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Household food waste across multiple food groups in Dodoma, Tanzania: A Multinomial Probit approach

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ABSTRACT

Food waste (FdW) undermines food security both directly and indirectly by disrupting sustainable food systems. Understanding the root causes of FdW and its effects across multiple dimensions is crucial. Despite extensive global research, studies focusing on Household Food Waste (HFdW) in Tanzania remain limited. This study addresses that gap by analyzing the determinants of FdW generation across combinations of Food Groups (FGs) in Dodoma, Tanzania. A cross-sectional survey of 402 households was conducted to collect data on FdW-related behaviors and preferences. Principal Component Analysis (PCA) with varimax rotation was applied to reduce dimensionality, revealing that Cereals, Legumes & Pulses, and Roots & Tubers contributed most strongly to the retained components that capture the main variation in HFdW patterns. Each group was then dichotomized into high or low waste based on the median, and the resulting binary indicators were combined to create eight possible FdW patterns, representing all combinations of waste intensity across the three groups. These FdW patterns formed the dependent variable in a Multinomial Probit Regression Model (MPRM). The model revealed that demographic factors such as higher education, female-headed, and older households were associated with lower HFdW. Behavioural practices, including meal planning and leftover reuse, also reduced waste, while attitudinal factors such as greater awareness of FdW impacts further reinforced this effect. In contrast, weaker perceptions of money value were linked to higher FdW levels. The findings highlight the importance of behavioral and contextual factors in shaping HFdW. Policymakers should consider targeted strategies such as meal planning support, storage and handling education, and gender-responsive interventions to reduce FdW and enhance food security in Tanzania and other low-resource settings.

Introduction

Food waste (FdW) has emerged as a critical global challenge, threatening the sustainability of food systems and undermining progress toward food security (Chengqin et al., 2022). It exerts pressure across multiple sectors including agriculture, natural resource management, and public health—by straining supply chains, exacerbating environmental stress, and intensifying economic and social vulnerabilities. Addressing FdW requires integrated, multi-sectoral strategies underpinned by reliable data and coordinated policy responses (Archip et al., 2023; Bhatia & Sharma, 2023; Li et al., 2023; Silayo, January, et al., 2025).

Although FdW tends to rise with increasing consumption and income levels, it remains a pervasive issue across all income groups, manifesting at every stage of the food supply chain (Galanakis, 2020; Veselá et al., 2023). FdW refers to food originally intended for human consumption that is subsequently discarded, whether at the Household (Hho), retail, or food service level and encompasses both edible and inedible fractions (Attiq et al., 2021; Rafique et al., 2023). This inclusive definition holds particular significance for monitoring efforts, as cultural differences in edibility perceptions shape measurement outcomes. In alignment with Sustainable Development Goal (SDG) 12.3.1(b), both portions are incorporated into global tracking frameworks (UNEP, 2024).

The widespread impact of FdW extends beyond food security, compromising environmental resilience and economic efficiency. According to the United Nations Environment Programme's Food Waste Index 2024, an estimated 1.05 billion tonnes of food and inedible parts were wasted globally in 2022, with Hhos accounting for 631 million tonnes—more than twice the combined total from the food service and retail sectors. HFdW is of particular concern due to its high proportion of

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avoidable waste (Bretter et al., 2022). Globally, FdW contributes between 8 % and 10 % of greenhouse gas emissions and consumes nearly 30 % of agricultural land, intensifying the challenge of feeding a growing population (Eves et al., 2024; Kohli et al., 2023; UNEP, 2024; Yang et al., 2022).

In lower-middle-income countries, the challenge of HFdW is particularly acute: annual per capita HFdW is estimated at approximately 86 kg (UNEP, 2024), while 46.6 % of the population cannot afford a healthy diet (FAO et al., 2025). Although policy attention to FdW reduction is increasing globally, the effectiveness of Hho-level interventions in low-income contexts remains uncertain. This uncertainty stems from the unique cultural norms, behavioural practices, and infrastructural limitations that differentiate these settings from high-income countries (Landells et al., 2025; Rahman et al., 2022; Todd & Faour-Klingbeil, 2024). While awareness campaigns and behavioural interventions have demonstrated promise in some regions (Stancu et al., 2016; Wang et al., 2021), evidence from empirical evaluations is mixed, with many interventions showing limited or short-lived effects (Brennan & Browne, 2021; Quested et al., 2013; Soma et al., 2020; Wang et al., 2023; Zamri et al., 2020). These inconsistencies indicate that findings from high-income settings cannot be easily transferred to low-resource environments such as Tanzania.

Beyond contextual differences, methodological challenges further complicate the evidence base on HFdW. Numerous studies have documented substantial measurement biases—particularly those associated with self-reported survey data, recall-based estimates, and Hho food diaries—which tend to underestimate true waste levels and limit the reliability of intervention evaluations (Ammann et al., 2021; den Boer et al., 2024; Giordano et al., 2019; Portugal et al., 2020; van der Werf et al., 2020). These limitations constrain the ability to draw accurate conclusions about HFdW behaviours and the factors that shape them (Aitken et al., 2024; Silayo, Bongole, et al., 2025). Consequently, there is a pressing need for locally grounded, methodologically robust research to better understand HFdW dynamics and to inform context-appropriate interventions in Tanzania.

Public awareness of FdW in Tanzania remains limited despite its increasing environmental and food security consequences (Das et al., 2023; Kuiper & Cui, 2021; Pandisha, 2025). Existing empirical studies demonstrate that strengthening awareness can play a pivotal role in reducing Hho waste generation (Lang et al., 2020; Manzoor et al., 2024). Current estimates indicate that Hho-level FdW in Tanzania averages 152 kg per capita annually—exceeding waste generated in both the food service and retail sectors (UNEP, 2024). Notably, this substantial level of waste coexists with a 58 % prevalence of moderate or severe food insecurity (FAO et al., 2025). These contrasting realities underscore the urgent need for context-specific interventions in low- and middle-income settings that enhance public awareness and promote more sustainable Hho food management practices.

Moreover, the existing literature on HFdW is dominated by studies from high-income countries, where differences in definitions, measurement methodologies, and sociocultural contexts limit their relevance to developing regions (Ahmed et al., 2021; Bhatti et al., 2023). In Tanzania, empirical research explicitly measuring HFdW remains scarce. Most existing studies focus on FdW in retail and food service environments (Cromwell et al., 2025; Kusolwa et al., 2025; Nyagali & Mpuya, 2024), while only one related analysis has explored methodological disparities in HFdW measurement using the same dataset (Silayo, Bongole, et al., 2025). To date, there is virtually no systematic analysis that quantifies HFdW across multiple FGs or investigates its socio-demographic, behavioural, and attitudinal determinants within the Tanzanian context. To address this gap, the present study uses primary data from a cross-sectional household survey in Chamwino District, Dodoma Region, and applies a multinomial probit model to analyse patterns of HFdW across multiple FGs.

This work contributes to the literature by examining HFdW across both individual and composite FGs—a perspective seldom addressed in existing empirical research. By situating the analysis in a low-resource, food-insecure context, it provides a deeper understanding of Hho waste dynamics and generates policy-relevant insights to guide interventions aimed at reducing HFdW and improving food security in Tanzania.

Materials and methods

Study area

This study was conducted in Dabalo Ward, Chamwino District, within the Dodoma region, Tanzania's administrative capital. Dabalo Ward was purposively selected due to its high Hho density and significant nutritional insecurity, making it an ideal context for investigating household FdW drivers (The United Republic of Tanzania (URT) et al., 2022; Assenga & Kayunze, 2020; Lukiko, 2023). Dodoma's semi-urban setting, with a mix of rural and *peri*-urban Hhos, reflects Tanzania's diverse socio-economic and cultural landscape.

Research design

This study employed a cross-sectional Hho survey to examine the socio-demographic, behavioural, and attitudinal drivers of HFdW in Dodoma, Tanzania. The design enabled the collection of quantitative data that captures variation in self-reported FdW patterns across a diverse sample of Hhos. In line with SDG 12.3.1(b), the survey considered both edible and inedible portions of FdW, following UNEP (2024) guidelines.

