



MUNICIPAL SOLID WASTE MANAGEMENT

Challenges in
Transforming Waste
into Potential
Resource for the
Sustainable Society



MUNCIPAL SOLID WASTE MANAGEMENT

Challenges in Transforming Waste into Potential Resource for the Sustainable Society

Policy Paper

*Developed by TERRE Policy Centre
And
Sampurn(e)arth Environment Solutions*

September 2014.

Shende. R, Banerjee. D, Beattah. L.



Technology, Education, Research and Rehabilitation for the Environment



About TERRE Policy Centre

TERRE Policy Centre is an India based global think-tank and local action-barrack. It is committed to find sustainable solutions that protect the planet by internalizing the development imperatives. Its focus is on energy and food security of our society in the 21st century. Evidence-based policy recommendation and scalability-centered pilot projects are at the core of TERRE's approach. Its motto is 'To think is good but to act is better'.

Not-for-profit, TERRE is partner with United Nations Environment Programme (UNEP) Safe Planet Campaign and Climate and Clean Air Coalition (CCAC).

See: www.terrepolicycentre.com

About Sampurn(e)arth Environment Solutions

Sampurn(e)arth Environment Solutions Pvt. Ltd. envisions a world where waste generation is reduced and transformed into utilizable resources without exploitation of people or the planet. We are working towards breaking the non-cyclic process of waste management which currently involves extraction, production, consumption and dumping or landfilling, resulting in green house gas emissions, ground water pollution and an ever-increasing strain on natural resource.

Sampurn(e)arth focuses on decentralized waste management solutions that engage communities. It is supported by DBS Bank-Singapore and Tata Institute of Social Sciences -India.

See: www.sampurnearth.com

Forward

Poverty, which United Nations General Assembly resolved to reduce by half between 1990 and 2015, is manifested by the sight of a child begging in public places or a woman scavenging in heaps of garbage. Poverty reduction was the very first of the Millennium Development Goals (MDGs) that were targeted by the world community at the dawn of the 21st Century. As the world launches itself towards yet another set of developmental goals, i.e. the Sustainable Development Goals (SDGs) and as the MDGs end their tenure with mixed results, waste management will be visibly or invisibly engrained in each of the issues addressed by MDGs and now SDGs, be it sanitation, health, gender equality, environmental sustainability, human rights or even hunger and access to clean drinking water.

Humans are the only specie, among the millions who share Earth's ecosystem, that pile up the waste that is harmful and hazardous. Today, waste generation is growing faster than the rate of urbanization, rate of population growth and even faster than Gross Domestic Product (GDP). It is painful to see that waste generation is considered inevitable and unwanted by-product of our life style. Worse still is the fact that it is disposed in every manner possible be it in form of packaging, used items, e-waste, gas from oil wells or discarded refrigerators or even dilapidated buildings. A little more than over a decade ago, the urban resident generated about 0.64 kg of Municipal Solid Waste (MSW) per capita per day. Today this amount has increased to 1.2 kg per capita per day. By 2025 this will likely increase to about 1.42 kg per capita per day during a time when 60% of the global population will be living within urban areas. What we need is not just Waste Management in the form of 'treating the given waste' but to envision it as 'minimizing the possible waste'. The transformation needed is not just 'disposing waste as an unwanted evil' but 'sourcing waste as the resource for much desired sustainability'. Integrated and end-to-end solutions that promote the development by internalizing the social, economic and ecological aspects are needed. Millions of workers, mainly women and children are informally engaged in the garbage collection, segregation and extraction. In ethical and socially sustainable waste management strategies, these 'poverty stricken' human elements cannot be ignored. They need to be rehabilitated and nurtured.

Today we stand at the cliff of opportunity to envision waste as not necessarily evil but as a resourceful good. There are shades of good examples and intentions. This paper lays out policy recommendations based on hands on experience and projects to give Waste Management a human face and transform the shades and intentions into full-fledged sustainable societies.

