https://doi.org/10.52131/irasd-jee.2026.v7i1.3278

*i*RASD Journal of Energy & Environment

Volume 7, Number 1, 2026, Pages 86 - 106

Journal Homepage:
https://journals.internationalrasd.org/index.php/jee

Household Food Waste in Urban Bahawalpur, Pakistan: Women's Food Management Practices, Maqasid al-Shariah, and Resource Sustainability

Muzian Sultana[1], Tusawar Iftikhar Ahmad[2]

[1] PhD Scholar, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
Email: muzian_sultana@yahoo.com
[2] Associate Professor, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
Email: tusawar.iftikhar@iub.edu.pk

ARTICLE INFO

Article History:

Received: April 16, 2026
Revised: June 28, 2026
Accepted: June 29, 2026
Available Online: June 30, 2026

Keywords:

Food Waste
Household Resource Management
Maqasid al-Shariah
Resource Sustainability
Theory of Planned Behavior
Women's Food Management

JEL Classification Codes:

D12, J16, Q18, Q53, Q56, Z12

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Household food waste poses significant challenges to food security and environmental sustainability, yet evidence from low- and middle-income developing countries remains limited. This study investigates the determinants of household staple-food wastage in urban Bahawalpur, Pakistan, using chapatti disposal as the outcome. Extending the Theory of Planned Behavior, it incorporates a composite Maqasid al-Shariah Index to capture religious and ethical orientation, alongside household structure, residential location, education, food-purchasing responsibility, women's expenditure monitoring, and per-capita food expenditure. Primary survey data were collected from 433 households, with 424 included in the analytical sample. Binary logistic regression served as the principal model, supported by a robustness specification treating expenditure monitoring as a four-level categorical variable and a negative binomial model examining the daily quantity of discarded chapatti. The results show that 59.7% of households reported chapatti wastage. Joint households had approximately half the odds of waste compared with nuclear households, while frequent expenditure monitoring by women was associated with 55.6% lower odds than no monitoring. Conversely, shared food-purchasing responsibility increased the odds of wastage by 61.3% relative to sole female responsibility. Unexpectedly, stronger Maqasid al-Shariah alignment was associated with higher odds of disposal, although the index was insignificant in the quantity model. Household structure, residential location, and the number of adults predicted discarded quantities. Overall, three hypotheses were supported, one partially supported, and four rejected, indicating a weaker attitudinal pathway. Policy recommendations include religiously grounded awareness campaigns, expenditure-tracking in financial-literacy programmes, joint meal-planning tools, and targeted municipal interventions for middle-income nuclear households. The study's limitations include self-reported, cross-sectional data, a single staple-food focus, and modest explanatory power; therefore, the findings establish associations rather than causal relationships.

OPEN ACCESS

© 2026 The Authors, Published by iRASD. This is an Open Access Article under the Creative Common Attribution Non-Commercial 4.0

Corresponding Author's Email: muzian_sultana@yahoo.com

Citation: Sultana, M., & Ahmad, T. I. (2026). Household Food Waste in Urban Bahawalpur, Pakistan: Women's Food Management Practices, Maqasid al-Shariah, and Resource Sustainability. IRASD Journal of Energy & Environment, 7(1), 86–106. https://doi.org/10.52131/irasd-jee.2026.v7i1.3278

1. Introduction

Food loss and waste is one of the biggest paradoxes of today's food systems: huge amounts of food that are edible are wasted in the very economies that still deal with hunger, micronutrient deficiency and resource scarcity. The global estimates suggest that one trillion United States dollars of costs are occurring for food waste in the supply chain each year, of which around 700 billion dollars are ecological costs and 900 billion dollars are social costs (Alvi et al., 2026). Food waste is estimated to represent about 8-10% of global GHGs and nearly 30% of the world's agricultural land base, and the amount wasted annually would feed the more than 800 million people who are chronically undernourished (UNEP, 2024). Food waste is thus a market failure, as well as an environmental failure (Pocol et al., 2020), with unusually high social returns of correcting the failure, as compared to the cost of intervention.

In this global context, the household is the key site of waste in the middle and high income countries. Households are at the end of the food supply chain where food decisions made throughout, including how much to purchase, how much to stock, how much to prepare and what to do with the leftover food, will decide what happens to food that has already been fully produced, processed and distributed (Gupta, 2022; Zainal & Hassan, 2019). In contrast to the shift towards questions of aggregate food availability, the international literature has increasingly turned to questions of domestic behavior and started to investigate how attitudes, subjective norms and perceived behavioral control collectively influence the behavior of conserving food or wasting food (Qian, Li, Zhao, Liu, & Liu, 2022). The Theory of Planned Behavior (TPB) is used to explain the overall relationship between the(Beáta Bittner et al., 2025; Haque, Salman, Hasan, Prithi, & Hossain, 2024). It has been a fruitful behavioral twist, but it has also led to a persistent lack of explanation: standard constructs in psychology often explain a small proportion of the variance observed and the gap between what households know and what they say, and what they do, the KAP paradox, is repeated in different countries.

A promising way to counter this deficiency is to add ethical and religious orientations that are locally relevant and not a part of the original TPB architecture. The most theoretically sound is perhaps Maqasid al-Shariah, the Higher Objectives of Islamic Law, which were put into systematic form by Al-Raysuni (2011) and developed in the modern writings on Islamic economics in Muslim majority societies (Chapra, 2008). Two of its dimensions touch directly upon consumption: hifz al-mal (preservation and wise use of wealth and material resources), and the clear command to avoid israf (extravagance) and tabdhir (squandering), and the positive command to be moderate with respect to material resources, which is termed 'iqsad'(Al-Raysuni, 2011; Chapra, 2008). At a superficial level, the framework produces an unambiguous prediction of behaviour: households that behave more in keeping with the Maqasid will have less edible food discarded. Empirical reality of a typical urban citizen's household economy in Pakistan is a pertinent and significant issue to discuss because a major chunk of public and civic waste-reduction campaigns in these contexts is premised upon exactly this claim.

Pakistan provides an uncompromising challenge. It is food insecure, yet has expensive and common cultural norms of generosity and over-provisioning. It is overwhelmingly Muslim, with high levels of outspokenly Muslim religious observance (Anila Sultana, 2011; Ilmas, Aslam, & Fatima, 2025; Zeenat, Ahmad, Adeel, Ahmed, & Rashid, 2025). Further, it is overwhelmingly urban, and the food budget of these households has a unique place for a staple item that is affordable and prepared on a daily basis, chapatti (unleavened wheat bread). The making of chapatti is an adhoc operation, typically made even before measurement and the low price of the chapatti does not create a significant monetary loss if it is discarded, but it is a significant symbolic and religious loss because it's the loss of rizq which is sustenance. This renders the disposal of staple foods as a particularly "pure" behavioral measure of the presence of an ethical orientation in practice or in theory.

In this context, the present study concerns three questions: What is the prevalence of staple-food wastage among households in the urban areas of the mid-sized city of Bahawalpur (southern Punjab)? Second, does compliance to Maqasid al-Shariah principles,

as operationalized in an aggregate index of ethical-economic alignment, have an impact on the likelihood of a household discarding edible staple food, after accounting for socio-economic and demographic factors? Third, which structural and behavioral characteristics of the household contribute to waste occurrence independently of the religious-ethical pathway, and how do its magnitude compare with the religious-ethical pathway?

To estimate the prevalence of staple-food wastage in a stratified sample of urban households, to construct and validate a composite Maqasid al-Shariah Index appropriate for use in household surveys. Further, to estimate a discrete-choice model of waste incidence that includes this index along with the usual socio-economic determinants, are the objectives that follow directly. The objectives that follow directly are to estimate the prevalence of staple-food wastage in a stratified sample of urban households, to construct and validate a composite Maqasid al-Shariah Index appropriate for use in household surveys, and to estimate a discrete-choice model of waste incidence that includes the Maqasid al-Shariah Index and any conventional socio-economic determinants. The scope is deliberately limited. The analysis is on urban households in the administrative jurisdiction of the Municipal Corporation of Bahawalpur, the report does not measure the amount of waste produced, but rather self-reported behavior, and operationalizes wastage as one culturally dominant item as opposed to the entire household waste stream.

The rest of the article follows. The literature relating to determinants of household food waste is examined, followed by a discussion on the theoretical link between Maqasid al-Shariah and ethical food consumption, and the gendersed nature of household food work, culminating in an identification of a research gap. The third section is dedicated to the conceptual framework, the hypotheses, the sampling design, the instrument and the econometric specification. The fourth section presents descriptive, bivariate, and multivariate statistics and that data is interpreted and compared to the existing evidence. The last section provides a summary of the results, policy and community recommendations and limitations.