The study investigates how HFdW behaviour varies across combinations of FGs using a multi-stage empirical approach. The analytical procedure involved applying PCA with varimax rotation to summarize correlations among FGs, dichotomizing each group into high or low waste based on the median, and employing a Multinomial Probit Regression Model (MPRM) to examine the socio-demographic, behavioural, and attitudinal determinants of the resulting food waste patterns.

This approach addresses underexplored dimensions in the existing literature by focusing not just on total waste levels, but on how waste behavior varies by food type and Hho context particularly in a low-resource setting where food insecurity and waste coexist.

Sampling design

This study employed a multistage sampling procedure to select Hhos within Dabalo Ward, Chamwino District. The sampling strategy was designed to capture variation in Hho characteristics within the study area; however, it followed a non-probability approach and therefore does not meet formal standards of geographic or demographic representativeness. The sample is thus concentrated in a single administrative ward, which limits the extent to which the findings can be generalized to the national level or to urban–rural contexts in Tanzania. Instead, the results should be interpreted as context-specific to Chamwino District, offering insights into FdW behaviors in a rural, semi-arid setting. Despite these limitations, the study provides valuable exploratory evidence for understanding HFdW in Tanzania, and it highlights the need for future research that applies probability-based sampling and covers diverse rural and urban settings to enhance representativeness and external validity.

In the first stage, Dabalo Ward was purposively selected due to its high Hho density, documented food insecurity, and agro-ecological relevance for food systems research in central Tanzania (Assenga & Kayunze, 2020; Lukiko, 2023). Its diverse livelihood profiles and vulnerability conditions made it a suitable site for examining Hho food FdW behaviours. In the second stage, villages within Dabalo Ward were selected to reflect variation in accessibility, population density, and socio-economic characteristics. While stratification was initially proposed, proportional stratified sampling was not formally implemented. Instead, village selection prioritized spatial and contextual diversity.

In the final stage, Hhos within each selected village were sampled using a modified random walk technique. Enumerators began at a central location (village office), determined their initial direction via coin toss, and selected every third home along the right-hand side of the street for participation. In areas with irregular or dispersed settlement patterns, field supervisors provided guidance to ensure broad spatial coverage. When a selected Hho was unavailable or declined participation, the next eligible Hho was approached. Although this method is commonly used in field-based surveys, it is not fully probabilistic and may introduce selection bias particularly in communities with non-uniform housing layouts.

The sampling frame was based on the 2022 Tanzanian Census, which recorded 486,176 Hhos in Chamwino district. The required sample size was determined using the Krejcie & Morgan, (1970) formula with a 90 % confidence level and a 4.89 % margin of error:

$$n = \frac{X^2NP(1-P)}{d^2(N-1)+X^2P(1-P)}$$

This yielded a minimum sample size of 391 Hhos. To strengthen representativeness and meet UNEP (2024) recommendations for Hho FdW surveys, the final sample was increased to 402 Hhos. While explicit stratification was applied at the village level, the multistage approach with systematic Hho selection ensured a diverse representation across Hho types, age groups, genders, and socio-economic profiles.

Questionnaire development

The questionnaire was adapted from validated instruments used in HFdW and food behaviour studies, selected for their robust measurement of waste quantities and behavioural drivers (Baliwati et al., 2023; Giordano et al., 2019; van Herpen et al., 2019). The questionnaire comprised three main sections with 37 closed-ended questions: (1) socio-demographic characteristics (e.g., Hho size, income, education, home ownership), (2) behavioural and attitudinal factors (e.g., meal planning, storage practices, use of purchase lists, eating leftovers, intentions, awareness of FdW impacts, perception of the value of money), and (3) self-reported HFdW quantities across twelve FGs defined by the World Food Programme (2022) and Bongole et al., (2022): cereals, legumes & pulses, vegetables, roots & tubers, fruits, meat, dairy, fish, eggs, oils, sweets, and spices. Respondents estimated discarded food quantities (in kilograms) for each FG, distinguishing between edible and inedible portions, based on consumption from the previous day to minimize recall bias (Giordano et al., 2019).

Prior empirical studies on Hho FdW were instrumental in informing the development of the behavioural and attitudinal items used in this study (Aktas et al., 2018; Etim et al., 2024; Rahman et al., 2022). Variables such as awareness of FdW's environmental impact, the belief that one was raised to avoid FdW, and practices like shopping with a list or consuming leftovers were included to reflect key aspects of Hho food management and waste prevention. While these variables do not represent formal constructs from any specific behavioural theory, they were selected to capture cognitive, normative, and practical dimensions that influence Hho food-related decision-making. A pilot study with 20 Hhos conducted by authors in March 2024 helped refine the instrument for cultural relevance and clarity. The finalized questionnaire was translated into Swahili and digitized using Kobo Toolbox for efficient data collection (Das, 2024).

Data collection process

Data were collected between June and August 2024 through face-to-face interviews conducted by six trained enumerators. Enumerators underwent a two-day training on interview techniques, Kobo Toolbox usage, and ethical considerations, including informed consent and confidentiality. Interviews, conducted in Swahili, lasted approximately 35 min per Hho. Respondents self-reported HFdW and behaviours using structured, closed-ended questions adapted from studies with established reliability in HFdW measurement (Bretter et al., 2022; Chen, 2023; Grant et al., 2023; van der Werf et al., 2020). A field supervisor performed random spot checks and reviewed daily submissions for completeness and consistency. Validation rules and skip patterns in Kobo Toolbox minimized data entry errors and ensured logical flow.

Respondent selection

The primary respondent in each Hho was the adult most responsible for food handling activities, such as purchasing, cooking, or waste disposal, as they were best positioned to provide accurate HFdW data (Flagg et al., 2014; van Herpen et al., 2019). While the gender of the Hho head was recorded separately, respondents were selected based on their primary role in food-related tasks, regardless of Hho head status. In this study, 86 % of respondents were female and 14 % were male, reflecting the predominant role of women in food handling in the sampled Hhos. This gender distribution aligns with cultural norms reported in similar studies (e.g., Addo et al. (2024); van Herpen et al. (2019) and (Fraser & Parizeau, 2018)).

Hho characteristics and Descriptive Statistics

The characteristics of the 402 Hhs in our sample are summarized in Table 1. Male-headed Hhs account for 40.8 % more than female-headed Hhos, indicating that most Hhs are headed by men, who are often the primary breadwinners. However, food handling practices are predominantly monitored by women. Additionally, the proportion of homeowners exceeds that of non-owners by 39.8 %. Homeowners are more likely to have open spaces for discarding waste and to keep domestic animals that may consume food remains. Most respondents (54.5 %) reported having more than one source of income, while the remainder relied on a single source. This suggests that a majority of Hhs are actively engaged in diverse economic activities, with respondents likely belonging to the working-age population.

The ages of Hho heads in the study ranged from 18 to 80 years, with a mean age of 42 years, indicating that most respondents were within the working-age population. Education level was assessed in terms of years of schooling, revealing a mean of approximately 10.8 years, with individual values ranging from 4 to 16 years. This suggests that a substantial proportion of respondents attained secondary education, reflecting moderate levels of formal schooling and potential variation in food management practices. Hho size ranged from 1 to 9 members, with a mean of 3.5, indicating that the majority of sampled Hhos were small to medium-sized.

Table 1
Household Head Characteristics.

Character	Description	Sample	%
Gender	Male	283	70.4
	Female	119	29.6
House Ownership	Own	281	69.9
	Rental	121	30.1
Sources of income	Dependent	6	1.5
	Dayworker	21	5.2
	Employed	23	5.7
	Self-employed	51	12.7
	Farmer	118	29.4
	More than one source	183	45.5
Continuous		**Mean**	**Std. Dev**
Age	Years	42.22	13.14
Years of schooling of HH head	Numerical	10.61	2.15
Hh size	Numerical	3.75	1.79
Number Income sources	Numerical	1.47	0.52

Source: Authors estimation from field survey, 2024.

