Sustainability Analysis of Municipal Solid Waste Management Programme in GMADA cluster, Punjab

Monikankana Sharma

Centre for Sustainable Technologies, Indian Institute of Science, Bangalore 560 012

DIALOGUE
Science, Scientists, and Society

Table of Contents

Sustainability Analysis of Municipal Solid Waste Management Programme in GMADA cluster, Punjab

Monikankana Sharma

Centre for Sustainable Technologies, Indian Institute of Science, Bangalore 560 012

Email: mksharma21@gmail.com

Corresponding Editor: MALAVIKA DADLANI

Abstract. Solid waste management (SWM) is one of the important components of Swachh Bharat Mission, a campaign taken up by the Government of India with an aim to clean up the streets of Indian cities/towns and make them free from open defecation. This paper analyses the action plans taken up by the government of Punjab in response to the new SWM Rules, 2016, for developing waste processing facilities. The focus is particularly on Mohali as it is emerging as an educational hub, and accordingly, the government is coming up with a plan to develop a centralized waste processing facility to generate Refuse derived Fuel (RDF). Through this study, we try to highlight that the current chosen technology - RDF may not sustain as a large fraction of the wastes generated in Mohali is wet organics (62%), while the dry combustible fraction required for RDF is only 17%. Further, it has been observed that Mohali plans to connect 15 urban local bodies (ULBs) to a single processing site and a few of them are far (~70 km) and generate low daily wastes (5-7 TPD). Thus, looking at the obvious difficulties, the current study concludes that the SWM plan needs a revision with more focus on anaerobic digestion (AD) or composting as they are the appropriate technology for handing wet organic wastes.

Keywords. Municipal Solid Waste; Solid waste management; Mohali; Refuse derived fuel; Composting.

Abbreviations

- MT: Million tonne
- CO_2: Carbon dioxide
- CH_4: Methane
- AD: Anaerobic digestion
- PPP: public-private partnership
- MSW: Municipal solid waste
- RDF: Refuse derived fuel
- SWM: Solid waste management
- ULB: Urban local bodies

1 Introduction

Population growth, economic development, and improved living standards have led to an increase in municipal solid waste (MSW) generation in the urban areas, and it has become a major concern for a country like India as it still does not have a proper infrastructure to treat the wastes. Studies have revealed that India generates about 62 MT (million tonnes) of wastes annually and of this only 43 MT is collected and 11.9 MT is treated [Press Information Bureau 2016]. Rest is disposed in open landfills. Now that the new Solid Waste Management Rules: SWM, 2016 have come into force, all states are asked to showcase their action plans towards building facilities for waste disposal and processing. Most states have submitted their strategies, and the Central Pollution Control Board has been reviewing the statuses of implementations [Consolidated review 2016].

Among the northern states, Punjab has followed a unique cluster approach comprising 163 Urban Local Bodies (ULBs) and plans to develop the processing facilities through Public-Private-Partnership (PPP) basis. The state has been divided into eight clusters: (i) Jalandhar (ii) Ludhiana (iii) Bathinda (iv) Ferozepur (v) Patiala (vi) Amritsar (vii) Pathankot and (viii) GMADA. Out of the eight clusters, four (Bathinda, Ludhiana, Jalandhar Amritsar) have already started operations while others are yet to build the facilities [www.ppcb.gov.in; pmidc.punjab.gov.in 2014]. This paper discusses the progress of GMADA cluster that plans to develop a processing and disposal facility and assesses their sustainability with respect to the availability of resources and waste quality.

