# AI based management of Food Wastage

Lakshit Sama[a] , Aaisha Makkar[b], Polemoni Prokshitha[c] , Bhav Kirti Sharma[d] , Devansh Dhaloria[e]

[a] (Student) School of Info Technology Deakin University, lakshit.sama@gmail.com, Waurn Ponds, Australia
[b] CSE Dept Chandigarh University, aaisha.e8847@cumail.com, Chandigarh, India
[c] (Student) CSE Dept Chandigarh University, polemoninikky6@gmail.com, Chandigarh, India
[d] (Student) CSE Dept Chandigarh University, bhavkirtis@gmail.com, Chandigarh, India
[e] (Student) CSE Dept Chandigarh University, devanshdhaloria@gmail.com, Chandigarh, India

**Abstract**
The problem we see here is of how food around us is wasted, even after having enough food to feed everyone, there's still hunger around us. The solution we are focusing on is not of the field, but to stop the wastage happening around us. The proposed scheme is to build an outline which contains general information to tackle similar kinds of problems. Just by taking a few initiatives we were actually able to reduce the food wastage in our hostel messes.

**Keywords:**
Food wastage, Hunger, Management.

## 1. INTRODUCTION

While we sit here tranquilly with our belly's plenary, some might be out there without even one grain of victuals. Now we can't solve the quandary with some impulse of activity. What we require to do is to act locally and make the ones around us cognizant of the genuine quandary. According to some studies [7], over 820 million people are suffering from starvation even after enough aliment for them on the planet. The quandary is not only hunger, the victuals wasted engenders greenhouse gases. And a plethora of aliment betokens an abundance of greenhouse gases which in some way affects the environment we live in. Around 3.3 billion Carbon dioxides are engendered annually by the amplitude of victuals wastage ecumenically. Now after the past incidents like amazon rain-forest fire and Australian forest fire, the impact on the ecosystem and the environment is going to be more consequential than ever and that will just be a slow doom for our planet. Even after all we endeavor, we are not going to solve the quandary entirely and that's because of the variety of quandaries all around the world and that is because countries like Africa are facing the scarcity of pabulum because of their lack of infrastructure and the lack of technology. Not only the aliment wasted has an impact on the environment but withal the economy of countries. For example, annual pabulum wastage can be summed up to 1 trillion US dollars. If we visually examine the topic, the quandaries caused by pabulum is hunger and the gases engendered due to victuals wastage can be solved by taking certain parameters.

## 2. LITERATURE SURVEY

### 2.1 Related work

There are various ways of predicting solid waste generation that can be grouped into five key groups: descriptive models, analysis, the flow of objects, the flow of time series, methods of strategic planning strategies [1]. The vector support machine (SVM) and its nearest neighbors to k (kNN) should use algorithms of machine sensors to test their predictive capacity for food waste produced [1]. These are the machine learning techniques that are to be considered for the present study and to obtain effective and efficient prediction results which help us to implement in

real time so as to decrease the food wastage [1]. These strategies do not include the development and improvement of existing structures but inform people to promote the reduction, recycling and recycling of solid waste generated [1]. The analysis of garbage generation could be accomplished with the help of data in the form of a time series, which contains the quantity of garbage being produced [1].
A project by the students of IIT Mandi for providing long term solutions for reducing food wastage [2]. The techniques they adopted for the same is:

- Determining the size of the food is trashed
- Exploring why the food is wasted
- Using new techniques like artificial intelligence on accurate data [2].

After the visualization of the data, many similarities are found between the two messes, for example wastage of the same type of food on the same days and at the same time. By maintaining different waste bins for the mess labelled for different types of food wastes. Asking people like chefs, mess staff, college staff members, students. The rental divisions in which they calculate the number of cooks, determine the behavior of each cook and measure the waste generated on each food menu [2]. An unequal distribution in which all of the above points are recorded but without the presence of a group. In this way they have used an Arduino-connected sensor so that every plate passing through the section is calculated and hence the daily data related to hostel mess [2]. Data mining and decision trees are used to manage food. Data mining basically collects all the data and analyzes high-value data to find reasonable patterns and rules [3]. Decision tree is a data mining method used for prediction and classification. While using these methods we can prevent food from being wasted [3]. And the food cooked is just the right amount [3].
A research is carried by the students of the science department of university 'Degli Studi di udine' [5]. They provided statistics relating to consumer attitude and behavior towards the food they consume. The techniques they adopted for the same is:

- Aiming at understanding the issue of food wastage at household level.
- Proposing a hypothesis based upon people's attitudes and individual behavior.

