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ASSESSING HOUSEHOLD FOOD WASTE IN HYDERABAD CITY

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Abstract

The world's population is growing by the day, yet food availability is dwindling due to a lack of effective techniques for dealing with food waste at various levels such as food supply chains, households, and restaurants, among others. The majority of food waste occurs in families and restaurants as a result of overcooking and allowing different foods to expire in the refrigerator without being noticed. We have concentrated more on food waste in households by considering the opinion of the people of different households in the city. We had taken the opinion based on some set of questions. Food waste is generated in the home by the consumer's refrigerator. Inadequate training, bulk ordering, and bad produce are all blamed. In this paper, we studied the relationships between food wastage and Family Size, Income, Age, Location for 132 households in Hyderabad city, Telangana. The proposed techniques have been evaluated by Analysis of Variance (ANOVA) for the performance and statistical analysis.

1. Introduction

The quantity, as well as the consistency of HW data, clearly demonstrates the viability of expanding urban centers. Household and metropolitan

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society's socio-economic conditions are also reflected in Household waste [Figure 2]. The amount of domestic waste produced and the purchasing power of the urban population have an interesting relationship [1]. According to the FAO, 1/3rd of food is wasting each year. This inevitably means that a large amount of materials used in food cultivation are squandered, as are the greenhouse effect produced by the production of food that is lost or squandered. Food waste may be reduced in developed countries by educating among food producers, resellers, and buyers. There is an urgent requirement to identify appropriate and favorable use for the healthy food that is now being fallen. Food security is a big issue concern today in the entire world. Food productivity must undoubtedly rise considerably to touch the coming demands of a larger and richer global population [2]. When food is thrown out, the problems do not stop there. More than 95% of FW is disposed of in debris, where it is converted to nitrogen, carbons, and other harmful gases. FW has a devastating effect on climate change [3]. With the world's population recently approaching 7 billion people, there are increasing questions about food security in the medium term. Fundamental food security issues are being posed as a result of such danger being added into the food supply chain (FSC), in addition to the need to feed an ever-growing number of mouths; expected to reach 9 billion by 2050, such population growth means that food depletion would be a problem. By 2030, population growth predicts that food demand will rise by 50%, and agriculture and power generation water demand will outstrip supply [4]. If the globe were a place, food loss and waste would be the third-largest source of dangerous gas emissions. Food waste is also a substantial donor to the three environmental concerns of climate change, habitat loss, and emissions and waste, since it poses problems for waste management programmers and exacerbates food shortages. As a result, Sustainable Development Goal 12.3 aims to cut food waste and depletion in half by 2030. UNEP's inaugural Food Waste Index study, released in support of this vital objective, provides awareness into the scale of food waste as well as a way that allows nations to create route map and track progress toward the SDG target. According to the survey report, food wastage from households, supermarkets, and the foodservice industry aggregates 931 million tons every year. Nearly 570 million tons of this total waste produced at home. The study also shows that the worldwide average of 74 kg of food lost per capita per year is strikingly comparable among low-,

middle-, and high-income nations, implying that most countries can do better [8]. Education programs have been one of the commonly used interventions for food waste awareness in the last decade, and they have slowly found their way into large extent coverage [5] [15]. The Natural Resources Defense Council's "Save the Food" initiative and the United States Environmental Protection Agency's (US EPA) "Food: Too Good to Waste" are two large-scale public advertising programs in the United States. These programs also provide a webpage providing realistic tips for customers about reducing food waste at home, and they are broadcast on TV, radio, online commercials, and social media. Local governments, non-profit organizations, and industry can work together to execute community-wide campaigns, such as conducting public events and workshops [6] [7] [14]. The composition of HW also shows patterns in waste reuse/recycling conduct, which is currently practiced as an informal act in many developed countries. In this procedure, households detach a few waste articles with economic/reusable/recyclable qualities to sell to interim customers, street hawkers, or junk shops. As a result, such practices have an effect on the initial makeup of the HW that will be collected at municipal waste storage and recycling sites. To explore the involvement of homes in MSW processing and handling activities, city planners, policymakers, and waste management organizations in the city may be interested in research on HW characterization [9] [13].

