1. Executive Summary

Kerala Suchitwa Mission (KSM) under Department of Local Self Government, Government of Kerala have been coordinating and supporting the municipal solid waste management programmes and projects in Kerala. The Malinya Mukta Keralam Action Plan which was evolved through the interventions made by KSM for the last 5 years in the field of solid waste management in Kerala, have paved way for an innovative and creative approach in solid waste management which is rooted in peoples planning.

Existing discard handling systems mostly focus on bio degradable discards which is the urgent priority for the Local Self Governments. There were not enough initiatives to address the non bio degradable discards in waste management system, which in turn became hurdles in efficient management of solid waste. At this juncture, KSM wanted 'Thanal' – a public interest research and campaign organisation working in the field of Environmental health and justice (www.thanal.co.in) – to do a feasibility study on Resource Recovery Facility for slow decaying organic matter and non bio degradable discards.

Resource Recovery Centres are a new concept in India though it is practiced in many countries. There is no model for us to follow in this country. The non formal sector consisting of waste pickers and scrap dealers are actually running systems similar to Resource Recovery Centres. The model of business they are running cannot be copied since it works with bare minimum facilities and little care for human rights, workers rights, safety, environment and public health. Their accounts are not accessible to analyse the market they deal with. In the other side the generators of this discards are unable to provide information since nobody accounts for discards. So it is totally a new area, where available information is mostly deceptive. It was a challenge to the Study team to unearth the facts with limited resources and time.

It was found that on an average a single household in Kerala over a months period is generating 45.29 Kg of organic (slow decaying) and non bio degradable discards. Organic materials (mostly coconut leaves, husks, coconut shells etc) constitutes about 80% whereas, the share of paper and plastics accounts for 11.2% and 3.6% respectively. It was also found that a household discharges on an average 3 tubelights / CFLs in a year. The total organic (slow decaying) and non bio degradable discards generated by a commercial establishment averages about 393.63 kg per month. Paper dominates with 52.4% and plastics account for 7.4%. Organic materials constitutes 24.5%.

The overall rate of recovery for households is 14.55% and for commercial establishments it is 17%. Paper dominates the rate of recovery at house hold level with 47.5% and commercial establishments level with 53.53%. The rate of recovery of plastic materials at house hold level is about 12.7% and at commercial establishment level it is 9.64%.

This shows the potential of a properly designed and placed resource recovery system for efficient resource management. Targeting at 50 % of recovery, it will be a great achievement in terms of solid waste management as well as resource conservation.

The study team strongly recommends for establishment of resource recovery facilities at Local Self Government level as part of municipal solid waste management system, incorporating waste pickers and scrap traders which will improve the efficiency of recovery of discarded materials in the state.

2. Introduction

One of the recent paradigm shifts in waste management was the change in approach from 'managing waste' to 'managing resources'. In this new approach which is based on Zero Waste philosophy focus is given on efficient, ethical and economical resource use and its resource recovery for resource conservation. Thus Resource Recovery Facilities are becoming an important part in any progressive waste management system.

City of Berkeley (C.A., USA) has demonstrated a well organised resource recovery facility which is run by Ecology Center of Berkeley. In Philippines, Barangays (Local Self Governments) in Manila started creating Material Recovery Facilities for collecting and sending non biodegradable discards for reuse/recycle.

In India, rag pickers and rag traders (Kabaadiwalahs / aakriwalahs) are providing the service of resource recovery through an informal and non recognized network. Their services which are not accounted formally, contributes to the conservation of energy and resources.

Malinya Mukta Keralam campaign opened a new opportunity in Rural Kerala's waste management arena. Segregation at source, decentralised handling and resource recovery were the key elements of this campaign. This created an opportunity to link the informal sector with formal sector to strengthen the flow of resources in our society. To bridge the gap intensive planning and institution building is necessary.

A resource recovery centre is a space provided with necessary infrastructure, machinery, tools and human power to sort, clean and store non biodegradable discards from primarily sorted municipal waste and made available for production or consumption purposes.

3. Scope of study

3.1. Objectives

The following are the objectives of the feasibility study;

a. Determine the quantity and percentage of non-biodegradable in the solid waste (plastics, metals etc) or slow biodegradable (like coconut shell, husk, leaf, tree cuttings etc) waste materials generated at Corporation/Municipality/Gram Panchayath level.
b. Suggest suitable mode of collection of non-degradable based on study at different areas.
c. Suggest, based on the quantity and type of non-biodegradable waste, their recycle/reuse potential and the appropriate level at which the RRC can be established and operated (which tier of LSGs?)
d. Suggest the minimum infrastructure requirement (Area of shed, shredder, baling machine and other accessories required etc.) for RRC including specifications, tentative costs and organisational mechanism for operationalising the same.
e. Conduct feasibility study on sustainability of RRC by identifying probable markets including addresses of recycle units in Kerala and neighbouring states
f. Suggest economic viability of operating and managing the RRC by SHG/NGO based micro enterprise units.
g. Assess the merit and demerits of the present mode of collection of non bio-degradable (formal and informal) and also the efficiency of the network of rag pickers and akri-kada (scrap dealers)

3.2. Area of Study

a. The discard characterisation study, for the entire state of Kerala was done through analysing samples collected from selected locations. Sample units, locations and materials on which data collected are given in Annexure – 10.1, 10.2 and 10.3.
b. For recycle/reuse potential study, major industrial hubs, scrap material collection centres both inside and outside of the State were considered.

4. Methodology and Limitations

4.1 Data collection methodology

Data for the study was collected directly through interviews and physical measurement. Supporting information was collected through literature survey.

4.1. a. Direct Sample Surveys:

Direct sample surveys were conducted with pre defined questionnaires. The sampling method followed was Stratified Random Sampling, where samples were selected from different strata to get a representation of maximum sectors. For example, data collection from households was done in three strata; High income group, Middle income group and Low income group. For commercial institutions data was collected from two strata; big and small.

Plot samplings were followed for generating data on discard generation in markets and public places. In this method discards from sample plots were physically measured and recorded. The objective was to find out discard characteristic of waste dumps.

Direct interviews and discussions were conducted to collect information on scrap markets, collection and distribution systems etc.

4.1.b. Secondary Data and literature survey

Census reports, business features, case studies etc were explored for collating data relevant to this study. Some of the data were collected using RTI Act.

4.2. Data processing

Data processing was done after selecting data records with sufficient and realistic information. For this purpose additional samples were collected as a back up.

4.2.a. Grouping and Arithmetic Mean

Data was grouped based on the nature of the discards, marketability and availability. Simple arithmetic mean was used to interpret the trend / common features.

4.3. Limitations

The following are the limitations of the study, which formed the barrier in data collection, processing and interpretation.

a. Limitation of Samples – Kerala is a consumerist state with a huge population and diverse culture. Large number of samples have to be collected for identifying true nature of central tendency of characteristics and quantity of discards generated. It was not possible since the time and resources were not enough to do an extensive survey. The team overcame this barrier up to an extent by capitalizing on the experience in the field of solid waste management and results from observation during the study.

b. Limitation of time and resources – The time and money allotted for this study was not sufficient.

c. Lack of perspective on waste – People are least bothered about the waste and most of the time their perception on quantity generated are either high values or low values and they cannot distinguish between volume and weight. It was very difficult to collect data through oral surveys from such persons.

d. Lack of cooperation - Cooperation from public, business men, primary collectors and scrap sellers were not satisfactory. In particular primary waste collectors including Kudumbasree units were either reluctant to reveal information or gave incorrect information to the survey team.

e. Lack of information – Some of the information was not available at all. For example information on tube lights, CFLs, and some other consumer goods were not available with Commercial Taxes department, who is supposed to have information on such products. Unfortunately the system they follow do not account for the product name, type or brand.

f. Complex classifications – Data collection from commercial establishments and institutions were difficult since they needed very complicated classifications based on their size, nature and type of operations. Collecting sufficient number of samples from each category was impossible with given time and budget.

5. Characterisation study and Quantification of Non Bio Degradable Discards

The study intended to collect information on non bio degradable discards and slow decaying organic materials. But for some categories there were no sufficient data to process or interpret a trend. Hence the analysis of data was limited to those materials which are not included or managed in the current waste management systems.

5.1. Household Sector

Table – 1 shown below reveals the general characteristics and share of non bio degradable and slow decaying discards generated in a house hold on a monthly basis.

Table - 1

Organics(slow decaying) and non bio degradable discards generated per month per household

#	Category	Kg	%
1	Tree trimmings	18.65	41.2
2	Furniture parts	0.02	0.0
3	Wood logs	0.45	1.0
4	Coconut shells (41.11 Nos.)	3.70	8.2
5	Coconut husk (23.39 Nos.)	13.03	28.8
6	Paper	5.05	11.2
7	Metal	0.21	0.5
8	Glass	1.42	3.1
9	Plastics	1.61	3.6
10	Cloths/fibers	1.10	2.4
11	Others	0.05	0.1
	Total	**45.29**	

Slow decaying organic materials (tree trimmings – mostly coconut leaves and garden trimmings – coconut shells, coconut husk, furniture parts and wood logs) constitutes

more than 79% of total Non Bio – Slow decaying discards. They weigh 35.85 kg per month per household. After coconut leaves, it is coconut husks and coconut shells which dominate the chart with their share in the waste stream. These slow decaying materials in household are generally not addressed in the existing discard handling systems.

Paper dominates the non bio degradable discards segment with 11% which accounts for about 5 Kg per house hold per month. The share of plastics which is 4% may mislead since by weight their share is comparatively low but by volume it is high. To make the presence of plastics more visible, for selected plastic discards, their count is also given. Plastics used as disposable packaging materials-Pet bottles, carry bags, wrappers and milk sachets- rank high among plastic discards. They constitute 1.15 kg which is almost 72% of plastic discards.

Share of metals are too low, since people never throw any metal piece out, instead it is being considered as good as money since they fetch good money from the scrap market. So the metal depicted in the table represents only that share of tiny amounts of metals which are normally found in dust bins. For example, aluminium foil, metal lids, tins and cans etc. Copper, brass etc are not included in this, since they do not end up in the dustbins.

