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"SOURCE SEGREGATION": A RESPONSIBLE STEP TOWARDS EFFECTIVE SOLID WASTE MANAGEMENT BY RESTAURANTS OF PUNE CITY, INDIA.

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ABSTRACT

With the increase in globalization and industrialization; Pune has seen a tremendous growth as one of the metropolitan city. Apart from Its nomenclature as 'Oxford of East', Pune city has also gained popularity as Silicon city and Automobile hub resulting in heavy influx of population. This has resulted into increase in generation of solid waste, ranging from 1200-1400 metric tons per day. This situation is alarming as this may increase in future and can prove to be uncontrollable. Remedial measures are been taken up by The Municipal Corporation of Pune city to cope up with this problem, but the efforts are proving to be insufficient.

To cater to the eating out habits of the growing population Pune city has experienced mushrooming up of various Food & Beverage outlets ranging from star hotels; Fine dine restaurants, Standalone restaurants, Fast Food outlets to small joints. It is noticed that out of total waste generated, approximately 25% is being contributed by hotels, restaurants and commercial organizations. The waste generated is mostly in the form of packaging material, paper, metal, glass, plastic and food waste.etc which can be segregated in various forms like- Dry- Wet, Degradable- Biodegradable, Recyclables, Reusable waste etc. All these waste is dumped in places like Urali Devachi and Phursungi which is 20 kms from main Pune city. This mixed waste (consisting of degradable and non degradable waste) if dumped on landfills in improper way may result in environmental pollution. The various poisonous gases emitted

due to decomposition of the waste can be hazardous to public health. This unscientific dumping of solid waste is creating lot of health issue for local residents of Urali Devachi and Phursungi.

Rather than considering solid waste as garbage, if it is segregated and processed scientifically can prove to be resourceful. Waste if segregated at source will help in assuring not only public health but will also reduce cost incurred in disposing and waste hauling fees. Properly segregated waste can be either reused, recycled or composted can fetch good monetary returns. Segregation at the source is one of the important steps in solid waste management system as it helps in categorizing the waste systematically in major categories and disposal will be easier and safer.

Dreaming to becoming India's Smart City and Clean city it is the responsibility of hospitality industry of Pune city to be the major contributor in this mission. Restaurants of Pune city is the integral part of the life of Pune's major population, so it is important to know their contribution in this mission. The purpose of this study is to find out the current situation in Pune city's Standalone and Fine Dine restaurants about their involvement in source segregation of solid waste.

KEYWORDS: Source Segregation, Waste Audit, Solid Waste Management, Waste Mapping, Waste Stream

INTRODUCTION

Solid waste disposal is a big challenge faced by many developing countries in the world. With growing population and globalization this challenge is getting more and more difficult and calls for urgent attention of not only the authorities but also people in general. The only solution to this problem is to have proper solid waste management practices implemented and followed by the stakeholders.

With growing population, Indian hospitality industry is also spreading its wings, not only the hotels but various Food And Beverage outlets like: Standalone Restaurants, Fine Dine Restaurants, Fast Foods Outlets, Pubs, Café etc are also growing with leap and bound. With this growth the problem of solid waste disposal is also proving headache for the industry. Various researches done on this issue shows that many Indian cities today are facing solid waste disposal problem and every city is trying their best to adapt to the best solid waste practices to overcome this problem.

Pune, once crowned to be the 'Pensioner's Paradise' with the increase in globalization and industrialization; it has evolved as one of the metropolitan city. Apart from Its nomenclature as 'Oxford of East', city has also gained popularity as Silicon city and Automobile hub resulting in heavy influx of population. This growth is being witnessed in last decade. Increase in population has created problem of solid waste disposal. Currently Pune is generating around 1200-1300 tons of solid waste in a day, which is disposed off 20 kms away in village Urali Devachi. This landfill near the city is becoming a health hazards for the residents of the village. There is lot of unrest amongst the residents of Urali Devchi due this unscientific disposal of solid waste on landfill which is polluting the environment in that area.

To cater to the eating out habits of this generation has paved a way for mushrooming up of various Food & Beverage outlets ranging from Star Hotels; Fine Dine Restaurants, Standalone Restaurants, Fast Food outlets to small joints. As per study done it is revealed that restaurants in Pune city generates around 435.20 tons of waste each day which is around 16% of total waste generated in a day by city [1]. The waste generated by Pune city is in the form of Dry and Wet waste amounting to 50-50% each. It is observed the percentage of wet waste is more prominent in residential and commercials areas of Pune such as hotels and food industry. This waste is mostly in the form of packaging material, paper, metal, glass, plastic and food waste. Organic waste contributes for about 24% of total generated waste [2], which mostly consist of food waste like cooked, uncooked scrapes, leftover, spoiled food etc.

Lots of researchers are working towards the solution for this problem. PMC is also taking extra efforts to implement solid waste management practices in the city. However these efforts are not sufficient to eradicate the major issue of waste disposal in scientific way. This involves proper collection, storage, segregation, transportation, processing and disposal of solid waste.

