Determinants of food waste at household level in Punjab Pakistan

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Abstract

Food waste indicates a significant threat to the economy the environment and food security. Food waste is one of the most pressing sustainability concerns that need to be addressed. Consumer behavior patterns that contribute to food waste at household level had been observed in Pakistan. In order to prevent food waste at the regional and global levels, it is imperative to identify the causes of food. The goal of the current study was identified and analyzed the determinants of food waste at household levels and suggests recommendations to decrease food waste in households. For this purpose, the data was collected from 200 consumers through a convenience sampling technique using a pre-tested questionnaire. Data was collected through a convenience sampling technique. Logit regression model was used to analyze the data. Identification of food waste determinants is very helpful to optimize operations, minimize losses, and improve profitability. The study found gap between perceptions and practices. Despite awareness and negative perceptions of food waste, actual waste levels were influenced by practical constraints such as storage facilities, Taste, and product appearance. The study findings indicate that taste, food stock waste, left over waste, un appealing texture, over quantity production waste, educational effect, awareness regarding food waste, expiry date, product appearance, nutritional value, overcooked waste all these variables led to increase the food waste at household level. Only brand reputation negatively affects the food waste behavior of the respondents. The findings provide a solid foundation for developing targeted policies and interventions aimed at reducing household food waste. By understanding the determinants, policy makers can create specific strategies to address each factor, such as educational campaigns on food storage, policies encouraging portion control, and community programs promoting the use of leftovers.

Keywords: Food waste, logistic regression, taste, freshness, storage.

Introduction

Pakistan is a food-sufficient nation with significant export potential, but 60% of its people live in food insecurity. This implies that food security is not guaranteed by food availability. The main obstacles to food security are accessibility as well as economic and socioeconomic inequality. Although Pakistan has an elevated per-capita income, the people's buying power has been decreasing due to the rising rate of inflation. A 20 percent rise in food costs, according to the Pakistan Economic Survey (2017–2018), would push an additional 100 million people into complete poverty. In contrast to urban households, those living in rural areas are more susceptible to malnutrition (Sleet, 2019).

Food waste is a global problem that receives attention because of its negative impacts on society, the environment, and the economy. According to the UN's food waste Index Report, wealthy nations waste 79 kg of food per person on average (UN, 2021). Households or consumers account for more than half of all food waste in middle-class and wealthy nations. Thirty-nine percent of all food waste worldwide is attributed to consumers. The actions of retailers and customers have a significant impact on how much food is wasted. By lowering food waste, the entire world agreed to efficiently battle hunger and malnutrition through the "Agenda 2030 for Sustainable Development." The goal of the agenda is to "halve per capita global food waste at the retail and consumer levels and to reduce food losses along production and supply chains, including post-harvest losses." This was highlighted on "The International Day against Food Waste" in September 2020 (Schmidt *et al.*, 2021).

FAO in 2024 estimated that food waste costs the world $940 billion annually, with sub-Saharan Africa losing out on nearly $4 billion of that amount. About 37% or 120–170 kg annually per person, of all food is thought to be lost or wasted in sub-Saharan Africa, and 280–300 kg annually per person in North America and Europe. Between 2021 and 2023, 23.8% of the (SSA) population was undernourished, accounting for almost 805 million cases of chronic hunger.

Food waste development is significantly influenced by household dynamics and socio-economic factors. Consumption patterns and waste habits are significantly influenced by household size and composition, income levels, and resource accessibility. Bigger families could have more trouble organizing meal plans and controlling food stocks, which could result in more waste. However, socioeconomic differences may contribute to food waste problems in poorer communities by causing unfair distribution of resources and shortages of food (Grizzetti *et al.*, 2023).

Six out of ten people in Pakistan experience food insecurity, and the nation wastes over 36 mill Household food waste formation is significantly influenced by sociodemographic characteristics, which include variables like family size, family income, education, and socioeconomic status (GOK, 2014). Bigger families frequently have more trouble organizing meal plans and controlling food inventory, which results in increased waste. Less food waste, on the other hand, might occur in smaller homes because they are better at resource and food management (Stancu & Lahteenmaki, 2018).in tons of food every year (Dawn, 2020). The largest cities in terms of food waste are Hyderabad, Lahore, Faisalabad and Karachi. Approximately 40% of the food offered during wedding ceremonies is wasted (NRDC,

2017).

