

CEECC TALK BEAT PLASTIC POLLUTION

Department of Environmental Economics Centre for Environmental Economics & Climate Change (CEECC)

RSVP: PIDE Society of Environmental Economists

Handling Plastic Waste in Pakistan

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Good Waste Management – Why Bother?

Urbanization and population booms mean, waste management is now needed for several reasons:

- Public Health
- Preventing Environmental Pollution
- Resource Conservation
- Managing Related Hazards
- Mitigating Nuisance









Source: Mohamed El-Newehy 2016

Source plastics waste materials



CHARACTERISTICS OF MSW STREAMS DEPENDING ON INCOME (UNDESA, <u>2010</u>)





Source: Patel, Scientific American 2018

Classification of Plastics





bottles, medicine jars, rope, clothing and carpet fibre. High-Density Polyethylene products are very safe and are not known to transmit any chemicals into foods or drinks. HDPE products are commonly recycled. Items made from this plastic include containers for milk, motor oil, shampoos and conditioners, soap bottles, detergents, and bleaches. It is NEVER safe to reuse

an HDPE bottle as a food or drink container if it didn't originally

Polyethylene Terephthalate sometimes absorbs odours and

flavours from foods and drinks that are stored in them. Items made from this plastic are commonly recycled. PET(E) plastic is used to make many common household items like beverage



Polyvinyl Chloride is sometimes recycled. PVC is used for all kinds of pipes and tiles, but is most commonly found in plumbing pipes. This kind of plastic should not come in contact with food items as it can be harmful if ingested.

Low-Density Polyethylene is sometimes recycled. It is a very healthy plastic that tends to be both durable and flexible. Items such as cling-film, sandwich bags, squeezable bottles, and plastic grocery bags are made from LDPE.

Polypropylene is occasionally recycled. PP is strong and can usually withstand higher temperatures. It is used to make lunch boxes, margarine containers, yogurt pots, syrup bottles, prescription bottles. Plastic bottle caps are often made from PP.

Polystyrene is commonly recycled, but is difficult to do. Items such as disposable coffee cups, plastic food boxes, plastic cutlery and packing foam are made from PS.

contain food or drink.



Code 7 is used to designate miscellaneous types of plastic not defined by the other six codes. Polycarbonate and Polylactide are included in this category. These types of plastics are difficult to recycle. Polycarbonate (PC) is used in baby bottles, compact discs, and medical storage containers.

Source: Ryedale Government, UK









Plastic Waste Management



Continuing on Circular Economy



Plastic Waste Management



Plastic Rules

18th Amendment

EPD Punjab Prohibition on manufacture, sale, use and import of polythene bags under 15 microns thickness, 2002

Updated again in 2004

EPD Sindh

Prohibition of Non-degradable Plastic Products (Manufacturing, Sale and Useage) Rules 2014

EPD KPK and Baluchistan – No rules

Are these enough? What other rules should there be? What goes into policy analysis?

Biodegradability and Landfills

Are there any laws or standards on biodegradability – only in Sindh

Are there any facilities such as landfills and dumpsites being tested and defined against specific local characteristics?

PRESS RELEASE 1st FEBRUARY 2013

PAKISTAN HAS NOT BANNED PLASTIC BAGS

IT HAS REQUIRED THEM TO BE OXO-BIODEGRADABLE PLASTIC

'Plastic-eating' fungus discovered in Islamabad garbage dump

	Generation	Rate	Waste Generated						
City	Kg/capita/day	Kg/h/day	Tons/day	Tons/year					
2014 Year									
Karachi	0.49	-	12000	1,44,000					
Hyderabad	0.212	1.284	300	109.500					
Peshawar	0.629	29521.31	781	282082.4					
Bannu	0.68	68000	68	24480					
Quetta	0.56	-	1250	456,250					
Sibi	1.276	2.8	46	16,790					
Faisalabad	0.50	3.52	1759	642035					
Lahore	0.56	4.032	5000	1825000					
Bahawalpur	0.50		398	145132					
Source:- Tehsil Municipal Admin	istration of each district								

		Table 1.5	Waste Gene	eration Estim	ates
S.No	Cities	Generation Kg/c/day	Rate Kg/h/day	Waste Tons/day	Generated Tons
1	Gujranwala	0.469	3.424	824.0	300
2	Faisalabad	0.391	2.737	924.3	337
3	Karachi	0.613	4.291	6,450.0	2,35
4	Hyderabad	0.563	3.941	975.7	356
5	Peshawar	0.489	3.423	809.3	295
6	Bannu	0.439	2.941	36.0	13,
7	Quetta	0.378	2.646	378.0	137
8	Sibi	0.283	1.896	17	6,2
	Total			10,414.3	3.60