Segregation of waste at source is the one of the major steps towards effective solid waste management activity. Systematic waste segregation will help to segregate the waste like degradable- non degradable, wet waste –dry waste, recyclables- non recyclables, reusable-non reusable etc which can further be processed depending on its nature and thus help reduce landfills being dumped with mixed waste.

Integrated approach in solid waste management, by Pune Municipal Corporation can be a fruitful effort towards reducing this issue, as city's population is estimated to grow by 2025 and, so do the estimated rise in generation of solid waste to approximately 3500 tons per day [1].

OBJECTIVE OF THE STUDY

The main aim of the researcher is to get acquainted with the waste segregation practices adopted and implemented by the Standalone and Fine Dine Restaurants of Pune city.

The objective of the study is to:

- Identify the current practices of waste segregation at source followed by the Standalone and Fine Dine Restaurants of Pune city.
- To explore the acceptance of the Waste Segregation at source practices by the employees.
- To understand the views of the Standalone and Fine Dine Restaurant owner's in terms of waste segregation at source concept.

HYPOTHESIS

- H_1: Waste segregation at source is highly recommended by the Standalone and Fine Dine Restaurants.
- $H_{0:}$ Many of the Standalone and Fine Dine Restaurants feels that segregating waste is not a crucial stage in waste management system.
- H_1: Employees are ignorant about the benefits of the waste segregation at source due to lack of proper training.
- $H_{0:}$ Training is not important to generate awareness amongst the employees for understanding the benefits of waste segregation.
- $H_{1:}$ Standalone and Fine Dine Restaurant owners realize that waste segregation at source is an important step in Waste Management System.
- $H_{0:}$ As per many Standalone and Fine Dine Restaurant owners waste segregation at source is an insignificant part of Waste Management system.

REVIEW OF LITERATURE

Managing Solid waste is becoming a major challenge for all the developing countries in the world. Hospitality industry, one of the major contributors in world's economy is also on radar of being one of the contributors in waste generation. The literature reviewed reflects the various aspects of need for effective solid waste segregation methods.

Solid Waste Management: Challenges Faced By The Developing Countries

In this article author expressed his view on waste management practices followed by Indian hotels and restaurants Industry. He insists on taking up a leading position by converting its tons of waste generated into resources. This could help India to reduce its $180 billion fossil fuel imports. He also shows concern on hotel's policy of handing over waste to the segregators, but since there is no follow up after that, the accountability remains unclaimed

leading to illegal dumping of waste on landfills. There is also hesitancy of the hospitality industry in establishing in house waste management system due to quantum of waste and problem of odour. But he is quiet positive about the new entrepreneurs, who would find solution for the problem for their restaurants and ancillary business by converting waste into useful resources in future [3].

It has been also observed that country like Egypt has many constraints in implementing proper waste management due to problem with collection process, recycling, disposal of waste and inadequate landfills. Egyptian hotels views waste as lost profits due to high capital cost, additional investment in purchasing recycling equipment and increased labour charges [4].

Inefficient, old and obsolete systems of solid waste management, dearth of formal organized system of proper segregation of waste into biodegradable and non-biodegradable, and process of segregation done by scavengers and scrape dealers in an unscientific way leading to hazardous health issue to the handlers are also major challenges faced by majority of the countries. Apart from this, the study highlights the verdict of committee constituted by Hon'ble Supreme Court of India in March 99, of unsatisfactory and inefficient services due to lack of financial resources, inefficient institutional arrangements, inappropriate technology, weak legislative measures and lack of public awareness towards solid waste management [5].

With growing concern about solid waste management recycling and incineration of waste has increased but the amount of waste to landfills is not decreased due to growth in waste generation. The authors point out the reason for the same is due to unsustainable trends to unsatisfactory implementation of waste laws, and need for improvement in certain elements of policy and legal framework. Another implementation problem is like dumping waste at mismanaged landfills and shipments of hazardous waste in violation of international conventions. Waste management was vital objective of European Union Waste management policies since, many years but there has been very limited progress noticed so far as neither community nor national targets have been satisfactorily met [6].

Study conducted in few selected Hotels in Owerri, Nigeria highlights alarming situation that none of the hoteliers practice source segregation of waste. The method of source segregation of waste is not very popular in developing countries, as people still have the feeling of being "below an accepted level of social dignity". The study also shows that some hoteliers still practices open dumping and open burning of waste which causes environmental degradation. Lack of source separation of solid waste, recycling of waste becomes inefficient as it gets contaminated [7].

Components Of Solid Waste Segregation

The researcher has identified three most important components related to waste separation [8]. Those are:

- Awareness among the stakeholders on waste separation has large impact on overall waste management system in the city.
- Knowledge about the right technology and good practices can provide decision makers to plan proper waste separation programme.
- Availability of right equipment and machinery to deal with separated waste can promote effective waste separation process.