2. Literature Review

2.1. Behavioral Determinants of Household Food Waste

The most prevalent analytical approach in the field of household food-waste studies is the Theory of Planned Behavior (TPB), which views behavior as a result of three factors: the attitude toward the behavior, subjective norms, and perceived behavioral control (PBC). Its simplicity and travelling nature make it attractive and systematic reviews across dozens of countries consistently show that all three constructs have statistically measurable impact on waste outcomes. But still, the same reviews note a common problem: Attitudinal measures often do not predict measured behavior and models that include only psychological antecedents account for small amounts of variance.

The best reply has been an elaboration of the framework using elements from the material aspects of domestic organization. Stancu, Haugaard, & Lähteenmäki, (2016) and in the previous study Stefan, Herpen, A, & Lähteenmäki, (2013), proved that planning routines, shopping routines and leftover-reuse behaviors are superior in predicting waste to attitudinal variables. This discovery has been confirmed in South Asia. In Faisalabad, Zafar, Ullah, Naqvi, Anwar, & Hussain, (2025) tested a restricted psychological TPB model against a pooled model that also included household routines and arrived at significantly better results for the pooled model, where PBC significantly lowered waste, the household routines had an immediate and indirect influence via shopping activities, and the skills of the households were found to predict the remainder of their reusable. In Malaysia, Ariffin et al., (2023) found that intention and routine explained actual waste behavior with no mention of the knowledge–attitude–practice paradox. In a Food Consumption Management framework, further studies by Fami, Aramyan, Sijtsema, & Alambaigi, (2019) on 1,197 urban Iranian women, found that the mechanism is through the food management ability, which lies between the motivation and the outcome, and highly motivated women with poor food-management skills were still able to produce considerable waste.

Socio-economic factors have been studied extensively with variable results in terms of direction. There are a number of studies in South and Southeast Asian countries that showed a positive income–waste gradient. When Khalid et al., (2023) physically collected and weighed the waste from 51 households in Tehsil Kahror Pakka, the high income households waste cost USD 12.80 per capita annually compared to USD 9.58 in the low income households, cooked food being the highest monetary value. Soma, (2020) proved that waste in Indonesia was significantly higher among higher income households in modern supermarkets, which was explained by the stocking-up behavior and wider refrigeration space. In the case of urban Nigeria, Sunday et al., (2022) reported a positive and significant income effect as well as a dependency-ratio effect mediated by over-preparation. To this, Alvi, Rehman, Nawaz, Hassan, & Anser, (2026) carried out an ordered logistic regression among 361 households of Islamabad to understand the energy, food, and water saving behaviors, where higher income was a negative factor in saving energy, and informal learning and media exposure were more significant for food saving. Krutprong and Pharino (2025) reported that they had contradicting income–waste correlations across sites, as they measured waste continuously over 28 days in 2,700 Thai households. It is reasonable to infer that the income effect is not structural, but depends on food type, food procurement and storage facilities.

Households are more homogeneous and residential context is more homogeneous. Srijuntrapun, Ket-Um, and Attavanich, (2025) conducted a national study in Thailand with 2,500 households and determined that knowledge, education, household size, and income were all significantly and positively correlated with effective waste-management practice, particularly residents' context within their household. Panda, Raut, Rana, and Shamsudin, (2024) examined the effects of a sense of community construct on personal norms and in turn planning routines in 214 households within India, and demonstrated how a sense of community was a significant predictor of personal norms and, via planning routines, waste-reduction and leftover-reuse intentions, suggesting that in collectivist societies in South Asia, communal obligation is more powerful than personal cost–benefit calculation in activating prosocial norms.

2.2. The Concept of Maqasid Al-Shariah, Religiosity and Ethical Consumption

The theoretical justification for linking maqasid al-Shariah to waste mitigation is solid. In Al-Raysuni (2011) higher objectives of the law (maqāṣid al-qaul), hifz al-mal is a normative obligation beyond wealth acquisition, to responsible allocation of wealth. Prohibitions against israf and tabdhir, plus identifying "squanderers" as "brothers of the devils," make the Quranic prohibition have an unusual rhetorical impact. The Maqasid-based literature of development and the argument of Chapra (2008) that the objectives of Islamic economics were operationalized as evaluative criteria for consumption, conceptualized moderation from this perspective as the efficient stewardship of the resources entrusted.

Empirical results, however, are far from conclusive. Based on a review of the literature on food waste and a discussion of the issue with Saudi students, Baig, Gorski,and Neff, (2019) found that food wastage is exacerbated by the traditional norms of hospitality service combined with an increase in affluence in Saudi Arabia, and that cultural values clearly outrank religious teachings in practice. In the study by Khorakian, Baregheh, Jahangir, Heidari, & Saadatyar, (2024) 475 employed females in Mashhad were assessed; the authors proposed a finer distinction such that, intrinsic religious orientation positively predicted waste-prevention behavior, whereas extrinsic religious orientation, or religiosity as a social conformity, exerted a negative effect ($\beta = -0.15$). Knowledge scores were the only one that could predict the waste-reduction intention among 340 young Muslims in Indonesia, whereas the other standard TPB attitudinal and normative constructs did not, as reported by Damanik et al., (2024). This indicates that knowledge and general observance are distinct constructs with different behavioral implications. In an Egyptian sample, Elhoushy and Jang, (2021) found that religious values did not directly influence the intention to reduce waste, but religious values did act indirectly through personal norms and activism.

One helpful comparison is provided by Qian, Li, Zhao, Liu, and Liu, (2022) who discovered that there was significantly less food waste per meal in religiously affiliated Chinese households compared to the non-religious, because the tradition of the Buddhist and Taoist communities in China is very frugal. In combination with the Gulf/South Asian evidence, this implies that the direction of the religiosity–waste relationship varies across cultures, depending on whether the dominant religious-normative complex emphasizes frugality or hospitality. This is evident in the research by Kansal, Mitsis, Ananda, & Pearson, (2022) on the reception of waste-reduction messaging among members of the South Asian community in Australia, who are both more susceptible to 'hostility' about over-provisioning and more accepting of 'hostility' for waste minimization.

The third literature aspect that is relevant is who is responsible for the management of food in the home. Fraser and Parizeau, (2018) from a feminist food-studies lens engage a conceptual approach to waste management as a type of gendered food work that is largely invisible in women's work at home. In a PLS-SEM study that involved 404 households in Malaysia, Ariffin et al., (2023) discovered that men were significantly more wasteful than women, and that a sense of exclusion in the normal responsibility of food management was a direct cause of waste for men. In Quetta, female-headed households produced less waste and were twice as likely to segregate waste as the other households, with this data being analyzed by Zand, Heir, and Tabrizi, (2020). Lizcano-Prada, Ayouaz, Mesías, and Maestre-Matos, (2025) proposed an extension of TPB for food purchasing responsibility and cooking frequency among 717 Spanish respondents, creating segments of consumers differentiated only by the extent of food provisioning involvement. However, there is a vital caution to be added by Mukhter and Chowdhary, (2024) and Sahoo et al., (2022): Where the responsibility for waste is socially defined as the province of women, women's participation is seen as unacknowledged and the remedy prescribed by the norm is to share, not to centralise, that responsibility.

2.3. Research Gap

Three research gaps in this study are as follows:

First, while religiosity has been studied in various contexts including in Indonesia, Iran, Egypt and Saudi Arabia. However, the study of religiosity in the Pakistani households did not operationalise Maqasid al-Shariah as a composite construct measured and included in a multivariate model for waste incidence.

Second, the gender literature shows that provisioning responsibility is an important factor nevertheless, it has yet to be tested as a distinct predictor, in addition to ethical and economic covariates, of provisioning responsibility without testing the difference in provisioning responsibility between sole and shared provision, respectively.

Thirdly, few studies examine an individual culturally salient food, and thus income and infrastructure impacts on perishable and discretionary foods are combined with behavior towards typical everyday staple foods. The aim of this study is to deal with all three by estimating a discrete choice model of the disposal of the chapattis, with the Maqasid al-Shariah Index, gendered responsibility for purchasing, and expenditure-monitoring behaviors included along with conventional socio-economic controls.

3. Data and Methodology

3.1. Conceptual Framework and Hypotheses

The analytical framework extends the Theory of Planned Behavior by mapping locally measurable household attributes onto its three antecedents and adding an explicit religious-ethical dimension. The attitudinal pathway is represented by the Maqasid al-Shariah Index and by educational attainment, the latter serving as a proxy for information-processing capacity and exposure to sustainability messaging. The subjective-norms pathway is represented by household type (nuclear versus joint) and by household adult composition,

both of which capture the density of informal monitoring and shared consumption norms surrounding food preparation. The perceived-behavioral-control pathway is represented by residential location, a proxy for storage, refrigeration, and market-access constraints by log per-capita food expenditure, and by the gendered allocation of food-purchasing responsibility together with the frequency of expenditure monitoring, which jointly determine who holds practical control over provisioning and whether that control is actively exercised.