Rajendra Shende

Debartha Banerjee

Table of Contents:

EXECUTIVE SUMMARY

I. CONTEXT.....	1
II. PROBLEM DESCRIPTION:.....	3
III. POLICY DRIVERS:	5
IV. POLICY RECOMMENDATIONS:.....	7

Acronyms:

CSR	Corporate Social Responsibility
EPR	Extended Producer Responsibility
GDP	Gross Domestic Product
GoI	Government of India
GWGM	Gross Waste Generation and Management Country- rating
HDI	Human Development Index
HFC	Hydrofluorocarbons
MDG	Millennium Development Goal
MoEF	Ministry of Environment ,Forests and Climate Change
MSW	Municipal Solid Waste
SDG	Sustainable Development Goal
SLCP	Short Lived Climate Pollutant
SWM	Solid Waste Management
UNEP	United Nations Environment Programme
WHO	World Health Organization

EXECUTIVE SUMMARY:

The citizens of emerging economies and developing countries are living in times of unprecedented economic growth, rising aspirations and rapidly changing lifestyles, which are raising the expectations on public health and quality of life.¹ Remediation and recovery of misused resources is in turn expected but when not met will result in poor living standards as has become today's case with solid waste management.

'Waste Management' of the modern society is a model of 'end of the pipe treatment' rather than an integral part of our developmental quintessential.

Today's development index relates to consumption patterns of energy, food, water and commodities ignoring the waste generation index and its consequent backlash. With sufficient spending ability, the standard of living in an urban setup also has undergone fundamental and dramatic change in various spheres like transportation, infrastructure, communication and entertainment and also in consumption of goods for comfort. However, waste management in all these sectors has not only failed to be mainstreamed as an integral part of this very transformation but also ignores the human face of waste management.

'Integrated solid waste management' refers to the strategic approach to sustainable management of solid waste covering all sources and aspects²; the design and manufacture of items that finally turn into waste, the consumers' attitude and behavior in creation, segregation, transfer, sorting, treatment, recovery and disposal of waste with an 'end-to-end' or 'cradle to incarnation' approach, with a definite and deliberate emphasis on maximizing resource-efficiency. This approach should also acknowledge as well as incorporate the millions of poor people i.e. informal waste workers, whose work is the backbone of resource recovery. These workers who are despised and shunned by society and many a times overlooked by policy-makers, also face the threat of displacement, loss of livelihood by alternate practices proposed by the modern MSW or continued exploitation within the current system.

Waste Management is closely related to climate change now referred to as 'the defining challenge of 21st century'. The reduced emissions of these Short Lived Climate Pollutants (SLCPs) particularly methane, black carbon and hydrofluorocarbons (HFCs) will provide much needed early relief from the adverse impact of climate change. Compelling scientific evidence indicates the importance of fast global action to reduce emission of SLCPs can help slow global warming by up to 0.5°C between 2010 and 2050, thus

¹ Annepu R. (January, 2012). 'Sustainable Solid Waste Management in India': Waste-to-Energy Research and Technology Council (WTERTC).

² Finnish National Report, Background Information and General Objectives: [Waste Management 1](#)

contributing to staying within the 2°C target in the near term if complemented by deep and persistent carbon dioxide emission reduction measures.³

The climate-related objective of waste policy therefore is to reduce the greenhouse gas emissions-that are short lived-generated by waste, particularly by:

- Reducing the methane emissions resulting from treatment at landfills. In order to reach this objective, the amount of landfilled biodegradable waste needs to be substantially reduced while at the same time measures taken to increase the recovery rates of methane presently generated at landfills.⁴

- Avoiding black carbon that would be generated mainly by open burning of waste.

- Preventing the release of HFCs from disposed and discarded appliances like domestic refrigerators, car and room air-conditioning systems.

It is evident that the current way of waste management in developing countries has been sector-ridden and adopts a linear approach of collecting, segregating and treating. Waste transitions from dumping pot directly into the dumping ground. These monolithic and centralized systems have become part of the 'social necessity'.

