Digital Assignment – III

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Q1) Prepare project proposal to be submitted to any Indian Government agencies or private sector for funding. The proposal should be framed in accordance with the points discussed in the class.

Abstract:

Municipal solid waste (MSW) services of developing countries often suffer from the lack of financial and operational autonomy, scientific approach, and resources. Compared to the solid waste management (SWM) practices of developed countries where participation and collaboration with private sector contributes to efficiency, developing economies depend on local municipalities to own and operate these services, not always efficiently though. With the demands of augmenting efficient and cost-effective SWM services to the expanding population of cities and towns of newly industrialized nations on the rise, municipalities are under pressure to adopt ways and means that can support it with efficient utilization of resources and better decision-making capabilities. This paper reflects on the current state of MSW services and its management in India and explores full cost accounting framework in its ability to generate information on cost-related aspects and sustainable deployment of resources. Lastly, the extensibility of the framework is tested by integrating externalities of MSW services.

Introduction :

Efficient and effective municipal solid waste management (MSWM) is a contentious and political issue in newly industrialized economies. In India, solid waste management (SWM) is the sole responsibility of local municipal bodies, but it is also a complex interaction of multiple stakeholders or constituents, who are part of it or participate in it. These stakeholders can be grouped into public sector (national, state, and local authorities to fund the SWM activities), private sector (large and small enterprises which carry out different municipal activities), informal sector entities (rag-pickers, itinerant buyers, traders and small-scale recyclers), and local communities and its agencies (including NGOs and voluntary bodies). With the 74th constitutional amendment, the purview of local municipalities in India is extended to include urban local bodies (ULBs). The expanded responsibilities of the ULBs include policy formulation and implementation of urban administration policies like social development, public health and sanitation, slum development, etc. However, the governance of ULBs is not uniform and depends on the current

status of its adoption of the said amendment by the respective municipalities of the regions (Mahadevia and Wolfe, 2008).

Along with the aforesaid complexities, municipalities in India are yet to be self-sufficient, as they depend on state and central agencies for financing its SWM and other activities. Until recently, municipal bodies have been following cash basis of accounting to record financial transactions based the flow of funds, which might not differentiate capital from revenue expenditures as per commercial accounting terms (ICAI, 2009; NIUA, 2010). The lack of transparency in accounting functions of municipalities and unavailability of its performance However, in the era of rapid industrialization, demand for efficiency in public services, rapid subcontracting, and participation with private sector, it is imperative for the policy makers and local administrators to understand the cost related implications of their decisions. Full Cost Accounting (FCA) is one of the decision-making frameworks recommended for SWM services in literature (EPA, 1997) and provides for the inclusion of external costs within the framework (Antheaume, 2004), through rarely explored for integration of externalities and in the context of MSWM of newly industrialized nations as that of India. With the help of financial data from the annual accounts of Municipal Corporation of Greater Mumbai (MCGM), this paper explores FCA framework the MSW services for the city of Mumbai and expands upon it by including evaluations of two externalities that are integrated within the extended FCA framework. To achieve this objective, the rest of the paper is organized as follows: Section 2 covers literature survey followed by the development of cost objects for FCA to handle SWM in section 3. Section 4 retro-fits the FCA framework with data collected from secondary sources and subsequently improvises it with the costs of externalities. Section 5 discusses and compares the results from FCA-based framework to test its validity in decision-making. Section 6 summarizes the findings from this exploratory study and suggests new areas of research

Literature Review

Review of literature on SWM practices can address multiple disciplines of research and scholarship. The focus of this literature review in this article is to cover contemporary economic outlook and the accounting practices of municipalities, as reported in literature.

