Waste to Energy in Delhi

Alternatives towards Sustainable Urban Waste Management

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Abstract

With the increasing waste production in urban areas, multiple technological solutions, models of waste governance and alternative practices of solid waste management have started acquiring momentum in Indian cities. Of the numerous solutions to this problem, waste to energy technology is emerging as an essential solution in India. Hence, this paper probes whether the emergence of waste to energy technologies is the 'preferred solution' for municipal solid waste management in Delhi, in the context of the wider political economy of environmental management in urban India. Specifically, it is concerned with (1) the processes that are involved in the prioritisation of particular types of urban waste management technological interventions, (2) The types of environmental, health and social justice issues that are formally recognized in these processes, and how and why others are unrecognised, (3) who gains and who loses from current interventions, and how people's understandings compare with those of local service providers and officials, and (4) Possible alternative waste management scenarios, institutional and regulatory arrangements that are emergent.

Keywords: Solid Waste Management, Waste-to-energy Technology, Waste Governance, Environmental Health, Social Justice

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Introduction

The increasing amount of urban waste, a proxy for increasing urbanisation and urban environmental health, is not expected to peak even by the end of the twentieth century anywhere in the world. Irrespective of the income-level of a country, urban waste is growing faster than the rate of urbanisation. Though the amount and composition of urban waste differ from low to high-income countries, the low and middle-income countries that generate a lower amount of waste, the rate of urbanisation is faster, and hence the rate of urban waste generation is expected to be higher. In these developing countries, while the cost of waste disposal is expected to be higher, the resources and technological alternatives are limited. Moreover, organic waste constitutes about 60 percent of the total urban waste resulting in the emission of methane and carbon dioxide and other green-house gases in the management of the urban waste. In many parts of the world, the gap between the generation and disposal of urban waste is widening. This will entail not only environmental but health and socioeconomic issues as well. Alternative technological and organisational attempts are afoot to resolve this conundrum as the outcomes have their own environmental and socioeconomic problems to be tackled. The significance of these issues is reflected in the fact that the recently launched sustainable development goals by the United Nations include goals such as "Make cities and human settlements inclusive, safe, resilient, and sustainable" and "Ensure availability and sustainable management of water and sanitation for all" as one of the seventeen major goals for the transformation of our world. It is also questionable whether other goals could be achieved without achieving these two goals.

In the preceding context, waste to energy technology is emerging as an important solution in India. Hence, this paper probes whether the emergence of waste to energy technologies is the 'preferred solution' for municipal solid waste management in Delhi, in the context of the wider political economy of environmental management in urban India. Specifically, it is concerned with the processes that are involved in the prioritisation of particular types of urban waste management technological interventions. Secondly, the types of environmental, health and social justice issues that are formally recognized in these processes, and how and why others are unrecognised and thirdly who gains and who loses from current interventions, and how people's understandings compare with those of local service providers and officials, and finally, possible alternative waste management scenarios, institutional and regulatory arrangements that are emergent.

By drawing insights from the pathway approach, the role of knowledge, power, and politics in the processes of determining waste management priorities and plans are analysed. The emergence and implementation of the WTE based waste strategy are discussed in detail, in terms of environmental health and social justice concerns, and compared with alternative waste management visions and approaches, which have been largely excluded from formal policies and planning. The ongoing reinforcement of the dominant centralised WTE based waste management system is also discussed in relation to governance structures and incentives to support large-scale centralised waste management systems, and the apparent disregard for the potential of existing decentralised practices.

The paper demonstrates how waste management in India is largely considered as an environmental issue; arguing that this overlooks the socio-material flows of waste, the socio-economic interactions on the ground and the larger context of urban process and planning. As a consequence, possibilities for the development of more sustainable waste management strategies that will address environmental, health and social justice concerns in an integrated manner are also overlooked. Drawing on the insights from empirical research into these issues, eight principles for 're-casting' of urban waste management policy through a sustainability lens are introduced.

Empirical research for the paper was carried out between 2012 and 2013 in Delhi. In order to acquire information on the ongoing waste to energy projects in Delhi, applications were filed under the Right to Information (RTI) Act. Forty semi-structured interviews were conducted with stakeholders including government officials representing the centre and state governments, local bodies, waste to energy plant officials, academics, NGO representatives and informal waste pickers and local residents. Visits and consultations also took place at waste to energy sites in Delhi, and detailed process documentation of informal waste management was carried out in Delhi, Ahmedabad, and Pune. A series of focus groups and stakeholder workshops and meetings were also organised or co-organised by the research team.