Instead what is required is a comprehensive approach, one that processes all categories of waste leaving only the bare minimum to go to the dumping ground, creating a near 'zero-waste' scenario. Decentralizing waste management can create huge livelihood opportunities and dramatic socio-economic changes. The informal segment in the waste management sector has a critically important role to play, particularly in developing and emerging economies that engage mainly marginalized and poor population. Modern waste management practices risk their further marginalization unless inclusive practices are developed within the modern systems to ensure their livelihood.

This paper also outlines further preemptive and management tactics. Preemptive tactics include targeted awareness programmes, creation of a best practice data base, institutionalization of a United Nations Waste Agency, development of a waste management index, producer responsibility tactics and a waste generation and management country rating. Pertaining to the management of waste at hand, recommendations include, creation of a regional network of cities and towns for support and knowledge exchange, rallying for support for Public Private Partnerships and advocacy for a re-negotiation of trade in waste between developed and developing countries.

³ Akimoto. H., et al. (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone. UNEP/WMO.

⁴ Finnish National Report, Background Information and General Objectives: [Waste Management 1](#)

I. CONTEXT

As the world hurtles toward its urban future the amount of MSW, one of the most important by-products of an urban lifestyle, is growing even faster than the rate of urbanization. In 2002 there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day (0.68 billion tonnes per year) when today generation levels are approximately 1.3 billion tonnes per year, and are expected to increase to approximately 2.2 billion tonnes per year by 2025 representing a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per day⁵ over the next eleven years.

One of the most obvious impacts of rapidly increasing urbanization and economic development can be witnessed in the form of towering heaps of MSW. Based on estimates, waste generation in Asia has reached 1 million tonnes per day. A World Bank Study showed that urban areas in Asia spent USD25 million per year on solid waste management, and this figure will increase to USD47 million per year.⁶ No country has ever experienced as large or as fast an increase in solid waste quantities that China is now facing. In 2004 China surpassed the United States as the world's largest waste generator, and by 2030 China's annual solid waste quantities will increase by another 150% - growing from about 190,000,000 tonnes in 2004 to over 480,000,000 tonnes in 2030.⁷

As a representation of Asian cities, Mumbai, a financial capital of India with a metropolitan population close to 20 million,⁸ alone generates an astounding 8,000 to 10,000 tonnes of waste every single day⁹ that finds its way into one of the city's three dumping grounds, Kanjurmarg, Mulund or Deonar. For urban India, the figure is beyond 100,000 tonnes daily indicating a 50% increase in MSW generated within a decade since 2001. In a 'business as usual scenario' urban India will generate 160.5 million tonnes per year (440,000 tonnes per day) by 2041.¹⁰

Municipalities are charged with an enormous task: get the waste out from underfoot and do so in the most economically, socially and environmentally optimal manner possible. However, they often face problems beyond their ability to tackle¹¹ mainly due to lack of organization, complexity, system multi-dimensionality,¹² poor allocation and corrupted use of financial resources resulting in the provision of an ineffective and inefficient system of works for inhabitants.

India is undergoing a waste accumulation crisis. While the average life of a dumping ground is 30 years,¹³ the remaining life of Mumbai's largest dumping ground,

⁵ Hoornweg, Bhada-Tata (March, 2012). *What a Waste: A Global Review of Solid Waste Management*, No. 15.

⁶ Asia Productivity Organisation (APO)(2007). *Solid Waste Management: Issues and Challenges in Asia*. Survey on Solid-Waste Management 2004-05.

⁷ Delvoie, Plessis-Fraissar (May, 2005). *Waste Management in China: Issues and Recommendations*, Urban Development Working Papers East Asia Infrastructure Department World Bank, Working Paper No. 9.

⁸ World Population Review: [Mumbai Population \(March 2014\)](#)

⁹ Annepu R. (January, 2012). *Sustainable Solid Waste Management in India: Waste-to-Energy Research and Technology Council (WTERT)*.