The break-up of each category are depicted in the tables 2 to 6

Table-2

Generation of Paper discards per month per household

#	Category	Kg.	%
1	Newspaper/magazines	3.69	73.1
2	Waste paper	0.31	6.1
3	Card board	1.05	20.8
	Total	**5.05**	

Table -3			
Generation of Metal discards per month per household			
#	Category	Kg.	**%**
1	Iron and Steel	0.11	52.4
2	Aluminum	0.10	47.6
	Total	**0.21**	

Table -4			
Generation of Glass discards per month per household			
#	Category	Kg.	**%**
1	Glass bottles	1.39	97.9
2	Glass pieces	0.03	2.1
	Total	**1.42**	

Table - 5			
Generation of Plastic discards per month per household			
#	Category	Kg.	**%**
1	Pet Bottles (7.7 Nos.)	0.54	33.5
2	Plastic carry bags (46.7 Nos.)	0.28	17.4
3	Plastic wrappers/covers (38.75 Nos.)	0.31	19.3
4	Milk sachets (12 Nos.)	0.02	1.5
5	Thick Plastic	0.19	11.8
6	PVC	0.13	8.1
7	Plastic foot wear	0.02	1.2
8	Other plastics	0.01	0.6
9	Sanitary Napkins (13.75 Nos.)	0.11	6.8
	Total	**1.61**	

Table - 6			
Generation of Cloth and other discards per month per household			
#	**Category**	**Kg.**	**%**
1	Cloths/fibres	1.10	95.7
2	Others	0.05	4.3
	Total	**1.15**	

Plastics used as disposable packaging materials-Pet bottles, carry bags, wrappers and milk sachets- rank high among plastic discards. They constitute 1.15 kg which is almost 72% of plastic discards.

Table 7 is showing the breakup of tube light and CFLs Per household.

Table - 7			
Average quantity of Tube lights and CFLs discarded per house hold per month			
#	Category	Nos.	**Kg.**
1	Tube lights and CFLs	0.25	0.05
	Total	**0.25**	**0.05**
This is a provisional figure for discussion, since there is no other records available for verification.			

5.2. Commercial Establishments

The collection of data from commercial establishments were very complex since the nature, type of products / service, scale of operation etc were too diverse and accessing data from they were very difficult. The State Government institutions also had little information on the name and quantity of goods traded. Most of the time the answers given by the commercial establishment owners were not satisfactory.

Table 8			
Organics (slow decaying) and non-biodegradable discards generated per month per commercial establishment.			
#	**Category**	**kg**	**%**
1	Tree trimmings	0.06	0.02
2	Furniture parts	0.02	0.01
3	Wood logs	0.00	0.00
4	Coconut shells	87.26	22.17
5	Coconut husk	7.37	1.87
6	Banana leaves	1.69	0.43
7	Paper	206.50	52.46
8	Metals	0.02	0.01
9	Glass	16.82	4.27
10	Plastics	29.21	7.42
11	Cloth/fibres	6.89	1.75
12	Others	37.79	9.60
	Total	**393.63**	

It was found that on an average a commercial establishment will be generating 393.63kg of organics(slow decaying only) and non biodegradable discards on a monthly basis. Paper dominates the waste stream with 52.46 percent, of which cardboard used

for packing ranks first with 83%. Among plastics PET bottles dominates with 48.51%. The information on wood logs and metals were not convincing even though the information gathered through surveys are presented here. The break up of each component is given in the following tables from 9 – 13.

Table.9

Generation of Paper discards per month per commercial establishments

#	Category	kg	%
1	Newspaper/magazines	7.57	3.67
2	Waste paper	25.87	12.53
3	Card board	173.06	83.81
	TOTAL	**206.50**	

Table.10

Generation of Glass discards per month per commercial establishment.

#	Category	kg	%
1	Glass bottles	16.16	96.08
2	Glass pieces	0.66	3.92
	Total	**16.82**	

Table.11

Generation of Plastic discards per month per commercial establishment.

#	Category	kg	%
1	Pet Bottles(404.73 Nos)	14.17	48.51
2	Plastic carry bags(701.86 Nos)	2.11	7.22
3	Plastic wrappers/covers(855.91 Nos)	3.43	11.74
4	Milk sachets(2147.83 Nos)	2.58	8.83
5	Thick Plastic	0.84	2.88
6	Plastic cups and plates(29.40 Nos)	0.08	0.27
7	Thermocol	0.19	0.65
8	PVC	0.02	0.07
9	Plastic foot wear	0.00	0.00
10	Other plastics	0.50	1.71
11	Sanitary Napkins (16.96 Nos)	0.07	0.24
12	Plastic sacks	5.22	17.87
	Total	**29.21**	

Table .12			
Generation of Cloth and other discards per month per commercial establishment.			
#	**Category**	**kg**	**%**
1	Cloths/fibers	0.74	1.66
2	Others	37.79	13.76
3	Jute sacks	6.15	13.76
	Total	**44.68**	

Table. 13			
Average quantity of Tube lights and CFLs discard per commercial establishment per month.			
#	Category	Nos	kg
1	Tube lights/CFLs	2.26	0.44
	Total	2.26	0.44

5.3 Markets

Existing waste dumps near markets were studied to get a picture about its composition.

Table. 14		
Discard Characterisation of waste dumps near market places		
Category	**Qty. (Kg / cubic Meter)**	**Percentage**
Organic matter	60.17	38.59
Plastics	4.07	2.61
Paper	9.56	6.13
Glass	0.43	0.28
Fibre	1.9	1.22
Sand and grit	79.8	51.18
Total	155.93	100

Since the category wise realistic number of commercial establishments on a district wise was not available, the projections for district level and local self Government levels are not possible. But this average can be helpful for those regions for which exact number of commercial establishments are available.

6. Marketability of Non Bio degradable Discards

Some of the non bio degradable discards and slow decaying discards have a market. A price list of selected materials is given in Annexure 10.5. which is derived after taking average price existing in different markets throughout the State.

Some of the discard materials do not move to the market just because they are not economically viable. Plastic carry bags, plastic wrappers, thermocols, some slow decaying organic materials are to name a few. This list varies from place to place depending upon the local demand. For example coconut husks, coconut shells, tree trimmings etc will find a utility in rural area, but in urban area they are found worthless. So mode of disposal of non bio degradable discards as well as slow decaying organic discards varies from place to place.

6.1. Present scenario of non bio degradable discards management.

The following tables show the trend in disposal methods adopted by the households and commercial establishments with respect to nonbiodiscards.

Table – 15

Mode of disposal of organic (slow decaying) and non-bio degradable discards at house hold level

MATERIAL	Mode of disposal (in percentage of house holds)					
	Reuse/Recycle	Door to Door collection	Dumping	Burning	Burying, Disposal at public places, Not known	Total %
Newspaper/magazines	85	2.5	0	0	12.5	100
Waste paper	17.5	7.5	0	32.5	42.5	100
Card board	40	5	0	10	45	100
Glass bottles	42.5	12.5	7.5	0	37.5	100
Glass pieces	0	12.5	10	0	77.5	100
Iron and Steel	22.5	0	2.5	0	75	100

Aluminum	27.5	0	0	0	72.5	100
Pet Bottles	32.5	17.5	2.5	10	37.5	100
Plastic carry bags	30	50	0	17.5	2.5	100
Plastic wrapper/covers	10	32.5	2.5	12.5	42.5	100
Milk sachets	17.5	27.5	2.5	10	42.5	100
Thick Plastic	12.5	5	0	2.5	80	100
PVC	5	2.5	0	2.5	90	100
Plastic foot wear	22.5	2.5	2.5	0	72.5	100
Other plastics	2.5	0	0	2.5	95	100
Sanitary Napkins	0	22.5	15	22.5	40	100
Tree trimmings	5	0	17.5	20	57.5	100
Furniture parts	2.5	0	0	10	87.5	100
Wood logs	0	5	2.5	12.5	80	100
Coconut shells	2.5	10	2.5	77.5	7.5	100
Coconut husk	2.5	5	0	50	42.5	100
Cloths/fibers	42.5	10	2.5	17.5	27.5	100
Tube lights/CFLs	0	25	52.5	2.5	20	100

Table 16						
Mode of disposal of non-bio degradables and slow decaying materials at commercial establishments level.						
Mode of disposal (in percentage of commercial establishment)						
MATERIAL	**Reuse / Recycle**	**Door to Door**	**Dumping**	**Burning**	**Burrying,Disposal at public places,Not known**	**Total %**
Newspaper/magazines	54.54	0.00	0.00	0.00	45.45	100.00
Waste paper	51.51	15.15	6.06	24.24	3.03	100.00
Card board	54.55	3.03	9.09	0.00	33.33	100.00
Glass bottles	24.24	3.03	0.00	0.00	72.73	100.00
Glass pieses	6.06	12.12	0.00	0.00	81.82	100.00
Iron and Steel	3.03	0.00	0.00	0.00	96.97	100.00
Aluminium	6.06	0.00	0.00	0.00	93.94	100.00
Pet Bottles	42.42	6.06	0.00	0.00	51.52	100.00
Plastic carry bags	12.12	18.18	9.09	0.00	60.61	100.00
Plastic wrapper/covers	3.03	24.24	9.09	0.00	63.64	100.00
Milk sachets	15.15	18.18	3.03	0.00	63.64	100.00
Thick Plastic	18.18	0.00	3.03	0.00	78.79	100.00
Plastic cups and plates	0.00	15.15	3.03	0.00	81.82	100.00
Thermocol	0.00	3.03	0.00	0.00	96.97	100.00
PVC	3.03	0.00	0.00	0.00	96.97	100.00
Plastic foot wear	0.00	0.00	0.00	0.00	100.00	100.00
plastic sacks	12.12	0.00	0.00	0.00	87.88	100.00
Other plastics	0.00	0.00	0.00	0.00	100.00	100.00
Sanitary Napkins	0.00	3.03	0.00	0.00	96.97	100.00
Tree trimmings	3.03	0.00	0.00	0.00	96.97	100.00
banana leaves	3.03	3.03	3.03	0.00	90.91	100.00
Furniture parts	0.00	0.00	0.00	6.06	93.94	100.00
Wood logs	0.00	0.00	0.00	0.00	100.00	100.00
Coconut shells	3.03	6.06	0.00	30.30	60.61	100.00
Coconut husk	3.03	0.00	0.00	12.12	84.85	100.00
Cloths/fibres	24.24	0.00	3.03	0.00	72.73	100.00
Jute sacks	12.12	0.00	0.00	0.00	87.88	100.00
Tubelights/CFLs	0.00	45.45	36.36	0.00	18.19	100.00
Others	0.00	3.03	0.00	0.00	96.97	100.00

6.2 Quantity of discards recovered through scrap dealers network

A part of the non bio degradable discards as well as slow decaying organic materials are recovered through the conventional network of waste pickers and scrap dealers. The data is available only for the members of this network. The data on recovery by the new stake holders – women SHG's and private enterprises engaged in door to door collection of discards – are not available.