Source: PBS

Compendium

on Environment

2015

Source: National SWM Guidelines 2005

									Table B-15: Physical C	ompos <mark>it</mark> ion of Was	ste			
									Cites/ →			2014 Year		
									Waste ↓	Karachi	Hyderaba	d Peshawa	Bannu	Sibi
	m .11	1.0.1	DI ' I	0					Plastic & Rubber	<mark>6.40%</mark>	1	5.00 16	.6 10	9.00
	Table	91.6-1	Physical	Compos	sition of	waste	(% weight)	-	Metals	0.75	0	0.90	1 3	1.1
Itoma	CWA	FGD	TAN	чvn	DWD	BNI		SBI	Paper	4.10		7.50	.2 7	1.4
Items	GWA	FSD	ITIT	ши	1 WIL	DIVU		5D1	Cardboard	1920.	(m. 1997)	5.40 1	.8 4	1.80
Plastic &	F 00	1.00	0.40	0.00	9.70	7 00		F F 0	Rags	8.40	1	9.60 2	.1 4	7.80
Rubber	5.00	4.80	6.40	3.60	3.70	5.30	8.20	7.70	Glass	1.50		4.50 1	.8 3	1.70
Metals	0.30	0.20	0.75	0.75	0.30	0.30	0.20	0.00	Board Papers			9.60 1	.6 1	1.48
Paper	2.50	2.10	4.10	2.40	2.10	3.30) 2.20	2.00	Food Waste	21.00	4	4.10 26	.7 8	11.90
Card board	1.80	1.60	2.40	1.50	1.90	1.60) 1.30	1.40	Animal Waste	3.40		3.00 3	.3 4	5.32
Rags	3.20	5.20	8.40	4.70	4.30	2.30) 5.10	5.30	Leaves Grass etc.	14.00	3	8.40 10	.6 14	18.21
Glass	1.50	1.30	1.50	1.60	1.30	1.20) 1.50	2.40	Wood	2.25	14	3.40 1	.3 1	1.02
Bones	3.20	2.90	3.00	2.00	1.70	0.20) 2.00	0.80	Debris	3.50	4	-		20.00
Food Waste	14.70	17.20	21.00	20.00	13.80	16.3	0 14.30	8.40	Stones	2.43	1	7.10	10 4	9.1
Animal									Others	2.00				-
Waste	1.00	0.80	3.00	5.80	7.50	2.40) 1.70	4.00			2014 Ye	ar		
Loovog									Type of waste	Bahawalpu	III	Type of wast		Lahore
Leaves,	12.80	15.60	14.00	13.50	13.60	14.7	0 10.20	14.50	Plastic & Rubber	2.6	8.20	Combustibles		3.842
Wood	0.90	0.70	0.05	0.05	0.00	0.50		1.00	Metals		0.30	Diaper		4.632
wood	0.80	0.70	2.20	2.20	0.60	0.50) 1.00	1.00	Paper	-	2.10	ElecElectro.		0.078
Fines	47.50	43.00	29.70	38.90	42.00	45.4	0 44.00	44.80	Cardboard	3 (C.	3.00	Glass		0.696
Champer	5 70	4.00	2 50	2.00	7.20	0.50	7.80	7 70	Glass		3.50	Biodegradable		64.776
Stones	0.70	4.60	3.00	5.00	1.30	6.50	1.80	1.70	Board Papers		0.60	Metals		0.07
Source: EPM	C Estima	ates 1996							Food Waste		0.90	Non-Combust		3.858
									Animal Waste		16.50	Paper-Card		2.492
									Leaves Grass etc.		16.50	Pet		0.134
	-								Wood		02.50	Nylon		9.53
		Sou	rcoi				Sourco: DE		Fines		3.00	Plastics		0.61
		30u	ice.				Source. PE		Stones		40.90	Tetrapak		0.97
		Nationa	al SWM				Compendiu	ım				Textile		7.096
		Cuidalia		-			on Environme		Courses Labors Marte M	anneat Correction		Total		100.00
		Guidelin					OII EIIVIIONII		Tehsil Municipal Adr	gement Company ninistration of each distr	icts			
							2015							

Waste and Recyclable Materials Flows through Pakistan



Source: Asma Majeed et al. 2016

Waste Characterization of Gujranwala City



Figure 3: Physical composition of waste generated from different sources (a) commercial restaurants; (b) commercial sources; (c) market sources; (d) institutions; (e) street sweeping; (f) park areas.

