International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 13 (2019) pp. 3069-3074

Development of Zero Waste Management System Model for Durg City

Shivanand Kamde[1], Dr. P.K. Ghosh[2], Dr. M.K. Gupta[3]

[1] *Senior Lecturer (Civil), Government Polytechnic, Durg, Chhattisgarh, India.*

[2] *Principal, Krishna Engineering College, Bhilai, Chhattisgarh, India.*

[3] *Head of Department, Civil Engineering, Bhilai Institute of Technology, Bhilai, Chhattisgarh, India.*

Abstract

The term zero waste was started in 1973 by Dr. Paul Palmer zero waste means 100% diversion of Municipal Solid Waste (MSW) from landfill. In this paper the conceptual background and mechanisms being used in 25 cities of the world including the area studied i.e., Durg city has been analysed through literature review and interactive survey method. Some important key issues involved in existing zero waste management system has also been studied and evaluate the system using Battle Environment Evaluation System (BEES). In this study the Delphi Technique has frequently used to evaluate existing municipal solid waste management system (MSWMS) of the area under study. The value of Environmental quality (EQ) has been calculated for existing MSWM system of the area under study was found to be 236, where as in ideal value for good rating of existing MSWM system should be 520. On the basis of facts and found, various conclusions were drawn such as develop innovative product design, focus on Solid Liquid Resource Management Centre (SLRMC), Domestic Composting System (DCS), design of optimal collection and transportation routes, develop transfer stations, implementation 3R principles and monitoring of MSWM system at different phases. A zero waste management model has also developed and proposed.

Keywords: Zero waste, zero waste management system, environmental quality (EQ), Environmental Impact Unit (EIU), Parameter Important Unit (PIU), Delphi Technique (DT), Solid Liquid Resource Management Centre (SLRMC), Domestic Composting System (DCS), Battlle Environmental Evaluation System (BEES).

1. INTRODUCTION

Zero waste is an abstract term not an absolute term. It is a philosophical concept which encourage the redesign of resourced life cycle so that all products are reused zero waste mainly focus on designing and managing products and processes systematically to avoid and eliminate the wastes and materials and to conserve and recover all resources from waste stream.[2]

Waste is a social problem created by us, therefore to make it zero, we will have to it using social engineering as well as modern technology. In fact zero waste management (ZWM) emphasise aspiration to minimize uses of resources or minimize consumption by society and maximize 8 R viz. rensing, recycling, repairing, redesigning, regenerating, reducing, remanufacturing and reselling of products.[3, 4]

Zero waste means 100% diversion of MSW from landfill by achieving 100% recycling of waste[5], which is possible only when the holistic waste management plan and some innovative approaches applied to the present SWM system.

The area under study i.e., Durg city is one of the most important city of Chhattisgarh state having population 2,68,806 as per census 2011. The quantity of MSW generated from the area is found to be 80 TPO is to be dumped at landfill site 6.0 km away from the zero point of the city. To achieve cleanliness which is next to godliness, 164 optimal collection and 25 optimal transportation routes have been designed and proposed. In this study 49 community Bins found to be adequate to collect 80 tonne MSW which will save about 41.6% collection devices. In this area containing 60 wards only 77 safai workers are found to be adequate which is about one third of the man power deployed in existing MSWW system.

1.1 Objectives

The basic aim of this study is to:

(i) Identify Key issues regarding minimum zero waste.

(ii) Develop awareness and extend responsibilities for both consumers and product – manufacturers.

(iii) Focus on SLRMC, domestic composting system and Rag picking services.

(iv) Develop zero waste picking services.

1.2 Status of zero waste cities in the world

On the basis of facts and finds through literature review following Table 1.2.1 shows status of zero waste achieved by cities, target years and mechanism used to achieve the target have been summarized in it.

