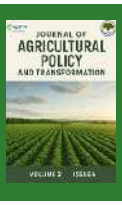

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Urbanization and Peri-Urban Household Food Security: Evidence from Faisalabad, Pakistan

Asim Yasin[1,*], Hammad Hussain[1] & Shabbir Akbar[2]
[1]Punjab Education Department, Faisalabad, Punjab, Pakistan
[2] Director (CTP/CB), Civil Services Academy, Lahore, Pakistan
[*] *Corresponding author:* asimyasin1930@gmail.com

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ABSTRACT
Unplanned urbanization is reshaping the rural–urban interface of Pakistani cities, converting agricultural land into housing and pressuring food systems. This study examines the association between urbanization and food security in peri-urban Faisalabad, Pakistan's textile hub. Using a random sample of 160 households from settlements located 2–14 km from city center, food security was assessed through a seven-day dietary recall against 2,350 kcal per adult equivalent per day. Binary logistic regression identified socioeconomic and locational correlates of food security, using migrant status and distance from city center as proxies for urbanization exposure. Results indicate that 26% of households were food insecure, with the highest prevalence in the settlement closest to city center. Both urbanization proxies were negatively associated with food security, although neither relationship was statistically significant. Headship age of 46 years and above was significantly and negatively associated with food security, while income, number of earners, and education of the household head were positively associated with food security. Household size showed a negative but partly significant relationship, whereas joint family structure showed a positive association that approached but did not reach significance. The study recommends agricultural zoning, land governance, and livelihood diversification to safeguard food security in peri-urban areas.

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1. INTRODUCTION

Urbanization, the physical and demographic expansion of urban areas through natural population growth and rural-to-urban migration, is among the defining structural transformations of the twenty-first century: the global urban share of population rose from under a third in the 1950s to a majority by 2018 and is projected to reach roughly two-thirds by mid-century, with the fastest growth occurring in low- and middle-income countries where urban populations are expanding without a commensurate expansion of infrastructure, formal employment, or food systems capacity (Cohen, 2006).

Pakistan exemplifies this pattern. The urban share of the national population rose from 17.7% in the 1951 census to 38.8% in the 2023 Population and Housing Census, with the urban population more than doubling in absolute terms over the past two decades (Gallup Pakistan, 2025; Pakistan Bureau of Statistics [PBS], 2023). Punjab, the country's most populous province, has been at the center of this shift, and Faisalabad, Pakistan's third-largest city and its principal textile-manufacturing hub, has grown from an estimated population of roughly 2 million in the late 1990s to more than 3.6 million residents within the city and over 9 million across Faisalabad District by 2023 (PBS, 2023). Much of this growth has occurred at the urban fringe, where housing societies and commercial development have expanded onto formerly cultivated land (Saqib et al., 2024).

This expansion carries direct consequences for food security. Urban growth in Pakistan has proceeded with limited land-use planning, converting irrigated farmland into residential and commercial plots, depleting groundwater tables,

and degrading the agro-ecological base on which peri-urban food supply depends (Saqib et al., 2024, 2025). At the national level, time-series evidence spanning 1973–2019 shows that urbanization growth was negatively and significantly associated with all four dimensions of food security i.e. availability, access, utilization and stability in Pakistan (Farrukh et al., 2022). At the household level, a 2026 survey of peri-urban villages in Faisalabad District found that most farmland sales were driven by financial distress rather than planned investment, that awareness of land-use regulation was extremely limited, and that respondents reported declining food adequacy and dietary quality following land conversion (Wajid & Bashir, 2026). These findings raise a more specific empirical question: within a single urbanizing corridor, is proximity to the expanding city center, and the migration associated with it, systematically associated with lower household food security once other socio-economic characteristics are controlled for?

This study addresses that question using primary household data from four peri-urban settlements of Faisalabad situated at increasing distance from the city center. Its objectives are to: (i) measure the household food security situation in the study area using a dietary-intake-based indicator; (ii) test the association between urbanization, proxied by migrant status and distance from the city center, and household food security, alongside relevant socio-economic covariates; and (iii) derive policy implications for agricultural land governance and food security planning in rapidly urbanizing districts of Punjab.

2. LITERATURE REVIEW

The relationship between urbanization and food security has been examined from two broad, complementary angles in the literature: macro-level studies that trace aggregate causal pathways, and micro-level household studies that identify the socio-economic correlates of food insecurity. At the macro level, Farrukh et al. (2022) applied a broad-spectrum approach to Pakistan's 1973–2019 time series and found that urbanization growth, alongside workers' remittance utilization, exerted a significant negative effect on multidimensional food security, while governance quality and agricultural GDP share were protective. This complements earlier work by Bashir and Schilizzi (2012, 2015), who assessed food security policy effectiveness in the Punjab and argued that policy responses have often been undermined by insufficiently disaggregated evidence that is, by treating food-insecure populations as homogeneous when in fact food security status and its determinants vary sharply across household categories and micro-regions (Bashir & Schilizzi, 2013).

Household-level determinants of food security have been documented extensively in the development economics literature. Household size and dependency burden are consistently negatively associated with food security (Babatunde et al., 2007; Hailu & Nigatu, 2007), while household income, the number of earning members, and household head's education are positively associated with it (Babatunde et al., 2007; Bashir et al., 2012). Household age structure and headship age have also been linked to food security outcomes, generally reflecting life-cycle effects on earning capacity and dependency ratios (Onianwa & Wheelock, 2006). For Punjab specifically, Bashir et al. (2012) found that the determinants of food insecurity differ systematically for landless households relative to other rural households, reinforcing the case for spatially and structurally disaggregated analysis rather than province-wide averages.