Waste Characterization of Lahore per LWMC – 2014



The biggest stakeholders needed for current waste reduction

- 1. Biodegradable composting
- 2. Nylon
- 3. Textiles
- 4. Combustibles and Non-Combustibles
- 5. Diapers



Average amount of plastic in LWMC waste streams

Plastic – 45.8 tons/day * PKR 25,000/ton Plastic Revenue – PKR 1,145,000/day PET – 9 tons/day * PKR 30,000/ton PET Revenue – PKR 270,000/day

Generic waste flows for Pakistani Cities



Generic waste flows for Pakistani Cities



Recycling Processors Purchasing Habits



Source: Urban Unit Report on IWPs Integration into LWMC 2017

Estimation of # of IWPs in Lahore

Area	Av. # of families	# of people*	Towns Division Map of Lahore
Mehmood Booti	150	1,320	Scavengers Detail with Towns Sr No Locations
Scheme 2 Gujjar Pura	80	704	1 Ravi Road Ravi Town 2 Scheme #2 Gujjar Pura Shalimar Town 3 Bakar Mandi Guberg Town 4 Ferozepur Road Bank Stop Nishter Town
Bakar Mandi	30	264	5 Hando Guijiran 6 Bajir Stop 7 Mehmood Booti 8 Guijar Colony
Dubai Chowk	38	334.4	9 Raiwind Road Nishter Town 10 Babu Sabu Samnabad Town 11 Cross the Motorway Allama Igbal Town 12 Sabdara Ray Town
Gujjar Colony	100	880	13 Jalio Mor Wehge Town 14 Dubai Chowk Cantt Area 15 Jutt Chowk Cantt Area
Jutt Chowk	75	660	
Bajri Stop	150	1,320	Legend
Babu Sabu	33	290	Lahore_New_UCS Town Alama Inhal Town
Across the Motorway	33	290	Aziz Bhatti Town DGBT
Shahdra	33	290	Gulberg Town Nishter Town
Ravi Road	33	290	Ravi Town Samnabad Town Sholiner Town
Ferozpur Road, Bank Stop	33	290	Wahga Town Scavengers locations
Jallo Mor	33	290	Cantt_Area
Hando Gujjar	33	290	Source: GODH Data 25/04/2017
Raiwind Road	33	290	*Calculated from Av. Family size of IWPs
Total	887	~7,800	If using 6 persons/urban family from PBS, results would be 5,4

IWPs in Joint Family System



Source: Urban Unit Presentation 03/04/2017



Category	# of People					
Total # of people in shared dwellings	1,000 +					
Av. # of people in shared dwellings	8.8					
Av. Ranges across all towns	6.3 - 13.9					
Median across all towns 7.4						
Max # of people in shared 25* dwellings						
Source: Urban Unit IWPs Data 31/10/2016						

*Outliers not considered (>25)

IWPs Collection Capacity & Income by Town



- Average waste collected by IWPs 45 kg/day
- Not possible to disaggregate by waste types data N/A
- 8,000 IWPs collect ~ 360 tons/day

Source: Urban Unit IWPs Data 31/10/2016



- Middle Dealers prefer to buy, in order: Plastics, Iron, Paper, Food Waste, E-waste and Aluminum
- Focus should be on Plastics and Paper as they are the largest recycling industries in Lahore. Secondary focus on Iron, Aluminum and E-waste is important, given the high prices of these items in the market
- A variety of people sell their waste to Middle Dealers by providing value-added collection, segregation and cleaning
- Beyond IWPs, maids and commercial aspects must be dealt with also



