

## Carbon Footprint of Household Food Waste

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**Abstract -** Household food waste is a major contributor of pollution. Translated into greenhouse gas production through the amount of carbon footprint, it is said that the environment could only take as much but not more. Taken from the individual family households in small quantities, it may not seem to make a difference but in global perspective, the amount of food waste produced per year could feed millions of hungry people around the world. The negative marks of the issue are not only in terms of environmental and health safety but also in socio-economic sustainability. In the international scene, numerous accounts of studies cite that food wastage is directly influenced by the monthly income earned by a family. Other studies contradict such statement while others assess that no relationship could be found to exist between the amount of household food waste and family income. In this study, fifteen families from three different locales participated to undertake this research in anticipation of finding the carbon footprint generated through household food waste from the low to middle income family groups in five days. Results show that the average percentage of food waste produced was directly related to the income yield per month. Furthermore, it was found out that the higher the family income, the higher the household food waste as well as the generated carbon footprint. With these results, it was suggested that a closer monitoring of household food waste generated be done to identify other problematic effects because awareness and prevention is still the best mitigating effort that people could give in order to achieve great and lasting results.

**Keywords** – carbon footprint, food waste, household food waste

### INTRODUCTION

The global community is experiencing a problem in food security and malnutrition yet a large percentage of food is reported to be wasted. This is the usual scenario experienced by first world countries such as the US, wherein the amount and variety of foods that goes in their landfills every day was estimated to range from 25% to 50% of the total 590 billion pounds of food produced each year. This amount is deemed to be enough to feed 860 million starving people (Payne, 2014). Consequently, 868 million people usually coming from third world countries, suffer from malnutrition and about two billion people are experiencing the negative effects of micronutrient deficiencies (Chakona and Shakleton, et.al., 2017). In addition, Food and Agriculture Association cited that in a total amount of approximately 6 billion

tons of food produced globally per year, around 1.6 billion tons of it was estimated to be wasted. FAO further reported that 54% of food waste happens during and after food harvesting. The remaining percentage is accounted during the food processing, distribution, and consumption stages.

Identifying the precise definition of food waste is no easy task. Defining food waste is highly dependent on its source along with its purpose. Factors such as the food supply chain (growing, processing, retailing, consumption); procedure of usage; production methods utilized to manufacture the food; point of discard; type of food and its part to be discarded, as well as fitness for human consumption are just but few of the issues that confounds those who concerns themselves in attempting to clarify what food waste is and what it is not. In 2016, Zitnik and

Vidik classified food waste into edible and inedible. According to them, edible food waste refers to food that is intended for human consumption under normal circumstances but discarded due to inappropriate storage, spoilage and non-consumption. On the other hand, inedible food waste was defined to refer to vegetable or fruit peelings, bones, and eggshells that were found unfit for human consumption. Additionally, food waste is differentiated from food loss (Chakona & Shackleton (2017)). Food waste refers to the discarded edible part of the food which is supposed to be intended for human consumption while food loss is the decrease in food quantity primarily on its mass or dry matter. Moreover, it could also refer to the lowering of food quality or nutritional value which makes it inappropriate for human consumption. Food waste occurs during consumption stage while food loss happens during production, postharvest and processing stages. There is one unifying theme that identifies food waste— that part of the food which could have been consumed by people without causing harmful effects to health. In this study, food waste is identified as those edible food materials which are discarded in the household communities during the course of food preparation and consumption.

Estimated global food waste due to non-consumption of the edible part of food alone is found to amount to 1.3 Gtonnes (FAO, 2013) and generation of food waste varies from country to country as well as among households. Gustavsson, et.al. mentioned in 2011 that annually the estimated food waste along the whole food chain is approximately US\$ 680 billion in industrialized countries while there is a US\$ 310 billion worth of waste in developing countries. Furthermore, researches reveal that the type and quantity of food waste or loss varies between developed and developing countries such as the Philippines. In developed countries, approximately 60% of food waste is generated during purchase and consumption stage. On the other hand, food waste in developing countries happens during production, harvesting, storage and distribution stages (Chakona, et.al, 2017). In

2013, the FAO published a report showing the different regions which include Europe, the Latin America and Asia, particularly the South and South-East Asia. The latter appears to be on the top food waste hotspots for wastes due mainly to vegetables and cereals because this region is noted to dominate the world vegetable production and consumption.

Household food wastes are inevitable products of day to day food consumption. Food wastage may come from different processing procedures that occur at home. Ultimately, the highest quantity of generated food waste is from throwing of leftover foods from people's plates. Factors such as economic status, social beliefs (Tucker and Farelly, 2016), inappropriate meal shopping and planning, food wastage while cooking, and bad eating habits including post-meal behaviors (Grandhi & Singh, 2016; Qi and Roe, 2016) could help explain why wastage of food from homes progress. Moreover, improper food storage as well as food safety are also considered among the leading causes of household food wastes that result to the bulk of bought food to be transported for disposal (Evans, 2011).