Comparative analysis of SWM between developed and newly industrialized nations

SWM practices may differ across countries and different regions may use different set of tools to measure and reflect upon the collective efficiency in dealing with the discards. Tojo (2008) used case study method to understand the effectiveness of SWM policies in Italy, Poland, and Denmark as part of the holistic assessment of waste management technologies (HOLIWEST) project

commissioned by European Union and evidenced well-aligned SWM policies that matches with the overall objectives supporting finance by levying service fees, while Davies (2007) highlighted the privatization and successful transformation of SWM practices in UK and the role of private parties contracted by local municipalities. Qian and Burritt (2007) studied the role of environmental accounting in municipalities and measured the awareness of municipalities through environmental index. Cuadros et al. (2011) investigated waste-to-energy (WTE) options from disposal of bio-wastes in four sites of Spain, while Parra et al. (2008) supported the use of contingent valuation model to develop environmental strategies to handle greenhouse gases (GHG) generated by the farmers of Campo de Dalías, Spain. Eshet et al. (2006) compared the economic valuation methods to review and analyze the valuation of externalities of selected SWM alternatives. Ham et al. (2013) investigated the impacts of closed landfills sites on the property values in Birmingham, UK.

FCA framework in Indian SWM environment

The first part of the study is to explain the cost elements (grouped into variable and fixed costs), followed by developing cost objects and formulation of cost functions. To achieve frugality, the cost elements are pruned to the few important ones.

Cost elements

Variable cost elements (variability with quantity of solid wastes)

a. Labor cost: Wages and benefits of workforce.

b. Running cost of vehicles: Fuel expenses, vehicle contracting charges, and annual depreciation.

c. Repair, maintenance, and servicing costs: Maintenance and service expenses of vehicles and other equipments.

d. Subcontracting: Cost of outsourced SWM services to third-parties.

e. Other expenses and overheads: All other incidental and operating expenditures that show variability with tonnage of waste handled.

Fixed expenses of SWM operations

a. Administrative expenses: Office expenses like communication, conveyance, stationary, etc.

b. Salaries and benefits: Salaries and statutory benefits of office staff.

c. Depreciation: Depreciation of all moveable and immoveable assets associated with the SWM

d. Others: All other expenses not covered and remain fixed over within a year.

Revenue

a. Earnings from the sale of treated/untreated garbage, equipment rentals, rental charges of landfill area (for sorting or recycling), and sale of recyclable items.
b. License, fines, rates and taxes collected from households, shops, markets, commercial establishments, and other contracting agencies.
c. Proceeds from waste-to-energy (WTE), composting, and/or waste recycling projects, less of costs.

Cost objects

Cost objects are the cost pools to link SWM function of a municipality and collect cost through the cost elements discussed earlier. The cost elements are grouped into three main activities of collection, transportation and disposal of wastes (Mahadevia and Wolfe, 2008):

Cost of collection

This includes labor, tools, vehicles, and cost of other direct and indirect expenses to collect wastes from source (households, commercial establishments, markets, industries, etc.). This also includes cost of cleanliness/hygiene of roads and drains in municipal wards.

Cost of transportation

This would include costs of running motorized equipments and vehicles to transport wastes from community and collection bins to sorting stations and from sorting stations to the processing factories or landfill sites. Also, repairs and maintenance of vehicles, depreciation of vehicles and other equipments, etc., can be part of it.

Cost of disposal

This would include the costs of landfilling, depreciated costs of sanitary landfills, costs of waste handling and maintenance at landfill site. This would include the cost of sorting, segregation, and processing waste under waste–to-energy (WTE), waste-to-compost and/or any other initiative, hazardous waste handling, or any other effort to processing wastes. Since, most of the landfill sites in India are dumping grounds, cost of disposal is assumed as negligible.