Table 17

Quantity of Organic (slow decaying) and non-bio degradable discards recovered through informal network of scrap dealers in the House Hold Sector

MATERIAL	Average discard generation at HH (Kg) / month	% of discards sent for Recycling	Quantity of discards handled by the network of Scrap dealers (Kg/month)	
			at House hold Level	at LSG level (6184.5 HH)
Newspaper/magazines	3.7	85.0	3.1	19397.7
Waste paper	0.3	17.5	0.1	335.5
Card board	1.1	40.0	0.4	2597.5
Glass bottles	1.4	42.5	0.6	3653.5
Glass pieces	0.0	0.0	0.0	0.0
Iron and Steel	0.1	22.5	0.0	153.1
Copper/Brass		0.0	0.0	0.0
Aluminum	0.1	27.5	0.0	170.1
Pet Bottles	0.5	32.5	0.2	1085.4
Plastic carry bags	0.3	30.0	0.1	519.5
Plastic wrappers/covers	0.3	10.0	0.0	191.7
Milk sachets	0.0	17.5	0.0	21.6
Thick Plastic	0.2	12.5	0.0	146.9
PVC	0.1	5.0	0.0	40.2
Plastic foot wear	0.0	22.5	0.0	27.8
Other plastics	0.0	2.5	0.0	1.5
Sanitary Napkins	0.1	0.0	0.0	0.0
Tree trimmings	18.7	5.0	0.9	5767.0

Furniture parts	0.0	2.5	0.0	3.1
Wood logs	0.5	0.0	0.0	0.0
Coconut shells	3.7	2.5	0.1	572.1
Coconut husk	13.0	2.5	0.3	2014.6
Cloths/fibers	1.1	42.5	0.5	2891.3
Others	0.1	0.0	0.0	0.0
Total Recovered (Kg)			**6.4**	**39590.1**
Total Generated (Kg)	**45.3**		**45.3**	**278510.9**
Overall % of Recovery	**14.13**			

Table 18

Quantity of Organic (slow decaying) and non-bio degradable discards un recovered in the House hold sector

MATERIAL	Average discard generation at HH (Kg) / month	% of discards un recovered	Quantity of discards un recovered (Kg/month)	
			at House hold Level	at LSG level (6184.5 HH)
Newspaper/magazines	3.69	15.00	0.55	3423.12
Waste paper	0.31	82.50	0.26	1581.69
Card board	1.05	60.00	0.63	3896.24
Glass bottles	1.39	57.50	0.80	4942.96
Glass pieces	0.03	100.00	0.03	185.54
Iron and Steel	0.11	77.50	0.09	527.23
Copper/Brass		100.00	0.00	0.00
Aluminum	0.10	72.50	0.07	448.38
Pet Bottles	0.54	67.50	0.36	2254.25
Plastic carry bags	0.28	70.00	0.20	1212.16
Plastic wrappers/covers	0.31	90.00	0.28	1725.48
Milk sachets	0.02	82.50	0.02	102.04
Thick Plastic	0.19	87.50	0.17	1028.17
PVC	0.13	95.00	0.12	763.79
Plastic foot wear	0.02	77.50	0.02	95.86
Other plastics	0.01	97.50	0.01	60.30
Sanitary Napkins	0.11	100.00	0.11	680.30
Tree trimmings	18.65	95.00	17.72	109573.88
Furniture parts	0.02	97.50	0.02	120.60
Wood logs	0.45	100.00	0.45	2783.03
Coconut shells	3.70	97.50	3.61	22310.58
Coconut husk	13.03	97.50	12.70	78569.43

Cloths/fibres	1.10	57.50	0.63	3911.70
Others	0.05	100.00	0.05	309.23
Total Unrecovered (Kg)			**38.89**	**240505.93**
Total Generated (Kg)	**45.29**		**45.29**	**280096.01**
Overall % of Non Recovery	**85.87%**			

Table 19

Value of Organic (slow decaying) and non-bio degradable discards unrecovered at house hold level

MATERIAL	Price (Rs)	Average discard generation at HH (Kg) / month	% of discards sent for Recycling	Value of discards handled by the network of Scrap dealers (Kg/month)	
				at House hold Level	at LSG level (6184.5 HH)
Newspaper/magazines	6.18	3.69	15.00	3.42	21154.89
Waste paper	5.80	0.31	82.50	1.48	9173.78
Card board	5.21	1.05	60.00	3.28	20299.38
Glass bottles	0.75	1.39	57.50	0.60	3707.22
Glass pieces	0.70	0.03	100.00	0.02	129.87
Iron and Steel	19.61	0.11	77.50	1.67	10338.95
Aluminum	73.30	0.10	72.50	5.31	32865.98
Pet Bottles	5.50	0.54	67.50	2.00	12398.38
Plastic carry bags	2.00	0.28	70.00	0.39	2424.32
Plastic wrappers/covers	2.00	0.31	90.00	0.56	3450.95
Milk sachets	7.00	0.02	82.50	0.12	714.31
Thick Plastic	12.17	0.19	87.50	2.02	12512.87
PVC	19.00	0.13	95.00	2.35	14511.93
Plastic foot wear		0.02	77.50	0.00	0.00
Other plastics	3.00	0.01	97.50	0.03	180.90
Sanitary Napkins		0.11	100.00	0.00	0.00
Tree trimmings	1.00	18.65	95.00	17.72	109573.88
Furniture parts		0.02	97.50	0.00	0.00
Wood logs	14.00	0.45	100.00	6.30	38962.35
Coconut shells	3.60	3.70	97.50	12.99	80318.10
Coconut husk	1.60	13.03	97.50	20.33	125711.09
Cloths/fibres		1.10	57.50	0.00	0.00
Others		0.05	100.00	0.00	0.00
Total Unrecovered (Rs.)				**80.59**	**498429.16**

Table 20							
Rate of recovery of non-bio degradables and slow decaying materials at commercial establishments level.							
	Price	**Total Qty. Generated**	**% of discards recovered for reuse or recycle**	**Quantity of discards handled by the network of Scrap dealers (Kg/month)**	**Value of Recovered Material**	**Quantity of discards un recovered(Kg/month)**	**Value of Un recovered Material**
Newspaper/magazines	6.18	7.57	54.54	4.13	25.51	3.44	21.26
Waste paper	5.8	25.87	51.51	13.33	77.28	12.54	72.75
Card board	5.21	173.06	54.55	94.40	491.84	78.65	409.79
Glass bottles	0.75	16.16	24.24	3.92	2.93	12.24	9.18
Glass pieses	0.7	0.66	6.06	0.04	0.02	0.62	0.43
Pet Bottles	5.5	14.17	42.42	6.01	33.06	8.15	44.87
Plastic carry bags	2	2.1	12.12	0.25	0.50	1.84	3.69
Plastic wrapper/covers	2	3.43	3.03	0.10	0.20	3.32	6.65
Milk sachets	7	2.58	15.15	0.39	2.73	2.18	15.32
Thick Plastic	12.17	0.84	18.18	0.15	1.85	0.68	8.36
Plastic cups and plates	6	0.08	0	0.00	0	0.08	0.48
Thermocol		0.19	0	0.00	0	0.19	0
PVC	19	0.02	3.03	0.00	0.01	0.01	0.36
plastic sacks	16	5.22	12.12	0.63	10.12	4.58	73.39
Other plastics	3	0.5	0	0.00	0	0.5	1.5
Sanitary Napkins		0.07	0	0.00	0	0.07	0
Tree trimmings		0.06	3.03	0.00	0	0.05	0
Furniture parts	14	0.02	0	0.00	0	0.02	0.28
Coconut shells	3.6	87.26	3.03	2.64	9.51	84.61	304.61
Coconut husk	1.6	7.37	3.03	0.22	0.35	7.14	11.43
Cloths/fibres		0.74	24.24	0.18	0	0.56	0
banana leaves		1.69	3.03	0.05	0	1.63	0
jute sacks	20	6.15	12.12	0.75	14.90	5.40	108.09
Others		37.79	0	0.00	0	37.79	0
Recovered				**127.21**	**670.90**	**266.393**	**1092.51**
Average Price/Kg					**5.27**		**4.10**
Overall % of Recovery				32.32		67.68115	
Total		**393.60**					

Table - 21		
Comparison of % of Recovery of materials in Households and Commercial Establishments		
Materials	**Percentage of Recovery of discards**	
	House Holds	**Commercial Establishments**
Paper	71.48	54.16
Glass	41.54	23.54
Metal	23.8	3.03
Others	0	0
Plastics	20.49	25.85
Organics	3.76	3.21
Cloth or fibres	42.72	13.35
Overall recycling rate	14.13	32.36

Table 22		
Comparison of Organic (Slow decaying) and non bio degradable discards generated in House hold and Commercial Establishments by quantity and value		
	House Holds	**Commercial Establishments**
Total Quantity of discards Generated per month (Kg)	45.3	393.60
Total value of discards generated in a month (Rs.)	108.9	1763.4

