

## Appendix - 1

### Solid Waste Amount and Composition in Future

## **1 Solid Waste Amount and Composition in Future**

### **1.1 Prediction of Solid Waste Amount in Future**

#### **1.1.1 Purpose**

To know the generation amount of solid waste amount in future is a fundamental factor to determine size or capacity of various equipment and facilities including the numbers of collection and transportation vehicles, waste transfer and storage capacity, waste disposal area, etc.

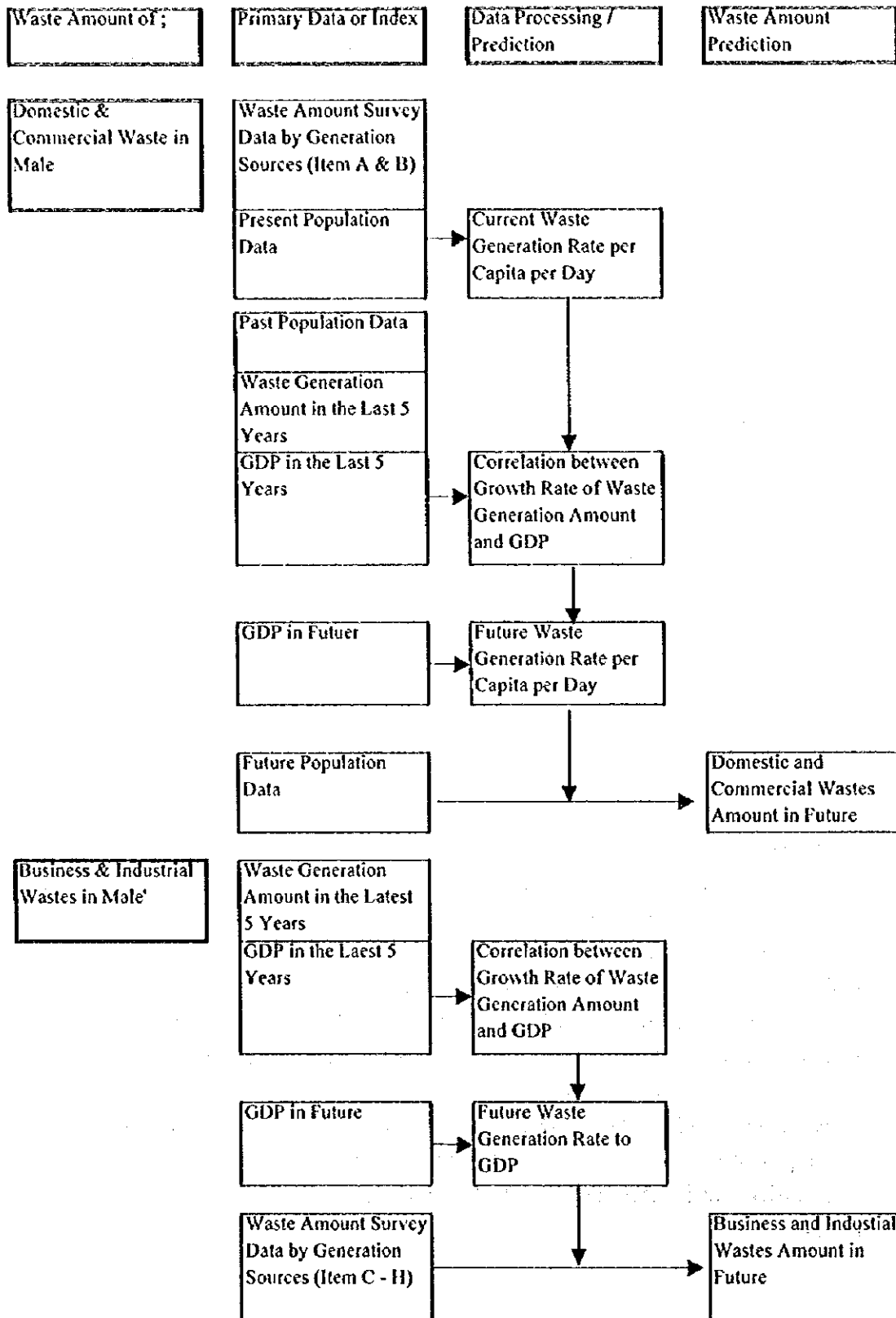
In order to obtain the demand required from the planning side, the prediction of waste generation amount is carried out for the items indicated as follows.

- Domestic & Commercial Waste in Male'
- Business & Industrial Wastes in Male'
- Construction & Demolition Wastes in Male'
- Domestic Waste in Villingili
- Domestic Waste in Inhabited Islands in Maldives
- Wastes in Resort Islands in Maldives
- Disposal Wastes in Thilafushi

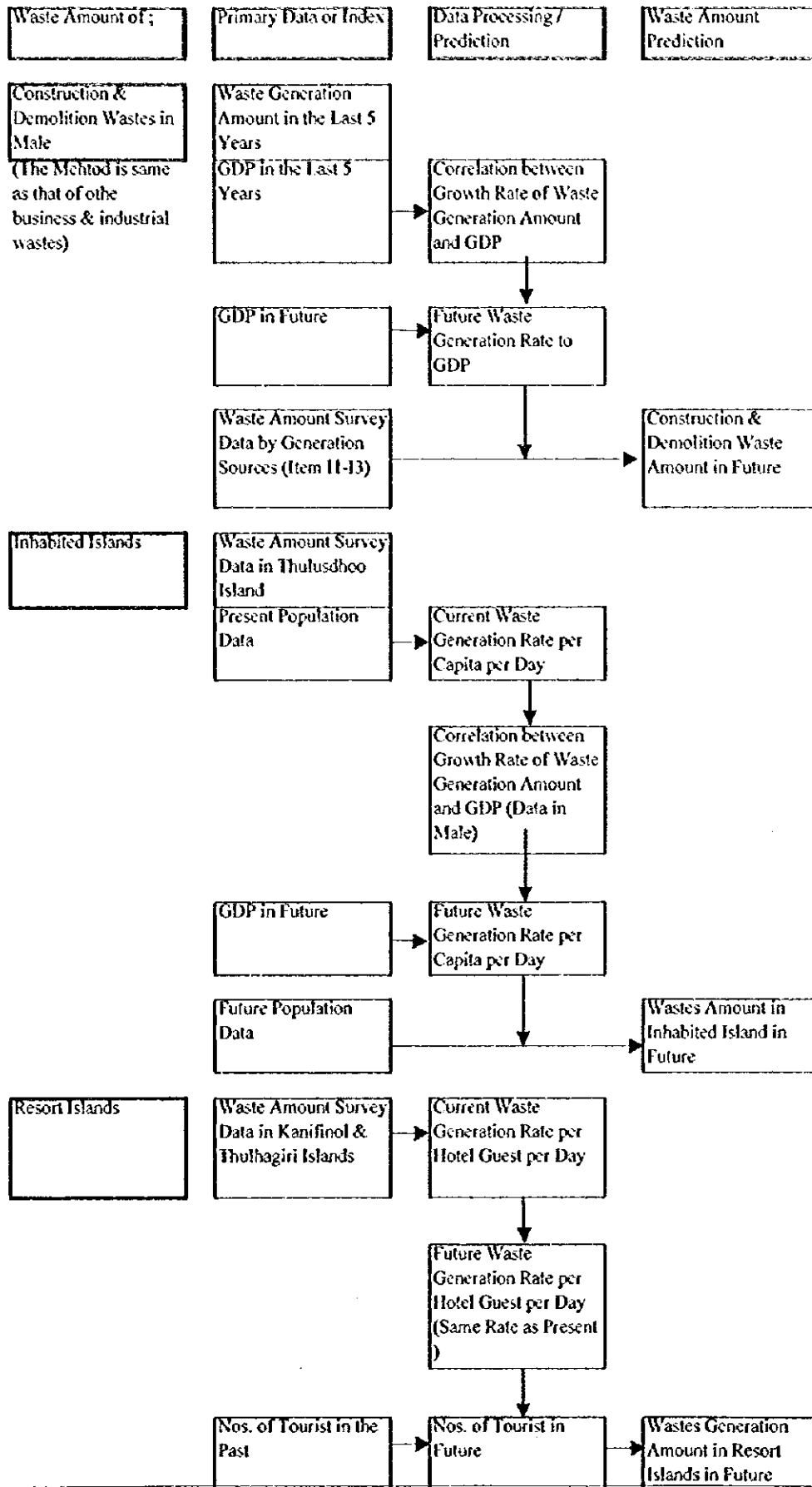
#### **1.1.2 Procedures of Solid Waste Amount Prediction**

Prediction of solid waste generation amount is the first step for planning and design of SWM system. Due to no weighing machine for measuring waste amount, the existing data was available with the records counting the numbers of the lorries transporting waste to the Thilafushi. The existing data had to be converted to the weight data and the types of the wastes as well to make an assumption in order to make use of the data for prediction. The Study Team carried out the Waste Amount Survey from June to September 1998 in Male', Inhabited Islands, Resort Islands and the Thilafushi and the data from the Survey shall be analysed for the basic data for prediction of the waste generation amount in together with the relevant data such as Gross Domestic Production (GDP), data from the tourism development plan, etc. The procedures for prediction of waste generation amount was carried out in accordance with the block flow charts shown in the following pages.

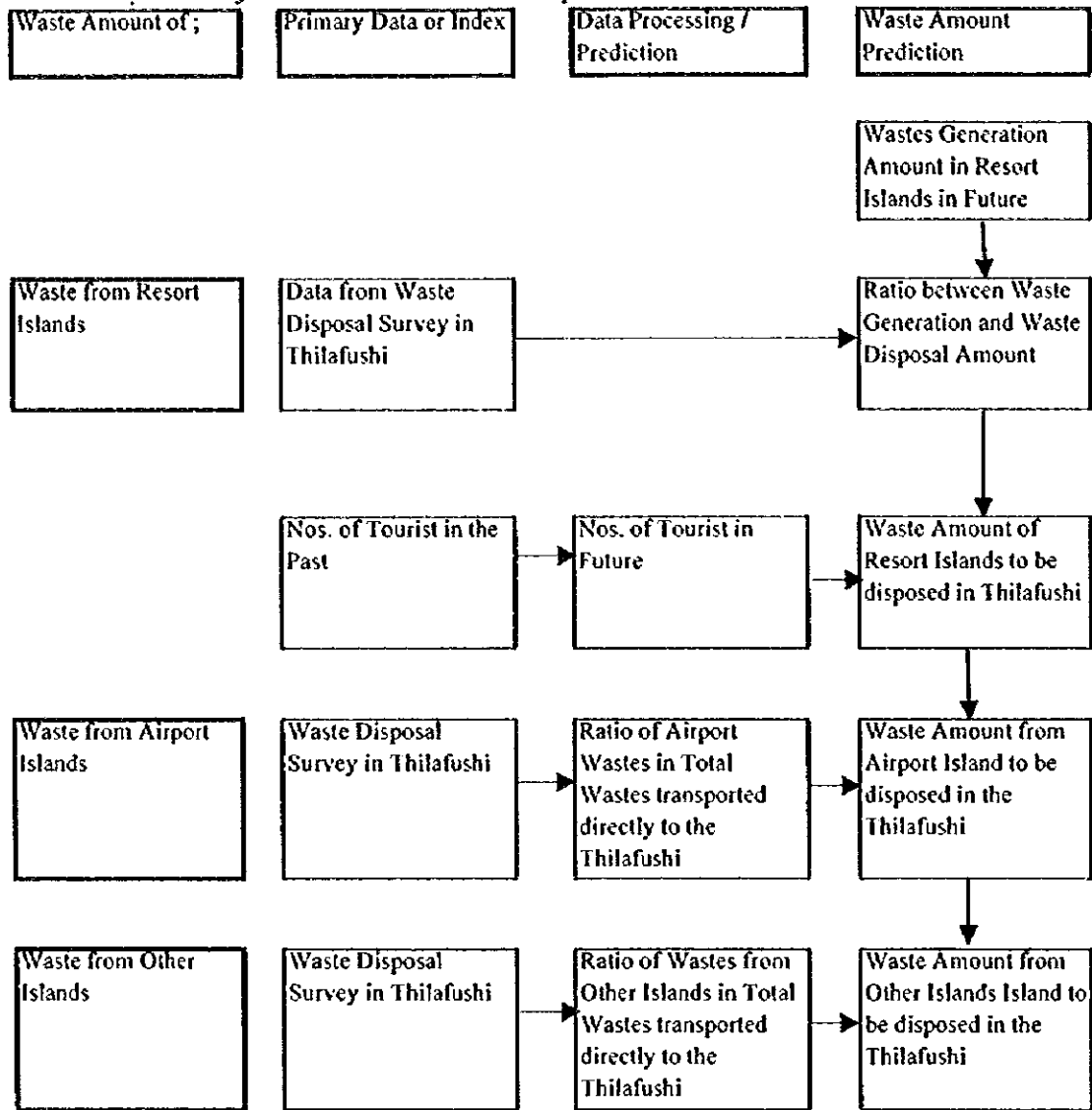
(I) Flow Chart for Prediction of Solid Waste Amount (1/2)



Flow Chart of Projection of Solid Waste Generation Amount (2/2)



**Flow Chart for Projection of Solid Waste Disposal Amount in Thilafushi**



**(2) Relevant Data for Prediction of Solid Waste Amount****a. Socio-Economic Projection****i) Population**

Year	Male' (incl. Villingili)		Villingili Island		Male' Island	
	Population	Growth*	Population	Growth*	Population	Growth*
1998	69,080	-	1,844	-	67,236	-
1999	71,417	3.383%	2,106	14.234%	69,311	3.086%
2000	73,833	3.383%	2,406	14.234%	71,427	3.053%
2001	76,049	3.002%	2,749	14.234%	73,300	2.622%
2002	78,332	3.002%	3,140	14.234%	75,192	2.581%
2003	80,684	3.002%	3,587	14.234%	77,097	2.534%
2004	83,106	3.002%	4,098	14.234%	79,008	2.479%
2005	85,601	3.002%	4,681	14.234%	80,920	2.420%
2006	87,936	2.727%	5,347	14.234%	82,589	2.063%
2007	90,334	2.727%	6,109	14.234%	84,225	1.981%
2008	92,797	2.727%	6,978	14.234%	85,819	1.893%
2009	95,328	2.727%	7,971	14.234%	87,357	1.792%
2010	97,928	2.727%	9,106	14.234%	88,822	1.694%

Method of calculation:

Male' (incl. Villingili island):

1995 to 2000:  $62,519 * \text{EXP}(0.033267 * n)$ 2000 to 2005:  $73,833 * \text{EXP}(0.029578 * n)$ 2005 to 2010:  $85,601 * \text{EXP}(0.026907 * n)$ 

Villingili island:

1998 to 2010:  $1,844 * \text{EXP}(0.133083 * n)$ 

Year	Atolls		Year	Atolls	
	Population	Growth*		Population	Growth*
1998	201,427	-	2005	249,598	3.002%
1999	208,240	3.383%	2006	256,405	2.727%
2000	215,284	3.383%	2007	263,398	2.727%
2001	221,747	3.002%	2008	270,582	2.727%
2002	228,404	3.002%	2009	277,962	2.727%
2003	235,261	3.002%	2010	285,543	2.727%
2004	242,323	3.002%			

Method of calculation:

1995 to 2000:  $182,295 * \text{EXP}(0.033267 * n)$ 2000 to 2005:  $215,284 * \text{EXP}(0.029578 * n)$ 2005 to 2010:  $249,598 * \text{EXP}(0.026907 * n)$ 

Note: \*=Growth rate compared with previous year

Sources: Ministry of Planning, Human Resources and Environment; Maldives; Housing and Urban Development Board; JICA Study Team

## ii) Economy of Maldives (GDP and Per Capita GDP)

Year	GDP at 1985 Prices (Rf. million)	Growth*	Population	Growth*	Per Capita GDP at 1985 Prices (Rf.)	Growth*
1998	1,629.8	-	270,507	-	6,025	-
1999	1,727.6	6.0%	279,657	3.383%	6,178	2.5%
2000	1,834.7	6.2%	289,117	3.383%	6,346	2.7%
2001	1,954.0	6.5%	297,796	3.002%	6,562	3.4%
2002	2,081.0	6.5%	306,736	3.002%	6,784	3.4%
2003	2,214.1	6.4%	315,945	3.002%	7,008	3.3%
2004	2,351.4	6.2%	325,429	3.002%	7,226	3.1%
2005	2,492.5	6.0%	335,199	3.002%	7,436	2.9%
2006	2,639.6	5.9%	344,341	2.727%	7,666	3.1%
2007	2,792.7	5.8%	353,732	2.727%	7,895	3.0%
2008	2,951.8	5.7%	363,379	2.727%	8,123	2.9%
2009	3,117.1	5.6%	373,290	2.727%	8,350	2.8%
2010	3,288.6	5.5%	383,471	2.727%	8,576	2.7%

Note: \* = Growth rate compared with previous year

Sources: Ministry of Planning, Human Resources and Environment;  
JICA Study Team

## iii) Tourists

Year	Low Projection		High Projection		Medium Projection	
	Number	Growth*	Number	Growth	Number	Growth*
1998	378,651	-	414,534	-	396,593	-
1999	399,910	5.61%	452,671	9.2%	426,291	7.49%
2000	421,169	5.32%	493,411	9.0%	457,290	7.27%
2001	442,428	5.05%	536,832	8.8%	489,630	7.07%
2002	463,687	4.81%	582,999	8.6%	523,343	6.89%
2003	484,946	4.58%	631,971	8.4%	558,459	6.71%
2004	506,205	4.38%	683,792	8.2%	594,999	6.54%
2005	527,464	4.20%	738,496	8.0%	632,980	6.38%
2006	548,723	4.03%	796,099	7.8%	672,411	6.23%
2007	569,982	3.87%	856,602	7.6%	713,292	6.08%
2008	591,241	3.73%	919,991	7.4%	755,616	5.93%
2009	612,500	3.60%	986,230	7.2%	799,365	5.79%
2010	633,759	3.47%	1,055,267	7.0%	844,513	5.65%

Note: \* = Growth rate compared with previous year

Sources: Statistical Yearbook of Maldives 1997; Tourism Master Plan 1996-2005;  
JICA Study Team

## (1) Low Projection

$$Y = 102,284 + 21,259 \times T$$

Where, Y: Number of tourists

T: Year (1998 = 13)

Period of data: 1986 to 1995 (10 years)

T-value = 16.8243 ; R = 0.9862

## (2) High Projection

Average annual growth rate: 1995-2000: 10%-9%  
 2000-2005: 9%-8%  
 2005-2010: 8%-7%

Period of data: 1986 to 1995 (10 years)

## (3) Medium Projection

$$((\text{Low Projection}) + (\text{High Projection})) / 2$$

Medium Projection was adopted.

GDP and Population in the Past

Year	GDP at 1985 Prices		Population of Maldives		Population of Male'	
	GDP (Rf. M)	Growth*	Population	Growth*	Population	Growth*
1993	1,190.2	6.2%	231,646	2.803%	59,451	2.547%
1994	1,268.6	6.6%	238,140	2.803%	60,966	2.547%
1995	1,359.4	7.2%	244,814	2.803%	62,519	2.547%
1996	1,447.7	6.5%	253,095	3.383%	64,634	3.383%
1997	1,537.5	6.2%	261,656	3.383%	66,820	3.383%
1998	1,629.8	6.0%	270,507	3.383%	69,080	3.383%

Note: \*=Growth rate compared with previous year

Sources: Annual Report 1996, Maldives Monetary Authority; Fifth National Development Plan; Ministry of Planning, Human Resources and Environment; JICA Study Team



## d. Future Population by Atoll

## Estimated future Population by Atoll for 2000, 2003, 2005 and 2010

Locality	1995		2000		2003*		2005		2010	
	Population	Ratio to 1995 (%)	Population	Ratio to 1995 (%)	Population	Ratio to 1995 (%)	Population	Ratio to 1995 (%)	Population	Ratio to 1995 (%)
Republic	244,814	289,117	315,945	129.05	335,199	136.92	383,471	156.64	383,471	156.64
Male (Including Villingili)	62,519	73,833	80,684	129.06	85,601	136.92	97,928	156.64	97,928	156.64
Atolls	182,295	215,284	235,261	129.05	249,598	136.92	285,543	156.64	285,543	156.64
North Thiladhunmathi	13,676	16,151	17,650	129.05	18,725	136.92	21,422	156.64	21,422	156.64
South Thiladhunmathi	15,365	18,146	19,830	129.06	21,038	136.92	24,067	156.64	24,067	156.64
North Miladhunmathulu	10,462	12,355	13,502	129.06	14,325	136.92	16,387	156.63	16,387	156.63
South Miladhunmathulu	10,103	11,931	13,038	129.05	13,833	136.92	15,825	156.64	15,825	156.64
North Maalhosmadhulu	12,953	15,297	16,716	129.05	17,735	136.92	20,289	156.64	20,289	156.64
South Maalhosmadhulu	8,712	10,289	11,243	129.05	11,928	136.91	13,646	156.63	13,646	156.63
Faadhippolhu	8,038	9,493	10,374	129.06	11,006	136.92	12,591	156.64	12,591	156.64
Male Atoll	11,675	13,788	15,067	129.05	15,985	136.92	18,287	156.63	18,287	156.63
South Ari Atoll	6,695	7,907	8,641	129.06	9,167	136.92	10,487	156.64	10,487	156.64
North Ari Atoll	5,260	6,212	6,788	129.06	7,202	136.92	8,239	156.63	8,239	156.63
Feidhu Atoll	1,678	1,982	2,166	129.08	2,298	136.95	2,628	156.62	2,628	156.62
Mulakatholu	4,859	5,738	6,271	129.05	6,653	136.92	7,611	156.64	7,611	156.64
North Nilandhe Atoll	3,165	3,738	4,085	129.07	4,334	136.94	4,958	156.65	4,958	156.65
South Nilandhe Atoll	4,793	5,660	6,186	129.06	6,563	136.93	7,508	156.65	7,508	156.65
Kolhumadulu	9,545	11,272	12,318	129.05	13,069	136.92	14,951	156.64	14,951	156.64
Hadhunmathi	10,156	11,994	13,107	129.06	13,906	136.92	15,908	156.64	15,908	156.64
North Huvadhhu Atoll	8,121	9,591	10,481	129.06	11,119	136.92	12,721	156.64	12,721	156.64
South Huvadhhu Atoll	12,031	14,208	15,527	129.06	16,473	136.92	18,845	156.64	18,845	156.64
Fovahmulah	7,004	8,271	9,039	129.05	9,590	136.92	10,971	156.64	10,971	156.64
Addu Atoll	18,004	21,262	23,235	129.05	24,651	136.92	28,201	156.64	28,201	156.64

The year, 2003\* indicate that the figure was estimated by JICA Study Team based on the following equation

$$P = P \cdot \text{EXP}(\text{LOG}(P/p) / (\text{period} (P - p) \cdot \text{LOG}(\text{EXP}(1)))^n)$$

Note:

Assumption 2

1. Proportion of Census 1995 - Place of enumeration (de facto) is taken as constant pu to 2010
2. Migration effect is not accounted for in the future years
3. 2003 is calculated by JICA study team

Source: Ministry of Planning, Human Resources and environment, Population Housing Census of Maldives 1995.

c. GDP Growth Rate and Waste Generation Increase Rate per Capita

Relations between Waste Generation Amount and Gross Domestic Production per Capita

Year	Solid Waste Generation Amount					Gross Domestic Production (GDP) at 1985 price										
	Population	Estimated Waste Amount	Waste Amount per Capita per day	Waste Increase Rate per capita per day to the Previous Year	Avg. Waste Increase Rate per capita per day from 1992 to 1998	Modified Waste Increase Rate per Capita per day	Calibrated Avg. Waste Increase Rate per capita per day to the previous year	Population (Whole Country)	Annual GDP	Growth Rate the Previous Year	Average Growth Rate 1992 to 1998	GDP per capita per day	GDP Growth Rate per capita per day from 1992 to 1998	Avg. GDP Growth Rate per capita per day to the Previous Year	Modified GDP Growth Rate per capita per day	Calibrated Avg. GDP Growth Rate per capita per day to the Previous Year
	(ton/yr)	(g/c/d)	(%)	(%)	(%)	(g/c/d)	(%)	(Rf. mill.)	(%)	(%)	(%)	(Rf./c/d)	(%)	(%)	(Rf./c/d)	(%)
1992	57974	16533 *1	1,041			1,041		1,121				13.63			13.63	
1993	59451	26545	1,223	17.534		1,172		1,190	6.164			14.08	3.242		14.08	3.237
1994	60966	23549	1,058	-13.491		1,319		1,269	6.587			14.59	3.681		14.53	3.237
1995	62519	27700	1,214	14.705		1,485		1,359	7.157			15.21	4.236		15.00	3.237
1996	64634	53473	2,260	86.216		1,672		1,448	6.496			15.67	5.011		15.49	3.237
1997	66820	58707	2,407	6.487		1,883		1,538	6.203			16.10	2.728		15.99	3.237
1998*	67236	21523 *2	2,120	-11.929		2,120		1,630	6.003			16.51	2.555		16.51	3.237