So, cost of SWM disposal services (SWC) at specific efficiency level: = [Cost of collection + Cost of transportation + Cost of segregation + Cost of Disposal] – Revenue generated by municipalities (1)

Unit cost of SWM services (in functional currency / TPD or tons per day) = Cost of SWM disposal services (in functional currency) / Total quantity of waste collected (TPD) (2)

Table 1

SWM cost sheet on extended FCA framework

Particulars	Collection	Transportation	Disposal	Total
Variable Costs:				
VC 1				
VC 2, etc.				
A) Total variable costs				
Waste Qty.				
Cost/unit				
Efficiency Levels				
Cost at 100% efficiency				
Add: Fixed Costs				
FC 1				
FC 2, etc.				
Total Costs				
B) Total fixed costs				
C) Total Cost (A) + (B)				
Revenue generated:				
R1				
R2, etc.				
D) Total Revenue				
E) **Net Cost (D) – (C)**				
Unit MSW Cost/TPD				

Example – SWM costs of Municipal Corporation of Greater Mumbai (MCGM)
In the absence of cost accounting data of MSWM activities, financial data from the annual account for the year 2011-12 of MCGM is used to experiment with the FCA construct. MCGM adopted accrual basis of accounting in 2007-08 (ICAI, 2009). The data has been sourced from the income statement for salaries, wages, and benefits (account codes 210000000 – 210501301), administrative expenses (account range on 22000000000 – 220809999), and operation and maintenance (O&M) expenditure (account range 230100101 – 230809907) for function codes 44100000000 – 44500000000 that represented gross SWM expenditures. The total SWM function costs obtained from the account code mapping was apportioned into individual cost heads, in the ratio

of its functional break-up to that of account totals. Fee and user charges (from schedule I – 40) provided the income side of the operations (MCGM, 2013). The variable costs are comprised of operation and maintenance (O&M) costs and includes costs of power and fuel, stores consumption, vehicle hire charges, repairs and maintenance, etc. The variables costs are apportioned into the SWM cost function of collection, transportation, and landfill, in the ratio of 7:2:1, based on past experience from similar studies (Hazra and Goel, 2009). Since power & fuel and repair & maintenance of vehicles are part of transportation expenses, 90% of these expenditures are allocated to transportation cost object while 10% has been allocated to landfill. Similarly, fixed expenses have been transformed from establishment (schedule 1-10a) and administrative expenditure (schedule 1-11a), covering the costs of salaries and benefits, communication expenses, travelling and conveyance, other admin expenses, etc., which lacks variability with the tonnage of waste. Due to insufficient information, fixed costs are not apportioned along the individual cost objects.

To derive total SWM generation in the financial period under study, the current census of Mumbai (12.50 million in 2012) is extrapolated by assuming 5% increase in SWM generation rate (from 541 gms/capita/day in 1999 – NIUA, 2005). The calculated level of waste – 7100 TPD (at 568 gms/capita/day) – works out to be slightly higher than that of 6500 TPD, quoted in MCGM website. Variations in the estimates from different sources represent uncertainty that has been inherent part of these studies and points towards the downside of not having a central database. The operational efficiency of MCGM in this analysis is considered at 100% (Rathi, 2007), though nation-wide SWM collection efficiency averages at 72.5% and transportation at 70% (Pattnaik and Reddy, 2010). The SWM function costs of INR 8354 million translates into marginal cost of SWM as INR 1724/TPD and net cost of INR 2880/TPD (table 2). Table 2

Cost of Solid Waste Management in Mumbai (in INR/day, unless specified)

Particulars	Collection	Transportation	Disposal	Total	%age
Variable Costs:					
Power and Fuel	--	1,430,563	158,951	1,589,515	6.94
Consumption of Stores	950,782	271,652	135,826	1,358,260	5.93
Hire Charges	613,271	175,220	87,610	876,101	3.83
Rep and Maint. – Vehicles	--	175,842	19,538	195,380	0.85
Wages	5,753,685	1,643,910	821,955	8,219,550	35.91
A) Total variable costs	**7,317,738**	**3,697,188**	**1,223,881**	**12,238,806**	**53.47**
Waste Collected (TPD)	7100	7100	7100	7100	
Marginal Cost (INR/TPS)	1031	521	183	**1735**	
Add: Fixed Costs:					

