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PPPs in Solid Waste Management in India

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PPPS IN SOLID WASTE MANAGEMENT IN INDIA

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Abstract

Rapid urbanisation, industrialisation and growth of disposable income have led to higher rates of Municipal Solid Waste generation. The Urban Local Bodies are unable to meet the rapidly growing challenge. They have increasingly sought private participation to manage entire Solid Waste Management (SWM) systems; more frequently PPPs are used to scale up capacity. We examine select PPP projects in SWM to identify the determinants of success. The design and structuring of the project is key to the success of PPPs, with the flexibility for renegotiation at critical points. We also conclude that small scale decentralised projects are more appropriate, with the assimilation of the informal groups.

Keywords: Privatization, Municipal Waste Management, Environment

1 introduction

The Environment Protection Agency defines trash as Municipal Solid Waste (MSW). The Municipal Solid waste management Rules 2000, defines MSW to include commercial and residential wastes which are generated in municipal or notified areas in either solid or semi-solid form. It is estimated that India produces about 100,000 MT of MSW daily.

Rapid urbanisation, industrialisation and growth of disposable income have led to higher rates of MSW generation throughout modern India. Various studies by the National Environmental Engineering Institute indicate the quantum of MSW generated is between 0.2 to 0.4 kg/capita/day in urban cities. City residents are estimated to generate 2–3 times more waste than rural residents.

The World Bank estimates a 1.3% per cent annual growth in the waste generation to reach 0.7 kg/capita/day of waste by the year 2025 (Imura et al., 2005). The urban population in India is expected to grow to 45% of the total from the prevailing 28%, which will significantly increase the MSW challenges.

Improper solid waste management deteriorates public health, causes environmental pollution, accelerates natural resources degradation, causes climate change and impacts the quality of life of citizens.

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The management of MSW is a public good; it is part of public health and sanitation. It is a critical element of sustainable metropolitan development. As MSW management services have a local character, the Urban Local Bodies (ULBs) or Municipalities are best positioned to provide them.

The ULBs have traditionally employed their own workforce to provide solid waste management services. However, the ULBs are unable to cope with the scale and speed of growth of generated waste. ULBs lack requisite capacity, management systems, infrastructure, and the strategic planning skills for this challenge. They gradually resorted to contracting out such services to the private operators. Increasingly, they have sought private participation to manage entire SWM systems.

The Public Private Participation (PPP) is a promising option to augment the government's capability. The primary incentives for using PPPs is the growing realisation that the public sector often has the financial, technical and institutional limitations in executing & managing large SWM projects. PPPs are designed to harness the wide range of managerial, commercial and technical skills of the private sector.

A competitive PPP contract model is superior in delivering such services because it encourages efficiency stemming from the inherent competition among market players. However, competition in the market is difficult in the case of MSW management services due to their inherent nature. As such, there is a need for setting proper criteria and corresponding limits in PPP contracts and the need to bring in more bidders for the market (Dolla and Laishram, 2019).

Proper market orientation affects the incentives of private firms to participate in any PPP in infrastructure projects (Forrer and Kee, 2002). A significant challenge in waste management PPPs projects is the need for periodic revisions of tariffs during the lifetime to compensate the changes in the macroeconomic environment while keeping the interests of the public in mind (Ye and Tiong, 2003).

This paper reviews select Municipal Solid Waste management projects developed on public private participation to identify key issues and elements of success for such projects.

2 municipal solid waste management

2.1 Waste Generation

MSW is a major cause of pollution (Kumar et al., 2004). About US $410 billion is spent every year to manage four billion Mt of MSW worldwide (Sanjeevi and Shahabudeen, 2016). This usually includes household garbage and rubbish, street sweepings, construction and demolition debris, sanitation residues, trade and non-hazardous industrial refuse and treated bio-medical solid waste (Joseph, 2002).