It is clear from the findings reported in the case study that mixed waste amounting for approximately; food waste 40%, glass 14%, paper 13%, cardboard 9% sent for disposal on landfills can be easily segregated and recycled. There is also a matter of concern that around 50% of waste is of organic nature and if it is mixed with other waste and not separated leads to contamination of those material which can otherwise recycled. Even sending mixed waste in an incinerator may hamper the burning process [9].

Factors Affecting Waste Segregation

The study also reveals the factors affecting waste segregation at Municipal level like [8] -

- Limited knowledge of technology and good waste management practices.
- Shortage of equipment for collecting and segregating waste
- Need for good decision maker who are concern about the environmental issues.

This study highlights problems arising during storage of solid waste at the point of generation. They refers that since most of the Indian cities lack practices of scientific and systematic storage of waste at source , there is possibility of dumping that waste in nearby open areas, streets etc causing environmental hazards. Non existence of system like segregation of waste into degradable and non degradable is not regular practice, placing different collection bins to segregate waste as per their types [5].

Waste Segregation At Source, The Solution

Waste segregation methods if done systematically have possibility of rerouting tons of waste from dumping stations and can save on disposal cost drastically .All this can be overcome by conducting awareness campaigns which can motivate individuals to play a part in segregating waste. Waste segregation at source can be facilitated by following ways:

Waste Mapping: Author suggests new concept of waste mapping. This is relatively new concept which means understanding from where and how the waste occurs and how much it cost [10].

Waste Audit: As specified in the report, waste audit is the assessment of identifying type and quantity of waste generated by an organization. This assessment will help in identifying the waste stream and collection containers to be deployed in various places of the organization so that the segregation of the waste at source can be possible [11]. This process will not only identify the type of waste generates, but it will also help in the recycling, reusing the material and even can give possible alternative ways on reducing waste.

Waste Stream: Restaurant waste stream consists of paper, plastic, cardboard, food waste, glass, metals, textile etc. All these waste if segregated and processed could result in reducing load on landfills.

As specified in a guide issued [12], the waste can be categorized into:

Garbage: mostly consisting of disposables made up of Styrofoam, aluminium foil, plastic, straws etc. This could be handed over to waste haulers or Municipal Waste pickers for further processing.

Organic waste: leftover food, paper napkins, paper products soiled with food, teabags, paper tray liners, soiled paper bags.

Recyclable: Beverage containers, glass bottles, juice cartons, metal food cans, newspaper, paper bags, office paper, cardboards etc.

This research paper throws light on importance of working towards sustainable waste management system. Author also shows concern on failure of management of Municipal Solid Waste due to non availability of means of processing the humongous amount of generated solid waste in metropolitan cities [13].

The effective way of disposing of solid waste is by source separation of waste into Dry waste and Wet waste, where Dry waste mostly compose of non biodegradable recyclable or reusable waste which can easily processed; whereas Wet waste mostly composed of biodegradable waste including vegetable waste, fruits, flowers, meat bones, ashes etc. which can be easily composted. This process will not only will prevent landfills from getting polluted due to mixed decomposed and will ease the job of the waste pickers and will also provide raw material to the manufacturer.

As specified in report [14] waste segregation is an important part of waste management and that can be done in various stages:

1) Segregating waste at source i.e (Point of origin)

2) In Municipal collection bins(where different bins are provided for different waste)
3) At transfer station where facilities are provided to sort the waste as per its nature.
4) At actual processing site where waste can be either sorted before processing or after processing, depending again on the nature of the waste.
5) Sorting at landfills

The actual segregation process of waste can be done in any of the given way-

1) Sorting the waste manually
2) Sorting waste using semi- mechanized way
3) Sorting waste in fully mechanized way.

Pune City Situation

As declared by the Pune Municipal Corporation 1st July 2005 onwards the residents and commercial establishments were bound to separate their waste and then it was being collected by the Municipal corporation vehicles. A ground trusting on solid waste segregation practices done by Pune Municipal Corporation in 14 wards including residential areas, commercial establishments like Hotels, Restaurants, wedding halls, slaughter houses, shops etc., it was found that 50% of the wards segregate hotel waste as dry and wet waste.

[15] The composition of Municipal waste which is of Heterogeneous in nature consists of organic waste (70%),paper(8%), plastics(7%), rags, metals(4%), glass pieces(6%), ashes, scrape material, dead animals, discarded chemicals, paints, agricultural and industrial waste. These wastes can be categorized into two types mainly:

a) Biodegradable and
b) Non-biodegradable

This is disposed off un-segregated at landfill site near Urali Devachi . The unscientific disposal of 1200-1300 metric tons of such mixed waste creates environmental pollution of air and ground water leading to health related issues. At Urali Devachi out of 43 hectors of land allotted for solid waste 15 hectors is already filled and sealed for further use.