The paper is structured into six sections. The second section discusses the trajectory of policy articulations on urban waste in India. The third section discusses the issue of knowledge, power and politics in the process of emergence of waste to energy initiative in Delhi, and the significance of a 'pathways approach'. The fourth section compares the official priorities of waste management with the situation on the ground; The fifth section discusses how the centralised WTE based solution of waste management are promoted, and how successful practices of decentralised

waste management are simultaneously being overlooked. The final section proposes a set of eight principles that would underpin the development of a sustainable urban waste management strategy.

Neo-liberal urbanisation and push for public-private-participation (PPP) model

Indian cities have been witnessing neo-liberal urbanisation since the declaration of new economic policies in 1991. The current form of neo-liberalisation has been shaped by economic globalisation and international capital mobility and characterised by fewer restrictions on business operations, extended property rights, privatisation, deregulation, the dismantling of the welfare state, devolution of central government, uneven economic development and increasing social polarisation (Harvey, 2005, 2006). Neo-liberalism has also been viewed as a restructuring of the relationship between private capital owners and the state, which rationalises and promotes a growth-first approach to urban development (Sheppard & Leitner, 2010). Neo-liberalism mobilises urban space as an arena for the market-oriented economic growth and elite consumption practices, and in so doing it transforms the politico-economic setting in which public plans and projects are implemented (Sager, 2011).

One of the key features of neo-liberal urbanisation is a push for the development of infrastructure projects through the public-private-partnership (PPP) model. PPPs are useful from a neo-liberal viewpoint in that they reduce the load on the public sector through some degree of privatisation, as well as presenting potential efficiency gains in the production process (Siemiatycki, 2007). PPPs also provide profitable investment opportunities and risk sharing for venture capital. As a management reform, 'partnerships are promoted as an innovative tool that will change the way government functions, largely by tapping into the discipline of the market' (Linder, 1999). PPPs facilitate implementation of mega-projects that help local image building and the competitiveness of the city. Private business often gains from the PPP infrastructure (Hodge, Greve, & Boardman, 2010), and a concern that PPPs might entail subsidies to private business (Grimshaw, Vincent, & Willmmott, 2002) and shift attention from the goals of elected governments to the interests of private business (Erie, Kogan, & MacKenzie, 2010). In particular, there is concern that the large projects being promoted might entail high user fees and play down considerations of equity between groups and between generations (Miraftab, 2004). Also, that democratic problems might also arise, in that PPPs can

restrict inspection rights and transparency (Siemiatycki, 2007, 2010), weaken public accountability and hamper citizen participation (Ball, 2004; Elwood, 2004).

Policies on municipal solid waste in India

Current municipal solid waste (MSW) management policy and legislation have been shaped by some key interventions, which reflect the wider political economy of urban India and policy responses to particular 'crisis' situations. While the pre-1990 initiatives for MSW management were limited to composting and disposal of solid waste outside the city (CPHEEO, 2005), the outbreak of the Surat (Gujarat) plague in 1994 was a pivotal event for urban waste management. It was followed by public interest litigation (PIL) case in the Supreme Court of India by environmental activists and NGOs, and a broader consensus among policymakers to broaden the scope of municipal waste management in the country (ibid). In 1995, the planning commission constituted a high-powered committee (Bajaj committee) to review urban solid waste management India, which proposed house-to-house collection, facilitation of local transportation and range of on-site technological options (PlanningCommission, 1995). In 1998, the Asim Burman Committee was formed under the Supreme Court of India to identify deficiencies and make recommendations to improve solid waste management in Class I cities. The committee suggested that composting should be used for organic waste, and inorganic waste should be recycled, with only rejects and hazardous waste going to landfills (Burman, 1999). It also advocated the involvement of the private sector in the management of MSW and advised that by involving the private sector, local bodies must raise finances to maintain minimum services. They should improve collection efficiency of taxes and charges, review the existing rates and introduce cost recovery (ibid). The principal recommendations of this committee were incorporated into the Municipal Solid Waste (Management and Handling) Rules 2000 notified by the Ministry of Environment and Forest (MoEF) in 2000. These rules were enacted as one of the many legislations under the Environment Protection Act (EPA) 1986 (MOEF, 2000).

The MSW Rules remain central to the process of determining formal municipal waste management practices in India and are therefore also a potential entry point for engagement and intervention. The rules outline the responsibility of multiple authorities dealing with waste within and beyond the city. They provide guidelines for dealing with the collection, segregation, storage, treatment, and disposal, and also prescribe standards for treatment and disposal of MSW. The initial rules

mandated that biodegradable waste be processed by adopting an appropriate combination of processing systems (composting, vermicomposting, anaerobic digestion, pelletization, etc.) and landfilling be restricted to only nonbiodegradable, inert waste and other appropriately stabilized biological waste. These required all cities to set up appropriate waste treatment and processing facilities by 2003 (MOEF, 2000). In 2004, a study to ascertain the status of compliance with the MSW Rules revealed that there was insignificant progress in the matter of processing of waste and construction of sanitary landfills. Major constraints for noncompliance were: unavailability of financial resources, lack of technically skilled workforce, lack of public awareness and motivation, and non-cooperation of the households, trade, and commerce (Asnani, 2004).

