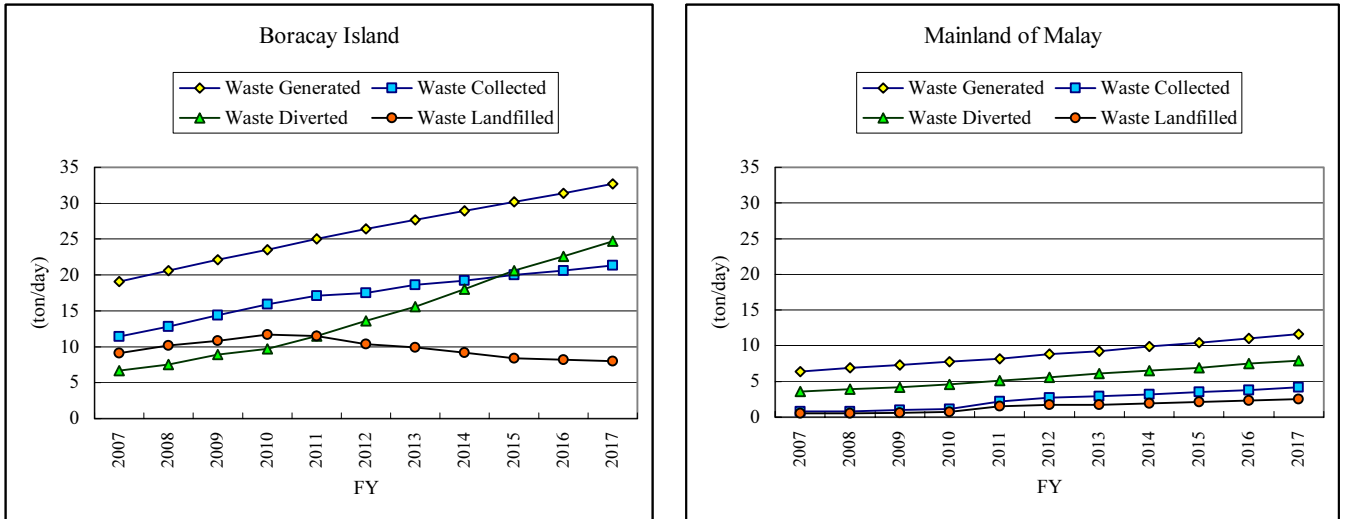
Source: JICA Study Team

Based on the activities discussed above, the total amount of the waste diverted during the 10-year SWM Plan period was projected as shown in Table 5.6-3 and Figure 5.6-1.

**Table 5.6-3 Diversion Projection during the 10-year SWM Plan**

	[ton/day]										
Boracay Island	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste Generated	19.1	20.6	22.1	23.5	25.0	26.4	27.7	28.9	30.2	31.4	32.7
Waste Collected	11.4	12.8	14.4	15.9	17.1	17.5	18.6	19.2	20.0	20.6	21.3
Waste Diverted	6.7	7.5	8.9	9.7	11.5	13.6	15.6	18.0	20.6	22.6	24.7
Waste Landfilled	9.1	10.2	10.8	11.7	11.5	10.4	9.9	9.2	8.4	8.2	8.0
Mainland of Malay	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Waste Generated	6.4	6.9	7.3	7.8	8.2	8.8	9.2	9.9	10.4	11.0	11.6
Waste Collected	0.8	0.8	1.0	1.1	2.2	2.7	2.9	3.2	3.5	3.8	4.2
Waste Diverted	3.6	3.9	4.2	4.6	5.1	5.6	6.1	6.5	6.9	7.5	7.9
Waste Landfilled	0.5	0.5	0.6	0.7	1.5	1.7	1.7	1.9	2.1	2.3	2.5

Source: JICA Study Team



**Figure 5.6-1 Diversion Projection during the 10-year SWM Plan**

Source: JICA Study Team

### 5.6.2 Future Waste Flow

Based on the strategies, the future waste flow in 2017 is described in Figure 5.6-1 as the final picture of solid waste generation, diversion and disposal of the 10-year SWM Plan.