Eight directional hypotheses follow:

H1: Joint household structure reduces the odds of staple-food wastage relative to nuclear structure.
H2: A larger number of resident adults increases the odds of wastage.
H3: Residence in a high-income locality reduces the odds of wastage relative to squatter settlements.
H4: Higher alignment with Maqasid al-Shariah principles reduces the odds of wastage.
H5: Literacy reduces the odds of wastage relative to illiteracy.
H6: Shared (women-and-men) food-purchasing responsibility alters the odds of wastage relative to sole female responsibility.
H7: More frequent monitoring of food expenditure by women reduces the odds of wastage.
H8: Higher log per-capita food expenditure increases the odds of wastage.

3.2. Study Area and Sampling

Bahawalpur is a mid-sized city in southern Punjab whose urban population spans a wide socio-economic range, from informal wage earners in older. It is densely built residential quarters to upper-middle and high-income residents of planned housing societies. Furthermore, eating habits focus on wheat flour, fresh fruits and vegetables, dairy, and halal meat, while convenience foods and food outside the home are becoming more common, especially among younger and wealthier residents. Similarly, retailers and vendors are equally segmented and traditional wholesale markets (mandis) and mobile vendors (rehris) are the main sources of fresh produce in lower income areas, whereas modern retail outlets dominate the affluent neighborhoods. The city's purchasing power, storage capacity and procurement rhythm is different, which makes the city suitable for stratified design.

The target population comprised urban households within the administrative boundaries of the Municipal Corporation of Bahawalpur, with the individual household as the primary sampling unit. Sample size was determined using Cochran and Cochran (1977) formula for large or unknown populations:

$$n = \frac{Z^2 p(1-p)}{e^2} \quad (1)$$

Where Z = 1.96 at the 95 percent confidence level, p = 0.50 to maximize variance, and e = 0.05. Substitution yields $n = 384.16 \approx 385$. The target was inflated to accommodate anticipated non-response, incomplete returns, and refusals, providing a buffer of approximately 17 percent above the minimum statistical requirement. The realized sample compares favorably with South Asian precedents employing discrete-choice models, including 200 households in Lahore and Faisalabad, 347 in Faisalabad, 361 in Islamabad, and 51 in a stratified rural Punjab sample.

A three-stage stratified random design was implemented. At the first stage, urban residential areas were classified into three socio-economic strata squatter, middle-income, and high-income on the basis of property valuation, housing density, and municipal classification. At the second stage, specific *mohallahs* and colonies were randomly selected within each stratum as secondary sampling units. At the third stage, households were selected by systematic random walk, with every *k*th household approached along a designated street path (practical step size of five to eight dwellings depending on density) and vacant or non-consenting households replaced by the immediately adjacent dwelling.

Data were collected through face-to-face interviews administered by a trained team of female enumerators fluent in Saraiki, Urdu, and Punjabi. Female enumeration was adopted both to comply with local socio-cultural norms governing household access and to secure direct contact with the primary food manager, who is in almost all cases a woman. Enumerators were trained in question-by-question interpretation, rapport building, and techniques for minimizing social-desirability bias in waste estimation; field supervisors conducted daily spot-checks and audits. Screening for incomplete or internally inconsistent returns produced a cleaned dataset of 433 households. List wise deletion across the full predictor set yielded an analytical sample of 424 households (97.9 percent), with 9 cases excluded on account of missing covariate values. Item-level missingness never exceeded 1.8 percent in any bivariate table and remained below 3 percent throughout, and was treated as non-systematic.

3.3. Instrument and Operationalization

The survey instrument was developed from the micro-level food-waste literature (Quested et al., 2013; Stancu et al., 2016; Stefan et al., 2013) and adapted to local socio-cultural and linguistic conditions, drawing on FAO and UNEP household frameworks and on validated Likert batteries used in comparable gender-and-food-waste studies. It comprised five modules: household socio-demographic profile; women's intra-household roles and decision-making autonomy; food procurement, storage infrastructure, and behavioral patterns; quantification and typology of wastage; and attitudes, cultural norms, and leftover management.

A pilot survey of 30 households across a higher-income and a lower-income locality preceded full deployment; pilot cases were excluded from the analytical sample. Pre-testing produced four substantive refinements. The instrument was translated into Urdu and local Saraiki idiom with attention to preserving the empirical intent of constructs such as decision-making autonomy. The SI units of mass were replaced by local volumetric aids (cups, plates, paao) which could be estimated by the respondents, and subsequently converted to weight equivalents during processing. High non-response items were rephrased into culturally appropriate and discrete brackets of income questions. The internal consistency of the Likert batteries was checked with the Cronbach's alpha for all sub-scales, and was found to be above the conventional value of 0.70.

3.3.1. Dependent Variable

The food wastage in the home was measured in terms of disposing off chapatti. If the family reported discarding chapatti as waste, then it is coded 1, otherwise it is coded 0. This binary specification sacrifices the precision of measurement for reliability; errors in self-reported amounts of waste and social desirability bias are well documented in self-reported quantities of waste and physical 24-hour collection protocols. Although they are better at precision, they are not feasible to operate at this sampling size. An ordinal severity measure based on aggregated weekly discarded mass (low, < 250 g; moderate, 250–750 g; high, > 750 g) was also maintained as a secondary measure to overcome the interpretive constraint of dichotomizing the severity of the condition.

3.3.2. Maqasid al-Shariah Index

The main independent variable is a composite index derived from Likert-scored items measuring the extent of a household's adherence to Islamic ethical-economic values in areas related to ritual behavior, philanthropy, lawful earning, family behavior and health stewardship. An item score was given for each item and was averaged to provide a continuous measure with a 1-5 scale, which was also collapsed into 5 ordinal categories (Not Aligned through Highly Aligned) for descriptive reporting.

3.3.3. Supporting Variables

Household type was dichotomized (nuclear = reference, joint). Adults from the household were entered as a continuous count. Residential location was measured categorically and the reference was the squatter area. Education was dichotomized as literate (reference) versus illiterate. Food-purchase responsibility was dichotomous with the sole female responsibility as reference and categories for men, both, and others. The item expenditure monitoring was entered as a four-point ordinal scale of how often women monitor their food spending to reduce food loss. The food expenditure data was strongly skewed, so it was taken in natural logarithm format to reduce variance and avoid the influence of extreme values when calculating per-capita monthly food expenditure.

3.4. Econometric Specification

Because the outcome is discrete and bounded, estimation by ordinary least squares would generate heteroskedastic errors, predicted probabilities outside the unit interval, and biased and inconsistent parameter estimates. A binary logit model is therefore adopted as the primary specification.

Following cumulative logistic probability theory (McFadden, 1974), let Y_i^* denote an unobserved latent propensity of household i to generate staple-food waste:

$$Y_i^* = W_i'\beta + C_i'\gamma + B_i'\delta + \varepsilon_i \quad (2)$$

where W_i is a vector of women's intra-household agency variables (purchase responsibility, expenditure monitoring, education), C_i a vector of socio-economic and demographic controls (household type, adult composition, residential location, log per-capita food expenditure), B_i the religious-ethical construct, and ε_i a stochastic error assumed to follow a standard logistic distribution with mean zero and variance $\pi^2/3$. The observed binary indicator is $Y_i = 1$ if $Y_i^* > 0$ and 0 otherwise, giving

$$\Pr(Y_i = 1|X_i) = \frac{\exp(X_i'\theta)}{[1+\exp(X_i'\theta)]} \quad (3)$$

Parameters are estimated by maximum likelihood (Greene, 2018; Wooldridge, 2010). Because logit coefficients are not directly interpretable as marginal effects, results are reported as odds ratios, Exp(B), with 95 percent confidence intervals, and average marginal effects are computed where probability-scale interpretation is required. Model adequacy is assessed through the omnibus likelihood-ratio test, Cox and Snell and Nagelkerke pseudo-R^2, the Hosmer–Lemeshow calibration test, and the classification matrix at a 0.50 cut-off. Two nested specifications are estimated on an identical sample: a Main Model treating expenditure monitoring as a linear ordinal term, and a Robustness Check Model re-specifying it as a four-level categorical factor (reference = "Never"), permitting a non-linear dose–response relationship and allowing assessment of coefficient stability across functional-form assumptions. Bivariate Pearson chi-square tests precede multivariate estimation as an unconditional diagnostic.

4. Results and Discussion

This section reports the empirical results in sequence: sample characteristics (Section 4.1), bivariate associations (4.2), the main logit model (4.3), a robustness check (4.4), and an evaluation of the eight hypotheses (4.5). Sections 4.6 and 4.7 then interpret the findings against the existing literature and the extended Theory of Planned Behavior (TPB) framework, and draw out their practical, pedagogical, and policy implications. Unless otherwise stated, multivariate results refer to the analytical sample of 424 households.

4.1. Sample Characteristics

Table 1 summarizes the profile of the sampled households. Of the 433 households surveyed, 67.0% were nuclear and 33.0% joint, with a mean of 2.84 resident adults (*SD* = 1.29). The sample was spread across the three residential strata, with a plurality in middle-income localities (41.6%), followed by squatter areas (30.9%) and high-income localities (27.5%). Per-capita monthly food expenditure averaged PKR 9,796.68 (*SD* = 10,214.26) and was strongly right-skewed, which motivated the log transformation used in the models.