In 2005 three major reports related to MSW management were tabled; a) the National Master Plan (NMP) for Development of Waste to Energy in India); b) the report of the Technology Advisory Group (TAG); and c) Report on Integrated Plant Nutrient Management using City Compost. The emphasis of these documents was much in tune with the underlying trajectories of neo-liberal urbanisation, in that they focussed on technology-based centralised solutions for processing urban waste, and increased the involvement of private companies for management the sector.

Between 2005 and 2010 several other policy pronouncements on urban waste were made. The most ambitious project of the central government in the field of urban development, Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was declared. Urban waste management was part of its first submission. 44 MSW projects were sanctioned under JNNURM. The estimated cost of these projects was Rs. 1, 97, 286.44 Lakh (MOUD, 2006). The implementation of the "polluter-pays" principle was emphasised in Comptrollers and Auditor General (CAG) report on the management of waste in India in 2008 (CAG, 2008). The Department of Economic Affairs (DEA) under the Ministry of Finance outlined a detailed plan for private sector participation for managing waste in India (DEA, 2009).

More recently in 2013, the MSW Rules 2000 were amended, and a draft version of these amendments was publically released with an opportunity for objections. Alongside reducing the role of the municipality and expanding the scope for private sector involvement, there are two major additions in the amended rules – a separate section on waste to energy technology and formal mention of waste pickers (MOEF, 2013). The role of the informal waste management and estimated 300000 waste pickers in Delhi is an issue that we return later to this paper. Of relevance at this stage is that the rule amendments proposed in 2013 made legal

provision, and suggested increased subsidies for waste to energy technology. While the informal sector is mentioned with regard to the role of waste pickers, no suggestions are made for how a constructive engagement could occur between sectors or how issues such as health and social security might be addressed.

Knowledge, power and politics in the process of emergence of waste to energy initiative in Delhi

Waste to energy technology is not a new phenomenon in India. It has been tried earlier in the late 80s. One of the first initiatives of the government was in supporting the setting up of the refuse incineration-cum-power generation plant at Timarpur, Delhi in 1987. This was set up as an R&D project using Danish Technology and financial support from Government of Denmark. However, it could not operate satisfactorily on a continuous basis due to a mismatch between the incoming waste fed into the plant and the plant design, and the government decided to close down the facility. It was later planned to lease it out to interested entrepreneurs who could make their own investment in making necessary modification in the plant and operate it on a commercial basis, but the exercise was dropped, as no offer was considered acceptable (CPHEEO, 2005).

After the failure of Timarpur project, the idea of WTE came back in India in the mid-1990s. The involvement of private players was the primary factor behind re-emergence of WTE in the country. It was promoted by the Ministry of Non-Conventional Energy Sources through two schemes, namely i) National Programme on Energy Recovery from Urban and Industrial Wastes and ii) UNDP/GEF assisted Project on Development of High Rate Biomethanation Processes as a means of Reducing Green House Gases Emission (Faridi, 2008).

The national programme on energy recovery was applicable to private and public sector entrepreneurs and organisations as well as Non-Governmental Organisations (NGOs) for setting up of waste-to-energy projects on the basis of Build, Own & Operate (BOO), Build, Own, Operate & Transfer (BOOT), Build, Operate & Transfer (BOT) and Build Operate Lease & Transfer (BOLT). It was implemented through State Nodal Agencies, who forward the Detailed Project Reports, received from the promoters, to the Ministry of Non-Conventional Energy (renamed as Ministry of Non-Renewal Energy - MNRE) along with their recommendations in respect of financial, managerial and technical capabilities of the promoters and on assured availability of waste materials on a long-term basis (over 10 years) for operating the project smoothly (IL&FS, 2008).

The UNDP/GEF project was started during September 1994 with the objectives to set up demonstration sub-projects, preparation of National Master Plan, capacity building and publication of a quarterly newsletter 'Bio-Energy News'. The project was implemented with the association of a few eminent National laboratories and institutions such as Central Leather Research Institute (Chennai) and others for providing assistance in the biomethanation technology related to issues like design, analysis of critical aspects of construction, supervision, commissioning, troubleshooting, monitoring and evaluation of projects at the demonstration stage. A total of 15 subprojects were designed under UNDP/GEF project (Faridi, 2008). It has to be noted that most of these sub-projects dealing with urban and industrial waste were mainly based on biomethanation technology.

