Eradicating the Barriers: Betterment of Waste Management

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***Abstract*—Being a human our duty should be keeping our Earth clean and tidy. But in the current scenario, a lot of unwanted and polluting wastes are being produced by different sources. The only way to deal with this problem is the perfect disposal and treatment of these waste. Always there exists some obstacles in the path of success, similarly here some barriers have been considered regarding disposal and treatment of waste. On overcoming these barriers our dream for greener & cleaner planet Earth may be reached. In this study three types of waste, namely Hospital Waste, Solid Waste & Paper Waste have been dealt andeach barrier common for each type of waste was analysed and the most important was found out. The method used was PROMETHEE II for inferences.**

***Keywords*—Waste Management, Hospital Waste, Municipal Solid Waste, Paper Waste, Vermicomposting, PROMETHEE II**

I.INTRODUCTION

Waste management refers to the supervised handling of waste material from generation at the source through the recovery processes to disposal. Waste management encompasses management of all processes and resources for proper handling of waste materials, from maintenance of waste transport trucks and dumping facilities to compliance with health codes and environmental regulations.There are 3 famous words also which must be implemented in our life. These words are – Reduce, Reuse and Recycle. Recycling plays a vital role in the reduction in pollution protecting earth from land fill effective utilization of the waste and also reduction in the raw material extraction.Also apart from the 3R's (Reduce, Reuse and Recycle), there are many other ways for the management of wastes. Such as-

Recycle-If we want to reduce the volume of our waste material, the best way to do so would be to recycle. It helps us to make new useful materials from the unwanted wastes.

Composting-This process involves breaking down the materials into organic compounds that can be used as manure and can be used in plantation.

Vermicomposting-It is the process of composting with the help of various species of worms for creating a heterogeneous mixture of decomposing vegetables or food waste, bedding materials, and Vermicast.

Composting Toilet-This kind of toiletscollects human excreta which isadded to a compost heap together with sawdust and straw or other carbon rich materials. There pathogens are destroyed to some extent and in this way it somehow helps in conservation of ground water.

Landfills-In this process, an area is dug and filled with waste and eventually covered by soil.It helps in managing and collecting of wastes at one place rather than loitering here and there.

Incineration- It is the process of controlled burning of wastes produced from households at a very high temperature. This helps in killing harmful germs and bacteria that reside and survive on those wastes.

Anaerobic Digestion-Microorganisms are used for breaking down biodegradable wastes in absolute absence of oxygen.

Biodrying-Biodegradable wastes are heated up by composting for removal of moisture and reduction of weight of the wastes.

The different types of wastes are Hospital Wastes, Municipal Solid Wastes, and Paper Wastes etc. The different types of wastes under Hospital Wastes are Plastics Disposables, Radioactive wastes, Discarded Glasses etc. Some wastes under Municipal Solid Wastes are Constructed Metals, Concrete, and Brick Masonry etc. Wastes coming under Paper Wastes are Old newspaper & magazines, Notebooks & textbooks, Examination Answer sheets etc. Waste disposal has many negative impacts on the environment. Some of the impacts of waste disposal on land are ground water contamination by the leachate generated by dumping of waste on open land, contamination of surface water by the run-off from dumping of waste, foul odour, pests, rodents and wind-blown litter in and around the waste.

II. LITERATURE REVIEW

Muduli and Barve (2012) attempted to identify potential barriers that hindered the greening effort of the health care waste sector in India by Interpretive Structural Modelling (ISM) and alsoanalysed them and their interdependencies. They said that hospitals are the epicentres for infectious and contagious wastes generation.They also made it clear that hospital wastes are risky and hazardous for patients and also for the people who are acclimatized with it.

Dwivedi et al., (2009) surveyed and investigated generated waste, recycling procedure for waste and safe disposal of waste. Hospital generates bandages, syringes and human waste which are thrown in open. Systematic management of these can prevent in harmful consequences of these hazardous waste.

Rakib et al., (2014) analysed and con that urban pollution growth and solid waste generation are some of the major

issues in the developed and developing countries.These factors have loads of negative impacts on environment, resilience and socio-economic conditions.

According to Tandon et al., (2013) Paper Industry have ended their tie-ups with economic growth as higher industrial output results in increased demand for industrial paper for packaging, office works and publishing books. Saving paper saves pulp, coal, electricity and water. It also reduces Green House Gases emission and import bill for waste paper.