They researched the key explanatory factors when predicting the possibility of food being eaten in the family, emphasizing a model for this [5].
Techniques followed in the paper "Hospitality Restaurant Operations in Regard to Food Security, Through Food Waste and Loss Control Mechanisms" [6]-

- Optimized quantities
- Waste tracking and analytics
- Portion Choices, Customized Dishes & Smaller Plates

#### 2.1.1 **How**?

To this end, they conducted a survey on the distribution of a questionnaire in homes [5]. Data obtained over a two-month period [5]. They used data collection methods [5]:

- Online questionnaire forms
- Face to face questionnaires

The number of responses they got are around 500 which is a complete dataset with clean and relevant values and without any null values [5].
Work includes in paper "Hospitality Restaurant Operations in Regard to Food Security, Through Food Waste and Loss Control Mechanisms" [6]-

- By tracking the food wastage, we can order the amount we need from suppliers [6]
- As everyone's preferences are different so we can make customized dishes for them [6].
- Provide small amounts of standard menu item with fill option [6].
- The strong data available makes a case for investing in food waste prevention efforts [6].

#### 2.1.2 **Methods**:

This paper reviewed the playful but fast-growing body of educational textbooks on consumer food waste [4]. First of all the authors received relevant studies based on the purpose of review to reduce the evidence of why food is being created in the area [4]. In the literature review the authors used information such as Web Science, Scopus and Google Scholar and reviewed 60 articles [4][9].

In addition, the collected papers are coded and the coded papers are compiled around the essentials that are considered and the items that seem to affect the amount of food delivered to the family centers and are assessed for equality.
Rewritten documents are originally converted into three domain types [4]:

i. Social class features
ii. Psychological and social factors
iii. Behavior related to family food standards

**Table: Research Papers**

| Sr. No. | Paper Name | Authors | Techniques | Methods |
|---|---|---|---|---|
| 1 | Forecasting municipal solid waste generation using artificial intelligence modelling approaches | Maryam Abbasi, Ali El Hanandeh | Descriptive statistical models, relapse investigation, Regression strategy, time series examination and Artificial-Intelligence techniques | Support vector machine (SVM) and k-nearest neighbors (kNN) are two intelligent Machine learning system algorithms. |
| 2 | Reducing Food Waste at IIT Mandi | Ryan Cooney, Harsh Gupta, Kathryn, Merritt, Colleen O'Shea, Raghav Sethi | They adopted simple Techniques like present and absent surveillance. | Analyzing every day wastage according to the number of meals taken. |
| 3 | Predicting food demand in food courts by decision tree approaches | Ahmet Selman Bozkir, Ebru Akcapinar Sezer | Data mining and decision trees are used | Data mining is basically collecting all the data and analyzing the data which is in huge amount in order to get the meaningful patterns and rules |
| 4 | Food waste matters - A systematic review of household food waste practices and their policy implications | Karin Schanes, Karin Dobernig, Burcu Gozet | For the literature search the authors used databases such as Web of Science, Scopus, and Google Scholar and reviewed 60 articles. | Initially reviewed codes scaled up into three core types:<br>i. Socio-demographic factors<br>ii. Mental-socio factors<br>iii. Food-according family-level behaviors |
| 5 | Food waste, consumer attitudes and behaviour. A study in the North-Eastern part of Italy | Francesco Marangon, Tiziano Tempesta, Stefania Troiano, Daniel Vecchiato | Providing statistics relating to customer demeanor and conduct towards the food they consume. | Aiming at understanding the issue of food wastage at household level.<br>Proposing a hypothesis based upon people's attitudes and individual behavior |
| 6 | Hospitality Restaurant Operations in Regard to Food Security, Through Food Waste and Loss Control Mechanisms | Simon Were Okwachi, Moses Miricho and Vincent Maranga | Optimized quantities, waste tracking and analytics, portion choice. | By tracking the food wastage, we can order the amount we need from suppliers.<br>Providing smaller amounts of a common menu thing with the choice of tops off. |