Theoretical model and empirical strategy

This study investigates HFdW decision patterns across multiple-FGs, recognising that Hhos may waste foods either in combination with other FGs or in isolation, reflecting distinct consumption and disposal behaviours. To better capture these patterns, the outcome variable was structured to reflect combinations of waste occurrence across selected FGs, consistent with previous studies emphasising the joint analysis of food categories (Kunchamboo, 2024). A framework illustrating this construction is presented in Fig. 1.

To reduce data dimensionality and identify underlying patterns in Hho-reported waste across twelve FGs, PCA with varimax rotation was applied. PCA was used as an exploratory tool to detect latent structure in the multivariate dataset and to identify clusters of related FGs. Based on the Kaiser criterion (eigenvalues > 1) and inspection of the scree plot, three principal components were retained, explaining approximately 53 % of the total variance. Interpretation of component loadings indicated that cereals, legumes & pulses, and roots & tubers contributed most strongly to the principal dimensions of variation in household food-waste behaviour. These three groups were selected for further analysis as representative dimensions emerging from the overall data structure, rather than as individual predictors.

Next, Hho-reported waste quantities for each of the three selected FGs were dichotomized into high and low levels using the median as the cut-off point. Hhos reporting waste above the FG-specific median were classified as "high," while those below were classified as "low." This procedure generated three binary indicators reflecting relative waste intensity within each FG.

These binary indicators were then combined to form a categorical variable with eight mutually exclusive profiles ($2^3 = 8$), representing all possible combinations of high/low waste across the selected FGs. These combinations serve as behavioral typologies, capturing joint Hho decisions regarding which food groups are wasted more frequently (detailed characteristics are presented in Table 2.

Since the dependent variable comprises more than two unordered categories, a Multinomial Probit Regression Model (MPRM) was employed. The MPRM is appropriate for this analysis because it accommodates potential correlation across unobserved components of the outcome categories and avoids the restrictive Independence of Irrelevant Alternatives (IIA) assumption associated with multinomial logit

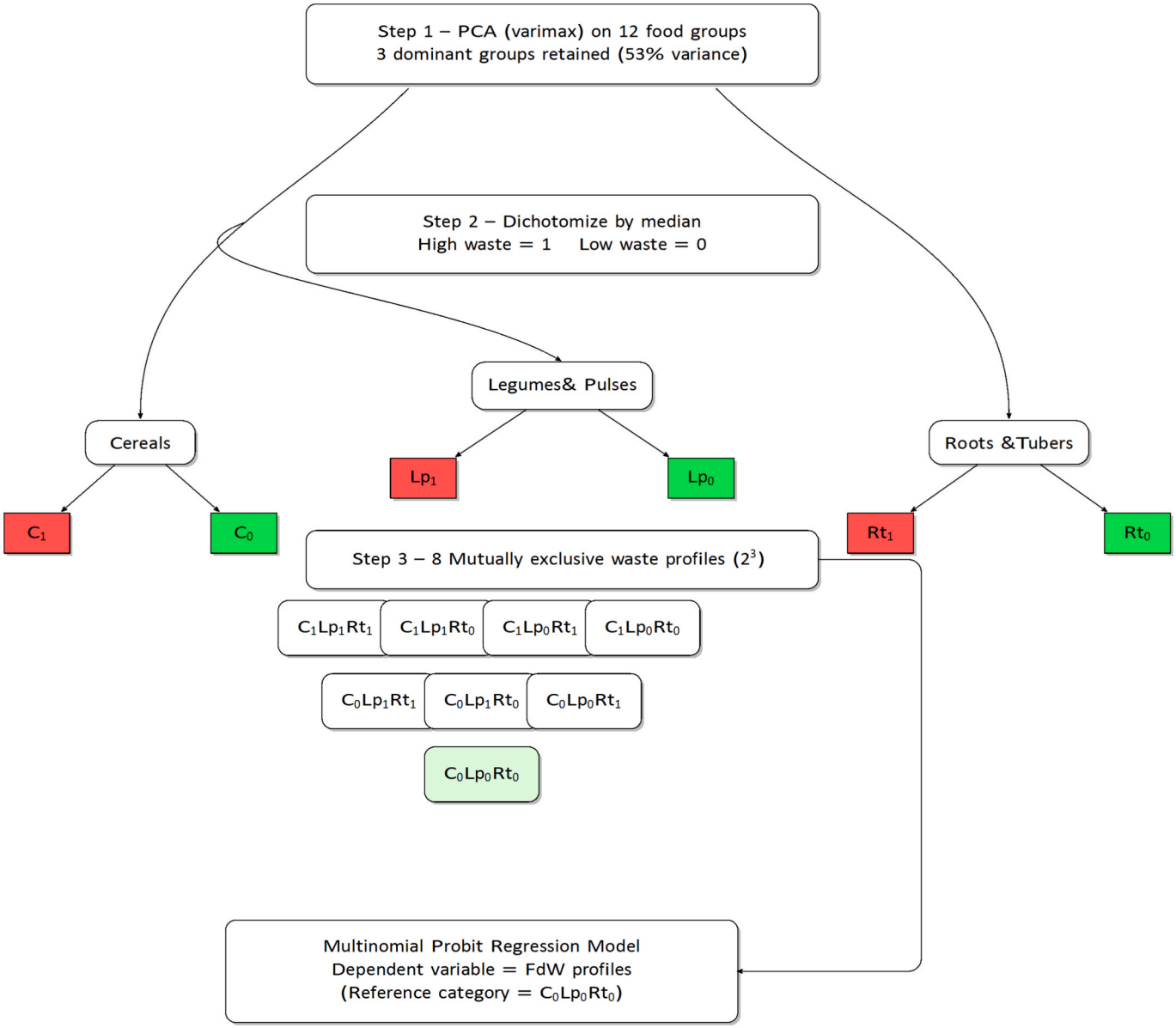

Fig. 1. Conceptual framework for constructing mutually exclusive HFdW pattern profiles.

Table 2
Food wasting in a combination of food groups.

S/n	Food group combinations (Categories)			Category Label	F	Mean	St. Dev	%
	Cereals	Legumes & Pulses	Root & Tubers					
1	0	0	0	$C_0Lp_0Rt_0$	109	0.271	0.445	27.11
2	1	0	0	$C_1Lp_0Rt_0$	106	0.264	0.441	26.37
3	1	1	0	$C_1Lp_1Rt_0$	56	0.139	0.347	13.93
4	1	1	1	$C_1Lp_1Rt_1$	25	0.062	0.242	6.22
5	0	1	0	$C_0Lp_1Rt_0$	26	0.065	0.246	6.47
6	0	1	1	$C_0Lp_1Rt_1$	18	0.045	0.207	4.48
7	0	0	1	$C_0Lp_0Rt_1$	24	0.06	0.237	5.97
8	1	0	1	$C_1Lp_0Rt_1$	38	0.095	0.293	9.45
Total					**402**			**100.00**

Source: Authors estimation from field survey, 2024.

models (Domanban et al., 2023). It should be noted that the model estimates the probability of a Hho belonging to a given FdW behavioural profile, rather than the absolute quantity of food wasted. This approach is intended to capture joint patterns in waste behaviour across multiple FGs.

The theoretical structure for investigating FdW in multiple FGs decisions are unordered and hence are enthused in a random utility model (McFadden, 1974). In modelling consider Hh k from a sample of N Hh who selects wasting among multiple FGs in a set i = 1, 2, 3…., J. Assume each of the Hh attaches a utility in each of the combination of FGs depending on Hh's own attributes, belief and food handling practices, this utility is represented by$\cup_{jk}$., and that a Hh choses a category that has the highest utility which cannot be observed different from the Chosen Category(Ch). Thus $Ch_{ik} = \{ {1if \cup_{ik}. = max(\cup_{1k}., \cup_{2k}, \cdots..\cup_{Jk}.) \atop 0Otherwise}$ which can then be expressed in a MPRM (Cameron & Trivedi, 2005; Greene, 2003).