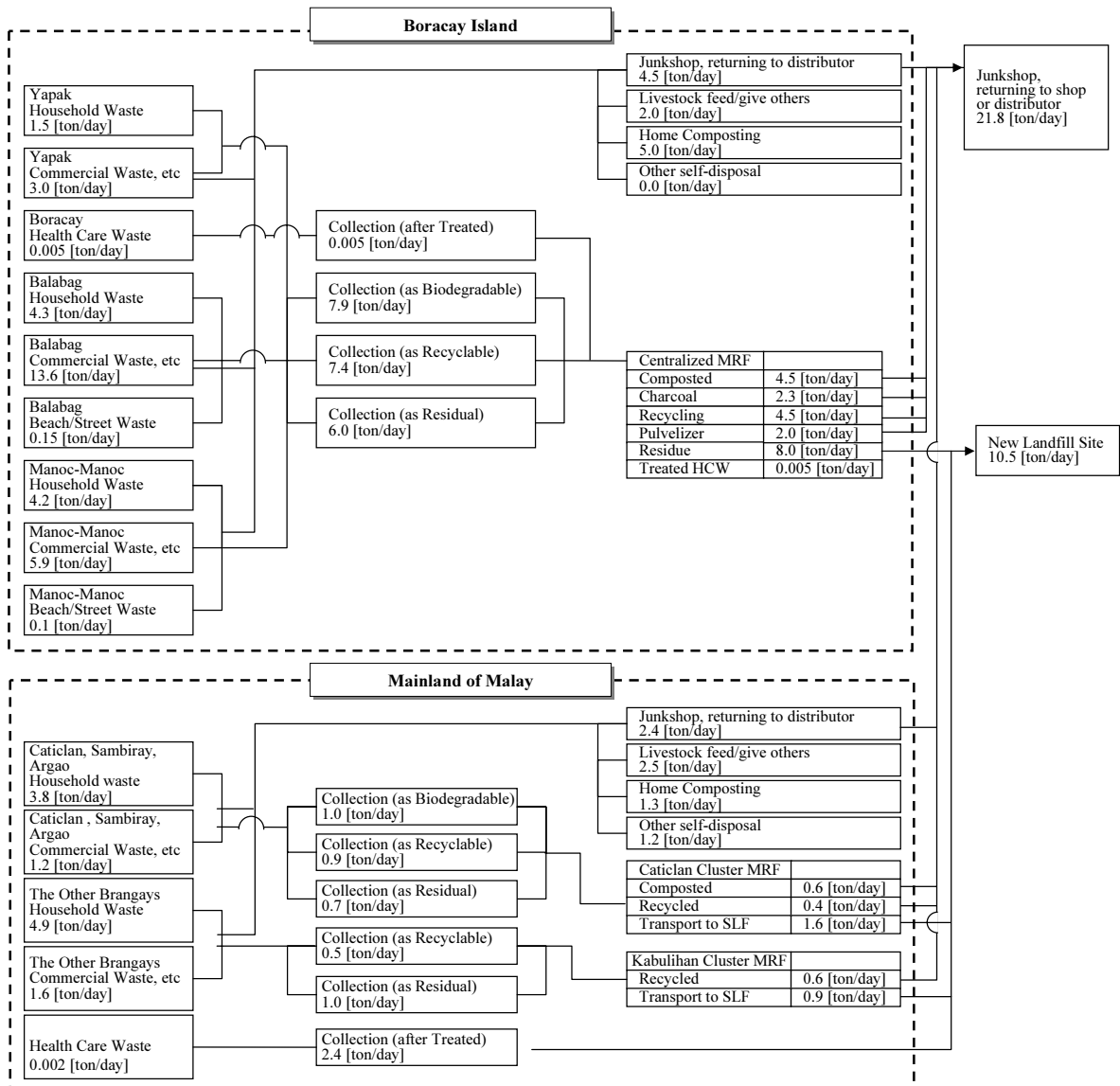


Figure 5.6-2 Future Waste Flow in 2017

Source: JICA Study Team