## 2.2 Problem Formulation

The basic problem starts at a very basic level, that is food wastage. According to some studies [8], if we divide the total food produced by the planet earth into 3 equal parts then we are easily wasting one part of that. Food wastage has been such a common topic since the time we were born that even now at such an advanced level, we still don't have any solution to this problem. The problem statement for our project is mainly to manage the food wastage by making new models in artificial intelligence to solve this problem. But for the very least, what we have thought to acted upon is to implement a model on our university's hostels.
What we plan to do is to solve the food wastage in the hostels by making a new model using artificial intelligence.

## 2.3 Proposed scheme

The proposed system is to form a new model for food wastage management which mainly deals with the technological aspects in solving the issue of food wastage in the university/college hostel mess at individual level. The proposed idea can be implemented by any university/college in their concern hostel messes in order to save food without being wasted.

As an overall impact the system will consist of set of algorithms best suited for problems of these kind and a model by which many future problems could also be solved by the saving the food from being wasted. The model will be a general logical system of a type which can work with distinct datasets and problems.

To create a model that could detect the patterns on how much a particular item is made for one-time meal so that we can save maximum amount of food and how much it is being wasted by the faculty and students. In this project we will first calculate the number of plates used by creating an Arduino based system, which will count the number of plates passing through it and this process will go on for about weeks including the number of students who eats in the mess. By knowing the number of absent student's waste food by not eating in mess we can decrease the quantity of food being prepared Simultaneously we will calculate the total amount of particular items being wasted and will calculate its weight. Once we get a sufficient amount of data to work upon, we will process our data and clean it. These are the steps to get the data on which we will work on them. After this, we will work on the data and create a machine learning model that can give us the desired. We will use the mixture of algos which gives us the best results. Once we analyse the result we will implement and observe how much food is wasted if it is greater than the limit, say 9 kg, then we will again put the input in our model and it will go on till we reach a less than a limit.