¹⁰ Annepu R. (January, 2012). *'Sustainable Solid Waste Management in India': Waste-to-Energy Research and Technology Council (WTERT)*.

¹¹ Sujaudhin, M., Huda, M.S., Rafiqul Hoque, A.T.M., (2008). *Household Solid Waste Characteristics and Management in Chittagong, Bangladesh*. Journal of Waste Management, 28, 1688-1695.

¹² Burntley S.J. (2007). *A review of Municipal Solid Waste Composition in the United Kingdom*. Journal of Waste Management, 27(10), 1274-1285.

¹³ Davis B. *Solid Waste Management in Mumbai*. Understanding Our Civil Issues: Bombay Community Public Trust.

Deonar, is only five to six years and so far, no economically or environmentally feasible alternative has been found for waste disposal. Accumulation of garbage, as happened in the streets of Pune, India's seventh largest city, is a result of a faulty collection system that residents revolted against by staging a protest. The residents of the suburban village around Pune banned the entry of garbage lorries and protested against the increase in number of centralized waste processing units that have been planned for construction within the vicinity their homes. As a result, the Government is now planning for use of 300 acres of virgin forestland for dumping and treatment purposes.¹⁴ The instruments used to protect the ecosystems, like forests, are now being sacrificed to solve a man-made waste crisis.

The same goes for Bangalore's Mandur landfill, where the city's civic body has recently pleaded with residents to allow for further dumping within an already overflowing site having failed to put scientific SWM practices in place and are now resulting to the use of quarries as dumping grounds.¹⁵ Also, once thought to be India's cleanest state, Kerala is now churning out more than 8,300 tonnes of garbage per day¹⁶ with the added danger of poorly disposed of waste being capable of polluting the city's backwater channels.

The world is on the verge of creating a new equation between GDP and a 'gross waste product' (GWP) . Protection of natural ecosystems and the effective management of man-made waste have emerged as two most critical issues of our generation. Not only does waste accumulation pose huge environmental health problem but also there are also occupational health risks to those who work with waste. The most marginalized and unrecognized of these workers are the waste pickers of Asia, Africa and Latin America, whose number, especially of those within in Asian cities, has been reported as on a constant increase since 1990.¹⁷ Inter-linkages between waste generation and poverty are now more obvious than ever.

The population employed in waste management is considered as low-grade jobs even in the developed countries. A 1988 World Bank Study estimated that informal waste workers comprised 1-2 % of the world's population¹⁸ that numerically would be more than 120 million people worldwide who earn an income from dealing with solid waste. A more recent study in India estimated waste pickers the country numbered 1.5 million people, primarily women and those from socially marginalized groups. ¹⁹

1% of Mumbai's population has their livelihood opportunities built around SWM.²⁰ This includes the municipal workers, scrap dealers, waste recyclers (formal and informal) and most importantly the waste pickers. Also known as rag pickers, waste pickers are an invisible set of people working in an un-organized manner who play the most important role of resource recovery and drive the recycling industry alive

¹⁴ The Times of India (August 11th, 2014) [Villagers Demand Prithviraj Chavan Meeting as Trash Piles Up](#)

¹⁵ The Times of India (May 14th, 2014) [Mandur Residents Stop Garbage Trucks From Dumping](#)

¹⁶ Ministry of Environment and Forests, India. [Status Report on Municipal Solid Waste Management](#) . Central Pollution Control Board

¹⁷ Furedy, C. (1990), *Social Aspects of Solid Waste Recovery in Asian cities*. Environmental Sanitation Review Series No.30, Environmental Sanitation Information Centre, Bangkok.

¹⁸ Bartone C. (January 1988). *The Value in Wastes*. Decade Watch.

¹⁹ Chaturvedi, Bharati (January, 2010). 'Mainstreaming Waste Pickers and the Informal Recycling Sector in the Municipal Solid Waste' Handling and Management Rules 2000', A Discussion Paper.