Pakistan is a food-sufficient nation with significant export potential, but 60% of its people live in food insecurity. Pakistan has an elevated per-capita income; the people's buying power has been decreasing due to the rising rate of inflation. 20 percent rise in food costs, according to the Pakistan Economic Survey (2017–2018), would push an additional 100 million people into complete poverty. In contrast to urban households, those living in rural areas are more susceptible to malnutrition (Sleet, 2019).

In homes, huge quantities of food are being wasted. Individual's eating habits are largely influenced by sociodemographic, economic, and behavioral variables (Witzel, *et al.*, 2015). Approximately 288,000 tons of food is wasted annually at household levels. In homes, food wastes are about 93 gram per person. It indicates that each person wastes 11 kg of food annually (Dawn, 2020). The main reasons for food waste in households were inadequate storage, poor quality food, improper meal planning, food not being consumed quickly, plate waste, dislike of eating leftovers, and ignorance of the consequences of food waste (Reich and Foley 2014).

Food waste is a complex problem that affects societies all over the world and presents serious obstacles to food security, environmental sustainability, and economic effectiveness. To effectively address this multifaceted issue and put effective solutions in place, it is essential to comprehend the factors that contribute to food waste at the family level. Consumer tastes, understanding of the market, high financial status, social and cultural standards, and other opinions about value are the major determinants (Gustavsson *et al.*, 2011).

It is difficult to pinpoint practical solutions for lowering food waste and encouraging more sustainable consumption habits due to the complex relationships between individual behaviors, home dynamics, socioeconomic variables, and cultural influences. The current research is conducted to analyze the key determinants of food wastage at the household levels. Reducing food waste is a social responsibility, as it reflects ethical considerations regarding equitable distribution of resources. In a world where millions suffer from hunger, wasting food is morally unacceptable. Households have a responsibility to minimize food waste by adopting practices that prioritize resource conservation, efficient management.

Objectives of Study

Following are the specific objectives of the study

- To identify the socioeconomic determinants of consumers that causes food waste at the household level.
- To identify and analyze the determinants of food waste at the household level.
- To suggest strategies and recommendations to reduce food waste at the household level.

Literature Review

Secondi *et al.,* (2022) analyzed approach to home food waste habit. In order to analyze the intricate food waste-related habits of families, this study used a two-step approach to examine important policies and activities at different administrative levels. Furthermore, the behavior of residents in the European Union regarding food waste was analyzed, using the data from

the 2013 Flash poll. Individually, city dwellers and those who live in major cities tend to produce greater food waste; for this reason, it was stressed that city governments should vary their policy actions according to the amount of globalization.

Matharu *et al.,* (2022) studied Examine what inspires customers in the home to reduce food waste. Purposive sampling was used to choose the 95 experts who provided data for the study. To examine the data, the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method was used. According to the study, there were twelve elements that can be used to reduce food waste: perceived behavioral control (PBC), knowledge and abilities on appropriate handling of food at home, views regarding wasted food, social norms, concerns regarding the environment, and financial variables. The results showed that the most important element driving home food waste reduction was Perceived Behavioral Control (PBC). Conversely, of the elements that were determined to be significant, knowledge and abilities on appropriate food management at home were shown to be the least significant. According to the research, the goal of educational initiatives and legislative changes should be to increase family knowledge of and capacity for managing food waste.

Deng and Lin. (2023) examined factors that contribute to food waste in households at the local level. The study make used of an extensive data set from Taiwan's Taipei City. To examine the data, the researchers used varying-coefficient co-integration evaluations that were semi-parametric and linear. The study's main specific variables were food prices, household sizes, earnings levels, and population age structure, specifically the proportions of the working and old-age populations. The results point out that increased food waste rates were positively correlated with higher food prices, a higher proportion of older population, and bigger household sizes. Reduced rates of food waste were correlated with a larger proportion of the working-age population

Elimelech *et al.* (2023) determined the main religious and cultural elements that lead to food waste in families by examining the attitudes and behaviors surrounding food waste in various religious and cultural contexts. A study comprising 600 houses from three distinct socioeconomic groups religious Jews, secular Jews, and Muslim Arabs was carried out in a particular location of Israel. A mixed-methods technique was used in the study to combine quantitative and qualitative data. Structured questionnaires and in-depth interviews were used to gathered data. The associations between the variables were investigated using regression analysis and additional statistical techniques. The research relied on real practices, cultural practices, and religious beliefs. The results of the study showed that households with strong religious beliefs were more inclined to use waste-reduction strategies. Waste production was generally higher in cultures that valued wealth and hospitality than in those that valued thrift and resilience. Food waste awareness and negative opinions were impacted by practical limitations like family size, access to storage, and economic situations, which also had an impact on actual waste levels.