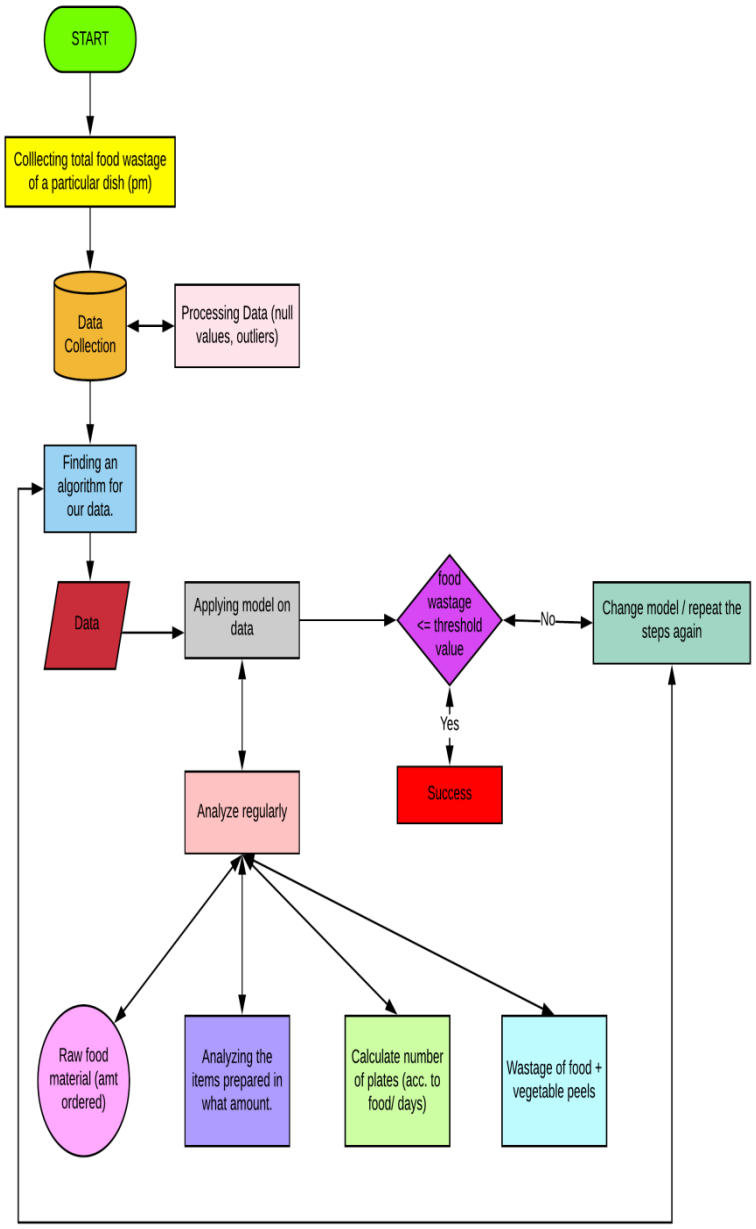


**Fig**: User Flow Chart for Mess Management

### 2.4 Methodology

The following methodology will be followed to achieve the objectives defined for proposed research work:

i. Detailed study of food wastage in the hostel mess will be done.
ii. Data would be collected and then cleaned to be used.
iii. Various parameters like artificial intelligence will be identified to evaluate the proposed system.
iv. Comparison of new implemented approach with existing system approaches will be done.

## 3 RESEARCH OBJECTIVES

The proposed research is aimed to decrease the wastage of food by the modern means of artificial intelligence. The proposed aim will be achieved by dividing the work into following objectives:

1) Data collection: The most important step in all of the steps. It is to attain all the information related to food wastage in the hostels. How we will do that is by surveying and observing the food wastage every day when students and staff members are to have their lunch (we choose this time because being present in the mess in the morning or night for just the data collection will not be easy). Still we will try to collect all the data regarding the topic according to the menu of every day.
2) Data integration and cleaning: Integrating all the data collected together and to clean the data for making it trustable and consistent. Without a good dataset, it will just be pointless to work upon the problem.
3) The next step is bit of a technical step, where we will just choose an algorithm to work and interact with our dataset for gaining insights and for gaining otherwise negligible (but important) data.
4) The final step would be to make a model which can solve the problem we are facing and what we really want to work upon is on making a model which can solve other problems with some constraints.

## 4 RESULTS

Derived from the papers that were researched as mentioned in the table for this research paper the results stated that most of the hostel mess experienced comparative waste examples [2]. Vegetarian main courses dips and were the most squandered [2]. Checked isolation decreased food wastage [2]. 33% of the expense of food is squandered [2]. Planning and shopping routines are important predictors of food wastage behaviour [5]. Socio-economic and segment family unit attributes are critical factors [5]. Factors like mentalities, age and pay influence squander conduct essentially [5]. Lack of attitudinal and control beliefs [5]. It could be helpful to expand collaboration between food esteem chain factors [5]. Describing food waste behaviour and practices and perceptions [4]

- Psychology-situated methodologies give bits of knowledge into purchaser concerns, inspirations and standards around food squander and their causal relationship on expectation to lessen food waste and (self-detailed) conduct [4].
- Generally, consumers consider throwing away food as improper behaviour, the vast larger part of family units indicate that they are at any rate to some degree worried about discarding away food [4].
- Implicating about food waste is a significant predictor of food squander reduction and plays an important job in the expectation to reduce food waste [4].
- Food-related household practices and routines- the complex essence of food waste, household routines such as planning, shopping, putting away, cooking, eating, and overseeing extras assume a conclusive job in food provisioning yet in addition in food squander generation [4].

The results are made on dataset that is collected from the journal “The quantity of food waste in the

garbage stream of southern Ontario, Canada households" which contains 86 rows and 18 columns. The dataset includes all the household waste that is produced by the Canada households. This research paper mainly focuses on the food wastage that is being disposed in the garbage stream.

The data was collected during year 2012-2015 where it includes the household wastage that is gathered from 9 municipalities of Southern Ontario which includes twenty-eight single-family households. Then the data was aggregated and analysed as to expand the food waste estimates in the garbage stream considered for the study[11].