\*1 Data from April to December Rate by EXP. Model 11.857 %  
 \*2 Data from January to May Rate by EXP. Model for reference 6.236 %  
 Rate by EXP. Model for reference 3.186 %

f. Summary of Waste Amount and Composition Survey in Resort Island

Summary of Waste Amount and Composition Surveys in Resort Island

Type of Waste	Kamifinol Resort Island				Thuhagiri Resort Island				(unit : gram)					
	Total Nos. of Hotel Guests		Avg. Nos. of Hotel Guests per day		Total Nos. of Hotel Guests		Avg. Nos. of Hotel Guests per day		Total in 9 days		Total in 19 days		Total Avg. Waste Amount per day	Ratio (%)
	1,500	150	150	150	659	73	53	Average	Minimum	Maximum	Ratio (%)			
Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		Solid Waste Amount (unit : g)		
	Total in 10 days	Minimum	Average	Ratio (%)	Total in 9 days	Minimum	Average	Ratio (%)	Total in 9 days	Minimum	Average	Ratio (%)	Total in 19 days	Ratio (%)
<b>Organic Waste</b>														
Food Waste	2,725,550	340,850	220,800	272,555	26,45	2,298,800	364,400	193,200	255,422	43.32	5,024,350	264,439	32.13	
Paper	219,030	61,070	4,100	21,903	2.13	69,250	18,450	0	7,694	1.30	298,280	15,173	1.85	
Cardboard	314,290	56,640	19,620	31,429	3.05	146,380	40,700	0	16,264	2.76	460,670	24,246	2.95	
Total	533,320	117,710	21,720	53,332	5.18	215,630	59,150	0	23,959	4.06	749,950	39,418	4.80	
Plastics	34,130	7,930	1,500	3,413	0.33	24,600	7,450	0	2,733	0.46	58,730	3,091	0.38	
Film	38,850	12,200	0	3,885	0.38	35,190	6,850	0	3,910	0.66	74,040	3,897	0.47	
Bottle & Other	31,900	6,830	880	3,190	0.31	26,520	5,950	0	2,947	0.50	58,420	3,075	0.37	
PET	104,880	26,960	2,380	10,488	1.02	86,310	20,250	0	9,590	1.63	191,190	10,063	1.22	
Total	14,870	6,450	0	1,487	0.14	3,370	2,350	0	370	0.06	18,200	958	0.12	
Rubber & Leather	32,410	7,100	1,000	3,241	0.31	8,320	3,020	0	980	0.17	41,230	2,170	0.26	
Textiles	4,014,000	1,224,000	270,000	401,400	38.96	1,415,850	447,500	62,650	157,317	26.68	5,429,850	285,782	34.78	
Yard Waste	66,360	13,700	240	6,636	0.64	32,060	14,500	0	3,562	0.60	98,420	5,180	0.63	
Wood	270,180	65,360	0	27,018	2.62	198,330	78,550	0	22,037	3.74	468,510	24,653	3.00	
Other Org. Waste	7,761,570	1,802,130	518,140	776,157	75.33	4,259,130	990,020	255,850	473,237	80.26	12,020,700	632,668	77	
<b>Total (Organic Wastes)</b>														
<b>Inorganic Waste</b>														
Glass	12,700	3,800	0	1,270	0.12	6,380	2,300	0	431	0.07	19,080	1,004	0.12	
Broken Glass	408,440	110,240	20,650	40,844	3.96	67,450	26,730	0	7,494	1.27	475,890	25,047	3.05	
Bottle	421,140	114,040	20,650	42,114	4.09	73,830	29,030	0	7,926	1.34	494,970	26,051	3.17	
Total	107,620	15,650	5,200	10,762	1.04	36,620	8,100	0	4,069	0.69	144,240	7,592	0.92	
Tin Cans (Steel Cans)	16,090	7,750	450	1,609	0.16	11,100	4,100	0	1,233	0.21	27,190	1,431	0.17	
Aluminum cans	20,370	4,750	100	2,037	0.20	9,940	2,840	0	1,104	0.19	30,310	1,595	0.19	
Other Metals	1,964,950	300,000	104,950	196,495	19.07	913,750	297,500	35,750	101,528	17.22	2,878,700	151,511	18.44	
Dirr. Ash, Sand	2,530,170	442,190	131,350	253,017	24.56	1,045,240	341,570	35,750	115,860	19.65	3,575,410	188,179	22.90	
<b>Total (Inorganic Wastes)</b>														
<b>Hazardous Waste</b>														
Batteries	600	340	0	60	0.01	340	340	340	38	0.01	940	49	0.01	
Other Hazardous Waste	11,590	6,350	260	1,159	0.11	4,670	1,800	150	519	0.09	16,060	845	0.10	
<b>Total (Hazardous Waste)</b>														
<b>Total Weight (kg) :</b>	10,303,730	2,251,010	649,750	1,030,373	100.00	5,309,380	1,333,730	292,090	589,653	100.00	15,613,110	821,743	100.00	

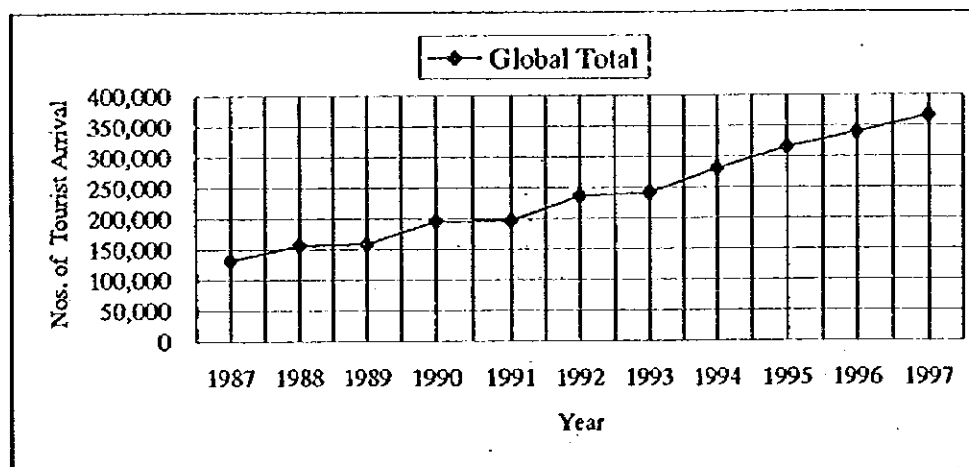
Waste generation amount per guest per day 7.232 g/capita/day  
 Waste generation amount per occupied room per day 14.5 kg/room/day  
 Average occupancy ratio of two hotels in survey period 53.4 %

**g. Tourist Arrivals by Country of Nationality 1987 - 1997 and Estimated Figure for 1998 - 2000**

**Tourist Arrivals by Country of Nationality 1987-1997**

Year	Europe	Asia	Africa	Americas	Oceania	Other Countries	Global Total
1987	98,809	26,541	322	1,539	4,050	138	131,399
1988	119,496	31,313	280	1,614	2,982	72	155,757
1989	123,343	30,172	372	1,702	2,861	38	158,488
1990	152,041	37,002	296	2,167	3,641	9	195,156
1991	147,045	43,866	321	2,008	2,859	13	196,112
1992	165,959	64,231	482	2,060	3,120	0	235,852
1993	174,403	60,413	975	2,311	2,781	137	241,020
1994	192,909	70,351	10,296	3,343	3,058	25	279,982
1995	227,199	71,783	8,191	3,628	4,063	5	314,869
1996	252,694	69,581	7,674	4,134	4,642	8	338,733
1997	272,918	72,739	8,075	6,101	5,730	0	365,563

Data Source: Statistic Section, Ministry of Tourism



Estimate figures for 1998-2000 (Resorts & Hotels)					
Year	Visitor Arrivals (frontier Arrivals)	Tourist Bed-Nights	Bed Capacity	Occupancy Rate (%)	Ave-Duration Stay (Days)
1991	196,112	1,724,742	8,013	63.2	8.8
1992	235,852	1,974,710	8,645	66.2	8.4
1993	241,020	2,092,298	9,219	64.8	8.6
1994	279,982	2,350,702	10,376	67.9	8.4
1995	314,869	2,725,064	11,000	70.5	8.7
1996	338,733	3,038,698	11,784	72.9	9.0
1997	365,563	3,275,534	12,234	77.5	9.0
1998	402,516	3,622,646	13,564	73.2	9.0
1999	444,344	3,999,100	15,648	70.0	9.0
2000	491,777	4,475,174	17,604	69.5	9.1

Revised Date: 22-Jun-98

Source: *Statistics Section  
Ministry of Tourism*

1.1.3 Solid Waste Amount in Future

(f) Domestic & Commercial Waste in Male' and Villingili

Prediction of Domestic & Commercial Wastes Generation Amount for Male' & Villingili

Year	Population in Male'	Population in Villingili	GDP Growth Rate (%)	Multiplier to Waste Generation Rate (%)	Estimated Domestic Waste Amount (ton/day)	Estimated Commercial Waste Amount (ton/day)	Estimated Waste Male' Amount (ton/day)	Estimated Waste Villingili Amount (ton/day)	Estimated Waste Total Amount (ton/day)	Estimated Domestic Waste Generation Rate per capita per day (g/c/d)	Estimated Commercial Waste Generation Rate per capita per day (g/c/d)	Estimated Waste Male' Generation Rate per capita per day (g/c/d)	Estimated Waste Villingili Generation Rate per capita per day (g/c/d)	Estimated Waste Total Generation Rate per capita per day (g/c/d)	Total Annual Waste Amount (ton/year)
1998	67,236	1,844			714	48.0	20.4	68.4	614	71.4	303	614	1.1	69.5	25,385
1999	69,311	2,106	6.0	50	736	51.0	21.6	72.6	632	736	312	632	1.3	74.0	27,001
2000	71,427	2,406	6.2	50	759	54.2	23.0	77.2	652	759	322	652	1.6	78.8	28,744
2001	73,501	2,749	6.5	50	783	57.4	24.4	81.8	673	783	332	673	1.8	83.6	30,525
2002	75,192	3,140	6.5	50	809	60.8	25.8	86.6	695	809	343	695	2.2	88.8	32,412
2003	77,097	3,587	6.4	50	835	64.3	27.3	91.7	717	835	354	717	2.6	94.2	34,393
2004	79,008	4,098	6.2	50	861	68.0	28.9	96.8	739	861	365	739	3.0	99.9	36,452
2005	80,920	4,681	6.0	50	886	71.7	30.4	102.2	761	886	376	761	3.6	105.7	38,588
2006	82,538	5,347	5.9	50	912	75.4	32.0	107.3	784	912	387	784	4.2	111.5	40,709
2007	84,225	6,109	5.8	50	939	79.1	33.6	112.6	807	939	398	807	4.9	117.6	42,912
2008	85,819	6,978	5.7	50	966	82.9	35.2	118.0	830	966	410	830	5.8	123.8	45,199
2009	87,357	7,971	5.6	50	993	86.7	36.8	123.5	853	993	421	853	6.8	130.3	47,567
2010	88,822	9,106	5.5	50	1,020	90.6	38.4	129.0	876	1,020	433	876	8.0	137.0	50,015

**(2) Business , Industrial, Construction & Demolition Wastes in Male'****Prediction of Generation Amount of Business and Industrial Wastes for Male'**

Year	GDP Growth Rate (%)	Multiplier to Waste Generation Rate (%)	Estimated Business and Industrial Waste per day (ton/d)	Annual Amount of Business and Industrial Wastes (ton/year)
1998			36.18	13,206
1999	6.0	50	37	13,602
2000	6.2	50	38	14,024
2001	6.5	50	40	14,479
2002	6.5	50	41	14,950
2003	6.4	50	42	15,428
2004	6.2	50	44	15,907
2005	6.0	50	45	16,384
2006	5.9	50	46	16,867
2007	5.8	50	48	17,356
2008	5.7	50	49	17,851
2009	5.6	50	50	18,351
2010	5.5	50	52	18,855

**Note**

Waste amount in 1998 was obtained from the result of the Solid Waste Amount Survey taking into consideration of the holiday on Friday.

**Prediction of Generation Amount of Construction Wastes for Male'**

Year	GDP Growth Rate (%)	Multiplier to Waste Generation Rate (%)	Estimated Construction Waste per day (ton/d)	Annual Amount of Construction Wastes (ton/year)
1998			68.8	25,113
1999	6.0	50	71	25,866
2000	6.2	50	73	26,668
2001	6.5	50	75	27,535
2002	6.5	50	78	28,430
2003	6.4	50	80	29,340
2004	6.2	50	83	30,249
2005	6.0	50	85	31,157
2006	5.9	50	88	32,076
2007	5.8	50	90	33,006
2008	5.7	50	93	33,947
2009	5.6	50	96	34,897
2010	5.5	50	98	35,857

**Note**

Waste amount in 1998 was obtained from the result of the Solid Waste Amount Survey taking into consideration of the holiday on Friday.

**(3) Domestic Waste in Inhabited Islands and Wastes in Resort Islands in Maldives****Prediction of Waste Generation Amount for Inhabited Islands**

Year	Population	GDP Growth Rate	Multiplier to Waste Generation Rate	Estimated Waste Generation Rate per capita per day	Waste Amount in Inhabited Island	Waste Amount in Inhabited Island
		(%)	(%)	(g/c/d)	(ton/day)	(ton/year)
1998	199,583			686	137	49,953
1999	206,092	6.0	50	706	146	53,129
2000	212,834	6.2	50	728	155	56,568
2001	218,954	6.5	50	752	165	60,086
2002	225,219	6.5	50	776	175	63,814
2003	231,629	6.4	50	801	186	67,731
2004	238,181	6.2	50	826	197	71,805
2005	244,875	6.0	50	851	208	76,038
2006	251,019	5.9	50	876	220	80,245
2007	257,257	5.8	50	901	232	84,625
2008	263,579	5.7	50	927	244	89,175
2009	269,976	5.6	50	953	257	93,897
2010	276,437	5.5	50	979	271	98,788

Note Waste amount in 1998 was obtained from the result of the Solid Waste Amount Survey taking into consideration of the holiday on Friday.

**Prediction of Waste Generation Amount for Resort Islands**

Year	Annual Nos. of Tourist Arrival	Estimated Length of Stay	Annual Nos. of Tourist Stay	Estimated Waste Generation Rate per guest per day	Daily Waste Amount in Resort Islands	Annual Waste Amount in Resort Islands
	(person)	(day)	(bed-nights)	(g/c/d)	(ton/day)	(ton/year)
1998	396,593	9.0	3,569,337	7,230	71	25,806
1999	426,291	9.0	3,836,619	7,230	76	27,739
2000	457,290	9.0	4,115,610	7,230	82	29,756
2001	489,630	9.0	4,406,670	7,230	87	31,860
2002	523,343	9.0	4,710,087	7,230	93	34,054
2003	558,459	9.0	5,026,131	7,230	100	36,339
2004	594,999	9.0	5,354,991	7,230	106	38,717
2005	632,980	9.0	5,696,820	7,230	113	41,188
2006	672,411	9.0	6,051,699	7,230	120	43,754
2007	713,292	9.0	6,419,628	7,230	127	46,414
2008	755,616	9.0	6,800,544	7,230	135	49,168
2009	799,365	9.0	7,194,285	7,230	143	52,015
2010	844,513	9.0	7,600,617	7,230	151	54,952

## (4) Summary of Solid Waste Generation Amount in Future

## Summary of Waste Generation Amount in Future

Year	Domestic Waste	Commercial Waste	Business & Industrial Waste	Construction Waste	Subtotal Waste Generation Amount in Male'	Domestic Waste in Villingili	Total Waste Generation Amount in Male & Villingili	Waste Generation Amount in Inhabited Island	Waste Generation Amount in Resort Islands	Total Waste Generation Amount in the Maldives	Total Waste Generation Amount in the Maldives
1998	48.0	20.4	36.2	68.8	173.4	1.1	174.5	136.9	70.7	382.1	139,463
1999	51.0	21.6	37.3	70.9	180.8	1.3	182.1	145.6	76.0	403.7	147,337
2000	54.2	23.0	38.4	73.1	188.7	1.6	190.2	155.0	81.5	426.7	155,760
2001	57.4	24.4	39.7	75.4	196.9	1.8	198.7	164.6	87.3	450.6	164,486
2002	60.8	25.8	41.0	77.9	205.5	2.2	207.6	174.8	93.3	475.8	173,660
2003	64.3	27.3	42.3	80.4	214.3	2.6	216.9	185.6	99.6	502.0	183,230
2004	68.0	28.9	43.6	82.9	223.3	3.0	226.3	196.7	106.1	529.1	193,129
2005	71.7	30.4	44.9	85.4	232.4	3.6	236.0	208.3	112.8	557.1	203,355
2006	75.4	32.0	46.2	87.9	241.4	4.2	245.6	219.9	119.9	585.3	213,651
2007	79.1	33.6	47.6	90.4	250.6	4.9	255.5	231.8	127.2	614.6	224,313
2008	82.9	35.2	48.9	93.0	260.0	5.8	265.7	244.3	134.7	644.8	235,340
2009	86.7	36.8	50.3	95.6	269.4	6.8	276.2	257.3	142.5	676.0	246,727
2010	90.6	38.4	51.7	98.2	278.9	8.0	286.9	270.7	150.6	708.1	258,468



**(5) Solid Waste Disposal Amount in Thilafushi****a. Estimation of Waste Disposal Ratio of Resort Islands**

Name of Island	Nos. of Times of Transportation	Waste Amount (ton)	Waste Amount per Time (ton)	No. of Rooms	Estimated Occupancy Ratio from the Survey Result (%)	Estimated Nos. of bed-night in 32 days	Estimated Waste Generation Rate per guest (g/day)	Estimated Waste Generation Amount in 32 days (ton)
Aarah	3	2.33	0.78	0	53.4	0	7,230	0.0
Abeeru	1	0.26	0.26	88	53.4	3,007	7,230	21.7
Allaarei	1	0.78	0.78	88	53.4	3,007	7,230	21.7
Ariadhoo	1	4.86	4.86	121	53.4	4,135	7,230	29.9
Bahadu	2	1.75	0.87	33	53.4	1,128	7,230	8.2
Bandos	12	24.77	2.06	225	53.4	7,690	7,230	55.6
Banyan Tree	1	0.39	0.39	48	53.4	1,640	7,230	11.9
Baros	6	9.57	1.60	75	53.4	2,563	7,230	18.5
Boduhithi	5	6.88	1.38	87	53.4	2,973	7,230	21.5
Embudhu	9	14.22	1.58	117	53.4	3,999	7,230	28.9
finolhu								
Faanody	4	4.75	1.19	0	53.4	0	7,230	0.0
Fihaalhohi	1	0.73	0.73	97	53.4	3,315	7,230	24.0
Fullmoon	29	14.84	0.51	150	53.4	5,126	7,230	37.1
Fun Island	8	9.82	1.23	100	53.4	3,418	7,230	24.7
Gangehi	1	1.17	1.17	25	53.4	854	7,230	6.2
Hulhule	64	90.79	1.42	0	53.4	0	7,230	0.0
Ihuru	3	3.94	1.31	45	53.4	1,538	7,230	11.1
Kanifinolhu	4	30.33	7.58	150	53.4	5,126	7,230	37.1
Kudahithi	1	1.17	1.17	7	53.4	239	7,230	1.7
Kudahuraa	20	26.37	1.32	106	53.4	3,623	7,230	26.2
Kudaveli	2	1.94	0.97	88	53.4	3,007	7,230	21.7
Kuramathi	4	45.68	11.42	274	53.4	9,364	7,230	67.7
Kurumba	38	52.20	1.37	170	53.4	5,810	7,230	42.0
Lagoon	2	5.36	2.68	129	53.4	4,409	7,230	31.9
Legun	1	1.56	1.56	129	53.4	4,409	7,230	31.9
Makunudhoo	4	10.76	2.69	37	53.4	1,265	7,230	9.1
Muun	1	0.49	0.49	150	53.4	5,126	7,230	37.1
Nakackafushi	11	16.03	1.46	51	53.4	1,743	7,230	12.6
Paanode	1	0.78	0.78	0	53.4	0	7,230	0.0
Paradise	6	6.89	1.15	260	53.4	8,886	7,230	64.2
Rangali	3	4.88	1.63	88	53.4	3,007	7,230	21.7
Rannalhi	1	2.98	2.98	116	53.4	3,964	7,230	28.7
Ziyaarayifushi	1	1.46	1.46	92	53.4	3,144	7,230	22.7
Sonevafushi	1	0.26	0.26	42	53.4	1,435	7,230	10.4
Taaj Lagoon	3	2.61	0.87	64	53.4	2,187	7,230	15.8
Tailanu	1	2.33	2.33	88	53.4	3,007	7,230	21.7
Thari Village	1	0.39	0.39	24	53.4	820	7,230	5.9
Thulhaagiri	12	18.85	1.57	58	53.4	1,982	7,230	14.3
Vaadhoo	10	9.55	0.96	33	53.4	1,128	7,230	8.2
Vabbinfaru	21	17.64	0.84	88	53.4	3,007	7,230	21.7
Unknown	2	1.25	0.62	88	53.4	3,007	7,230	21.7
<b>Total</b>	<b>302</b>	<b>453.57</b>	<b>1.50</b>	<b>3,631</b>	<b>-</b>	<b>124,093</b>	<b>-</b>	<b>897.19</b>
<b>Estimated Ratio of Wastes transported from Resort Islands (%)</b>						<b>50.6</b>		

Note) An average number of room 88 obtained from the Resort Island Questionnaire Survey was adopted for the resort island where the number of room were not available,.