Table 23		
Comparison of % of Organic (Slow decaying) and non bio degradable discards recovered in House hold and Commercial Establishments by quantity and value		
	House Holds	**Commercial Establishments**
Total Quantity that is recovered per month (Kg)	6.4	127.2
% of Recovery by Qty	14.1%	32.31%

Table 24		
Comparison of Average value of recovered Organic (Slow decaying) and non bio degradable discards generated in House hold and Commercial Establishments		
	House Holds	**Commercial Establishments**
Value of Recovered (Rs.)	28.3	670.9
% of Recovery by Value	25.9%	38%
Average Price per Kg. (Rs.)	4.4	5.3

Table 25		
Comparison of % of Organic (Slow decaying) and non bio degradable discards unrecovered in House hold and Commercial Establishments by quantity and value		
	House Holds	**Commercial Establishments**
Total Quantity of Un recovered (Kg)	38.9	268.7
% of Qty-Unrecovered	85.9%	67.9%

Table 26		
Comparison of Average value of unrecovered Organic (Slow decaying) and non bio degradable discards generated in House hold and Commercial Establishments		
	House Holds	**Commercial Establishments**
Value Unrecovered by value (Rs.)	80.6	1092.5
% of Unrecovery by Value	**24.1%**	**62%**
Average Price per Kg. (Rs.)	**2.1**	**4.1**

7. Viability of Resource Recovery Centre

The current resource recovery process through informal sector sustains despite a large number of middlemen involved due to cheap labour, poor or no safety mechanisms and minimum investment cost on space and other infrastructure. This is unacceptable for any progressive society since it negates basic minimum human rights and compromises environmental health which directly and indirectly affects the entire population.

A paradigm shift is necessary where resource recovery is sustained without compromising human rights and environmental health. This will be possible only through a phased manner where it need to wait for suitable responsible consumer behaviour (where consumers voluntarily participate in resource recovery process through prompt segregation and regular delivery to local RRFs.) and elimination of middlemen. So there is a transition period where State support in terms of investment on infrastructure and facilitation is needed. This transition period can vary between 3 to 5 years depending upon the places and their waste generation pattern.

A resource Recovery Facility having a capacity of 10MT / day capacity is analyzed for its economic viability. The assumptions are made on the characteristics and quantity of organic and non biodegradable discards generated from house holds in an area only since number of commercial establishments or its proportion to number of households are not known.

A 10 MT/Day capacity RRF can take discards generated in a Block of 4 to 5 Grama Panchayaths or a Municipality with minimum of 7,820 house holds.

It is assumed that the Resource Recovery Facility is getting only unrecovered discards since the rest of the 'high value' materials are traded in the competitive scrap market with its established system. It may take 2 to 3 years to attract those materials to a RRF.
It is assumed that the RRF is getting unrecovered discards at free of cost and is being dropped at doors of RRF.

The average price per Kilogram of un recovered mixed non bio degradable discards is assumed to be Rs.2.1.

7.1 Cost of Resource Recovery Centre:

A RRF of 10 MT/ Capacity needs minimum 10.11 Ares (25 Cents) of Land. The land value is excluded from costing, since it highly varies from place to place.

7.1.1 Fixed Capital and Working Capital for a Resource Recovery Facility of 10TPD

The following table gives an account of Fixed Capital cost for a RRF. It is approximately Rs. 31,00,000/-

Table 27

Estimate of Fixed Capital Requirement for a RRF of 10 TPD capacity

#	Assets		Cost (in Rs.)
1	Plant (1900 sq.ft.@Rs.900/sq.ft + perimeter fence)		20,00,000
2	Machinery Shredder (Rs85,000) X 2 units Baling Machine (Rs. 7,00,000) Water Pumps (Rs.5,000)X2 Trollies (Rs.4,000)X12 Tools and Equipments Weighing scales	 1,70,000 7,00,000 10,000 48,000 25,000 25,000	 9,78,000
3	Furniture and Fixtures	50,000	50,000
4	Computer and Printer	50,000	50,000
	Total (Rupees)		30,78,000

Table. 28			
Estimated of Working Capital Requirement of a RRF of 10TPD			
1	Wages Salary	3,76,000 50,000	 4,26,000
2	Transportation	6,71,000	
3	Maintenance	12,500	
4	Electricity and Water	40,250	
5	Depreciation	77,000	
6	Miscellaneous	4,000	8,04,750
	Total		12,30,750

7.2 Estimated Revenue Calculations

It is estimated that about 14.13% of Slow decaying organic and non bio degradable discards at house hold level are recovered and the rest is left un recovered. It amounts to be 85.87% Assuming that this 85.87% from house holds are collected and deposited at RRF efficiently and RRF could recover about 70% of it, the total quantity and its value stands as follows

Total slow decaying organic and non bio degradable discards generated at house hold level	=	45.3Kg / month
Quantity of discards unrecovered	=	85.87% of 45.3Kg
	=	38.89Kg.
Average price for low value discards	=	Rs.2.1/Kg
Value of discards un recovered	=	Rs.81.68
Successful recovery rate	=	70%
	=	70% of Rs.81.68
	=	Rs. 57.18
Revenue from 7,820 House holds/Month	=	Rs.4,47,125

Table 29

Estimated Income and Expenditure Account of Resource Recovery Facility

Expenditure	Amount		Income	Amount
Collection and Transportation	2682750		Estimated Sales	5365500
Direct Wages	1502340		Estimated Subscription	300000
Rent and rates	100000			
Electricity and Water	160965			
Gross Profit c/d	**1219445**			
Total	**5665500**		**Total**	**5665500**
			Gross Profit b/d	1219445
Salary	200000			
Incentives and Commission	75000			
Maintenance Expenses	50000			
Health Care Expenses	50000			
Depreciation	307800			
Provision for bad debts	100000			
Insurance for Assets	25000			
Miscellaneous	16000			
Net Profit c/d	**395645**			
Total	**1219445**		**Total**	**1219445**

8. Observations

The following are the observations regarding the existing scenario of handling of non bio degradable discards in Kerala.

8.1 Policy / Law

8.1.1 The 'Malinya Mukta Keralam' Action Plan put forward by Department of Local Self Government, follows the principles of zero waste and laid foundation for resource recovery as a policy. Still there is a lack of comprehensive policy and guidelines for effective resource recovery and resource management in the State.

8.1.2 There is no strategy / plan / policy to record, monitor and handle the post consumer discards like disposable plastic products, sanitary napkins, mercury containing bulbs and tubes, plastic packaging materials, house hold chemicals (including pesticides and paints etc.)

8.1.3 No policy or programmes are available within the Government to accredit and incorporate the people working in the non formal sector starting from waste picking to recycling.

8.1.4 The law for restricting the use of plastic carry bags are inefficient and insufficient, which allows proliferation of disposable plastic products in the State.

8.1.5 The plastic use reduction policy observed by some of the Government institutions and offices are effective and visible.

8.1.6 Bringing in new stake holders – Kudumbashree Units and Women Self Help Groups – in the field of waste collection and transportation have reduced the livelihood opportunities of the traditional waste pickers and door to door scrap traders.

8.2 Infrastructure

8.2.1 Most of the infrastructure available for collecting and processing the non bio degradable discards are in the non formal or un organized sector. They are inhumane in nature and are causing problems to environment and public health.

8.2.2 There is no infrastructure facility for utilizing slow decaying biomass discards generated.

8.2.3 The infrastructure available with existing discard handling facilities set up by Local Self Governments are not sufficient to address the non bio degradable discards.

8.3 Process

8.3.1 Except for few places in urban areas the efficiency of segregation of discards are not even 50%. This causes mixing of discards which blocks the opportunity of recycling or reuse.

8.3.2 In the existing system of collection bio degradable discards as well as non bio degradable discards are collected separately at the same time and on a daily basis. This system have the following disadvantages

a. The chances of getting mixed are high. This may result in organics contaminating the recyclables.
b. People are lazy about segregation since it leaves their home on a daily basis. Often waste collectors are compelled to dump the improperly segregated non bio degradables into bio degradable section.
c. The efficiency of segregated transportation is low, since the chambers provided may not fit to the varying quantities on a daily basis.

8.3.3 Apart from bins distributed by the municipal authorities free of cost, a few house holds / commercial establishments / institutions have designated storage space for non bio degradable discards.

8.3.4 Most of the high value non biodegradable discards like news paper and magazines, metals, glass bottles, card boards are not found in waste dumps since they are treated as commodity and is sold to the waste picker / scrap dealer.

8.3.5 Coconut leaves, coconut husks, tree trimmings are 'zero' value product in Cities and big towns. They are not utilized or channelized to people who live in the rural area. This led to dumping of these materials in large quantities on the road sides.

8.3.6 In most of the urban areas where door to door segregated discards collection facility are available, non bio degradable discards are dumped and or burnt at their waste processing sites.

8.3.7 The door to door collectors and municipal workers hunt the non bio degradable discards collected for 'valuable' discards that can be sold for personal benefit. This reduces the chances of saleability of collected non bio degradable discards and challenges the livelihood opportunities of waste pickers.

8.4 Institutional

There is a well established network across the state which enables flow of major components of non biodegradable discards into recycling facilities. It starts with

a. Waste pickers – who collects the recyclables from waste dumps and house holds for free;
b. Door to door scrap dealers- who buys recyclables from house holds, commercial establishments and other institutions in exchange of money or other articles;
c. Local Scrap dealers – who procures discards from waste pickers and door to door scrap traders or buys discards directly from those who deliver at their shops.

d. Wholesale dealers / brokers – who coordinates with local scrap dealers in a large region to pool desired discards in desired quantity and facilitate for its transportation to the recycling units.

This institutional mechanism has been built around market demands and mechanism which is largely controlled by whole salers and recyclers. This network is huge in terms of reclaiming a major quantity of resources from our waste stream.