Every one of the 28 datasets comprise of waste organization study information from 100 families. Normally, each example of 100 families is incorporated from 10 inspecting zones of 10 continuous homes deliberately chose by the particular region to work as an agent test. One region spoken to by five inspecting territories of 20 homes. Along these lines, there were a sum of 85 inspecting regions over the nine regions. Every district chooses their diverse examining regions dependent on elements, for example, lodging type (e.g., more established homes, more up to date homes) and neighbourhood financial status. The examining zones are spread out over week by week squander assortment days and commonly 2 to 4 testing regions are gathered every week day. Squander tests are gathered from examining regions on their waste assortment day and are blocked at the control before city assortment. The examples are taken to an arranging territory and are arranged into upwards of 120 arranging classifications, including a solitary "food squander" classification. The arranged food squander is gauged and recorded. Assortment and arranging of squanders is attempted by squander reviewers (i.e., organizations that give proficient waste piece study administrations to regions). Each waste creation study is rehashed twice more than two back to back a long time for similar families. Along these lines, two week after week information focuses (i.e., week 1 and week 2) make up the normal of each testing territory's occasional information point. Squander creation examines are rehashed up to 4 times each year (i.e., to include every one of the four seasons) for a similar testing regions and family units[10].

Moreover, we ordered information on a few factors which might impact the assessments of food garbage removal for incorporation as free factors in factual models. For every one of the examples, we recorded the waste evaluator, period of each examination (i.e., winter, spring, summer, fall), testing zone type (i.e., urban, or country), and family unit access to food squander redirection programs (i.e., green container program for gathering food squanders at the control). Moreover, appraisals of the quantity of individuals per family and middle family salary (Canadian dollars) were aggregated for each example region utilizing information from the 2011 Canadian registration at the scattering region level, which is the littlest areal unit for which Statistics Canada discharges segment information
and is a solid intermediary for each inspecting territory.

By analysing the data and graphs, we discovered the patterns in our data which results in knowledgeable discovery. By finding out the solutions we can implement on a small scale at first and if it's successful then, we will try to make our model close to accurate based on the quality data which follows the V's of big data. Following are the data visualizations which are made in Jupyter notebook using various python libraries such as pandas, seaborn, plotly etc after pre-processing techniques applied on our sample data so that patterns about the kind of data and the patterns of food waste can be noticed.

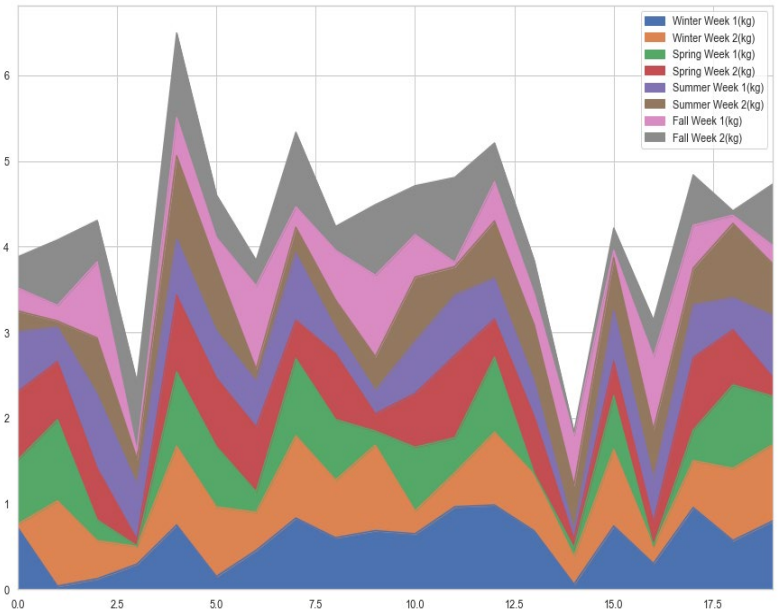

**Fig**: Stacked Area chart

The above figure is stacked area chart which is made by Winter Week 1(kg), Winter Week 2(kg), Spring Week 1(kg), Spring Week 2(kg), Summer Week 1(kg), Summer Week 2(kg), Fall Week 1(kg), Fall Week 2(kg) columns in the dataset. Where every zone of shading speaks to one piece of the entirety. The parts are stacked up, generally vertically. The tallness of each shaded stack speaks to the rate extent of that class at a given point in time. A stacked zone diagram may be utilized to show the breakdown of help for various ideological groups after some time. The stacked area chart displays how the amount of food waste that is being produced of the households which are considered for the survey.