The selection of independent variables, including leftover consumption habits, FdW awareness, Hho size, education level, and gender roles was guided by prior empirical studies on Hho-level FdW behaviours (Aktas et al., 2018; Rahman et al., 2022; Shmueli, 2021; Tahir, 2023; van der Werf et al., 2020). These variables were intended to capture behavioural and contextual dimensions relevant to household FdW, particularly within resource-constrained settings. To customize this, our estimation equation is expressed as follows:

$$ln\left(\frac{Pr(Ĭ = j|Gen_1, Age_2, \cdots)}{Pr(Ĭ = J|Gen_1, Age_2, \cdots)}\right) = \beta_{jo} + \beta_{j1}Gen + B_{j2}Age + B_{j3}Edu + \beta_{j4}Hh\_Size$$

$$+ \beta_{j5}Income + \beta_{j6}Hh\_ownship + \beta_{j7}Pp\_list + \beta_{j8}Pp\_low + \beta_{j9}Ck\_finish + \beta_{j10}Frq\_cking + \beta_{j11}Frq\_pp + \beta_{j12}Pcvmoney + \beta_{j13}ef\_fdw\_env + \beta_{j14}Rb\_fdw\_nwst + \beta_{j15}E\_leftover + \varepsilon_j$$

Where;

ε_j is the error term for category j, β_{jo} is the intercept for category j, $\beta_{j1,j2\cdots j11}$ = coefficients for respective independent variable for waste category j, Ĭ is the dependent variable with J waste categories. The abbreviations of the independent variables are defined in Table 4.

Results and discussions

Hho self-reported food waste

Table 3 presents the average self-reported FdW by FG in kilograms. Four FGs—oil, spices, milk, and sugar—are not included, as most households reported either no consumption or negligible waste for these items.

Root and tubers have the highest average total waste (0.065 kg), largely driven by inedible portions, such as thick skins or peels. Cereals also show a relatively high total waste (0.040 kg), with a substantial fraction being inedible. Fruits and vegetables exhibit a higher proportion of inedible waste compared to edible waste, reflecting common discarded components like peels and cores. Eggs have the smallest total waste, with most of it being inedible portion.

Table 3
Average self-reported Food Waste by FG.

Food Group	Edible	Inedible	Total Waste (kg)
Cereals	0.018	0.023	0.040
Fruits	0.003	0.018	0.021
Legumes and Pulses	0.004	0.033	0.037
Meat	0.002	0.032	0.034
Fish	0.000	0.012	0.012
Eggs	0.000	0.003	0.004
Root and Tubers	0.003	0.062	0.065
Vegetables	0.008	0.019	0.026

Table 4
Description of variables.

Variable name and label	Measurement	Mean	Std. Dev
Preparing purchase list (pp_list)	Do you buy groceries with a purchase list?Never(0), Sometimes(1), Always (2)	0.796	0.889
Purchase more at low price(pp_low)	I purchase more groceries when price is low.Strongly disagree(0)……..Strongly agree (4)	2.132	1.344
Cook exact needed food (ck_finish)	I always cook what can be finishedNever(0), Sometimes(1), Always (2)	1.542	0.631
Cooking Frequency (frq_cking)	How often do you cook in a day?	2.679	0.594
Purchase Frequency (frq_pp)	How often a week do you shop for groceries?	4.261	1.566
Price sensitive (pcvmoney)	Before I buy groceries, I compare prices.Never (0), Sometimes (1), Always (2)	0.965	0.635
Awareness (ef_fdw_env)	Are you aware of how FdW affects the environment?No (0), Not conversant (1) Fully aware (2)	1.134	0.718
Believe (rb_fdw_nwst)	Food must not be wasted, that's how I was raised.Strongly disagree(0)…….. Strongly agree (4)	2.622	1.152
Eating Leftover (e_lftover)	Do you eat healthy leftover food?Yes (1), No (0)	0.672	0.47

Source: Authors estimation from field survey, 2024.

Description of Hho food behavioural indicators

This section presents the Hh-level food related behaviours captured

by the study, including food purchasing habits, awareness of FdW, cooking practices, price sensitivity, beliefs, and leftover consumption. These behavioural variables, detailed in Table 4, are measured using ordinal or binary scale to reflect frequency, agreement, or awareness levels. On average, majority of Hh report cooking only what can be finished, with a high mean score of 1.54 on the statement 'I always cook what can be finished'. This is also aligning with 67.2 % of respondents who confirmed to be eating healthy leftover food in variable of leftover consumption. However, a few Hh are found to prepare a grocery shopping list, with a lower mean score of 0.786, such spontaneous purchases indicated could increase the risk of buying more than required and, ultimately risking food spoilage. Similarly, only a moderate level of price sensitivity is observed, which suggest that not all Hh compare prices before they buy groceries.

Purchasing more when price is low implies a tendency towards bulk food buying. However, there is also a strong agreement (mean value = 2.622), with the belief that food must not be wasted, these may also reveal cultural and social norms that discourage wasteful behaviour. On awareness of the FdW effects to the environment a mean value of 1.134 reveal that respondents are not fully informed. These revealed mix of both reactive and proactive Hh food management behaviours, reveal a need for a comprehensive understanding so as to set targeted behavioural change interventions from Hh-level.

Empirical model results

The likelihood that a Hh will belong into a specific combination of FGs is shown in Table 5.

The results presented in Table 5 indicate that the category $C_0Lp_0Rt_0$ which represents Hhs reporting very low waste across all three FGs, comprises more Hhs than any other FG combination (with of probability 0.27) This finding aligns with previous studies on self-reported FdW, which have shown that reported amounts are often lower than the actual amounts (Delgado et al., 2021; Delley & Brunner, 2018; van der Werf et al., 2020); that is majority will report very low amounts and thus this category includes a substantial number of Hhs. The category $C_1Lp_0Rt_0$ is also expected to be high (0.262) due to cereals being one of the most consumed FGs (Jan et al., 2024). Therefore, those who waste food are likely to be more prevalent in this group. Furthermore, the category of Hhs wasting less cereal, $C_0Lp_1Rt_1$ than other FGs having lowest probability for Hh to belong to this category.

Results of the Multinomial Probit model

Table 6 presents robust estimates from the MPRM, identifying factors associated with FdW across combinations of dietary categories. For clarity, Fig. 2 illustrates the significant marginal effects. Variables with confidence intervals crossing the red zero line are statistically insignificant; red triangles mark significant variables, while green triangles denote those without significant effects.

The results pertaining to age, Hh size, income, and education align with the existing body of literature about their impact on FdW in the Dodoma area. Hh's individual traits define the different techniques selected, and choices are essential when developing sustainable strategies addressing FdW. Furthermore, individual traits contributing to FdW could be influenced by initiatives aimed at improving Hh behaviour and decision-making regarding FdW.

Gender of the Hh: Male-headed Hh are revealed to less likely waste cereals only by 12.2 percentage points but 9.2 percentage point more likely to waste combination of cereals, legumes & pulses. Which suggest that spread of waste across multiple FGs rather than one is engaged more by men.

For some groups age appears to be associated with more efficient utilization of food. An extra year of age decreases the likelihood of wasting only root and root tubers by 4.1 percentage point in combination $C_0Lp_0Rt_1$. Less significantly increase wastage in all selected FGs $C_1Lp_1Rt_1$ by 0.16 percentage points, legumes and pulses, and root and root tubers treated in combination $C_0Lp_1Rt_1$ by 2.1 points. This may suggest for particularly for the FG of root and tubers dietary practices may be changing with age.

Education level reveals that an increase in year of schooling reduces the probability of not wasting in all FGs $C_1Lp_1Rt_1$ by 2.1 percentage points, suggesting that Hhs that are more educated are less likely to report no FdW. On the other hand increase wasting combination of cereal, root and tubers $C_1Lp_0Rt_1$ by 1.41 percentage points. These indicates that there is a shift in waste types, were educated Hh reduce some diets but not FdW across all FGs.