India produces significantly lower volumes of waste as compared to the developed economies around the world. The household per capita waste generation is positively correlated with income and education levels and negatively related to household size (Ramachandra et al., 2018). Consequently, a disproportionately higher volume of urban waste is generated per capita relative to the overall economic status given the affluence of urban residents. India's urban population grew at a rate of 31.8% during the last decade to 377 Million, which is higher than the entire population of the USA (Calautit et al., 2017; Subramani, Florence, and Kavitha, 2014).

An estimated 68.8 MT of MSW is generated by about 380 million urban population annually. This waste has the potential of generating 439 MW of power from 32,890 TPD of combustible wastes, 72 MW of electricity from biogas, and 5.4 million metric tonnes of compost annually to support agriculture. The existing policies, programmes and management structure do not adequately address the immediate challenge of managing this waste which is projected to be 165 million tonnes by 2031 and 436 million tonnes by 2050.

MSW needs to be collected, segregated, transported, stored, treated and before disposal. The waste collection efficiency ranges between 70% and 95% in metropolitan cities, whereas in several smaller cities, it is below 50% (Subramani, Florence, and Kavitha, 2014; Sharholy et al., 2007). The rest of the waste is disposed of in open dumps (Sharma and Jain, 2019; Joshi and Ahmed, 2016).

A substantial part of the waste is littered, which has consequences for public health (Kumar et al., 2017; Kumar et al., 2009). The indiscriminate disposal of waste on the outskirts of cities without any prior treatment, leads to groundwater contamination and increases air pollution due to leachate percolation and the release of gases, which causes health problems such as diarrhoea, cholera and malaria among the masses which results in a loss of human resources, economic output and lower quality of life. A significant part of the waste is also littered on the road, due to poor discipline among the generators and the absence of appropriate and adequate storage capacity.

The existing waste collection system leverages the abundance of rag pickers in the country. A substantial amount of MSW is recycled and reused through the primary intervention of rag pickers and second-hand markets and recycling industries (Sterner and Köhlin, 2003). This labour-intensive model of waste disposal provides livelihood to a large number of ragpickers.

The government is aware of the significant contribution of this informal group of waste collectors and is sensitive to their impact of future policies on them. There is increasing awareness of the health hazards along with the degradation and devaluation of the recyclables collected by the rag pickers. With rapid increase in the MSW challenge coupled with rapid techno-economic developments, these traditional 'values' will lose ground.

2.2 Integrated Solid Waste Management

The Municipal Solid Waste Rules 2000 and 2016 provide valuable guidelines to Urban Local Bodies for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes.

The MSW needs to be segregated at source, preferably with use of specialised waste processing facilities to separate recyclable materials, this process can be greatly facilitated if the residents can make efforts to segregate and then dispose of their wastes. The presence of organic matter in tremendous proportions in the Indian MSW suggests the desirability of biological processing of wastes. The inability to ensure segregation of Solid Waste and associated challenges leads to the release of un-wanted toxic pollutants into the atmosphere.

The open waste dumps account for about 12 per cent of the total global emissions of methane (Subramani, Florence, and Kavitha, 2014). Chandra and Devi (2009) argue that MSW should be recognised as a resource material for the production of energy, compost and fuel. Various studies like Ramachandra et al. (2018) indicate that up to 80% of the solid waste can be recycled.

A theoretical framework of an integrated approach of a solid waste management system including waste to energy and the challenges faced by developed and developing countries is provided in (Bhanot et al., 2019).

Combustion of waste is the cheapest way to dispose of waste; consequently, many people burn their waste, notwithstanding the many threats associated with it. However, waste incineration on an industrial scale is complicated and an expensive process to ensure regulatory compliance with emission limits (Jouhara et al., 2017).

Waste to energy can be considered as a potential alternative source of energy, which is economically viable and environmentally sustainable (Negi et al., 2019). CDM projects for MSW management which can contribute to emission reduction and assist in reducing pollutants and landfill space, and generating energy and useful by-products. (Potdar et al., 2016; Sharma and Jain, 2019).