Source: Urban Unit MDs Data 31/10/2016



Source: Urban Unit MDs Data 31/10/2016



Source: Urban Unit MDs Data 31/10/2016

The Economic Benefit of Informal Recycling to the Formal Waste Management System

Towns	Population (PDS 2015)	Waste Generation S3* (KG/dav)	Combined ALB OzPak Transportation + Collection Cost/day	Additional Waste Burden Reduced by Informal Recycling @ 21% (KG/day)	Additional Waste Burden Reduced by Informal Recycling @ 27% (KG/day)	Reduction in Collection and Transportation Cost/day @ 21% Informal Recycling	Reduction in Collection and Transportation Cost/day @ 27% Informal Recycling
Aziz Bhatti Town	623,000	498,400	\$8,223.60	134,891	184,340	\$2,225.70	\$3,041.61
DGBT	1,070,000	856,000	\$14,124.00	231,675	316,603	\$3,822.63	\$5,223.95
Gulberg Town	859,000	687,200	\$11,338.80	185,989	254,170	\$3,068.82	\$4,193.80
Iqbal Town	853,000	682,400	\$11,259.60	184,690	252,395	\$3,047.39	\$4,164.51
Nishtar Town	1,104,000	883,200	\$14,572.80	239,036	326,663	\$3,944.10	\$5,389.94
Ravi Town	1,749,000	1,399,200	\$23,086.80	378,691	517,512	\$6,248.40	\$8,538.95
Samnabad Town	1,086,000	868,800	\$14,335.20	235,139	321,337	\$3,879.79	\$5,302.06
Shalamar Town	585,000	468,000	\$7,722.00	126,663	173,096	\$2,089.94	\$2,856.08
Wagha Town	720,000	576,000	\$9,504.00	155,893	213,041	\$2,572.24	\$3,515.18
Cantt	892,000	713,600	\$11,774.40	193,134	263,034	\$3,186.72	\$4,354.92
Total	9,541,000	7,632,800	\$125,941.20	2,065 T/D	2,823 T/D	\$34,085.74	\$46,580.99

*S3 refers to Scenario 3, assuming a waste generation rate of 0.8 kg/capita/day. This figure is seem as an update on the 0.5-0.65 kg/capita/day that was previously used to calculate economic potential. Average of \$16/ton as tipping fee was applied, per LWMC GIS team. Although this figure is also based on 2009 data collection in AIT, and is likely in need of an update as well. Source: Asim, Batool & Chaudhry 2012

Economic Valuation of Informal Recycling

Previously priced at \$4.5 million in 2005 and \$15.3 million in 2016

Same methodology: Price * Quantity (WCS + Middle Dealers Data)

Current capacity of IWPs is 45 kg/person/day

- 100% of LWMC + subcontractors Zonal Offices Survey stated: "Only issue with IWPs is container mess"
- LWMC as a policy does not want to disrupt their economic incentive, but needs that issue resolved

Middle Dealers capacity is ~ 200 kg/MD/day

- At minimum the Middle Dealers should be registered with the TMA
- However,
- Follow up with TMA, DC and Company Secretary awaited

Large Scale (Centralized) Material Recovery Facility – Proposed for LWMC Operation

Assumption Type	Assumption Amount
Population	9,545,000 persons
Waste Generation Rate	0.82 kg/capita
Collection Efficiency	85%
Waste Components	Paper-Cardboard, TetraPak, Glass, Plastic, PET, Metals and E-Waste
Waste Characterization	See LWMC WCS 2014
Recovery Rate	50%
Price of Recyclable Materials	See LWMC WCS Data Sheet 2017
Man-hours for MSW segregation	15
IWPs work day	7 hours/day
Labor Wage and Benefits	PKR 19,000/month or PKR 22,000/month
Scenario 1-3	IWPs Minimum, Average and Maximum Selling Prices

Large Scale (Centralized) Material Recovery Facility – Annual Revenue versus Annual Labor Cost

Scenario	Annual Revenue (PKR)	Annual Labor Cost (PKR 19,000/month) Labor = 325	Ratio LC/R	Annual Labor Cost (PKR 22,000/month) Labor = 325	Ratio LC/R
1 – IWPs Minimum Selling Price	489,104,290	74,027,854	15.1%	85,716,463	17.5%
2 – IWPs Average Selling Price	897,141,444	74,027,854	8.3%	85,716,463	9.6%
3 – IWPs Maximum Selling Price	1,305,178,598	74,027,854	5.7%	85,716,463	6.6%

Waste Diversion Rate = 2% or 151 tons per day

The Economic Benefit of Informal Recycling to the Formal Waste Management System

				Additional	X		Reduction in
			Combined ALB	Waste Burden		Reduction in	Collection and
			OzPak	Reduced by	Additional Waste	ollection and	Transportation
		Waste	Transportation	Informal	Burden Reduced by	Fransportation	Cost/day @
	Population (PDS	Generation	+ Collection	Recycling @	Informal Recycling	Cost/day @ 21%	27% Informa
Towns	2015)	S3* (KG/day)	Cost/day	21% (KG/day)	@ 27% (KG/d-y)	Informal Recycling	Recycling
Aziz Bhatti Town	623,000	498,400	\$8,223.60	134,801	184,340	\$2,225.70	\$3,041.61
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Small Scale (Decentralized) Material Recovery Facilities – Proposed for Model Junkyards