Table 1.2.1: Summary of zero waste cities

S. No.	Name of city	Mechanism	Status of zero waste	Target Year
1.	Austin[6]	Food donation (i.e., reuse), composting	90%	2040
2.	Ambikapur, Chhattisgarh, India[7]	Segregation at segregation centre, composting and use of biodigesters recycling	No dumping ground	2019-20
3.	Argentia (Bueroaires)[8]	Banned on recycling and empowered waste pickers	100%	2020
4.	Auckland (Newzeland)[9]	Emphasis on waste incineration	100%	2040
5.	Belgium[10]	Focus on waste reduction at source	100%	2020
6.	Cappanori (Italy)[11]	Reduction at source	100%	2020
7.	Casual (Ireland)[12]	Emphasis on Waste preventation, composting and education	75%	2030
8.	Chhota Narena, Rajasthan, India[13]	Reduction at source	80%	2020
9.	California[14]	Composting	95%	2020
10.	Durg, India[15]	Reduction at source, develop domestic composting service and SLRM centre	90%	2030
11.	Fort collians (Colombo)[16]	Expanded reuse recycle and composting	100%	2030
12.	Gipuzkoa shain[17]	Focus on waste reduction	70%	2020
13.	Kamikatasu (Japan)[18]	Reduction at source	100%	2040
14.	Lapus (Rumania)[19]	Focus on composting and recycling	80%	2020
15.	Medimurje[20]	Avoidance of incineration and implementation of 3R principle	70%	2020
16.	Mumbai, India[21]	Focus on waste segregation using waste pickers composting	70%	2030
17.	Nova Scotia[22]	Reduction at source	90%	2020
18.	New York[23]	Reduction at source, composting	70%	2020
19.	Pune, India[24]	Focus a waste pickers, reduction at source	75%	2025
20.	Sant Movika, U.S.[25]	Reduction at source	95%	2030
21.	Slovenia[26]	Door to Door collection of waste, reduction at source	100%	2025
22.	Swedan[27]	Protect burning rubbish, 50% incinerated and converted into energy	50%	2020
23.	Sun Diego[28]	Reduction at source	100%	2040
24.	Taiwan[29]	Focus on zero waste policies, banned as disposable – utensils from restaurant	50%	2020
25.	Wales[30]	Focus on 3R principles	70%	2025

The results shown that about 44% focused on reduction at source where as 28% emphasis on composting. The value of recycling of waste was found to be 12% where as the value of waste picking system was 8% and only 8% focused on reuse. It is very clear from the above facts that the zero waste management system will be achieved at 2040 i.e., after two decades.

1.2 Identification of key issues related to existing waste management system

In this study some common key issues were identified using interactive survey method and literature review strategy and summarized in Table 1.2.1.

Table 1.2.1: Summary of common issues pertaining to existing waste management

S. No.	Issues
1.	Old infrastructures i.e., collection vehicles, tricycles, community bins were located haphazardly.
2.	Old and conventional consumption practice.
3.	Open burning of MSW.
4.	Open dumping of MSW.
5.	Unwillingness to change behavior.
6.	Lack of participate of community and other public private participate (PPP).
7.	Poor awareness and education policy of MSW system.
8.	Improper implementation of incentive services viz. levy, taxes, penalty.
9.	Unengineered landfill.
10.	Provision of finance in budget regarding MSW is unadequate and demoralized service.
11.	No provision of Rag pickings service in MSWM system.
12.	No provision of transfer station.
13.	Poor monitoring of MSWM system.

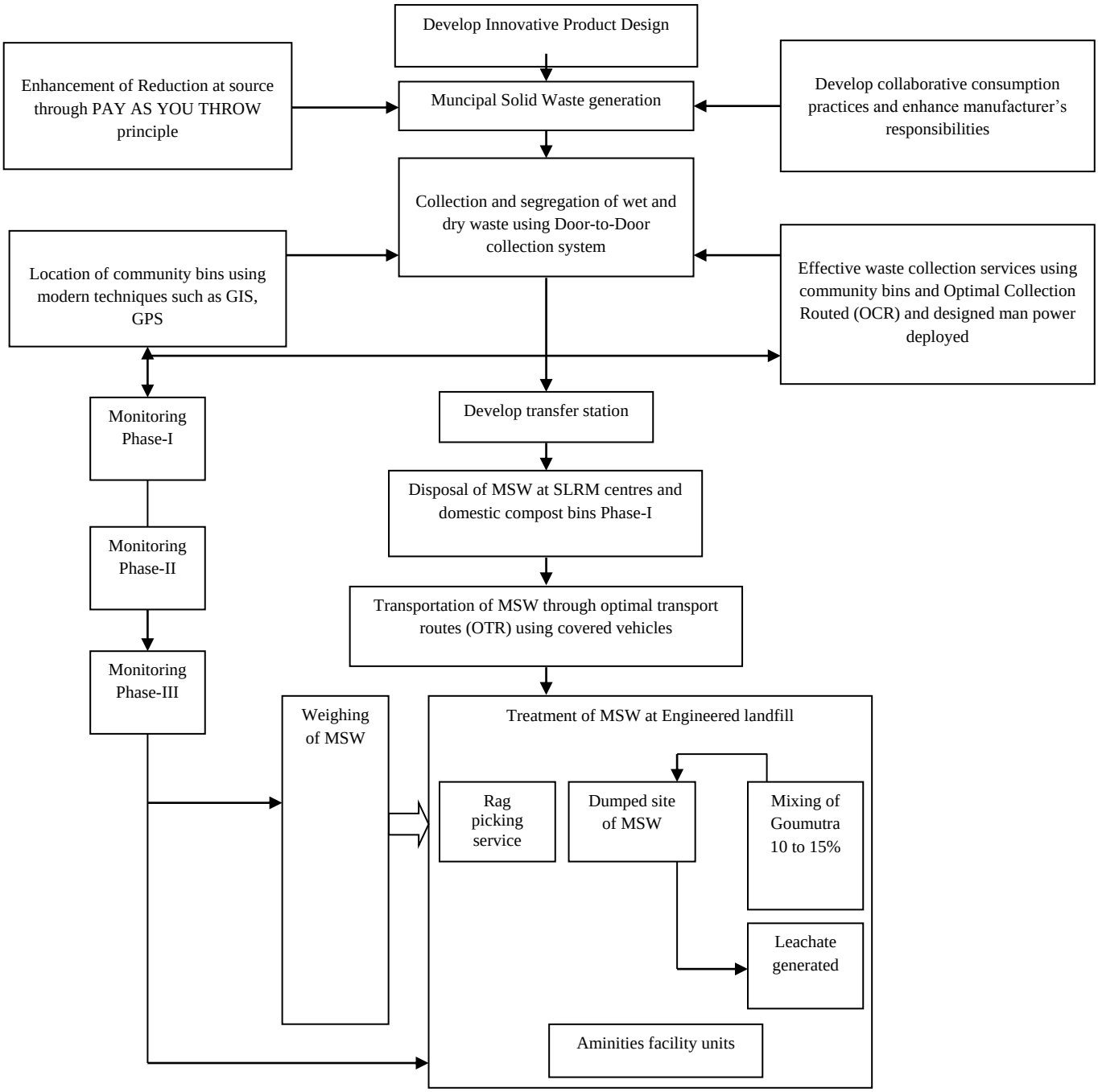
To achieve zero waste, a zero waste management model has been developed involving all those key issues which may likely to influence the ZWM system.