The Ministry of Non-conventional Energy Sources (MNES) initiated a pilot program to promote waste to energy WTE projects in India in 1996, which has led to a new era of waste-to-energy programs in the country. Sites allocated for landfills are used as open dumping sites where far too much waste is dumped without resource recovery, generating leachate and methane gas and indicates the potential for waste to energy (Patel and Ahluwalia, 2018).

The Ministry is promoting all technology options available for setting up projects for recovery of energy from urban wastes. Waste-to-energy (bio-methanation, palletisation, incineration) are some leading methods of waste processing adopted. In developed countries, environmental concerns rather than energy recovery are the prime motivator for waste-to-energy facilities, which help in treating and disposing of wastes. The energy in the form of biogas, heat or power is preferable, as it improves the viability of such projects. While incineration and

bio-methanation are the most common technologies, pyrolysis and gasification are also emerging as preferred options.

The significant advantages for adopting technologies for recovery of energy from urban wastes are to reduce the quantity of waste and a net reduction in environmental pollution, besides generation of a substantial quantity of energy. However, the public response to these MSW initiatives is generally in line with NIMBY (Fischer, 1995). The lack of a clear connection from the collection point and the final disposal areas has added to the resistance.

Incinerators are associated with cremation in India. Consequently, public perception is negative for housing such a facility in their vicinity, which results in the execution delays and e failures, as in the case of Perungudi solid waste to an energy recycling facility. It was set up in local dumpsite in Chennai for the conversion of 600 MTPD of MSW to 14.85 Mw electricity through the Pyrolysis and Gasification route but did not materialise due to public protests.

The processing plants in major cities run as departments of the ULBs or public sectors undertaking. These have heavy subsidies and have generally suffered from poor technologies, using inappropriate technologies and over. Also, financial and marketing aspects have not been given importance resulting in poor management and high operational costs.

A new framework for inter-regional mega waste projects could serve more than one municipalities. The underlying reasons are a shortage of landfills and better financial viability of the project. However, ULBs, waste management systems, are traditionally 'centralised services' with one authority for the whole city.

The weakest points of centralised waste management systems are the transportation of waste to large processing facilities and the requirements of complex waste separation systems (Jouhara et al., 2017).

The discussion suggests that a decentralised system could be more amenable for the participation of the local community and Waste to Energy configuration. A decentralised system offers some advantages. Such schemes provide income and employment options to the lower sections of society. It is also more aesthetic, and it will not require a secondary collection service by the ULBs.

3 ppps in urban waste management

The MSW practices in major cities are grossly inadequate and requires considerable improvements (Sharma, Ganguly, and Gupta, 2018). Most ULBs are unable to manage such a large amount of solid waste due to inadequate manpower, financial debilities and inadequate infrastructure. The waste collection fee is at best an instrument in affluent districts. The limited revenues earmarked for the municipalities make them ill-equipped to provide for the high cost involved in the collection, storage, treatment and proper disposal of waste.

The ULBs spend a significant share of their budget in MSW management in the range of 5 - 25%. This translates to approximately Rs.500 to Rs.1500 per tonne for

collection, transportation, treatment and their disposal. Of this, about 60–70% is spent on collection, 20–30% on transportation and less than 5% on processing and final disposal (Visvanathan et al., 2004). In major cities transport costs are more significant proportion of the MSW management costs, constituting more than 50% of expenditure even with GIS and related optimization of hauling routes (Sanjeevi and Shahabudeen, 2016).

PPPs can be used for urban waste management (Meng, 2017; Narayan and Sharma, 2016). PPPs are facilitated with the development of enabling legislation, facilitation of licensing procedures, and activation of the Investment Promotion Law (Saadeh, Al-Khatib, and Kontogianni, 2019; Spoann et al., 2019).

The PPP experiences in MSW in many parts of the world have been positive and addresses the capacity constraint challenges (Siagian et al., 2019). PPPs are expected to eliminate decision making in the managerial bureaucracy associated with the public sector (Perrot and Chatelus, 2000). It is a promising option to augment the government's capability.