GMADA cluster comprises of 16 ULBs, including Mohali, that is situated south-west of Chandigarh, and has developed as an extension to Chandigarh with the organized cellular system of sectors. Urban planning is however different in both the cities and so is the waste management system. Chandigarh has been known for its high waste collection efficiency (95%), and the city retains a 500 TPD processing plant since 2008, while Mohali does not have any waste processing facility yet, and also the waste collection system is largely unmanaged and unscientific [Solid Waste Management 2018; Overview of the municipal solid waste management practices 2017; Rana R 2017; Ravindra K, et al. 2015; Singh V 2015]. There is no organized system of door-to-door collection and the transfer of wastes to the dumping site is irregular. Segregation is missing in all ULBs. Further, open dumping is a common sight in Mohali and its nearby towns. There are 17 MSW dumpsites in the GMADA cluster and these sites are almost filled. There has also been reports on environmental pollution due to open burning of wastes [Sharma G, et al. 2019]. Now that the new SWM 2016 rules are passed, Municipal Corporation Mohali (MCM) has decided to adopt the scientific disposal techniques and has proposed two routes (i) 200 TPD RDF and 400 TPD composting facility (ii) 2 × 300 TPD facility to produce RDF and 6 MW power plant based on RDF [www.mcmohali.org]. Earlier, GMADA planned to build 150 TPD composting facility and 250 TPD RDF [Integrated MSW Management Project for GMADA Cluster 2011]. The bidding process was initiated to carry out collection, storage, transport, and processing by a private agency [Request for Proposal 2012; www.tribuneindia.com]. However, no response was received, and experts express their apprehension over the feasibility of the project as a major concern. The processing facility was supposed to be set up within two years after the bids were received and now three years have passed by and no third party approached the government [Government of Punjab 2018]. In this backdrop, we take the opportunity to analyze the prevailing situation, evaluate the barriers, and provide policy recommendations towards sustainable management.

The paper is organized in the following manner. First, a brief introduction is given to the GAMDA cluster and its current and proposed planning for building waste disposal facility, followed by a highlights of the barriers. Next, the sustainable options are discussed and policy recommendations are made.

2 GMADA cluster: MSW management

GMADA cluster includes the Municipal Corporation of Mohali/Sahibjada Ajit Singh Nagar (S.A.S. Nagar) and 14 other cluster of ULBs: Mohali, Zirakpur, Kharar, Rajpura, Mandi Gobindgarh, Ropar, Naya Gaon, Sirhind-Fatehgarh Sahib, Kurali, Dera Bassi, Morinda, Lalru, Basi Pathana, Banur and Chamkaur Sahib covering 4 districts: S.A.S. Nagar, Patiala, Fatehgarh Sahib and Rupnagar.

Mohali, Zirakpur, Kharar, Naya Gaon, Kurali, Dera Bassi, Lalru, Banur comes under S.A.S. Nagar district; Rajpura under Patiala district; Mandi Gobindgarh, Sirhind-Fatehgarh Sahib, Bassi Pathana are under Fatehgarh Sahib district, and Ropar, Morinda, Chamkaur Sahib are part of Rupnagar district.

At present, these cities/towns are carrying out their waste collection processes individually. However, the cluster approach aims to develop a common processing cum disposal facility on PPP mode. The scopes of the common action plan are as follows:

1. To develop, operate, and maintain the MSW processing facility comprising RDF and a compost plant.
2. To develop an engineered sanitary Landfilling facility for scientific disposal of rejects.

Table 1 shows the current and the predicted daily waste generation data for all the ULBs and Fig 1 shows the schematic diagram of the facility planned. As is observed, MCM expects to get two different streams: green and mixed wastes. The mixed waste is planned to reach the integrated processing site where it would be processed and converted to RDF and the wet organics would go to the compost pit. The rejects are planned to be scientifically disposed off in the landfill site. Green wastes are planned to go to the compost plant and the rejects to the sanitary landfill. A village named Samgauli (approximately 35 km from Mohali) has been identified for developing an integrated processing facility for the entire cluster, and no-objection certificates from the Ministry of Environment, and Forest, Ministry of Defense and from Punjab Pollution Control Board have been obtained.

Table 1 Daily generation of waste for the current year and the projected year: 2024 [www.mcmohali.org].

ULBs	Daily generation (TPD)	Daily generation (TPD) projected for year 2024
S.A.S. Nagar (Mohali)	117	128
Zirakpur	115	230
Kharar	49	66
Rajpura	42	45
Gobindgarh	35	39
Ropar	26	28
Nayagaon	23	30

Sirhind- Fatehgarh Sahib	21	23
Kurali	13	15
Derabassi	11	14
Morinda	8	9
Lalru	8	9
Bassi Pathana	7	8
Banur	6	7
Chamkaur Sahib	6	8
Total	487	659