²⁰ Medina. M (October 2008). *The Informal Recycling Sector in Developing Countries: Organizing Waste Pickers to Enhance Their Impact*. Grid Lines. Note No 44.

but at the same time are disadvantaged, exploited by middle-men, subject to social stigma and face poor working conditions even with their contribution to local economies, to public health and safety and to environmental sustainability. The value of waste picking is increasingly important to global environmental efforts and the development of cities.

Research has found that in Pune each waste picker contributed USD 5 worth of free labor to the municipality every month and their combined labor saved the municipality USD 316,455 in municipal waste transport costs.²¹ Collectively waste pickers earned USD 2.25 million annually. It is estimated that in Pune alone nearly 118,000 tonnes of material was recovered by the informal sector annually, diverting 22% of the recyclables away from landfills in 2006. In monetary terms the net environmental benefit accruing from the informal sector is calculated as USD 3,615,900 for the same year.²² These individuals whose contributions are rarely acknowledged by authorities and whose average daily earning is USD 1.12²³, can be termed in the truest sense as 'Invisible Environmentalists'.

II. PROBLEM DESCRIPTION:

Poor SWM policies and practices heavily impact the environment, well-being and quality of life. Despite municipalities in India spending up to 50% of their budgets on SWM²⁴, they are often not prepared or lack a sound vision on how to address mounting quantities of wastes. Due to the urgency of urban environmental problems and the growing recognition that improper solid waste disposal is a contributor to local disease episodes, regional water resource pollution and global greenhouse gases; municipal SWM has become a top development and environmental priority in India but hardly any Indian policy document examines waste as part of a circular economy, or green economy or cycle of production-consumption-recovery, or perceives waste through a prism of overall sustainability. Even if a few do, they are not enforceable by law yet. Waste management is still a non-cyclic system of collection and disposal, either in dumping grounds or incineration chambers, consequently creating considerable health and environmental hazards.

In view of the continuing legacy of poor SWM, the Ministry of Environment and Forests and Climate Change (MoEF), of the Government of India (GoI) passed the Municipal Solid Waste Management (Management and Handling) Rules, in 2000 under the Environment Protection Act of 1986. The Rules mandate, not only Class I Cities of India but also all municipal authorities (4378 in number), to implement improved systems of SWM. Still implementation remains extremely weak. The principal reasons reported for non-compliance were lack of technical knowledge,

²¹ Chikarmane P., Deshpande M., Narayan L., (2001). *Scrap Collectors, Scrap Traders and Re-cycling Enterprises in Pune*. Report. Geneva: ILO-UNDP.

²² Scheinberg, A., Simpson M., Gupta Y., (2010). *Economic Aspects of the Informal Sector in Solid Waste, Final Report and Annexes*. GIZ (German International Co-operation), the CWG (Collaborative Working Group on Solid Waste Management in Low- and Middle-income Countries), and the German Ministry of Foreign Affairs, Eschborn, Germany

²³ Tangri N., (2012) *Waste Pickers Lead the Way to Zero Waste*. Zero Waste: Successes and Lessons from Around the World- Global Alliance for Incinerator Alternatives (GAIA) Case Study.

²⁴ Climate Change, Environment and Natural Resources Management: World Bank Initiative (2006-2008) [Solid Waste Management Program, India](#)

lack of community participation²⁵ poor planning and improper use of financial resources. In 2013 a division bench of India's Karnataka High Court ordered status quo on the controversial proposal to comprehensively amend these laws on the basis that the proposed modifications, by the very same MoEF, to the existing rules were highly retrograde and would promote unjust, unscientific and unnecessary techniques of municipal solid waste management²⁶ that did not recognize the value of waste segregation.

In short a scenario has emerged in which there is ample talk about the 'waste to something' scheme but unable to sustain it as viable proposition. MSW Initiative should break away from the 'business as usual approach' and firmly invest in decentralization and integration as the way to revolutionize waste management and its systems.