Farooq *et al.* (2023) identified the damages done annually to Pakistan's hotel industry due to food security. Data were gathered from 100 hotels; with the hotel industry in district Swat serving as the study's target demographic. The information was gathered about food waste in the hospitality sector. The pre-and post-consumer forms of food waste were used to quantify

it. The goal of this investigation coincided with the quantitative research approach. The information was gathered using a pre-tested questionnaire. Food waste can be measured using a variety of methods, but one common method is to weigh the food before and after consumption. Waste was a relatively straightforward technique without any protocols. According to the outcomes of the findings, district Swat discards 694 tons of food annually on average. One kilogram of overall food waste costs, on average, approximately 350 rupees.

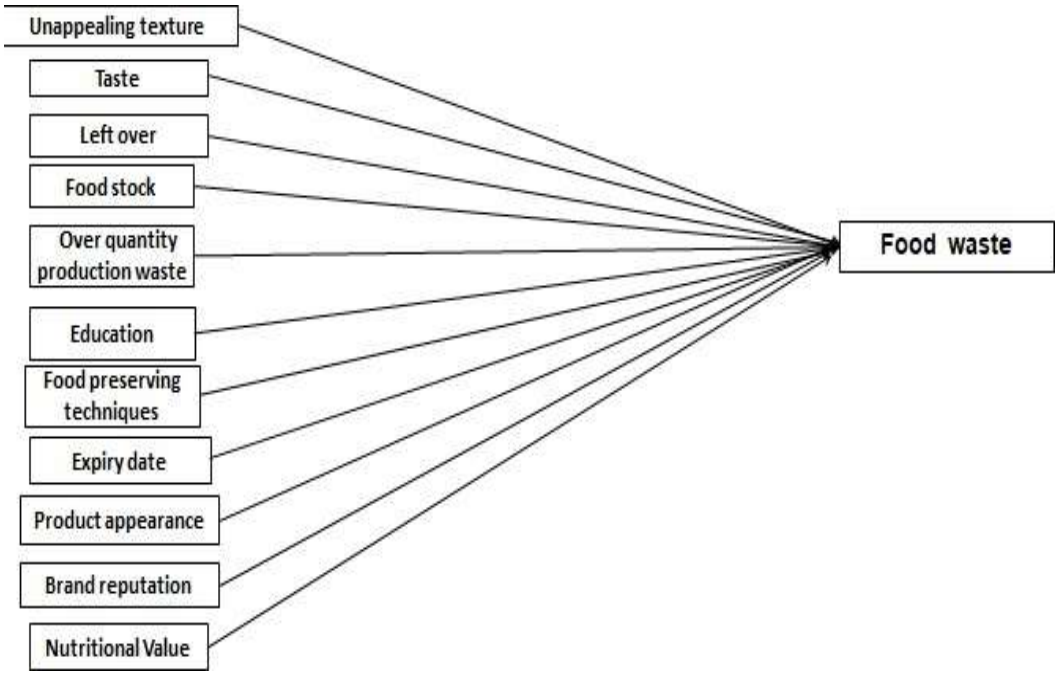
Tahir (2023) investigated the moderating effects of guilt and demographics on the determinants of wasted food using TPB. This study was to look at how moderators (gender, age, and education) affected the link between TPB's elements and behavior intention. It also looked at how guilt affected the connections between the intention to behave and the actual behavior. Participants were surveyed using a structured, closed-ended questionnaire as they visited restaurants in Pakistan's Punjab province's Rahim-Yar-Khan District. September and October of 2021 were the months when the information was gathered. A total of 450 questionnaires were provided by the researcher to randomly chosen customers of restaurants and stores. The results indicate a positive correlation between intention and its determinants (attitude, subjective norms, perceived behavioral control), as well as a moderating effect of demographic characteristics. The outcomes also indicate a positive correlation between waste of food and intention, as well as a beneficial effect of guilt on both variables.