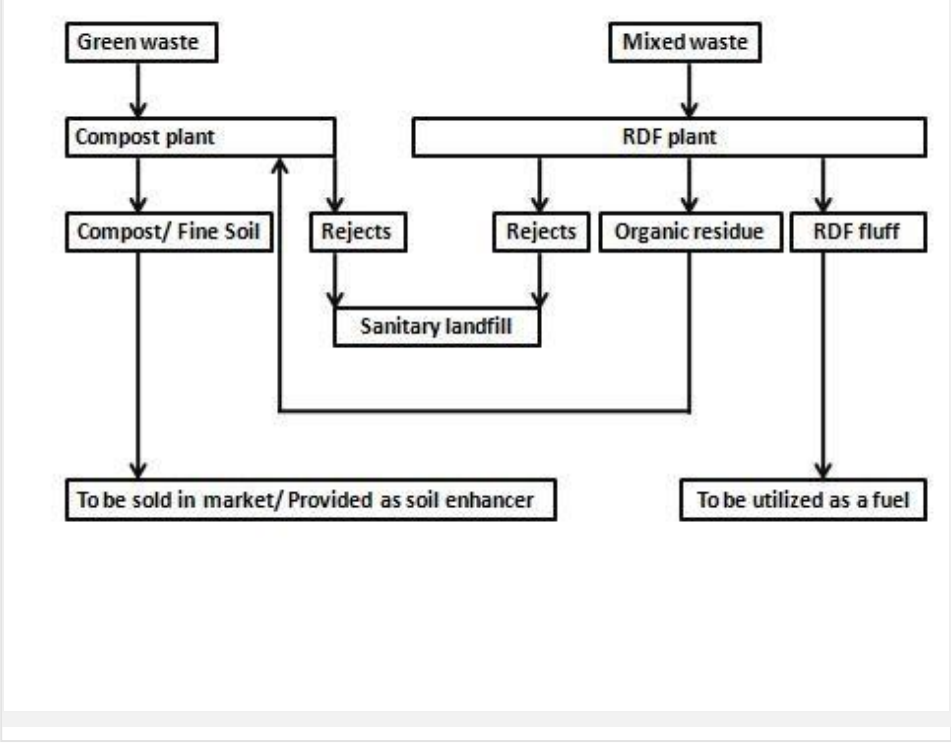

Fig 1 Flow diagram showing waste disposal strategy for the proposed RDF and composting facilities in Mohali [Integrated MSW Management Project for GMADA Cluster 2011].

3 Appraisal of the current plans: barriers

GMADA has selected RDF and compost technology to process its wastes and recover energy. However, it is felt that the selection of RDF is not appropriate, for it needs dry waste while the waste in GMADA is largely wet organics. A large scale composting plant is inevitable to manage the organic trash that otherwise will keep accumulating in the dumping ground as is observed in Chandigarh.

Chandigarh has a 500 TPD RDF plant but is not operating in its optimum capacity as the combustible fraction in the city is only ~20% and in absence of a compost plant, the rest of the waste goes to the dumping ground. Municipal Corporation is now reviewing the issues as the city's position in the *Swachh Survekshan* (annual cleanliness survey) ranking is going down due to improper management [www.timesofindia.indiatimes.com]. Mohali can be foreseen to have a similar situation if priority is given to construct the RDF facility despite knowing the fact that the type of waste is wet organic. Further, the location of the processing site may pose as a problem. The following section discusses the issues in detail.

3.1 Inadequate dry waste for RDF

Mohali generates mixed waste, and the wet organic fraction dominates (62%). The total waste in the GMADA cluster at present is 487 TPD and of this 17% is a combustible fraction and 12% recyclable (Fig 2). Currently, the wastes go to the designated dumping sites, and now MCM is planning a 200-300 TPD RDF facility. However, it is important to realize that RDF can be produced only from dry combustibles and the GMADA cluster is generating only 82 TPD dry wastes at the moment. Further, uninterrupted supply to the processing site from all the ULBs can be a major issue as some places are very far (~75 km).