The WTE technology took a different trajectory in the mid-2000. Besides biomethanation, other technological options for generating energy from waste also started emerging. As discussed in the previous section in the year 2000 MSW Rules were declared. Along with a major emphasis on the involvement of private players in the management of solid waste in the cities, the rules also mentioned about the incineration of MSW with or without energy generation (MOEF, 2000). In the early 2000, Department of Science and Technology (DST) and Technology Information, Forecasting and Assessment Council (TIFAC) initially perfected the technology of processing municipal solid waste to separate combustible fraction and densification into fuel pellets to a scale of 2 tons per hour in a demonstration plant at Deonar Dump Yard of Mumbai Municipal Corporation. Fuel pellets produced in the demo plants were found to have calorific value in excess of 3000 K. Cal Kg and fuel was test marketed around 1000 per tonne in and around Mumbai. The Technology Development Board of DST and TIFAC have assisted Selco to set up a 6.6 MW power plant using refuse derived fuel (RDF) and generate electricity. DST has also transferred the technology to M/s Sriram Energy Systems Ltd to set up a similar plant at Vijayawada. Both these plants have been operational since November 2003 (CPHEEO, 2005).

After Vijaywada, the idea of RDF based WTE technology came in Delhi. In the year 2004, IL&FS organised the meeting of experts to explore the possibilities of the optimal solution for MSW (IL&FS, 2008). The focus of the meeting was to overcome the problem of MSW management through WTE technology. In 2005, IL&FS pushed the idea of WTE in Delhi to New Delhi Municipal Council (NDMC) and Municipal Corporation of Delhi (MCD). As a result on the basis of BOOT, an Integrated Municipal Waste Processing Facility at Timarpur & Okhla in Delhi was planned. IL&FS was mandated to structure the project, evaluate various technologies, carry out project development activities and select suitable developer through competitive

bidding (ibid). IL&FS formed a subsidiary company named Timarpur-Okhla Waste management Private Company Limited (TOWMPCL) to undertake the job (UNFCC, 2007). According to IL&FS, the project development entailed detailed technical studies and reviews, financial evaluation, contractual clarity, risk evaluation and regulatory as well as statutory approvals (IL&FS, 2008).

Except for EIA, none of the technical studies and reviews are available in the public domain. Upon completion of the project development activities and approval of regulatory bodies, bids were floated to select the BOOT Operator. The project received interests from as many as 35 parties from all over the world including Europe, USA, and other parts of Asia. Finally, six bids were received (2 foreign parties and 4 Indian parties) and based on the specified criteria, M/s Jindal Urban Infrastructure Limited (JUIL) were selected as the successful bidder for implementing the project (IL&FS, 2008).

The discussion so far suggests that the WTE technology in India is dependent on the knowledge coming from outside the country. There has been an effort by DST and TIFAC to develop indigenous WTE technology based on RDF, but its success is yet to be proven. The analysis also illustrates that non-technical or non-expert knowledge has been completely missing in the process of evolution of WTE in India. The other issue that clearly emerges in the analysis is that there is a long list of consultants and private companies who have been playing a significant role in the decision-making and implementation process while there is a complete absence of people's participation.

Official priorities and ground realities

After Jindals took over the project, the technical reports and reviews done by IL&FS became irrelevant because Jindals changed both the location of the plant and the technology specified in the Detailed Project Report (DPR) (CPCB, 2011). According to the DPCC official, the technology used in Okhla plant is not RDF rather it could simply be called incineration-based technology, where waste is fed directly into the boilers. The approval of the plant was given by CPCB on the basis that it would use RDF pellets to generate energy from MSW, but eventually, they went for mass incineration. There are two kinds of emission standards applicable for the Okhla WTE plants, namely incineration standards prescribed in MSW Rules 2000 and stringent standards set by the CPCB. The DPCC monitors emission levels at Okhla plant on a monthly basis. The data shows that the Okhla plant meets the standards

prescribed in MSW Rules, but it does not comply with the stringent standards prescribed by CPCB.

An evaluation committee constituted by the CBCB has found the violation of stringent standards by the Okhla plant. According to the committee report, there is a deviation from the technology outlined in the DPR and EIA reports submitted by the project proponent. The report suggests that the modified technology has a risk of producing emissions having severe environmental implications (CPCB, 2011). In May 2013 another round of inspection of the WTE plant at Okhla was done by a six-member committee headed by CPCB on the direction of National Green Tribunal (NGT) dealing with the public interest litigation (PIL) filed by Sukhdev Vihar Resident Welfare Association (RWA) against the plant on the ground of its environmental health impacts on the people living in the vicinity of the plant. According to the report, the levels of dioxins and furans in the vicinity of the plant were several times higher than the permissible limits.