The Food and Nutrition Research Institute of the Department of Science and Technology (FNRI-DOST) also mentioned from an interview that every year an individual Filipino wastes 3.29 kg of food per year. In 2014, rice wastage alone amounting to PhP 7.3 billion accounted to an estimated 296 869 metric tons of food loss, the quantity of which could have fed approximately two million Filipinos. Meanwhile, a 2012 report furnished by the World Bank stated that by the year 2025, South Asia and the Pacific will have to endure a 150% increase in household waste alone. In addition, they had also cited that the Philippines, being one of the fastest developing countries in Asia, will not be able to manage with its existing area thus warranting that more land should be converted and be made readily available just to accommodate the household wastes that Filipinos throw on a daily basis.

Aside from negative implications of food waste to food security, it

also contributes to the emission of greenhouse gases (GHG). Increasing atmospheric greenhouses gases is believed to be the culprit of unusual weather phenomena and climate change (Scholz, 2013). FAO also cited that about 3.3 billion tons of carbon-dioxide equivalents are produced from food waste which is equivalent to 7% of all global emissions. According to the Center for Sustainable Systems, University of Michigan (2017), carbon footprint is the total greenhouse gas emissions caused by an individual, organization, event, or product. It is calculated by getting the sum of the emissions resulting from every stage of a product or service's lifetime. Carbon footprints is a measure of how human impact the environment through their continuous usage of carbon-containing materials such as fossil fuel-based substances like oils and petroleum, coals and gases. Increase in carbon footprint could also be due to the indiscriminate cutting of trees or burning of wastes or simply having wastes thrown relentlessly (Scholz, 2013).

Many people are not aware of the environmental impact of food waste. Any issue related to food waste being generated by a household is taken for granted because it is seen in a micro-scale level. However, when combined at global perspective, the impact of household food waste will be perceived to be a major contributor of GHG as well as increasing carbon footprint. With a lack of published studies concerning food wastage as well as insufficient information which is readily available for research purposes, the state of the Philippine household food waste cannot be easily determined. Thus, the purpose of the conducted study was to give basic information as to the household food waste generated by Filipino families.

### **OBJECTIVES OF THE STUDY**

This study aims to determine the amount of carbon footprint being generated from household food waste. Specifically, it will answer the following objectives: determine the average percentage of household food waste due to preparation and food consumption; to

compare the food waste and carbon footprint from different family groups in terms of monthly income.

### **MATERIALS AND METHOD**

The study was quantitative in nature. Preliminary data incurred was obtained through the use of a self-made survey questionnaire where the information gathered during the course of the investigation was recorded. It was conducted from the localities of San Pablo City, Caloocan City, and Tiaong, Quezon. Each enlisted family was specifically selected based on the number of their household members as well as their categorized economic status which was identified based on the income generated per month. Such was perceived to be the standard for selection to limit other mediating variables that may give a negative impressionable effect on the study which may later render the research unreliable. Identified families for the study was composed of five members and belongs to any of the following bracket: Group 1, Group 2 and Group 3. Group 1 has monthly net income of Php 10, 000.00 and below; Group 2 with 10,000.00 to Php 14,999 and group 3 with Php 15 000.00 and above. Five families per group were selected by the researchers for the conduct of the study.

Household food wastes generated by the family during the course of food consumption for each targeted day were retrieved using ordinary weighing scales. A five-day data collection transpired for each family group using self-prepared tabular data sheets with measured variables. All quantity which was gathered for the weights of the household food waste materials obtained was expressed in kilograms (Kg).

The carbon footprint of the participating family households was obtained through the use of a preprogramed carbon footprint calculator developed by the Royal Melbourne Institute of Technology (RMIT) University research team

## RESULTS AND DISCUSSION

Table 1. Average percentage of household food waste during food preparation

Family Group	Average Food Waste(%)	F-value	p-value
Group 1	0.32	13.02	0.00
Group 2	11.44		
Group 3	13.33		

The table indicated above expressed the average percentage values obtained from the amount of household food wastes generated for five days by each family group during the preparation stage of the food processing. Increasing values of 0.32%, 11.44%, and 13.33% respectively resulted from the food wastes produced by the three participating family groups, of which it was found that group 3 had the highest value, followed by group 2, then group 1, with the lowest average percentage. Calculation of the p-value at a significance level of 0.05 had resulted to  $F = 13.02$ ,  $p=0.00$  marking that there exists a significant difference between the values obtained for the average percentage of the food waste generated by the family groups.

Data showed that of the comparison among the three family groups, those participating family households with the highest income bracket and are relatively more capable of buying food generates the highest food waste. Furthermore, the information gleaned that due to the proportional increase in income and waste, the family with the lowest income generated per month had achieved the lowest quantity of generated average waste

percentage, ascertaining in this study that the higher the income of a particular family household, the higher is the probability that food wastes generated is also higher.