Hyderabad has a unique ecosystem. The city's rocky and hilly surroundings are being obliterated by urbanization. The Deccan Shield is made up of granite ridges and hillocks that have weathered into beautiful balancing shapes. According to the last census, the city of Hyderabad has a population of about 6.7 million people [10]. To create a localized waste controlling and management plan at the neighborhood level in the region, the characterization of HW for local purposes must be investigated. Infrastructure availability, family socioeconomic position, degree of social consciousness, environmental education and training, and other considerations all play a part in the construction of a decentralized HW management system in metropolitan environments. As a result, the aim of this research was to look at the composition and pace of HW generation in various socioeconomic groups in the region, as well as the viability of employing HW as a valuable energy resource and a long-term urban expansion plan [9]. The major reasons for wasting the food in these two

categories are:

- Spoiled/Damaged.
- Inedible part
- Overbuying
- High food serving in the plate
- Lack of Space in Refrigerator
- Unplanned Cooking

Some of the participants (8%) confirmed that even they do not have Traditional Refrigerator at their home till today and the majority of the participants (70%) confirmed that they do not have a smart refrigerator. Only 22% of the people confirmed that they are having smart refrigerators in their homes. Due to traditional refrigerators, people may not have an idea regarding the stock of food items kept inside the refrigerator. In connection to this, people do not care about the food items' expiry date and how much they need to buy every day and consume where as Smart Refrigerator provides the data and SMS based information to the user every time about the food items keeping inside and stock of the available items [11] [12].

2. Methodologies

2.1 Sampling and data collections.

HW's sample approach was created by testing with residential settlement patterns in the city and employing in-house data design. The opinion about waste was collected from 132 houses in 40 different locations across the city to participate in the HW collection project. The number of people per sampled household, total household income, household size, education, age, and other characteristics were captured using a thorough questionnaire developed from sampling locations/points. To establish the household's socioeconomic status, data on the household's annual income, colony location, and available housing amenities were collected. Kitchen trash-peeling waste, abandoned vegetables, food waste, thrown food, seeds, and so on were the primary kinds of home rubbish. This data collected from 132 households from various locations across the city in May 2021 about 3-4 weeks.

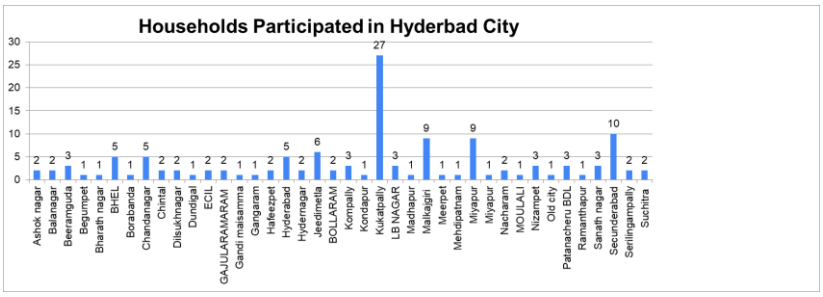

Figure 1. Households participated from different locations of Hyderabad (May 2021).

The questionnaire covers about different parameters like "how many kgs of Vegetables Purchasing per day", "how many kgs of fruits you're Purchasing", "how many kgs of rice, wheat etc purchasing or consuming", what is the main reason wasting Vegetables and Fruits and etc.

Figure 2. Household food waste including edible and inedible.