A task taken up by Hanjer biotech Pvt. Ltd co. who is working on the concept of 3 R's i.e. Reduce, Reuse and Recycle, as this plant has technology which can process mixed waste, there is no compulsion on garbage segregation at source. But looking into the growing population and its effect on increase in garbage creation, the author feels that the capacity of the plant can be increased if the waste is segregated at source and only wet garbage is processed in plant and that is possible only if municipality sticks to the garbage segregation at source which is mandatory as per MSW (handling and Management) Rules 2000 [16].

There is lot of concern on the less percentage of segregation of waste done in different wards of Pune city. Author in this paper adds that 'segregation at source is the only solution to overcome the problem of solid waste. The positive association of corporation and the citizen can play a major role in these efforts [17].

Research Methodology

To obtain data related to above research problem, both primary and secondary data collection methods were used.

Literatures on solid waste management practices were reviewed. Based on which a questionnaire was drafted which included 16 questions based on following

1) General information of Restaurants
2) Current solid waste management practices adopted
3) Staff training and support
4) Views of the restaurateurs about the restaurants role in solid waste segregation activity

Sample size was 50 out of which 30 responses were usable.

Result and Discussion:

The obtained results are represented in the form of various charts and tables.

CHART NO I: TYPE OF RESTAURANTS

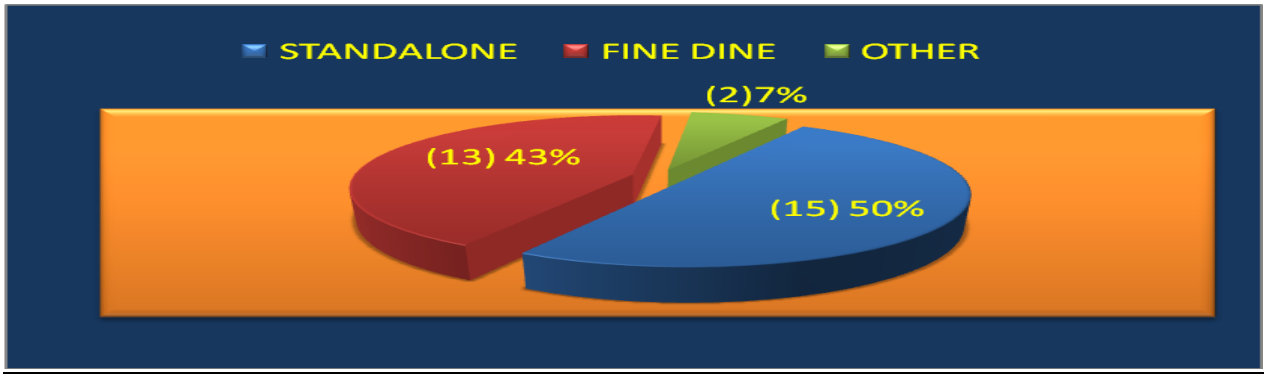

Chart I, shows the number of respondent from various categories of restaurants.This study was conducted in 30 Restaurants of Pune city, including Fine Dine, Speciality And Standalone. Maximum respondents 50% were from Standalone Restaurants.

CHART NO II: NUMBER OF COVERS IN RESTAURANT

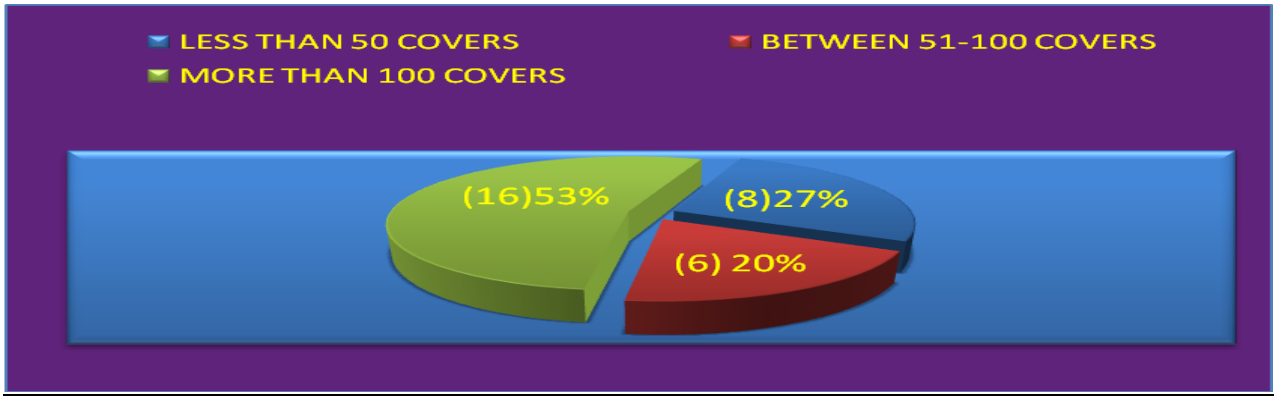

Chart II, shows Mixed samples chosen for number of covers in the restaurant, the maximum respondents were from more than 100 covers restaurants.