2. MATERIAL AND METHOD

A survey was conducted to analyse of various key issues pertaining to zero waste management system being used in area under study and collected all important informations through insight using questionnaire then a comprehensive check list were developed and each parameter were given a relating of Good (G), Fair (F), Satisfactory (S), Poor (P) and Nil (N). Assessment of criteria were done according to EIU as shown in Table 2.1.

Table 2.1: Assessment of criteria according to EIU

S. No.	Criteria	Rank	EIU
1.	Effective modern techniques being used for collection transportation and disposal of MSW in existing MSWM system.	G	100
2.	Monitoring and controlling on MSWM system is not effective.	F	75
3.	Strategies used in existing MSW management system need to be improve.	S	50
4.	Implementation of MSWM Rules and Regulation.	P	25
5.	Open burning and dumping of MSW is in common practice.	N	0



Now evaluation of existing MSWM system of area under study has been done with the application of Delphi Technique[31] which focused on the following relations of EQ, PIU, EIU.

viz., $EQ = PIU \times EIU$

Where EQ stands for Environmental Quality (EQ)

PIU means Parameter Important Unit and

EIU is nothing but Environmental Impact Unit.

The advantage of Delphi Technique (DT) is the anonymity.
The result has been summarized in Table 2.2.

Table 2.2: Evaluation of existing MSWM system of area under study with the application of Delphi Technique (DT)

S. No.	Attributes	PIU	Rating	EIU	EQ = PIU x EIU
1.	Development of innovative product design	0.9	N	0	0
2.	Application of source reduction pattern through PAY AS YOU THROW (PAYT) Principle	0.1	P	25	2.5
3.	Enhancement of manufacturers responsibilities and develop collaborative consumption practices.	0	N	0	0
4.	Segregation at source (Door to Door collection of waste with result to dry and wet house hold waste separately.	0.8	G	100	80
5.	Status of Domestic Composting Service (DCS)	0.75	F	75	56.25
6.	Location of community bins using modern techniques viz. GPS, GIS.	0	N	0	0
7.	Design and development of optimal collection routes	0	N	0	0
8.	Provision of transfer station.	0	N	0	0
9.	Deployment of man power to MSWM system without following MSWM Rules and Regulation 2005.	0	N	0	0
10.	Develop SLRM centres	0.5	5	50	25
11.	Design and identification of optimal transfer routes.	0	N	0	0
12.	Treatment of MSW at landfill using with modern techniques.	0.6	P	25	15
13.	Status of composting system at landfill	0.75	S	50	37.5
14.	Application of rag bicking services at landfill	0.8	P	25	20
15.	Preventive measure of leachate generated from landfill	0	N	0	0

Total PIU = 0 + 0.1 + 0 + 0.8 + 0.75 + 0 + 0 + 0 + 0 + 0.5 + 0 + 0.6 + 0.8 + 0.75 + 0 = 5.2

Total EQ = 0 + 2.5 + 0 + 80 + 56.25 + 0 + 0 + 0 + 0 + 25 + 0 + 15 + 25 + 20 + 37.5 = 236.25

$\simeq 236.0$

Based on the above result, an ideal MSWM system with uniformly good rating (= 100) should have an EQ of 5.2 x 100 = 520.