Using a harmonic mean sample size of 5, the degree of similarity and, or difference is calculated utilizing the Tukey HSD. From the resulting values generated, although the result from the ANOVA conducted showed that there exists a significant difference between all three participating family household groups further evaluation showed that group 1 (0.32) is more different as compared with groups 2 and 3 which resulted to belong to the same subset having calculated values which are near to one another, 11.44 for group 2 and 13.33 for group 3. The results easily show that the last two groups are more comparable than the first group thus, it could be said that the amount of household food waste generated by family groups 2 and 3 have a closer significance while that of family group 1 is more different.

Table 2. Average percentage of household food waste during food consumption

Family Group	Average Food Waste(%)	F-value	p-value
Group 1	2.94	0.37	0.07
Group 2	4.46		
Group 3	4.20		

Table 2 on the other hand gives pertinent information regarding the average waste produced by each identified family groups during the consumption of the served food. Since there is no clear pattern as to the way

wastes in this stage is generated, no link is detected that could associate the relationship of the earned monthly family income to the waste made from their food consumption. This assumption is based from obtained result of the

statistical treatment made, where the calculated significance gave values of  $F=0.37$  and  $p=0.07$  at 0.05 level of significance. This attests that there is no significant difference between the generated values of the three households thus, no differentiating characteristics exists. Further evaluation using Tukey HSD gathered a homogenous result that had been generated from the values of the family household food waste during consumption. Based from the data

collected there is a relatively close interaction between the information presented above. With values of 2.94, 4.46, and 4.20, this further strengthens the result obtained from the ANOVA that there was no significant difference from the values obtained from the previous treatment

Table 3. Carbon footprint generated from food waste

Family Group	Carbon footprint CO <sub>2</sub> eq. per kg	F-value	p-value
Group 1	0.28	7.72	0.00
Group 2	0.84		
Group 3	0.95		

The given table above is the resulting carbon footprint generated by the family household groups. From the same level of significance as previously used, the calculated values gave  $F = 7.72$ ,  $p = 0.00$  which corroborates with the results garnered from the average total wastes generated per day of the families. Both indicated a significant difference. Moreover, using Tukey, the level of difference was achieved.

In the data collected, though significant differences were obtained, the magnitude was more pronounced in family group 1 which was placed on a different subset. Upon comparison with that of family groups 2 and 3, though it is clearly seen on the result of the ANOVA that there was difference in all

groups, the distance or degree of difference between group 2 and 3 is not quite far from another. A point remains that group 1 is very dissimilar from the other groups.

Given the data collected from the resulting values, it could be stated that the result was the same as that of the information rendered in Tables 1 and 2 where there was tangible evidence that a positive relationship exists between the amounts of carbon footprint generated per type of participating family. It is construed that from the assessment of the information collected, it could be stated that as the total waste generated per family type increase, so does the carbon footprint as well as the amount of income generate by each family household.

Table 4. Average food waste and carbon footprint of the different family groups

Family Group	Average waste	Carbon footprint CO <sub>2</sub> eq. per kg
Group 1	0.19	0.28
Group 2	0.44	0.84
Group 3	0.50	0.95



Of the listed variables reported from the table, an increasing value both for the average waste generated per household group and the carbon footprint. From family groups of 1, 2, and 3 respectively the following values are found to be increasing with the increasing monthly income of the families – for the average waste: 0.19 kg, 0.44 kg, and 0.50 kg, for the carbon footprint: 0.28 CO<sub>2</sub> eq per kg, 0.84 CO<sub>2</sub> eq per kg, and 0.95 CO<sub>2</sub> eq per kg. Also as mentioned earlier in the onset of the analysis of the results, a direct relationship had been continuously observed that would provide the idea of how these three variables work together. On the premise of the previous studies cited by Wageningen in 2016, the result of this investigation lead to the belief that in the local setting, Filipinos with a higher income would be vulnerable to prevalent increase in food wastage basically from the preparation stage and as is the case, the same is true for the amount of

greenhouse gas-causing carbon footprint present. The later would increase as food wastage increases.

As for the status of carbon footprint in the Philippines, it is worth mentioning that the issue on food waste is always related to the carbon being emitted in the atmosphere. Both food waste and carbon footprint give negative impacts on our society. It is already established that food wastes and carbon footprint are contributors to food security, economy, health, and environmental problems, and raising public awareness starting from family, the basic unit of the community, is an important step to achieve positive result in the mitigation of global problems specifically food wastage and greenhouse gases emission.

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## CONCLUSION AND RECOMMENDATION

Based from the data gathered, it is concluded that family income is positively related to the amount of household food waste being generated. It can also be concluded that when food waste is reduced, the amount of carbon footprint will also decrease significantly.

It is recommended that further studies be conducted using larger sample size and longer period of data collection. It is also suggested that the type of food waste be identified and classified to find out the leading sources of household food waste. Other variables such as eating habits and food types may also be used to further explore the food waste generated by households.

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