Particulars	Collection	Transportation	Disposal	Total	%age
Rents, Rates and Taxes				13,206	0.06
Office Maintenance				15,490	0.07
Salary – Supervisors				7,001,839	30.59
Repairs and Maint. – Others				3,515,783	15.36
Others				102,908	0.45
B) Total fixed costs				**10,649,226**	**46.53**
C) Total Cost (A) + (B)				**22,888,032**	**100**
Total Costs (in INR/TPD)				3224	
Revenue generated:					
Fees and User Charges				2,439,277	
Sale of compost				--	
Earnings from recycling				--	
D) Total Revenue				**2,439,277**	
Total Revenue(INR/TPD)				344	
E) Net Cost (C) - (D)				**20,448,755**	
Net Cost (INR/TPD)				2880	

Externalities within FCA framework

In line with the expectation that FCA framework should be able to handle externalities (IFAC, 2005), the framework is being extended here by introducing two selected externalities that are relevant to the Indian MSW practices. These are social externalities due to the contributions of the informal sector and the economic losses contingent upon the LFG being allowed to escape in the environment from the dumping grounds. The FCA framework is being tested here for its expandability to assimilate these externalities and contribute towards improved decision-making.

Contributions from social sector

The collection and transfer of recyclable materials through scavenging by rag-pickers from the waste heaps contributes to the recycle chain. The contribution by the informal sector supplements the demand of raw materials and reduces the ecological rucksack of the input materials. However, the contributions of rag-pickers are not part of fair trade (Agarwal et al. 2005; Rathi, 2007). Though municipalities lose out on the economic value of recyclables, it also saves operational costs due to lower quantities of wastes to be handled and extended lives of the dumping grounds. The net economic benefit to the municipalities is a positive externality generated and paid for by the informal sector (bad working conditions, economic losses on scavenging, health costs etc.) and society (Petcharat and Mula, 2012). So, net saving due to the involvement of informal sector = Saving in costs due to (reduced municipal solid waste (MSW) tonnage + saving due to extension of life of landfill capacity – economic contributions of informal recycling. (3) Where, savings due to extended life of landfilling area = Saving in landfill capacity converted into time period of equivalent present value of rental earning of the land.

Economics of wasted energy

The landfilling of garbage with biodegradable materials leads to the generation of methane and carbon dioxide gases – classified as greenhouse gases (GHG). In the absence of scientific waste-to-energy (WTE) programs or sanitary landfills, these gases (LFG) escape in environment (Saini et al., 2012). Using IPCC default methodology, it is possible to compute equivalent energy that is lost by allowing methane to escape in the environment, which could have otherwise been used to augment the energy needs of the economy (Petcharat and Mula, 2012). So, the cost of methane emissions from landfill = Methane generation potential derived based on the degradability of the solid waste X Gross Calorific Value (GCV) of methane X Density of methane.

Computation of externalities associated with SWM

Considering 80,000 rag-pickers on the streets of Mumbai (estimates vary anywhere between 50K to 100K) and average earnings of INR 60 per day, the quantity of waste handled by the rag-pickers works out to be 1600 MT (18%).

Other studies peg the quantities anywhere between 10 – 15% (Agarwal et al., 2005). Shifting 15 – 20% of waste generates net saving in operating costs of INR 5.43 million/day for MCGM (annexure -2) and has been captured as the social costs of SWM operations (table 3). Secondly, the quantity of methane can be converted into equivalent quantity of alternate fuel source, e.g. coal. Using IPCC default methodology, the methane generation capability of SWM works out as energy equivalent of 234000 MJ/year (assuming biodegradability factor of 0.21 and 60% recovery potential) or 196000 equivalent tons of coal (at GCV of 5000 kcal/ton). With base price of coal at INR 1270/ton (ET bureau, 2013), this leads to a yearly loss of INR 250 million to the economy (annexure -3). Both of these externalities improve the MSW costs from INR 2880 TPD to INR 3741 TPD (at 8700 MT of SWM) and add 529 tCO2e/day of GHG to the inventory.