Babu(year) has giveninnovative ideas for converting Waste into Energy by proposing a plan of setting up a 3MW landfill gas based power plant on DBOOT basis at Gurai,Mumbai.

Sen and Patel(2015) have worked on a paper for selection of industrial robot by PROMETHEE II method.Brans and Vincke (1985) did establish the PROMETHEE I & PROMETHEE II methods. Amongst many Multi Criteria Decision Making tools, PROMETHEE II is considered one of the best.

III. RESEARCH METHODOLOGY

Some common barriers for all categories of wastes are considered. Then suggestions from 18 people who belonged to Municipal Corporation, Central Pollution Control Board, and Bihar State Pollution Control Boardare taken. Eventually, literature review is done and those barriers are matched with expert analysis and then analysis done.

IV.DATA ANAYLSIS

Preference function based outranking method is a special type of Multi Criteria Decision Making tool that can provide a ranking ordering of decision offers. All title and author details must be in single-column format and must be centred.

Step 1— Decision matrix was normalized using the following equation:

$$R_{ij} = [X_{ij}-\min(X_{ij})]/[\max(X_{ij})-\min(X_{ij})] \quad (i=1,2..n;j=1,2..m)$$

whereR_{ij} is the performance measure of i^{th}barrier with respect to j^{th} criterion.

Step 1I— Evaluative differences of i^{th}barrier were calculated with respect to other barriers. This step involved the calculation of differences in criteria values between different barriers pair-wise.

Step 1II— Preference function Pj (i, i') was calculated using the following equation:

$$P_j (i,i') = 0 \quad \text{If } R_{ij} \leq R_{i'j}$$

$$P_j (i,i') = (R_{ij} - R_{i'j}) \quad \text{If } R_{ij} > Ri'j$$

Step 1V— Aggregated preference function was calculated taking into account the weight criterion. Aggregated preference function:

$$\Pi (i,i') = [\sum_{j=1}^{m} Wj \times Pj(i,i')]/\sum_{j=1}^{m} Wj$$

whereW_j was the relative importance (weight) of i^{th} criterion.

Step V— Leaving and Entering outranking flows were determined as follows. Leaving (or positive) flow for i^{th}barrier:

$$\omega^{+} (i) = \frac{1}{n-1} \sum_{i'=1}^{n} \Pi(i,i') \quad (i \neq i')$$

Entering (or negative) flow for i^{th}barrier:

$$\omega^{-}(i) = \frac{1}{n-1} \sum_{i'=1}^{n} \Pi(i',i) \quad (i \neq i')$$

Here n was the number of barriers.

Step V1— Net outranking flow for each barrier was calculated using:

$$\omega (i) = \omega^{+} (i) - \omega^{-}(i)$$

Step VI1— Ranking of all the considered barriers was determined depending on the values of ϕ (i).The higher value of ϕ (i), the more important was the barrier to be looked upon. Thus, the most importantbarrier to be looked upon was the one having the highest ϕ (i) value.

The barriers for different types of waste-

- Budgetary allocation by Municipalities for solid waste management
- Bulk of spending on collection & transportation
- Lack of budget on processing or treatment
- Tremendous processing & disposal of municipal solid waste
- Lack of perfect disposal
- Lack of institutional & financial capability
- Lack of viable business module in the sector
- Dependence of Municipalities on State & Central Government for budget
- Identification of suitable site
- Willingness to pay for waste (Reluctance to change & adopt)
- Awareness & training program
- Lack of proper technology

Table I. Numerical Data For Barrier Selection

	HOSPITAL WASTE	MUNICIPAL SOLID WASTE	PAPER WASTE
A. Budgetary allocation by Municipalities For Solid Waste Management	4	3.67	3.5
B. Bulk of spending on Collection & Transportation	3.33	2.67	3.17
C. Lack of budget on processing or treatment	3.83	2.83	3.17
D. Tremendous processing & disposal of Municipal Solid Waste	3	3	3.67
E. Lack of perfect disposal	2.83	3	4.33
F. Lack of institutional & financial capability	3.67	3.17	3.33
G. Lack of viable business module in the sector	3	3.67	3.67
H. Dependence of Municipalities on State & Central Government for budget	4	3.5	3.67
I. Identification of suitable site	3.16	3.5	3.17
J. Willingness to pay for waste (Reluctance to change & adopt)	2.67	3.5	3.67
K. Awareness & Training Program	4.33	3.5	4.67
L. Lack of proper technology	3.33	3.33	4