## b. Prediction of Waste Amount transported from Resort Islands

## Prediction of Waste Amount transported from Resort Islands

Year	Annual Nos. of Tourist Arrival	Ratio of Nos. of Tourist Arrival to 1998	Total Nos. of Hotel Rooms Trans- porting Wastes to Thilafushi	Estimated Occupancy Ratio (%)	Nos. of Tourist Stay per day	Estimated Waste Genera- tion Rate per Guest per day	Daily Waste Genera- tion Amount in Resort Islands	Daily Waste Amount to be Trans- ported to Thilafushi	Annual Waste Amount to be Trans- ported to Thilafushi
	(person)	(%)	(person)	(%)	(bed- nights)	(g/c/d)	(t/d)	(t/d)	(t/year)
1998	396,593	100	3,631	73.2	5,316	7,230	38	19	7,014
1999	426,291	107	3,903	70.0	5,464	7,230	40	20	7,210
2000	457,290	115	4,187	69.5	5,820	7,230	42	21	7,679
2001	489,630	123	4,483	69.5	6,231	7,230	45	23	8,222
2002	523,343	132	4,791	69.5	6,660	7,230	48	24	8,788
2003	558,459	141	5,113	69.5	7,107	7,230	51	26	9,378
2004	594,999	150	5,448	69.5	7,572	7,230	55	27	9,991
2005	632,980	160	5,795	69.5	8,055	7,230	58	29	10,629
2006	672,411	170	6,156	69.5	8,557	7,230	62	31	11,291
2007	713,292	180	6,531	69.5	9,077	7,230	66	33	11,977
2008	755,616	191	6,918	69.5	9,616	7,230	70	35	12,688
2009	799,365	202	7,319	69.5	10,173	7,230	74	37	13,423
2010	844,513	213	7,732	69.5	10,747	7,230	78	39	14,181

Estimated Occupancy Ratio by Statistic Section, Ministry of Tourism

1998	73.2 (%)
1999	70.0 (%)
2000	69.5 (%)

**c. Prediction of Waste Amount transported from Hulhule (Airport)**

Year	Annual Nos. of Tourist Arrival	Estimated Length of Stay	Annual Nos. of Tourist Stay	Estimated Waste Genera- tion Rate per guest per day	Daily Waste Amount in Resort Islands	Annual Waste Amount in Resort Islands	Waste Amount Increase Ratio to 1998 Value	Airport Waste Amount transport- ed to Thilafushi	Airport Waste Amount transport- ed to Thilafushi
	(person)	(day)	(bed- nights)	(g/c/d)	(t/d)	(t/year)	(%)	(ton/day)	(t/year)
1998	396,593	9.0	3,569,337	7,230	71	25,806	100.000	2.8	1,036
1999	426,291	9.0	3,836,619	7,230	76	27,739	107.488	3.0	1,113
2000	457,290	9.0	4,115,610	7,230	82	29,756	115.305	3.3	1,194
2001	489,630	9.0	4,406,670	7,230	87	31,860	123.459	3.5	1,279
2002	523,343	9.0	4,710,087	7,230	93	34,054	131.960	3.7	1,367
2003	558,459	9.0	5,026,131	7,230	100	36,339	140.814	4.0	1,458
2004	594,999	9.0	5,354,991	7,230	106	38,717	150.028	4.3	1,554
2005	632,980	9.0	5,696,820	7,230	113	41,188	159.604	4.5	1,653
2006	672,411	9.0	6,051,699	7,230	120	43,754	169.547	4.8	1,756
2007	713,292	9.0	6,419,628	7,230	127	46,414	179.855	5.1	1,863
2008	755,616	9.0	6,800,544	7,230	135	49,168	190.527	5.4	1,973
2009	799,365	9.0	7,194,285	7,230	143	52,015	201.558	5.7	2,087
2010	844,513	9.0	7,600,617	7,230	151	54,952	212.942	6.0	2,205

**(Cut-off from the Result of Waste Amount Survey at the Thilafushi)**

Name of Island	Nos. of Times of Trans- portation	Waste Amount (ton)	Waste Amount per Time (ton)	Remarks
Aarah	3	2.33	0.78	Airport
Faanody	4	4.75	1.19	
Hulhule	64	90.79	1.42	
Paanode	1	0.78	0.78	
Total	72	98.65	1.37	

**d. Prediction of Waste Amount transported from Nearby Inhabited Islands**

Year	Popula- tion	GDP Growth Rate	Multiplier to Waste Genera- tion Rate	Estimated Waste Genera- tion Rate per capita per day	Waste Amount in Inhabit- ed Island	Waste Amount in Inhabit- ed Island	Waste Amount Increase Ratio to 1998 Value	Daily Waste Amount trans- ported from nearby Inhabit- ed Islands	Annual Waste Amount trans- ported from nearby Inhabit- ed Islands
		(%)	(%)	(g/c/d)	(t/d)	(t/yr)	(%)	(t/d)	(t/yr)
1998	199,583			686	137	49,953	100	0.2	90
1999	206,092	6.0	50	706	146	53,129	106	0.3	95
2000	212,834	6.2	50	728	155	56,568	113	0.3	101
2001	218,954	6.5	50	752	165	60,086	120	0.3	108
2002	225,219	6.5	50	776	175	63,814	128	0.3	114
2003	231,629	6.4	50	801	186	67,731	136	0.3	122
2004	238,181	6.2	50	826	197	71,805	144	0.4	129
2005	244,875	6.0	50	851	208	76,038	152	0.4	136
2006	251,019	5.9	50	876	220	80,245	161	0.4	144
2007	257,257	5.8	50	901	232	84,625	169	0.4	152
2008	263,579	5.7	50	927	244	89,175	179	0.4	160
2009	269,976	5.6	50	953	257	93,897	188	0.5	168
2010	276,437	5.5	50	979	271	98,788	198	0.5	177

(Cut-off from the Result of Waste Amount Survey at the Thilafushi)

Name of Island	Nos. of Times of Trans- portation	Waste Amount (ton)	Waste Amount per Time (ton)
Aarah	3	2.33	0.78
Faanody	4	4.75	1.19
Hulhule	64	90.79	1.42
Paanode	1	0.78	0.78
Total	72	98.65	1.37

**c. Estimated Waste Disposal Amount in Thilafushi**

Year	Resort Islands	Airport	Nearby Inhabited Islands	Waste Disposal Amount except for Male'	Waste Disposal Amount of Male'	Daily Total Waste Disposal Amount	Annual Waste Disposal Amount	Accumulated Waste Disposal Amount
	(ton/day)	(ton/day)	(ton/day)	(ton/day)	(ton/day)	(ton/day)	(ton/year)	(ton)
1998	19.2	2.8	0.2	22.3	174.8	197.1	71,956	71,956
1999	19.8	3.0	0.3	23.1	182.7	205.7	75,094	147,049
2000	21.0	3.3	0.3	24.6	191.1	215.7	78,720	225,770
2001	22.5	3.5	0.3	26.3	199.9	226.3	82,587	308,357
2002	24.1	3.7	0.3	28.1	209.3	237.4	86,658	395,015
2003	25.7	4.0	0.3	30.0	219.0	249.1	90,905	485,920
2004	27.4	4.3	0.4	32.0	229.1	261.1	95,297	581,217
2005	29.1	4.5	0.4	34.0	239.5	273.5	99,836	681,053
2006	30.9	4.8	0.4	36.1	250.1	286.2	104,460	785,513
2007	32.8	5.1	0.4	38.3	261.0	299.4	109,275	894,787
2008	34.8	5.4	0.4	40.6	272.5	313.1	114,290	1,009,077
2009	36.8	5.7	0.5	43.0	284.5	327.4	119,515	1,128,592
2010	38.9	6.0	0.5	45.4	297.0	342.4	124,962	1,253,554

## **1.2 Prediction of Solid Waste Composition in Future**

### **1.2.1 Purpose**

Waste composition is one of the most important elements for planning and design of solid waste management system and facilities. Planning for separation of wastes or materials recovery at generation sources must take into consideration of the recyclable components commingled in the waste. The capacity or sizing of equipment and facilities composing the solid waste management system is determined by the waste components in together with waste amount.

Generally, the waste amount and composition varies depending on the life style and economic growth. Accordingly, estimation of waste composition in future is made based on the data obtained from the Waste Composition Survey and the future trends in economy and society in Male and the Maldives.

In respect of the requirements for planning of waste management system, the future waste composition is estimated based on the following 5 categories of wastes and 18 components according to the Waste Composition Survey.

- Waste Composition for Domestic & Commercial Waste in Male'
- Waste Composition for Business & Industrial Wastes in Male'
- Waste Composition for Construction & Demolition Wastes in Male'
- Waste Composition for Domestic Wastes in Inhabited Islands
- Waste Composition in Resort Islands

### **1.2.2 Procedures for Estimation of Waste Composition**

The existing data was available only for 5 samples surveyed in 1993 and the number of the data is not sufficient for utilising for analysis. The Study Team carried out the Waste Composition Survey for 39, 20 and 20 samples for Male', inhabited islands and resort islands respectively from June to September in 1998. The result of the Waste Composition Survey shall be analysed for estimating the waste composition in 2010 taking into consideration of the future trends in economic growth and social movements and some other factors surrounding in establishment of future solid waste management system.

### 1.2.3 Waste Amount and Composition in 2010

#### (I) Waste Amount and Composition in Male' & Villingili

(Domestic, Commercial, Business and Industrial Wastes in Male' & Villingili)

Type of Waste	Domestic & Commercial Wastes		Business & Industrial Wastes		Construction Waste		Total		
Total Weight	147		52		98		297		
Sampling Weight & Composition Ratio	Weight (ton)	Ratio (%)	Weight (ton)	Ratio (%)	Weight (ton)	Ratio (%)	Weight (ton)	Ratio (%)	
<b>Organic Waste</b>									
Food Waste	28.82	19.60	12.62	24.43	0.00	0.00	41.44	13.95	
Paper	Paper	14.78	10.05	9.55	18.48	0.21	0.22	24.54	8.26
	Cardboard	18.97	12.90	6.48	12.54	0.74	0.76	26.20	8.82
	Subtotal	33.75	22.95	16.03	31.03	0.96	0.97	50.74	17.08
Plastics	Film	6.36	4.32	1.45	2.80	0.52	0.53	8.33	2.80
	Bottle & Others	5.15	3.50	1.18	2.28	0.09	0.09	6.41	2.16
	PET	1.37	0.93	0.51	0.99	0.01	0.01	1.89	0.63
	Subtotal	12.87	8.75	3.14	6.07	0.62	0.63	16.63	5.60
Rubber & Leather	1.58	1.08	0.45	0.87	0.03	0.03	2.06	0.69	
Textiles	4.45	3.03	0.42	0.80	0.01	0.01	4.87	1.64	
Yard Waste	16.20	11.01	4.03	7.80	0.19	0.20	20.42	6.88	
Wood	4.79	3.26	8.58	16.61	17.52	17.83	30.89	10.40	
Other Org. Waste	15.20	10.33	1.23	2.39	0.13	0.13	16.56	5.58	
<b>Organic Waste Total</b>	<b>117.67</b>	<b>80.00</b>	<b>46.49</b>	<b>90.00</b>	<b>19.45</b>	<b>19.80</b>	<b>183.61</b>	<b>61.83</b>	
<b>In-organic Waste</b>									
	0.00		0.00		0.00		0.00	0.00	
Glass	Broken Glass	0.55	0.38	0.11	0.22	0.00	0.00	0.67	0.22
	Bottle	2.32	1.58	0.53	1.03	0.01	0.01	2.86	0.96
	Subtotal	2.87	1.95	0.64	1.24	0.01	0.01	3.53	1.19
Tin Cans (Steel Cans)	3.83	2.61	0.69	1.34	0.24	0.25	4.77	1.61	
Aluminum cans	0.75	0.51	0.20	0.39	0.01	0.01	0.96	0.32	
Other Metals	1.77	1.20	1.87	3.62	0.32	0.32	3.96	1.33	
Dirt, Ash, Sand	19.90	13.53	1.66	3.21	78.01	79.41	99.56	33.53	
<b>In-organic Waste Total</b>	<b>29.12</b>	<b>19.80</b>	<b>5.06</b>	<b>9.80</b>	<b>78.59</b>	<b>80.00</b>	<b>112.78</b>	<b>37.97</b>	
<b>Hazardous Waste</b>									
	0.00		0.00		0.00		0.00	0.00	
Batteries	0.15	0.10	0.05	0.10	0.00	0.00	0.20	0.07	
Other Hazardous Waste	0.15	0.10	0.05	0.10	0.20	0.20	0.40	0.13	
<b>Hazardous Waste Total</b>	<b>0.29</b>	<b>0.20</b>	<b>0.10</b>	<b>0.20</b>	<b>0.20</b>	<b>0.20</b>	<b>0.59</b>	<b>0.20</b>	
<b>Total Weight (kg)</b>	<b>147</b>	<b>100.00</b>	<b>52</b>	<b>100.00</b>	<b>98</b>	<b>100.00</b>	<b>297</b>	<b>100.00</b>	
<b>Total Waste Volume (m3)</b>	<b>694</b>		<b>325</b>		<b>89</b>		<b>1,107</b>		
<b>Bulk Density (ton/m3)</b>	<b>0.212</b>		<b>0.159</b>		<b>1.104</b>		<b>0.283</b>		

## (2) Waste Amount and Composition for Inhabited Islands and Resort Islands

Type of Waste		Waste Amount and Composition in 2010 in Inhabited Islands except for Male'			Waste Amount and Composition in 2010 in whole Resort Islands		
		Estimated Waste Composition (%)	Daily Waste Amount (t/d)	Annual Waste Amount (t/yr)	Estimated Waste Composition (%)	Daily Waste Amount (t/d)	Annual Waste Amount (t/yr)
<b>Organic Waste</b>							
	Food Waste	31.35	84.8	30,968	33.44	50.3	8,629
	Paper	1.80	4.9	1,777	1.92	2.9	495
	Paper						
	Cardboard	2.87	7.8	2,839	3.07	4.6	791
	Total	4.67	12.6	4,616	4.98	7.5	1,286
	Plastics	0.37	1.0	362	0.39	0.6	101
	Film						
	Bottle & Others	0.46	1.3	456	0.49	0.7	127
	PET	0.36	1.0	360	0.39	0.6	100
	Total	1.19	3.2	1,178	1.27	1.9	328
	Rubber & Leather	0.11	0.3	112	0.12	0.2	31
	Textiles	0.26	0.7	254	0.27	0.4	71
	Yard Waste	33.88	91.7	33,468	36.14	54.4	9,326
	Wood	0.61	1.7	607	0.66	1.0	169
	Other Org. Waste	2.92	7.9	2,888	3.12	4.7	805
<b>Total (Organic Wastes)</b>		<b>75.00</b>	<b>203.0</b>	<b>74,091</b>	<b>80.00</b>	<b>120.4</b>	<b>20,645</b>
<b>In-organic Waste</b>							
	Glass	0.13	0.4	131	0.11	0.2	27
	Broken Glass						
	Bottle	3.30	8.9	3,261	2.65	4.0	684
	Total	3.43	9.3	3,392	2.75	4.1	711
	Tin Cans (Steel Cans)	1.00	2.7	988	0.80	1.2	207
	Aluminum cans	0.19	0.5	186	0.15	0.2	39
	Other Metals	0.21	0.6	208	0.17	0.3	44
	Dirt, Ash, Sand	19.97	54.0	19,725	16.02	24.1	4,135
<b>Total (Inorganic Wastes)</b>		<b>24.80</b>	<b>67.1</b>	<b>24,499</b>	<b>19.90</b>	<b>30.0</b>	<b>5,135</b>
<b>Hazardous Waste</b>							
	Batteries	0.15	0.4	148	0.05	0.1	13
	Other Hazardous Waste	0.05	0.1	49	0.05	0.1	13
<b>Total (Hazardous Waste)</b>		<b>0.2</b>	<b>0.5</b>	<b>198</b>	<b>0.10</b>	<b>0.2</b>	<b>26</b>
<b>Total Weight (ton)</b>		<b>100.00</b>	<b>270.7</b>	<b>98,788</b>	<b>100.00</b>	<b>150.6</b>	<b>25,806</b>
<b>Total Waste Volume (m3)</b>		<b>-</b>	<b>972</b>	<b>354,790</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Bulk Density (ton/m3)</b>		<b>-</b>	<b>0.278</b>	<b>0.278</b>	<b>-</b>	<b>-</b>	<b>-</b>



## Appendix - 2

### Manuals for Small Scale Composting

## **1. WHAT IS COMPOSTING?**

Composting is a controlled process of decomposing larger organic fractions of wastes into smaller stable substances which is mainly made use of a soil conditioner. This process normally occurs due to the activities of soil micro organisms that live in the soil and is indispensable for maintenance of the nature cycle to return of nutrients back to the soil once an organism dies.

Composting is one of the most effective processes for recycling organic wastes intended for use in agriculture. It is a natural process which convert the waste material into a valuable natural fertiliser.

If done properly, composting can be a valuable income generating activity that can also help to keep the environment clean!

This manual will assist you to start your own compost production by telling you what you will need in order to start and how to make compost. Composting is hard work, but it can be rewarding.

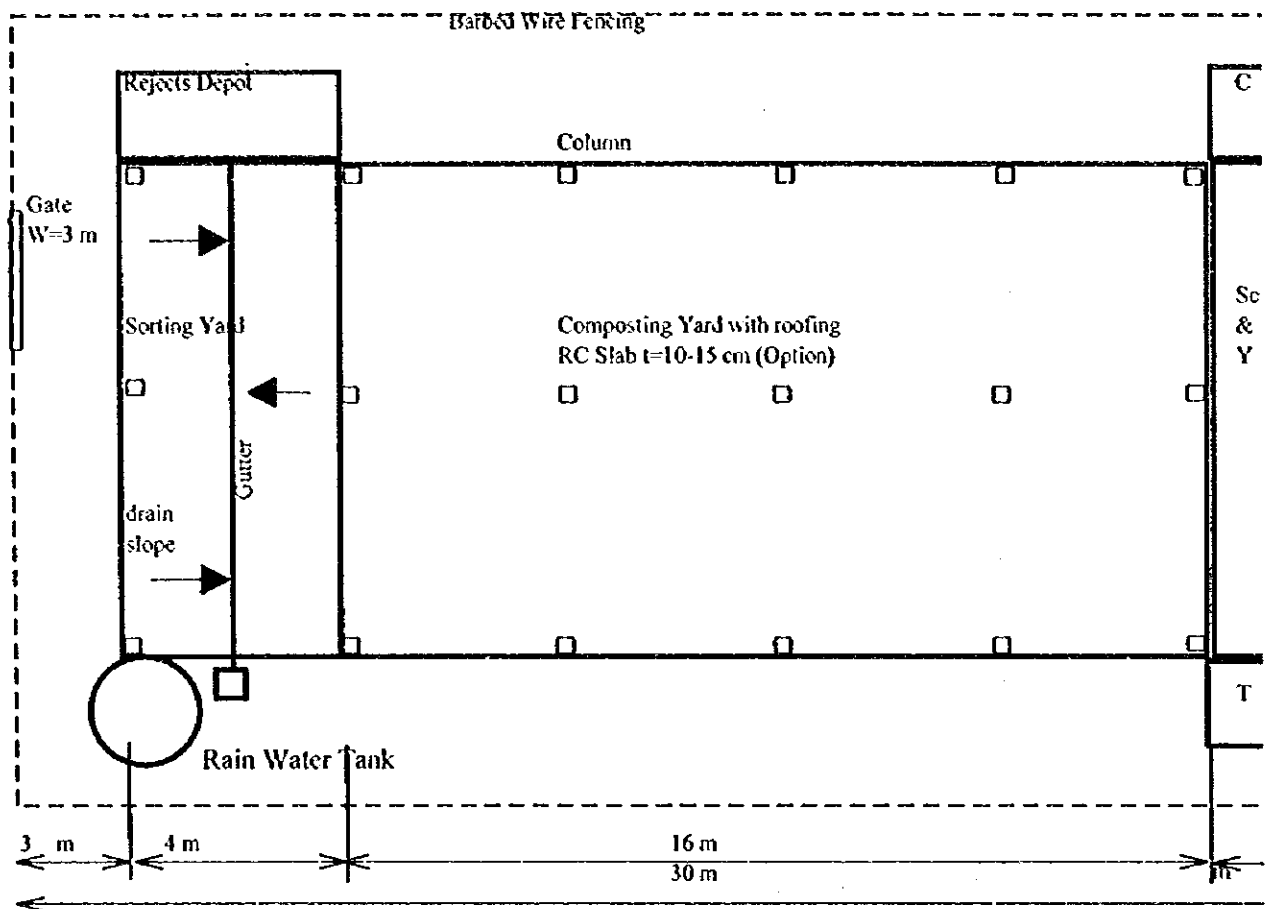
This manual was mainly prepared for pilot scale composting in Thilafushi but most of the principles are applicable for the community groups wishing to produce compost

## **2. WHAT YOU WILL NEED TO START**

### **2.1 Requirement of Land**

The most important requirement for composting is the space on which to do it. A flat shady piece of land is ideal for composting. A minimum size of approximately 30m by 14m is recommended to start with, in order to ensure you have a consistent production of compost. The space must also include an area for sorting out waste, and a secure area for storage of your tools and equipment and storage of the ready compost. A small office would also be ideal, where records may be stored and any administrative work carried out. Figure 1 below shows a typical layout for a compost yard.

**Floor Plan**



**Figure 1 Typical Layout for a Composting Yard**

## 2.2 Infrastructure Requirements

You will require a certain amount of basic infrastructure for your composting facilities. The compost yard should be covered by a shade (but left open at the sides) so that the compost is protected from drying out by too much sun, and from becoming too moist from too much rain. The sides of the compost yard should be left open to allow fresh air to blow through. You could use chainlink fencing or timber off cuts to prevent animals getting into the yard. A simple structure will be required for storage houses for tools and final products, etc. Also recommended is a rain water tank and a rain water collecting system, as it is important to add just the right amount of water during the composting process, especially during the dry season. You may also have to dig trenches in case of water accumulation (especially during the rainy season) to direct excess water and any overflow from the rainwater collection tank into the nearest drain.

## 2.3 Tools and equipment required

The followings are the requirements for tools and equipment that you will need. The tools will make the work easier, as composting is very labour intensive. In addition, protective items such as gumboots, gloves and masks are very important, particularly when sorting out waste. This is because waste could cause some health problems if not handled with care. Also note that the quantities of the tool requirements will depend on the size of your group/the number of people who are going to work on the composting project.

### List of Tools Requirements:

- Wheelbarrows/handcarts
- Spades
- Forks (hay fork, pitch fork)
- Jembes
- Pangas
- Watering Cans
- Sieves
- Weighing Scales
- Gumboots
- Gloves
- Scarves
- Rakes
- Packaging Bags

## 2.4 Requirement of Labour

You will need labour in order to construct your composting yard, and you will need labour in order to carry out the compost production.

Provided that you already have the space designated, and that you are able to readily purchase materials required, it should only take approximately 5 days labour to construct the yard. Labour requirements at a minimum would be a supervisor experienced in construction, 2 labour assistants. You may also require the services of a specialist e.g. in installing the rain water collection system. This may take a further 5 days labour.

Labour will be required for a minimum of 2 days or times in a week in order to start and maintain one composting pile (you may find that you need more days in the week in which to do the work). Tasks that will need to be done are outlined under "Starting the Compost Production" below. It is recommended that you have about 4 people available to work on the pilot facilities, Windrow type composting, to treat 3 to 4 tons of raw materials in a week and turning of the processing piles. You would need this many people (possibly even more!) especially if you are also going to collect organic wastes from households and institutions, or even dumps.

### **3. STARTING THE COMPOSTING PRODUCTION**

#### **3.1 Ingredients for composting**

The following raw materials are needed in order to produce compost:

#### **(1) A Reasonable Types of Waste in Two Different Forms for Composting**

##### **(i) Green (wet) Wastes**

- food remains including egg shells, fish waste, bones (without meat or fat)
- fruit and vegetable peelings
- freshly cut grass, tree leaves, weeds etc.
- tea leaves, coffee residues

These are rich in Nitrogen and contain trace elements

##### **(ii) Dry Wastes**

- saw dust from timber workshops
- dry grass, tree leaves
- straw, maize stalks etc.
- paper, cardboard

These are rich in Carbon. Also wood ash (for potash) may be used. Note that the ash must be from wood and not charcoal or coal.

#### **(2) Top Forest Soil/Fertile Soil**

Note:

Other excellent materials that can be used to make compost include: animal manure such as chicken manure, dried blood, bone and fish meal.

Soil is good as it adds the micro-organism population in the pile, gives the compost a good texture, keeps moisture and nitrogen from escaping, reduces odour and keeps flies away.

The following materials may NOT be composted:

- charcoal ashes - high carbon dioxide content robs a compost pile of oxygen, slowing down the composting process
- dog and cat manure - contain harmful pathogens
- any organic matter contaminated by pests or disease - pests and bacteria might not be killed during the composting process, and could be transferred to new crops.
- eucalyptus and cassia tree leaves - poisonous to some of the microbes important for composting
- meat and animal fat - attracts pests such as flies and rodents, take a long time to decompose, and cause odour

### 3.2 Collecting the Wastes

The process starts at household level, where the wastes are generated. The easiest way to conduct your operation is to convince householders in your area to set aside their food wastes, vegetable wastes, yard wastes for you to collect regularly. This is preferable to sorting out suitable wastes from a dumping area - the wastes may be contaminated, and it is a health hazard. One incentive that you could use for obtaining householders co-operation is to distribute garbage bags to them, to facilitate source separation of the wastes. The separated wastes can then be collected by wheel barrows twice or thrice a week. Once all wastes are brought to the site, the recycling process begins with the composting process in "wind row" systems.

### 3.3 Setting up Compost Production

#### The windrow system of compost production

The method of composting described is known as the "windrow" system. This is the most suitable system for initiating compost production with solid wastes, because:

- it is low cost
- easy to understand and operate
- uses local equipment
- can be carried out in the open in most climates
- adapts easily to changing material types and through-put rates
- can be used for small community schemes and even larger installations

The main disadvantage of the windrow system is that control of the process is not as good as some of the other systems, which means an extended process time is required. Typical production time for compost is 6 to 8 weeks.

### **Step 1: Preparing the land**

In the Windrow system, a pile of compost is made and then "turned". The turned pile is put in an adjacent space, whilst a new pile is started in the original area. This is a continuous process: every time a pile is turned, it is turned into a new space. Figure 2 shows how to arrange the land for the windrow system, and how the system works. Each pile should take a space of about 1 feet m by 1 feet approximately.

The land will need to be cleared of all vegetation. The soil should be dug and loosened up to a depth of about a foot. This will allow any excess water to drain away.

### **Step 2: Starting the pile**

Make a space of 1 feet by 1 feet at one edge of the cleared and loosened land. Evenly spread a layer of dry wastes (saw dust, straw, banana leaves etc.) up to a thickness of up to half a foot. Add a layer of green wastes (fruits and vegetable peelings, food wastes, etc.) on top of this, to make up the layer to about 1 foot. The dry layer is then followed by a layer of the same thickness of green wastes again. The dry layer is important as it will allow air to pass freely through the pile so it may not to cut smaller as long as turning operation is inconvenient. If possible, the green waste layer should then be covered with 1 inch of soil or animal manure.

Precaution must be taken when balancing these two important layers, as these are the layers that determine the decomposition rate of a compost pile (C/N ratio).

Moisten the pile, and then repeat this process of layering until the pile is about 5 ft high. Remember to water each layer.

Once the pile has been built, insert a long sharpened stick diagonally right through to the centre of the pile and leave the process to start. The stick acts like a thermometer. Within the first 72 hours the pile should attain the thermophilic temperature (35-45°C). This is indicated by steam seen flowing from the pile, and hotness of the part of that stick that was driven into the pile on completion of layering (take the stick out of the pile every week, and feel it!). If the stick is hot, the process is going well. If the stick is not hot, the pile may need more or less water, and more air. If the stick shows signs of a white substance on it, the pile will need more water added to it. To increase the amount of air, the pile should be "turned" more frequently (see below).