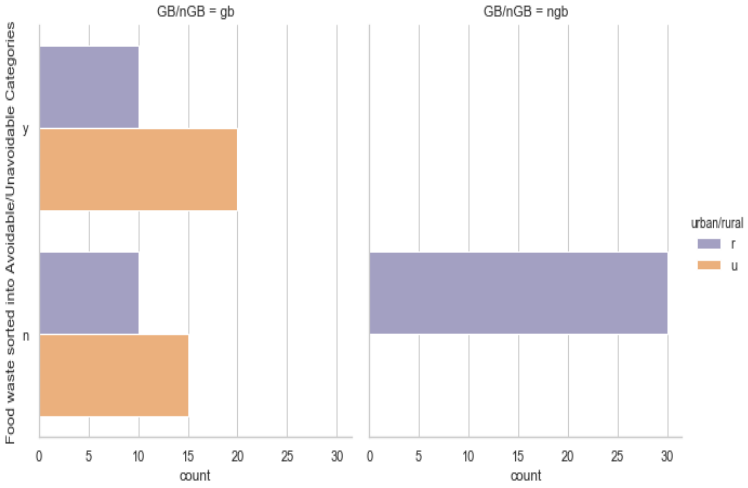


**Fig**: Count Catplot Seaborn Graph

Count catplot plot basically plots the quantity of perceptions in each straight out factor with a bar, the above figure represents a caplot which shows the relationship between a numerical and one or more categorical variables using one of several visual representations on columns GB/nGB and Food waste sorted into Avoidable/Unavoidable Categories.

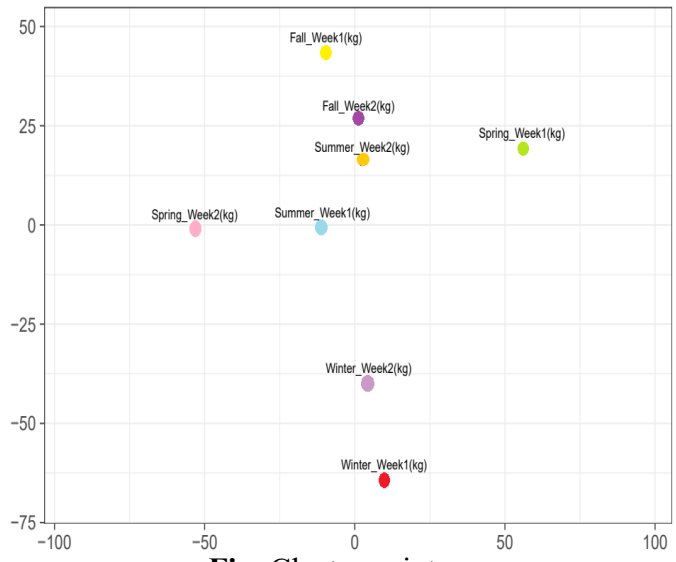


**Fig**: Cluster points

The above figure represents the cluster points charts which is a clustering chart, where found the average waste engendered by each student with which we can analyse the minimum quantity of pabulum that can be preserved.

*M1 = (total-(food_wasted+food_left))*
*$M_1$, $M_2$, $M_3$……..*
*M= ($M_1$+$M_2$+……+$M_n$) / N*
*Taking mean of food not used per day or months as per requirement.*

Applying the model on our data and with the avail of k-denotes we can engender clusters and find the center points which is most proximate point to all other values as shown in fig cluster points.
We abbreviated the amplitude of pabulum being made on daily substratum and accumulated the data of aliment wasted or leftover. We applied the model on data and will go on until we reach the wastage of aliment at its min.