Table II. Normalized Decision Matrix

	HOSPITAL WASTE	MUNICIPAL SOLID WASTE	PAPER WASTE
A	0.801205	1	0.22
B	0.39759	0	0
C	0.698795	0.16	0
D	0.198795	0.33	0.333333
E	0.096385	0.33	0.773333
F	0.60241	0.5	0.106667
G	0.198795	1	0.333333
H	0.801205	0.83	0.333333
I	0.295181	0.83	0
J	0	0.83	0.333333
K	1	0.83	1
L	0.39759	0.66	0.553333

Table III.Preference Functions Matrix

	HOSPITAL WASTE	MUNICIPAL SOLID WASTE	PAPER WASTE
AB	0.404	1	0.22
AC	0.103	0.84	0.22
AD	0.603	0.67	0
AE	0.705	0.67	0
…			
…			
…			
LH	0	0	0.22
LI	0.103	0	0.553
LJ	0.398	0	0.22
LK	0	0	0

The weights for Hospital Waste, Municipal Solid Waste, and Paper Waste are 4, 4.67, and 2.5 respectively.

Table IV.Aggregated Preference Function Matrix

L	0.286464	0	0.107431	0	0.049239	0.073053	0.142149	0.215389	0.071074	0.071074	0.386696	NA
K	0.071074	0	0	0	0	0	0.071074	0	0	0	NA	0
J	0.357914	0.142167	0.249955	0.070904	0.132856	0.215577	0.142337	0.28684	0.10564	NA	0.507386	0.191764
I	0.301513	0.036526	0.144315	0.07453	0.173008	0.133885	0.145604	0.25573	NA	0.07453	0.476276	0.160654
H	0.071074	0	0	0	0.098478	0	0.071074	NA	0	0	0.220546	0.049239
G	0.215577	0.070904	0.178693	0	0.098478	0.144315	NA	0.215577	0.034378	0	0.436124	0.120501
F	0.305595	0	0.034378	0.050582	0.14906	NA	0.259624	0.259812	0.137968	0.18855	0.480358	0.166714

	A	B	C	D	E	F	G	H	I	J	K	L
A	NA	0	0	0.025291	0.123769	0	0.025291	0.025291	0	0.025291	0.245837	0.07453
B	0.611996	NA	0.174682	0.212498	0.310976	0.306401	0.492614	0.566213	0.34701	0.42154	0.786759	0.400063
C	0.437314	0	NA	0.145604	0.244082	0.166097	0.425721	0.391531	0.280116	0.354646	0.612077	0.332811
D	0.496052	0.071262	0.179051	NA	0.098478	0.215748	0.280475	0.424978	0.243778	0.209042	0.645524	0.258827
E	0.532578	0.107789	0.215577	0.036526	NA	0.252274	0.317001	0.461504	0.280304	0.209042	0.583572	0.246115

Table V. Net Outranking Flow Matrix

	Φ+(i)	Φ-(i)	Φ(i)	RANK
A	3.687151	0.5453	3.141851	2
B	0.428648	4.630752	-4.2021	12
C	1.284082	3.389999	-2.10592	10
D	0.615935	3.123215	-2.50728	11
E	1.478424	3.242282	-1.76386	9
F	1.50735	2.032641	-0.52529	7
G	2.372964	1.514547	0.858417	4
H	3.102865	0.510411	2.592454	3
I	1.500268	1.976571	-0.4763	6
J	1.553715	2.40334	-0.84963	8
K	5.381155	0.142148	5.239007	1
L	2.001218	1.402569	0.598649	5

V. CONCLUSIONS

In the above study, twelve number of barriers were considered and the most important barrier to be looked upon was ranked according to PROMETHEE II method. From the study, it was realized that "Awareness and Training Program" should be given maximum importance for proper waste management.It was also found that Vermicompost is one of the best methods for the utilization of biodegradable wastes. It has no harmful by-products that ruins the environment rather its by-products are used as manure for improvement of soil quality for finer plantation. Subsequently, there are many other methods like recycling, landfill etc. which also help significantly in waste management.It should be kept in mind that wastes are the misplaced resources and by proper management of wastes income can also be done.

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