Table 1
Descriptive Statistics of Household Demographic, Socio-Economic, and Behavioral Variables

Variable	*n*	%	*M* (*SD*)
Household type			
Nuclear	290	67.0	
Joint	143	33.0	
Household adults (count)	433	—	2.84 (1.29)
Residential location			
Squatter area	134	30.9	
Middle-income society	180	41.6	
High-income society	119	27.5	
Maqasid al-Shariah Index (1–5)	433	—	3.86 (0.79)
Alignment category			
Not aligned	5	1.2	
Less aligned	17	3.9	
Moderately aligned	87	20.1	
Aligned	248	57.3	
Highly aligned	76	17.6	
Education level			
Illiterate	75	17.5	
Primary–higher secondary	236	55.1	
Above higher secondary	111	25.9	
Food purchase responsibility			
Women	217	50.1	
Men	23	5.3	
Both (women and men)	187	43.2	
Others	6	1.4	
Women track food expenses			
Never	56	12.9	
Rarely	80	18.5	
Sometimes	165	38.1	
Often	132	30.5	
Per-capita food expenditure (PKR/month)	432	—	9,796.68 (10,214.26)
Chapatti discarded (dependent variable)			
No	171	40.3	
Yes	253	59.7	

Note: *N* = 433 unless otherwise noted. Education *n* = 428 (the three listed categories account for 422 respondents); per-capita food expenditure *n* = 432. Percentages for the dependent variable are based on the analytical sample (*n* = 424). *M* = mean; *SD* = standard deviation.

Ethical-religious orientation was strong and focused. The Maqasid al-Shariah Index was moderately high with an average of 3.86 (SD = 0.79) on a 5-point scale, with 57.3% of households being Aligned, 17.6% being Highly Aligned, and 5.1% being Less or Not Aligned. The agreement for individual sub-scales ranged from 53.1% (health stewardship) to 74.8% (ritual prayer). This restricted dispersion has a direct impact on the interpretation of the estimated effect of this index (Section 4.6.1).

The majority of the respondents (55.1%) had completed up to higher secondary level of schooling, 17.5% were illiterate and 25.9% had education beyond higher secondary level.

Provisioning was unequivocally gender based with women buying food in 50.1% of households, men in 5.3% and both genders in 43.2%. The practice of women monitoring food expenditure to cut down on waste was quite common but not uniform (30.5% often, 38.1% sometimes, 18.5% rarely and 12.9% never). There was some high level of staple-food waste - 59.7% of households in the analytical sample (253 of 424) reported discarding chapatti, while 40.3% did not. This implies that about 60% of households in a town or city of declared religious affiliation where food staples are mostly wheat products end up as waste.

4.2. Bivariate Associations

Pearson chi-square tests offer an unadjusted view of the association between each predictor and chapatti waste (Table 2). Household family composition ($\chi^2(10) = 23.64$, $p = .009$), residential location ($\chi^2(2) = 11.58$, $p = .003$), the Maqasid al-Shariah Index ($\chi^2(20) = 39.06$, $p = .007$), and log per-capita food expenditure ($\chi^2(103) = 136.05$, $p = .016$) were significantly associated with waste, while household type was marginal ($\chi^2(1) = 3.63$, $p = .057$), with joint households appearing less wasteful. Education ($p = .211$), purchase responsibility ($p = .122$), and expense monitoring ($p = .191$) showed no bivariate association.

There are two patterns to note. Firstly, the location gradient was not monotonic, with waste being reported by 47.1% of high income households, compared to 61.2% of squatter-area households and 66.7% of middle income households. Second, the Maqasid al-Shariah Index was found to be correlated in the opposite direction from what was expected; a positive Spearman correlation (rs = .141, p = .003) was found, meaning that households with higher scores on the index reported slightly higher, rather than lower amounts of waste. The household size association with family composition and the location association with family location are consistent with previous studies that found household size and dependency (Krutprong & Pharino, 2025; Sunday et al., 2022) and household location (Srijuntrapun et al., 2025) influence household food waste. There were a number of cells in the family-composition cross tabulation, Maqasid, and log-expenditure cross tabulation with expected counts below 5, which makes the results of these tests indicative only and should be superseded by the multivariate estimates below.

Table 2
Chi-Square Tests of Association Between Predictors and Household Chapatti Waste

Predictor	χ^2	*df*	*p*	Interpretation
Household type	3.63	1	.057	Marginal
Household family composition (adults)	23.64	10	.009	Significant
Residential location	11.58	2	.003	Significant
Maqasid al-Shariah Index (score)	39.06	20	.007	Significant
Education level (binary)	1.57	1	.211	Not significant
Food purchase responsibility	5.79	3	.122	Not significant
Women track food expenses	4.75	3	.191	Not significant
Log per-capita food expenditure	136.05	103	.016	Significant (sparse cells)

Note: Valid *n* ranges from 425 to 430 across tests. Expected counts were below 5 in 50.0% of cells for family composition, 40.5% for the Maqasid al-Shariah Index, and 88.5% for log per-capita food expenditure; these tests should be interpreted cautiously. The Spearman correlation between the Maqasid al-Shariah Index and waste was $r_s = .141$, $p = .003$.

4.3. Main Model

The Main Model was statistically significant overall: the full predictor set improved on the intercept-only model, $\chi^2(11) = 36.34$, $p < .001$ (Table 3). Explained variance was modest (Cox and Snell $R^2 = .082$; Nagelkerke $R^2 = .111$), as is common for multiply determined behavioral outcomes, and the Hosmer–Lemeshow test indicated adequate calibration, $\chi^2(8) = 13.36$, $p = .100$. At a 0.50 cut-off the model classified 62.7% of households correctly, only modestly above the 59.7% obtainable by predicting waste for every household. Performance was asymmetric: sensitivity was 79.8% but specificity only 37.4%, so the model identifies waste-reporting households far better than non-wasting ones.

Table 3
Model Fit Diagnostics for the Main and Robustness Check Models

Statistic	Main Model	Robustness Check
Omnibus χ^2 (*df*)	36.34 (11)***	37.18 (13)***
−2 log likelihood	535.49	534.65
Cox and Snell R^2	.082	.084
Nagelkerke R^2	.111	.113
Hosmer–Lemeshow χ^2 (*df*), *p*	13.36 (8), .100	5.81 (8), .668
Overall classification accuracy	62.7%	63.4%
Sensitivity (waste correctly classified)	79.8%	81.0%
Specificity (no waste correctly classified)	37.4%	37.4%

Note: n = 424 for both models; classification cut-off = 0.50. The modal-class benchmark (predicting waste for all households) is 59.7%. ***p < .001.

Table 4 reports the coefficient estimates. Five predictors were significant or near-significant. Joint households had 49.5% lower odds of discarding chapatti than nuclear households (B = −0.682, SE = 0.233, Exp(B) = 0.505, 95% CI [0.320, 0.798], p = .003), supporting H1. Residential location was jointly significant, Wald(2) = 11.25, p = .004, although the individual contrasts were weaker: high-income households had 45.7% lower odds than squatter-area households at marginal significance (Exp(B) = 0.543, p = .059), and the middle-income contrast was not significant (p = .259), offering qualified support for H3.

Contrary to H4, a higher Maqasid al-Shariah Index score was associated with higher odds of waste (B = 0.374, SE = 0.171, Exp(B) = 1.454, 95% CI [1.039, 2.034], p = .029); each one-point increase raised the odds by 45.4%. Households in which women and men shared purchasing responsibility had 61.3% higher odds of waste than households in which women purchased alone (Exp(B) = 1.613, 95% CI [1.047, 2.484], p = .030). H6, which predicted only a difference, is therefore supported, but the direction shows that shared responsibility was not protective. More frequent expenditure monitoring by women, by contrast, was protective (B = −0.231, SE = 0.112, Exp(B) = 0.794, 95% CI [0.637, 0.989], p = .040): each step up the four-point frequency scale lowered the odds of waste by 20.6%, supporting H7. Household adults (H2), education (H5), and log per-capita food expenditure (H8) were not significant. Neither were the purchase-responsibility contrasts for men (Exp(B) = 1.343, p = .533) and other members (p = .903), although the small numbers in these categories (n = 23 and n = 6) limit statistical power.