Size of the Hh are revealed to have significant effect in wasting across combination of FGs. Specifically, large sized Hhs are less likely to waste combination of cereal and root and tubers in combination $C_1Lp_0Rt_1$ by 3.75 percent points. In African settings some of the FGs are easily shared even after preparation especially in large size Hhs, example is such as root crops like sweet potatoes, cassava can be easily shared even after being plated.

Hh income reveals a classic inverse relationship with FdW aversion. Hhs with higher income are 11.6 percentage point less likely to report no FdW in combination $C_0Lp_0Rt_0$. Such results suggest Hh with greater purchasing ability and more cereal harvest stock might be less constrained in food use, hence waste more.

House ownership has revealed interesting results, owning a house lowers the probability of wasting food in combination of all FGs $C_0Lp_0Rt_0$ by 9.1 percentage points, which may indicate access to proper food storage facilities. Simultaneously, Hhs owning a house are 9.33 points more likely to waste only legumes and pulses $C_0Lp_1Rt_0$, noting a possible compromise in food preservation.

The use of a purchase list was associated with mixed effects on household FdW across FGs. Specifically, Hhos using a shopping list were 53.03 percentage points more likely to waste cereals and legumes in combination $C_1Lp_1Rt_0$, 4.6 percentage points less likely to waste only legumes/pulses $C_0Lp_1Rt_0$, and 2.71 percentage points more likely to fall in the roots and tubers-only waste category $C_0Lp_0Rt_1$. These findings suggest that while shopping lists may promote a more structured approach to purchasing, they do not necessarily prevent over-purchasing, misestimation of quantities, or spoilage, particularly when

Table 5
Predicted Probabilities.

Food group	Probability	Std. Err.	z	P>|z|	[95 % Confidence Interval] Lower	Upper
$C_0Lp_0Rt_0$	0.2700	0.0211	12.8	0.0000	0.228665	0.311374
$C_1Lp_0Rt_0$	0.2621	0.02025	12.94	0.0000	0.222374	0.301754
$C_1Lp_1Rt_0$	0.1392	0.01634	8.52	0.0000	0.107182	0.171235
$C_1Lp_1Rt_1$	0.0633	0.010988	5.76	0.0000	0.041775	0.084848
$C_0Lp_1Rt_0$	0.0642	0.01149	5.59	0.0000	0.041709	0.086747
$C_0Lp_1Rt_1$	0.0457	0.009689	4.72	0.0000	0.026706	0.064684
$C_0Lp_0Rt_1$	0.0604	0.011048	5.47	0.0000	0.038766	0.082074
$C_1Lp_0Rt_1$	0.0951	0.012639	7.52	0.0000	0.070283	0.119825

Source: Authors calculation based on Field survey, 2024.

Table 6
Marginal Effects of the estimated model results.

Variable	$C_0\,Lp_0\,Rt_0$	$C_1\,Lp_0\,Rt_0$	$C_1\,Lp_1\,Rt_0$	$C_1\,Lp_1\,Rt_1$	$C_0\,Lp_1\,Rt_0$	$C_0\,Lp_1\,Rt_1$	$C_0\,Lp_0\,Rt_1$	$C_1\,Lp_0\,Rt_1$
	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$	$\frac{dy}{dx}$
Gender	0.0358 (0.0476)	−0.1220*** (0.0424)	0.0921** (0.0402)	−0.0045 (0.0248)	0.0001 (0.0251)	0.0083 (0.0220)	−0.0106 (0.0243)	0.0010 (0.0271)
Age	−0.0005 (0.0020)	0.0029 (0.0019)	−0.0018 (0.0016)	0.0016* (0.0010)	−0.0014 (0.0010)	0.0021** (0.0008)	−0.0041*** (0.0014)	0.0012 (0.0011)
Education	−0.0205** (0.0101)	0.0227** (0.0099)	0.0008 (0.0081)	−0.0210*** (0.0056)	−0.0020 (0.0053)	0.0036 (0.0036)	0.0023 (0.0052)	0.0141*** (0.0049)
Hh-Size	0.0073 (0.0154)	0.0025 (0.0148)	−0.0010 (0.0118)	0.0096 (0.0067)	0.0099 (0.0070)	−0.0086 (0.0076)	0.0179** (0.0087)	−0.0375*** (0.0097)
Income	−0.1160*** (0.0408)	0.0706* (0.0396)	0.0433 (0.0297)	0.0351 (0.0221)	−0.0113 (0.0232)	−0.0285 (0.0183)	−0.0287 (0.0216)	0.0354 (0.0242)
House	−0.0910* (0.0544)	−0.0628 (0.0514)	−0.0301 (0.0419)	−0.0109 (0.0289)	0.0933*** (0.0357)	0.0094 (0.0252)	0.0474 (0.0291)	0.0446 (0.0302)
P-List	−0.0132 (0.0249)	−0.0197 (0.0240)	0.5303*** (0.0183)	0.0069 (0.0125)	−0.0460*** (0.0157)	−0.0073 (0.0120)	0.0271** (0.0125)	−0.0008 (0.0148)
Price-Low	−0.0025 (0.0157)	−0.0297** (0.0148)	0.0203* (0.0111)	−0.0003 (0.0072)	0.0165** (0.0077)	−0.0036 (0.0058)	−0.0012 (0.0082)	0.0005 (0.0091)
Ck-Finish	−0.0532 (0.0350)	0.1234*** (0.0340)	−0.0173 (0.0243)	−0.0059 (0.0168)	0.0485** (0.0198)	−0.0128 (0.0135)	−0.0017 (0.0171)	−0.0809*** (0.0186)
Freq-Ck	0.0076 (0.0389)	−0.1073*** (0.0346)	0.0790*** (0.0323)	−0.0496*** (0.0193)	0.0118 (0.0242)	0.0207 (0.0197)	0.0305 (0.0188)	0.0072 (0.0192)
Freq-P	−0.0125 (0.0143)	−0.0135 (0.0131)	0.0126 (0.0104)	0.0038 (0.0062)	0.0080 (0.0069)	−0.0010 (0.0046)	−0.0024 (0.0082)	0.0051 (0.0098)
Pv-Money	−0.0488 (0.0342)	0.0316 (0.0333)	−0.0099 (0.0259)	0.0356*** (0.0144)	−0.0204 (0.0200)	0.0072 (0.0146)	−0.0297*** (0.0147)	0.0342* (0.0201)
Awareness	0.0989*** (0.0317)	−0.0200 (0.0288)	−0.0333 (0.0242)	−0.0204 (0.0194)	−0.0245 (0.0156)	−0.0253*** (0.0137)	−0.0110 (0.0175)	0.0355** (0.0177)
Blv-Nwst	0.0031 (0.0178)	0.0429** (0.0181)	0.0154 (0.0147)	0.0018 (0.0083)	0.0200** (0.0101)	−0.0235*** (0.0058)	−0.0232*** (0.0083)	−0.0364*** (0.0095)
Leftover	0.0574 (0.471)	−0.0943** (0.0444)	0.0675* (0.0369)	−0.0300 (0.0217)	−0.0135 (0.0246)	0.0696** (0.0292)	0.0021 (0.0226)	−0.0587** (0.0270)

Standard Error in parenthesis; The asterisks refer *.$p < 0.1$, **$p < 0.05$, ***$p < 0.01$
Source: Authors calculation based on Field survey, 2024.

multiple FGs are bought simultaneously. In other words, the lists may guide what to buy, but Hhos may still overestimate needs or fail to store items properly, leading to higher waste for certain combinations of foods.

Purchasing more at low prices also shapes the Hh waste patterns. Such Hhs are less likely to only waste cereals $C_1Lp_0Rt_0$ by 2.97 percentage points, 2.03 percentage points more likely to waste combination of cereals, legumes and pulses in combination $C_1Lp_1Rt_0$, only legumes and pulses $C_0Lp_1Rt_0$ by 1.65 points. Bulk buying might be cost effective and food could be bought also at cheaper price, but it also risks food spoilage if storage and usage planning is not adequate.