There are several stakeholders outside the official parlance who are not very optimistic about the WTE technology for waste management in Delhi or elsewhere. The informal waste workers and several environmental NGOs argue that once all the three WTE plants are operational in Delhi, they would require approximately 7,300 tons of waste per day to produce the projected amount of energy leaving only about 1,200 tons of waste to share between private contractors and waste-pickers. In other words, there would be a major impact on the livelihood of approximately 300000 informal waste workers involved in the waste recycling chain (Chintan, 2009, 2012).

Residents of Sukhdev Vihar colony, located in the vicinity of the Okhla plant, have filed a PIL against the plant. There are three major arguments against the plant. First, it is not located in the area specified in the EIA. According to the EIA, it should have been located 5 Km away from its existing location near the Okhla Landfill site. Second, it is not one of the five pilot projects that were recommended by the Supreme Court of India as claimed by its proponents. Third, the plant would emit toxic gases such as dioxins and furans, which would have an environmental health impact on the population of 1.5 million inhabiting in its proximity (W.P.(C)No.9901, 2009). In addition, there is also a dissent against the way the public hearing was conducted before the construction of the Okhla plant. The public hearing was scheduled for January 20, 2007. While inspecting the Okhla plant, Environment Minister Jairam Ramesh was informed that only a few government officials attended the public hearing. Residents of the areas surrounding the plant were absent in this consultation. More significantly, the meeting was not held at the

project site, rather, it was held somewhere else in a place called Saket (Lalchandani, 2011). People in the vicinity of the plant complained that it was given clearance without listening to the affected people.

The academics from IIT, Delhi and Jamia Milia Islamia argue that the demerit of such technology is the air pollution that can never be avoided even in highly sophisticated power plants. The additional cost of the complete pollution control systems is about 30 percent of the power plant cost, which makes it financially unattractive to the already high investment system. The pollution is caused mainly due to particulate matter, CO_2, SO_2, NOx, dioxin, and furan. Totally 210 different types of toxins and furans exist, but the Tetra series (containing four chlorine atoms) are believed to be the most toxic. The remaining ash after incineration also contains toxic elements such as arsenic, cadmium, lead, and mercury and treating the ash for the pollutants beyond the limit is another costly affair.

Despite so much of dissent against the Okhla plant in Delhi, presently the Waste to Energy and Technology Council (WTERT) has been propagating WTE technology in India. The WTERT has collaborated with National Environment Engineering Research Institute (NEERI) for the same. As a part of this collaboration, the 1st International Brainstorming workshop on "Waste to Energy in India" was held in Mumbai in August 2012. The Council of Scientific and Industrial Research (CSIR) and NEERI organized the event under the CSIR's mission of Wealth from Waste in association with Earth Engineering Centre, Columbia University, New York. Other collaborating organizations were the Ministry of Forests and Environment (MoEF), Maharashtra Pollution Control Board (MPCB) and Municipal corporations of different cities. The workshop was sponsored by several private companies (Annepu, 2012).

The discussion above shows that despite oppositions by several stakeholders against the WTE technology, it is being pushed with complete ignorance of the existence of decentralised practices of MSW management. In the official parlance, waste has to be dealt with by any means with or without incineration. Generation of energy from waste is a secondary issue and therefore despite the change in technology by the Jindals and violation of emission norms prescribed by the CPCP, the WTE technology is being preferred and promoted by the government.

Centralised solutions vs. decentralised options of MSW management

WTE has been emerging as a major technological option for handling MSW in the Indian cities. Delhi being a capital of the country has been witness to such a case. Three WTE plants are proposed for Delhi. So far, the WTE plant at Okhla with a capacity of 2500 Metric Ton (MT) estimated to generate 16 MW of electricity is operational since 2012. The construction of the plant at Gazipur with a capacity of 1300 MT with an estimation of generating 10 MW energy is completed, but it is not yet operational. The Narela-Bawana plant with a capacity of 1000-4000 MT would produce 35 MW is under construction (DPCC, 2006, 2008, 2010).