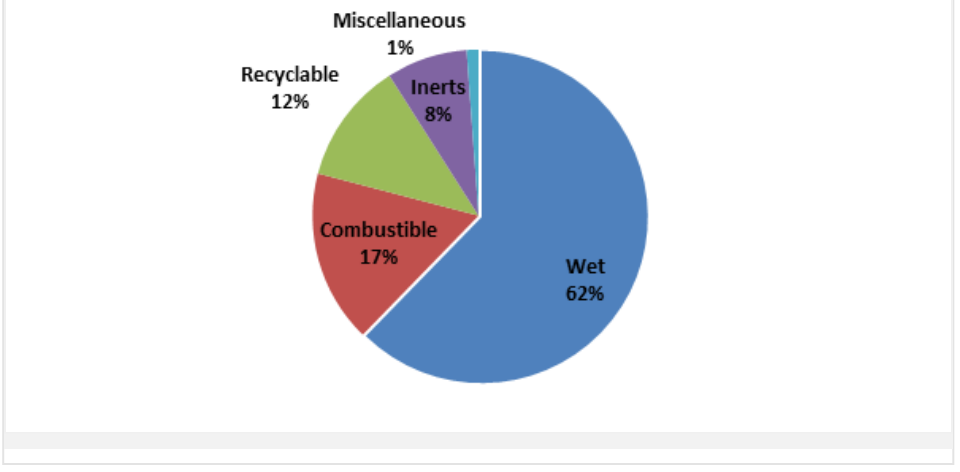

Fig 2 Composition of MSW Mohali [www.mcmohali.org].

3.2 Location of processing site

Samgauli village is located in the southern part of the S.A.S. Nagar district. The distances from the ULBs' to Samgauli vary between 12 km (Dera Bassi) to 83 km (Chamkaur Sahib), and the daily waste generations vary from 6 TPD (Chamkaur Sahib) to 117 TPD (Mohali city). Now, one needs to understand that as planned, if a processing plant is set up at Samgauli, the transfer from Chamkaur Sahib involves 83 km travel with just 6 TPD wastes. Bassi Pathana, Morinda too involves 78 and 66 km travel with 7 and 8 TPD wastes (Table 1). It has been observed that there are 7 such places within the radius of 50-80 km involving 6-35 TPD wastes (Fig 3). MCM has planned for mass collection and daily transfer. However, regular transportation is doubtful with just 6 to 8 tonnes of waste to the transfer station which is ~70 km away from the generating point. Littering or illegal dumping can be well-envisioned in the absence of regular collection. A robust MSW management is thus strongly felt.

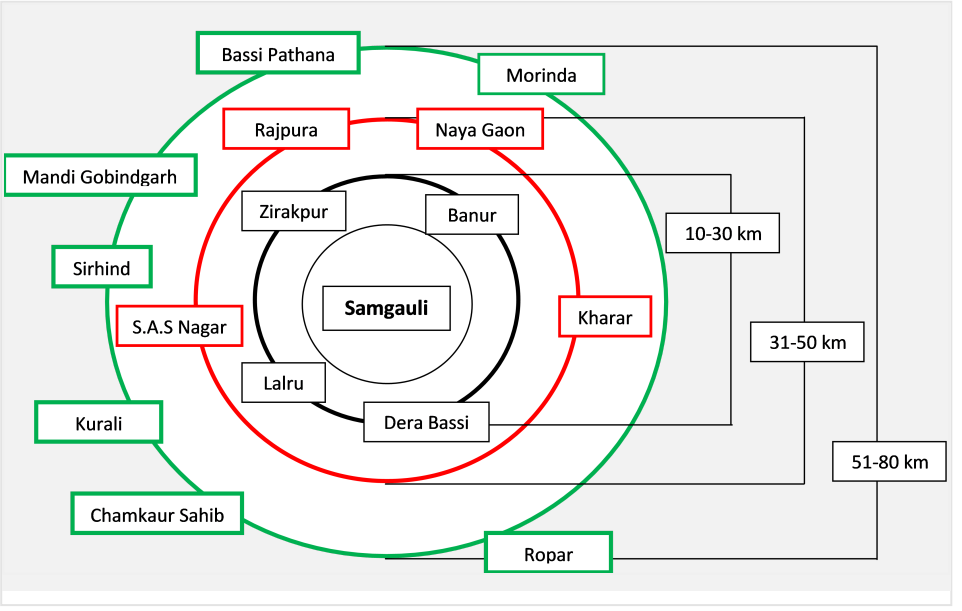

Fig 3 Distance between Samgauli and the ULBs under GMADA cluster.