With the recommendations and policy drivers within this document we hope to address the following pain points;

- I. The everyday collection and transportation that incurs considerable expenditure. Last year alone, Mumbai Municipal Corporation spent nearly USD 400 million for its waste management out of which nearly USD 150 million was spent only for collection and transportation of waste to the dumping ground.²⁷ For any country, developing and or otherwise this is a huge budget considering there is very little resource recovery.
- II. Lack of at-source-segregation of waste. Recyclable waste material needs to be saved from going into the waste processing and disposal sites and using up landfill space. Organic waste also needs to be viewed as a precious resource in its ability to produce bio-fertilizer and biogas. Efforts need to be made to segregate waste prior to disposal, a strategy that would save national resource and also save the cost and efforts to dispose of such waste.
- III. The dumping grounds and landfill sites that have become enormous and almost unmanageable owing to rapid urbanization, population increase and also change consumption patterns.
- IV. The huge amounts of greenhouse gases like methane, black carbon and HFCs being released to the environment every day from open dumping of waste, open fires in the dumps and gases released from disposed refrigerators and air-conditioning systems. Other severe pollutants like dioxins, furans and unknown hazardous substances from e-waste are being released into the air and water on a continuous basis.
- V. The low standards of living of the waste pickers along with their 'outcast'

²⁵ Climate Change, Environment and Natural Resources Management: World Bank Initiative (2006-2008) [Solid Waste Management Program, India](#)

²⁶ Down to Earth (21st October, 2013). [Court Stays Proposed Changes Municipal Solid Waste Management Rules](#)

²⁷ Mumbai Municipal Corporation: [Annual Budget Expenditure Estimate: 2012-2013](#)

status in society. They have a much lower life expectancy; generally suffer from chronic diseases and various infections apart from suffering from frequent work related injuries.

- VI. The collection, transportation and centralized processing currently being followed that has given rise to a nexus of Waste-Mafias, Collection and Transportation Lobbies built around vested interests where the true nature of waste processing and reducing the pollutants going to the air and water has completely taken a back seat.

III. POLICY DRIVERS:

a) Health Impact

As per World Health Organization (WHO) long-term, low-level exposure of humans to dioxins and furans that are generated from waste and incomplete burning of the waste may lead to the impairment of the immune system, the impairment of the development of the nervous system, the endocrine system and hamper reproductive functions. Short-term, high-level exposure may result in skin lesions and altered liver function. Exposure of animals to dioxins has resulted in several types of cancer. The public health is at risk and the poor people engaged in waste picking, segregation and dumping and informally scavenging are at an even greater risk.

The streets and open spaces where garbage lies in heaps due to inadequate transport and lack of dumping area, pose a direct threat to the society in their day to day activities and risk the spread of epidemics.

b) Climate Change

Environmental impact of green house gases like methane, HFCs and black carbon generated and released from waste contribute significantly to global warming and thus climate change.

c) Poverty

Waste treatment and management in the formal and informal sectors is a typical example of 'Poverty breeds more poverty'. Society or employers do not treat the workers in either sector with dignity. Self-employed workers, mainly scavengers, work in abnormally hazardous conditions. Their earnings are extremely low and they suffer from malnutrition. Their children remain uneducated and thus the next generation poverty takes birth.

d) Resource Inefficiency and Economics

With the amount of waste produced in manufacturing, transporting and consuming there is little resource efficiency. As a result the economy and ecosystem that provides resources are adversely affected.

e) Availability of Effective Waste Management Approaches

There have been a number of interesting and promising alternative waste handling methods and technologies that have come up in recent times. Integrating waste management as the part of the manufacturing process and making it 'inclusive green accounting' would provide the seminal difference in the way in which waste management is looked upon in the industry. Deploying the concepts of 'circular economy' right from the individual to the communities and nations would help in considering waste-management as important as 'industrial management' and as a normal part of social behavior.

