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DEVELOPING A ZERO WASTE MANGEMENT FOR AN INSTITUTION

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Abstract— The management of solid waste has become a great deal due to economic activities and rapid urbanization. The government and private bodies has given a acute interest in resolving this issue with great deal of safety and maintain better hygiene. Recycling and reusing can be useful tool in handling this uprising issues. In Thiagarajar college of Engineering (TCE) campus the amount of paper, plastic, leaves generated are 5692.8kg, 1478.4kg & 8533.8kg per year respectively. The present waste disposal system is not sustainable. The dry leaves which are in fact the major component in total waste generation can be converted into Activated carbon instead of burning (an adsorbent widely used for its adsorption capability). And the plastic, paper wastes can be weighed and sold out to local market for recycling. The wastes generated in hostel are mostly organic [(i.e.) food, vegetable wastes, woods, twigs, leaves) and Miscellaneous wastes (plastic and paper)]. The total wastes from old mess is 40kgs/day new mess is 30kgs/day and vegetable peels is about 40kgs/day with leaves 20kgs/day. The wastes are being sent to bio-gas plant and nearly half the amount of total percentage is refilled as bio-gas (i.e.) old mess – 20kgs/day and new mess- 8 to 15kgs/day .The present study illustrates a detailed literature survey on "ZERO WASTE MANAGEMENT". Through the findings from questionnaire survey indictors were identified and RIAM-software-in which the indicators were prioritized. Thus a set of framework/toolkit is to be developed and following it to achieve zero waste in the institution.

Keywords— Activated carbon RIAM,TCE,ZERO-WASTE- MANAGEMENT,

I. Introduction

Waste is discarded material which has no consumer value to the person abandoning. It may be in solid, liquid, or gas. Due to evolution, industrialization transition, urbanization of mankind and demanding consumerism it is impossible to stop generating waste both Non-biodegradable (plastics, rubbers, chemicals) Bio-degradable.

A. *Classification of Solid waste*

The following are the types of wastes generated,
Domestic/Residential waste, Municipal waste, Commercial waste, Institutional waste, Garbage, Rubbish, Construction& Demolition waste, Industrial wastes, Hazardous waste.

B. *Solid Waste Management*

Management of solid waste is defined as the process related to generation, storage, transferring, processing and disposing the solid as per the principals of public health, economical, engineering, conservative, aesthetic, recyclable, and reusable. **Zero Waste** is a goal that is ethical, economical, efficient and a visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use.
Functional elements of Zero waste management
Source reduction, Onsite storage, Collection and Transfer Processing Techniques & Disposing must be implemented to achieve Zero waste management.

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II. METHODOLOGY

A. RIAM

Rapid Impact Assessment Matrix (RIAM) which comes under one of the options of Environmental Impact Assessment(EIA) was used to see overall rating and prioritize the indicators for the future. The suitability was evaluated considering ecological, social, cultural and economical as components in decision making. Different components were used to produce a cumulative score. (i.e.) Environmental Score (ES) for each option of the site for MSW disposal facility creation in accordance with ecological, physical, biological, social/ cultural, and economic quality of the project. In this study for physical/chemical component the site recommendation & waste transportation and distance were the major factors, while in biological/ecological components showed few negative impact of the project in all sub-sectors (**A1, A2, B1, B2, B3**). Socio-cultural and economical components showed the different ranges of ES. This study extends the possibility of utilizing RIAM as a tool in decision making support system.

A1- Importance of condition
A2-Magnitude of change/effect
B1-Permenanace
B2-Reversibilty
B3-Cumulative
ES-Environmental score

B. Study Area Description

Type Of Area	**In Acres**	**In Square Metres**
Total Land Area	140.3	5,67,773.89
Building Area	8.2	33,184.22
Road Area	4.632	18,745.04
Walkway	0.85	3,439.83
Parking Area	0.35	1,416.40
Playground Area	32.123	1,30,000
Green Cover Area Including Open Space	94.145	3,80,988.42

II. FACTORS INFLUENCING WASTE GENERATION

In this scenario, the factors influencing the waste generation were classified from 56 indicators referred from AtiqUzZaman"Identification of key assessment Indicators of Zero Waste Management Systems*" Ecological indicators 36(2014)682-693.*

A. List of factors identified

And was reduced to a total of 14 indicators that was necessary for the Institution and based on these a questionnaire survey was plotted to prioritize the schematics that would help to initiate a set of strategies for creating a zero waste environment in the institution. The indicators are as follows:

- *Inadequate service coverage*
- *Lack service quality (not frequent enough)*
- *Lack of authority to make financial and administrative decision*
- *Lack of financial resources*
- *Lack of trained personnel*
- *Lack of legislation*
- *Lack of enforcement measure and Capability*
- *Lack of planning (short, medium and long term plan)*
- *Difficult to locate and acquire landfill site*
- *Difficult to obtain cover material*
- *Poor cooperation by students*
- *Bad odour*
- *Uncontrolled use of packaging material*
- *Poor response to waste minimization(reuse/recycling).*

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B. Prioritizing Factors

A survey has been conducted to obtain the view of the public and to prioritize various solid waste management practices. The prioritizing was done by adopting **VERY STRONG =3, STRONG=2,AVERAGE=1, LOW=0** as the indicators and concised based on the above cadre.

Thus from above the indicators were ranked in order and prioritized and the numbering values indicate the total no. persons answered the questionnaire. Totally 28 persons answered the questionnaire survey and thus from their perspective the indicators were prioritized and ranked accordingly to finalise it to 6 indicators as follows:

- *Lack of legislation*
- *Poor cooperation by students*
- *Uncontrolled use of packaging material*
- *Poor response to waste minimization (reuse/recycling)*
- *Lack of planning (short, medium and long,term plan)*
- *Bad odour*

C. *RIAM Analysis*

Fu Furthermore analysis was conducted using RIAM-(Rapid Impact Assessment Matrix). The same 14 indicators were used and incorporated into 4 major components

PC-Physical and chemical
BE-Biological and Ecological
SC-Social and Cultural
EO-Ecological and operational

And then the values were assigned in accordance with the ES-(Environmental Score) ; thus the range bands (A1, A2, B1, B2, B3) were assigned and then in accordance with the cumulative; the positive and negative impacts were can be demonstrated and the indicators were prioritized to show the similar result as such observed from the questionnaire survey. A1& A2 are multiplication values of group A and B1, B2, B3 are the values of addition from group B.

The assessment criteria was done as per the below standard

TABLE I. Criteria Table

ENVIRONMEN--TAL SCORE	RANGE BANDS	DESCRIPTION OF RANGE BANDS
+72 to +108	+E	Major positive change/impacts
+36 to +71	+D	Significant positive change/impacts
+19 to +35	+C	Moderately positive change/impacts
+10 to +18	+B	Positive change/impacts
+1 to +9	+A	Slightly positive change/impacts.
0	N	No change/status quo/not applicable
−1 to −9	-A	Slightly negative change/impacts.
−10 to −18	-B	Negative change/impacts
−19 to −35	-C	Moderately negative change/impacts
−36 to −71	-D	Significant negative

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		change/impacts
−72 to −108	-E	Major negative change/impacts

III. DATA COLLECTION

TABLE I Types of wastes and its weight from each Department

DEPARTMENT	TOTAL WEIGHT (KGS/DAY)	PAPER (kgs/ day)	(%)	PLASTIC (kgs/ day)	(%)	Miscella--eous (kgs/ day)	(%)
Civil	1.8	1.022	56.78	0.21	11.67	0.568	31.56
EEE	1.019	0.904	88.71	0.104	10.20	0.011	1.08
ECE	0.908	0.380	41.85	0.309	34.03	0.219	24.12
IT	3.976	2.225	55.96	0.424	10.66	1.302	32.75
CSE	1.328	0.891	64.47	0.226	16.35	0.265	19.17
Architecture	1.788	0.733	40.99	0.513	28.69	0.542	30.31
Mechanical	3.5	2.997	85.63	0.111	3.17	0.392	11.20
Average			62.06		16.40		21.46

TABLE II.Total weight of the waste generated in TCE campus Annually:

TYPES OF WASTES GENERATED	TOTAL WEIGHT (KGS/YEAR)	PAPER (KGS/YEAR)	PLASTIC (KGS/YEAR)	MISCELLANEOUS (KGS/YEAR)	LEAVES (KGS/YEAR)
LEAVES	15705				8533.8

TABLE III .Waste generation in hostel per day

PLACE OF GENERATION	TOTAL AMOUNT GENERATED PER DAY IN KGS
Old mess hall (A & B)	40
Mess Hall (1&2)	30
Veg-peels(organic wastes)	40
Leaves	20

Through a ***Bio-gas*** plant nearly ½ the amount of percentile is retrieved and can be used for refilling.(i.e.). and the rest of wastes are being ***Incinerated***.