TABLE NO 1 : TYPE OF SOLID WASTE GENERATED BY RESTAURANTS

TYPE OF SOLID WASTE GENERATED	NO. OF RESTAURANT	PERCENTAGE
FOOD WASTE	**30**	**100%**
PLASTIC &RUBBER	**18**	**60%**
CARDBOARD	**18**	**60%**
FEROUS METALS	**2**	**6.70%**
GLASS AND CERAMIC	**18**	**60%**
PAPER	**23**	**76.70%**
TEXTILE	**1**	**3.30%**
ANY OTHER	**2**	**6.70%**

Table I ,shows different types of solid waste generated in restaurants. It was observed that all the restaurants generated food waste(30), followed by paper waste (23 restaurants), glass waste (18), cardboard(18), Plastic & Rubber (18), Ferrous Metals(2), Textile(1), Any Other , which includes waste like coal ash, e-waste and thermocol waste (2).

CHART NO III: SEGREGATION OF WASTE BY RESTAURANT INTO BIODEGRADABLE AND NON BIODEGRADABLE

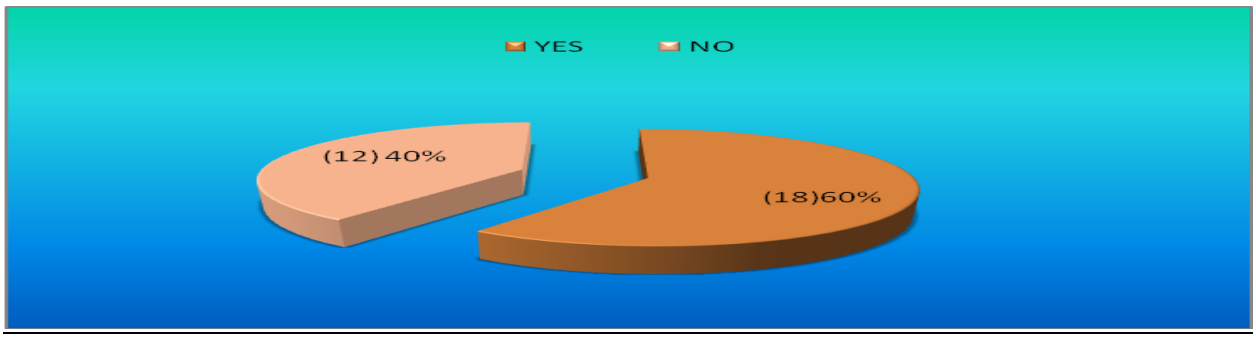

Chart III, It was observed from chart that only 77% (23) Restaurants Segregate waste into biodegradable and non biodegradable. The remaining 23% (7) restaurants segregate waste into dry and wet waste as made compulsory by the Municipal Corporation.

TABLE NO 2: DISPOSAL OF WASTE BY RESTAURANTS WHO DO NOT SEGREGATE WASTE INTO BIODEGRADABLE AND NON BIODEGRADABLE

DISPOSAL OF WASTE	NO OF RESTAURANTS	PERCENTAGE
OPEN DUMPING	1	14%
OPEN BURNING	0	0%
BY MUNICIPAL WASTE COLLECTOR	0	0%
BY CONTRACT WASTE HAULER	5	72%
ANY OTHER METHOD	1	14%

Table II, The remianing 7 restaurants who does not segregate waste into biodegradable and non biodegradable but segregate waste into dry and wet waste and dispose off their waste in different way like 1 restaurant dump dry waste on an open area and hand over wet to the municipal waste collector, where as 5 restaurants hand over waste to the contract waste hauler and remining 1 restaurant hand it over to Mall Waste Management team for further processing.

TABLE NO 3: SEGREGATION METHODS ADOPTED BY RESTAURANTS

SEGREGATION METHODS ADOPTED BY RESTAURANTS	NO OF RESTAURANTS	PERCENTAGE
SORTING WASTE BY USING DIFFERENT CONTAINERS	12	40%
SORTING BY DRY WASTE AND WET WASTE	18	60%
COMBINING WASTE AND HANDING IT OVER TO HAULER FOR SEGREGATION	0	0%
ANY OTHER	0	0%

Table III, Around 18 restaurants sort their waste into Dry and Wet as specified by Municipal Corporation, whereas 12 restaurant actually sort their waste using different containers.