The primary incentives for using PPPs is the growing realization that the public sector often poses financial, technical and institutional limitations in executing and managing such projects. The public authority remains 'responsible' to the public for the performance of solid waste management services.

During the last decade, most major ULBs have called for proposals for Solid waste management (SWM) on PPP basis. The ULBs outsource services which they are unable to provide. The services are outsourced after appropriately defining it to fit into the larger SWM plan of the ULBs like the provision of specified solid waste collection, transportation, treatment, processing, and disposal services. More frequently, such services are being provided on PPP basis and scale up capacity.

One of the earliest PPP ventures for a compost plant was in July 2000. POABS Envirotech Private Limited (POABS) set up a large compost plant of 300 TPD capacity at Thiruvananthapuram, in Kerala. The facility could process MSW into Organic Bio Manure under one roof of 1,25,000 square feet. However, the plant's suffered from inadequacies related to managing the rejects and disposal of residues.

The Lucknow city bio-methanation project was conceived on a PPP basis in 1998 and completed only in August 2003. The BOT project was subject of multiple controversies, which considerably delayed transfer of land, government guarantee, identification of financiers and other activities. The project also suffered from the non-availability of acceptable waste and has reportedly become non-operational.

The Tirupur Water Supply Project discussed below is another example of a project conceptualized as a PPP on BOT basis. It was touted as first of its kind success. However, with the change in the international economic environment, the demand fell sharply, and the project is unable to meet with its debt and equity obligations.

Other challenges have also been reported in similar projects. The quality of the waste available for such plants has significantly varied from what was initially projected and tested. A significant finding has been that the operators tasked with providing the waste, mix the waste with sand and construction debris to meet weight and volume targets. This adulterated waste having a large percentage of inert material exceeds the design parameters with resultant operational difficulties and failures.

Considerable challenges exist in structuring and implementation of PPP projects given the lack of enabling legal and regulatory environment at the ULB level and general lack of confidence in managing PPP related contracts, capacity and knowledge gaps among institutions and key stakeholders.

The focus of the SWM PPP contracts should be on the flexibility and dynamism and not on comprehensiveness. However, a lack of comprehensiveness can lead to a conflict of interests between the private and public entities which can emanate from two factors: (a) the contract cannot be fully specified, or complete (b) the participants have different objective functions (goals). The private sector participant seeks to maximize risk-adjusted profits over the contract life. Given that the contract cannot be fully specified ex-ante, this implies that participants will maximize the expected NPV of the contract at the beginning and at any other time during the life of the contract. i.e. profit maximization is not a one-period phenomenon. If new profit opportunities are seen as the contract unfolds, they will seek to capture them (Vining and Boardman, 2008).

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) intends to promote PPPs in urban India. Given the PPP experience in the SWM sector, the expert opinion is that PPPs in the sector requires considerable customisation.

The revenue and financial incentives could flow from grants, subsidies, viability funding, government equity, carbon credits and user fees. There is potential for progressive levy of fees on uptown and corporate locations.

Palanichamy (2015) provides a framework to compare the economic viability of waste to energy projects with wind farm projects of the same megawatt capacity by using the same equity/debt ratios. It concludes that the capital cost, as well as the operation and maintenance costs of the MSW projects, are higher than the wind farm project. However, the net operating profit per annum from the MSW projects are found to be much higher than that of the wind farm projects. The ten year payback period of the MSW projects is considerably reduced if the revenues due from by-products generated from the MSW-fuelled power plant are also considered.

Most PPP concession in sector ranged from 6 years to 30 years. There appears no clear advantage of centralized schemes over decentralized schemes, a big project over a small/single operator project.