8.4.1 Most of the small scale local scrap dealers and wholesalers are affiliated to traders associations or industry associations. There are a couple of dedicated association of scrap dealers in Kerala.

Waste pickers and door to door waste traders are still un organised and are often exploited by the local scrap dealers. In Ernakulam there is an association of door to door waste collectors which is affiliated to a political party.

8.4.2 In major towns the local self governments have established door to door collection system. In some places it is only meant for commercial establishments in the main commercial streets.

8.4.3 Except for a few places the LSGs made no initiatives to incorporate the scrap traders to dispose off non bio degradable discards.

8.5 Technology

8.5.1 Most of the scrap traders and whole salers do not engage in the recycling of discards in the state. Instead they do primary sorting, cleaning and baling. These processes are done with minimum machines and maximum labour in their godowns or backyards.

8.5.2 Small scale plastic recyclers are also working in the state who depends upon LDPE covers and packing materials (not carry bags or thin plastic films) to make polymer pellets for re moulding or reprocessing.

Visit to one of the popular plastic recycling facility in north Kerala revealed working with bare minimum facilities and no pollution control mechanisms

or certificates. The unit was feeding on selected types of LDPE thick plastic covers supplied at their door step by people, but claimed that they are recycling all plastic carry bags of all types.

8.5.3 Hindustan Newsprint Limited (HNL) in Velloor, Kottayam has technology for de inking newspapers. HNL is one of the biggest recycler of paper.

8.5.4 Most of the plastics, cardboards, metals and glass are transported to neighboring states like Tamil Nadu and Karnataka for recycling.

8.6 Finance

8.6.1 Collection, cleaning and sorting are labour intensive process which increases the cost of recycling.

8.6.2 Local Scrap traders advance money to waste pickers and door to door scrap traders for procurement of recyclables.

8.6.3 Door to door waste collectors engaged by residence associations or LSGs are sustaining their activity with the money collected through subscription.

9. Recommendations

Based on the discard characterisation study and observations, the team would like to recommend the following.

9.1 Policy / Law

9.1.1 A policy for Resource Recovery may be formed to guide the collection, transportation, reprocessing and disposal of discards generated in the state in an efficient manner that revitalizes local economy and conserving energy and resources.

9.1.2 It is recommended that the department of Commercial Taxes may initiate process and systems to record product details and its quantity being distributed in the state. The present system of recording does not reflect the quantity and type of products. It is very important to have information on quantity of products sold such as mercury containing equipments and bulbs, house hold chemicals, electronic and electrical equipments, products sold in plastic packages and containers etc. This information will help the Government to plan and implement projects to handle and dispose the post consumer products arising from the products being sold in the State.

9.1.3 The service of people in the non-formal sector is very valuable who can save resources for us. Appropriate policies and projects may be initiated to incorporate their experience and enhance their capacity to increase the efficiency of recovery. It is also important to provide better working conditions and access to materials in a dignified manner.

9.1.4 The use of disposable plastic products and tetra packs despite of their thickness may be restricted to smoothen the current municipal solid waste management systems and to reduce the wastage of resources and energy. A packaging law to encourage eco friendly packing and local buying may be initiated.

9.1.5 All Government owned and operated offices, institutions and establishments should become model places for public to learn efficient resource use patterns and waste reduction practices.

9.1.6 Waste pickers and waste traders should be involved in the current system of waste management to supplement the efforts of women SHGs and Municipal workers so as to provide maximum livelihood opportunities.

9.1.7 It will be ideal for LSGs to add information on local scrap dealers, re processors and waste pickers in their approach paper on Solid Waste Management. This information will help in planning and implementing resource recovery programmes.

9.1.8 It is recommended to hold a State level / regional level consultation involving scrap dealers and re processors both from Kerala and outside Kerala to formalise an efficient network for continuous and sustainable resource recovery.

9.2 Infrastructure

9.2.1 Resource recovery Centres should be established across the State for efficient recovery of discards generated in the State. These resource recovery centres can be a hub for material / product exchange markets.

For efficient collection, transportation, cleaning and sorting the discard stream, a three tier system, which includes Material Recovery Facility, Resource Recovery Centre and Resource Recovery Parks, is suggested.

9.2.2 Material Recovery Facility (MRFs)

MRF is a simple infrastructure for procuring and storing non bio degradables and slow decaying bio degradables for a maximum of one month period. The MRFs will be connected to the Resource Recovery Centres run by the LSG. MRFs can be established at

a. Flats / multi storied residential buildings
b. Access controlled residential colonies
c. Hostels
d. Hotels / Lodges / Resorts / Spas
e. Community Centres
f. Pilgrim Centres
g. Shopping malls / complexes
h. Hospitals
i. Educational Institutions
j. Public and Private offices / institutions having more than 20 people
k. Industrial estates / parks
l. Others

The components / infrastructure requirement of a MRF is as follows

i. Transfer point – This is a platform protected with a roof to unload the discards collected in the bins.
ii. Cleaning station – A couple of discarded bath tubs, or any other tanks can be used for cleaning of plastics, metal containers and glass bottles containing organic matter. For example, milk covers, soft drink bottles and aluminum cans, ice cream cups, snacks packets and so on. These materials need a rinse in water to avoid stinking of organic matter inside the covers or containers. Washed materials need to be drained and dried in sun before storing.
iii. Store – A shed with a couple of cupboards, hanging sacks / box containers / tanks to store materials in a sorted manner. Suggested classification as follows:
    1. News Paper and magazines – can be stored in the cupboard / shelves
    2. Carboard boxes and sheets – can be stored in the cupboard / shelves
    3. Office paper (white) – can be stored in a hanging sack or in a box container
    4. Waste paper (mixed) – can be stored in a hanging sack or in a box container

5. Disposable plastics – plastic cups, plates, plastic spoons, cling films and film wraps, carry bags, toffee wrappers, snack covers etc can be stored in a hanging sack or in a box container
6. Thick plastics – plastic containers, and other plastic discards can be stored in a hanging sack or in a box container.
7. Milk Sachets – plastic milk sachets and other similar plastic covers can be kept in a hanging sack or in a box
8. Metal – All kinds of metal discards can be stored in a box container.
9. Glass bottles – Need to be stored in a box container
10. Glass pieces – Need to be stored in a secured cloth bag
11. Tubelights / bulbs / CFLs – Need to be stored separately where Tubelights have to be stored in shelves and bulbs and CFLs have to be stored in secured cloth bag.
12. Cloth / Fibre – A box container can be used to store discarded clothes, jute bags and such materials
13. Slow decaying bio degradables – can be stored in a small shed attached to the MRF.
14. Others – All other discards can be stored in a box container.

See Annexure 10.9 , drawing for micro MRF with bare minimum facility.

9.2.3 Resource Recovery Centres (RRC)

Every Urban LSG or Rural LSGs having 7000 or more house holds or having more than 10 TPD non bio discards should have a Resource Recovery Centre as a common facility. It can be established along with existing waste management facilities such as bio gas plants / composting yards. Based on the nature and quantity of discards some of the components of RRC can be separated from the common facility and can be located elsewhere to ensure segregated collection. The essential components and infrastructure requirement of a Resource Recovery Centre is as follows

Table-30					
Components and space requirement of a Resource Recovery Centre of 10TPD					
#	**Component**	**Function**	**Area/Volume**	**Sq. M**	**Sq. ft**
1	Drive way	Transporting non bio degradable discards into RRF	7.2 M wide	7.2sq.M	77.5008
2	Transfer Station	Tipping point for Non bio degradable discards -	7 M x 2.5 M	17.5 sq. M	188.37
3	Primary sorting bins	Sorting the materials into primary broad categories such as Paper, Plastic, Metal, Glass, Cloth and Fibers and Others	1.2 M x 1.2 M x 1.2M x 6 Boxes Volume 10000 Litres	1.73 sq. M	18.6
4	Final sorting yard	Sorting area for each category into sub categories. Sorted materials will be directly collected in trollies for transfer	7 M x 3.48 M	24.35 sq. M	262.10
5	Shredder	Shredder machine for breaking plastics into pieces for volume reduction	2.4 M x 2 M	4.8 sq. M	51.7
6	Washing tubs	Two washing tubs for washing soiled plastic and glass bottles	1.8 M x 0.75 M x 0.5 M x 2 Volume 1350 Litres	1.35 cu.M	47.682 cu.ft.
7	Drying yard	Space for drying wet materials	5.36 M x 2.4 M	12.8 sq. M	137.8
8	Passage	Passage	2 M wide	2 sq. M	21.5
9	Hazardous Waste Store	Storing space for hazardous waste such as batteries, tube lights, chemicals etc	7 M x 1.8 M	12.6 sq. M	135.6
10	Water Treatment unit and pumps	Grey water collection point and water treatment equipments	2.7 M x 2 M	5.4 sq. M	58.13
11	Soak pit	Soak pit for draining treated water	2.7 M x 2 M x 3M Volume 16000 Litres	16.2 cu. M	572 cu.ft
12	Gents toilet and rest room	Gents toilet and rest room	1.69 M x 2.74 M	4.6 sq. M	49.51
13	Ladies toilet and rest room	Ladies toilet and rest room	1.69 M x 2.74 M	4.6 sq. M	49.51
14	Office	Operation Management of RRF	5 M x 2.7 M	13.5 sq. M	145.3
15	Baling unit	Space for compacting plastics and paper .Space for installing Bailing machine	3.7 M x 3.4 M	12.5 sq. M	134.55
16	Store	Storing space for materials ready for recycling	3.4 M x 8.4 M	28.5 sq. M	306.8
17	Shop	Space for selling and buying reusable and recyclable	3.4 M x 3.2 M	10.8 sq. M	116.3

		materials			
18	C & D Waste yard	Space for storing construction and demolition waste for reuse in construction purpose	12 M x 9.8 M 3 cents	117.6 sq.M	1265.8
19	Fuel wood yard	Storing tree trimmings, coconut husk, coconut shells, lumbers etc	12 M x 12 M 3.5 cents	144sq. M	1550
20	Bore well	Source of water for operations			
21	Underground Water Tank-1	Water tank for storing rain water collected in the facility	4 M x 1.6 M x 2M Volume 14000 Litres	12.8 cu.M	452 cu.ft
22	Underground Water Tank-2	Water tank for storing rain water collected in the facility	4 M x 1.6 M x 2M Volume 14000 Litres	12.8 cu. M	452 cu.ft
25 to 30 cents of land may require for setting up a RRC of 10 TPD See Annexure 10.10 – Drawing for 10TPD Resource Recovery Centre.					