2.2 Statistical analysis

An analysis of variance (ANOVA) was used to determine if there was a significant difference in rubbish generation rates across various households and income categories. Data was submitted to descriptive statistical analysis in order to provide a variety of statistical parameters such as median, standard deviation, range, skewness and kurtosis, variance, and stem-and-leaf plots. The data was analysed using the SPSS statistical software. All of the claims in this study are statistically significant at the F 0.05 level. A simple correlation matrix was used to calculate the relationship between the

number of dwellings per home and overall garbage produced. Anova calculated using SPSS software for all the 25 categories (Table 1). For each category the values generated like Sum of Squares, Degree of Freedom, Mean Square and total for two groups are between groups and within groups. Anova results are results are taken from the software, the actual formula of Anova Calculation is mentioned here:

Table 1. ANOVA Formula.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares (MS)	F
Within	$SSW = \sum_{j=1}^{k}\sum_{j=1}^{l}(X-\bar{X}_j)^2$	$df_w = k-1$	$MSW = \frac{SSW}{df_w}$	$F = \frac{MSB}{MSW}$
Between	$SSB = \sum_{j=1}^{k}(\bar{X}_j - \bar{X})^2$	$df_b = n-k$	$MSB = \frac{SSB}{df_b}$	
Total	$SST = \sum_{j=1}^{n}(\bar{X}_j - \bar{X})^2$	$df_t = n-1$		

SSW = Sum of squares within the groups

SSB = Sum of squares between the groups

MSB = Mean sum of squares between the groups

MSB = Mean sum of squares within the groups

SST = total Sum of squares

n = The total number of samples in a population

df_w = Degree of Freedom within groups

df_b = Degree of Freedom Between Groups

df_t = Total Degree of Freedom

Where F = Anova Coefficient

In most variance analyses, the f distribution is utilised. The degree of freedom affects the f-distribution curve. The f distribution is the distribution that contains all possible values of the f-statistics.

Degree of Freedom Numerator $(v1)$ = Between Groups = MSB (Mean Squares Between) Degree of Freedom Denominator $(v2)$ = Within Groups = MSW (Mean Squares Within) $F_{\text{calculated}}$ = Degree of Freedom Numerator $(v1)$/ Degree of Freedom Denominator $(v2)$.

S. no.	Category	ANOVA	Sum of Squares	Degree of Freedom(Df)	Mean Square	F
1	Household size and Vegetable consumption.	A	10.082	6	1.1331	347
			185.434	125	1.483	
			195.515	131		
2	Household size and Fruit consumption.	B	14.028	5	2.806	1.948
			181.487	126	1.440	
			195.515	131		
3	Household size and Wheat and Rice consumption	C	10.765	5	2.153	1.468
			184.751	126	1.466	
			195.515	131		
4	Household size and Vegetable, Fruit Waste	D	6.853	6	1.142	.757
			188.663	125	1.509	
			195.515	131		
			188.663	125	1.509	
			195.515	131		
5	Household size and Wheat, Rice Waste.	F	1.931	5	386	.938
			193.584	126	1.536	
			195.515	131		
6	Income and	G	19.567	6	3.261	.445

	Fruit consumption.		418.311	125	3.346	
			437.679	131		
7	Income and Vegetable consumption	H	1.769	5	354	.102
			436.110	126	3.461	
			437.879	131		
8	Income and Wheat, Rice consumption	I	32.235	5	6.447	.083
			405.644	126	3.219	
			437.879	131		
9	Income and Vegetable, Fruit Waste	J	20.035	6	3.339	.999
			417.844	125	3.343	
			437.879	1		
10	Income and Wheat, Rice Waste	K	10.664	5	2.133	.629
			427.215	126	3.391	
			437.879	131		
11	Job Role and Fruit Consumption	L	8.972	6	1.495	.755
			247.664	125	1.981	
			256.636	131		
12	Job Role and Vegetable Consumption	M	15.397	5	3.079	1.608
			241.239	126	1.915	
			256.636	131		
13	Job Role and Wheat, Rice Consumption	N	17.442	5	3.488	1.838
			239.195	126	1.898	