Misniakiewicz *et al.* (2024) analyzed that living arrangements and eating habits influence university student's food waste perception. This study was a cross-national investigation conducted in Poland and Italy. 382 participants from Poland and 699 university students from Italy took part in the study. After being created in English, the questionnaire was then translated into Italian and Polish. The survey, which was translated into Polish and Italian, was used with Google Forms, an online tool that is helpful for getting quick responses and evaluating data in multiple forms. Using the non-probabilistic snowball sampling method, it was shared online between May 1 and June 1, 2023, on social media platforms including Facebook, LinkedIn, and Instagram. The Mann-Whitney U test and the Kruskal-Wallis test were used to evaluate the data. One important consideration was age, which indicates a generational gap in the knowledge and perspective of food waste. A noteworthy finding of the study refers to the impact of both socio-economic and environmental crises on the perception of food waste, exhibiting a significant association in Poland. Students who eat lunch at home with their families were more conscious of food waste.

Research Methodology

The systematic procedure, principles and technique for performing and analyzing any empirical or analytical research are known as research methodology. This study will be employing a selected methodology to effectively examine the determinants of food waste at household level in District Lahore and Faisalabad. The conceptual framework offers a foundation for evaluating the data gathered as well as help in the development of research questions or hypotheses.

Figure 1
Determinants of Food wastage at household level



Study Area

The nature of the problem warrants a much broader scope, such as the entire country, but due to financial constraints, the study was limited to Lahore and Faisalabad districts of Province Punjab, Second and third largest city in terms of population residence of approximately 13 and 3.5 million individuals. Both cities face challenges related to food security, environmental sustainability, and waste management. As a result, it was an effort to learn about the determinants of food wastage at household level in the chosen location.

Data collection

A questionnaire that was created and tested in accordance with the objectives of this paper was used to gather the data. A direct survey with closed-ended questions and an organized survey approach was employed for gathering the data. The convenience sampling method and goggle survey forms were utilized for addressing the respondents, who were willing to being questioned.

Questionnaire Designing and Data Coding

A systematic questionnaire was used to collect the data. Arrow *et al.* (1993) and Mitchell and Carson (1989) guidelines were taken into consideration when creating the questionnaire. The questionnaire consists of 3 sections. Questions about the respondent's demographics were asked in the first portion of the survey. The second section captured the respondent

behavior toward determinants of food wastage. The third section mainly provides suggestion related to problem faced by respondents in reducing the food waste and their solution.

The survey questionnaire was thoroughly reviewed after collecting data to ensure that all items had been appropriately answered. After that all the data were numbered in serial order. Data were transformed from the questionnaire to computer excel sheet and also in STATA software for further process and results.

Logit Model

In the survey to determine the impact of the Scio-economic factors and other independent variables on food wastage binary logistic regression model is use. To investigate the response of participants regarding determinants of food wastage, the logit model, a binomial response model, is utilize. The dependent variable for this model, food waste, was set to 1 if respondent waste food and 0 otherwise.

Hanemann's (1984) method was utilized to calculate food wastage determinants.

$$\text{Food wastage} = \ln\left(\frac{P_i}{1 - P_i}\right) = \beta_1 + \beta_2 X_i + \epsilon$$

Where: Pi = probability of wasting food, $1 - Pi$ = Probability of not wasting food X= independent variables
β = Parameter of estimations
∈= Error of estimation

Following the method used by Ara (2002), the dichotomous question about food waste was posed. The calculated model was as follows as a first step:

$$Food\ waste = \beta_\circ + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots \beta_{12} X_{12} + \epsilon$$

X1: Taste, X2: Food stock waste, X3: Left over waste, X4: Unappealing texture, X5: Over quantity production waste, X6: Educational effect, X7: Awareness regarding food waste, X8: Expiry date, X9: Product appearance, X10: Brand reputation, X11: Nutritional value, X12: Overcooked waste, **ϵ**: error of estimation.

Results And Discussion

The result section frequently summarizes the empirical findings from experiments, surveys, interviews, or any other data gathering techniques used in the study in an organized and brief manner. This part seeks to explain the major conclusions by objectively presenting the facts, frequently utilizing tables, graphs, or figures. It must to be logically structured and stick to the study's goals or research questions.