Cooking just the right amount by Hhs paradoxically more likely to waste only cereals $C_1Lp_0Rt_0$ by 12.34 percentage points, and 4.85 points more likely to fall in legumes and pulses $C_0Lp_1Rt_0$ waste-only category. However, less likely to waste cereals, root and tubers in combination $C_1Lp_0Rt_1$ by 8.09 points. This may infer that Hhs with good intentions to reduce FdW, control of food portion may not be fully effective across all FGs.

Cooking frequency also significantly influence wasting behavior. High cooking frequency is associated with 10.73 percentage point reduction of cereal waste only $C_1Lp_0Rt_0$ and 4.96 point in combination of all selected FG $C_1Lp_1Rt_1$. On the other hand, 7.90 percentage point increase waste in cereals, legumes and pulses treated in combination $C_1Lp_1Rt_0$. This reflect that greater flexibility in the use of leftovers through smaller frequent meals.

Price sensitivity is also found to be significantly related to influence waste behaviors across FGs. An increase in price comparison likely to increase probability of wasting combination of cereals, legumes and pulses, root and tubers $C_1Lp_1Rt_0$ by 3.56 percentage points, and combination of cereals, root and tubers $C_1Lp_0Rt_1$ by 3.42 points, while decreasing in root and tubers only $C_0Lp_0Rt_1$ by 2.97 points. Such patterns indicate the presence of bargain driven purchases which often do not translate into responsible food use, especially for perishable root crops.

Hhs who are aware of the effects of FdW in the environment are more likely to report no waste in combination of all FG $C_0Lp_0Rt_0$ by 9.89 percentage points. At the same time, 2.53 points less likely to waste combination of legumes, pulses, root and tubers $C_0Lp_1Rt_1$, but 3.55 points more likely to waste combination of cereals, root and tubers $C_1Lp_0Rt_1$, which may indicate partial behavioral shifts.

Hhs who agree that food should not be wasted are more likely to waste cereals alone $C_1Lp_0Rt_0$ by 4.29 percent points and only legumes and pulses $C_0Lp_1Rt_0$ by 2 points, conversely less likely to waste combination of legumes, pulses, roots and tubers $C_0Lp_1Rt_1$ by 2.35, roots and tubers only $C_0Lp_0Rt_1$ by 2.32 points and combination of cereal, root and tubers by 3.64 points. This suggest that belief that food should not be wasted curbs more FdW in FG treated in combination rather than when wasted alone.

Eating of leftover food is also found to influence several FG combinations. Hhs who eat leftovers are 9.43 percentage points less likely to waste cereals alone $C_1Lp_0Rt_0$, 5.87 points less likely to waste cereals, root and tubers treated in combination $C_1Lp_0Rt_1$. These imply that in leftover consumption may prevent spoilage and reduce amount of FdW across divers FGs.

Discussion

The current findings point to consistent behavioural patterns shaped by Hho demographics, food management practices, and socio-economic characteristics (Fig. 2), within the broader context of Chamwino's high Hho density and persistent nutritional insecurity (Sheahan & Barrett, 2017; Tanzania et al., n.d.). The MPRM results (Table 6) indicate that

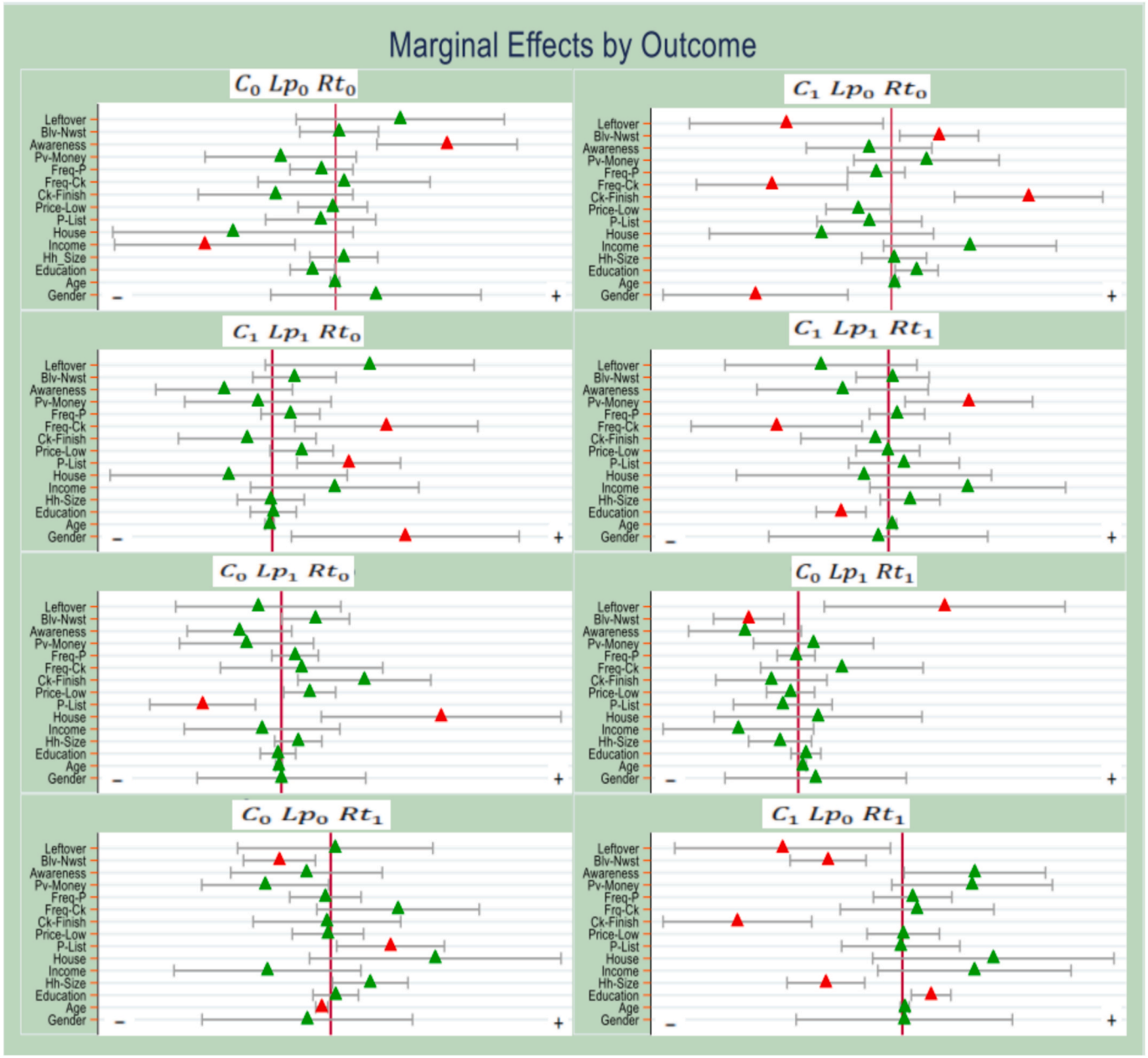

Fig. 2. Marginal Effects of Wasting by Category of FG.

older respondents were statistically less likely to report HFdW, particularly within the roots and tubers category. This aligns with findings from rural Sub-Saharan African contexts, where older individuals often engage in conservative food practices shaped by prior experiences of food scarcity or prevailing cultural norms (Kulwijila et al., 2018; Rashid et al., 2024). These patterns likely reflect waste-reducing habits developed through long-term food management and potentially reinforced by cultural values of frugality. Future research could investigate the specific behavioural mechanisms underlying these age-related differences—such as attitudes toward resource conservation, food-storage practices, and meal-planning, which may help explain the observed age disparities in FdW patterns.

In Chamwino, these behaviours appear to reduce Hho-level FdW. However, it is important to note that Hhos may still face limitations due to poor access to storage infrastructure. As Pandey (2021) highlights, inadequate food storage remains a critical barrier to sustainable food handling in rural settings. This suggests that structural factors can constrain the effectiveness of even well-intentioned food management practices. Policy strategies should therefore integrate behavioural interventions with investments in food preservation infrastructure. Further inquiry is recommended to examine age-related patterns in food management and their implications for Hho-level FdW across rural Tanzania.