Table 4
Main Model: Binary Logistic Regression Predicting Household Chapatti Waste

Predictor	*B*	*SE*	Wald	*p*	Exp(*B*)	95% CI
Household type (joint vs. nuclear)	−0.682	0.233	8.58	.003	0.505	[0.320, 0.798]
Household adults (count)	0.118	0.092	1.66	.198	1.125	[0.940, 1.346]
Residential location (overall, *df* = 2)	—	—	11.25	.004	—	—
Middle-income vs. squatter	0.300	0.265	1.28	.259	1.350	[0.802, 2.271]
High-income vs. squatter	−0.611	0.323	3.58	.059	0.543	[0.288, 1.022]
Maqasid al-Shariah Index	0.374	0.171	4.77	.029	1.454	[1.039, 2.034]
Education (literate vs. illiterate)	0.464	0.284	2.68	.102	1.591	[0.912, 2.774]
Food purchase responsibility (overall, *df* = 3)	—	—	4.86	.182	—	—
Men vs. women	0.295	0.473	0.39	.533	1.343	[0.531, 3.396]
Both vs. women	0.478	0.220	4.71	.030	1.613	[1.047, 2.484]
Others vs. women	−0.106	0.865	0.02	.903	0.900	[0.165, 4.904]
Women track food expenses (linear)	−0.231	0.112	4.23	.040	0.794	[0.637, 0.989]
Log per-capita food expenditure	−0.170	0.150	1.29	.257	0.843	[0.628, 1.132]
Constant	0.283	1.397	0.04	.840	1.327	—

Note: n = 424. Reference categories: household type = nuclear; residential location = squatter area; education = illiterate; food purchase responsibility = women. Wald statistics for single coefficients have 1 *df*. CI = confidence interval for Exp(B).

4.4. Robustness check

Re-specifying expenditure monitoring as a four-level factor (reference = Never) on the same sample left the substantive picture unchanged (Tables 3 and 5). Fit improved marginally: the −2 log likelihood fell from 535.49 to 534.65, Nagelkerke R^2 rose from .111 to .113, and calibration improved markedly, with the Hosmer–Lemeshow statistic falling from $\chi^2(8) = 13.36$ ($p = .100$) to $\chi^2(8) = 5.81$ ($p = .668$). Classification accuracy edged up to 63.4% through higher sensitivity (81.0%), with specificity unchanged at 37.4%.

The core estimates were stable: household type (Exp(*B*) = 0.523, $p = .006$), the Maqasid al-Shariah Index (Exp(*B*) = 1.447, $p = .031$), shared purchasing (Exp(*B*) = 1.597, $p = .035$), and the high-income contrast (Exp(*B*) = 0.549, $p = .064$) all retained their sign, magnitude, and significance. Relative to households in which women never monitored expenses, the odds of waste were lower at every higher frequency: Rarely, Exp(*B*) = 0.580 ($p = .179$); Sometimes, Exp(*B*) = 0.494 ($p = .052$); and Often, Exp(*B*) = 0.444 (95% CI [0.210, 0.941], $p = .034$), a 55.6% reduction. Only the Often contrast reached conventional significance, however, and the joint test of the four-level factor did not, Wald(3) = 4.90, $p = .179$. The dose–response pattern should therefore be read as suggestive: it is monotonic and consistent with the significant linear term in the Main Model, but protection is concentrated at the top of the frequency scale.

Table 5
Robustness Check Model: Binary Logistic Regression With Categorical Expense-Monitoring Term

Predictor	*B*	*SE*	Wald	*p*	Exp(*B*)	95% CI
Household type (joint vs. nuclear)	−0.647	0.237	7.46	.006	0.523	[0.329, 0.833]
Household adults (count)	0.117	0.092	1.63	.201	1.125	[0.939, 1.347]
Residential location (overall, *df* = 2)	—	—	11.32	.003	—	—
Middle-income vs. squatter	0.315	0.266	1.40	.236	1.371	[0.813, 2.310]
High-income vs. squatter	−0.600	0.324	3.42	.064	0.549	[0.291, 1.037]
Maqasid al-Shariah Index	0.369	0.172	4.63	.031	1.447	[1.033, 2.025]
Education (literate vs. illiterate)	0.455	0.284	2.57	.109	1.577	[0.903, 2.753]
Food purchase responsibility (overall, *df* = 3)	—	—	4.61	.202	—	—
Men vs. women	0.318	0.477	0.44	.505	1.374	[0.539, 3.502]
Both vs. women	0.468	0.222	4.44	.035	1.597	[1.033, 2.470]
Others vs. women	−0.079	0.864	0.01	.927	0.924	[0.170, 5.019]
Women track food expenses (overall, *df* = 3)	—	—	4.90	.179	—	—
Rarely vs. never	−0.545	0.405	1.81	.179	0.580	[0.262, 1.283]
Sometimes vs. never	−0.705	0.363	3.77	.052	0.494	[0.242, 1.007]
Often vs. never	−0.812	0.383	4.49	.034	0.444	[0.210, 0.941]
Log per-capita food expenditure	−0.154	0.152	1.03	.310	0.858	[0.637, 1.154]
Constant	0.333	1.402	0.06	.812	1.395	—

Note: $n = 424$. Reference categories: household type = nuclear; residential location = squatter area; education = illiterate; food purchase responsibility = women; women track food expenses = never. Wald statistics for single coefficients have 1 *df*. CI = confidence interval for Exp(*B*).

4.4.1. Extension: Negative Binomial Regression on Physical Waste Quantity

The logit models above treat waste as an occurrence and therefore cannot show how much is discarded. To complement them, a negative binomial generalized linear model with a log link was estimated on the quantity of chapatti thrown away per day, a count ranging from 0 to 15 ($M = 2.48$, $SD = 3.01$). A substantial share of households report no waste while a minority report comparatively high counts, so the outcome is over-dispersed, non-negative, and integer-valued; a negative binomial specification (dispersion parameter fixed at 1) is therefore preferred to ordinary least squares or Poisson regression. The model retained the covariate set of the Main Model and was estimated on the same sample ($n = 424$ valid cases, 97.9% of the total sample), so that the severity of waste can be examined alongside its occurrence.

Fit was acceptable (Table 6). The full predictor set significantly improved on the intercept-only model, $\chi^2(11) = 56.827$, $p < .001$, and the deviance and Pearson dispersion statistics (value/*df* = 1.265 and 0.851) lie close to the value of 1.0 expected under a correctly specified model, indicating that the fixed dispersion parameter adequately accommodated the over-dispersion in the raw counts.

Table 6
Negative Binomial Regression: Model Fit Diagnostics for Physical Quantity of Chapatti Waste

Statistic	Value
Omnibus likelihood-ratio χ^2 (*df*)	56.827 (11), $p < .001$
Deviance (*df*), value/*df*	521.211 (412), 1.265
Pearson χ^2 (*df*), value/*df*	350.658 (412), 0.851
Log likelihood	−857.057
Akaike information criterion (AIC)	1738.113
Finite-sample corrected AIC (AICC)	1738.872
Bayesian information criterion (BIC)	1786.710
Consistent AIC (CAIC)	1798.710

Note: n = 424. Dependent variable: quantity of chapatti thrown away per day (count, 0–15). Distribution = negative binomial (dispersion fixed at 1); link = log.

Table 7 reports the parameter estimates, with Exp(*B*) interpreted as the incidence rate ratio (IRR). Household type again had the strongest effect: joint households were expected to discard 47.3% fewer chapattis than nuclear households ($B = -0.641$, $SE = 0.141$, Wald = 20.57, $p < .001$; IRR = 0.527), which corroborates the subjective-norms interpretation of the binary result (Section 4.6.2). Residential location was jointly significant, Wald(2) = 9.14, $p = .010$: middle-income households discarded significantly more than high-income households ($B = 0.494$, IRR = 1.639, $p = .003$), and squatter-area households showed a similar, marginally significant elevation ($B = 0.386$, IRR = 1.471, $p = .060$). Because the logit contrasts were estimated against squatter areas whereas the reference here is high-income, the two sets of estimates are not directly comparable, but the direction is consistent: the high-income advantage is visible in quantity as well as occurrence. Household adults, which was not significant in either logit model, was significant here ($B = 0.176$, $SE = 0.050$, Wald = 12.28, $p < .001$; IRR = 1.192): each additional adult was associated with a 19.2% higher expected count, consistent with over-preparation in larger households.

In contrast, three predictors that were significant in the Main Model were not significant for quantity. The Maqasid al-Shariah Index changed sign and lost significance ($B = -0.112$, $SE = 0.090$, Wald = 1.54, $p = .215$), against its positive association with the odds of waste (Exp(B) = 1.454, $p = .029$; Section 4.3). This bears directly on the counterintuitive religiosity result discussed in Section 4.6.1, which should be read as a caution on the robustness of that finding across operationalizations of the outcome rather than as a replication. Likewise, shared purchasing responsibility, significant in the Main Model (Exp(B) = 1.613, $p = .030$), was not significant for quantity ($B = -0.153$, $p = .753$ for the both-versus-others contrast), and nor was expense monitoring (Exp(B) = 0.794, $p = .040$ in the Main Model; $B = -0.056$, $p = .375$ here). Education and log per-capita food expenditure were non-significant under both specifications.

Overall, the determinants of chapatti waste are not fully invariant to how waste is measured. Structural and resource-linked predictors (household type, residential location, and household adults) are implicated in both whether a household wastes and how much, lending convergent support to the subjective-norms and perceived-behavioral-control pathways of the TPB. Behavioral and attitudinal predictors (expense monitoring, shared purchasing, and the Maqasid al-Shariah Index) appear more closely tied to the occurrence of waste than to its magnitude. This qualifies, but does not reverse, the interpretations advanced in Sections 4.3 and 4.6, and the divergence between the two specifications is itself a subject for the discussion that follows.