Table 1
Descriptive summary of variables used in logit model

Variables	**Definition**	**Descriptive summary**		
		Mean	Variance	Standard deviation
Food wastage	Food waste =1 if respondent waste the food at household level, 0 otherwise	0.475	0.250628	0.500628
Unappealing texture	Unappealing texture =1 if respondent waste the food due to unappealing texture, 0 otherwise	0.680	0.219716	0.468739
Taste	Taste =1 if respondent waste the food due to its bad taste,0 otherwise	0.32	0.218693	0.467647
Left over	Leftover =1 if respondent waste the leftover food, 0 otherwise	0.395	0.240176	0.490077
Food stock waste	Food stock =1 if it cause to the food wastage, 0 otherwise	0.41	0.243116	0.493068
Over quantity production waste	Over quantity Production =1 if it	0.355	0.230126	0.479714

	Causes to the food wastage, 0 otherwise			
Education reduce waste	Education = 1 if it help to reduce the food wastage, 0 otherwise	0.79	0.166734	0.40833
Awareness about food wastage	Awareness=1if respondent avoid the food wastage,0 otherwise	0.844	0.132176	0.36356
Food preserving techniques	Preserving techniques =1 if it help to reduce the food wastage, 0 otherwise	0.755	0.185905	0.431166
Expiry date	Expiry date=1 if respondent waste the food due to its expiry date, 0 otherwise	0.842	0.132176	0.36356
Product Appearance	Product appearance =1 if it help to reduce the food wastage,0 otherwise	0.76	0.183317	0.428155
Brand reputation	Brand reputation =1 if it help to reduce the food wastage, 0 otherwise	0.64	0.230126	0.479714
Nutritional value	Nutritional value =1 if it help to reduce the food wastage, 0 otherwise	0.86	0.117362	0.342581
Over cooked waste	Over cooked waste=1 if causes to the food wastage, 0 otherwise	0.417	0.244353	0.494321

Source: Author's own calculations

This table 4.13 provides descriptive statistics for various items related to the determinants of food wastage at household level. The "mean" represents the average score given by respondents for each attribute. The "standard deviation" measures the amount of variability or dispersion in the responses. The "variance" is another measure of variability and is calculated as the square of the standard deviation. Each item represents a specific aspect of food wastage and respondents are indicating whether they agree or disagree with the given statement.

Table

Logit model estimation: Logistic regression was used to examine the determinants of food wastage at household level.

Food Wastage	Coefficient	Standard error	Z value	P> |z|	Marginal effect (dy/dx)
Taste	1.18	0.494454	2.40	0.017	0.283
Left over Waste	1.15	0.5755791	2.01	0.044	0.278
Food stock	1.16	1.230731	2.13	0.057	0.248
Unappealing texture	1.70	0.765307	2.22	0.026	0.274
Over quantity production waste	0.27	0.5011126	4.82	0.000	0.631
Education affect	1.08	0.8400017	3.25	0.001	0.436
Awareness regarding preserving techniques	1.73	0.517388	3.36	0.001	0.408
Expiry date	0.45	0.3540982	2.44	0.015	0.360
Product appearance	0.95	0.6353632	2.37	0.022	0.208
Brand reputation	-1.72	0.837474	-2.06	0.040	0.277

Nutritional Value	0.48	0.4617108	2.78	0.053	0.242
Over cooked waste	0.84	0.4617108	2.11	0.035	0.211
Constant	6.78	2.022854	3.36	0.001	
Log Likelihood = -104.70668				LR Chi² = 50.78	
Pseudo R² = 0.1952				Prob> Chi²= 0.0000	

Source: Author's own calculations

The coefficients, standard errors, z-values, and p-values are all listed in this table. The factors listed in table 4.14 include; Taste, Food stock waste, Leftover waste, unappealing texture, over quantity production waste, Educational effect, awareness regarding food waste, expiry date, product appearance, Brand reputation, Nutritional value, Overcooked waste. The coefficients highlight the strength and direction of every variable's impact on food waste. A positive coefficient represents a favorable influence, whereas a negative coefficient shows an adverse influence.

The z-values measure the significance of each coefficient. A higher absolute z-value suggests a more significant effect of the corresponding factor on the Food waste. A p-value less than the chosen significance level (typically 0.05) suggests that the corresponding factor has a significant impact on the food waste. The pseudo R-squared is 0.1952, which means that the model explains about 19% of the variance in the dependent variable.

The LR chi-square is 50.78, which is statistically significant at the p =0.0000 level. This suggests that the logistic regression model as a whole is statistically significant. The marginal effect's sign (+/-) indicates whether this factor has an effect on food waste in a positive or negative way.

Summary

Coefficient of taste indicates that for every respondent increase in the perception that taste affects food wastage increase by a factor of 1.18. This means that individuals who perceive taste as a significant factor in food wastage are more likely to discard food based on its taste, potentially leading to higher levels of food waste. In the perception of tastes influence on food wastage leads to a 0.283 increase in the probability of food wastage. Leftover waste coefficient suggests that increase in the leftover waste influences food wastage by a factor of 1.15. This means that respondents who perceive leftover food as a significant factor in food wastage are more likely to discard food that remains uneaten, leading to higher levels of food waste.