CHART NO IV: WASTE AUDIT CONDUCTED BY RESTAURANT

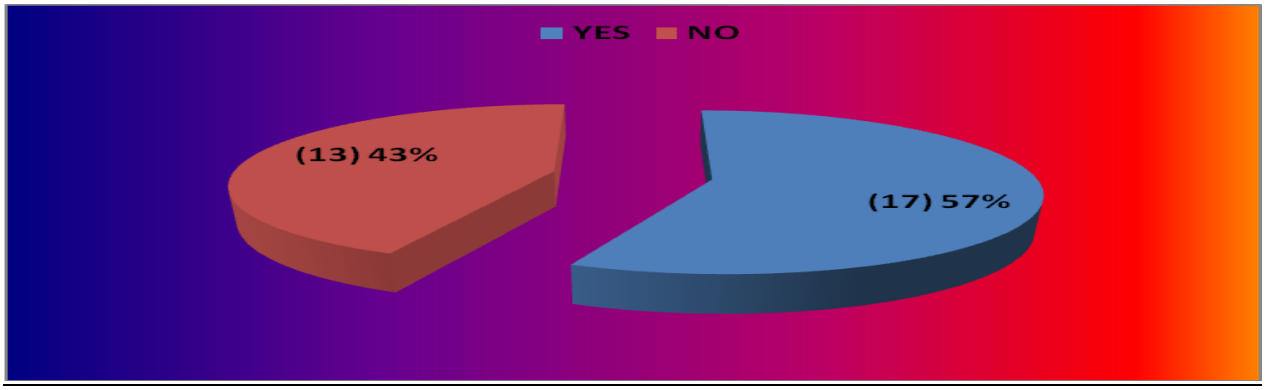

Chart IV, It has been observed that around 17 restaurants conducts waste audit.

CHART NO V: FREQUENCY OF WASTE AUDIT CONDUCTED BY RESTAURANTS

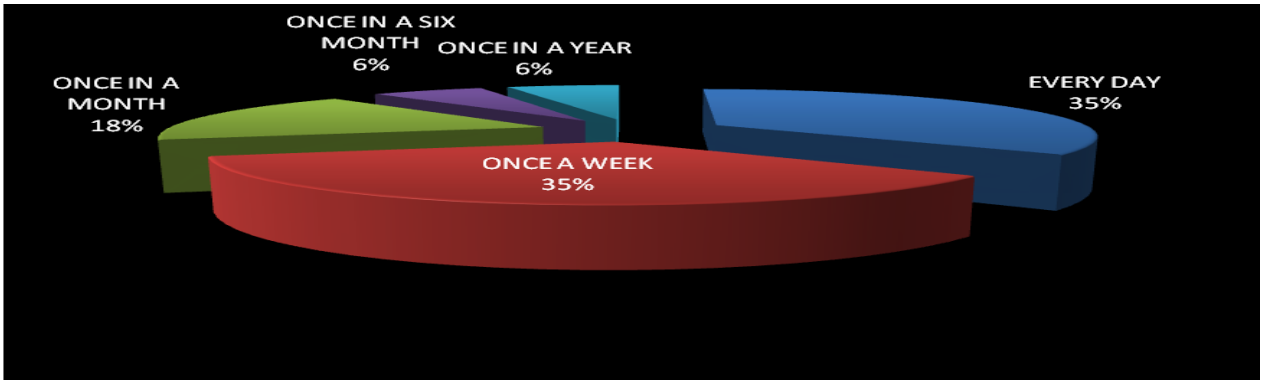

Chart V, To know the frequency of waste audit conducted by the 17 restaurants, it was found that 35% of the respondent conduct waste audit every day, 35% of the respondent conduct waste audit once in a week, 18% conduct once in month whereas 6% respondent once in a six month and 6% conduct once in a year.

CHART NO VI: PERSONNEL APPOINTED TO CONDUCT WASTE SORTING ACTIVITY

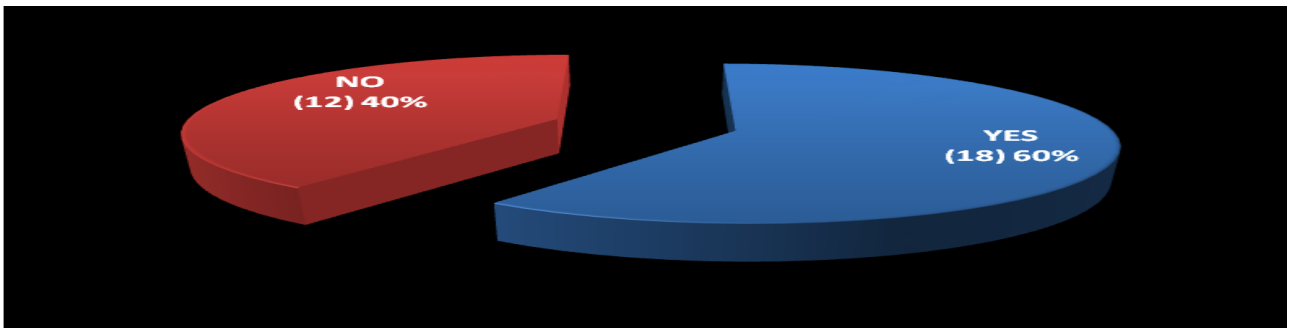

Chart VI, It was being observed that to conduct waste sorting activity around 60% of the respondents have appointed a separate personnel, either their utility staff or contract person . Remaining 40% have not appointed person for waste sorting as either the waste is directly handed over to waste hauler or their job is mostly carried out by the person who hands over waste to the corporation trucks.