Interviews with the officials involved in the process of emergence of WTE in Delhi revealed that there were two main reasons behind the adoption of WTE technology in Delhi. First, it was the non-availability of land for dumping (Landfill) site within and beyond the city, and second, it was the changing nature of the quality of waste having high calorific value. Many government officials including the Chief Engineer, East Delhi Municipal Corporation (EDMC), Senior Environmental Engineer, Delhi Pollution Control Board (DPCB), Scientist, Central Pollution Control Board (CPCB) argue that since there is no land left to create more landfill sites in Delhi, one has to think about an alternative solution for MSW management. Senior Environmental Engineer at DPCB explains, "WTE is the future of MSW management in Delhi. It is not an energy plant; rather, it is a waste management plant." Similar kind of argument was given by an IL&FS official in a focus group discussion on waste to energy initiatives in Delhi organized by Chintan (an NGO) at DPCC office. It is true that WTE has emerged due to lack of options for creating landfill sites, but then its proponents promoted it as an option of renewable energy and intending to earn carbon credits for the same. Further, in favour of WTE based solution, the Senior Environmental Engineer at DPPCC states that with the increasing westernization, WTE plants would be successful in Indian cities because due to changing consumption pattern, there is more use of processed and packaged products. Moisture content in waste is decreasing, and calorific value is increasing. At present 30-35 percent of waste is recycled, 15-20 percent goes to compost plant, and remaining waste is transferred to landfill sites.

The centralised solution of MSW management dominated by WTE technology in Delhi is implemented through a new governance model of public-private participation (PPP). The private companies that are involved in WTE project in Delhi under PPP include Jindal Ecopolis, IL&FS, and Ramky. The WTE projects in Delhi usually have a tripartite agreement between Municipal Corporation of Delhi (MCD), Delhi Government and a private company. The Delhi Government provides land for

the plant and also monitors the emission levels of the plant. The MCD provides garbage for processing and recovering energy.

Alongside free land and garbage, there are many other kinds of incentives availed by the private companies managing WTE projects. There are four broad categories of incentives provided to the operator of WTE plants in Delhi including carbon credits, free land, funds for generating per MW energy and subsidy. The first incentive is in the form of getting carbon credit through clean development mechanism. The WTE plants in Delhi are registered to earn 2.6 million CER over ten years period (JindalITF, 2014). It has to be noted that presently the Okhla WTE plant run by the Jindals is not registered under the CDM. The Senior Executive of Jindal's explained that initially this plant was registered for CDM based on the technology proposed in the DPR. Now there have been changes in the project design and process, so they had to make a fresh application for earning carbon credits. The first review of their application is already over by the UNFCC. The process is still on where validation and verification of the project are done by Validator. Project design change review is also done.

The second incentive, in the form of land, has been given by the Municipal Corporation of Delhi or New Delhi Municipal Council through Delhi Development Authority to all the three plants on the lease of 25 years, which can be extended on the success of the project (MOF, 2014). The main argument behind the adoption of WTE technology is non-availability of land for making more landfill sites in the city. The landfill is a good or bad option for managing waste is an important question, and one needs to engage critically with it, but it is not the focus of this current paper. However, it is argued that on the one hand there is a scarcity of land for creating landfill sites, on the other hand, a huge amount of land is being given on free of cost to the private companies for setting up WTE plants in Delhi. The Jindals got 13.5 acres of land for Okhla plant while IL&FS was given 5.7 acres for the Ghazipur plant. Ramky got the highest amount of 100 acres of land to set up an integrated waste management plant at Narela-Bawana (DPCC, 2006, 2008, 2010).

The third kind of incentive is paid by the MNRE. Presently the WTE projects receive 20 million rupees for the generation of each megawatt of energy from MNRE under the 'energy recovery programme from urban waste'. Besides receiving fund from the MNRE, the WTE plant would also receive tipping fee from the concerned municipality. Currently, the Okhla plant has been receiving tipping fee of Rs. 500 to 1000 from MCD and NDMC for incinerating every ton of waste.

In addition to all these incentives, WTE is further promoted through subsidy and other kinds of initiatives. In its budget speech of 2013, the Finance Minister P

Chidambaram announced a scheme to encourage cities and municipalities to take up WTE projects in PPP mode. The finance minister announced different instruments such as viability gap funding, repayable grant and low-cost capital to encourage civic bodies to set up such plants (Pereira, 2013, Feb 28). In support of this announcement, the chairperson of ICRIER argues that by encouraging WTE projects, the government can kill two birds with one stone. We can clean our cities by scientifically disposing of solid waste and generating electricity, and at the same time, help reduces the large electricity deficit in the country (Ahluwalia, 2013, March 6). In contrast, Ravi Agarwal states, "it is a very skewed way of looking at things. Why is burning waste the most important thing? We still don't have the infrastructure to regulate these toxic emissions, which are critical. Why can't we focus on recycling and composting as a means to tackle the problem of waste management? Composting plants failed not because of the method, but because it couldn't survive in the market. You subsidize fertilizers but don't provide subsidies for compost" (quoted in Pereira, 2013).