The following table shows the suggestions for sorting and storing discards to increase its marketability.

Table - 31

Discard classification and Disposal options

Category	Sub Category	Disposal Options
Paper	News Paper	Recycling
	Magazines – glossy paper	Recycling
	Magazines – News print	Recycling
	Card board boxes	Recycling
	Card board sheets or pieces	Recycling
	Notebooks	Recycling
	Text books	Recycling / Reuse
	Office Paper – White	Recycling
	Office Paper – Color	Recycling
	Waste Paper – mix	Recycling
	Carbon Paper	Not available / unknown
Plastics	Plastic carry bags, covers, sachets	Recycling
	Disposable plastics – cups, plates (except Styrofoam) and packing containers	Recycling
	PET bottles and conainers	Recycling
	PVC	Recycling
	Thermo plastics	Recycling
	Thermo setting plastics	Not available / unknown
	Foam plastics – foot wears	Not available / unknown
	Styrofoam plastics	Not available / unknown
	Poly propylene sacks	Recycling
	Others – includes sanitary napkins, tetrapacks, metal coated plastic covers	Not available / unknown

	PVC flex	Not available / unknown
	X-ray films / photo films	Recycling
Rubber	Tyres and tubes	Recycling
	Sandals	Recycling
	Other rubber products	Recycling
Cloth and fibres	Cotton cloth or pieces - white	Recycling / Reuse
	Cotton cloth or pieces - colour	Recycling / Reuse
	Reusable cloths or pieces	Reuse
	Cloth waste – mixed	Reuse
	Jute sacks	Reuse
	Others	
Metal	Copper	Recycling
	Iron	Recycling
	Stainless steel	Recycling
	Aluminum	Recycling
	Bronze	Recycling
	Tin	Recycling
Glass	Glass pieces – white	Recycling
	Glass pieces – green	Recycling
	Glass pieces – amber	Recycling
	Glass pieces – blue	Recycling
	Glass bottles – beer	Recycling / Reuse
	Glass bottles – beverage	Recycling / Reuse
	Glass bottles – containers	Recycling / Reuse
	Sheet glass	Recycling
	Sheet glass – automotive	Not available / unknown
	Other	
Construction and Demolition Waste	Bricks	Reuse
	Tiles – terracotta	Reuse
	Tiles – ceramic	Reuse
	Slabs – granites and marble	Reuse
	Concrete pieces	Reuse
	Granites and pieces	Reuse
	Ceramic wares – wash basins, closets, bath tubs	Reuse (after disinfection / sanitization)
	Ceramic pieces	Reuse
	Soil and sand	Reuse
	Wood logs	Reuse
Slow decaying bio degradable	Coconut leaves,	Reuse / Fuel / Biochar / biomass briquettes
	Coconut husk	Recycle
	Coconut shells	Reuse / Fuel / Biochar
	Tree trimmings	Reuse / Fuel / Biochar / biomass briquettes
	Furniture parts and timber	Reuse / Repair
	Palm leaves, screw pine leaves,	Reuse / Fuel / Biochar /

	grass used in making packing materials and mats.	biomass briquettes
	Coir products	Recycle
	Cut hair	Recycle / Compost / Burn
Hazards	Fluroscent tube lights, CFLs, Mercurry and Sodium vapour lamps	Containment
	Batteries	Containment
	House hold chemicals and paints	Containment
	Discarded medicines	Containment
	Waste from Electrical and Electronic Equipments	Containment
Others		

Table – 32

Suggested staff requirement for Resource Recovery Centre

#	Designation	No. of Posts	Function	Monthly Remuneration (In Rupees)
	Supervisor	1	Overall supervision of RRC and coordination and facilitation with MRFs and scrap traders	7000 – 8000
	Salesman cum store keeper	1	Maintenance of inward outward flow of materials in the RRC and managing the Sales in the counter	4500 Plus Commission
	Workers	2 per 1 tonne of discards	Handling discards	4000 -5000

9.2.4 Process

i. Collection of discards to be separated. There can be a daily collection system for bio degradable discards where as non bio degradable and slow decaying bio degradable discards should be collected on a weekly basis, maximum 2 days a week. This will encourage source segregation and will reduce chances of materials getting mixed. Another advantage is that it will improve the efficiency of collection and transportation.

ii. People who do not have door to door facility should be allowed to deposit segregated non bio degradable discards at the nearest MRFs or restricted drop off points by paying a tipping fee. Resource Use Centre can buy reusable / recyclable discards directly from public and can levy tipping fee for those materials which do not have recycling / reuse options.

iii. Resource Recovery Centre can extend their field service on payment to

'haul' discards generated in special occasions / events such as marriage, fairs, demolition of buildings etc.

9.2.5 Resource Recovery Parks

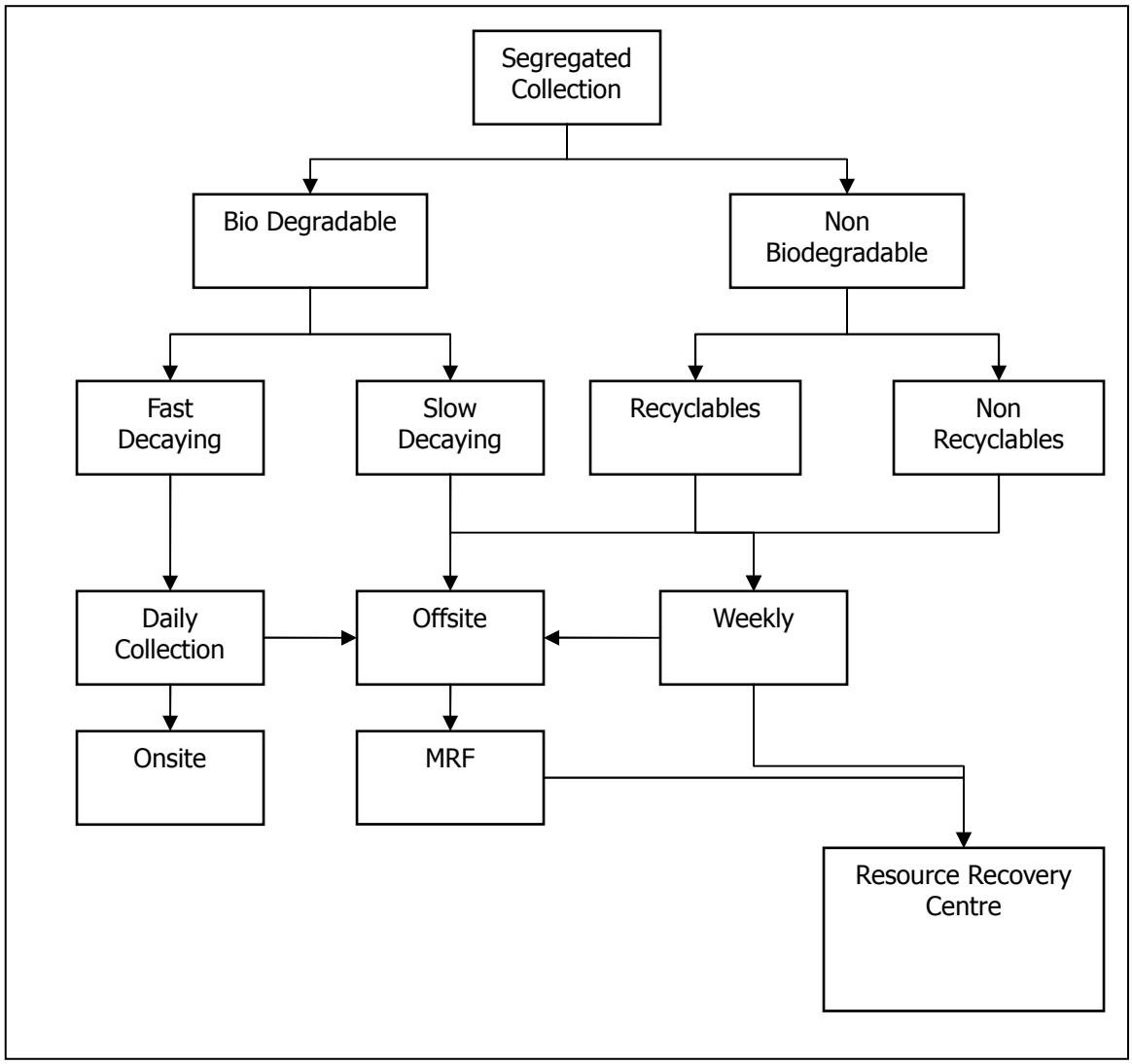
In the State level at selected commercial hubs, the Government can establish Resource Recovery Parks where innovative entrepreneurs can set up their recycling centres or processing centres. It can also be a hub for traders who can access infrastructure facilities like shredding, baling, storage etc, in exchange of a fee for improving and widening their scrap trade. Suggested recycling industries and processes as follows:

- Hand made paper making
- Floor Mat making from waste cloths
- Cushions and pillows from waste cloths
- Biomass briquetting from tree trimmings, saw dust..
- Bio char manufacturing from coconut leaves and tree trimmings
- Electrical and electronic equipments repairing units
- Second hand good stores
- Bottle banks for used glass and plastic bottles