3.1 Select Cases of PPPs in Waste Management

3.1.1 Tirupur Municipal Corporation

Privatisation of solid waste has been a contested issue in Tamil Nadu. The Tirupur Municipal Corporation privatized the SWM and awarded a concession to a private operator in 1998. The municipal workers collect waste and supply it to a treatment facility which would be developed and operated by a private operator over the fixed concession period.

A large informal group of rag-pickers earn their livelihood from gathering solid waste and segregating them in search of recyclables that they can sell. Considering these sensitivities, the ULB did not privatize waste collection, which ensured a central role for the rag-pickers in the new scheme of things. The private operator was required to segregate the biodegradable and non-biodegradable solid waste components. The biodegradable components would be processed in the treatment facility and turned into manure, which was then sold as fertilizer, the sole source of revenue for the private operator.

The non-biodegradable waste is sent to landfills. The corporation bore the risk of supplying 100 Metric Tons (MT) of mixed waste every day, and it expected that around 40 MT of waste of that would be biodegradable. New legislation in 2000 mandated segregation of waste at the source and not at the processing facility. Subsequently, the ULB proposed that it would supply 40MT of segregated biodegradable waste in lieu of supplying 100MT of un-segregated garbage. However, the private operator refused to operate the facility unless the municipality supplies 100 MT of biodegradable waste, the quantity specified in the original agreement. This resulted in arbitration proceedings which delayed the projects considerably.

The ULB manages about 10 lakh residents, who generate about 520 tons of MSW per day. The MSW rules require the local bodies to have a separate garbage dumping yard to segregate the waste, which should be recycled and reused. However, Tirupur corporation has been switching to different stone quarries to dump all kinds of wastes collected from the wards. It still does not have a designated dumping yard.

ULB had tried to create designated dumping yards and had also started with some projects for producing manure from waste. But all such projects failed and culminated in open dumping. New initiatives to produce biomass from green waste has started with the signing of an MOU with the Central Leather and Research Institute

Tirupur city was recently in the news as the ULB reduced the frequency of removing MSW from one day to 3–4 days. The denizens protested the move, and the ULB is struggling to alternative dumping locations.

The corporation shifts locations after utilizing various stone quarry pits for dumping to capacity. First in Nallur, then Velliyangadu, and now in Kanjampalayam.

However, there is increasing resistance from local residents for such activities in their backyard.

The key issues related to the failure of the project was the absence of public support, waste quality, and waste quantity. The initial land acquisitions were well executed by public authority. However, the project was not well structured, and it lacked market orientation. The project had no clarity on the buyers for the energy produced by the facility.

3.1.2 Alandur Solid Waste Management Project

The techno-economic feasibility study and project structuring of the Alandur municipality SWM project on PPP basis was done by PwC. The project envisaged privatising only the waste collection process., and the waste processing facility was retained within the corporation's control.

The private operator's responsibility during the concession period was restricted to the collection of garbage and transferring the same to the processing and landfill areas. Such a system incentivized the private operator to increase the amount of waste collected. The operator was paid for the amount of waste collected. This system created a perverse incentive for the private operator to mix construction debris and other materials in the waste in order to earn higher revenues. This problem was overcome by amending the agreement with the private operator by agreeing on a fixed fee to be paid on a daily basis, irrespective of the amount of waste collected.

The project involved the local resident's associations in the system. The residents were charged with monitoring the operations and providing the operator with a certificate of satisfaction which was the basis on which the municipality released payments to the operator. The direct involvement of the residents ensured the overall objective of clean streets and with considerably reduced social risks.

The project is worthy of emulation, as it involved a service never before made available by the city, with financing and management responsibilities being shared by the ULB, residents, the private sector, and the State Government bodies. The key features of the success of the project was an effective outreach program, direct involvement of the residents, affordable and effective sewer fee system. The auction system for selecting the operator was a transparent competitive bidding process, contracting procedures and payment assurances to the private sector operators.

3.1.3 Kochi Waste to Energy Project

The Kerala Sustainable Urban Development Project (KSUDP) 2006 survey indicates that the waste generation in Kochi city was about 295 tonnes per day. It is estimated that about 450 tonnes per day of waste would be generated in 2016.