f) Enhanced Awareness on the 3 R

The 3R principle of Reduce, Reuse and Recycle practiced by ancient societies is now being recalled by countries like Japan where people, businesses and the central and local government are working cooperatively to create a society in which waste is reduced, reusable products are reused and waste is recycled as a resource under the Fundamental law for Establishing a Sound Material-Cycle Society. Each stage of 3R is an opportunity for a start up in the 'green business' and social enterprise.

g. Community Driven Initiatives on Zero Waste

In Mumbai there are examples where families have processed their waste on an individual level by using small-scale biogas and composting solutions. There are many examples of "Zero Waste" housing societies, corporate houses and educational campuses that have taken the initiative to an institutional level. There have also been cases where Municipal Corporations along with citizen groups, relevant NGOs and implementing agencies have established solutions at a community level. Many of them have proved to be successful. They have encouraged emulation by individuals and communities and have also helped to raise awareness levels.

h. Lack of Scalability and Wider Implementation at City Level

The initiatives at community level have remained only as good examples considering the enormous amount of waste the city generates. They have also been limited in the size of impact they are able to create and also have not adequately challenged the existing way of waste-management and drawn enough attention towards them to trigger a policy level change.

On a national scale, over the last few years India has seen a few of such

initiatives being taken to convert a larger area or a ward into a near 'zero waste' zone. Processing of waste included biogas plants or large-scale waste processing techniques, while focusing on dry waste recycling at the same time. Pune and Bangalore have been one of the most prominent cities regarding these types of initiatives. Many Municipal Corporations have gone ahead to set up biogas plants to process their market and hotel waste. However their effectiveness is something, which is open to debate. All these examples have been based on the idea of decentralized waste processing. While they have been many good examples and functional models, many of them have suffered a sudden or systematic failure.

The general conclusion that can be drawn from here is that what is needed is promoting more 'zero waste' examples within smaller communities so that the examples can be extrapolated over an entire municipal area and thus impact can be quantified. The difference in the budget of the Municipal Corporation owing to decentralization and source processing and also the reduction in emissions through this scalable impact will become significant enough to be used as an example as well as an experiment to draw concrete policy level changes on at-source segregation and decentralized processing by the central government. Policy interventions are needed to transform the need into implementable, measurable sustained projects and practices.

IV. POLICY RECOMMENDATIONS:

1. Extended Producer Responsibility (EPR) Policies

Launching the process of reducing the waste in manufacturing, distribution, marketing and consumer supply chain should be handled through the implementation of EPR policies. This integration of environmental costs associated with goods throughout their life cycles into the market price of the products is not a foreign concept. In 2010 the GoI and MoEF in New Delhi issued a draft rule on the management and handling of waste electrical and electronic equipment for a 60-day period of public consultation. The draft 'E-waste (Management and Handling) Rule 2010 was based on the Extended Producer Responsibility principle and is the first such legislation to be put forward by a developing country.²⁸ Using a similar principle, both developing and developed countries should amend and create legislations to incorporate all industrial producers thus targeting every form of solid waste in the market.

2. Waste Management Index

Rating based on the index to measure how the waste is managed gainfully by large industries and multi-corporations should be carried out. This index would be used to rank the private sector on its consciousness or contribution of waste thus by this approach, industries will be challenged to develop products, appliances, practices and methodologies that generate less waste and create 'wealth from waste'.

²⁸ Government of India, Ministry of Environment and Forests and Climate Change (MoEF) (May, 2010) Vide Number S.O. 1125 Gazette of India.

3. Advocacy for Implementation of Demonstration Projects using the Decentralized Zero-Waste Model.

Decentralization of waste management allows communities to meet their needs and micro-manage their solid waste while ensuring it meets the larger waste management strategy. The implementation of these projects for demonstration purposes within what would be considered the smallest building block of a municipal council i.e. at ward level and or its equivalent will allow for sizable impact that is quantifiable and viable for extrapolation over the whole municipality. This 'zero-waste ward model' that will incorporate composting, biogas production and other relevant techniques for wet waste at locality level and storage sorting and value addition centers for dry waste, will be able to produce substantial data in terms of carbon emissions saved, reduction in expenditure on transportation by municipal council and employment creation within the ward to entice the adoption of a decentralized system at an entire municipal level.