Waste type	Households (%)	Commercial (%)	Institutional (%)	Overall (%)
Biodegradable	67.0	67.5	45.6	64.8
Combustibles	3.2	2.3	1.5	2.1
E-waste	0.1	0.6	0.10	0.3
Glass	0.7	0.6	1.8	0.8
Hazardous waste	0.8	0.6	13.6	1.5
Metals	0.1	0.02	0.30	0.10
Other	7.6	4.0	7.3	5.3
Paper-cardboard	2.8	1.9	6.1	2.4
Plastics	0.8	0.4	1.3	0.9
Plastic bags	9.00	13.7	11.7	11.7
Tetra pak	1.0	1.0	2.6	1.0
Textile	6.9	7.4	8.1	9.1
TOTAL	100.0	100.0	100.0	100.0

Source: Masood, Barlow and Wilson 2014. Originally from ISTAC 2012

Small Scale (Decentralized) Material Recovery Facilities – Proposed for Model Junkyards

Assumption Type	Assumption Amount
# of Small Scale MRFs	10
Segregation and Storage Capacity	10 tons/day
21% Recycling above 7,000 tons/day collected by LWMC	1,470 tons/day
27% Recycling above 7,000 tons/day collected by LWMC	1,890 tons/day
Waste Components	Plastics and Plastic Bags, Paper-Cardboard, Glass and Metals
Waste Characterization	See LWMC WCS 2014
Recovery Rate	75%, since partially segregated material
Price of Recyclable Materials	See LWMC WCS Data Sheet 2017
Man-hours for MSW segregation	8 man-hours/ton/day
IWPs work day	7 hours/day
Labor Wage and Benefits	PKR 19,000/month or PKR 22,000/month
Scenario 2	IWPs Average Selling Prices

Small Scale (Decentralized) Material Recovery Facilities – Total Recycling Amounts

For one MRF with a capacity of 10 tons/day. Labor needed = 11/day. Recovery rate = 75%

Recyclable	Percentage of	Materials in 10	Price/Ton	Annual
Material	Lahore MSW	tons (tons)	(PKR)	Recyclable
				Material
				Revenue (PKR)
Plastics	13%	0.98	27,500	9,786,563
Paper	2%	0.15	11,625	636,469
Glass	1%	0.08	2,500	68,438
Metals (Iron and	0.1%	0.01	55,000	150,563
Aluminum)				
Total	16.1%			10,642,031

Waste Diversion Rate = 12% or 10 tons per facility per day

Small Scale (Decentralized) Material Recovery Facilities – Annual Revenue versus Annual Labor Cost

Scenario	Annual Revenue (PKR)	Annual Labor Cost (PKR 22,000)	Ratio LC/R (PKR 22,000)	Annual Labor Cost (PKR 19,000)	Ratio LC/R (PKR 19,000)
2 – IWPs Average Selling Price	10,642,031	3,017,143	28%	2,065,714	19%

Waste Diversion Rate = 12% or 10 tons per facility per day

Model Junkyard Bye-Laws 2012

RESPONSIBILITIES OF THE LICENSEE.-

The licensee shall ensure that:

- (i) the junk is kept under a proper covering or shed;
- (ii) premises is kept clean, ventilated, well-lit, well drained and junk appropriately stacked;

Proposed Amendments

- Inspection Template
- Monitoring Template
- Government facilitation and decision making tools

Extended Producer Responsibility/Producer Responsibility Organizations

- (iii) the size of stacks should not obstruct inspection of junkyard around the year;
- (iv) as far as possible, junkyard shall have pedestrian passages between stacks to facilitate inspection;
- (v) all junk is kept empty and turned upside down to prevent water retention;
- (vi) water from coverings and junk kept outdoor is drained immediately after rain;
- (vii) all depressions in junkyard are filled to prevent water pooling;
- (viii) timely preventive measures are taken and, where necessary, larviciding and fumigation is carried out during mosquito breeding seasons; and
- (ix) all junk is kept dried around the year.

Urban Unit Integration Strategy: Pilot a Waste Pickers Cooperative



IWPs specialties

- 1. Door-to-Door Collection
- 2. Sorting and cleaning recyclable materials



Thank you!

Questions