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2$$

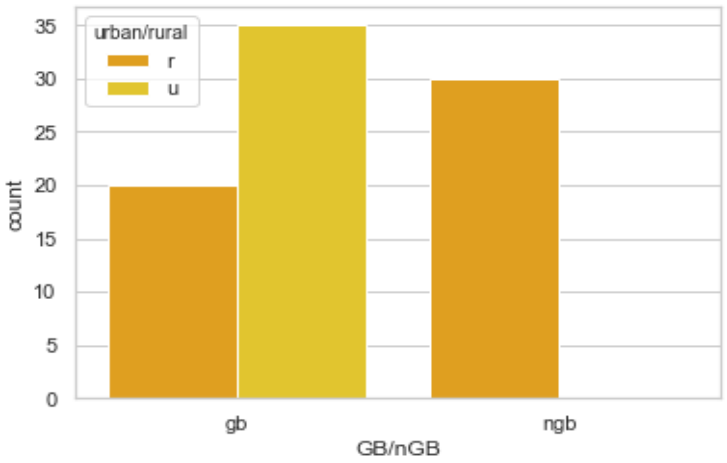

**Fig**: Count plot Seaborn Graph

Structured presentations are valuable for showing connections between all out information and in any event one numerical variable. Seaborn countplot is a barplot where the needy variable is the quantity of occurrences of each occasion of the free factor. The above figure represents a countplot which is kind of like a histogram or a reference chart for some clear-cut territory, here we considered GB/nGB and urban/rural columns. It basically shows the quantity of events of a thing dependent on a particular kind of classification on columns GB/nGB along the rural and urban columns in the dataset considering the household count.

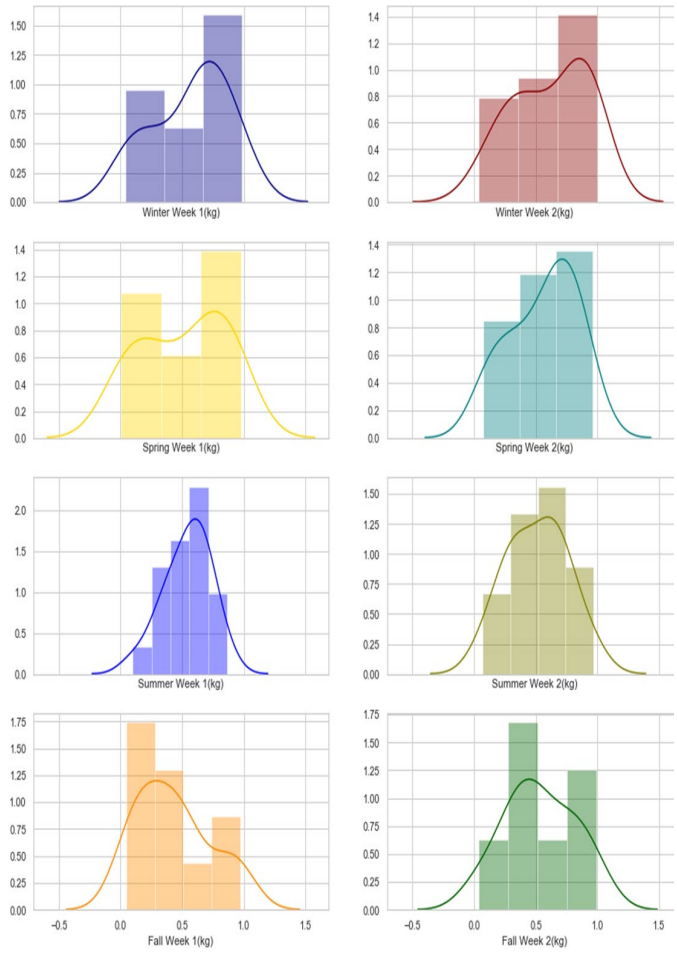


**Fig**: Distplot Seaborn Graph

A distplot plots a univariate distribution of observations. Seaborn distplot lets us show a histogram with a line on it. The above figure is Seaborn Distplot which allows us to show a histogram with a line on it. This can be shown in all kinds of variations.