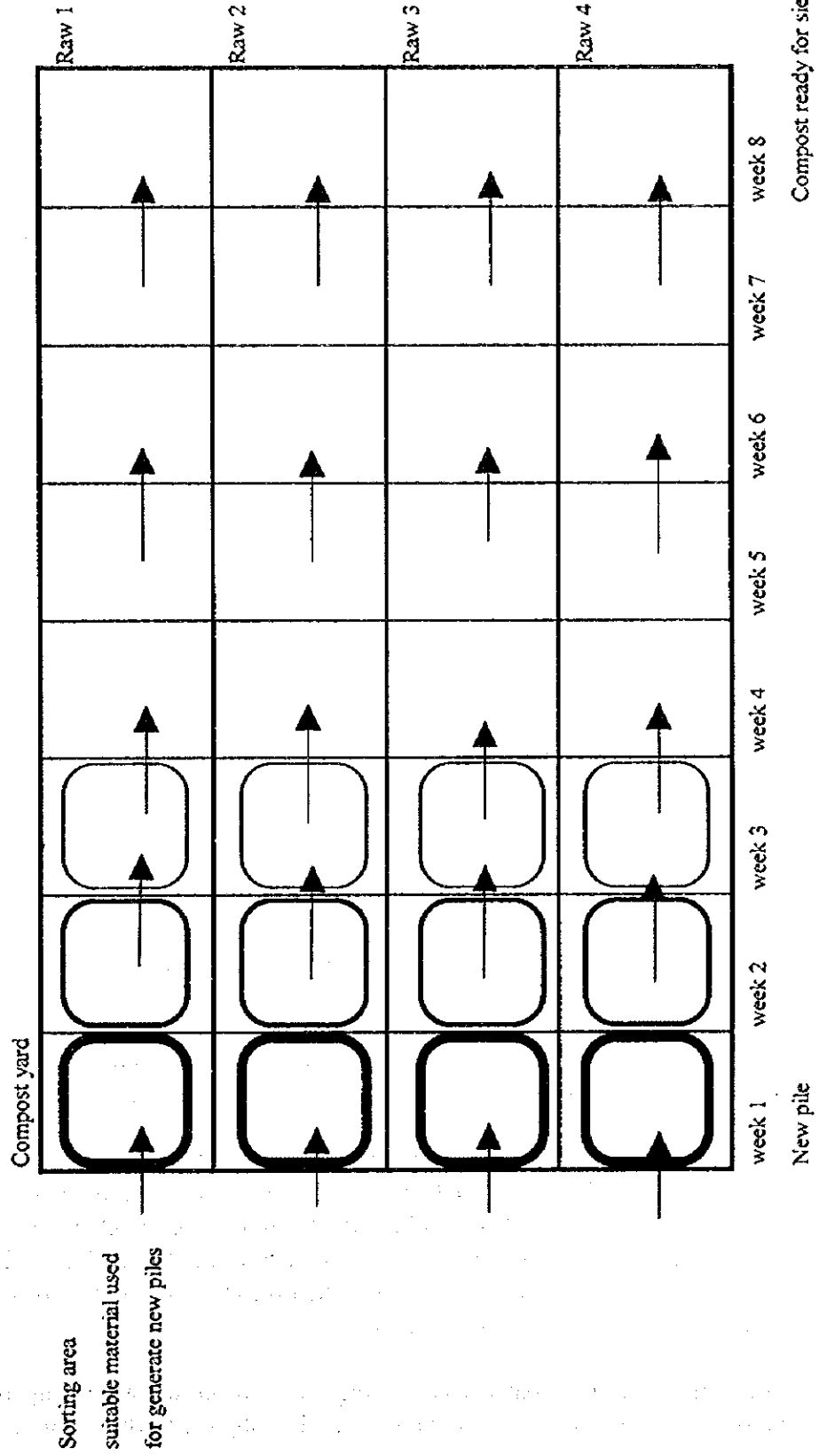


Figure 2 How to Arrange the Compost Piles for the Windrow System



### **Step 3: Turning**

Within one week, the pile shall have sunk down by almost a quarter. This would block all the air spaces in the pile and most moisture shall have escaped due to high temperatures. If the pile is not turned to improve these two conditions the process would change into an anaerobic process, which is slow, time consuming, and unhygienic. Turning also promotes uniform decomposition of all the wastes.

On a loosened bare land of the same measurement and conditions above, all the outer layer of the pile is scooped to the centre and moistened. The rest of the pile is scooped and evenly spread over these with limited moistening till the whole pile is done and the stick (thermometer) is returned. The pile should end up being turned from the inside out, so that the outer layer of the old pile becomes the middle of the new pile, and the middle of the old pile becomes the outer layer of the new pile. The pile should gain some temperature over 45°C within 72 hours.

The turning process is necessary on a weekly basis till between 6-8 weeks when the pile will cool off, an indication that all the organic fraction has decomposed.

### **Step 4: Once the Compost is Ready**

A little drying may be necessary before the compost is sieved, weighed and packed for sale. The final product should be both easily handled, and visually acceptable (e.g. should not have contaminants such as pieces of glass etc.).

Typical screening sizes are:

Fine compost (first grade): less than 5 mm  
Mulch standard compost (second grade): 5 to 25mm  
Return to the process: greater than 25 mm

### **Controlling the Process to Maintain Compost Quality**

The following need to be considered for achieving a good standard of compost quality.

**Porosity:** The dry waste layers permit the free flow of air and expose larger surface areas to the active organisms

**Moisture content:** Moisture is needed in order to have high microbial activity. The optimum moisture level depends on the type of material - the thermometer stick will give you a good indication. Bear in mind that the moisture content value reduces during the process due to evaporation, so more moisture should be added. If the thermometer stick, or visual inspection reveals that the moisture content is too high, it may be reduced by adding a "bulking agent".

**Nutrient content:** Nutrient balance is very important to suit the wide range of organisms involved in the composting process. Usually the Carbon/Nitrogen ratio

about 25:1 is used as an indication. The C/N ratio of typical refuse is about optimum.

**Aeration:** Sufficient air is required to meet the microbial needs in order to maintain aerobic conditions, and to promote evaporative cooling of the pile (to prevent temperatures getting too hot).

**Temperature control:** Maintaining an elevated temperature is very important as it greatly increases the rate of biodegradation, and exposure to high temperatures for a controlled time kills harmful pathogens. The temperature must not get too hot, however, as this will kill the micro organisms carrying out the composting.

The method of composting by turning has been widely used by existing groups involved with this kind of activity, but conditions are not controlled very well. This affects both the quality and the quantity of compost produced. Composting is a natural process, and it can flourish if certain procedures are followed in order to control conditions.

- ① The pile should be covered with mature compost at each turning until flies and odour are no longer a problem (generally after the second turning).
- ② Turning should be carried out every 3 days for the first three weeks (approximately). The quicker you need compost, the more often it needs to be turned.
- ③ The water content should be kept in the range of 45-55% and adjusted if necessary during turning. If measuring stick shows prominence of white "fire. fang" fungus, this means that the water content is less.
- ④ The operating temperature should be kept in the range of 45-70°C by making the appropriate changes in pile cross-section during the turning process, if necessary.
- ⑤ The composting must be carried out in two phases, the end of the first phase being achieved when the temperature does not rise above 40°C.
- ⑥ The material should only be considered as compost (for general purpose use) after a two-phase system of composting as described, in order to ensure that the compost has fully decomposed, and there are no pathogens in the end product.

### Summary of Tasks Required

The following is a summary of tasks that will need to be done during compost production:

- Collecting the wastes
- Sorting the wastes
- Shredding the wastes
- Carrying the wastes to the composting yard
- Making the compost piles
- Covering the piles with soil or finished compost

- Turning the compost piles
- Adding water to the compost piles
- Checking the compost piles' temperatures
- Clearing any leachates and maintaining drainage channels in the composting yard
- Drying the compost (if necessary)
- Sieving the compost
- Blending the compost
- Weighing and packaging the compost

### **3.4 Certifying Compost Quality**

It would be helpful to test the quality of the compost once in a while, to ensure that you are managing the process correctly, and also to have a clear idea of the quality of compost you are producing. This would also be useful information when you are trying to use or market the compost. The important parameters are listed below.

#### **Parameter for Compost Quality Test**

Moisture Content, pH (in H<sub>2</sub>O), Carbon, Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Sodium, Copper, Iron, Zinc, Manganese

The compost can be incorporated in soils of strong acidity (high pH and phosphorous). In acidic soils (low pH) phosphorous is fixed and hence not available to crops. Addition of the compost in such soils would be an advantage since phosphorous will be availed and there is a possibility of improving the pH levels with time.

The application of the compost should be in freely draining soils and restricted to areas of high rainfall where pH values are less than 5.0.

### **4. SETTING UP A VEGETABLE TRIAL GARDEN**

To effectively test and market your product, your group may be required to set aside a piece of land within their project site to be used as a demonstration/trial garden. An area of at least 20 ft by 20 ft would be ideal, because it would be able to provide at least 5 beds of 3 ft wide and 20 ft long and a 1 ft pathway in between the beds.

The demonstration/trial garden is important because it will offer a practical example of compost utilisation and how crops flourish in a garden dressed by compost. It will also give your group first hand knowledge about rates of application of compost, and possibly even how to use it in conjunction with other fertilisers for best effect.

To effectively make use of the small piece of land the group, it is recommended that the group adopts a biointensive gardening system, which although labour intensive in the initial stages, has an impressive long term result.

#### **Step by Step Preparation:**

- ① Clear the land of any vegetation and measure out the area.
- ② Sub-divide land into beds of a width of 3 feet, leaving a space of 1 foot in between the beds to serve as a pathway.
- ③ Spread compost along every bed up to about 1 - 3 inches thick.
- ④ Loosen the soil in the beds. This process loosens soil up to 2 feet deep to avoid competition of plant roots once planted in the bed. Compacted soil forces plant roots to spread sideways rather than going down, hence creating competition between plant roots, hence stunted growth and poor yield.
- ⑤ Level the bed and water well using a fine nozzle, and prepare to sow the seedlings.
- ⑥ Since the idea is to loosen the soil, it is advisable that no one steps in the bed during planting, weeding or harvesting. The person must use the pathway in order to do the work.
- ⑦ The benefits of double digging (intensive gardening), although labour intensive in the initial stages, include:
  - the land will enjoy 3 years of working on the garden without having to redig it again;
  - since there is less competition in plant roots, the yield is expected to be very high and the farmer may plant as many different crops as closely as possible;
  - the moisture loss will be very limited, hence the farmer is able to have his garden the whole year round. (in dry season, mulching will be necessary).

## **5. THINGS TO BE AWARE OF**

### **5.1 Health and Safety**

There is a need for protective clothing, especially when picking and sorting wastes and sieving the compost. Gumboots, gloves and scarves/masks for the face are essential items in order to prevent coming into contact with hazardous matter, and accidents such as cuts and grazes.

You may find that there are excess flies during the production of the compost. It is very important to control this through the simple method of covering each compost pile with a layer of ready compost or soil, as stated earlier in this manual. This will prevent flies from breeding. It is also important to control the composting process as much as possible, ensuring that enough air and moisture is present, and the piles are turned frequently. This will ensure thorough decomposition, and effective removal of harmful pathogens. There will be no bad odour from the compost, and the final product will be of a high quality.

### **5.2 Seasonality of Production**

From the experience of existing composting groups, compost production is high during the months from April to September (harvesting seasons).

Production is especially low during dry seasons due to a lack of green wastes, and the scarcity of water.

During your planning, you must take these factors into account, and try to find an adequate source of water. You might try approaching the Nairobi City Council (Community Development Unit) for gathering green wastes from markets during dry seasons.

### **5.2 Trends in Demand and Supply**

Demand is very high at the on set of the long rains (for planting), and is low during the cool season.

During your planning, take into account the fact that currently supply cannot meet demand, which is very high when the rainy season starts. See if it may be worthwhile for you to continue production at a high level during the dry season, in order for you to be able to meet the demand sufficiently when required. This will mean you will need adequate storage space for all the compost you produce.

### **5.3 Resistance to Your Operation**

You may encounter resistance from neighbours because of:

- Lack of understanding about composting
- leading to a fear of dumping/creating a new dumpsite/nuisance

- Fear of land grabbing, especially where land is given under temporary ownership by the provincial administration
- Selfishness - people reluctant to give you their waste if they know you are making money from it

How to counter the resistance:

- Creating awareness by distributing posters, public barazas jointly with island office I;
- Distributing collection bags to every household, and regularly collecting their organic wastes.

Please note that the most important and effective tool is to spread public awareness and information about what you are trying to do. If you have managed to solve the problem of a dump site, as one group has managed to do, the results speak for themselves, and the community around your area will appreciate your efforts!

## 5.4 Advantages of Compost

Compost is a very good product for the following reasons:

- It has been produced by using a natural process
- It doesn't cost much to produce compost
- It is cheap to buy
- adds soil fertility - compost contains trace elements such as iron, zinc, and magnesium that are not found in ordinary chemical fertilisers. Although they occur in very small quantities, these trace elements are as important to plants as nitrogen, phosphorous and potassium.
- Improves soil structure over time which means that good compost can hold up to six times its own weight in water. The water is held in reserve so that plant roots can use it during the dry season. This is especially important in arid areas. The rich light texture of compost loosens clay soils and makes sandy soils less porous. This allows air and micro-organisms to pass more freely and lets roots grow easily into the soil.
- Provides plant nutrients
- Provides ideal conditions for micro organisms and worms in the soil
- It has been produced from solid waste that would have just been dumped, adding to solution of the waste problem

## 5.5 Can Compost Compete with Chemical Fertilisers?

It is important to know the advantages and disadvantages of chemical fertilisers in order for you to be able to convince using compost. However, until more research has been done about compost production, and until there is an institution that can fully certify the compost, it is recommended to use the compost in conjunction with chemical fertilisers for commercial farming. This is because at the moment compost production is not a controlled process, and not enough tests have been done to test the compost quality.

### 5.5.1 Advantages of Chemical Fertilisers

- Provide a guaranteed amount of nutrients to the soil
- Have a high degree of farmer awareness
- Are well distributed in shops

### 5.5.2 Disadvantages of Chemical Fertilisers

- Chemicals leach quickly out of the soil when it rains, taking their nutrients with them
- Chemicals can kill worms and micro-organisms that improve soil quality and help crops grow
- Chemical fertiliser can make the soil more susceptible to erosion
- Chemical fertiliser is known to increase soil salinity hence rendering it unfit for plants.

## **5.6 Instructions for Use of Compost**

One of the best ways of testing the capabilities of the compost you are producing is to apply it on your own vegetable/flower trial gardens, as explained previously in this manual. This is a very practical way to determine what your compost works best on, and also to be able to answer an enquiry.

### **Use of Compost in Gardens**

Compost is excellent for growing quickly maturing crops like vegetables and flowers, and when combined with the proper way can increase production by as much as 3 to 5 times. Rates of application depend upon the quality of the soil, and the type of the plant.

Compost can and should be regularly dug into any soil - in the garden, in pots, vegetable beds, etc. to add nutrients and keep plants growing healthily. It can be sifted through 5 mm mesh and used for planting seeds in boxes.

Top dress the area with an inch or two of compost and cultivate it into the upper layers of the soils. Do this every time you plant. The results will be evident within a few seasons.

### **Planting Trees**

When trees or seedlings are planted, compost should be mixed generously and added below where the roots will sit, and watered well. Compost can also be added around the seedling hole. This will encourage the roots to grow downward rather than up to the surface, and will make the plant stronger and more resilient in wind or rain. The trees will need less water, and will also be more resistant to attacks from pests and disease.

### **Using Compost on Larger Land Areas**

For planting crops like maize on larger areas, a mixture of compost and soil can be placed in holes directly with the seeds. You will need to experiment with different amounts most suitable for your area.

### **Using Compost in Conjunction with Chemical Fertilisers**

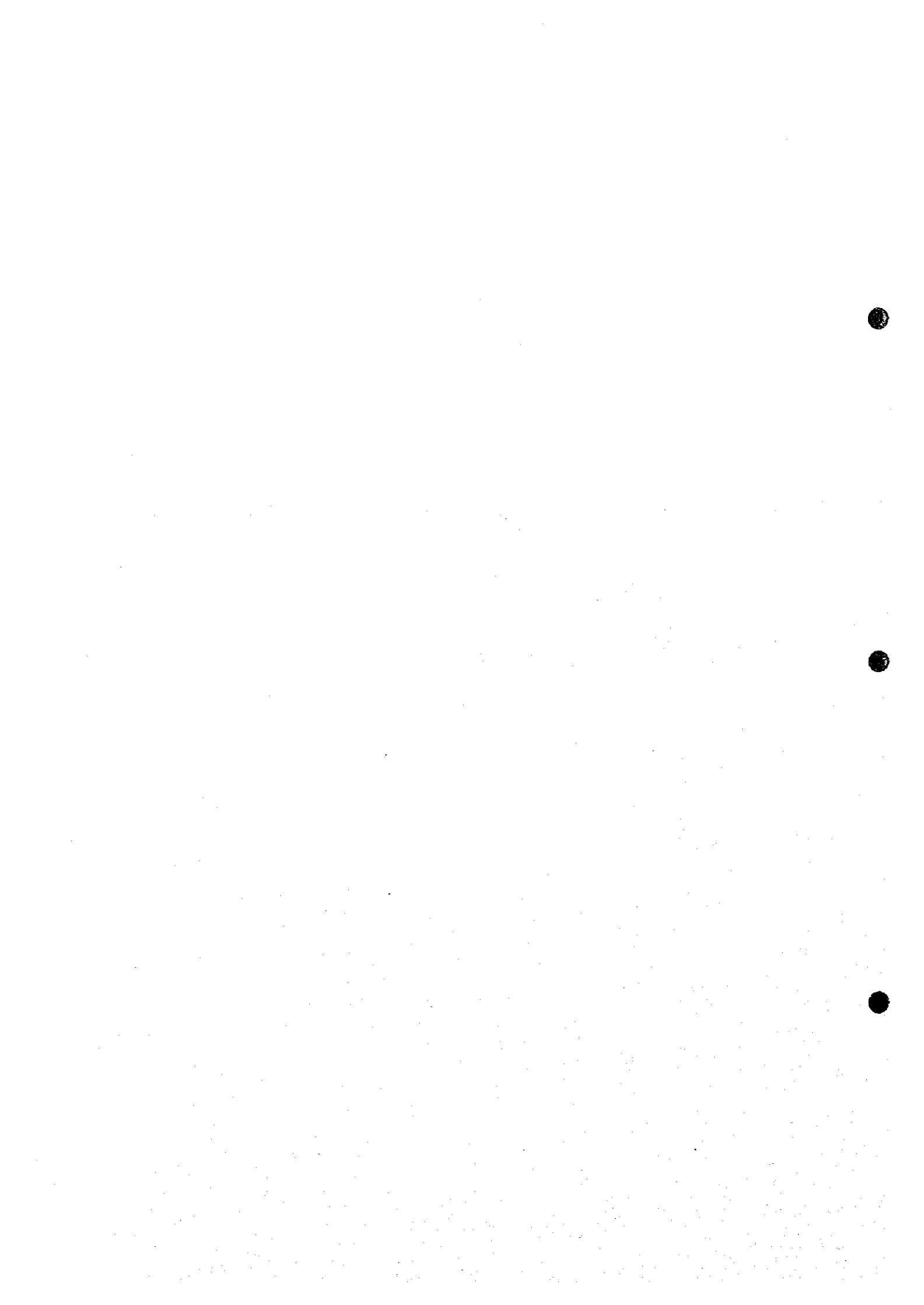
The main function of compost is as a soil conditioner. Compost also contains nutrients in the form of Nitrogen, Phosphorous, and Potassium and trace elements such as Iron, Zinc, and Magnesium, which are also very important to plant growth.

Compost may be used in conjunction with chemical fertilisers, and in fact both Phosphorous and Nitrogen are made more available (through the combination of organic compounds found in the compost and the activity of the bacteria with the fertiliser) to the plants than if the chemical fertilisers are used alone. The effect also lessens leaching of soluble inorganic Nitrogen.





*F. Construction Cost Estimation*



### **The Construction Cost Estimation**

The construction costs for the facilities were estimated based on the calculations as attached Tables. The construction costs are calculated by the quantities of the work items for the facilities and these unit prices. The tables are divided into the following items consisted of the planned facilities in the development plan.

1. Construction of New Landfill Site for 2003 (Thilafushi (2))
2. Construction of New Landfill Site for 2004 to 2010 (Thilafushi(3))
3. Construction in Existing Thilafushi (Thilafushi (1))
  - (1) Construction Cost for Imported Material Use
  - (2) Construction Cost for Local Material Use and Construction by Local Company
4. Construction in Male' (Transfer Station)
5. Construction in Villingili (Transfer Yard)

Short Term Development Plan consists of No.1, 3, 4 and 5 of above and Master Plan includes all of the items.

The cost of foreign and local currency for above construction items are also presented as attached the Tables.

**Construction Cost in Thirafushi(1)**  
(Short Term development 2003)

Unit: 1,000Rf

Description		Unit	Quantity	Unit Price	Amount	Remarks
<b>Direct Construction Work in New Thirafushi</b>						
<b>1 Direct Construction Work(New Area)</b>						
<b>(1) Breakwater (Seabed Level=0.0)</b>						
1)	Rubble Stone (5~10kg)	m	700	4,981	3,487	1.61 m <sup>3</sup> /m
2)	Protection Stone (30~50kg)	m	700	7,606	5,324	2.46 m <sup>3</sup> /m
3)	Armor Stone (300~500kg)	m	700	8,942	6,259	2.57 m <sup>3</sup> /m
<b>(2) Revetment for Waste</b>						
1)	Steel Sheet Pile (I-SP111)	m	970	13,056	12,664	4.5 m × 2.5 pcs
2)	Coping Concrete	m	970	7,525	7,259	1.4 m <sup>3</sup> /m
3)	Reinforcing Steel	t	34	17,650	600	35 kg/m
4)	Armor Stone (100~300kg)	m	970	6,183	5,998	2 m <sup>3</sup> /m
<b>(3) Protection for Waste</b>						
1)	Rubble Stone	m	740	4,641	3,434	1.5 m <sup>3</sup> /m
2)	Armor Stone	m	740	4,019	2,974	1.3 m <sup>3</sup> /m
3)	Concrete Revetment	m	740	1,055	781	0.2 m <sup>3</sup> /m
4)	Filter sheet	m <sup>2</sup>	3,000	293	879	4 m <sup>2</sup> /m
(3)	Proving of PVC Pipe (D=200)	set	466	1,289	601	set/225 m <sup>2</sup>
<b>Sub-Total</b>					50,300	
<b>(1) Quay Wall for Dhoni</b>						
1)	Base Gravel (5~10kg)	m	50	141	7	1.0 m <sup>3</sup> /m
2)	Concrete Block	m	50	41,922	2,096	7.3 m <sup>3</sup> /m
3)	In situ Concrete	m	50	4,114	206	0.78 m <sup>3</sup> /m
4)	Filter Sheet	m <sup>2</sup>	500	293	147	10 m <sup>2</sup> /m
5)	Backfill Stone (5~10kg)	m	50	19,127	956	6.8 m <sup>3</sup> /m
<b>(2) Work Shop &amp; Garage</b>						
1)	Soil Replacing	m <sup>3</sup>	1,000	199	199	
2)	Pavement	m <sup>2</sup>	600	1,934	1,160	0.25 /m <sup>2</sup>
3)	Work Shop Building	m <sup>2</sup>	375	4,102	1,538	
4)	Utilities	L.S	1	58,600	59	
<b>(3) Quay Wall for Ferry</b>						
1)	Base Gravel (5~10kg)	m	15	140	2	1.0 m <sup>3</sup> /m
2)	Concrete Block	m	15	41,922	629	7.3 m <sup>3</sup> /m
3)	In situ Concrete	m	15	4,114	62	0.78 m <sup>3</sup> /m
4)	Filter Sheet	m <sup>2</sup>	150	293	44	10 m <sup>2</sup> /m
5)	Backfill Stone (5~10kg)	m	15	19,127	287	6.8 m <sup>3</sup> /m
6)	Pavement	m <sup>2</sup>	100	1,934	193	
<b>(4) Compost yard</b>						
1)	Pavement	m <sup>2</sup>	420	1,934	812	
2)	Roof Work	m <sup>2</sup>	200	1,113	223	
3)	Brick Wall	m <sup>2</sup>	64	762	49	
<b>(5) Stock Yard</b>						
1)	Wall	m	32	762	24	
2)	Pavement	m <sup>2</sup>	60	1,934	116	
<b>(6) Battery Box</b>						
		L.S	1	23,440	23	
<b>(7) Excavation for Landfill</b>						
		m <sup>3</sup>	51,000	199	10,149	
<b>Sub-Total</b>					18,981	
<b>2 Direct Temporary Work</b>						
<b>(1) Temporary Jetty for Construction</b>						
		L.S	1	1,992,400	1,992	
<b>(2) Temporary Road for Construction</b>						
1)	New Landfilling area	m	1,630	1,735	2,828	16.5 m <sup>3</sup> /m
<b>(3) Silt Protection</b>						
1)	placing	Time	81	900	73	
<b>Sub-Total</b>					5,113	
<b>Total Direct Cost</b>					74,395	
<b>Indirect Construction Cost</b>						
<b>(1) Common Temporary Work</b>						
		%	10	D.C	7,439	
<b>(2) Site Expenses</b>						
		%	13	D.C	9,671	
<b>(3) Overhead</b>						
		%	8	D.C	5,952	
<b>Total Indirect Cost</b>					23,062	
<b>Total Construction Cost</b>					97,457	