Contrary to the centralised solutions of waste management dependent on large technologies, there are different kinds of decentralised options of MSW management such as involvement of informal waste pickers a the level of primary collection and segregation of waste, recycling of non-biodegradable waste, decentralised composting and extraction of compressed natural gas (CNG) from biodegradable waste, etc. MSW comprises approximately 30 percent of recyclable waste (TERI, 2002). According to the study done by Institute of Human Development, there are 54 different kinds of recyclables items in the waste generated in a city like Delhi (Bhargava, Gupta, & Kumar, 2012). Presently in Delhi, the informal sector involved in the recycling of these items reduce 1500 MT load of waste disposal. Official data suggest that, during 2002-03, waste trading added social value of 358.7 crores in Delhi (Khandelwal, 2012). There is a huge army of informal waste pickers in Delhi that contribute in this process. It is estimated that there are approximately 300000 informal waste pickers in Delhi. (ref.)

The role of informal waste pickers has been very well recognised by national policies on urban waste, and several recommendations have also been made (Burman, 1999; CPHEEO, 2005; MOEF, 2010). Bajaj Committee recommended cooperative for waste workers, community toilet, bath, etc. for their hygiene and also arrangements to conduct non-formal education and training for them (PlanningCommission, 1995). The Burman Committee report states, "NGOs may be encouraged to enter into the field of organising ragpickers [informal waste workers] in doorstep collection of waste and ULBs may provide financial and logistic support to NGOs for the purpose" (Burman, 1999). TAG also suggests that

NGOs/CBOs should be involved for primary collection by charging a small user fee. They can organise ragpickers for collection, segregation of recyclable, as also involve them in decentralised composting (CPHEEO, 2005). The report by the MOEF also mentions that collection of segregated waste should be done by NGOs, associations of waste workers or Self Help Group. Inorganic waste should be channelised through informal sector to the registered recyclers for recycling, and only the remaining waste should be transported to the landfill sites (MOEF, 2010). Thus, we can see that there were several policy recommendations on incorporating informal waste pickers with the formal system of waste management, However, but they were neither incorporated into the MSW Rules 2000 nor translated into any other form of action. Despite negligence in the policies and plans, there are several successful examples of recognition of the waste pickers and decentralised practices of waste management.

The initiatives in Pune led by the Kagad Kach Patra Kahstakari Panchayat (KKPKP) – Scrap Collectors Association – has set a precedence by demonstrating waste pickers' efficiency in recovering the materials for recycling, generation of employment for the waste pickers and their contribution to the public health and environment. With this initiative, the waste pickers of Pune city were able to get their photo-identity cards in the 1990s. Later, in 2007, SWaCH (an acronym for Solid Waste Collection Handling that also means clean, in the local language) – a wholly worker-owned cooperative of waste pickers was formed to integrate waste pickers into the municipal system (Chikarmane, 2012). The formal Memorandum of Understanding (MoU) was signed with the Pune Municipal Corporation (PMC) in 2008. There are three stakeholders involved in the door-to-door waste collection system of SWaCH model. These are the Pune Municipal Corporation (PMC), the citizens and the waste pickers. PMC is responsible for covering administrative and management cost of the cooperative and equipment (carts, gloves, masks, slippers, scarves, coats and uniform, etc.). Citizens were made mandatory to segregate the waste as well as pay the user fee to the waste pickers for collecting the waste from the household. Waste pickers are responsible for the decentralised processing and recycling of waste, which includes door-to-door collection, segregation, decentralised composting, and transfer of remaining waste to the transportation vehicles of PMC. The new SWaCH model has provided a lot of social and economic security to the waste pickers of Pune.

In a similar vein, Self-Employed Women's Association (SEWA) in Ahmedabad has organised 49240 waste pickers and cleaners in Ahmedabad. Despite privatisation of primary and secondary collection in the city, SEWA has been organizing women waste pickers and has constituted Gitanjali Cooperative Society of waste pickers.

Due to SEWA's effort, there is a verbal understanding with municipality regarding door-to-door collection by members of cooperative in selective colonies. The cooperative gets Rs.10 from the municipality for collecting waste from each house, and it pays at the rate of Rs. 8 to each waste picker. So, the total wage of each waste picker is Rs. 2000 per month with some additional earning of Rs. 200-250 by selling the recyclables, which they procure during collection. There is also a stationary unit of Gitanjali cooperative. The members in this cooperative are waste pickers who lost their livelihood after the privatisation of MSW and also the daughters/daughters-in-law of erstwhile waste pickers. The stationary unit is involved in making various products out of recycled waste. These include notebooks, notepads, diaries, pen, pen stand, paper bags innovative jewellery, etc. There are around 150 women employed in the stationary unit. They get a wage of Rs. 3000 per month. In addition to wages, they also avail the other benefits because of their association with the cooperative. Being a member of Gitanjali Cooperative provides a great sense of social security to the waste pickers. Some of the waste pickers members of SEWA are also part of Urban Informal Economy Board (city level). The board issues them identity card and provide medical benefits, tools, and equipment, skill upgrading training, etc. SEWA played a significant role in the creation of this board. The creation of board by the Ahmadabad administration is a big achievement of SEWA. The board not only provides recognition to the waste pickers, but they also give a sense of recognition to them.