4 Sustainable planning

The proposed processing plant is located in S.A.S. Nagar district while the GMADA cluster covers 7 ULBs from three other districts. It is felt that the reintegration of the ULBs with two processing sites might help to have better waste management. Now since few ULBs are far

from S.A.S. Nagar, better management can be envisioned with another plant setting up in Rupnagar district. Now the question is, whether there is land available in Rupnagar to develop a new plant. If it is available, whether NOC from the Ministry of Environment and Forest, Ministry of Defense, and Punjab Pollution Control Board can be obtained easily. Nevertheless, the idea should be explored. Fig 4 suggests how the cluster can be further divided and a new plant can be built in Rupnagar district that can process the wastes from 6 nearby places (Mandi Gobindgarh, Bassi Pathana, Sirhind, Morinda, Kurali, Chamkaur Sahib). Samgauli can continue taking the wastes from S.A.S. Nagar, Zirakpur, Kharar, Rajpura, Derabassi, Lalru, etc. We name the bifurcated cluster as Sub-cluster 1 and Sub-cluster 2.

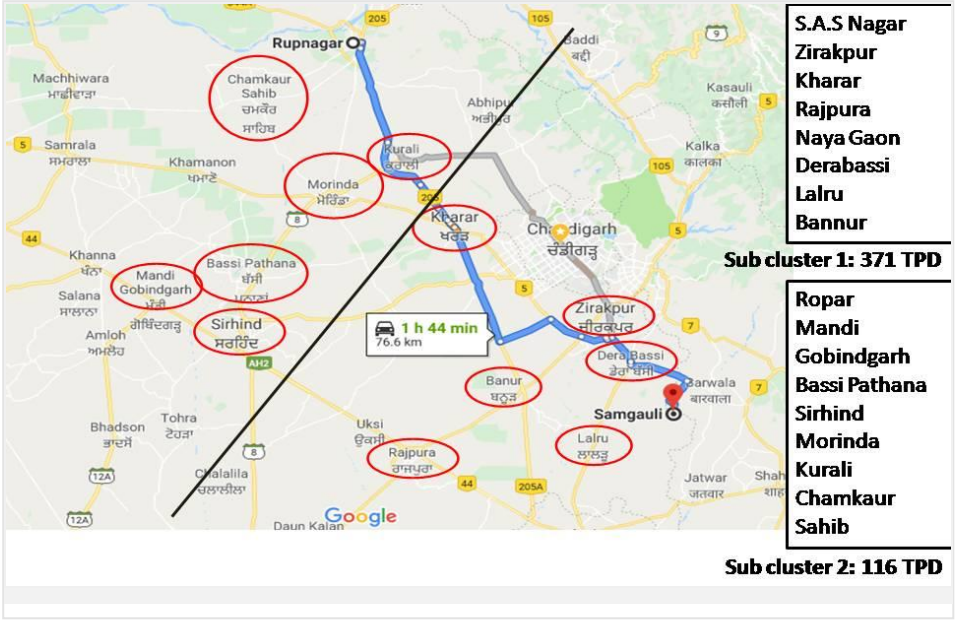

Fig 4 Map showing Samgauli, and the proposed bifucrcated cluster with ULBs [Rupnagar Google map].

Fig 5 shows the shares of dry and wet wastes in each cluster. As evident, Sub-cluster 1 would generate more wastes (371 TPD) than Sub-cluster 2 (116 TPD), and the dry waste qualifying for RDF is small (63 and 19 TPD respectively) in both the clusters. Higher wet organics justifies the adoption of Anaerobic Digestion (AD) or composting. Sub-cluster 1 has the scope for a medium capacity (less than 100 TPD) RDF plant too, as it generates 63 TPD dry wastes. Alternately, a combination of (AD) and compost plants may be attempted. Sub-cluster 2, however, needs to adopt composting facility only as it has more wet organics (72 TPD) and the dry combustibles are limited (19 TPD). If segregation can be maintained then the dry fraction may be sent to the cluster 1 for making RDF.