CHART NO VII: DISPOSAL OF SEGREGATED WASTE BY THE RESTAURANTS

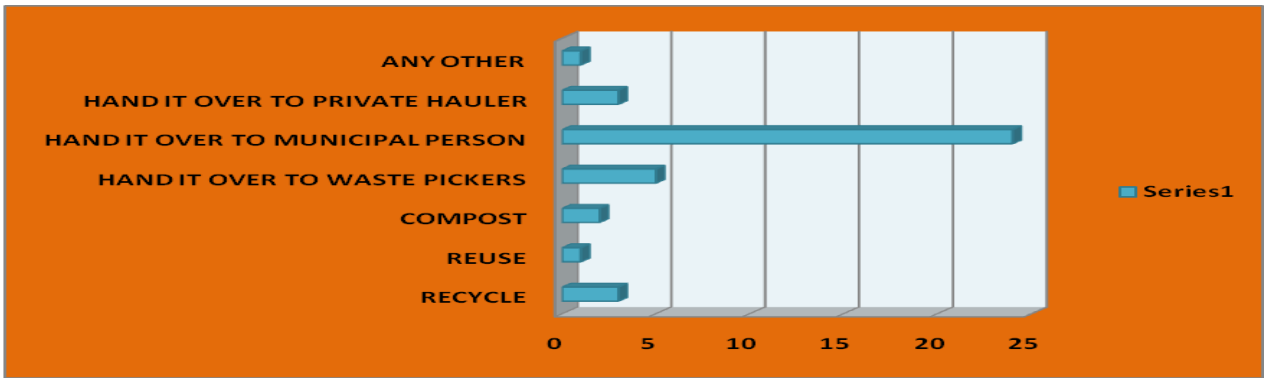

Chart VII, Most of the respondent hand over segregated waste (mostly wet waste) to the corporation trucks. Around 5 respondents hand over dry waste to the waste picker.one of the respondent reuses the material like plastic containers, cardboard cases etc. 3 respondent recycles materials like tin , glass, plastic, cardboard etc. through the private recyclers. 2 of the respondent compost their wet waste in their composting pit which is then handed over to the local farmers. 3 respondents hand over their both wet and dry (segregated) waste to private hauler. 1 of the respondent waste is being collected by the mall management team for further processing.

TABLE NO IV: STAFF AWARENESS ABOUT SOLID WASTE SEGREGATION METHODS

STAFF AWARENESS ABOUT WASTE SEGREGATION METHODS	NO OF RESTAURANT	PERCENTAGE
YES	30	100%
NO	0	0%

Table IV, 100% Restaurants feels that there staff are aware about waste segregation methods.

CHART NO VIII: WASTE HAULING FEE PAYED BY THE RESTAURANTS

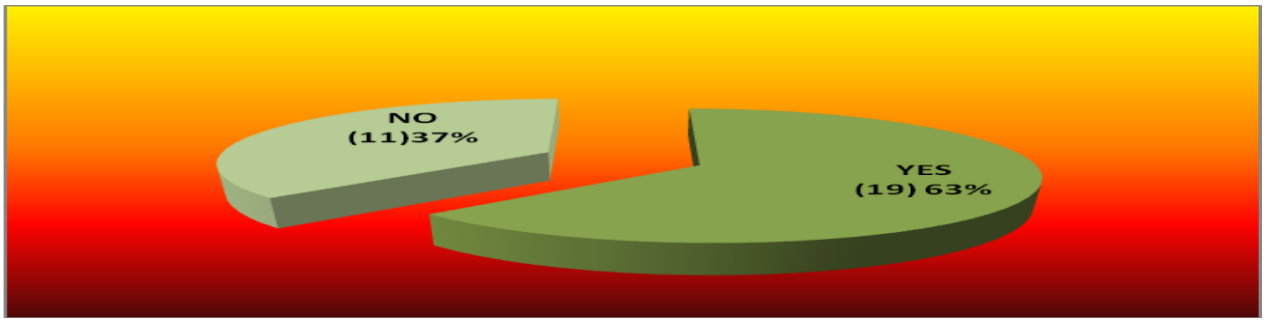

Chart VIII, It has been observed that mostly waste hauling fee is being paid by only those who hand over both dry and wet waste to the private hauler as against hauling fee.63% do not pay any waste hauling fee.