This would be pertinent to note here that the calculations for these externalities are not exhaustive; neither does it cover the full externalities concerning other elements of MSW operations, e.g., GHG due to waste transportation, emissions due to waste reprocessing, cost of water and underground contaminations, and so on. These areas would need separate studies and comprehensive data to be incorporated as part of FCA framework. Table 3

Externalities of SWM operations of MCGM (in INR/day, unless specified)

Particulars	Total
E) Net cost (From table 2)	20,448,755
Net Cost (INR/TPD)	2,880
Externalities	
a. Loss to the economy due to unharnessed energy from emission release	680,847
b. Financial gain contributed by informal sector (net of earning from recyclables)	5,433,603
F) Cost of externalities	6,114,450
Total Cost of Externalities (E) + (F)	26,563,206
Overall cost of SWM (in INR/TPD)	**3741**
GHG inventory addition due to LFG (in tCO2e per day)	529

Results and discussion

Earlier studies have pegged the cost of MSW services anywhere between INR 500 to 1500 per TPD for different class of cities (based on population) and by using different economic methods, discussed in detail by Parthan and Milke (2009). Yedla and Kansal (2003) estimated the costs at INR 1668 TPD for MCGM (at 6256 TPD), which was reworked at INR 1678 in 2001-02 based on

MCGM budget (at 6500 TPD) and INR 2117 TPD for the same period (at 6000 TPD) (excluding environmental costs of disposal at sanitary landfill) (Rathi, 2007). In comparison, the MSW costs (excluding externalities) for MCGM works out at INR 2880 TPD at waste generation level of 7100 TPD (table 2). Though the absolute unit costs from this study seems higher, adjusting cost inflation index of 100% for the decade points out to the reduction in the overall costs (20-40%). This reduction can be attributed to the advancements in SWM operations and other intiatives that might have been taken up by MCGM in last decade (Mahadevia and Wolfe, 2008).

Sensitivity analysis of costs (table 2) shows salary (fixed) and wages (variable) accounts for around 67% of the expenses while repairs and maintenance (fixed) coveres another 15%. This leads to salaries and wages as the single most important factor in the cost composition of MSW services to effectively manage solid wastes. Even though the labor wages (variable costs) and salaries (fixed costs) seems to be at parity (1.17: 1), its also reflects the high administrative overheads that is being borne by MSW services. This also supports high level of manual labour employed and engaged by MSWM operations in India, supported by others studies as well (Kumar et al., 2009; Sharholy et al., 2008). Efficiency factor is another variables that would impacts the costs, depending on the quantity of waste being handled at present. Also important to note the miniscule earnigns of MCGM, which indicates MSW is (mostly) a free service and the tipping fee being charged is insufficient to cover SWM operational costs and supported by other studies as well (Mahadevia and Wolfe 2008). These results support the view that the decision makers need to search for avenues that would reduce unit costs of MSW operations by including strategies like, outsourcing of SWM operations, partnership with private sectors, implement staggered tipping fees to the consumers, and so on. However, caution should be exercised to compare the cost figures across studies, due to the differences in data sources and methods employed to derive these values.

Insights from FCA to support internalization of externalities This section is devoted to understand the role of FCA to support decision-making due to the inclusion of externalities as part of its framework. The overall cost of MSW (including selected externalities) works out at INR 3741 TPD (30% over and above the accounted costs) plus inventory of LFGs. By following scientific waste management principles in landfilling, the current level of garbage being handled in Mumbai alone would generate INR 42 million/year worth of equivalent carbon credits (as per the rates prevalent in voluntary carbon market) and savings of INR 249 million/year worth in equivalent fuel costs. By considering the investment costs of scientific landfilling of INR 130 per m3 and operating cost of INR 250 per MT of waste (Prathan, et al., 2012a), a 100 hectare (10 meter deep) scientific landfill supports break-even point of less than four years (INR 400 million in capital and INR 650 in operations) as