Younger Hhos were statistically associated with higher levels of FdW, particularly within the roots and tubers category. While the present study does not directly examine behavioural mechanisms behind this relationship, evidence from similar low-income settings suggests that limited cooking skills, less experience with portion planning, and challenges in managing meal acceptability tend to be more pronounced among younger Hho members and can contribute to higher FdW (Mmereki et al., 2024; Molapo, 2023; Monteza-Quiroz et al., 2025; Thyberg & Tonjes, 2016). Studies from rural East Africa also document that younger family members often take on food preparation tasks, and lower experience in meal management may increase the risk of over-

preparation and spoilage (Kalumanga, 2024; Oderinde et al., 2023; Oganga, 2013). Supporting the broader relevance of these mechanisms, Huho et al. (2020) found that managing meal preferences and leftovers among children in rural Kenyan Hhos contributes to elevated FdW. Although these contextual factors were not directly measured in this study, they provide plausible pathways that future research could examine more systematically, particularly through mixed-methods designs that capture intra-Hho food preparation practices.

Gender of the Hho head was significantly associated with FdW patterns, with male-headed Hhos reporting higher levels of waste, especially in the cereals category. A plausible explanation is that, while food is typically prepared for the entire Hho—including children and spouses—male Hho heads, often primary income earners, frequently dine outside due to occupational and social commitments (Ananda et al., 2024; Liu & Nguyen, 2020). Their absence can result in portions being left unused, contributing to higher reported waste (Rashid et al., 2024; Sunday et al., 2022). Akerele et al. (2017) similarly found that male-headed Hhos in Nigeria exhibited significantly higher levels of cereal waste, reinforcing the gendered dynamics of food management. In Zimbabwe, Kairiza & Kembo (2019) observed that female-headed Hhos, often more vulnerable to food insecurity, adopt more conservative food management strategies. These findings underscore the influence of gendered responsibilities on HFdW behaviours. Additionally, evidence from Indonesia demonstrates that women-led community efforts can substantially reduce HFdW, highlighting the importance of grassroots leadership in promoting sustainable practices (Bainus et al., 2025). While contextual differences must be acknowledged, these patterns suggest the need for gender-responsive strategies, such as awareness campaigns targeting male-headed Hhos and support for female leadership in Hho and community food management in districts like Chamwino.

Larger Hhos in Chamwino were significantly associated with lower levels of FdW in cereals and root tubers (Table 6). Many of these Hhos engage in subsistence farming of staples such as maize and cassava, which are typically harvested as needed—helping to reduce over-preparation and spoilage (Mtunguja et al., 2019; Wahab et al., 2022). Their larger food needs and limited financial resources could also encourage more efficient consumption habits and a stronger awareness of food value. Similar patterns of waste-conscious behaviour among larger, resource-constrained Hhos have been observed in South Africa (Oelofse & Nahman, 2013).

Higher education levels were generally associated with lower HFdW across FGs in Chamwino. This pattern is consistent with studies in similar African contexts showing that education enhances awareness of food waste impacts and encourages the adoption of preventive practices (Mmereki et al., 2024; Ssepuuya et al., 2023). From a behavioural standpoint, education can strengthen attitudes and perceived control related to food management, fostering more deliberate decisions to reduce waste (Veselá et al., 2023). However, this association was not uniform across all FGs. For cereals and root crops, Hhos with higher education occasionally exhibited higher waste levels. This may reflect the indirect influence of education through increased income and dietary diversity, leading to greater food purchasing and experimentation with varied dishes (Rashid et al., 2024). In such cases, food surpluses or spoilage may arise when Hhos attempt to satisfy diverse tastes and cultural meal preferences (Monterrosa et al., 2020; Oderinde et al., 2023; Ssepuuya et al., 2023). These findings suggest that education alone does not guarantee waste reduction—it must be complemented by awareness campaigns emphasizing portion control, planning, and storage practices tailored to local diets.

House ownership, often used as a proxy for higher socio-economic status, was positively associated with elevated levels of FdW, particularly involving legumes and pulses prepared independently. In Chamwino, Hho ownership typically corresponds with increased income, which can drive bulk purchasing and overproduction of meals factors linked to higher FdW. This trend echoes findings from Lebanon, where Chalak et al. (2019) noted that high purchasing power significantly contributes to domestic food wastage. Moreover, multisource-income Hhos, especially those engaging in agricultural production, may generate increased waste when members routinely eat outside the home, resulting in the accumulation of uneaten prepared meals (Sunday et al., 2022). These observations suggest that FdW interventions in Chamwino should prioritize home-owning Hhos with targeted messaging that promotes responsible purchasing, coordinated meal planning, and portion control all essential strategies for minimizing avoidable FdW.

Higher household income was statistically associated with increased FdW across several FGs in Chamwino (Table 6). This pattern aligns with prior findings suggesting that as income rises, the perceived economic significance of food declines, often resulting in bulk purchasing and greater waste accumulation (Akerele et al., 2017; Haque et al., 2022; Pandey et al., 2023). In Chamwino, where food insecurity intersects with widening income disparities, higher-income Hhos may also pursue greater dietary diversity, inadvertently contributing to the disposal of surplus or uneaten food (Ignowski et al., 2023; Pandisha, 2025; Wanyama et al., 2019). Insights from other low-income contexts further support this trend. Opiyo et al. (2021) reported that Kenyan low-income Hhos typically purchase food in smaller, daily quantities, thereby minimizing waste whereas FdW is more common among middle- and high-income Hhos due to enhanced purchasing power. Rashid et al. (2024) similarly observed in Tanzania that rising income levels can exacerbate FdW even in areas grappling with food insecurity, a finding echoed by Aragie et al. (2018). These results underscore the urgency for targeted interventions promoting mindful purchasing and effective food storage among higher-income Hhos in Dodoma, where avoidable FdW may intensify alongside continued economic advancement.

The use of purchase lists in Chamwino demonstrated mixed effectiveness: while they reduced waste for legumes and pulses only, they were associated with increased FdW when cereals and legumes were bought together. Although purchase lists are intended to optimize food use, their effectiveness is shaped by Hho behaviour and contextual constraints (Di et al., 2019; Jia et al., 2022; Nabi et al., 2021). In low-resource settings, market instability, fluctuating prices, and variable availability of preferred items can lead Hhos to over-purchase or acquire excess quantities, even when using a list (French et al., 2019). From a behavioural perspective, lists may guide what to buy but cannot fully correct misestimating of quantities or improper storage, leading to spoilage (Amicarelli & Bux, 2020). Similarly, the opportunity cost framework suggests that Hhos may prioritize convenience or perceived dietary variety over strict resource conservation, resulting in unintended waste (Goossens et al., 2019; Yang et al., 2022). These patterns are also influenced by localized consumption behaviours and culinary traditions: for example, cereals and bakery items are most wasted in Algeria, whereas Tanzanian Hhos discard vegetables more frequently (Mmereki et al., 2024). Collectively, these findings underscore the importance of contextually grounded interventions that combine shopping planning with education on portioning, storage, and culturally appropriate food management practices to reduce HFdW across diverse FGs.

Price sensitivity was linked to increased HFdW across several FGs. However, when examined without combination with other FGs, root and tuber foods displayed reduced waste levels. In Chamwino, this pattern likely reflects consumer adaptation to short-term market fluctuations. Temporary reductions in food prices may incentivize price-sensitive Hhos to acquire larger quantities of perishable goods, particularly those with limited shelf life and inadequate storage stability (Choudhury et al., 2025; Fesenfeld et al., 2022; Lourenco et al., 2022). Without coordinated planning or preservation infrastructure, such purchasing behaviours elevate the risk of spoilage, a pattern that disproportionately affects low-income Hhos lacking refrigeration facilities (Mmereki et al., 2024). Regional studies reinforce this trend: Aragie et al. (2018) and Opiyo et al. (2021) found that over-purchasing driven by affordability considerations is a consistent contributor to HFdW in Sub-Saharan Africa. To mitigate such outcomes, FdW reduction strategies in Dodoma

should prioritize community awareness campaigns on aligning affordability with perishability, encouraging Hhos to harmonize purchases with actual consumption capacity.