Table 7
Negative Binomial Regression Predicting the Physical Quantity of Chapatti Waste

Predictor	*B*	*SE*	Wald	*p*	Exp(*B*)	95% CI for *B*
Household type (joint vs. nuclear)	−0.641	0.141	20.57	< .001	0.527	[−0.918, −0.364]
Residential location (overall, *df* = 2)	—	—	9.14	.010	—	—
Squatter vs. high-income	0.386	0.205	3.54	.060	1.471	[−0.016, 0.787]
Middle-income vs. high-income	0.494	0.164	9.10	.003	1.639	[0.173, 0.814]
Education (literate vs. illiterate)	0.190	0.172	1.23	.268	1.209	[−0.146, 0.527]
Food purchase responsibility (overall, *df* = 3)	—	—	3.12	.374	—	—
Women vs. others	−0.123	0.482	0.07	.799	0.884	[−1.068, 0.822]
Men vs. others	0.305	0.532	0.33	.567	1.357	[−0.738, 1.348]
Both vs. others	−0.153	0.487	0.10	.753	0.858	[−1.107, 0.801]
Household adults (count)	0.176	0.050	12.28	< .001	1.192	[0.077, 0.274]
Maqasid al-Shariah Index	−0.112	0.090	1.54	.215	0.894	[−0.288, 0.065]
Women track food expenses (linear)	−0.056	0.063	0.79	.375	0.946	[−0.179, 0.067]
Log per-capita food expenditure	−0.044	0.086	0.26	.608	0.957	[−0.213, 0.125]
Constant	0.618	1.036	0.36	.551	—	[−1.413, 2.649]

Note: *n* = 424. Reference categories: household type = nuclear; residential location = high-income; education = illiterate; food purchase responsibility = others. Exp(*B*) is the incidence rate ratio (IRR). *B* and its 95% Wald confidence interval are on the log-count scale. Wald statistics for single coefficients have 1 *df*.

4.5. Evaluation of Hypotheses

The results are summarized in Table 8 on the basis of hypotheses and TPB pathways. Three of the hypotheses were completely accepted (H1, H6 and H7), one was accepted with reservations (H3) and four were rejected (H2, H4, H5 and H8). The strongest support was along the perceived-behavioral-control (PBC) pathway and the subjective-norms pathway via household type. There was no support in the hypothesized direction for the attitudinal pathway (Maqasid al-Shariah Index and education). H4 is a special case in that it had only a nominal effect and sign, and so is considered "rejected" rather than "confirmed.

4.6. Discussion

Results overall show that, while the religious-ethical orientation is a broad general attitude, influencing staple-food waste in urban Bahawalpur is more influenced by concrete monitoring practices, household structure, and provisioning practices. The following sections elaborate on each of the main findings using examples of previous evidence and the extended TPB framework.

4.6.1. Ethical-Religious Alignment and Staple-Food Waste

The most theoretically significant finding is that there is a positive correlation between the Maqasid al-Shariah Index and the waste of chapatti. It seemed at the bivariate level and in both specifications (Exp(B) ≈ 1.45), and it contradicted the prediction that a higher commitment to hifz al-mal and the prohibition of israf (Al-Shatibi, ca. 2011; Chapra, 2008) should reduce waste. It does not, however, contradict those principles. It's explained by four considerations based on previous evidence.

The first is ‘normative competition'. Baig et al. (2019) found that although Saudi Arabia has clear injunctions against israf, the norms of the hospitality sector and increasing affluence help to maintain food waste. The parallel to southern Punjab is close: there is a religious dimension to generous provisioning and surplus chapatti is the product of more, not less, devotion to plenty of generosity. Kansal et al. (2022) also find that households in South Asia in Australia both over-provision and are sensitive to messages about food waste reduction in the context of the hospitality industry. In contrast, and as mentioned by Qian et al. (2022),

religiously affiliated Chinese families managed to waste less (approximately 2.08% less per meal), a result of the frugality they had in their religious practices, namely Buddhist and Taoist traditions. The religiosity and waste relationship thus seems to be bidirectional, depending on which religious normatively complex focuses on frugality versus hospitality.

Table 8
Summary of Hypothesis Tests by Theory of Planned Behavior Pathway

Hypothesis	Predictor (Pathway)	Expected Effect	Exp(*B*) (*P*)	Verdict
H1	Joint household (subjective norms)	Lower odds	0.505 (.003)	Supported
H2	Household adults (subjective norms)	Higher odds	1.125 (.198)	Not supported
H3	High-income locality (PBC)	Lower odds	0.543 (.059)	Partially supported (marginal)
H4	Maqasid al-Shariah Index (attitude)	Lower odds	1.454 (.029)	Not supported (significant, opposite sign)
H5	Literacy (attitude)	Lower odds	1.591 (.102)	Not supported
H6	Shared purchasing (PBC)	Different odds	1.613 (.030)	Supported (higher odds)
H7	Expense monitoring (PBC)	Lower odds	0.794 (.040)	Supported
H8	Log per-capita food expenditure (PBC)	Higher odds	0.843 (.257)	Not supported

Note: Exp(*B*) and *p* values are from the Main Model (n = 424). PBC = perceived behavioral control. H6 predicted a difference from sole female purchasing without specifying direction.

The second is to build aggregates. The results presented by Khorakian et al. (2022) indicated that the intrinsic religious orientation was positively related to waste prevention (β = +0.17) while the extrinsic religion-socially performative dimension was negatively related to waste prevention (β = −0.15). The Maqasid Index combines general observance (ritual, charity, lawful earning, family relations, and health stewardship) in one, without distinguishing between the orientations; thus, there might be a waste reducing intrinsic component and a waste increasing extrinsic component which could balance each other and result in a net positive coefficient. The third is mismatched and indirect pathways. Religious values proved to have indirect effect on waste-reduction intentions through personal norms and activism in Egypt (Elhoushy & Jang, 2020), and in the case of the Indonesian Muslims, they were found to predict intentions but only through religious knowledge rather than general observance (Damanik et al. 2024). Such mediated pathways cannot be captured in a linear direct-effects logit on an observance index, and may report the wrong direct-effect.

The fourth is the specificity of measurement. According to the compatibility principle of the TPB (Ajzen, 1991), attitudes predict behavior as long as both are measured at the same level of specificity as the behavior, but general dispositions predict specific behaviors weakly. The Index is operationalized as such to measure general ethical-economic alignment, not food-specific stewardship; the narrow range of the Index (three-quarters of households Aligned or Highly Aligned) suggests limited variation to exploit. The null effect of education (Exp(B) = 1.591, p = .102) is in line with other findings that demonstrated an attitude–behaviour gap, such as the lack of sustainable consumption among Romanian consumers by education alone (Pocol et al., 2020) and the good knowledge and attitudes, but poor to moderate waste-prevention practices among Indian adults (Saxena & Saxena, 2019). The finding, however, should not be interpreted as evidence against Maqasid principles, but as evidence that general patterns of religious alignment do not necessarily lead to a reduction

in waste of staple foods; a question that can only be answered empirically for food-specific stewardship (iqsad).

4.6.2. Household structure and gendered provisioning

This is very similar to the subjective-norms pathway (Exp(B) ≈ 0.51–0.52) for the protective effect of joint household structure. In Faisalabad, Zafar et al. (2024) demonstrated routine-based constructs (planning, shopping, and leftover reuse) outperformed purely psychological TPB models and joint households likely foster these routines via shared cooking and coordinated portioning to reduce discretionary surplus. Panda et al. (2024) demonstrated that a sense of community led to a greater activation of personal norms and, via the planning routines, waste-reduction intentions among Indian households, suggesting that communal obligation in South Asian cultures is more likely to promote prosocial norms than individual cost–benefit calculations. Note that the number of adults, a proxy for the same normative environment, does not appear to have an independent effect (Exp (B) = 1.125, p = .198); the quality of shared routines and the level of accountability is more important than the number of adults in the household.

The greater likelihood of waste in shared purchasing groups compared to the sole female purchasing groups is similar to the findings of Ariffin et al. (2023) who found that men wasted significantly more than women in 404 Malaysian households, and attributed this to the exclusion of the men from routine food management; and Ali et al. (2025) who reported that female headed households in Quetta wasted less, and were twice as likely to separate waste. Parizeau and Fraser (2018) define waste management as gendered foodwork, and a focused female job of purchasing is also a focal point for routinized waste aversion without restructuring, but rather by delegating the task to others. But, in terms of food security, Haque et al. (2024) determined that greater control over financial decisions, and not simply mobility, had a positive effect on household levels of food security in rural Bangladesh, indicating that the critical explanatory mechanism is control over decision-making and not gender, per se.