current waste generation level, which can be operated with the participation of private sector. Similarly, by formalizing the recycling network and assuming double the minimum rate of recyclables (in comparison to the informal recycle chain), MCGM can generate additional earnings of INR 3.75 billion/year, which is sufficient to provide investment opportunity of INR 2.70 billion/year (at 10% plus yield) and rehabilitate 50% of the rag-pickers at minimum wages (table 4). The strategies outlined above (table 4) would also help the industries with steady source of recyclables and would benefit economy as a whole.

Table 4

Capital investment alternatives to internalize externalities

Particulars	Daily	Annual
1) Externalities (quantitative aspects)		
i) Methane production at 60% capture rate (in tons)	435	158,775
ii) Current level of SWM picked up by informal sector (in tons)	1,600	584,000
iii) LFG generated (in tCO2e)	529	193,085
2) Corresponding opportunity gains by internalization (financials)		INR (in millions/year)
i) Wholesale price of rags (at twice the rate received by rag-pickers)		3,504
ii) Equivalent value of energy supply		249
iii) Market value of carbon credit, if LFG is contained (at INR 220/ tCO2e1)		42
Total opportunity income (a) + (b) + (c)		3,795
3) Investments opportunities, e.g.,		
i) Develop and operate 100 hectare (10 meter deep) scientific SWM facility to capture LFG		1,050
ii) Rehabilitate 50% of the rag-pickers at minimum wages of INR 6000		2,880
iii) Investment with 10% plus ROI in five years at 10% interest rate		2,700

Other than the economic benefits, rehabilitation of rag-pickers can also offer a transit pool of individuals/ contractors to municipalities that can help it rationalize the important element of manpower costs. In fact, by including externalities, FCA improves the decision-making process by offering information on costs and to evaluate opportunities, which otherwise never surfaces in traditional accounting frameworks. In this article, the discussions on the strategies to internalize the externalities could be carried out with the help of insights gained on the MSW costs that covered not only the usual economic costs, but also developed insights on hidden ones, contingencies, external costs, and environmental ones. For example, insights from the FCA helps to ideate that by applying uniform tipping fee of just one rupee/TPD, MCGM would

generate revenue pool of INR 2.60 billion/year, which is sufficient to rehabilitate remaining 50% of the rag-pickers, while creating a nominal burden of INR 1.70 per month/capita, a simple approach that can help MCGM to be self-reliant while discharging its social responsibilities. However, this would call for operational autonomy of municipalities and streamlined policy goals. Even though some of the impacts of SWM practices could not be covered as equivalent costs (e.g., LFG from landfill), the alternate route of recording physical inventories of LFG as part of the construct is also a way to extend its boundaries.

Conclusion :

The SWM function of municipalities in India is a complex set-up of multiple stakeholders with limited financial and administrative autonomy. With 74th constitutional amendment, the central government of India has allowed self-governance of urban legal bodies, but it is yet to become a driving force in municipal set-up (Mahadevia and Wolfe 2008). The review of literature reiterated the lack in the adoption of scientific SWM practices, prevailing practice of dumping garbage in open grounds, and uncertain cost of services. The broken chain of garbage sorting and recycling along with the lack of scientific arrangement to treat garbage is not only forcing the economy to lose out on the benefits of optimized recycling levels but are also contributing towards the harmful environmental impacts of unscientific handling of garbage. This article highlighted the lack of authentic accounting data of MSWM, absence of centralized database, and paucity of scientifically recorded physical quantities to evaluate the cost aspects of SWM more holistically. In a well developed accounting and cost-conscious environment, FCA can be implemented to develop the cost profiles by depending on the scientific accumulation of costs. However, this places the burden on the municipalities to have the cost accounting system in place, before the data can be utilized. Since the shift of municipal accounting service from cash accounting to accrual based accounting in India is only a recent phenomenon (ICAI, 2009; NIUA, 2010), the adoption of FCA framework in this exploratory study was tested in its ability to use the accounting data and generate information on the costs of SWM services. This study supports the view that FCA can be used as an interim arrangement in MSW decision-making by relying on accounting data that could generate useful information for decision-making, instead of waiting for the implementation of scientifically accurate cost accounting system. The results from the study detailed the unit costs of operations, highlighted its most sensitive cost heads, cost of externalities, and economics of alternative decisions with reasonable approximations. The introduction of externalities