**Construction Cost in Thirafushi(3)**  
(Development 2004~2010)

						Unit: 1000Rf
	Description	Unit	Quantity	Unit Price	Amount	Remarks
<b>Direct Construction Work in New Thirafushi</b>						
<b>1) Direct Construction Work (New Area)</b>						
(1)	Breakwater					(Sealed Level=0.0m)
	1) Rubble Stone (5~10 kg)	m	750	4,981	3,786	1.61 m <sup>3</sup> /m
	2) Protection Stone (30~50 kg)	m	760	7,606	5,781	2.45 m <sup>3</sup> /m
	3) Armor Stone (300~500 kg)	m	760	8,942	6,795	2.57 m <sup>3</sup> /m
(2)	Revetment for Waste					(Sealed Level=-0.5m)
	1) Steel Sheet Pile (HSP11)	m	1,300	13,055	15,973	4.5 m <sup>2</sup> ×2.5 ps
	2) Coping Concrete	m	1,300	7,525	9,783	1.4 m <sup>3</sup> /m
	3) Reinforcing Steel	t	45	17,650	812	35 kg/m
	4) Armor Stone (100~300 kg)	m	1,300	9,275	12,058	3 m <sup>3</sup> /m
(3)	Protection for Waste					(Sealed Level=0.0m)
	1) Rubble Stone	m	800	4,641	3,713	1.5 m <sup>3</sup> /m
	2) Armor Stone	m	800	4,019	3,215	1.3 m <sup>3</sup> /m
	3) Concrete Revetment	m	800	1,055	844	0.2 m <sup>3</sup> /m
	4) Filter sheet	m <sup>2</sup>	3,200	293	938	4 m <sup>3</sup> /m
(4)	Providing of PVC Pipe (D=200)	set	800	1,289	1,031	set/225 m <sup>2</sup>
<b>Sub-Total</b>					<b>65,728</b>	
(1)	Quay Wall for Dhoni					
	1) Base Gravel (5~10 kg)	m	50	141	7	1.0 m <sup>3</sup> /m
	2) Concrete Block	m	50	41,922	2,095	7.3 m <sup>3</sup> /m
	3) In situ Concrete	m	50	4,114	206	0.78 m <sup>3</sup> /m
	4) Filter Sheet	m <sup>2</sup>	500	293	147	10 m <sup>3</sup> /m
	5) Backfill Stone (5~10 kg)	m	50	19,127	956	6.8 m <sup>3</sup> /m
(2)	Work Shop & Garage					
	1) Soil Replacing	m <sup>3</sup>	1,000	199	199	
	2) Pavement	m <sup>2</sup>	600	1,934	1,160	0.25 m <sup>2</sup>
	3) Work Shop Building	m <sup>2</sup>	375	4,102	1,538	
	4) Utilities	L.S	1	58,600	59	
(3)	Quay Wall for Ferry					
	1) Base Gravel (5~10 kg)	m	15	140	2	1.0 m <sup>3</sup> /m
	2) Concrete Block	m	15	41,922	629	7.3 m <sup>3</sup> /m
	3) In situ Concrete	m	15	4,114	62	0.78 m <sup>3</sup> /m
	4) Filter Sheet	m <sup>2</sup>	150	293	44	10 m <sup>3</sup> /m
	5) Backfill Stone (5~10 kg)	m	15	19,127	287	6.8 m <sup>3</sup> /m
	6) Pavement	m <sup>2</sup>	100	1,934	193	
(4)	Compost yard					
	1) Pavement	m <sup>2</sup>	420	1,934	812	
	2) Roof Work	m <sup>2</sup>	200	1,113	223	
	3) Brick Wall	m <sup>2</sup>	64	762	49	
(5)	Stock Yard					
	1) Wall	m	32	762	24	
	2) Pavement	m <sup>2</sup>	60	1,934	116	
(6)	Battery Box	L.S	1	23,440	23	
(7)	Causeway					
	1) Concrete Pipe (D=1000)	m	73	3,292	240	24.3 m×3 sets
	2) Road Filling	m <sup>3</sup>	2,800	199	557	56 m <sup>3</sup> /m
	3) Filter Sheet	m <sup>2</sup>	750	293	220	15 m <sup>3</sup> /m
	4) Protection Stone (30~50 kg)	m <sup>3</sup>	360	3,094	1,114	7.2 m <sup>3</sup> /m×50m
	5) Armor Stone (300~500 kg)	m <sup>3</sup>	365	3,094	1,129	7.7 m <sup>3</sup> /m×50m
<b>Sub-Total</b>					<b>12,092</b>	
<b>2) Direct Temporary Work</b>						
(1)	Temporary Jetty for Construction	L.S	1	1,992,400	1,992	
(2)	Temporary Road for Construction					
	1) New Landfilling area	m	2,000	1,735	3,470	16.5 m <sup>3</sup> /m
(3)	Silt Protection	m	40	5,500	220	
	1) placing	Time	100	900	90	
<b>Sub-Total</b>					<b>5,772</b>	
<b>Total Direct Cost</b>					<b>83,592</b>	
<b>Indirect Construction Cost</b>						
(1)	Common Temporary Work	%	10	D.C	8,359	
(2)	Site Expenses	%	13	D.C	10,857	
(3)	Overhead	%	8	D.C	6,687	
<b>Total Indirect Cost</b>					<b>25,914</b>	
<b>Total Construction Cost</b>					<b>109,506</b>	

**Construction Cost in Existing Thirafushi(1)  
(Imported Rock Protection System)**

Unit: 1,000Rf

Description		Unit	Quantity	Unit Price	Amount	Remarks
<b>1</b>	<b>Direct Construction Work (Existing Land)</b>				<b>26,308</b>	
(1)	Seawall (Existing land)					
	1) Armor Stone	m	1,320	8,356	11,030	2.4 m <sup>3</sup> /m
	2) Rubble Stone	m	1,320	6,341	8,370	2.05 m <sup>3</sup> /m
	3) Insitu Concrete	m	1,320	2,649	3,497	0.5 m <sup>3</sup> /m
	4) Filter Sheet	m <sup>2</sup>	8,580	293	2,514	6.5 m <sup>2</sup> /m
	5) Filling/Backfilling	m	1,320	680	898	6.5 m <sup>3</sup> /m
<b>2</b>	<b>Direct Temporary Work</b>					
(1)	Temporary Road for Construction					
	1) Existing Land	m	1,320	94	124	Grading 8 m <sup>2</sup> /m
<b>Total Direct Cost</b>					<b>26,432</b>	
<b>Indirect Construction Cost</b>						
(1)	Common Temporary Work	%	10	D.C	2,643	
(2)	Site Expenses	%	13	D.C	3,436	
(3)	Overhead	%	8	D.C	2,115	
<b>Total Indirect Cost</b>					<b>8,194</b>	
<b>Total Construction Cost</b>					<b>34,626</b>	

**Construction Cost in Existing Thirafushi(1)  
(Coral Masonry Protection System By Local Company)**

Unit: 1,000Rf

Description		Unit	Quantity	Unit Price	Amount	Remarks
<b>1</b>	<b>Direct Construction Work (Existing Land)</b>					
(1)	Seawall (Existing land)					
	1) Coral Masonry	m	1,320	6,000	7,920	5 m <sup>3</sup> /m
	2) Gavion Net Cover	m	1,320	1,240	1,637	7.5 m <sup>2</sup> /m
	3) Excavation and Leveling	m	1,320	343	453	3 m <sup>3</sup> /m
<b>3</b>	<b>Direct Temporary Work</b>					
(2)	Temporary Road for Construction					
	2) Existing Land	m	1,320	94	124	Grading 8 m <sup>2</sup> /m
<b>Total Direct Cost</b>					<b>10,134</b>	
<b>Indirect Construction Cost</b>						
(1)	Common Temporary Work	%	7	D.C	709	
(2)	Site Expenses	%	5	D.C	507	
(3)	Overhead	%	5	D.C	507	
<b>Total Indirect Cost</b>					<b>1,723</b>	
<b>Total Construction Cost</b>					<b>11,856</b>	

**Construction Cost in Male'**  
**(Transfer Station)**

Unit: 1,000Rf

Description	Unit	Quantity	Unit Price	Amount	Remarks
<b>1 Direct Construction Cost in Male'</b>					
<b>(1) Truck Garage</b>					
1) Concrete Pavement	m <sup>2</sup>	416	1,934	805	
2) Roofing Work	m <sup>2</sup>	416	1,113	463	
<b>(2) Car Parking</b>					
1) Block Paving	m <sup>2</sup>	280	879	246	
<b>(3) Truck Washing Yard</b>					
1) Concrete Pavement	m <sup>2</sup>	40	1,934	77	
2) Block Wall	m	21	1,149	24	H=3m
3) Drainage system	L.S	1	11,720	12	
<b>(4) Truck Scale Base</b>					
1) Basement	L.S	2	93,760	188	
2) Scale House	m <sup>2</sup>	14.0	6,212	87	3.5m x 2m
3) Access Pavement	m <sup>2</sup>	36	1,934	70	3m x 3m x 2
<b>(5) Waste Retaining House</b>					
1) Concrete Pillar & Beam	m <sup>3</sup>	15	6,915	104	
2) Wall (Siding)	m <sup>2</sup>	425	586	249	
3) Pavement	m <sup>2</sup>	430	1,934	832	10m x 43m
4) Heavy Roofing Work	m <sup>2</sup>	1,050	1,875	1,959	
9) Utilities	L.S	1	293,000	293	
<b>(6) Waste Retaining Yard</b>					
1) Concrete Pillar & Beam	m <sup>3</sup>	20	6,915	138	
2) Wall (Siding)	m <sup>2</sup>	450	585	281	
3) Pavement	m <sup>2</sup>	1,300	1,934	2,514	
4) Drainage & Pit	L.S	1	218,000	218	L=130
<b>(7) Building for Office</b>					
1) Basement Work	m <sup>2</sup>	384	2,051	788	
2) Building Work	m <sup>2</sup>	680	6,798	4,623	
3) Utilities	L.S	1	234,400	234	
<b>(8) Work Shop</b>					
1) Concrete Pavement	m <sup>2</sup>	256	1,934	495	
2) Building Work	m <sup>2</sup>	225	4,102	923	
3) Utilities	L.S	1	128,920	129	
(9) Road and Yard Block Pavement	m <sup>2</sup>	3,160	879	2,778	
(10) Drainage System	L.S	1	410,200	410	
(11) Other Utilities	L.S	1	293,000	293	
(12) Fence	m	198	762	151	H=3m
(13) Water tank	L.S	1	87,900	88	
(14) Rest House	m <sup>2</sup>	25	6,798	170	
<b>Total Direct Cost</b>				<b>19,650</b>	
<b>3 Indirect Construction Cost</b>					
(1) Common Temporary Work	%	10	D.C	1,965	
(2) Site Expenses	%	13	D.C	2,555	
(3) Overhead	%	8	D.C	1,572	
<b>Total Indirect Cost</b>				<b>6,092</b>	
<b>Total Construction Cost</b>				<b>25,742</b>	

**Construction Cost in Villingili**  
**(Transfer Yard)**

Unit: 1,000Rf

Description	Unit	Quantity	Unit Price	Amount	Remarks
<b>1 Direct Construction Cost in Villingili</b>					
<b>(1) Truck Garage</b>					
1) Concrete Pavement	m <sup>2</sup>	16	1,934	31	
2) Roofing Work	m <sup>2</sup>	16	1,113	18	
<b>(2) Deposit Yard</b>					
1) Concrete Pavement	m <sup>2</sup>	825	1,934	1,596	
3) Drainage system	m	130	1,700	221	
<b>(3) Fence</b>					
Masonry wall	m	130	300	39	
Net Fence	m	130	180	23	H=3m
<b>Total Direct Cost</b>				<b>1,928</b>	
<b>3 Indirect Construction Cost</b>					
(1) Common Temporary Work	%	10	D.C	193	
(2) Site Expenses	%	13	D.C	251	
(3) Overhead	%	8	D.C	154	
<b>Total Indirect Cost</b>				<b>598</b>	
<b>Total Construction Cost</b>				<b>2,525</b>	



**Construction Cost in Thirafushi(2)**  
(for 2003 Foreign and Local Portion)

Unit: 1,000Rf

Description	Total Amount	Foreign Portion	Local Portion			Total	Currency (%)	
			Local Goods	Skilled Labour	Unskilled Labour		Local	Foreign
<b>Direct Construction Work in New Thirafushi</b>								
<b>1) Direct Construction Work (New Area)</b>								
(1) Breakwater								
1) Rubble Stone (5~10 kg)	3,487	3,400	44	35	9	87	2.5	97.5
2) Protection Stone (30~50 kg)	5,324	5,191	67	53	13	133	2.5	97.5
3) Armor Stone (300~500 kg)	6,259	6,103	78	63	16	156	2.5	97.5
(2) Revetment for Waste								
1) Steel Sheet Pile (FSPH)	12,664	12,411	177	51	25	253	2.0	98.0
2) Coping Concrete	7,299	7,131	84	67	17	168	2.3	97.7
3) Reinforcing Steel	600	588	8	2	1	12	2.0	98.0
4) Armor Stone (100~300 kg)	5,998	5,845	75	60	15	150	2.5	97.5
(3) Protection for Waste								
1) Rubble Stone	3,434	3,345	43	34	9	86	2.5	97.5
2) Armor Stone	2,974	2,900	37	30	7	74	2.5	97.5
3) Concrete Revetment	781	763	9	7	2	18	2.3	97.7
4) Filter sheet	879	813	20	13	33	66	7.5	92.5
(3) Providing of PVC Pipe (D=200)	601	595	5	0	1	6	1.0	99.0
<b>Sub-Total</b>	<b>50,300</b>	<b>49,090</b>	<b>647</b>	<b>415</b>	<b>148</b>	<b>1,210</b>	<b>2.4</b>	<b>97.6</b>
(1) Quay Wall for Dhoni								
1) Base Gravel (5~10 kg)	7	6	1	0	0	1	13.5	86.5
2) Concrete Block	2,096	2,045	24	19	5	48	2.3	97.7
3) Insitu Concrete	206	201	2	2	0	5	2.3	97.7
4) Filter Sheet	147	136	3	2	6	11	7.5	92.5
5) Backfill Stone (5~10 kg)	956	932	12	10	2	24	2.5	97.5
(2) Work Shop & Garage								
1) Soil Replacing	199	172	16	5	5	27	13.5	86.5
2) Pavement	1,160	1,090	21	14	35	70	6.0	94.0
3) Work Shop Building	1,538	1,392	23	29	44	146	9.5	90.5
4) Utilities	59	54	3	1	1	5	8.5	91.5
(3) Quay Wall for Ferry								
1) Base Gravel (5~10 kg)	2	2	0	0	0	0	13.5	86.5
2) Concrete Block	629	615	7	6	1	14	2.3	97.7
3) Insitu Concrete	62	61	1	1	0	1	2.3	97.7
4) Filter Sheet	44	41	1	1	2	3	7.5	92.5
5) Backfill Stone (5~10 kg)	287	280	4	3	1	7	2.5	97.5
6) Pavement	193	181	3	2	6	12	6.0	94.0
(4) Compost yard								
1) Pavement	812	763	15	10	24	49	6.0	94.0
2) Roof Work	223	202	11	4	6	21	9.5	90.5
3) Brick Wall	49	40	3	2	4	9	18.5	81.5
(5) Stock Yard								
1) Wall	24	20	1	1	3	4	18.5	81.5
2) Pavement	116	109	2	1	4	7	6.0	94.0
(6) Battery Box	23	22	0	0	1	1	2.5	97.5
(7) Excavation for Landfill	10,143	8,774	822	274	274	1,369	13.5	86.5
<b>Sub-Total</b>	<b>18,981</b>	<b>17,140</b>	<b>1,105</b>	<b>368</b>	<b>368</b>	<b>1,841</b>	<b>9.7</b>	<b>90.3</b>
<b>2) Direct Temporary Work</b>								
(1) Temporary Jetty for Construction	1,992	1,723	161	54	54	269	13.5	86.5
(2) Temporary Road for Construction								
1) New Landfilling area	2,828	2,446	229	76	76	382	13.5	86.5
(3) Silt Protection	220	220	0	0	0	0	0.0	100.0
1) placing	73	63	6	2	2	10	13.5	86.5
<b>Sub-Total</b>	<b>5,113</b>	<b>4,452</b>	<b>396</b>	<b>132</b>	<b>132</b>	<b>661</b>	<b>12.9</b>	<b>87.1</b>
<b>Total Direct Cost</b>	<b>74,394</b>	<b>70,683</b>	<b>2,148</b>	<b>916</b>	<b>648</b>	<b>3,711</b>	<b>5.0</b>	<b>95.0</b>
<b>Indirect Construction Cost</b>								
(1) Common Temporary Work	7,435	6,881	335	112	112	558	7.5	92.5
(2) Site Expenses	9,671	9,478	58	77	58	193	2.0	98.0
(3) Overhead	5,952	5,952	0	0	0	0	0	100
<b>Total Indirect Cost</b>	<b>23,062</b>	<b>22,311</b>	<b>451</b>	<b>150</b>	<b>150</b>	<b>751</b>	<b>3.3</b>	<b>96.7</b>
<b>Total Construction Cost</b>	<b>97,457</b>	<b>92,993</b>	<b>2,598</b>	<b>1,066</b>	<b>799</b>	<b>4,463</b>	<b>4.6</b>	<b>95.4</b>

**Construction Cost in Thirafushi(3)**  
(For 2004-2010 Foreign and Local Portion)

Unit: 1,000RF

Description	Total Amount	Foreign Portion	Local Portion				Currency (%)	
			Local Goods	Skilled Labour	Unskilled Labour	Total	Local	Foreign
<b>Direct Construction Work in New Thirafushi</b>								
<b>1 Direct Construction Work (New Area)</b>								
(1) Breakwater								
1) Rubble Stone (5~10 kg)	3,785	3,691	47	38	9	95	2.5	97.5
2) Protection Stone (30~50 kg)	5,781	5,636	72	58	14	145	2.5	97.5
3) Armor Stone (300~500 kg)	6,796	6,626	85	68	17	170	2.5	97.5
(2) Revetment for Waste								
1) Steel Sheet Pile (FSHII)	16,973	16,634	238	68	34	339	2.0	98.0
2) Coping Concrete	9,783	9,558	113	90	23	225	2.3	97.7
3) Reinforcing Steel	812	796	11	3	2	16	2.0	98.0
4) Armor Stone (100~300kg)	12,058	11,757	151	121	30	301	2.5	97.5
(3) Protection for Waste								
1) Rubble Stone	3,715	3,622	46	37	9	93	2.5	97.5
2) Armor Stone	3,215	3,135	40	32	8	80	2.5	97.5
3) Concrete Revetment	844	825	10	8	2	19	2.3	97.7
4) Filter sheet	938	868	21	14	35	70	7.5	92.5
(3) Providing of PVC Pipe (D=200)	1,031	1,021	8	0	2	10	1.0	99.0
<b>Sub-Total</b>	<b>65,728</b>	<b>64,167</b>	<b>842</b>	<b>536</b>	<b>186</b>	<b>1,565</b>	<b>2.4</b>	<b>97.6</b>
(1) Quay Wall for Dhoni								
1) Base Gravel (5~10 kg)	7	6	1	0	0	1	13.5	86.5
2) Concrete Block	2,096	2,048	24	19	5	45	2.3	97.7
3) In Situ Concrete	206	201	2	2	0	5	2.3	97.7
4) Filter Sheet	147	136	3	2	6	11	7.5	92.5
5) Backfill Stone (5~10 kg)	956	932	12	10	2	24	2.5	97.5
(2) Work Shop & Garage								
1) Soil Replacing	199	172	16	5	5	27	13.5	86.5
2) Pavement	1,160	1,090	21	14	35	70	6.0	94.0
3) Work Shop Building	1,538	1,392	73	29	44	145	9.5	90.5
4) Utilities	59	54	3	1	1	5	8.5	91.5
(3) Quay Wall for Ferry								
1) Base Gravel (5~10 kg)	2	2	0	0	0	0	13.5	86.5
2) Concrete Block	629	615	7	6	1	14	2.3	97.7
3) In Situ Concrete	62	61	1	1	0	1	2.3	97.7
4) Filter Sheet	44	41	1	1	2	3	7.5	92.5
5) Backfill Stone (5~10 kg)	287	280	4	3	1	7	2.5	97.5
6) Pavement	193	181	3	2	6	12	6.0	94.0
(4) Compost yard								
1) Pavement	812	763	15	10	24	49	6.0	94.0
2) Roof Work	223	202	11	4	6	21	9.5	90.5
3) Brick Wall	43	35	2	2	4	8	18.5	81.5
(5) Stock Yard								
1) Wall	24	20	1	1	3	4	18.5	81.5
2) Pavement	116	109	2	1	4	7	6.0	94.0
(6) Battery Box	23	22	0	0	1	1	2.5	97.5
(7) Causeway								
1) Concrete Pipe (D=1000)	240	235	1	2	2	5	2.0	98.0
2) Road Filling	557	482	45	15	15	75	13.5	86.5
3) Filter Sheet	220	204	5	3	8	17	7.5	92.5
4) Protection Stone (30~50 kg)	1,114	1,086	14	11	3	28	2.5	97.5
5) Armor Stone (300~500 kg)	1,129	1,101	14	11	3	28	2.5	97.5
<b>Sub-Total</b>	<b>12,092</b>	<b>11,469</b>	<b>282</b>	<b>156</b>	<b>182</b>	<b>623</b>	<b>5.2</b>	<b>94.8</b>
<b>2 Direct Temporary Work</b>								
(1) Temporary Jetty for Construction	1,992	1,723	161	54	54	269	13.5	86.5
(2) Temporary Road for Construction								
1) New Landfilling area	3,470	3,002	281	94	94	468	13.5	86.5
(3) Silt Protection	220	220	0	0	0	0	0.0	100.0
1) placing	90	78	7	2	2	12	13.5	86.5
<b>Sub-Total</b>	<b>5,772</b>	<b>5,022</b>	<b>450</b>	<b>150</b>	<b>150</b>	<b>750</b>	<b>13.0</b>	<b>87.0</b>
<b>Total Direct Cost</b>	<b>83,592</b>	<b>80,659</b>	<b>1,574</b>	<b>842</b>	<b>517</b>	<b>2,937</b>	<b>3.5</b>	<b>96.5</b>
<b>Indirect Construction Cost</b>								
(1) Common Temporary Work	8,359	7,732	376	125	125	627	7.5	92.5
(2) Site Expenses	10,867	10,650	65	87	65	217	2.0	98.0
(3) Overhead	6,687	6,687	0	0	0	0	0	100
<b>Total Indirect Cost</b>	<b>25,913</b>	<b>25,069</b>	<b>507</b>	<b>169</b>	<b>169</b>	<b>845</b>	<b>3.3</b>	<b>96.7</b>
<b>Total Construction Cost</b>	<b>109,505</b>	<b>105,728</b>	<b>2,081</b>	<b>1,011</b>	<b>686</b>	<b>3,782</b>	<b>3.5</b>	<b>96.5</b>

**Construction Cost in Existing Thirafushi(1)  
(Foreign and Local Portion)**

Unit: 1,000RF

	Description	Total Amount	Foreign Portion	Local Portion			Currency (%)		
				Local Goods	Skilled Labour	Unskilled Labour	Total	Local	Foreign
<b>1</b>	<b>Direct Construction Work (Existing Land)</b>								
(1)	Seawall (Existing land)								
	1) Coral Masonry	7,920	4,950	1,485	1,188	297	2,970	37.5	62.5
	2) Gavion Net Cover	1,637	1,326	31	218	62	311	19.0	81.0
	3) Excavation and Leveling	453	360	28	56	9	93	20.5	79.5
<b>3</b>	<b>Direct Temporary Work</b>								
(1)	Temporary Road for Construction								
	1) Existing Land	120	99	11	8	2	21	17.5	82.5
	<b>Total Direct Cost</b>	<b>10,134</b>	<b>6,735</b>	<b>1,554</b>	<b>1,470</b>	<b>371</b>	<b>3,395</b>	<b>33.5</b>	<b>66.5</b>
	<b>Indirect Construction Cost</b>								
(1)	Common Temporary Work	709	461	124	99	25	248	35.0	65.0
(2)	Site Expenses	507	160	101	174	69	347	68.5	31.5
(3)	Overhead	507	0	152	355	0	507	100.0	0.0
	<b>Total Indirect Cost</b>	<b>1,723</b>	<b>621</b>	<b>380</b>	<b>628</b>	<b>94</b>	<b>1,102</b>	<b>64.0</b>	<b>36.0</b>
	<b>Total Construction Cost</b>	<b>11,856</b>	<b>7,356</b>	<b>1,935</b>	<b>2,098</b>	<b>465</b>	<b>4,497</b>	<b>37.9</b>	<b>62.1</b>