Food stock waste refers to the perception that having excess food stock contributes to food wastage. In this context, a coefficient of 1.16 suggests that food stock influences food wastage, increase to 1.16. Individuals who perceive having a surplus of food stock as a significant factor in food wastage are more likely to discard food. Over quantity production waste coefficient 0.27 indicates that the over quantity production waste influences food wastage by a factor of 0.27. In this case, increase in the over quantity production waste's

influence on food wastage leads to a 0.631 increase in the probability of food wastage.

Education affect coefficient indicates increase in the perception that education affects food wastage food increase wastage by a factor of 1.08. Change in the probability of food wastage change the perception of education affecting food wastage. Awareness regarding preserving techniques" measures hat being aware of preserving techniques influences food wastage. The coefficient of 1.73 indicates that awareness regarding preserving techniques affects food wastage.

Expiry date coefficient of 0.45 suggests that the expiry date affects food wastage, increase by a factor of 0.45. Expiry date measures the perception that food wastage is influenced by the expiration date of food items. Product appearance coefficient of 0.95 suggests that the product appearance affects food wastage, the odds of food wastage increase by a factor of

0.95. Brand reputation coefficient of -1.72 suggests that brand reputation affects food wastage. The negative coefficient indicates that a higher perception of brand reputation is associated with lower of food wastage.

Nutritional Value measures the perception that the nutritional value of food influences food wastage. A coefficient of 0.48 suggests that nutritional value affects food wastage by a factor of 0.48. Consumers who are highly health-conscious may contribute to food waste when they prioritize nutritional value but are misinformed about what constitutes healthy food. Overcooked waste measures the perception that overcooking food contributes to food wastage. A coefficient of 0.84 suggests that the perception that overcooked waste influences food wastage increase by 0.84.

In Pakistan, food waste is estimated to be 36 million tonnes annually. That would be the same as every person in Faisalabad and Lahore throwing away their whole daily meal and dinner. 40% of Pakistan's food supply has apparently been wasted. Our country's food loss is projected to be greater than agricultural departments have calculated due to adverse weather

conditions. In both Lahore and Faisalabad, households often buy more food than needed, influenced by bulk discounts, promotions, and the desire to minimize frequent shopping trips. This leads to excessive stockpiling, resulting in food spoilage and wastage as items surpass their shelf life before being consumed. Most of the people who responded were single. The woman showed good involvement in the region.

Regarding food waste, every respondent had a decent level of awareness. 79% of participants in the study's low-income house region and 100% of participants understand what food waste is. When given the same question in a survey conducted only 66% of participants responded "Yes" for 10% waste. It demonstrated that while people in the research area were aware of food waste, it may be assumed that people were too busy or distracted to consider the issue. However the majority of respondents in this poll indicated they would not waste food, individuals in developing countries waste food and tolerate it.

One explanation for this might be that the majority of the population in the research area belonged to the average to low income group and had simple eating patterns and habits. They therefore claimed that they wasted relatively little food. The family with a lower income had greater processed food waste.

Recommendations

Conduct workshops and informational campaigns to educate households on proper food storage techniques and preservation methods such as freezing, canning, and drying to extend the shelf life of food. Encourage households to plan their meals for the week and create shopping lists to avoid overbuying. Educate the community on responsible hospitality practices, such as preparing reasonable quantities of food during social events. Implement and promote household and community composting programs to recycle food waste into useful compost for gardening and agriculture. Encourage stores to donate unsold but edible food to food banks or charities. Establish food sharing networks where households can share excess food with neighbors or community members in need.

Contribution

This study systematically identifies and analyzes the key determinants of food wastage at the household level, such as taste, food stock waste, left over waste, unappealing texture, over quantity production waste, educational effect, awareness regarding food waste, expiry date, product appearance, brand reputation, nutritional value, overcooked waste. The findings provide a solid foundation for developing targeted policies and interventions aimed at reducing household food waste. By understanding the determinants, policymakers can create specific strategies to address each factor, such as educational campaigns on food storage, policies encouraging portion control, and community programs promoting the use of leftovers.

Implementations

By implementing a comprehensive plan that combines policy initiatives, educational campaigns, community engagement, technological solutions, and improved waste management infrastructure, the study's findings on the determinants of food wastage at the household level can be effectively addressed.

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