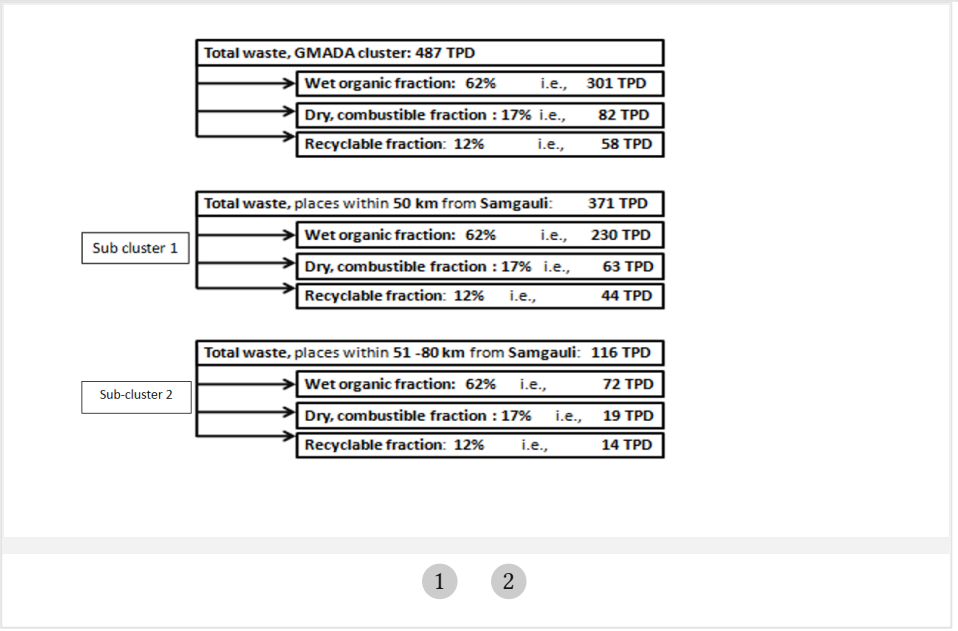

Fig 5 Distribution of wastes, if GMADA cluster is sub-divided (as proposed in this work).

The government has provided a sound policy framework for RDF utilization in SWM Rules 2016, by mandating its use in cement industry at least by 5% of their fuel requirement, located within 100 km from the waste processing plant. The price has also been fixed (INR 1350/ Tonnes of RDF) [www.cpheeo.gov.in]. However, feasibility remains a major concern in GMADA cluster though policies are lucid and support profit.

"*The Concessionaire shall, pursuant to the provisions of the abovementioned agreements, implement the Project in line with the scope mentioned in the agreements and briefly mentioned hereinabove. All revenues from the sale of any recyclables/byproducts from MSW processing including Compost, RDF, etc., will accrue to the Concessionaire. Concessionaire shall be allowed to use the space available at the Project Facilities for display of advertisements as per applicable laws and the provisions of the Concession Agreement. Appropriate authorities shall have the right to charge applicable advertisement tax on display of such advertisements by the Concessionaire. In addition to above, 80% (eighty percent) of the total earning (net of cash) available or Certified Emission Reductions (CERs), if any, under Kyoto Protocol/Climate Change initiative can be retained by the concessionaire/developer. On a case to case basis and in line with the provisions of the relevant land Lease Agreement, the designated Land ULBs shall be entitled to charge from the Concessionaire, annual land lease rental, advertisement tax and other taxes as per Applicable Laws; and negative Tipping Fee, if applicable*." [Request for Proposal 2012].

Since it has been three years since the bid was invited and no third party has turned up, MCM can consider revising its strategies and aim for an achievable target [Government of Punjab 2018]. Following are a few recommendations that may need changes in the current policies.

5 Recommendations

5.1 Focus on anaerobic digestion and composting

Successful management demands right selection of the technology considering availability and the volume of the wastes generated. Since GMADA cluster generates more wet organics and less dry combustible, the region should shift its focus from RDF to AD and composting. It is important to realize that by shifting towards AD the region could see ~50-80% lower CO_2 and CH_4 emissions [Singh and Basak 2018]. Composting provides an economical advantage [Cost Benefit Analysis of Composting 2017].

5.2 Special policy for educational institutes

GMADA cluster houses several government-funded educational institutions, such as Indian Institute of Science, Mohali, National Institute of Pharmaceutical Education and Research, Indian Institute of Technology Ropar, etc., and the residential campuses of these institutes generate a large quantum of wastes (3-5 TPD; exact quantification not known). Currently, MCM deploys personnel to collect this waste and transfer to a collection point. Though the collection is regular, segregation is missing. In compliance with the new SWM rules, if these institutes may be notified to segregate their wastes and asked to build up strategies to develop their own compost pits within their premises, the trash in the dumpsite can be reduced. Policy reformation with clear rules for incentives and penalties is vital for decentralized management.