**Construction Cost in Male (Transfer Station)  
(Foreign and Local Portion)**

Unit: 1,000Rf

	Description	Total Amount	Foreign Portion	Local Portion			Currency (%)	
				Local Goods	Skilled Labour	Unskilled Labour	Total	Local
1	Direct Construction Cost in Male							
(1)	Truck Garage							
	1) Concrete Pavement	805	757	14	10	24	48	6.0 94.0
	2) Roofing Work	463	419	26	9	9	41	9.5 90.5
(2)	Car Parking							
	1) Block Paving	245	219	11	3	14	27	11.0 89.0
(3)	Truck Washing Yard							
	1) Concrete Pavement	77	72	2	1	2	5	6.0 94.0
	2) Block Wall	24	20	1	1	3	4	18.5 81.5
	3) Drainage system	12	11	1	0	0	1	9.0 91.0
(4)	Truck Scale Base							
	1) Basement	185	180	5	2	1	8	4.0 96.0
	2) Scale House	87	78	5	2	3	9	10.5 89.5
	3) Access Pavement	70	66	1	1	2	4	6.0 94.0
(5)	Waste Retaining House							
	1) Concrete Pillar & Beam	104	102	2	0	0	2	2.3 97.7
	2) Wall (Siding)	249	203	9	9	28	45	18.5 81.5
	3) Pavement	832	782	15	10	25	50	6.0 94.0
	4) Heavy Roofing Work	1,969	1,792	106	35	35	177	9.0 91.0
	9) Utilities	293	268	15	7	2	25	8.5 91.5
(6)	Wast Retaining Yard							
	1) Concrete Pillar & Beam	135	135	2	1	0	3	2.3 97.7
	2) Wall (Siding)	281	229	10	10	31	52	18.5 81.5
	3) Pavement	2,514	2,362	45	30	75	151	6.0 94.0
	4) Drainage & Pit	218	195	12	4	4	20	9.0 91.0
(7)	Building for Office							
	1) Basement Work	785	741	14	9	24	47	6.0 94.0
	2) Building Work	4,623	4,184	261	85	68	439	9.5 90.5
	3) Utilities	234	214	14	4	2	20	8.5 91.5
(8)	Work Shop							
	1) Concrete Pavement	435	409	8	5	13	26	6.0 94.0
	2) Building Work	923	840	50	17	17	83	9.0 91.0
	3) Utilities	129	118	7	3	1	11	8.5 91.5
(9)	Road and Yard Block Pavement	2,778	2,472	122	31	153	306	11.0 89.0
(10)	Drainage System	410	373	22	7	7	37	9.0 91.0
(11)	Other Utilities	293	265	15	7	2	25	8.5 91.5
(12)	Fence	151	123	6	6	17	28	18.5 81.5
(13)	Water tank	88	74	8	4	1	14	15.5 84.5
(14)	Rest House	170	154	10	3	3	16	9.5 90.5
	<b>Total Direct Cost</b>	<b>19,650</b>	<b>17,864</b>	<b>822</b>	<b>320</b>	<b>587</b>	<b>1,728</b>	<b>8.8 91.2</b>
3	Indirect Construction Cost							
(1)	Common Temporary Work	1,965	1,906	35	12	12	59	3.0 97.0
(2)	Site Expenses	2,555	2,501	15	20	15	51	2.0 98.0
(3)	Overhead	1,572	1,517	60	0	0	55	3.5 96.5
	<b>Total Indirect Cost</b>	<b>6,092</b>	<b>5,927</b>	<b>111</b>	<b>32</b>	<b>27</b>	<b>165</b>	<b>2.7 97.3</b>
	<b>Total Construction Cost</b>	<b>25,742</b>	<b>23,791</b>	<b>932</b>	<b>352</b>	<b>614</b>	<b>1,893</b>	<b>7.4 92.6</b>

**Construction Cost in Villingli  
(Transfer yard)**

Unit: 1,000Rf

	Description	Total Amount	Foreign Portion	Local Portion			Currency (%)	
				Local Goods	Skilled Labour	Unskilled Labour	Total	Local
1	Direct Construction Cost in Villingli							
(1)	Truck Garage							
	1) Concrete Pavement	31	29	1	0	1	2	6.0 94.0
	2) Roofing Work	18	16	1	0	0	2	9.5 90.5
(2)	Deposit Yard							
	1) Concrete Pavement	1,596	1,500	29	19	48	95	6.0 94.0
	3) Drainage system	221	201	12	4	4	20	9.0 91.0
(3)	Fence							
	Masonry wall	39	32	1	1	4	7	18.5 81.5
	Net Fence	23	22	1	0	0	1	5.0 95.0
	<b>Total Direct Cost</b>	<b>1,928</b>	<b>1,800</b>	<b>44</b>	<b>26</b>	<b>58</b>	<b>128</b>	<b>6.6 93.4</b>
3	Indirect Construction Cost							
(1)	Common Temporary Work	193	187	3	1	1	6	3.0 97.0
(2)	Site Expenses	253	246	2	2	2	5	2.0 98.0
(3)	Overhead	154	149	60	0	0	5	3.5 96.5
	<b>Total Indirect Cost</b>	<b>598</b>	<b>582</b>	<b>65</b>	<b>3</b>	<b>3</b>	<b>16</b>	<b>2.7 97.3</b>
	<b>Total Construction Cost</b>	<b>2,525</b>	<b>2,382</b>	<b>109</b>	<b>29</b>	<b>60</b>	<b>144</b>	<b>5.7 94.3</b>

**Cost Comparison of the Water Supply System 1 & 2  
(Thilafushi)**

Unit : US\$

	Items	Unit	Unit Cost	Amount	Remarks
<b>System 1</b>	Track ( 4 ton )	1	25,000	25,000	( CIF Male' )
	Water tank ( 2 ton )	2	430	860	
	Engine Pump	2	1,300	2600	
<b>TOTAL COST</b>				<b>28,460</b>	
<b>System 2</b>	Water Truck ( 4 ton )	1	31,000	31,000	( CIF Male' )
	Engine Pump	1	1,300	1,500	
<b>TOTAL COST</b>				<b>32,500</b>	

**Cost for Water System in Thilafushi**

Unit : MRf

Item	Description	Unit	Unit Cost	Amount	Remarks
<b>Supply system</b>					
	Track ( 4 ton )	1	293,000	293,000	( CIF Male' )
	Water tank ( 2 ton )	2	5,000	10,000	
	Engine Pump	2	15,249	30,498	
	Sub-Total			333,498	
<b>Reservoir system</b>					
	Reservoir Tank	3	5,000	15,000	
	Pipe Distribution	1	11,000	11,000	
	Basement and installation	1	90,000	90,000	
	Engine Washing Machine	1	152,000	152,000	
	Sub-Total			268,000	
<b>TOTAL COST</b>				<b>601,498</b>	

G. *Finance and Economy*

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**I. Existing Conditions**





Table 1(1) Expenditure Budget of Male Municipality

Item	Unit: Rf.		
	1990	1991	1992
Recurrent	5,874,890	5,931,228	6,056,262
Capital	2,885,632	3,061,568	2,985,128
Total	8,760,522	8,992,796	9,041,390

Item	Unit: Rf.		
	1993	1994	1995
Recurrent	6,241,119	6,558,261	6,741,261
Capital	3,004,516	3,126,118	3,165,321
Total	9,245,635	9,684,379	9,906,582

Item	Unit: Rf.		
	1996	1997	1998
Recurrent	7,537,863	9,849,200	10,485,520
Capital	3,146,796	3,815,922	1,663,000
Total	10,684,659	13,665,122	12,148,520
Recurrent			
Personnel	4,877,245	5,418,200	6,604,520
Transportation	106,302	50,000	70,000
Stock	461,504	556,000	536,000
Maintenance & Repairs	526,053	811,000	965,000
Communications	1,554,248	2,114,000	2,310,000
Welfare & Subsidies	12,511	900,000	-
Total	7,537,863	9,849,200	10,485,520
Capital			
Construction & Land Expenses	3,146,796	3,815,922	1,663,000
Total	3,146,796	3,815,922	1,663,000
Personnel			
Salaries	3,301,832	4,155,200	4,284,980
Overtime	255,800	258,000	400,000
Professional Allowances	6,541	7,500	7,500
Medical & Domestic Market Allowances	460,137	500,000	647,800
Other Expenses	679,333	337,500	1,003,800
Total	4,877,245	5,418,200	6,604,520
Transportation			
Domestic Trips	50	-	-
International Trips	13,583	-	-
Foreigners' Travel Expenses	92,669	50,000	70,000
Total	106,302	50,000	70,000
Stock			
Stationery*	147,273	200,000	175,000
Fuel*	52,689	75,000	100,000
Spare Parts*	78,332	100,000	60,000
Road Cleansing*	13,827	20,000	21,000
Tools*	4,979	11,000	5,000
Miscellaneous†	164,404	150,000	175,000
Total	461,504	556,000	536,000

Table 1(2) Expenditure Budget of Male Municipality

Item	Unit: Rf.		
	1996	1997	1998
Maintenance & Repairs			
Construction & Renovation*	239,221	426,000	500,000
Machinery & Equipment*	42,501	20,000	20,000
Vehicle Repairs*	88,237	150,000	150,000
Furniture Repairs	4,950	10,000	5,000
Road Construction*	143,545	190,000	275,000
Other Maintenance & Repairs+	7,599	15,000	15,000
<b>Total</b>	<b>526,053</b>	<b>811,000</b>	<b>965,000</b>
Communications			
Labour*	14,561	9,000	10,000
Telephone	37,191	54,500	57,000
Postage, Fax & Telex	59,479	60,000	60,000
Electricity	939,843	1,259,460	1,417,000
Rent for Buildings	64,923	30,000	-
Conference Expenses	32,328	50,000	50,000
Toilets, Water Sanitation*	41,744	220,000	300,000
Washing & Ironing	2,567	1,040	1,000
Renting	35,035	30,000	15,000
Others	326,577	400,000	400,000
<b>Total</b>	<b>1,554,248</b>	<b>2,114,000</b>	<b>2,310,000</b>
Welfare & Subsidies			
Welfare	300	900,000	-
Scholarship	4,511	-	-
<b>Total</b>	<b>12,511</b>	<b>900,000</b>	<b>-</b>
Construction & Land Expenses			
Furniture	20,315	16,455	250,000
Machinery & Equipment	45,413	113,175	73,000
Vehicles*	489,325	958,271	18,000
Tools*	-	878	5,000
Land & Property	500,000	435,858	-
Buildings	1,571,940	544,780	930,000
Communications	2,760	52,730	12,000
Road Construction, Water, Toilets & Sanitation*	517,043	1,693,775	375,000
<b>Total</b>	<b>3,146,796</b>	<b>3,815,922</b>	<b>1,663,000</b>

Note: \*=for Community Services Section, += some are for Community Services Section

Table 2 Expenditure of Community Services Section

Item	Unit: Rf.			
	1990	1991	1992	1993
Road lights	333,733	77,070	233,485	296,419
Cemetery renovation	-	-	-	75,000
Martyrs block	-	-	-	-
Road lights for Villingili	-	-	-	-
Ramp for microbin wash	-	-	-	-
Toilet blocks	-	-	-	-
New buildings for smoked fish	-	-	-	-
Pay toilets	-	-	-	-
National flags	-	-	-	-
Maintenance of the fountain	-	-	-	161,218
Maintenance of Jumhooree Maidhan	-	-	-	-
Maintenance of vehicles	-	-	-	94,861
Spare parts	-	-	-	222,056
Fuel	-	-	-	522,689
Tools	-	-	-	198,261
Road construction	-	935,526	1,087,184	-
Construction of fish market	1,153,114	124,741	11,959	-
Construction of Flats 1	509,996	45,652	-	-
Construction of Flats 2	-	290,072	457,122	-
Garbage collection and disposal	327,500	5,256,408	1,317,203	-
Foreign delegates	-	-	130,005	-
Others	212,310	156,681	211,351	-
Total	2,536,653	6,886,150	3,448,309	1,570,504

Item	Unit: Rf.			
	1994	1995	1996	1997
Road lights	215,180	152,501	322,814	218,576
Cemetery renovation	112,186	430,240	490,904	914,582
Martyrs block	-	60,756	-	-
Road lights for Villingili	101,141	50,630	91,544	49,833
Ramp for microbin wash	-	-	100,190	-
Toilet blocks	-	-	307,865	-
New buildings for smoked fish	-	-	94,550	-
Pay toilets	-	-	449,771	1,072,855
National flags	-	-	-	175,925
Maintenance of the fountain	121,200	-	-	80,000
Maintenance of Jumhooree Maidhan	-	-	-	254,769
Maintenance of vehicles	216,541	248,765	394,962	1,496,527
Spare parts	165,781	-	-	-
Fuel	486,526	-	-	-
Tools	226,748	-	-	-
Road construction	-	-	-	-
Construction of fish market	-	-	-	-
Construction of Flats 1	-	-	-	-
Construction of Flats 2	-	-	-	-
Garbage collection and disposal	-	-	-	-
Foreign delegates	-	-	-	-
Others	-	-	-	-
Total	1,645,303	942,892	2,252,600	4,263,067

**Table 3 Revenue of Male Municipality**

Unit: Rf.

Item	1990	1991	1992	1993
Rent from flats*	92,550	402,689	634,555	802,967
Rent from buildings	93,715	260,119	222,000	696,221
Rent from land	818,414	852,167	812,532	786,162
Rent from leasing	46,721	39,556	42,281	42,656
Birth certificates and forms	34,567	28,588	36,785	46,551
Waste collection fee*	69,765	66,674	72,315	-
Rent from markets*	81,720	105,180	117,110	82,641
Land registration fee	10,683	8,787	10,385	42,561
Drawing land maps	213	384	1,546	28,678
Public toilets*	-	-	-	-
Fines	10,683	8,788	10,385	141,961
Oxen*	-	1,850	9,551	11,785
Revenues not specified	73,355	2,068	135,575	16,785
<b>Total</b>	<b>1,332,386</b>	<b>1,776,850</b>	<b>2,105,020</b>	<b>2,698,968</b>

Note: \*=for Community Services Section

Unit: Rf.

Item	1994	1995	1996	1997
Rent from flats*	842,678	797,460	786,933	1,064,240
Rent from buildings	596,748	629,333	699,558	784,426
Rent from land	796,248	830,999	831,825	663,350
Rent from leasing	52,674	33,880	22,300	21,820
Birth certificates and forms	48,765	23,216	57,083	27,043
Waste collection fee*	-	87,374	321,093	357,572
Rent from markets*	79,568	81,140	83,940	261,600
Land registration fee	25,486	37,600	33,077	32,312
Drawing land maps	16,718	36,966	42,792	41,982
Public toilets*	-	-	-	187,277
Fines	184,651	600	315,232	290,331
Oxen*	96,784	16,571	19,821	75,047
Revenues not specified	16,781	94,687	126,874	176,998
<b>Total</b>	<b>2,757,101</b>	<b>2,669,826</b>	<b>3,340,528</b>	<b>3,983,998</b>

Note: \*=for Community Services Section

**Table 4 Expenditure Budget of Ministry of Construction and Public Works**

Item	Unit: Rf.				
	1988	1989	1990	1991	1992
Ministry	3,962,541	5,173,876	10,417,555	20,730,127	21,605,134
Male' Harbor Project	4,029,040	11,140,359	11,945,347	13,368,247	14,602,871
Deepening of Island Harbors Projects	3,119,791	4,746,390	4,925,767	4,735,258	11,805,563
<b>Total</b>	<b>11,111,372</b>	<b>21,060,625</b>	<b>27,288,669</b>	<b>38,833,632</b>	<b>48,013,568</b>

Item	Unit: Rf.				
	1993	1994	1995	1996	1997
Ministry	11,759,729	11,446,332	32,050,467	34,909,909	58,780,169
Male' Harbor Project	11,081,414	6,764,326	4,860,222	4,998,287	5,818,133
Deepening of Island Harbors Projects	13,366,621	23,809,706	27,274,605	33,093,896	43,372,864
<b>Total</b>	<b>36,207,764</b>	<b>42,020,364</b>	<b>64,185,294</b>	<b>73,002,092</b>	<b>107,971,166</b>

Table 5 Expenditure Budget of Waste Management Section

Item	1994	1995	1996	1997	1998
Recurrent	3,369,033	3,118,195	4,557,533	4,952,998	4,918,037
Capital	76,285	24,309	1,207,933	2,979,794	1,918,335
<b>Total</b>	<b>3,445,319</b>	<b>3,142,505</b>	<b>5,765,466</b>	<b>7,932,792</b>	<b>6,836,372</b>
Recurrent					
Employee expenditure	434,442	828,374	1,027,638	1,327,002	1,645,037
Air tickets	116,451	47,003	33,995	49,009	60,000
Expenditure stock	1,773,859	1,477,212	2,489,352	2,417,633	2,123,000
Repair & maintenance	709,668	463,541	606,964	689,427	657,000
Post & carriage	334,611	302,063	399,582	469,924	433,000
<b>Total</b>	<b>3,369,033</b>	<b>3,118,195</b>	<b>4,557,533</b>	<b>4,952,998</b>	<b>4,918,037</b>
Capital					
Equipment & land valuables	76,285	24,309	1,207,933	2,979,794	1,918,335
Employee expenditure					
Salary	392,129	550,449	598,543	657,644	806,805
Overtime	24,710	819,909	121,626	170,908	268,935
Long-term allowance	-	-	9,848	9,108	9,072
Ramazan allowance	750	9,686	12,091	35,271	22,411
Medical & domestic market allowance	3,603	4,000	5,675	5,947	6,000
Miscellaneous	13,250	182,329	279,853	448,123	531,814
<b>Total</b>	<b>434,442</b>	<b>828,374</b>	<b>1,027,638</b>	<b>1,327,002</b>	<b>1,645,037</b>
Airtickets					
Airtickets	116,451	47,003	33,995	49,009	60,000
Expenditure stock					
Stationery	24,482	8,841	10,644	14,040	15,000
Fuel & oil	701,805	607,078	198,229	1,097,601	1,000,000
Spare parts	484,567	633,942	873,329	706,741	600,000
Cleaning	120,545	1,810	10,315	11,894	8,000
Crockery	442,458	224,538	396,834	587,355	500,000
<b>Total</b>	<b>1,773,859</b>	<b>1,477,212</b>	<b>2,489,352</b>	<b>2,417,633</b>	<b>2,123,000</b>
Repair & maintenance					
Office innovation	415	4,755	19,947	19,701	15,000
Machinery & equipment	650	981	1,005	910	1,000
Vehicles	74,798	206,670	386,939	407,077	400,000
Vessels	629,424	244,033	195,278	258,490	200,000
Furniture	-	-	564	-	-
Water, sewerage & harbor	-	-	-	-	40,000
Miscellaneous	4,180	7,101	3,229	3,248	1,000
<b>Total</b>	<b>709,668</b>	<b>463,541</b>	<b>606,964</b>	<b>689,427</b>	<b>657,000</b>
Post & Carriage					
Carriage	4,620	20,381	19,692	19,428	20,000
Telephone	2,882	2,209	10,936	12,607	10,000
Postage	12,837	10,785	7,795	14,213	17,000
Electric	4,067	28,096	59,845	44,014	50,000
Water & sanitation	4,650	8,925	-	11,471	15,000
Miscellaneous	305,554	231,666	301,312	368,189	321,000
<b>Total</b>	<b>334,611</b>	<b>302,063</b>	<b>399,582</b>	<b>469,924</b>	<b>433,000</b>
Equipment & land valuables					
Furniture	13,040	-	-	-	5,000
Machinery & heavy equipment	48,149	-	7,822	-	298,000
Vehicles	-	-	971,930	1,598,000	1,030,335
Vessels	-	24,309	-	-	-
Tools	-	-	5,352	-	55,000
Buildings	-	-	191,789	440,968	450,000
Communication equipment	15,096	-	-	15,189	-
Road & harbor	-	-	31,040	925,636	80,000
<b>Total</b>	<b>76,285</b>	<b>24,309</b>	<b>1,207,933</b>	<b>2,979,794</b>	<b>1,918,335</b>

## **II. Master Plan**





Table 6 Comparison of Project Cost with Government Budget

1. Comparison with Government Revenue Budget Estimation  
(Regression Analysis of GDP and Government Revenue Budget)

$$Y = -183.8190 + 1.34542 \times X$$

where Y: Government revenue budget at 1998 prices (Rf. million), 1996-2002

X: GDP at 1985 prices (Rf. million), 1996-2002

R = 0.9971482; T-value = 29.54475

(Unit: Rf. E6)

Year	Government Revenue Budget	Initial Cost of the Project	Ratio (%)	Initial Cost of Atoll Project	Ratio (%)	Total Ratio (%)
	A	B	C=B/A	D	E=D/A	F=C+E
1998	1,996					
1999	2,147					
2000	2,290	21	0.9	0	0.0	0.9
2001	2,436	103	4.2	33	1.4	5.6
2002	2,616	92	3.5	33	1.3	4.8
2003	2,795	21	0.8	33	1.2	1.9
2004	2,980	86	2.9	33	1.1	4.0
2005	3,170	23	0.7	33	1.0	1.8
2006	3,368	1	0.0	33	1.0	1.0
2007	3,574	0	0.0	33	0.9	0.9
2008	3,788	1	0.0	33	0.9	0.9
2009	4,010	1	0.0	33	0.8	0.8
2010	4,241	0	0.0	33	0.8	0.8
Total*	35,268	349	1.0	330	0.9	1.9

Note: \*=total 2000 to 2010

2. Comparison with MCPW Expenditure Budget  
(Regression Analysis of GDP and MCPW Expenditure Budget)

$$Y = -23579.063 + 84.02814 \times X$$

where Y: MCPW budget at 1998 prices (Rf. thousand), 1991-1997

X: GDP at 1985 prices (Rf. million), 1991-1997

R = 0.7013141; T-value = 2.199874

(Unit: Rf. E3)

Year	MCPW Budget	Initial Cost of the Project	Ratio (%)	Initial Cost of Atoll Project	Ratio (%)	Total Ratio (%)
	A	B	C=B/A	D	E=D/A	F=C+E
1998	113,370					
1999	121,588					
2000	130,587	21,498	16.5	0	0	16.5
2001	140,612	103,366	73.5	32,936	23.4	96.9
2002	151,283	91,657	60.6	32,936	21.8	82.4
2003	162,468	21,536	13.3	32,936	20.3	33.5
2004	174,005	86,144	49.5	32,936	18.9	68.4
2005	185,861	22,971	12.4	32,936	17.7	30.1
2006	198,222	718	0.4	32,936	16.6	17.0
2007	211,086	0	0.0	32,936	15.6	15.8
2008	224,455	718	0.3	32,936	14.7	15.0
2009	238,345	718	0.3	32,936	13.8	14.1
2010	252,756	0	0.0	32,936	13.0	13.0
Total*	2,069,880	349,326	16.9	329,360	15.9	32.8

Note: \*=total 2000 to 2010

Table 7 Initial Cost of Projects  
MALE' AND VICINITIES PROJECT  
A. Transportation and Disposal

## I. Construction Cost in Thilafushi (2)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Direct Construction Work (New Area)</b>		
(1) Breakwater	15,070	50
(2) Revetment for Waste	26,561	50
(3) Protection for Waste	8,068	50
(4) Providing of PVC Pipe	601	50
Sub-Total	50,300	
(1) Quay Wall for Dhoni	3,412	50
(2) Workshop & Garage	2,956	35
(3) Quay Wall for Ferry	1,217	50
(4) Compost Yard	1,084	30
(5) Stock Yard	140	30
(6) Battery Box	23	35
(7) Excavation for Landfill	10,149	
Sub-Total	18,981	
2. Direct Temporary Work	5,113	
Total Direct Cost	74,395	
Total Indirect Cost	23,062	
Total Construction Cost	97,457	

## II. Construction Cost in Thilafushi (3)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Direct Construction Work (New Area)</b>		
(1) Breakwater	16,363	50
(2) Revetment for Waste	39,624	50
(3) Protection for Waste	8,710	50
(4) Providing of PVC Pipe	1,031	50
Sub-Total	65,728	
(1) Quay Wall for Dhoni	3,412	50
(2) Workshop & Garage	2,956	35
(3) Quay Wall for Ferry	1,217	50
(4) Compost Yard	1,084	30
(5) Stock Yard	140	30
(6) Battery Box	23	35
(7) Causeway	3,260	30
Sub-Total	12,092	
2. Direct Temporary Work	5,772	
Total Direct Cost	83,592	
Total Indirect Cost	25,914	
Total Construction Cost	109,505	

## III. Construction Cost in Male' (Shovel Loading System)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Direct Construction Work in Male'</b>		
(1) Truck Garage	1,268	35
(2) Car Parking	246	30
(3) Truck Washing Yard	113	30
(4) Truck Scale Base	345	35
(5) Waste Retaining House	3,447	35
(6) Waste Retaining Yard	3,151	30
(7) Building for Office	5,643	35
(8) Workshop	1,547	35
(9) Road and Yard Block Pavement	2,778	30
(10) Drainage System	410	30
(11) Other Utilities	293	30
(12) Fence	151	35
(13) Water Tank	88	35
(14) Rest House	170	35
Total Direct Cost	19,650	
Total Indirect Cost	6,092	
Total Construction Cost	25,742	

## IV. Construction Cost in Villingili

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Direct Construction Work (Existing Land)		
(1) Truck Garage	49	35
(2) Deposit Yard	1,817	30
(3) Fence	62	35
Total Direct Cost	1,928	
Total Indirect Cost	598	
Total Construction Cost	2,525	

## V. Construction Cost in Existing Thilafushi (Coral Masonry Protection System by Local Company)

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Direct Construction Work (Existing Land)		
(1) Seawall (Existing Land)	10,010	50
2. Direct Temporary Work	124	
Total Direct Cost	10,134	
Total Indirect Cost	1,723	
Total Construction Cost	11,856	