These findings are not to be interpreted normatively. Mukhter and Chowdhary (2023) and Sahoo et al. (2022) illustrate how the responsibility of waste is also socially constructed as women's work that goes unrecognised and overlooked, and Sahoo et al. explain how responsibility for waste can be socially more collectively located within the household. The message here is not to focus provisioning on women but to shift the "shared responsibility" to a "shared accountability" for provisioning. The estimates for male-only purchasing (n = 23) are not precise enough to suggest whether male-only purchasing is protective or harmful.

4.6.3. Expenditure monitoring and perceived behavioral control

Expenditure monitoring provides the clearest support for the PBC pathway. Its protective effect converges with evidence from Pakistan (Zafar et al., 2024), Malaysia (Zainal & Hassan, 2019), and Iran (Fami et al., 2019) that concrete, ability-based routines, rather than general awareness or motivation, translate intentions into reduced waste. In Fami et al.'s Food Consumption Management framework, for example, highly motivated women with weak food-management skills still generated considerable waste. The result also accords with findings that planning and shopping routines outperform attitudes as predictors of waste (Stancu et al., 2016; Stefan et al., 2013) and with Quested et al. (2013) portrayal of waste as the product of interacting household routines. The threshold pattern in the robustness check adds a programmatic nuance: occasional tracking was not distinguishable from none, so interventions should aim at establishing the habit of monitoring, not merely raising awareness of it. Because the design is cross-sectional, reverse causation cannot be excluded, as households that already waste little may be more inclined to report tracking their spending.

4.6.4. Socio-economic Constraint

The marginal protective association of high-income residence is consistent with the PBC logic that better-resourced households have more storage, refrigeration, and planning

capacity, and with evidence that residential context shapes waste practices (Srijuntrapun et al., 2025). It contrasts with studies reporting greater waste among wealthier households: Khalid et al. (2023) in Tehsil Kahror Pakka (USD 12.80 versus 9.58 per capita annually), Sunday et al. (2022) in Nigeria, Soma (2019) in Indonesia, where supermarket shoppers stocked up, and Pocol et al. (2020) high-income "careless" consumer cluster in Romania. A plausible reconciliation lies in the food category. Chapatti is an inexpensive staple cooked daily, unlike the costly, perishable, and discretionary items that dominate those studies' waste streams, so affluent households may waste less of it while wasting more of higher-value foods not captured here. Consistent with this, per-capita food expenditure was not significant in either model, in line with Alvi et al. (2026), who found informal learning and media exposure more influential than economic indicators in Pakistani food-saving behavior, and with Krutprong and Pharino (2025) conflicting income–waste correlations across Thai sites. The non-monotonic prevalence pattern (highest, at 66.7%, among middle-income households) and the attenuation of the income contrast once household and provisioning variables were controlled suggest that any income effect is largely mediated by those variables, a proposition that formal stratified analysis should test.

4.6.5. Contribution to the Theoretical Framework

The results provide a nuanced judgement of the three TPB pathways (Table 8). Monitoring frequency, an indicator of control that is actually applied, most strongly predicted waste in both models, and control of purchasing was important beyond participation. This supports the proposition by Ajzen (1991) that perceived control and actual control, rather than a positive attitude, will translate into behaviour. Household type was used to partially mediate the subjective-norms pathway. The attitudinal pathway was the weakest as neither the religious-ethical index nor education was in the expected direction. The TPB is also widely used for food waste in the home (Bittner et al., 2025), but the explained variance (Nagelkerke R^2 = .111–.113) is still moderately small, suggesting that there is room to include other unmeasured factors (e.g., planning routines, hospitality demands, and storage practices) that influence food waste.

Two extensions follow. First, the Maqasid result indicates that the religious-ethical dimension can only be introduced at the level of the target behaviour; an index of general observance would not be a faithful test of the framework as testing attitudes towards hifz al-mal, iqsad and avoidance of israf against the food would be. Second, in the extension of the PBC construct, control is not just a function of individual skills, resources, etc., as in most TPB applications, but also on the distribution of provisioning authority and accountability within the household.

4.7. Practical, pedagogical, and policy implications

Because the strongest findings concern modifiable behaviors and household arrangements, they favor targeted rather than generic interventions. Table 9 links each principal finding to a proposed action, the actors best placed to deliver it, and a realistic time horizon.

Three points sharpen these implications. First, the graded pattern of protection implies that programs should aim to move households from occasional to habitual monitoring; only 30.5% currently monitor often, and it is at this level that protection was clearest. Second, religious education offers a credible channel but, as the Maqasid result shows, only if messages translate the prohibition of *israf* into specific portioning and leftover practices rather than relying on diffuse piety. Third, the pedagogical implication is to equip adolescents, who will later take on provisioning roles, with budgeting and meal-planning skills in school settings, and to include boys, since shared accountability appears to matter and men's exclusion from routine food management has been linked to higher waste (Ariffin et al., 2023). Because the evidence is cross-sectional, each initiative should incorporate baseline and follow-up measurement, for example with a shortened version of the present survey instrument, so that pilots test the causal claims that this design cannot.

Table 9
Empirical Findings and Corresponding Practical, Pedagogical, and Policy Actions

Empirical Finding	Proposed Action	Key Actors	Horizon
Frequent expense monitoring was protective (Often vs. Never: Exp(*B*) = 0.444)	Food-budgeting literacy programme with low-cost, low-literacy tools (paper diary, SMS reminders), delivered by trained female community mobilisers	Union council welfare offices; women's community organizations; microfinance institutions; NGOs	0–12 months (pilot); 1–3 years (scale-up)
Joint households had lower odds of waste (Exp(B) = 0.505)	Community and mosque-based campaigns framing waste reduction as a shared family and neighborhood duty, including at weddings and gatherings	Municipal administration; mosque committees; ulema; welfare associations	0–24 months
Shared purchasing increased odds of waste (Exp(B) = 1.613)	Joint meal-planning checklists and portioning guides that assign explicit ownership without re-burdening women	NGOs; food-security extension services; local media and community radio	1–2 years
Maqasid Index was positively associated with waste (Exp(B) = 1.454)	Food-specific israf messaging in Friday sermons and study circles, pre-tested with religious scholars, instead of generic appeals to piety	Mosque committees; ulema; Auqaf department; madrassahs	0–18 months
High-income location marginally protective; middle-income and squatter households wasted most (66.7%, 61.2%)	Storage and refrigeration support in lower-income settlements; municipal planning that treats middle-income nuclear households as a high-incidence group	Development authority; urban planning units; microfinance institutions; NGOs	2–5 years
Education had no effect (attitude–behavior gap)	Practical food-budgeting and meal-planning skills in home economics and civics curricula, for girls and boys alike	Education departments; schools	Medium term

Note: Exp(*B*) values are from the Main Model, except monitoring (Robustness Check Model). Actors and horizons are indicative and should be validated through pilot implementation.

5. Conclusion

This study computed the determinants of household wastage on staple food in urban Bahawalpur using a composite Maqasid al-Shariah Index along with functional-form, gendered and socio-economic determinants in a binary logit framework tested by cross validating across two functional-forms. There are three points to be noted. Wastage of staple food is prevalent, 59.7 per cent of all households reported that they wasted chapatti despite their strong declared ethics and religious sentiments. The joint household had about half the odds of waste, the household in which the female tended to keep a record of her expenses had 56 percent lower odds than the household in which the female did not keep a record, and the increased distribution of responsibility to the male increased the risks of waste by about 60 percent relative to the concentrated female responsibility. Alignment with generalized Maqasid was correlated with increased, rather than decreased, odds of waste; this was most likely because of the competition from the norms that underpin hospitality, the tendency for intrinsic and extrinsic religious orientations to be combined in the one Maqasid index, and the indirect relationship between religiosity and waste instead of a direct one.

Four recommendations follow. First, community or mosque-based awareness campaigns need to be reframed, to focus on doctrinal specificity and not general piety – the israf prohibition and the obligation to hifz al-mal should be taught as specific rules of portioning, leftover use and provisioning restraint, and explicit focus should be paid to the situations where there is hospitality-driven surplus, such as at weddings and family gatherings. Secondly, food-expenditure tracking should be directly targeted in the household financial-literacy programs offered by union-council welfare offices, women's community-

based organizations and microfinance institutions, and the measurable goal be to increase the proportion of households that track "Often" above the observed baseline of 30.5 per cent, at which the protective effect begins to take effect. Third, tools of accountability for joint provisioning, such as simple joint meal-planning checklists and portioning guides for both household provisions, should be trialed to bridge the divide between nominal shared provisioning and shared ownership of household meals without re-burdening women. Fourth, municipal waste-management planning needs to acknowledge nuclear households in middle-income municipalities as a special high incidence sector, for which special attention needs to be paid.

These conclusions are limited by several factors. The dependent variable is incidence, not quantity, and the results show that wastage takes place, but not by how many grams or kilograms. Even with the neutral wording and assurances of anonymity and limited recall period, self-reported measurement is sensitive to recall error and social-desirability bias. The cross-sectional design doesn't allow for causal inference. The explained variance is relatively small and the model specificity of 37.4 percent shows that the model has only limited ability to classify non-wasting households. The findings which focus on one staple and are analytically deliberate do not generalize to the other perishable or discretionary food categories.