CHART NO IX: TRAINING CONDUCTED FOR STAFF BY RESTAURANT FOR WASTE SEGREGATION METHODS

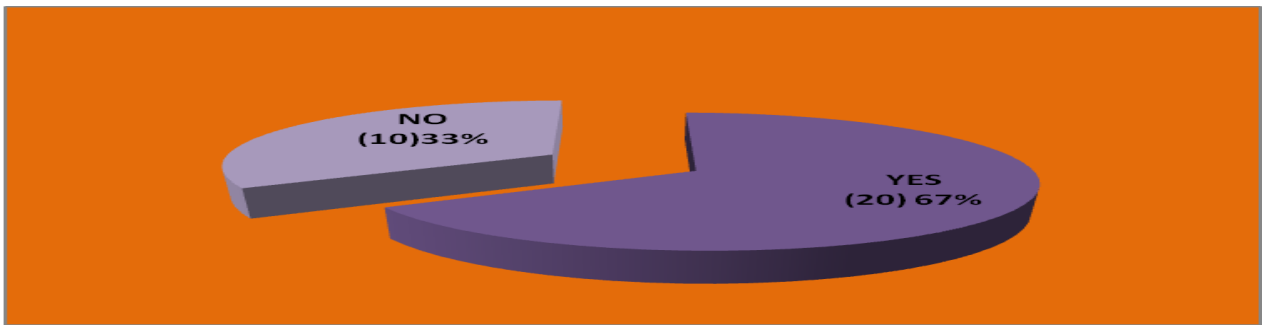

Chart IX, 67% respondent organise staff training related to waste segregation where as 33% does not conduct any training related to waste segregation methods though they feel it is very essential aspect in waste managemnt system.

TABLE NO V: RESTAURANT STAFF SUPPORT IN WASTE SEGREGATION ACTIVITY

STAFF SUPPORT FOR WASTE SEGREGATION	NO OF RESTAURANT	PERCENTAGE
100%	10	33%
75%	18	60%
50%	2	7%
25%	0	0%
NONE	0	0%

Table V, 33% of respondent feels that their 100% of their staff is supportive about the waste segregation activity whereas 33% of respondent felt that their 75% of the staff is supportive, remaining 7% feels only 50% of their staff are supportive.

Views Expressed by Restaurateur about their role in solid waste segregation activity:

1) Restaurant use degradable and non- degradable materials in massive quantity which if segregated can be recycled or reused and harmful material can be separated and dispose off separately.
2) Disposing mixed waste can become unmanageable and crucial if not taken proper care.
3) A blanket rules to be framed for large restaurants above 75 covers and they should be made compulsory to maintain wet waste processing unit.
4) Segregation waste will not only help preventing pollution but the reuse and recycling method can be a good revenue generating activity.

5) Restaurateur understands and supports the view of compulsorily conducting activities like Waste Audit, Training Programme, and Awareness about segregation methods etc.
6) Restaurateur also feels that following different bins methods for waste segregation can boost up the process.
7) Waste minimization through waste segregation can also be an important step in reducing load on landfills.
8) Few Restaurateurs feels that waste segregation is the 'least discussed topic in hospitality fraternity' and can be a menace if neglected.
9) Restaurants need to put little extra efforts to make a huge difference.
10) Lack of space to store the segregated waste and to compost is the major hurdle in implementing waste management activities.
11) Restaurants can be given benefits in tax concession if they are involved in solid waste segregation activity.
12) Since waste processing equipments are costlier, by following simple waste segregation methods restaurant can help reduce the waste load.

Recommendation and suggestions:

After going through the study the researcher recommends following points which could be useful in minimizing the waste on landfills:

1) Creating awareness for Source Segregation of solid waste amongst the restaurants.
2) Insisting on following Separate Bin Systems(different colour coded bins for different types of waste)
3) Conducting staff training frequently by the Municipal authorities or expert to inculcate habit of waste segregation at source.
4) Conducting periodically, waste audits to understand the waste stream and then diverting waste into its respective categories for easy disposal.
5) More incentives in terms of tax relaxation, discount should be given to the restaurants that practices segregation at source.

Conclusions:

From the study conducted in various restaurants, we can conclude that though majority of the restaurants are aware about the segregation of waste at source and its benefits, the same is not being systematically followed due to various reasons like: Lack of space for waste segregation, Lack of training, Lack of support from the staff. To inculcate the habit of segregation of waste at source the Restaurateurs needs to put in extra efforts by creating

awareness amongst the staff and by implementing effective waste segregation systems. To reduce the heavy load of ever increasing solid waste, there is an urgent need to implement "segregation at source" practices on all front and this should be lawfully made compulsory.

Limitations

The sample chosen does not cover all strata of restaurant population. This study was limited to Fine Dine and Standalone restaurants of Pune City. These are the outlets those have to manage their own operations and are situated in prime locations of the Pune city. The study includes the data provided by the restaurant employees like Restaurant Owner, Chefs, and Restaurant Managers etc.

Scope for Future Research:

Limitation on sample size can be overcome considering the quantum of other types of restaurants and Food and beverage outlets for future research. Apart from just concentrating on the restaurant involvement, research can be conducted on exploring employee's attitude and behavior towards acceptance of these practices and even studying consumer's perception on effective solid waste segregation practices adopted by restaurants. Even research can be done demographically on restaurants approach towards waste segregation methods and 3R concept (Reduce/ Reuse/Recycle).

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