5.3 Site-specific segregation

Segregation is currently missing in most Indian cities due to the lack of awareness and strict regulations from the municipal corporations. MCM plans to incorporate segregation in their action plan. However, it is important to realize that most of the ULBs under the GMADA cluster have a population less than 50,000 and they generate wet organics higher than Mohali or Zirakpur (70% or higher; exact data is not available). Now, in this backdrop, if separate bins can be provided to these areas and the public be asked to deposit their wet waste daily and dry waste once in a week or so, the probability of gathering wet wastes for composting will be higher. Cities like Mohali, Zirakpur, Kharar, etc., need segregation and regular collections.

MCM should bring in stringent regulations and make public aware of the benefits of segregating wastes.

5.4 Segregation of wastes in gated communities

SWM policy 2016 [Press Information Bureau 2016] emphasizes segregation of wastes in gated communities, market associations, hotels, etc., comprising an area greater than 5,000 sq. m, and handing over the recyclable materials to the authorized recyclers. Further, the developers of Special Economic Zone, Industrial Estate, Industrial park, etc., are to earmark at least 5% of the total area of the plot or minimum 5 plots/sheds for recovery and recycling facility. However, segregation is not happening, and the rules against penalties are found missing. New regulations may thus focus on incentives or penalties at the cost of segregation. Needless to say that Indore became the cleanest city in India because they could create awareness of segregation among the public and it is strictly followed [www.thebetterindia.com].

5.5 User fee based on type and volume of waste

SWM policy 2016 [Press Information Bureau 2016] directs the local bodies to decide the user fee or fine for littering, etc. However, it has been observed that a fee has been fixed for different organizations while it could be in a form of incentive to reduce wastes by fixing the charge according to the weight and volume of wastes.

5.6 Emphasis on recycling

At this moment, Mohali does not have formal recycling facilities. Rag pickers usually collect the recyclable fractions and sell it to some firms. Now MCM has planned to develop a dedicated recycling facility in compliance with the new SWM rule. However, the bidding process has not been initiated. Nevertheless, the need for a recycling facility is inevitable as the fraction of recycling is just a few per cent lower than the fraction of combustion.

6 Conclusions

SWM is challenging for developing cities like Mohali, for it does not have the required infrastructure to treat the wastes while urbanization is taking place at a faster rate. Now that the center directs all the states to build up an integrated processing facility, the Punjab Government has adopted a cluster approach and GMADA cluster plans to develop RDF and compost facilities. However, this study reveals that RDF may not be a sustainable option as the dry waste required for the planned 250 TPD RDF plant is not available at the moment. The nature of the wastes in the region is wet organics and it actually qualifies for AD and

composting. Further, there is a need to bifurcate the cluster as it is observed that a few places under GMADA cluster are far from the processing site and they generate very low waste per day which may affect regular collection and transport. For sustainable waste management, MCM should revise their policies and emphasize on setting up AD or composting facilities. AD provides environmental benefits [Kumar and Samaddar 2020], however, the cost can be a major concern, especially in the post-Covid period.

Acknowledgement

Monikankana thanks Prof. S. Dasappa, Centre for Sustainable Technologies, IISc., Bangalore for his valuable inputs, and the University Grants Commission for the Post Doctoral fellowship for Women.

References

1. Press Information Bureau. Government of India. Solid Waste Management Rules Revised After 16 Years; Rules Now Extend to Urban and Industrial Areas. 2016. https://pib.gov.in/newsite/PrintRelease.aspx?relid=138591. (Accessed on 25/6/2020)
2. Consolidated review report on implementation of solid waste management rules. 2016. http://nswai.com/docs/Status_Report_on_MSW.pdf (Accessed on 25/6/2020)
3. http://www.ppcb.gov.in/MunicipalSolidWaste.aspx(Accessed on 25/6/2020).(Accessed on 25/6/2020).
4. Punjab model municipal solid waste management plan. 2014. https://pmidc.punjab.gov.in/wp-content/uploads/2018/07/Notification-Punjab-SWM-Policy-2018-Final.pdf (Accessed on 25/6/2020).
5. Solid Waste Management in India. An Assessment of Resource Recovery and Environmental Impact. 2018. https://icrier.org/pdf/Working_Paper_356.pdf (Accessed on 25/6/2020).