within the FCA framework was aimed to extend its boundary, develop support for decision-making for MSW services, and to help decision-makers by offering a scientific tool to evaluate multiple SWM strategies. For example, previous studies in SWM practices considered the contributions of informal sector as potential gain of municipalities (Chaturvedi, 2003; Mahadevia and Wolfe, 2008; Yedla and Kansal, 2003) thatare being borne by the rag-pickers due to different socio-economic reasons, e.g., existing sub optimal legal, economic, and policy arrangements (Agarwal et al., 2005; Chaturvedi, 2003), but the extended FCA framework developed the external costs and incorporated these so as to enable a better decision-making process that can be used to evaluate different policy alternatives. Policy makers can improve the conditions of rag-pickers by judicious use of policy instruments (by recognizing the efforts of informal sector) and/or a mix of suitable economic arrangements (creating single collection window, bringing rag-pickers within waste collection practices, etc.), including investments in social welfare schemes. Although the rehabilitation of rag-pickers is considered in this study from economic perspectives alone, the rehabilitation process can contribute to improve effective waste sorting practices, develop formal waste recycling chains, build industry linkages, improve the costs of recyclables, help municipalities generate higher revenue, and contribute to the economy with better managed recycle policies. Should any of the suggested alternatives be implemented, the rag-pickers will be benefitted from the economic rearrangement of resources. Similarly, the evaluation of GHG getting released from the organic decay of wastes in the dumping area allows the invitation to host of other environmental and social externalities and handled in here partially, future studies can address the issues of GHG due to transportation of wastes, emissions in processing vs. composting, LFG not covered, and so on, as independent research area and strategies that would be needed to develop suitable infrastructure to internalize these. Although, the accuracy of data and results remains a limitation, the aim of the study was not to establish the accuracy of data or its classification but to invite the attention to the transparency of FCA framework, which can help municipalities with identification, ascertainment, and control of costs of MSW operations and support decisions-making process. The role of FCA here is to offer a comprehensive tool to offer insights in costs by integrating externalities extensible FCA framework and enable comparative study of alternate strategies.

Limitations and future directions

Though the current study suffers from the limitations of arbitrary interpretation and reclassification of accounting data, it would be pertinent to remind the reader of this article that the data used in this article is sourced from the annual accounts of the concerned municipality instead of building the costs from the

physical ingredients as: a) there is no central database of municipality activities to derive all the needed information and b) cost accounting of MSWM services is still at a distance in India. Future studies on accounting of MSW services may use primary data from the books of accounts in different municipalities and derive costs that could address impacts of demographic variations. Research can also focus on the improvement in the accounting and accountability of the MSW services being achieved by adopting scientific SWM practices in few of the municipalities and extending the coverage to other externalities. If the prevailing practices of MSW services do not change for better in near future, increased levels of wastes from rapidly developing industrial towns and hubs will force the municipalities to develop higher acreage of dumping grounds and deploy increased levels of resources, thanks to prevailing practices of sub-optimal utilization of resources. This necessitates corrective steps that would overhaul the entire SWM operations, adopt scientific waste management system, and develop cost-effective initiatives. Adoption of FCA framework can be one of the steps to help municipalities improve overall unit costs of its operations, something that is useful to study and develop cost functions of its others services as well. Policy owners andmunicipalities would do well to include professional accounting services and invite academia to improve its operational and structural costs.

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