## VI. Procurement Cost in Male' (Transportation)

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Equipment for Male'		
(1) Truck Scale	3,610	10
(2) Dump Truck	7,161	5
(3) Compactor Truck	16,500	5
(4) Equipment for Workshop	294	10
(5) Washing Machine	152	10
(6) Wheel Loader	4,030	5
(7) Excavator	2,574	5
Procurement Cost in Male'	34,321	
2. Overhead	1,201	
Total Procurement Cost	35,522	

## VII. Procurement Cost in Thilafushi (Disposal)

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Equipment for Male'		
(1) Excavator	2,574	5
(2) Bulldozer	1,450	5
(3) Dump Truck	2,046	5
(4) Equipment for Workshop	317	10
(5) Incinerator	634	10
Procurement Cost in Male'	7,021	
2. Overhead	246	
Total Procurement Cost	7,267	

Item	Amount (Rf. thousand)	Depreciation Period (years)
VIII. Engineering Service	21,050	
IX. Physical Contingency	24,708	
Grand Total	335,632	

## B. Collection

## I. Procurement in Male'

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Equipment		
(1) Compactor	12,115	5
2. Overhead	424	
Total Procurement Cost	12,539	

Item	Amount (Rf. thousand)	Depreciation Period (years)
II. Engineering Service	376	
Grand Total	12,915	

## C. Others (Procurement of Cleaning Equipment)

## I. Procurement of Port Cleaning Equipment

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Equipment		
(1) Motor Boats (@US\$4,400x2x11.72)	103	10
(2) Dump Truck (@US\$42,000x1x11.72)	492	5
Procurement Cost	595	
2. Overhead	21	
Total Procurement Cost	616	

## II. Procurement of Dust Bin

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Procurement Cost of Dust Bin	136	10
2. Overhead	5	
Total Procurement Cost	141	

Item	Amount (Rf. thousand)	Depreciation Period (years)
III. Engineering Service	22	
Grand Total	779	

Item	Amount (Rf. thousand)	Depreciation Period (years)
Grand Total (A+B+C)	349,326	

## ATOLLS PROJECT (INHABITED ISLANDS)

## I. Construction Cost

Item	Amount (Rf. thousand)	Depreciation Period (years)
I. Direct Construction Work		
(1) Construction of Seawall	7,867	50
(2) Enclosing Earth Wall	50	50
(3) Access Road	27	30
(4) Temporary Road	238	30
Total Direct Cost	8,182	
2. Indirect Construction Cost		
(1) Quay Wall for Dhoni	1,700	
(2) Common Temporary Work	750	
(3) Site Expenses	974	
(4) Overhead	600	
Total Indirect Cost	4,024	
Total Construction Cost	12,206	

## II. Procurement Cost

Item	Amount (Rf. thousand)	Depreciation Period (years)
Procurement		
(1) Excavator	1,550	10
(2) Float Fence	360	10
(3) Container for Compost	27	10
Overhead	68	
Total Procurement Cost	2,005	

Item	Amount (Rf. thousand)	Depreciation Period (years)
III. Engineering Service	1,037	
IV. Physical Contingency	1,221	
Grand Total	16,468	

**Table 8 O & M Cost Estimation**  
**1. Male' and Vicinities Project**

(Unit: Rf. 000)

Year	Collection Cost	Transportation Cost	Disposal Cost	Administration Cost	Total	Depreciation	Grand Total
	A	B	C	D	E=A+B+C+D	F	G=E+F
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2001	0	0	1,495	1,289	2,784	0	2,784
2002	0	0	1,495	962	2,457	0	2,457
2003	2,910	9,065	1,495	618	14,088	13,954	28,042
2004	2,910	9,577	1,495	618	14,600	13,954	28,554
2005	3,183	9,577	1,495	618	14,873	13,954	28,827
2006	3,420	9,577	1,495	618	15,110	13,954	29,064
2007	3,460	10,059	1,495	618	15,632	13,954	29,586
2008	3,616	10,059	1,495	618	15,788	13,954	29,742
2009	3,809	10,059	1,495	618	15,981	13,954	29,935
2010	3,889	10,541	1,495	618	16,543	17,397	33,940

**Breakdown of O & M Cost (2010)**

Collection :3,889=1,280(personnel)+766(maintenance)+1,843(operation)

Transportation:10,541=1,831(personnel)+2,059(maintenance)+6,651(operation)

Disposal :1,495=670(personnel)+461(machine operation)+364(machine maintenance)

Administration :

Personnel

Sub-Division	Position	Number	P.Cost/c/m	P.Cost/m
Administration	Director	1	Rf.5,500	Rf.5,500
	Ast. Director	1	Rf.5,000	Rf.5,000
	Secretary	1	Rf.2,500	Rf.2,500
	Engineer	2	Rf.3,500	Rf.7,000
	Accountant	2	Rf.3,500	Rf.7,000
Special Task Team	Ast. Director	1	Rf.5,000	Rf.5,000
	Secretary	1	Rf.2,500	Rf.2,500
	Engineer	2	Rf.3,500	Rf.7,000
	Staff	4	Rf.2,500	Rf.10,000
Monthly Total				Rf.51,500
Annual Total				Rf.618,000

**Program for Raising Public Awareness to Waste Reduction in Year 2001**

Preparation of Education Video	Rf.240,000
Education Text for Adults (@Rf.20x7,000)	Rf.140,000
Education Text for Children (@Rf.20x20,000)	Rf.400,000
Preparation of Posters	Rf.200,000
<b>Total</b>	<b>Rf.980,000</b>

**Program for Recovery/Recycling of Solid Waste in Year 2002**

Promotion of Recycling Industries	Rf.144,000
Study for Recycling Technologies	Rf.200,000
<b>Total</b>	<b>Rf.344,000</b>

## 2. Atolls Project

(Unit: Rf. 000)

Year	O & M Cost A	Depreciation B	Total C=A+B
1998			
1999			
2000			
2001	190	989	1,179
2002	380	1,978	2,358
2003	570	2,967	3,537
2004	760	3,957	4,717
2005	950	4,946	5,896
2006	1,140	5,935	7,075
2007	1,330	6,924	8,254
2008	1,520	7,913	9,433
2009	1,710	8,902	10,612
2010	1,900	9,892	11,792

## Breakdown of O &amp; M Cost (for one Atoll)

(Unit:Rf. 000)

Item	Machine Operator	Laborer	Sub-Total	Fuel	Repairs	Sub-Total
Amount:	13	13	26	30	39	69
Item	Total					
Amount:	95					

**Table 9 Projection of Budget for MCPW and MM****1. MCPW****(1) Expenditure of MCPW in the Past****(a) At Current Prices**

(Unit: Rf. thousand)

Item	1991	1992	1993	1994	1995	1996	1997
Expenditure of MCPW	38,834	48,014	36,208	42,020	64,185	73,002	107,971

**(b) At 1998 Prices**

(Unit: Rf. thousand)

Item	1991	1992	1993	1994	1995	1996	1997
Expenditure of MCPW	67,642	73,880	50,420	53,194	76,726	82,171	113,370

**(2) Regression Analysis**

$$Y = -23579.063 + 84.02814 \times X$$

Where Y: Expenditure of MCPW at 1998 prices (Rf. thousand)  
 X: GDP at 1985 prices (Rf. million)

Period of data: 1991 - 1997

R = 0.7013141

T - Value = 2.199874

**(3) Projection of Expenditure of MCPW**

(Unit: Rf. thousand)

Item	1999	2000	2001	2002	2003	2004
Expenditure of MCPW	121,588	130,587	140,612	151,283	162,468	174,005
Item	2005	2006	2007	2008	2009	2010
Expenditure of MCPW	185,861	198,222	211,086	224,455	238,345	252,756

**2. Male' Municipality****(1) Recurrent Expenditure of MM in the Past****(a) At Current Prices**

(Unit: Rf. thousand)

Item	1994	1995	1996	1997	1998*
Recurrent Expenditure of MM	6,558	6,741	7,538	9,849	10,486

Note: \*=budget



## (b) At 1998 Prices

(Unit: Rf. thousand)

Item	1994	1995	1996	1997	1998*
Recurrent Expenditure of MM	8,302	8,058	8,485	10,341	10,486

Note: \*=budget

## (2) Regression Analysis

$$Y = -1,544.499 + 7.38158 \times X$$

Where Y: Recurrent expenditure at 1998 prices (Rf. thousand)  
 X: GDP at 1985 prices (Rf. million)

Period of data: 1994 - 1998

R = 0.8918009

T - Value = 3.414122

## (3) Projection of Recurrent Expenditure of MM

(Unit: Rf. thousand)

Item	1999	2000	2001	2002	2003	2004
Recurrent Expenditure of MM	11,208	11,998	12,879	13,816	14,799	15,813
Item	2005	2006	2007	2008	2009	2010
Recurrent Expenditure of MM	16,854	17,940	19,070	20,245	21,465	22,730

## (4) Projection of Expenditure of MM

Recurrent Expenditure x 1.467 (8 year average 1991 to 1997)

(Unit: Rf. thousand)

Item	1999	2000	2001	2002	2003	2004
Expenditure of MM	16442	17,601	18,893	20,268	21,710	23,198
Item	2005	2006	2007	2008	2009	2010
Expenditure of MM	24,725	26,318	27,976	29,699	31,489	33,345

Table 10 Revenue Estimation for Male' and Vicinities Project

## I. Revenue from Solid Waste Charge

## 1. Domestic Customers

## (a) Male' Island

Year	Population	No. of People in a House	No. of Houses (Theoretical)	Average Income (Rf./month)	Willingness to Pay	Coefficient	Revenue (Rf. 000)
	A	B	C=A/B	D	E	F	G=C*D+E*F*12*95
1998	67,238	14.32	4,695	11,152	0.013	0.885	6,867
1999	69,311	14.32	4,840	11,434	0.013	0.885	7,258
2000	71,427	14.32	4,988	11,746	0.013	0.885	7,684
2001	73,300	14.32	5,119	12,145	0.013	0.885	8,154
2002	75,192	14.32	5,251	12,557	0.013	0.885	8,648
2003	77,097	14.32	5,384	12,971	0.013	0.885	9,159
2004	79,008	14.32	5,517	13,374	0.013	0.885	9,678
2005	80,920	14.32	5,651	13,783	0.013	0.885	10,200
2006	82,589	14.32	5,767	14,189	0.013	0.885	10,733
2007	84,225	14.32	5,882	14,613	0.013	0.885	11,273
2008	85,819	14.32	5,993	15,036	0.013	0.885	11,818
2009	87,357	14.32	6,100	15,456	0.013	0.885	12,366
2010	88,822	14.32	6,203	15,874	0.013	0.885	12,914

## (b) Villingli Island

Year	Population	No. of People in a House	No. of Houses (Theoretical)	Average Income (Rf./month)	Willingness to Pay	Coefficient	Revenue (Rf. 000)
	A	B	C=A/B	D	E	F	G=C*D+E*F*12*95
1998	1,844	11.3	163	7,500	0.005	1.77	123
1999	2,106	11.3	186	7,690	0.005	1.77	145
2000	2,406	11.3	213	7,899	0.005	1.77	170
2001	2,749	11.3	243	8,168	0.005	1.77	200
2002	3,140	11.3	278	8,445	0.005	1.77	237
2003	3,587	11.3	317	8,724	0.005	1.77	279
2004	4,098	11.3	363	8,994	0.005	1.77	329
2005	4,681	11.3	414	9,256	0.005	1.77	387
2006	5,347	11.3	473	9,542	0.005	1.77	455
2007	6,109	11.3	541	9,828	0.005	1.77	536
2008	6,978	11.3	618	10,112	0.005	1.77	630
2009	7,971	11.3	705	10,395	0.005	1.77	740
2010	9,106	11.3	806	10,675	0.005	1.77	868

## 2. Non-Domestic Customers

## (a) Male' Island

Year	No. of Establishments/Institution	Willingness to Pay (Rf./month)	Coefficient	Revenue (Rf. 000)
	A	B	C	D=A*B*C*12*95
1998	352	1,000	0.885	3,551
1999	363	1,025	0.885	3,754
2000	374	1,053	0.885	3,973
2001	384	1,089	0.885	4,219
2002	394	1,126	0.885	4,476
2003	404	1,163	0.885	4,740
2004	414	1,199	0.885	5,008
2005	424	1,234	0.885	5,279
2006	432	1,272	0.885	5,544
2007	441	1,310	0.885	5,829
2008	449	1,348	0.885	6,106
2009	457	1,386	0.885	6,390
2010	465	1,423	0.885	6,676

## (b) Villingili Island

Year	No. of Establish- ments/Institution	Willingness to Pay (Rf./month)	Coefficient	Revenue (Rf. 000)
	A	B	C	D=A*B*C*12*95
1998	10	1,000	0.885	101
1999	11	1,025	0.885	114
2000	13	1,053	0.885	138
2001	14	1,089	0.885	154
2002	16	1,126	0.885	182
2003	19	1,163	0.885	223
2004	21	1,199	0.885	254
2005	25	1,234	0.885	311
2006	28	1,272	0.885	359
2007	32	1,310	0.885	423
2008	37	1,348	0.885	503
2009	42	1,386	0.885	587
2010	48	1,423	0.885	689

## 3. Total Revenue

(Unit: Rf. 000)

Year	Domestic		Non-Domestic		Resort Islands	Airport Island	Total
	Male'	Villingili	Male'	Villingili			
1998	6,867	123	3,551	101	108	15	10,784
1999	7,258	145	3,754	114	109	17	11,398
2000	7,684	170	3,973	138	116	18	12,099
2001	8,154	200	4,219	154	124	19	12,870
2002	8,648	237	4,476	182	133	20	13,695
2003	9,159	279	4,740	223	142	22	14,566
2004	9,678	329	5,008	254	151	24	15,444
2005	10,200	387	5,279	311	161	25	16,362
2006	10,733	455	5,544	359	171	26	17,289
2007	11,273	536	5,829	423	181	28	18,269
2008	11,818	630	6,106	503	192	30	19,280
2009	12,366	740	6,390	587	203	31	20,318
2010	12,914	868	6,676	689	212	33	21,392

## II. Allocations from Public Budget

(Unit: Rf. 000)

Year	MCPW Budget Estimates	Ratio to be Allocated	Allocations from MCPW Budget	MM Budget Estimates	Ratio to be Allocated	Allocations from MM Bgt	Allocations from Public Budget
	A	B	C=A*B	D	E	F=D*E	G=C+F
1998	113,370	0.0667	7,562	15,383	0.0785	1,176	8,738
1999	121,588	0.0667	8,110	16,442	0.0785	1,257	9,367
2000	130,587	0.0667	8,710	17,801	0.0785	1,346	10,056
2001	140,612	0.0667	9,379	18,893	0.0785	1,445	10,824
2002	151,283	0.0667	10,091	20,268	0.0785	1,550	11,641
2003	162,468	0.0667	10,837	21,710	0.0785	1,660	12,497
2004	174,005	0.0667	11,606	23,198	0.0785	1,774	13,380
2005	185,861	0.0667	12,397	24,725	0.0785	1,891	14,288
2006	198,222	0.0667	13,221	26,318	0.0785	2,013	15,234
2007	211,088	0.0667	14,079	27,976	0.0785	2,140	16,219
2008	224,455	0.0667	14,971	29,699	0.0785	2,271	17,242
2009	238,345	0.0667	15,898	31,489	0.0785	2,408	18,306
2010	252,756	0.0667	16,859	33,345	0.0785	2,550	19,409

**III. Revenue and Allocations from Public Budget**  
(Unit: Rf. 000)

Year	Revenue	Allocations from Public Budget	Total
	A	B	C=A+B
1998	10,764	8,738	19,502
1999	11,396	9,367	20,763
2000	12,099	10,056	22,155
2001	12,870	10,824	23,694
2002	13,695	11,641	25,336
2003	14,566	12,497	27,062
2004	15,444	13,380	28,824
2005	16,362	14,288	30,650
2006	17,289	15,234	32,523
2007	18,269	16,219	34,489
2008	19,280	17,242	36,522
2009	20,318	18,306	38,624
2010	21,392	19,409	40,800

Note: Revenues from 1998 to 2002 are shown only for reference.

Table 11 Revenue Estimation for Atolls Project

## 1. Domestic Customers

Year	Beneficiaries in Population	No. of People in a House	No. of Houses (Theoretical)	Average Income (Rf./month)	Willingness to Pay	Coefficient	Revenue (Rf. 000)
	A	B	C=A/B	D	E	F	G=C*D*E*F*12*95
1998							
1999							
2000							
2001	22,175	11.9	1863	5,663	0.016	0.36	693
2002	45,681	11.9	3839	5,855	0.016	0.36	1476
2003	70,578	11.9	5931	6,048	0.016	0.36	2355
2004	96,929	11.9	8145	6,238	0.016	0.36	3335
2005	124,799	11.9	10487	6,418	0.016	0.36	4420
2006	153,843	11.9	12928	6,616	0.016	0.36	5616
2007	184,379	11.9	15494	6,814	0.016	0.36	6933
2008	216,466	11.9	18190	7,011	0.016	0.36	8374
2009	250,166	11.9	21022	7,207	0.016	0.36	9949
2010	285,543	11.9	23995	7,402	0.016	0.36	11663

## 2. Non-Domestic Customers

Year	No. of Establish- ments/Institution	Willingness to Pay (Rf./month)	Coefficient	Revenue (Rf. 000)
	A	B	C	D=A*B*C*12*95
1998				
1999				
2000				
2001	81	762	0.36	253
2002	167	788	0.36	540
2003	259	814	0.36	865
2004	355	839	0.36	1222
2005	457	864	0.36	1620
2006	564	891	0.36	2062
2007	676	917	0.36	2544
2008	793	944	0.36	3072
2009	917	970	0.36	3650
2010	1,046	996	0.36	4276

## 3. Total Revenue

(Unit: Rf. 000)

Year	Domestic	Non-Domestic	Total
1998			
1999			
2000			
2001	693	253	946
2002	1476	540	2016
2003	2355	865	3221
2004	3335	1222	4558
2005	4420	1620	6040
2006	5616	2062	7679
2007	6933	2544	9477
2008	8374	3072	11447
2009	9949	3650	13599
2010	11663	4276	15938

Table 12 Cost Benefit Streams for Masterplan  
(Economic Analysis)

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

(Unit: Rf. thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	2000	21499	0	21499	0	-21499
2	2001	103368	2784	106152	4200	-101952
3	2002	91658	2457	94115	21000	-73115
4	2003	21536	14088	35624	41309	5685
5	2004	86144	14600	100744	49470	-51274
6	2005	22971	14873	37844	79250	41406
7	2006	6995	15110	22105	87462	65357
8	2007	41591	15632	57223	88505	31282
9	2008	718	15788	16506	89577	73072
10	2009	718	15981	16699	90677	73978
11	2010	1435	16543	17978	91802	73825
12	2011	718	16543	17261	91802	74542
13	2012	41591	16543	58134	91802	33669
14	2013	718	16543	17261	91802	74542
15	2014	718	16543	17261	91802	74542
16	2015	1435	16543	17978	91802	73825
17	2016	718	16543	17261	91802	74542
18	2017	41591	16543	58134	91802	33669
19	2018	718	16543	17261	91802	74542
20	2019	718	16543	17261	91802	74542
21	2020	1435	16543	17978	91802	73825
22	2021	718	16543	17261	91802	74542
23	2022	41591	16543	58134	91802	33669
24	2023	718	16543	17261	91802	74542
25	2024	718	16543	17261	91802	74542
26	2025	1435	16543	17978	91802	73825
27	2026	718	16543	17261	91802	74542
28	2027	41591	16543	58134	91802	33669
29	2028	718	16543	17261	91802	74542
30	2029	718	16543	17261	91802	74542

Table 13(1) Financial Statements for Solid Waste Management  
Project for Male' and Vicinities  
- Master Plan -

(Unit: Rf. thousand)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>Income Statement</b>										
Revenue	0	0	0	27058	28827	30642	32529	34490	36522	38627
Operation and Maintenance	0	2784	2457	14088	14600	14873	15110	15632	15788	15981
Depreciation	0	0	0	13954	13954	13954	13954	13954	13954	13954
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	0	2784	2457	28042	28554	28827	29064	29586	29742	29935
Profit before Tax	0	-2784	-2457	-984	273	1815	3465	4904	6781	8692
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	0	-2784	-2457	-984	273	1815	3465	4904	6781	8692
<b>Funds Statement</b>										
Profit after Tax	0	-2784	-2457	-984	273	1815	3465	4904	6781	8692
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	21499	103368	91658	21536	86144	22971	718	0	718	718
Depreciation	0	0	0	13954	13954	13954	13954	13954	13954	13954
Sources	21499	100584	89201	34506	100371	38739	18137	18858	21452	23364
Capital Works	21499	103368	91658	21536	86144	22971	6995	41591	718	718
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	0	-2784	-2457	12970	14227	15769	11142	-22733	20734	22646
Applications	21499	100584	89201	34506	100371	38739	18137	18858	21452	23364
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	21499	122082	211284	231835	318253	343038	347222	352126	359624	369034
Liabilities and Capital	21499	122082	211284	231835	318253	343038	347222	352126	359624	369034
Current Assets	0	-2784	-5241	7729	21956	37724	48148	25415	46150	68795
Fixed Assets	21499	124866	216525	224107	296297	305314	299073	326710	313475	300239
Assets	21499	122082	211284	231835	318253	343038	347222	352126	359624	369034

Source: JICA

Table 13(2) Financial Statements for Solid Waste Management  
Project for Male' and Vicinities  
- Master Plan -

(Unit: Rf. thousand)

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Income Statement</b>										
Revenue	40800	37637	37637	37637	37637	37637	37637	37637	37637	37637
Operation and Maintenance	16543	16543	16543	16543	16543	16543	16543	16543	16543	16543
Depreciation	17397	17397	17397	17397	17397	17397	17397	17397	17397	17397
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	33940	33940	33940	33940	33940	33940	33940	33940	33940	33940
Profit before Tax	6859	3696	3696	3696	3696	3696	3696	3696	3696	3696
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	6859	3696	3696	3696	3696	3696	3696	3696	3696	3696
<b>Funds Statement</b>										
Profit after Tax	6859	3696	3696	3696	3696	3696	3696	3696	3696	3696
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	17397	17397	17397	17397	17397	17397	17397	17397	17397	17397
Sources	24257	21094	21094	21094	21094	21094	21094	21094	21094	21094
Capital Works	1435	718	41591	718	718	1435	718	41591	718	718
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	22822	20376	-20497	20376	20376	19659	20376	-20497	20376	20376
Applications	24257	21094	21094	21094	21094	21094	21094	21094	21094	21094
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	375893	379590	383286	386983	390679	394376	398072	401769	405465	409162
Liabilities and Capital	375893	379590	383286	386983	390679	394376	398072	401769	405465	409162
Current Assets	91617	111993	91497	111873	132249	151908	172284	151787	172163	192539
Fixed Assets	284276	267596	291790	275110	258431	242468	225788	249982	233302	216623
Assets	375893	379590	383286	386983	390679	394376	398072	401769	405465	409162

Source: JICA



Table 13(3) Financial Statements for Solid Waste Management  
Project for Male' and Vicinities  
- Master Plan -

(Unit: Rf. thousand)

No.	21	22	23	24	25	26	27	28	29	30
Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
<b>Income Statement</b>										
Revenue	37637	37637	37637	37637	37637	37637	37637	37637	37637	37637
Operation and Maintenance	16543	16543	16543	16543	16543	16543	16543	16543	16543	16543
Depreciation	17397	17397	17397	17397	17397	17397	17397	17397	17397	17397
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	33940	33940	33940	33940	33940	33940	33940	33940	33940	33940
Profit before Tax	3696	3696	3696	3696	3696	3696	3696	3696	3696	3696
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	3696	3696	3696	3696	3696	3696	3696	3696	3696	3696
<b>Funds Statement</b>										
Profit after Tax	3696	3696	3696	3696	3696	3696	3696	3696	3696	3696
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	17397	17397	17397	17397	17397	17397	17397	17397	17397	17397
Sources	21094	21094	21094	21094	21094	21094	21094	21094	21094	21094
Capital Works	1435	718	41591	718	718	1435	718	41591	718	718
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	19659	20376	-20497	20376	20376	19659	20376	-20497	20376	20376
Applications	21094	21094	21094	21094	21094	21094	21094	21094	21094	21094
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	412858	416555	420251	423948	427644	431341	435037	438734	442430	446127
Liabilities and Capital	412858	416555	420251	423948	427644	431341	435037	438734	442430	446127
Current Assets	212198	232574	212078	232454	252830	272489	292865	272368	292744	313120
Fixed Assets	200660	183980	208174	191494	174814	158852	142172	166365	149686	133006
Assets	412858	416555	420251	423948	427644	431341	435037	438734	442430	446127

Source: JICA

Table 14(1) Financial Statements for Solid Waste Management  
Project for Atolls  
- M/P -