9.3 Proposed system of discard flow for incorporating Resource Recovery

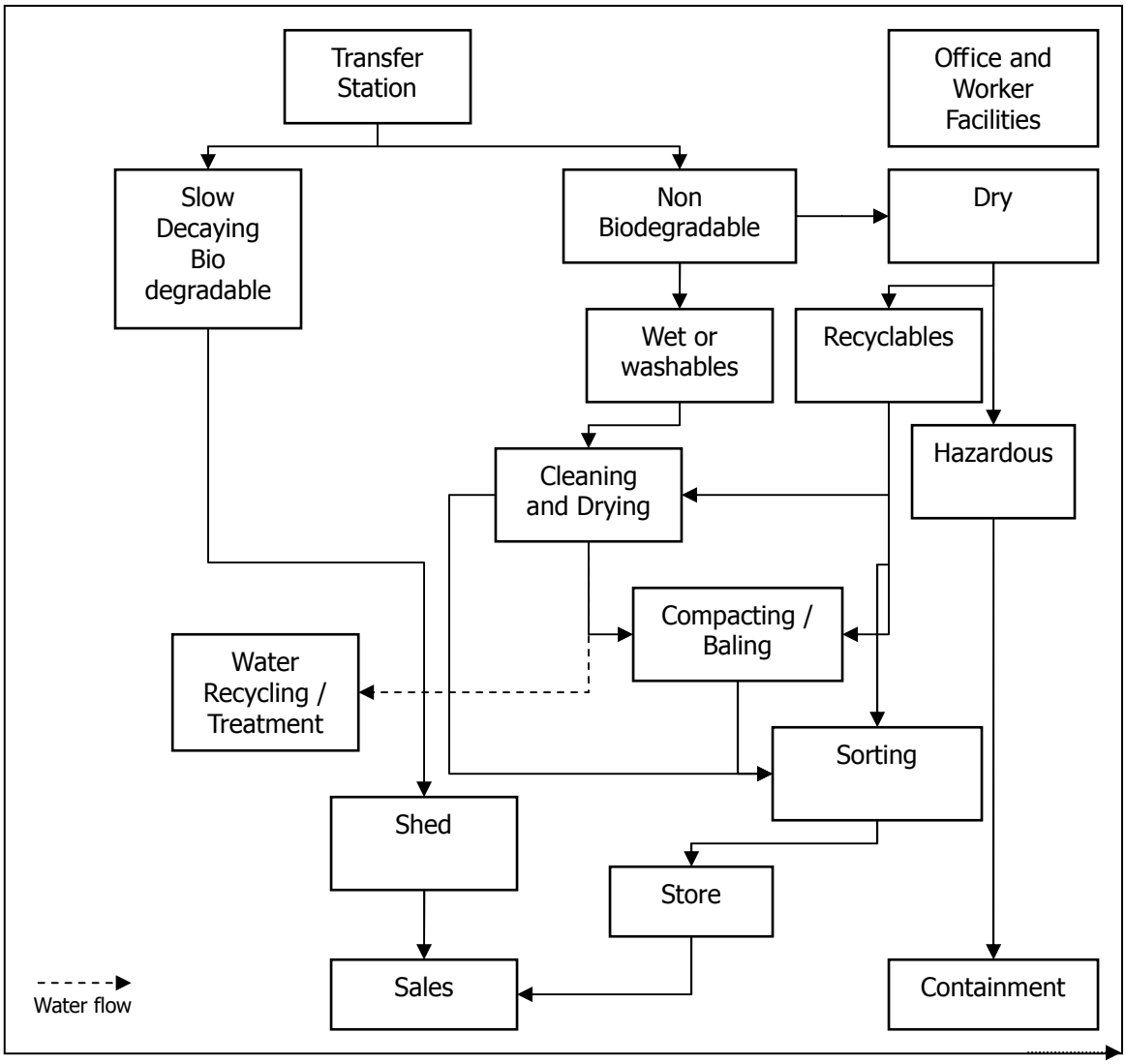
Flow Chart – 1

Discard flow in a Resource Recovery Centre



Flow Chart - 2

Process in a Resource Recovery Centre

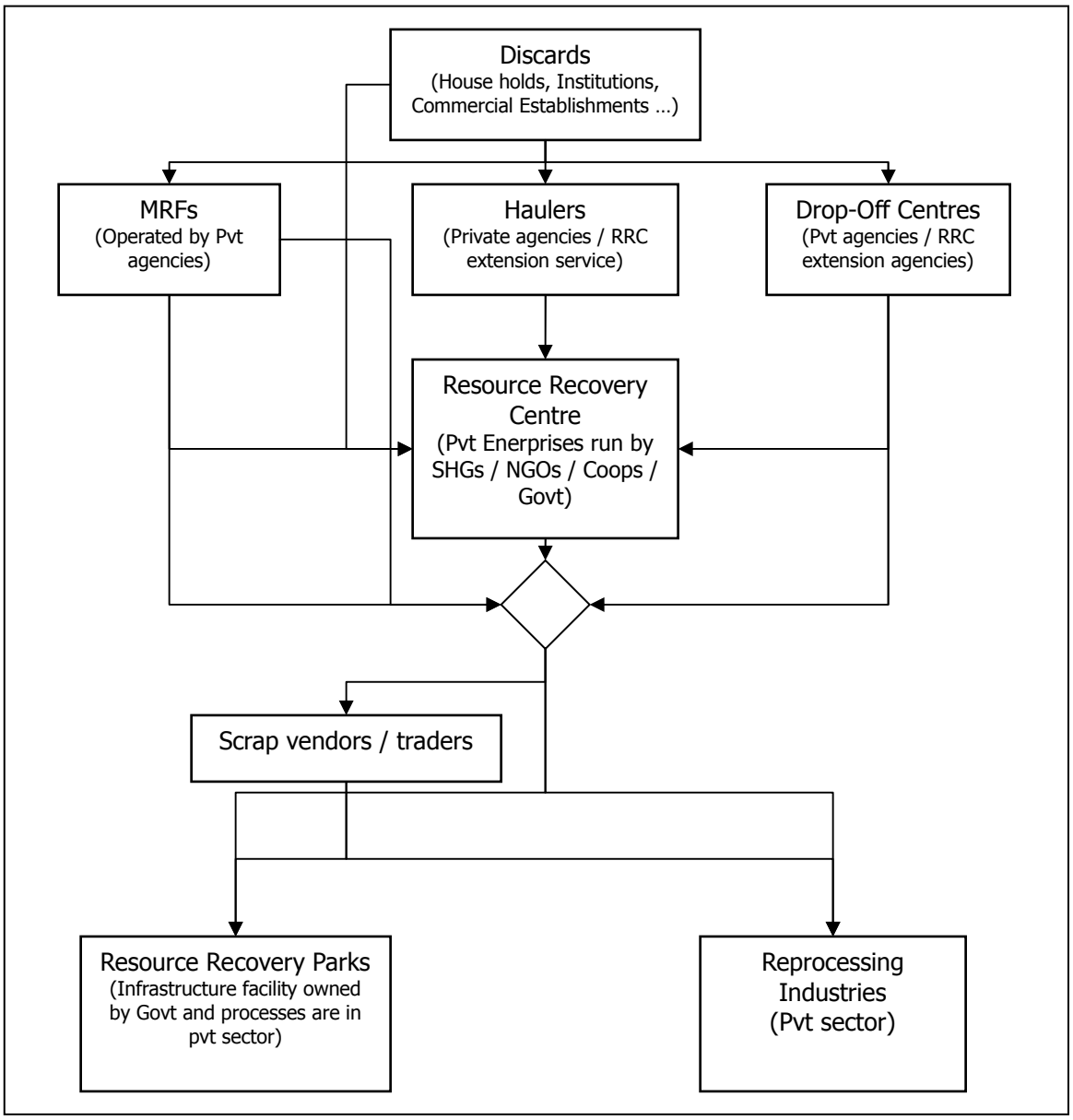


9.4 Institutional

9.4.1 The suggested Institutional mechanism for the operation of Resource Recovery for a LSG is given below;

Flow Chart – 3

Institutional mechanism for resource recovery



9.5 Technology

9.5.1 MRFs and RRCs may need basic tools and machines for disassembly. Plastic shredders and baling machines may be required at RRCs and RRPs.

9.5.2 The operators / workers engaged in resource recovery should be given special training to improve their capacity and efficiency

9.6 Finance

9.6.1 Door to door collection of discards on payment have to be established.

9.6.2 Tipping fee can be levied from those who are not linked to any existing door to door collection system and want to dispose of their discards once in a while.

9.6.3 MRFs should be financed by concerned stake holders where LSG may give subsidies

9.6.4 RRC needs investment from LSG since it is the part of LSG's Municipal Solid Waste Management programme. The operation can be in private sector like Cooperative Societies, Self Help Groups, NGOs or private entrepreneurs.

9.6.5 Resource Recovery Parks need investment from the State Government since it involves higher infrastructure and land costs.

9.6.6 RRCs can advance small amount (Rs.1000 – Rs.5000) to accredited waste pickers / vendors for procuring recyclable materials for RRCs.

9.7 Awareness

9.7.1 Extensive and continuous awareness programmes have to be organised to encourage resource recovery. The awareness programmes should focus on a behavioural change in public to support the resource recovery programmes and mechanisms.

9.8 Documentation

9.8.1 Reports and accounts regarding the flow and movement of discards in

terms of quantity and value should be documented as management information system for future expansion and decision making.

9.8.2 It is recommended to have periodical social audit of the Resource Recovery Programmes which will improve the efficiency and will help in taking corrective measures.