In this study the value of EQ was found to be 236 on the basis of facts and found following conclusions were drawn.

1. No any innovative product design concept were developed and implemented to existing MSWM system.
2. The implementation of 3R principle and PAY AS YOU THROW (PAYT) were found to be very low.
3. Segregation at source system were successfully implemented by the local authority.
4. Launching of Domestic Composting System (DCS) and utilization of floral waste, collected from various holy places were reduced effectively.
5. Location of community bins were done randomly without any justification.
6. Optimal collection and transportation routes were not identified and designed.
7. MSWMS Rules were not followed.
8. Improper deployment of man power causing misappropriation of finance.
9. No provision of transfer stations, conversion of landfill to engineered landfills and rag picking services.

10. The quantity of MSW has been minimized using 3 SLRM centres located at different places of area under study.
11. Condition of composting system being done at landfill was found to be very poor and irregular.
12. No provision of monitoring services at any stage of the MSWM system existing.
13. No precautions were taken for preventive measures of leachate generated from landfill.

3. CONCLUSIONS

In this study various key issues pertaining to zero waste strategy has been identified and analysed through literature review and interactive survey method. Assessment of some common criteria involved in the existing MSWM system of the area under study has been done using Battlle Environmental Evaluation System (BEES), Environmental Impact Unit (EIU) and Dolphi Technique (DT). On the basis of facts and found the value of Environmental Quality (EQ) was found to be 236. However an ideal value of good rating should be 520. It means modification and more improvement is to be required for some attributes such as enhancement of manufacture of products responsibilities, appropriate location of community bins with proper justification similarly development of optimal collection and transportation routes should be used using advanced techniques. Development of SLRM centres and transfer station should be specially considered. Rag Picking Services should be included in MSWM system proper deployment and utilization of man power should be done. Application of preventive measures of leachate generated from landfill should be done. Special attention should be pay for monitoring services for every stage of MSWM system. A model of modified strategy of MSWM system for area under study has been developed.

REFERENCES:

[1] Zero waste International Alliance; zwla.org.
[2] ZW7A. Zero waste definition adopted by zero waste planning group; 2004.
[3] EL-Hagger, S; Sustainable industrial design and waste management: cradle-to-cradle for sustainable development; Elsvier Academic Press, Burlington, MA, U.S.A., 2007.
[4] Dileep, M.R., Tourism and Waste Management-A review of implementation of "Zero-Waste" at Kovalam Asia Pac. J. Tour, Res. 12, pp. 377-392, 2007.
[5] Atiq Uz Zamn, Steffen Lehmann; "Challenges and opportunities in transferring a city into a zero waste city", Challenges, 2011, pp. 73.
[6] Austin Resource Recovery Master Plan.pdf, December, 2015, 2011.
[7] Nagar Palik Nigam, Ambikapur Swatch Bharat Mission, 2015.
[8] https://blog.spoieleralert.com/zerowastecities
[9] https://zerowasteeurop.eu>2013
[10] www.zerowastecasual.ie.
[11] Karelia, Gopi, Swatch India.nutv, 2018
[12] www.greencitiescalifornia.or>zerowaste
[13] Durg Nagar Palik Nigam, 2017.
[14] https://www.fcgov.com>zerowaste
[15] https://zerowasteeurope.eu.tag>gipuz
[16] https://www.businessinside.com
[17] zerowasteeurope.eu>city
[18] https://zerowasteeurope.eu>incities
[19] https://mfacebook.com
[20] https://www.chc.ca>nova-scotia
[21] https://www.1.nvc.gov>site>ourwork
[22] https://timesofindia.indiatimes.com>
[23] https://www.smgov.net>solidwaste
[24] https://zerowasteeurope.eu>tag7
[25] https://www.researchgate.net>publication
[26] https://www.sandiego.gov>sustainability
[27] https://www.epa.gov.tw>public>Data
[28] https://gov.wales>files>publication>t.pdf
[29] Khan. H. Iqbal, Naved Ahsan; Textbook of solid waste management, CBS Publishers & Distributor Pvt. Ltd., New Delhi, 2003, pp. 180.