The proposed Kochi Waste to Energy Project is to be developed on Design, Build, Finance, Operate and Transfer (DBOFT) basis for 20 years. The Public

Private Partnership project is developed by the ULB, Kerala Government and the Government of India. It hopes to position Kochi globally for adopting proven scientific initiative for carbon reduction through sustainable MSW management solution. Eight Hectares of land has been earmarked by Cochin Municipal Corporation for this purpose.

The project requires the Kochi Municipal Corporation to assume responsibility for delivery of 300 Metric Tonnes of Municipal Solid Waste to the facility on a daily basis. The proposed plant will have a gross installed capacity of 12.4 MW. The power generated from MSW would be purchased by Kerala State Electricity Board (KSEB) under a secured power purchase agreement as part of the contract. This green energy power will prevent significant amount of methane and CO2 generation from the existing MSW dumping site.

The total cost of the project is estimated to be INR 295 CR. Total debt and equity that needs to be raised are INR 206 CR and INR 89 CR respectively, which translate to a Debt to Equity ratio of 70:30. The tenure of the loan is considered to be 12 years with a moratorium period of 2 years. Majority of the revenue comes from the sale of electricity. The plant also produces around 28- 30 tons per day of aggregate suitable for the manufacture of secondary products such as bricks, tiles etc. Where possible recycled materials such as (plastics and metals) are sold to reduce the burden on electricity price. The quoted tariff as per the concession agreement for the first 250 kwh/ton of electricity (Net electricity) is Rs 15 per kWh indexed to 60% of WPI as of Dec 2014. The requested Levelized Tariff for Net Electricity Excess with revenue sharing of 20% with Cochin Municipal Corporation is Rs 13.8 per kWh.

The capital cost for this project is significantly lower than the European projects due to the local sourcing of some of the proven project components. The concession agreement ensures a guaranteed price for electricity from KMC, and additional revenue will be generated from recycled material and the concrete blocks manufactured using aggregates and residual bottom ash.

4 conclusion

Public-Private Partnerships has proved to be a viable option to augment and improve MSW management services. A suitable legislative and regulatory environment will have the ability to promote PPPs. The establishment of good public governance in compliance with the secured regulatory framework and appropriate financial support and strict contract implementation is required for the success of PPP models. The Alandur SWM project suggests that it is essential to allow for the direct participation of the local stakeholders to exert a positive influence on the project execution.

The ability of the PPP contracts to transfers risks to the party most suitable to handle it and ability to enhance, quality, time and cost-efficiency in the projects. The design and structuring of the project is key to the success of PPPs. None-the-less, what is perfect now could become a liability over the long concession

duration. The economic, regulatory, and technological environment could change significantly. A correctly structured project could become flawed after some time. Hence there is a need for flexibility to allow for negotiation at critical points or threshold values.

The Indian experience with PPPs has been encouraging. The public perception is a critical aspect for the success of SWM PPP projects. The public needs to be sensitised to the benefits of the projects, the cost involved, willingness to pay concerns, dispel bias against private participation. There is a need to encourage segregation of waste at the household. A salient point in the Indian context is the need to assimilate the informal group of rag pickers in any such system.

An important learning from waste management projects has been that there is a large deviation from the initial estimates of the quality and quantity of waste. A decentralised system is therefore recommended. A successful small scale model not only has less demand for managerial skills and collateral impacts on the society but is also more aesthetic. The cost-benefit analysis is easier to visualise, and successful models can be easily replicated. Small scale projects are more agile to deal with these deviations, have the added advantage of involving the local populace and facilitate employment options to the underprivileged sections of the society.

A key issue in PPP for the private sector is the profit motive and recovery of investments. This essentially means tariffs and volumes. There is a need to create a market for the compositor other products of the waste recycling facility to bring in the financial incentives for a PPP. At present, the output is given away to the public or used in the farms.

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