This model though, needs to incorporate the informal waste sector so as to create a fully integrated system as it will not only increase resource recovery through customized end-to-end solutions but will be an opportunity to generate employment opportunities for waste pickers in which they are provided with formal training and employment that will ensure access to social security, better working conditions and redeemed self-esteem.

4. Targeted Awareness Programs

Knowing that future urbanization will be mainly through migration of population from towns and villages, there is need to globally initiate massive awareness campaigns in towns and villages as a preemptive measure to make future urbanization ready to reduce and manage the waste in its hierarchy of treatment.

One of the ways to curb the domino effect of increased urbanization is to target outskirt towns and villages from which migration is predicted to emanate, for intensive and extensive awareness coverage on the importance of integrated waste management. Promoting small-scale waste management techniques that can be employed in waste segregation and its conversion into energy or composting for use as fertilizer, would not only assist in waste management within the villages and towns but would also prepare the future urban population for such practices.

5. Development of a Best Practice Database

Creation of a database of waste treatment and waste-to-energy technologies based on an assessment of input waste-composition and evaluation of effective functionality of the technologies from an environmental and economic viability standpoint to effectively meet their intended societal needs before deployment should be undertaken.

6. Gross Waste Generation and Management Country- rating (GWGM)

Similar to GDP and Human Development Index (HDI), there is a need to

establish country rating on 'per capita waste generation and treatment'. This would be based on a Zero Waste Index to quantify solid waste flows and measure the extent to which materials may be reused as substitutes for virgin materials. In addition to the overall percentage of material recovery and substitution, the approach would calculate other savings made, including energy used and or saved, greenhouse gases avoided, and water savings (regarding the water use within material supply chains). ²⁹

7. Establishment of an International Waste Agency Within the United Nations

There is a need to enlist an agency to play the specialist role in setting standards and guidelines, formulate policies, provide technical assistance and other forms of practical help to ensure that solid waste management receives the required attention it demands.

8. Initiating International Negotiations on Trade in Waste

Recalling the Basel Convention on the 'Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal', there is a need to engage in talks on trade in waste. Although it is difficult to know exactly how much e-waste is exported out of developed countries, developing countries in Asia or Africa appear to be active importers of it. Many of these countries lack, or do not enforce, labor or environmental laws that would mitigate or prevent the harms to human and environmental health that are associated with e-waste processing. The result is that some overseas e-waste recycling operations may pose a significant risk to human and environmental well-being. ³⁰

9. Creating Regional Networks of Cities and Towns

A regional network of cities and towns around the world to share the knowledge and experience on methods of combating SLCPs through reducing the waste generation at source, improved municipal solid waste collection and disposal practices should be established with focal points. The regular meetings of such networks should be financed through funding projects and the proceedings should be widely disseminated.

10. Building Public Private Partnerships

There is an opportunity to build win-win partnership that would benefit businesses targeted at tackling waste. By enhancing the resource efficiency and competitiveness, consumers would benefit from a quality service with lower prices. Also social enterprises built around waste management business models that would be able to offer livelihood opportunities by

²⁹ Zaman A., (October 2013). *Measuring Waste Management Performance Using the 'Zero Waste Index: The Case Of Adelaide, Australia*. Elsevier Journal, Zero Waste SA Research Centre for Sustainable Design and Behaviour., Australia.

³⁰ Barbour E., (February, 2012). *Issues in International Trade Law: Restricting Exports of Electronic Waste*. Congressional Research Service. U.S.A.

employing and training waste-pickers and other marginalized workers need to be developed and implemented with the help of micro-credits and under Corporate Social Responsibility (CSR).