(Unit: Rf. thousand)										
No.	1	2	3	4	5	6	7	8	9	10
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Income Statement</b>										
Revenue	947	2017	3220	4559	6041	7677	9476	11447	13599	15941
Operation and Maintenance	190	380	570	760	950	1140	1330	1520	1710	1900
Depreciation	989	1978	2967	3957	4946	5935	6924	7913	8902	9892
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	1179	2358	3537	4717	5896	7075	8254	9433	10612	11792
Profit before Tax	-232	-341	-318	-157	145	602	1222	2014	2987	4150
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-232	-341	-318	-157	145	602	1222	2014	2987	4150
<b>Funds Statement</b>										
Profit after Tax	-232	-341	-318	-157	145	602	1222	2014	2987	4150
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	32936	32936	32936	32936	32936	32936	32936	32936	32936	32936
Depreciation	989	1978	2967	3957	4946	5935	6924	7913	8902	9892
Sources	33694	34574	35586	36736	38027	39473	41082	42863	44826	14041
Capital Works	32936	32936	32936	32936	32936	32936	32936	32936	32936	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	757	1637	2650	3799	5091	6537	8146	9927	11889	14041
Applications	33694	34574	35586	36736	38027	39473	41082	42863	44826	14041
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	65641	98236	130855	163634	196716	230255	264413	299363	335286	339436
Liabilities and Capital	65641	98236	130855	163634	196716	230255	264413	299363	335286	339436
Current Assets	757	2395	5044	8844	13935	20472	28618	38544	50434	64475
Fixed Assets	64884	95842	125811	154791	182781	209783	235795	260819	284853	274961
Assets	65641	98236	130855	163634	196716	230255	264413	299363	335286	339436

Source: JICA

Table 14(2) Financial Statements for Solid Waste Management  
Project for Atolls  
- H/P -

(Unit: Rf. thousand)

No.	11	12	13	14	15	16	17	18	19	20
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>Income Statement</b>										
Revenue	13284	13284	13284	13284	13284	13284	13284	13284	13284	13284
Operation and Maintenance	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Depreciation	9892	9892	9892	9892	9892	9892	9892	9892	9892	9892
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	11792	11792	11792	11792	11792	11792	11792	11792	11792	11792
Profit before Tax	1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
<b>Funds Statement</b>										
Profit after Tax	1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	9892	9892	9892	9892	9892	9892	9892	9892	9892	9892
Sources	11384	11384	11384	11384	11384	11384	11384	11384	11384	11384
Capital Works	4130	4130	4130	4130	4130	4130	4130	4130	4130	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	7254	7254	7254	7254	7254	7254	7254	7254	7254	11384
Applications	11384	11384	11384	11384	11384	11384	11384	11384	11384	11384
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	340929	342421	343914	345407	346900	348393	349885	351378	352871	354364
Liabilities and Capital	340929	342421	343914	345407	346900	348393	349885	351378	352871	354364
Current Assets	71729	78983	86237	93491	100745	107999	115253	122507	129761	141145
Fixed Assets	269200	263439	257577	251916	246155	240394	234633	228871	223110	213219
Assets	340929	342421	343914	345407	346900	348393	349885	351378	352871	354364

Source: JICA

Table 14(3) Financial Statements for Solid Waste Management  
Project for Atolls  
- M/P -

		(Unit: Rf. thousand)									
No.		21	22	23	24	25	26	27	28	29	30
Year		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Income Statement</b>											
Revenue		13284	13284	13284	13284	13284	13284	13284	13284	13284	13284
Operation and Maintenance		1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Depreciation		9892	9892	9892	9892	9892	9892	9892	9892	9892	9892
Payment of Interest		0	0	0	0	0	0	0	0	0	0
Expenditure		11792	11792	11792	11792	11792	11792	11792	11792	11792	11792
Profit before Tax		1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
Tax		0	0	0	0	0	0	0	0	0	0
Profit after Tax		1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
<b>Funds Statement</b>											
Profit after Tax		1493	1493	1493	1493	1493	1493	1493	1493	1493	1493
Loans		0	0	0	0	0	0	0	0	0	0
Government Budget		0	0	0	0	0	0	0	0	0	0
Depreciation		9892	9892	9892	9892	9892	9892	9892	9892	9892	9892
Sources		11384	11384	11384	11384	11384	11384	11384	11384	11384	11384
Capital Works		4130	4130	4130	4130	4130	4130	4130	4130	0	0
Payment of Principal		0	0	0	0	0	0	0	0	0	0
Working Capital		7254	7254	7254	7254	7254	7254	7254	7254	11384	11384
Applications		11384	11384	11384	11384	11384	11384	11384	11384	11384	11384
<b>Balance Sheet</b>											
Liabilities		0	0	0	0	0	0	0	0	0	0
Capital		355857	357349	358842	360335	361828	363320	364813	366306	367799	369292
Liabilities and Capital		355857	357349	358842	360335	361828	363320	364813	366306	367799	369292
Current Assets		148399	155653	162907	170161	177415	184669	191923	199177	210562	221946
Fixed Assets		207457	201696	195935	190174	184412	178651	172890	167129	157237	147346
Assets		355857	357349	358842	360335	361828	363320	364813	366306	367799	369292

Source: JICA

### **III. Feasibility Study**

Table 15 Initial Cost of Priority Projects

## A. Transportation and Disposal

## I. Construction Cost in New Thilafushi

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>1. Direct Construction Work (New Area)</b>		
(1) Breakwater	15,070	50
(2) Revetment for Waste	26,561	50
(3) Protection for Waste	8,068	50
(4) Providing of PVC Pipe	601	50
Sub-Total	50,300	
(1) Quay Wall for Dhoni	3,412	50
(2) Workshop & Garage	2,956	35
(3) Quay Wall for Ferry	1,217	50
(4) Compost Yard	1,034	30
(5) Stock Yard	140	30
(6) Battery Box	23	35
(7) Basement & Install. for Water Distrib. Syste	90	35
(8) Excavation for Landfill	10,149	
Sub-Total	19,071	
<b>2. Direct Temporary Work</b>	<b>5,113</b>	
<b>Total Direct Cost</b>	<b>74,485</b>	
<b>Total Indirect Cost</b>	<b>23,062</b>	
<b>Total Construction Cost</b>	<b>97,547</b>	

## II. Construction Cost in Male' (Shovel Loading System)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>1. Direct Construction Work in Male'</b>		
(1) Truck Garage	1,268	35
(2) Car Parking	246	30
(3) Truck Washing Yard	113	30
(4) Truck Scale Base	345	35
(5) Waste Retaining House	3,447	35
(6) Waste Retaining Yard	3,151	30
(7) Building for Office	5,643	35
(8) Workshop	1,547	35
(9) Road and Yard Block Pavement	2,778	30
(10) Drainage System	410	30
(11) Other Utilities	293	30
(12) Fence	151	35
(13) Water Tank	88	35
(14) Rest House	170	35
<b>Total Direct Cost</b>	<b>19,650</b>	
<b>Total Indirect Cost</b>	<b>6,092</b>	
<b>Total Construction Cost</b>	<b>25,742</b>	

## III. Construction Cost in Villingili

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>1. Direct Construction Work (Existing Land)</b>		
(1) Truck Garage	49	35
(2) Deposit Yard	1,817	30
(3) Fence	62	35
<b>Total Direct Cost</b>	<b>1,928</b>	
<b>Total Indirect Cost</b>	<b>598</b>	
<b>Total Construction Cost</b>	<b>2,525</b>	

## IV. Construction Cost in Existing Thilafushi (Coral Masonry Protection System by Local Company)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>1. Direct Construction Work (Existing Land)</b>		
(1) Seawall (Existing Land)	10,010	50
<b>2. Direct Temporary Work</b>	<b>124</b>	
<b>Total Direct Cost</b>	<b>10,134</b>	
<b>Total Indirect Cost</b>	<b>1,723</b>	
<b>Total Construction Cost</b>	<b>11,858</b>	

## V. Procurement Cost in Male' (Transportation)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Equipment for Male'</b>		
(1) Truck Scale	3,610	10
(2) Dump Truck	7,161	5
(3) Compactor Truck	16,500	5
(4) Equipment for Workshop	294	10
(5) Washing Machine	152	10
(6) Wheel Loader	4,030	5
(7) Excavator	2,574	5
Procurement Cost in Male'	34,321	
2. Overhead	1,201	
<b>Total Procurement Cost</b>	<b>35,522</b>	

## VI. Procurement Cost in Thilafushi (Disposal)

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Equipment for Male'</b>		
(1) Excavator	2,574	5
(2) Bulldozer	1,450	5
(3) Dump Truck (10t)	2,046	5
(4) Equipment for Workshop	317	10
(5) Wheel Loader	856	5
(6) Tractor Trailer	698	5
(7) Incinerator	634	10
(8) Dump Truck (4t)	283	5
(9) Water Tank	10	35
(10) Engine Pump	29	10
(11) Reservoir Tank	14	35
(12) Distribution Pipe	11	30
(13) Washing Machine	147	10
Procurement Cost in Male'	9,069	
2. Overhead	317	
<b>Total Procurement Cost</b>	<b>9,386</b>	

Item	Amount (Rf. thousand)	Depreciation Period (years)
VII. Engineering Service	12,361	
VIII. Physical Contingency	13,767	
<b>Grand Total</b>	<b>208,707</b>	

## B. Collection

## I. Procurement in Male'

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Equipment</b>		
(1) Compactor	8,749	5
2. Overhead	306	
<b>Total Procurement Cost</b>	<b>9,055</b>	

Item	Amount (Rf. thousand)	Depreciation Period (years)
II. Engineering Service	272	
<b>Grand Total</b>	<b>9,327</b>	

## C. Others (Procurement of Cleaning Equipment)

## I. Procurement of Port Cleaning Equipment

Item	Amount (Rf. thousand)	Depreciation Period (years)
<b>I. Equipment</b>		
(1) Motor Boats (@US\$4,400x2x11.72)	103	10
(2) Dump Truck (@US\$42,000x1x11.72)	492	5
Procurement Cost	595	
2. Overhead	21	
<b>Total Procurement Cost</b>	<b>616</b>	

## II. Procurement of Dust Bin

Item	Amount (Rf. thousand)	Depreciation Period (years)
1. Procurement Cost of Dust Bin	136	10
2. Overhead	5	
Total Procurement Cost	141	

Item	Amount (Rf. thousand)	Depreciation Period (years)
III. Engineering Service	23	
Grand Total	779	

Item	Amount (Rf. thousand)	Depreciation Period (years)
Grand Total (A+B+C)	218,813	



Table 16 O &amp; M Cost Estimation of Priority Projects

(Unit: Rf. 000)

Year	Collection Cost	Transportation Cost	Disposal Cost	Administration Cost	Total	Depreciation	Grand Total
	A	B	C	D	E=A+B+C+D	F	G=E+F
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2001	0	0	1,495	1,289	2,784	0	2,784
2002	0	0	1,495	962	2,457	0	2,457
2003	2,910	9,065	1,495	618	14,088	14,369	28,457
2004	2,910	9,065	1,495	618	14,088	14,369	28,457
2005	2,910	9,065	1,495	618	14,088	14,369	28,457
2006	2,910	9,065	1,495	618	14,088	14,369	28,457
2007	2,910	9,065	1,495	618	14,088	14,369	28,457
2008	2,910	9,065	1,495	618	14,088	14,369	28,457
2009	2,910	9,065	1,495	618	14,088	14,369	28,457
2010	2,910	9,065	1,495	618	14,088	14,369	28,457

**Breakdown of O & M Cost**

Collection :2,910=986(personnel)+525(maintenance)+1,465(operation)

Transportation:9,065=1,831(personnel)+2,059(maintenance)+5,175(operation)

Disposal :1,495=670(personnel)+461(machine operation)+364(machine maintenance)

**Administration :****Personnel**

Sub-Division	Position	Number	P.Cost/c/m	P.Cost/m
Administration	Director	1	Rf.5,500	Rf.5,500
	Ast. Director	1	Rf.5,000	Rf.5,000
	Secretary	1	Rf.2,500	Rf.2,500
	Engineer	2	Rf.3,500	Rf.7,000
	Accountant	2	Rf.3,500	Rf.7,000
Special Task Team	Ast. Director	1	Rf.5,000	Rf.5,000
	Secretary	1	Rf.2,500	Rf.2,500
	Engineer	2	Rf.3,500	Rf.7,000
	Staff	4	Rf.2,500	Rf.10,000
Monthly Total				Rf.51,500
Annual Total				Rf.618,000

**Program for Raising Public Awareness to Waste Reduction in Year 2001**

Preparation of Education Video	Rf.240,000
Education Text for Adults (@Rf.20x7,000)	Rf.140,000
Education Text for Children (@Rf.20x20,000)	Rf.400,000
Preparation of Posters	Rf.200,000
<b>Total</b>	<b>Rf.980,000</b>

**Program for Recovery/Recycling of Solid Waste in Year 2002**

Promotion of Recycling Industries	Rf.144,000
Study for Recycling Technologies	Rf.200,000
<b>Total</b>	<b>Rf.344,000</b>

Table 17 Comparison of Initial Cost with Government Budget

## 1. Initial Cost of Priority Projects

(Unit: Rf. thousand)

Year	Construct. New Thilafu.	Construct. Male'	Construct. Villingili	Construct. Exist. Thilafu.	Procure. Transport.	Procure. Thilafu.	Procure. Collection	Procure. Cleaning	Total
2000	19,167			2,332					21,499
2001	76,865	9,113		9,326		7,485		779	103,368
2002	19,167	21,263	2,979	2,332	36,588		9,327		91,656
Total	114,999	30,376	2,979	13,990	36,588	7,485	9,327	779	216,523

## 2. Comparison with Government Revenue Budget and MCPW Expenditure Budget

(Unit: Rf. thousand)

Year	Gov'nment Budget	Initial Cost	Ratio (%)	MCPW Budget	Initial Cost	Ratio (%)
	A	B	C=B/A	D	E	F=E/D
2000	2,290,000	21,499	0.9	130,587	21,499	16.5
2001	2,436,000	103,368	4.2	140,612	103,368	73.5
2002	2,616,000	91,656	3.5	151,283	91,656	60.6
Total	7,342,000	216,523	2.9	422,482	216,523	51.3

Table 18 Revenue Estimation for Priority Projects

## I. Revenue from Solid Waste Charge

## 1. Domestic Customers

## (a) Male' Island

Year	Population	No. of People in a House	No. of Houses (Theoretical)	Average Income (Rf./month)	Willingness to Pay	Coefficient	Revenue (Rf. 000)
	A	B	C=A/B	D	E	F	G=C*D*E*F*12*.95
1998	67,236	14.32	4,695	11,152	0.013	0.818	6,348
1999	69,311	14.32	4,840	11,434	0.013	0.818	6,709
2000	71,427	14.32	4,988	11,746	0.013	0.818	7,102
2001	73,300	14.32	5,119	12,145	0.013	0.818	7,536
2002	75,192	14.32	5,251	12,557	0.013	0.818	7,993
2003	77,097	14.32	5,384	12,971	0.013	0.818	8,466
2004	79,008	14.32	5,517	13,374	0.013	0.818	8,945
2005	80,920	14.32	5,651	13,763	0.013	0.818	9,428
2006	82,589	14.32	5,767	14,189	0.013	0.818	9,920
2007	84,225	14.32	5,882	14,613	0.013	0.818	10,419
2008	85,819	14.32	5,993	15,036	0.013	0.818	10,924
2009	87,357	14.32	6,100	15,456	0.013	0.818	11,430
2010	88,822	14.32	6,203	15,874	0.013	0.818	11,936

## (b) Villingili Island

Year	Population	No. of People in a House	No. of Houses (Theoretical)	Average Income (Rf./month)	Willingness to Pay	Coefficient	Revenue (Rf. 000)
	A	B	C=A/B	D	E	F	G=C*D*E*F*12*.95
1998	1,844	11.3	163	7,500	0.005	1.636	114
1999	2,106	11.3	186	7,690	0.005	1.636	134
2000	2,406	11.3	213	7,899	0.005	1.636	157
2001	2,749	11.3	243	8,168	0.005	1.636	185
2002	3,140	11.3	278	8,445	0.005	1.636	219
2003	3,587	11.3	317	8,724	0.005	1.636	258
2004	4,098	11.3	363	8,994	0.005	1.636	304
2005	4,681	11.3	414	9,256	0.005	1.636	358
2006	5,347	11.3	473	9,542	0.005	1.636	421
2007	6,109	11.3	541	9,828	0.005	1.636	495
2008	6,978	11.3	618	10,112	0.005	1.636	582
2009	7,971	11.3	705	10,395	0.005	1.636	684
2010	9,106	11.3	806	10,675	0.005	1.636	802

## 2. Non-Domestic Customers

## (a) Male' Island

Year	No. of Establishments/Institution	Willingness to Pay (Rf./month)	Coefficient	Revenue (Rf. 000)
	A	B	C	D=A*B*C*12*.95
1998	352	1,000	0.818	3,282
1999	363	1,025	0.818	3,470
2000	374	1,053	0.818	3,672
2001	384	1,089	0.818	3,900
2002	394	1,126	0.818	4,137
2003	404	1,163	0.818	4,381
2004	414	1,199	0.818	4,629
2005	424	1,234	0.818	4,879
2006	432	1,272	0.818	5,124
2007	441	1,310	0.818	5,387
2008	449	1,348	0.818	5,644
2009	457	1,386	0.818	5,907
2010	465	1,423	0.818	6,170

## (b) Villingili Island

Year	No. of Establish- ments/Institution	Willingness to Pay (Rf./month)	Coefficient	Revenue (Rf. 000)
	A	B	C	D=A+B+C*12*.95
1998	10	1,000	0.818	93
1999	11	1,025	0.818	105
2000	13	1,053	0.818	128
2001	14	1,089	0.818	142
2002	16	1,126	0.818	168
2003	19	1,163	0.818	206
2004	21	1,199	0.818	235
2005	25	1,234	0.818	288
2006	28	1,272	0.818	332
2007	32	1,310	0.818	391
2008	37	1,348	0.818	465
2009	42	1,386	0.818	543
2010	48	1,423	0.818	637

## 3. Total Revenue

(Unit: Rf. 000)

Year	Domestic		Non-Domestic		Resort Islands	Airport Island	Total
	Male'	Villingili	Male'	Villingili			
1998	6,348	114	3,282	93	106	15	9,959
1999	6,709	134	3,470	105	109	17	10,543
2000	7,102	157	3,672	128	116	18	11,193
2001	7,536	185	3,900	142	124	19	11,907
2002	7,993	219	4,137	168	133	20	12,670
2003	8,468	258	4,381	206	142	22	13,475
2004	8,945	304	4,629	235	151	24	14,288
2005	9,428	358	4,879	288	161	25	15,138
2006	9,920	421	5,124	332	171	26	15,995
2007	10,419	495	5,387	391	181	28	16,902
2008	10,924	582	5,644	465	192	30	17,837
2009	11,430	684	5,907	543	203	31	18,798
2010	11,936	802	6,170	637	212	33	19,791

## II. Allocations from Public Budget

(Unit: Rf. 000)

Year	MCPW Budget Estimates	Ratio to be Allocated	Allocations from MCPW Budget	MM Budget Estimates	Ratio to be Allocated	Allocations from MM Bgt	Allocations from Public Budget
	A	B	C=A*B	D	E	F=D*E	G=C+F
1998	113,370	0.0649	7,358	15,383	0.0730	1,122	8,480
1999	121,588	0.0649	7,891	16,442	0.0730	1,200	9,091
2000	130,587	0.0649	8,475	17,601	0.0730	1,284	9,759
2001	140,612	0.0649	9,126	18,893	0.0730	1,379	10,505
2002	151,283	0.0649	9,818	20,268	0.0730	1,479	11,297
2003	162,468	0.0649	10,544	21,710	0.0730	1,584	12,128
2004	174,005	0.0649	11,293	23,198	0.0730	1,693	12,986
2005	185,861	0.0649	12,062	24,725	0.0730	1,804	13,866
2006	198,222	0.0649	12,865	26,318	0.0730	1,921	14,786
2007	211,086	0.0649	13,699	27,976	0.0730	2,042	15,741
2008	224,455	0.0649	14,567	29,699	0.0730	2,168	16,735
2009	238,345	0.0649	15,469	31,489	0.0730	2,298	17,767
2010	252,756	0.0649	16,404	33,345	0.0730	2,434	18,838

**III. Revenue and Allocations from Public Budget**  
(Unit: Rf. 000)

Year	Revenue	Allocations from Public Budget	Total
	A	B	C=A+B
1998	9,959	8,480	18,438
1999	10,543	9,091	19,634
2000	11,193	9,759	20,952
2001	11,907	10,505	22,411
2002	12,670	11,297	23,967
2003	13,475	12,128	25,603
2004	14,288	12,986	27,274
2005	15,138	13,866	29,004
2006	15,995	14,786	30,780
2007	16,902	15,741	32,643
2008	17,837	16,735	34,572
2009	18,788	17,767	36,564
2010	19,791	18,838	38,628

Note: Revenues from 1998 to 2002 are shown only for reference.

Table 19 Cost Benefit Streams for F/S  
(Economic Analysis)

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

(Unit: Rf. thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	2000	21516	0	21516	0	-21516
2	2001	96670	2784	99454	4200	-95254
3	2002	50084	2457	52541	21000	-31541
4	2003	0	14088	14088	41309	27221
5	2004	0	14088	14088	42270	28182
6	2005	0	14088	14088	43250	29162
7	2006	8954	14088	23042	44262	21221
8	2007	41591	14088	55679	45305	-10374
9	2008	0	14088	14088	46377	32289
10	2009	0	14088	14088	47477	33389
11	2010	0	14088	14088	48602	34514
12	2011	8954	14088	23042	48602	25561
13	2012	41591	14088	55679	48602	-7076
14	2013	0	14088	14088	48602	34514
15	2014	0	14088	14088	48602	34514
16	2015	0	14088	14088	48602	34514
17	2016	8954	14088	23042	48602	25561
18	2017	41591	14088	55679	48602	-7076
19	2018	0	14088	14088	48602	34514
20	2019	0	14088	14088	48602	34514

Table 20(1) Financial Statements for Solid Waste Management  
Project for Male' and Vicinities  
- Feasibility Study -

(Unit: Rf. thousand)										
No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
<b>Income Statement</b>										
Revenue	0	0	0	25599	27277	28997	30786	32644	34572	36567
Operation and Maintenance	0	2784	2457	14088	14088	14088	14088	14088	14088	14088
Depreciation	0	0	0	14369	14369	14369	14369	14369	14369	14369
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	0	2784	2457	28457	28457	28457	28457	28457	28457	28457
Profit before Tax	0	-2784	-2457	-2858	-1180	540	2329	4188	6115	8110
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	0	-2784	-2457	-2858	-1180	540	2329	4188	6115	8110
<b>Funds Statement</b>										
Profit after Tax	0	-2784	-2457	-2858	-1180	540	2329	4188	6115	8110
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	21516	96670	50084	0	0	0	0	0	0	0
Depreciation	0	0	0	14369	14369	14369	14369	14369	14369	14369
Sources	21516	93886	47627	11511	13189	14909	16698	18556	20484	22479
Capital Works	21516	96670	50084	0	0	0	8954	41591	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	0	-2784	-2457	11511	13189	14909	7744	-23034	20484	22479
Applications	21516	93886	47627	11511	13189	14909	16698	18556	20484	22479
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	21516	115402	163030	160172	158992	159532	161861	166049	172164	180274
Liabilities and Capital	21516	115402	163030	160172	158992	159532	161861	166049	172164	180274
Current Assets	0	-2784	-5241	6270	19459	34368	42112	19078	39561	62040
Fixed Assets	21516	118186	168271	153902	139533	125165	119749	146971	132602	118234
Assets	21516	115402	163030	160172	158992	159532	161861	166049	172164	180274

Source: JICA

Table 20(2) Financial Statements for Solid Waste Management  
Project for Male' and Vicinities  
- Feasibility Study -

(Unit: Rf. thousand)										
No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Income Statement</b>										
Revenue	38627	31118	31118	31118	31118	31118	31118	31118	31118	31118
Operation and Maintenance	14088	14088	14088	14088	14088	14088	14088	14088	14088	14088
Depreciation	14369	14369	14369	14369	14369	14369	14369	14369	14369	14369
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	28457	28457	28457	28457	28457	28457	28457	28457	28457	28457
Profit before Tax	10171	2661	2661	2661	2661	2661	2661	2661	2661	2661
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	10171	2661	2661	2661	2661	2661	2661	2661	2661	2661
<b>Funds Statement</b>										
Profit after Tax	10171	2661	2661	2661	2661	2661	2661	2661	2661	2661
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	14369	14369	14369	14369	14369	14369	14369	14369	14369	14369
Sources	24539	17030	17030	17030	17030	17030	17030	17030	17030	17030
Capital Works	0	8954	41591	0	0	0	8954	41591	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	24539	8076	-24561	17030	17030	17030	8076	-24561	17030	17030
Applications	24539	17030	17030	17030	17030	17030	17030	17030	17030	17030
<b>Balance Sheet</b>										
Liabilities	0	0	0	0	0	0	0	0	0	0
Capital	190444	193105	195766	198427	201088	203749	206410	209072	211733	214394
Liabilities and Capital	190444	193105	195766	198427	201088	203749	206410	209072	211733	214394
Current Assets	86580	94656	70095	87125	104155	121184	129261	104700	121730	138759
Fixed Assets	103865	98450	125671	111303	96934	82565	77150	104372	90003	75634
Assets	190444	193105	195766	198427	201088	203749	206410	209072	211733	214394

Source: JICA