TABLE IV. Labour details

S.NO	TYPE OF EMPLOYER/EMPLOYEE	NO. OF EMPLOYEES
1	Scavengers+ Sweepers	11

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2	Gardeners	5
3	Carpenter+ Helper	1 each = 2
4	Mason	1
5	Dump operator	2
6	Electrician	3
7	Mess supervisor	2

IV. COST ANALYSIS

TABLE V. The cost of collection involves cost of labourers which depends upon the tot. Waste generated.

S.NO	LABOURERS REQUIRED	LABOUR SALARY/MONTH	TOTAL COLLECTION COST/MONTH
1	33	5600	1,84,800

A. Cost Of Transportation

The wastes from dumper bins are transported to the disposal site through labours, so there's no need for vehicle.
Total cost for transport=0.

TABLE VI. *Processing Cost At Segregation Yard*

S.NO	WASTE GENERATION/MONTH	PROCESSING COST/KG	LABOUR REQUIRED	LABOUR SALARY/MONTH	PROCESSING COST/MONTH
1	2502	2.0	6	834	5004

Total cost= Cost of Collection + Transportation cost+ Processing cost

= 1,84,800+5004=Rs.1,89,804/month

TABLE VII. Market value of paper and plastic

ITEM	MARKET VALUE (RS.)
Paper	10.0
Plastic	8.0

Thus the total amount of wastes generated in the institution and in depth cost cost analysis were collected through data surveying and finalized.

IV. CONCLUSION

The solid waste materials generated in student housing areas is a vital component in campus materials management and Zero Waste practices. With students occupying campus living facilities and impacting the university waste stream, this policy also applies to all University owned living facilities. Additionally, with a diverse campus population that includes students without personal transportation and intra-state students who are unfamiliar with local resources, part of a Zero Waste campus includes providing opportunities for all students to divert personal items such as: electronics (i.e. computers, printers, , stereos, televisions, etc..), cell and smart phones, textiles, and other items that students bring to campus owned facilities that often get abandoned and landfilled into the University waste stream. And thus, the total amount waste generated in the

institution and Hostel and the factors influencing the waste generation were identified using RIAM and questionnaire survey. And set of suggestions were suggested for achieving the zero waste institution.

Growing volumes of solid and hazardous wastes are major threats to the environment. This study is made at TCE campus in Madurai, which covers a total area of 5,67,773.89 square meters and Green area covers about 67% of total area. The total amount of waste generated from college is 83.71kgs/day. For each day23.7kgs of Paper, 6.16 kgs of Plastics, 47.41 kgs of leaves and 6.42kgs of Miscellaneous wastes (sand, clothes, food etc.) are collected. The plastic and paper wastes produced can be recycled and hence it's sold into the local market forRs.69,136/- year. Leaves are more than 50% of the total waste which can be recycled into activated carbon a low cost adsorbent (**"**Sustainable Waste Disposal System For TCE Campus" April 2016**).** Thus a engineered way of disposing the solid waste can be used to protect the environment and increase the economic value. The total wastes generated in Hostel is 130 kgs/day (i.e) Old-Mess Hall (A,B) is 40kgs/day, New-Mess Hall is 30 kgs/day, vegetable wastes is 40 kgs/day and Leaves constitute about 20 Kgs/day. The total wastes are being sent to bio gas plants thus a total bio-gas of ½ the amount of refill is attained.

A. suggestions

- Ensure that all new office, classroom and meeting space, have an integrated waste management collection system such as a small desk side bin that is suited to collecting paper, glass, metal, plastic and possibly composting with a small mini bin for garbage.
- The plastic and paper produced can be recycled and hence its sold into the local market.
- Ensure that all new office, classroom and meeting space, have an integrated waste management collection system such as a small desk side bin that is suited to collecting paper, glass, metal, plastic and possibly composting with a small mini bin for garbage.
- The plastic and paper produced can be recycled and hence its sold into the local market.
- Sustainable purchasingE.g.: Products made from renewable resources are typically viewed as more sustainable and rapidly renewable products would be most preferred. Purchases of products sourced regionally typically require less energy to transport and benefit the local social and economic community.
- Require all campus meetings, conferences, events, whether catered or not, to be sustainable events including: incorporating Zero Waste practices and collection, minimization of print materials distribution, ensure all print materials follow University Recycled Paper Policy for type of paper utilized and to default to all double-sided copies, among other sustainability principles..
- Ensure campus construction projects and campus facilities are in compliance with the principles.

Zero waste management provides a great deal in achieving a zero waste institution**,** however, adapting to the changes required to take up ZWM is necessary Without proper commitment, ZWM will be back to the old method using critical path, or even worse, and this broken implementation of ZWM will provide no benefit over the previous methods, but with extra cost overhead.

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