Such restrictions correspond to an agenda of research. The intrinsic and extrinsic orientation sub-scales of the Maqasid should be decomposed and personal norms should be tested as a mediator between the three explanations offered here, with priority. Even on a small validation sub-sample, measurement of physical waste would be able to adjust self-reported incidence to the observed amount. If the dependent variable is extended across food categories, then the staple specific interpretation of income result would be tested. Finally, a randomized comparison of messages grounded in Quranic commands on the pros and cons of the message in comparison to generic messages on environmental topics would determine if the doctrinally specific ethical appeal would be more effective than general religiosity and secular sustainability framing in a Muslim-majority household setting.

Authors Contribution

Muzian Sultana: contributed to conceptualization, research design, survey development, data collection, empirical analysis, and manuscript drafting.
Tusawar Iftikhar Ahmad: provided academic supervision, methodological guidance, critical review, and manuscript refinement; both authors reviewed and approved the final manuscript.

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

References

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-t

Al-Raysuni, A. (2011). *Imam Al-Shatibi's Theory of the Higher Objectives and Intents of Islamic Law*. The International Institute of Islamic Thought.

Alvi, S., Rehman, A., Nawaz, S. M. N., Hassan, M. U., & Anser, M. K. (2026). The Role of Lifestyle, Environmental Concerns, and Personal Preferences in Energy, Water, and Food Saving Behaviors. *Environmental Progress & Sustainable Energy*, *45*(3). https://doi.org/10.1002/ep.70419

Ariffin, Z. Z., Anuar, S. N., Mangadi, N. F., Yaakop, A. Y., Sakawi, Z., Jusoh, S., & Ibrahim, M. A. (2023). Household Food Waste Behavior in Klang Valley, Malaysia, and Its Potential in the Circular Economy. *Sustainability*, *15*(12), 1-15. https://doi.org/10.3390/su15129431

Bittner, B., Vida, V., Szakos, D., Kasza, G., Kovács, S., & Nagy, A. (2025). A Study of the Behavioral and Environmental Factors Influencing Food Waste in Higher Education. *Cleaner Waste Systems*, *11*. https://doi.org/10.1016/j.clwas.2025.100256

Chapra, M. U. (2008). *Vision of Development in the Light of Maqāsid Al-Sharī'Ah*.
Cochran, W. G., & Cochran, W. G. (1977). *Sampling Techniques* (Vol. 3). wiley, New York.
Elhoushy, S., & Jang, S. (2020). Religiosity and Food Waste Reduction Intentions: A Conceptual Model. *International Journal of Consumer Studies*, *45*(2), 287-302. https://doi.org/10.1111/ijcs.12624
Fami, H. S., Aramyan, L. H., Sijtsema, S. J., & Alambaigi, A. (2019). Determinants of Household Food Waste Behavior in Tehran City: A Structural Model. *Resources, Conservation and Recycling*, *143*, 154-166. https://doi.org/10.1016/j.resconrec.2018.12.033
Haque, S., Salman, M., Hasan, M. M., Prithi, A. A., & Hossain, M. E. (2024). Women's Empowerment and Its Role in Household Food Security to Achieve Sdgs: Empirical Evidence from Rural Bangladesh. *Sustainable Development*, *32*(4), 4297-4314. https://doi.org/10.1002/sd.2893
Kansal, M., Mitsis, A., Ananda, J., & Pearson, D. (2022). Challenges for Food Waste Reduction Campaigns: Requirements for Asian Consumers in Australia. *Australasian Journal of Environmental Management*, *29*(4), 368-385. https://doi.org/10.1080/14486563.2022.2143917
Khalid, S., Malik, A. U., Ullah, M. I., Khalid, M. S., Javeed, H. M. R., Naeem, M. A., & Naseer, A. (2023). Food Waste: Causes and Economic Losses Estimation at Household Level in Pakistan. *Environ Sci Pollut Res Int*, *30*(44), 99284-99297. https://doi.org/10.1007/s11356-023-28775-4
Khorakian, A., Baregheh, A., Jahangir, M., Heidari, A., & Saadatyar, F. S. (2022). Household Food Waste Prevention Behavior: The Role of Religious Orientations, Emotional Intelligence, and Spiritual Well-Being. *Journal of Environmental Planning and Management*, *67*(1), 59-84. https://doi.org/10.1080/09640568.2022.2097062
Krutprong, V., & Pharino, C. (2025). Nationwide Household Food Waste Generation Rates in Rural and Urban Settings: Evidence in Thailand. *Applied Environmental Research*, *47*(2), ---. https://doi.org/10.35762/AER.2025011
Mukhter, I., & Chowdhary, R. (2023). What Rural Women Say About Their Role in Household Waste Management in Kashmir? A Case-Series Approach. *Local Environment*, *29*(9), 1129-1134. https://doi.org/10.1080/13549839.2023.2284937
Panda, D., Raut, S. K., Rana, S., & Shamsudin, M. N. (2024). Household Food Waste Reduction and Leftover Reuse Intention: Interplay of Personal Norms and Mediating Variables. *Journal of Foodservice Business Research*, *29*(5), 1075-1104. https://doi.org/10.1080/15378020.2024.2430063
Parizeau, K., & Fraser, C. (2018). Waste Management as Foodwork: A Feminist Food Studies Approach to Household Food Waste. *Canadian Food Studies / La Revue canadienne des études sur l'alimentation*, *5*(1), 39-62. https://doi.org/10.15353/cfs-rcea.v5i1.186
Pocol, C. B., Pinoteau, M., Amuza, A., Burlea-Schiopoiu, A., & Glogoveţan, A.-I. (2020). Food Waste Behavior among Romanian Consumers: A Cluster Analysis. *Sustainability*, *12*(22), 9708. https://doi.org/10.3390/su12229708
Qian, L., Li, F., Zhao, X., Liu, H., & Liu, X. (2022). The Association between Religious Beliefs and Food Waste: Evidence from Chinese Rural Households. *Sustainability*, *14*(14), 1-15. https://doi.org/10.3390/su14148555
Quested, T. E., Marsh, E., Stunell, D., & Parry, A. D. (2013). Spaghetti Soup: The Complex World of Food Waste Behaviours. *Resources, Conservation and Recycling*, *79*, 43-51. https://doi.org/10.1016/j.resconrec.2013.04.011
Sahoo, K. C., Soni, R., Kalyanasundaram, M., Singh, S., Parashar, V., Pathak, A.,…Diwan, V. (2022). Dynamics of Household Waste Segregation Behaviour in Urban Community in Ujjain, India: A Framework Analysis. *Int J Environ Res Public Health*, *19*(12), 1-14. https://doi.org/10.3390/ijerph19127321
Saxena, R., & Saxena, G. (2019). Knowledge, Attitude and Practices Related to Cervical Cancer. *International Journal of Medical and Biomedical Studies*, *3*(6), 65-69. https://doi.org/10.32553/ijmbs.v3i6.299
Soma, T. (2019). Space to Waste: The Influence of Income and Retail Choice on Household Food Consumption and Food Waste in Indonesia. *International Planning Studies*, *25*(4), 372-392. https://doi.org/10.1080/13563475.2019.1626222

Srijuntrapun, P., Ket-Um, P., & Attavanich, W. (2025). Socio-Demographic Drivers of Household Food Waste Management Practices in Thailand. *PLoS ONE*, *20*(4), e0321054. https://doi.org/10.1371/journal.pone.0321054

Stancu, V., Haugaard, P., & Lahteenmaki, L. (2016). Determinants of Consumer Food Waste Behaviour: Two Routes to Food Waste. *Appetite*, *96*, 7-17. https://doi.org/10.1016/j.appet.2015.08.025

Stefan, V., Herpen, E. v., A, A. A. T., & Lähteenmäki, L. (2013). Avoiding Food Waste by Romanian Consumers: The Importance of Planning and Shopping Routines. *Food Quality and Prefernce*, *28*(1), 375-381.

Sunday, C. O., Sowunmi, F. A., Obayelu, O. A., Awoyemi, A. E., Omotayo, A. O., & Ogunniyi, A. I. (2022). Disentangling Drivers of Food Waste in Households: Evidence from Nigeria. *Foods*, *11*(8), 1-17. https://doi.org/10.3390/foods11081103

Zafar, S., Ullah, E., Naqvi, S. A. A., Anwar, S., & Hussain, B. (2024). Assessment of Self-Reported Food Waste from Households Via Two Routes in Pakistan. *Journal of the Knowledge Economy*, *16*(2), 8961-8982. https://doi.org/10.1007/s13132-024-02244-w

Zainal, D., & Hassan, K. A. (2019). Factors Influencing Household Food Waste Behaviour in Malaysia. *International Journal of Research in Business, Economics and Management*, *3*(3), 56-71.