6. Overview of the municipal solid waste management practices in Tricity. Chapter 3. 2017. https://pdfs.semanticscholar.org/cf8c/f3eb21349e5f491950f1320346f4a7dd5e38.pdf (Accessed on 25/6/2020).
7. Rana R 2017. Municipal solid waste characterization and analysis In Tricity. PhD thesis. http://122.252.232.85:8080/jspui/bitstream/123456789/15020/1/PHD0129_RISHI%20RANA_CE_2017.pdf (Accessed on 25/6/2020).
8. Ravindra K, Kaur K and Mor S 2015. System analysis of municipal solid waste management in Chandigarh and minimization practices for cleaner emissions *J. Cleaner Prod.* 89: 251-256.
9. Singh V 2015 Solid waste management in Chandigarh *Int. J. Curr. Res.* 7 (03): 13728-13733.
10. Sharma G, Sinha B, Hakkim, Haseeb H et al. 2019. Gridded Emissions of CO, NOx, SO_2, CO_2, NH_3, HCl, CH_4, PM2.5, PM10, BC, and NMVOC from Open Municipal Waste Burning in India *Environ. Sci. Technol.* 53: 4765-4774.
11. Detailed project report MC Mohali. http://mcmohali.org/dpr.pdf(Accessed on 25/6/2020).http://mcmohali.org/dpr.pdf(Accessed on 25/6/2020).(Accessed on 25/6/2020).
12. Integrated MSW management project for GMADA cluster. 2011. http://www.mcmohali.org/EIAforPH.pdf(Accessed on 25/6/2020)
13. Request for Proposal: Integrated solid waste management project. GMADA cluster. 2012. http://www.mcmohali.org/RFQ_cum__RFP-GMADA-040812.pdf (Accessed on 25/6/2020).
14. Processing of waste:Mohali MC tenders draws blank. 2018. https://www.tribuneindia.com/news/archive/chandigarh/processing-of-waste-mohali-mc-tender-draws-blank-576850 (Accessed on 25/6/2020).
15. Government of Punjab, notification. 2018. https://pmidc.punjab.gov.in/wp-content/uploads/2018/07/Notification-Punjab-SWM-Policy-2018-Final.pdf. (Accessed on 25/6/2020).
16. https://timesofindia.indiatimes.com/city/chandigarh/city-drops-from-3rd-to-20th position-in-swachh-ranking/articleshow/68294120.cms (Accessed on 25/6/2020).
17. https://www.google.com/maps/dir/Rupnagar,+Punjab+140001/Samgauli,+Punjab/@30.7486645,76.4379381,10z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1s0x390555b542ad06ab:0x6489ccba3c7f2fa7!2m2!1d76.5230961!2d30.9661003!1m5!1m1!1s0x390fbeee95fe1263:0x209b7af6f9b61343!2m2!1d76.8962919!2d30.5315633!3e0 (Accessed on 25/6/2020).(Accessed on 25/6/2020).
18. Guidelines on usage of Refuse Derived Fuel in various industries. 2018. http://cpheeo.gov.in/upload/5bda791e5afb3SBMRDFBook.pdf (Accessed on 25/6/2020)
19. Singh A and Basak P 2018. Economic and environmental evaluation of municipal solid waste management system using industrial ecology approach: Evidence from India *J. Cleaner Prod.*

195:10-20.

20. Cost Benefit Analysis of Composting and Anaerobic Digestion in a Community: A Review. 2017 . https://www.aidic.it/cet/17/56/297.pdf (Accessed on 25/6/2020).
21. https://www.thebetterindia.com/128451/100-door-door-urban-garbage-collection-indian-city-shown-possible(Accessed on 25/6/2020).(Accessed on 25/6/2020).
22. Kumar A and Samadder S R 2020. Performance evaluation of anaerobic digestion technology for energy recovery from organic fraction of municipal solid waste: A review. https://doi.org/10.1016/j.energy.2020.117253 (Accessed on 25/6/2020).