Here we considered Winter Week 1(kg), Winter Week 2(kg), Spring Week 1(kg), Spring Week 2(kg), Summer Week 1(kg), Summer Week 2(kg), Fall Week 1(kg), Fall Week 2(kg) columns in the dataset to show how the observations are made.

## 5. CONCLUSION

The final solution is not only using information alone by using various technological aspects alone in order to create behavioural change to save the food from being wasted, but is also majorly depends on the challenging habits of the users and the working of the mess management in the universities/colleges. The current paper set out to audit observational, peer-checked on concentrates on family units' food squander rehearses, and distil socio-segment and psycho-social factors just as food-related family rehearses. Generally speaking, we see that examination in the field of family units' shopper food squander happening in families just as inn wrecks is advancing admirably, prove by the developing number of studies. As featured by different creators, food squander age on the family unit/inn level is a profoundly mind boggling and multifaceted issue driven by an assortment of reasons and sorts of conduct. In any case, our examination has indicated that family units are commonly concerned and feel remorseful about squandering food. These sentiments of blame are principally founded on close to home concerns, for example, financial misfortune, as opposed to on worries about the natural and social ramifications of food squander. A few investigations have shown that blame, saw conduct control, and negative perspectives towards food waste may anticipate the expectation to lessen food squander or potentially revealed food squander.

While stressing the procedures that can be embraced by people to forestall food squander in their family units, one should nonetheless, recognize the person as inserted in more extensive social, economic, and social structures that may forestall the reception of less inefficient practices. Besides, insufficient time to think about food all in all, and food squander specifically, combined with the apparent unpredictability of everyday lives may transform food squander counteraction into an overwhelming undertaking. Yet, there has been little examination led on how seen time accessibility influences individuals' waste practices. On the off chance that we are to handle

food squander in a deliberate manner, we should likewise consider. Accordingly, an all-encompassing food squander counteraction approach needs to go past putting the duty exclusively on people. In the quest for arrangements, more mindful and competent purchasers are required as much as submitted strategy producers who are eager to actualize the correct blend of strategy measures to make squander counteraction the favoured alternative for lodging wrecks just as family units.

## 6. REFERENCES


[1] Abbasi, M., & El Hanandeh, A. (2016). Forecasting municipal solid waste generation using artificial intelligence modelling approaches. *Waste management*, *56*, 13-22.

[2] O'Shea, C. E., Merritt, K. A., & Cooney, R. J. (2017). Reducing Food Waste at IIT Mandi.

[3] Bozkir, A. S., & Sezer, E. A. (2011). Predicting food demand in food courts by decision tree approaches. *Procedia Computer Science*, *3*, 759-763.

[4] Schanes, K., Dobernig, K., & Gözet, B. (2018). Food waste matters-A systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production*, *182*, 978-991.

[5] Marangon, F., Tempesta, T., Troiano, S., & Vecchiato, D. (2014). Food waste, consumer attitudes and behaviour. A study in the North-Eastern part of Italy. *Italian Review of Agricultural Economics*, *69*(2-3), 201-209.

[6] Okwachi, S. W., Miricho, M., & Maranga, V. (2018). *A Study Focus in to Hospitality Restaurant Operations in Regard to Food Security, Through Food Waste and Loss Control Mechanisms* (No. 458). EasyChair.

[7] Pinstrup-Andersen, P. (2000). The future world food situation and the role of plant diseases. *Canadian Journal of Plant Pathology*, *22*(4), 321-331.

[8] Depta, L. (2018). Global food waste and its environmental impact.

[9] Makkar, A., & Kumar, N. (2020). An efficient deep learning-based scheme for web spam detection in IoT environment. *Future Generation Computer Systems*.

[10] Makkar, A., Garg, S., Kumar, N., Hossain, M. S., Ghoneim, A., & Alrashoud, M. (2020). An Efficient Spam Detection Technique for IoT Devices using Machine Learning. *IEEE Transactions on Industrial Informatics*.

[11] Makkar, A., Kumar, N., Zomaya, A. Y., & Dhiman, S. (2020). SPAMI: A Cognitive Spam Protector for Advertisement Malicious Images. *Information Sciences*.