Limiting meal preparation to quantities that reflect actual consumption was associated with reduced FdW for cereals and root tubers when assessed jointly. In Chamwino, excessive cooking remains a predominant contributor to FdW, mirroring trends in other low-income settings (Kunchamboo, 2024). More frequent cooking was associated with lower cereal waste, likely due to improved portioning and fresher preparation (Hermanussen et al., 2022). However, this may simultaneously increase unavoidable waste when meals are left unfinished or made in surplus, a tendency also documented across Sub-Saharan Africa (Mmereki et al., 2024). Extending beyond Hho settings, Sanniti et al. (2024) found that in Uganda, overcooking, overstocking, and large portions particularly in institutional and faith-based environments are leading drivers of FdW. These findings highlight the multifaceted nature of cooking behaviour as a determinant of food sustainability. To advance more responsible practices in Chamwino, policy efforts should prioritize context-specific interventions that promote portion control, strategic meal planning, and efficient cooking techniques—vital for minimizing waste and optimizing Hho food resources.

Higher levels of environmental awareness were consistently associated with reduced HFdW across FGs, reinforcing trends reported in other low-income contexts. Environmental consciousness may instil a heightened sense of resource stewardship and promote intentional consumption behaviours (Szakos et al., 2021). For instance, Sanniti et al. (2024) noted that in resource-constrained settings, limited awareness, technical skills, and food system knowledge pose substantial barriers to engagement in food loss and waste mitigation efforts. In Chamwino, Hhos demonstrating greater environmental concern were more likely to adopt waste-reducing practices, a pattern similarly observed among Tanzanian respondents by Sunday et al. (2022). Collectively, these findings reinforce the urgency of designing context-specific environmental education initiatives aimed at bolstering sustainability knowledge and fostering deliberate consumption behaviours within rural Hhos.

Hhos exhibiting pronounced anti-waste convictions tend to generate less FdW, particularly in relation to legumes, pulses, roots, and tubers both individually and when paired with cereals. In many developing regions, cultural norms and embedded beliefs significantly shape Hho food management behaviours (Hermanussen & Loy, 2024; Jerie et al., 2024). For instance, Phasha et al. (2020) found that in South Africa, culturally grounded attitudes directly influenced food-related practices. Similarly, Kulwijila et al. (2018) reported that in Chamwino, awareness of food scarcity and adherence to traditional values nurtured more conservative consumption habits. These beliefs often manifest through portion control, reuse of leftovers, and communal preparation rituals aimed at minimizing waste (Mmereki et al., 2024). In food-insecure settings like Chamwino, such convictions may be further amplified and translated into cautious food handling practices. Educational campaigns that reinforce and integrate these cultural values can serve as foundational pillars for sustainable FdW reduction strategies across low-income contexts.

Reusing nutritionally acceptable leftover foods was associated with reduced household FdW in cereals and in combinations that include cereals, roots, and tubers. In Chamwino, leftover management practices may be influenced by cooking styles, taste preferences, and prevailing Hho norms. Sunday et al. (2022) observed that in Tanzanian Hhos, reuse behaviours are shaped by sensory appeal and food preparation methods. Likewise, Opiyo et al. (2021) reported that in Kenya, staple-heavy diets and Hho income levels significantly affect consumption and waste behaviours, reinforcing the importance of context-specific analysis. Studies from Uganda (Ssepuuya et al., 2023) and Kenya (Kamau et al., 2020) also document structural constraints such as unreliable refrigeration and inadequate food preservation techniques that contribute to avoidable household waste. Chamwino shares these challenges, as noted by Haug and Hella, (2013) and Phasha et al. (2020), highlighting the potential role of infrastructure in shaping food handling outcomes. To mitigate FdW, interventions could focus on practical meal planning, improved cooking and storage techniques, and education campaigns that strengthen Hho competencies. Specifically, enhancing food preparation skills and encouraging leftover reuse may provide important benefits for Hho-level food sustainability in rural Dodoma.

Limitations and Future research

While this study provides valuable insights into HFdW behaviours in Chamwino District, it is not without notable methodological and contextual constraints.

First, the cross-sectional design limits the ability to infer causality regarding factors influencing HFdW outcomes. While the analysis identifies significant associations (e.g., higher income with higher FdW, or larger household size with lower waste), these relationships cannot be interpreted as causal. Observed patterns may also be shaped by unmeasured contextual or cultural factors. Furthermore, mechanisms through which core variables such as education and gender influence HFdW could not be fully disentangled within this design. We have therefore interpreted the results with caution and framed them as correlational evidence. Future longitudinal or experimental research is necessary to establish causal pathways and validate the theoretical mechanisms suggested in this study.

Second, reliance on self-reported data may introduce biases such as recall inaccuracies and social desirability effects. In particular, our use of a “previous day recall” method for reporting the amount of food discarded may lead to underestimation, as households might forget or downplay actual quantities. While this approach is widely applied in HFdW studies and reduces respondent burden in low-resource contexts, it cannot fully eliminate recall bias. Future studies should complement self-reported data with direct measurement techniques (e.g., waste diaries, waste composition analysis) to enhance accuracy and robustness.

Third, the study did not account for seasonal variations in food availability, handling, and consumption, which may significantly influence HFdW patterns. Tanzania’s agricultural calendar leads to clear differences between rainy and dry seasons, affecting both the quantity and types of food households purchase, store, and discard. As our data were collected during a single period, the findings may not fully capture these seasonal dynamics. Additionally, while the MPRM captured combinations of FGs, it may not fully reflect the cultural significance and social meanings embedded within those combinations, including gender roles and traditional practices such as the reuse of leftovers. Future research should consider longitudinal and mixed-methods approaches to better account for seasonal, cultural, and social factors shaping HFdW.

Finally, building on these findings, future studies should integrate direct measurement techniques such as waste audits and volumetric weighing to improve data accuracy. Mixed-methods approaches can elucidate cultural preferences and intra-household dynamics shaping meal composition and HFdW behaviours. Experimental interventions, including culinary education and behavioural sensitization campaigns, can test targeted waste reduction strategies, aligning with evidence emphasizing food literacy in low-income settings. These methodological enhancements would provide a stronger empirical foundation for context-sensitive policy recommendations in Chamwino and similar regions.

Conclusion

This study examined household food waste patterns in Chamwino District, Tanzania, and identified significant associations with household characteristics, behavioural practices, and attitudinal factors. Analysis of individual and combined FGs revealed that waste arises not only from specific food types but also from how meals are composed, prepared, and managed within households. Key factors associated with

HFdW included household size, gender, age, education, income, leftover consumption, meal preparation habits, and price sensitivity. While causality cannot be inferred, these findings highlight critical leverage points for targeted interventions. The results suggest that localized education programs tailored to household structures and cooking behaviours may promote more efficient food management. Integrating behavioural insights—such as portion control, meal planning, and leftover utilization—into local food system strategies could substantially reduce waste and enhance food security. Future research should explore intra-household dynamics and culturally embedded consumption norms using mixed-methods approaches to triangulate self-reported and observed practices.

Ethical statement.

This study was approved by the Ethics Committee of the University of Dodoma (Reference No. MA.84/261/77/17). Before completing the questionnaire, all participants were informed about the purpose of the study, and informed consent was obtained upon their agreement to participate. Participants were assured of their anonymity and privacy throughout the research process. We confirm that this manuscript is original, has not been published elsewhere, and is not under consideration for publication in another journal.

CRediT authorship contribution statement

Denis M. Silayo: Writing – original draft, Software, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Mary Kulwijila:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization. **Abiud J. Bongole:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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