10. Annexure

10.1

Table - 33							
Sample units and locations for discard Characterisation Study							
Category & Locations	City Corporation			Other LSGs including Municipalities			Grand Total
	Number of Samples	Number of Locations	Total Number of Samples	Number of Samples	Number of Locations	Total Number of Samples	
House Holds (Thiruvanantha puram, Kochi, Mararikulam North, Kumily, Kannur, Mananthavady)	10	2	20	5	4	20	40
Commercial Establishments (Thiruvanantha puram, Kochi, Mararikulam North, Kumily, Kannur, Mananthavady)	5	2	10	5	4	15	25
Institutions (Thiruvanantha puram, Kochi, Mararikulam North, Kumily, Kannur, Mananthavady)	2	2	4	1+	4	6	10
Markets (Neyyattinkara, Maranalloor, Thiruvanantha puram, Kollam,	2	3	6	1	5	5	11

Karunagappally, Kayamkulam, Alappuzha)							
Public Places (Neyyattinkara, Thiruvananthapuram, Kollam, Kayamkulam, Alappuzha)	1	2	2	1	3	3	5
Total			42			49	**91**

10.2

Table - 34			
Discards Recycle / Reuse Potential and Resource Recovery function Study			
Category	**Number of Locations**	**Number of Samples**	**Total Number of Samples**
Wholesale markets of Discards / Second hand goods	8	1+	18
Rag pickers / Primary collectors	6	3	18
Total			**36**

10.3

Table - 35	
List of materials on which data was collected	
1	News Paper / Magazines
2	Waste Paper
3	Card board
4	Glass bottles
5	Glass pieces
6	Iron and Steel
7	Copper / Brass
8	Aluminium
10	Pet Bottles
11	Plastic carry bags
12	Plastic wrappers/ covers
13	Milk sachets
14	Thick Plastic
15	Plastic cups and plates
16	Thermocol
17	Poly Vinyl Chloride (PVC) items /bags
18	Plastic foot wear
19	Other plastics
20	Sanitary Napkins
21	Tree trimmings
22	Furniture parts
23	Wood logs
24	Coconut shells
25	Coconut husk
26	Cloths / fibres
27	Tube lights / CFLs
28	Light bulbs
29	Torch Cells
30	Chemicals
31	Others

10.4

Table - 36			
Average Number of house holds per district and per Local Self Government			
Districts	**No. of House Holds**	**No. of LSG**	**Average No.of House holds**
Thiruvananthapuram	787729	83	9490.7
Kollam	593626	73	8131.9
Pathanamthitta	284269	58	4901.2
Idukki	265347	53	5006.5
Kottayam	450201	79	5698.7
Alappuzha	134311	78	1721.9
Ernakulam	845422	97	8715.7
Thrissur	647353	99	6538.9
Palakkad	548586	95	5774.6
Kozhikkode	602516	83	7259.2
Wayanad	166763	26	6414.0
Malappuram	617393	104	5936.5
Kannur	456625	88	5188.9
Kasaragod	237952	41	5803.7
Total	**6638093**	**1057**	
State Average	**474149.5**		**6184.5**
As per provisional figures from 2001 census			

10.5

Table - 37		
Average Price list of Non bio and slow decaying materials		
	MATERIAL	Rs. / Kg.
1	Newspaper	7.36
2	Magazines	5
3	Waste paper	5.8
4	Card board	5.21
5	Glass bottles	0.75
6	Glass pieces	0.7
7	Iron	13.43
8	Steel	25.8
9	Copper	270
10	Aluminum	73.33
11	Brass	192.5

12	Pet Bottles	5.5
13	Plastic carry bags	2
14	Milk sachets	7
15	Thick Plastic	12.17
16	Plastic cups and plates	6
17	PVC	19
18	Other plastics	3
19	Tree trimmings	1
20	Wood logs	14
21	Coconut shells	3.60
22	Coconut husk	1.6

10.6

Table - 38

List of Recyclers Re-Processors

Material	Kerala	Tamil Nadu	Others
Paper		1)Sripathi Paper and Board P Ltd Sukravar Patti Aanai Kuttam P.O Sivakasi	
Plastic	1)Global Light Enterprises Eranipalam,Chala-Nadal Byepass road Kannur Mob:09249723431	1)Madura Polymers Mfg:HDPE/PP Bags,Woven Sacks 164-A,Alagar Kovil road,Near Suriya Nagar,Madurai-625014 Mob:09894629264,09443129211 Tel:0452 2566645,2564186 2)Pandiyan Plastic Industries Mfrs:LD,HMHDPE,P.P&LLD Polythene bags Plain & Printed Office: 34,West Avani Moola Street,Madurai-625001,PH: 0452 4375560,Fax:0452 2346937 Factory:99,SIDCO Industrial Estate,Kappalur,Madurai-625008	1)Safeways Shipping pvt Ltd(PET Bottles),Hyderabad K.K Kaushik Managing Director Mob:09912069427

Metals	1)Vanchinad Forgings Pvt Ltd.(Steel Rolling Mill) Mfrs:M.S Bars,Rods,Angles,TMT Rebars NIDA-Kanjikode,Palakkad,Kerala-678621 Ph:0491 2566912 Mob:09446491257 2)PPS Steels Kerala Pvt Ltd Reg Office VIII/864,865,NIDA, Kanjikode,Palakkad,Kerala-678621	1)Aruna Alloy Steels Near to PRB Granite ,Narasimgapatti,Melur Highway Madurai Tel: 0452 2433321,2433323 Head Office Aruna Alloy Steels Othakadai,Melur Road,Madurai 2)MEPCO-The Metal Powder Company Thirumangalam-625706 Tel: 04549 281995 N.MuthuKamatchi(Associate Manager) Mob:09585506187 3)Matha Steels Viragannur Mob:09842962442	
Glass	1)Rajeswari Glasswares (Dealers in Empty bottles) Door NO:33/1343,Chalikkavattom, SVennala P.O,Cochin-682028 Tel : 0484 2803583,2807877,2368706 Fax:0484 2803583 Mob:09539063784		
Others			

10.7

Table -39	
List of Scrap Traders	
Kerala	**TamilNadu**
1)Kumaraswamy Aryashala,Trivandrum Mob:09447581721 2)Taju Attakulangara ,Trivandrum Mob:09447587760 3)Nagasundar Byepass Road ,Attakulangara,Trivandrum Mob:09744445565 4)Ansari Andamukam,Payikkada,Kollam Tel:0474 2748651 5)Mohammed Ibrahim Andamukkam,Kollam Mob:09387324411 6)Radha Singh Thamarakulam Road,Kollam Mob:09809784764 7)Ibrahim ML road,Chanthakala,Kottayam Mob:09895604157 8)Shaji ML Road,Kottayam Mob:08086384235 9)Rasheed K.H Kochi Market Mob:09349274481 10)Mufeed Kokala,Thrissur Mob:9946213149 11)Mohammed Koya CH Fly over,Calicut Mob:9447929693 Tel: 0495 2768409 12)Rashid Manathavady,Wayanad Mob:9895510468 13)Nizar .K Thalaserry,Kannur Mob:09447488342 14)Sanith Traders Stadium Complex Kannur Tel : 0497 2700315 15)Shaji Thevakkara,Kannur Mob:09846175185 16)Sathar AG Road,Calicut Mob:9447174646	1)Matha Waste Paper Store Prop:Y.Soosai Antony HSIDS Complex,57/4,MUnichalai Road,Madurai -625009 Mob: 09842162442 Tel : 6585176,2622442,2310858 2)Ramanathan (Paper) Mob:09442090070

10.8

Table - 40			
List of Suppliers of equipments and machines			
#	**Name of the Equipment**	**Supplier**	**Estimated Cost**
1.	Electronic Weighing Machine	Accurate Trade Links T.C 26/640(3),Future Centre, Ootukuzhi Road, Trivandrum 1 Ph: 0471 2334553,6541047 Fax:0471 2327899 Mob:9847141007 Email:accuratetradelinks@gmail.com www.accuratetradelinks.com	
2		2)P.M.S Stores Chalai,Thiruvanathapuram Ph:0471 2470634	50kg- Rs. 5500+Tax 100kg- Rs. 7800+Tax 125kg- Rs. 8500+Tax 300kg- Rs. 10800+Tax
3		Ashwyl Ph:0487 2325541	
4	Plastic Recycling Machines Srew type blow Moulding Hydraulic Injection Moulding Injection Moulding Plastic Scrap Grinder	Mani Engineering Works 133b,SubramaniamRoad R.S.Puram,Coimbatore-2 Ph:0422 2471540 Mob:9894071540	 Rs. 1,10,000+Tax Rs. 1,45,000 + Tax Rs. 42000 +Tax Rs. 50000+Tax
5	Die Clapping	Sri Srinivasa Agencies 13-C,Kaleeswara Mill Road,Coimbatore-641009 Ph:2231922,2387098	Rs. 29,500 +Tax
6	Hand Operated Injection Moulding	Appus Plastics 8/746,C,NIDA,Kanjikode 678621 Ph:(O)0491 2567351,(R)2568878	

7	Pulverizer Plastic Injection Moulding Component injection Type bottles Injection Blow Moulding	Vision Plast 615c,Attapallam,Pampamp allam	
8	Vertical Baling Machine	Santec Group Corporate Office Plot No:92/6,Road No.1, Mundka Extn,Delhi-110041 Ph:11 28343082/3,28342825 Fax:11 28343081,27316436 Email:uksangal@santecind ia.com, santec@bol.net.in sales@santecindia.com	Rs.7,00,000+Tax
9	Vertical Baling Machine	Advance Hydra U-Tech Pvt Ltd B-91 Mangol Puri Industrial Area,Phase-2,N.Delhi-34(India) Ph:27026728,27015528,27 027130 Fax:91-11-27017409 Mob:9958596001 Email:advance@bol.net.in Website:www.advancehydr autech.in	
10	Vertical Bailing Machine Shredding Machine	Jawa Equipments,Jothivilla Building New No 68, Anupparpalayam,Coimbato re-641009 Mob:9894146685	Rs. 7,00,000+ Tax Rs. 85,000 + Tax

10.9 Drawing of Material Recovery Facility

10.10 Drawing of Resource Recovery Facility

Reference

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2. Manual on Solid Waste Management, Dr:Sneha Palnitkar,All India – Institute of Local Self Government-Mumbai 29th May 2000

3. A Muncipal Solid Waste Management System for Thiruvnathapuram city-Jessey M Joseph-University of Kerala-1993

4. Population Census 2001

   a)PCA(District,Taluk & Village level 2001)

   b)PCA(Panchayath 2001)

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Notes

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