Alongside involvement of informal waste pickers in the process of primary collection and segregation, there are also examples of decentralised technologies of waste management across the Indian cities. Parisar Vikas programme initiated by the Stree Mukti Sanghtana (SMS) in Mumbai is one of the most successful cases. The Parisar Vikas programme was launched in the year 1998 by the Stree Mukti Sanghatana with the cooperation of the Municipal Corporation of Greater Mumbai (MCGM). Under this programme, decentralised composting and bio-methanation are being run successfully at many places in 13 wards of Mumbai, including Tata Institute of Social Sciences (TISS), Tata Institute of Fundamental Research (TIFR), various housing societies, etc. SMS have constructed 4 Nisargaruna plant and have been maintaining eight under the guidance of Bhabha Atomic Research Centre (BARC) for processing biodegradable waste and generating Biogas and high-quality manure. Each plant saves Rs. 250 /-per day tipping fee and transport cost of Rs. 3 per kg. per day for MCGM apart from saving space at dumping ground, transport cost of cylinders and other environmental benefits (Stree Mukti Sanghatana, 2014).

It is quite evident that existing system of MSW management in most Indian cities is predominantly occupied by the treatment based waste disposal practices. Dumping

of waste over the landfill sites or incineration based waste processing mechanism is projected as a practically realisable alternative to get rid of an ever-increasing volume of waste in the cities. Contrary to this, there are several examples of resource recovery and recycling driven alternatives that are less energy intensive and might have low carbon footprints are yet to appear in the mainstream discourse of municipal policies and planning activities.

Concluding Observations

The changing patterns of urban consumption and associated waste generation require sustainable solutions to urban waste management that simultaneously addresses environmental and social challenges, embrace opportunities to reuse and recycle, engage with citizens and be responsive to changing circumstances.

The current solid waste management interventions in Delhi and other Indian cities are being made on the basis of a standardized model of flows of waste that incompletely reflect the ground situation in a number of important ways. There is a significant push for PPP and capital-intensive technologies in the recent solid waste management policies in India. WTE technology has been becoming a major solution for waste management problems. The detailed analysis of the emergence of WTE technology in Delhi reveals that it is an outcome of top-down process pushed by powerful stakeholders both from outside the country and within. This includes several companies and consultants. There has been no involvement of stakeholders at the bottom in the decision-making process.

The existing approach of viewing waste flows as a linear process fails in addressing threats to the environment, health, and livelihoods of local residents. It is argued that centralised solutions of waste management could intensify these risks instead of minimising them. Evidence from the waste to energy plant reveals that in the crisis of solid waste management, though it is resolving one set of problems of waste disposal, it is exacerbating the problems of environmental health and social justice.

It also overlooks opportunities for more innovative solutions. The case of public-private partnership is however quite ineffective for primary collection and segregation. Some private companies have also started realising these challenges. New system between private companies and the informal sector has been emerging. The private companies are now formally contracting waste pickers' for local functions. Such contract for primary collection and segregation could be given

directly to the informal sector by the municipalities through Resident Welfare Associations (RWAs) or NGOs. Alongside space for segregation of waste should be provided for waste pickers with proper hygiene standards.

Some waste streams like bio medical waste, e-waste or plastic waste, construction and demolition waste need technical interventions that work best at larger scale owing to the kind of technologies needed as well as the regulation required to keep their operations within discharge and emission limits. However, degradable solid waste, such as is generated in households, institutions and markets places, by its very nature can be processed using technologies such as composting and bio-methanation, which can be applied both centrally as well as at local levels. Biodegradable waste can also be handled in a decentralised manner. Possibilities of supplying compost on subsidy for urban/peri-urban agriculture should be explored. There is also a need to incentivise small-decentralised projects supporting other local technologies as well as other 'solutions' for different stages of waste management.

Finally, it seems that there is an urgent need to rethink urban waste management strategies through a sustainability lens that can bring together and address environmental, health and social justice concerns. It also argues that a number of alternative waste management scenarios, institutional and regulatory arrangements are possible.

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