			256.636	131		
14	Job Role and Vegetable, Fruit Waste	O	26.493	6	4.415	2.398
			230.144	125	1.841	
			256.636	11		
15	Job Role and Wheat, Rice Waste	P	5.860	5	1.1.72	.589
			250.776	126	1.990	
			256.636	131		
16	Age and Fruit consumption	Q	4.544	6	.757	.651
			145.539	125	1.164	
			150.083	131		
17	Age and Vegetable consumption.	R	14.479	5	2.896	2.691
			135.604	126	1.076	
			150.083	13		
18	Age and Wheat, Rice consumption.	S	5.532	5	1.070	.932
			144.731	126	1.149	
			150.083	131		
19	Age and Vegetables, Fruit Waste	T	6.950	6	1.158	1.012
			143.133	125	1.145	
			150.083	131		
20	Age and Wheat, Rice Waste	U	7.498	5	1.500	1.325
			142.585	126	1.132	
			150.083	131		
21	Location and	V	16.966	6	2.828	1.004

	Fruit Consumption		351.913	125	2.815	
			368.879	131		
22	Location and Vegetable Consumption	W	9.538	5	1.908	0.648
			359.340	126	2.852	
			368.879	131		
23	Location and Wheat, Rice Consumption	X	11.434	5	2.287	0.806
			357.445	126	2.837	
			368.879	131		
24	Location and Vegetable, Fruit Waste	Y	16.963	6	2.827	1.004
			351.916	125	2.815	
			368.879	131		
25	Location and Wheat, Rice Waste	Z	11.183	5	2.237	.788
			357.696	126	2.839	
			368.879	131		

3. Results and Discussion

The FCalculated is compared with Ftable value and mentioned that accepted/rejected for various categories specified in the (Table 3). This work gives an opportunity to study more about food waste generated from households of Hyderabad city, Telangana. If we observe in the statistical analysis in the above section, it is clearly indicating that in all categories like household size, Income, Age, Job role and location the value of F is less than 0.05. At the same time, the total number of households participated in the survey (Figure 1) colony/are wise considered. The full form of Abbreviations used in the table 3 are mentioned in table 2.

Table 3. Category wise Comparison of FCalculated and FTable.

o	Category	1	2	FCalculated	FTable	Accept/ Reject
1	HVC	6	25	1.33	0.0302478	Reject
2	HFC	5	26	1.948	0.0466243	Reject
3	HWRC	5	26	1.468	0.0466243	Reject
4	HVFW	6	25	0.757	0.0302478	Reject
5	HWRW	5	26	0.251	0.0466243	Reject
6	IFC	6	25	0.975	0.0302478	Reject
7	IVC	5	26	0.102	0.0466243	Reject
8	IWRC	5	26	2.003	0.0466243	Reject
9	IVFW	6	5	0.99	0.0302478	Reject
10	IWRC	5	26	0.629	0.0466243	Reject
11	JRFC	6	25	0.755	0.0302478	Reject
12	JRVC	5	126	1.608	0.0466243	Reject
13	JRWRC	5	126	1.838	0.0466243	Reject
14	JRVFW	6	25	2.398	0.0302478	Reject
15	JRWRW	5	126	0.589	0.0466243	Reject
16	AFC	6	125	0.757	0.0302478	Reject
17	AVC	5	26	2.691	0.0466243	Reject
18	AWRC	5	126	.932	0.0466243	Reject
19	AVFW	6	125	1.012	0.0302478	Reject
20	AWRW	5	26	1.325	0.0466243	Reject
21	LFC	6	125	1.004	0.0302478	Reject
22	LVC	5	26	0.669	0.0466243	Reject
23	LWRC	5	26	0.806	0.0466243	Reject
24	LVFW	6	125	1.004	0.0302478	Reject
25	LWRW	5	26	0.788	0.0466243	Reject

4. Conclusions

The GHMC will segregate the food waste, plastic, and other particles from every colony in the city. The study also revealed about lack of awareness for the city households regarding tons of food waste per day in the country/world. The future work suggested focusing on the entire city with an

increase in the number of collections points to get the more accurate values. We conclude that there is a significant difference between food waste at household and household size, Income, Job Role, Age and Location.

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