A smaller but growing body of work situates these determinants within the specific context of peri-urban land conversion. Cross-country evidence from Ghana and Ethiopia shows that peri-urban households lose farmland access as cities expand, with adverse consequences for local food production and dietary diversity (Sumbo et al., 2023; Tufa & Megento, 2022). In Pakistan, Saqib et al. (2024, 2025) documented that agricultural land conversion into housing societies in Punjab is driven primarily by short-term financial need among landowners and disproportionately disadvantages tenant farmers who lose access to cultivable land altogether. Most directly relevant to the present study, Wajid and Bashir (2026) surveyed peri-urban households in Faisalabad District and reported that farmland conversion was associated with declining food adequacy and water-system sustainability and recommended legally binding agricultural zoning and mandatory food-security impact assessments for land-use conversions. A related study of a different vulnerable population within the same district, university students in Faisalabad, also found non-trivial levels of food insecurity intersecting with other deprivations (Saddique et al., 2026), suggesting that food insecurity in Faisalabad is not confined to a single demographic group but is patterned by the district's broader urbanization dynamics.

Taken together, this literature establishes that (a) urbanization is associated with food security erosion in Pakistan at the national level, (b) household-level food security determinants are well documented but vary by locality and household type, and (c) peri-urban Faisalabad specifically has recently been shown to experience farmland-conversion-driven food security decline. What remains comparatively underexplored is a household-level econometric test of whether proximity to the urban core as a graduated, spatial proxy for urbanization exposure predicts food security status once standard socio-economic covariates are controlled for. This study contributes such evidence using a stratified sample spanning a 2–14 km urbanization gradient within a single peri-urban corridor of Faisalabad.

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Research gap and hypotheses

Despite this body of work, no household-level econometric study has yet tested proximity to the urban core as a graduated, continuous spatial proxy for urbanization exposure, alongside migrant status, within a single peri-urban corridor of a rapidly growing Pakistani secondary city, net of standard socio-economic covariates. This study addresses that gap using a stratified sample of 160 households spanning a 2–14 km urbanization gradient in peri-urban Faisalabad. Based on the literature reviewed above, the study tests the following hypotheses:

1. H1: Migrant status of the household head (Urb1) is negatively associated with the odds of household food security.
2. H2: Distance from the city center (Urb2) is positively associated with the odds of household food security that is, households located closer to the urban core face lower odds of food security than otherwise-similar households farther away.
3. H3: Household size and headship age of 36–55 years are negatively associated with the odds of household food security.
4. H4: Household income, the number of earning members, joint family structure, and the household head's education level are positively associated with the odds of household food security.

3. MATERIALS AND METHODS

Study area

Faisalabad is the third-largest city in Pakistan after Karachi and Lahore, and the country's principal center for textile manufacturing. According to the 2023 Population and Housing Census, Faisalabad city had a population of approximately 3.69 million, within a district population exceeding 9 million (PBS, 2023), a substantial increase from the roughly 2 million residents recorded at the time the underlying fieldwork for this study was designed (Government of Pakistan [GOP], 1998). As an industrial city, Faisalabad continues to attract labor migration from surrounding rural areas, and its peri-urban fringe has expanded rapidly through the conversion of agricultural land into low- and middle-income labor colonies and housing societies.

Faisalabad was selected as the study site, in preference to Lahore or Karachi, for three reasons. First, unlike Lahore (the provincial capital) and Karachi (the national commercial hub), whose peri-urban fringes have already been substantially absorbed into contiguous metropolitan built-up areas, Faisalabad retains an actively expanding, more sharply defined peri-urban gradient in which discrete labor colonies at increasing distance from the urban core can still be identified and sampled. Second, Faisalabad's growth is driven predominantly by textile-industrial labor migration rather than by administrative or port-related functions, making it a more representative case of the industrial secondary cities that are absorbing the bulk of Pakistan's future urban growth. Third, recent peri-urban land-conversion evidence from Faisalabad District (Saqib et al., 2024, 2025; Wajid & Bashir, 2026) provided a documented, food-security-relevant land-use context against which the present household-level findings could be directly benchmarked.

Sampling and data collection

Both secondary and primary data were used. Secondary data on the pace of urban population growth were obtained from the City District Government Faisalabad. Primary data were collected from 160 households using a two-stage stratified random sampling technique. In the first stage, the peri-urban fringe of Faisalabad was divided into four strata i.e. Christian Town, Ashrafabad, Nalka Kohala, and Kamalpur corresponding to labor colonies situated at 2–5 km, 5–8 km, 8–11 km, and 11–14 km from the city center, respectively (Table 1), with strata boundaries defined using the road-network distance of each settlement from the Faisalabad Clock Tower, the conventional zero-point used in official City District Government distance records. In the second stage, a household listing was compiled for each settlement with the assistance of local union council records, and forty households were then randomly selected from each stratum's listing using a random-number draw, yielding a total sample of 160 households; no household refused participation or was replaced. Distance from the city center and migrant status of the household head were used as proxy indicators of urbanization exposure, following the approach used in related household-level food security studies in Punjab (Bashir & Schilizzi, 2013, 2015).

These two proxies capture complementary dimensions of urbanization exposure. Distance from the city center is a continuous, graduated measure of a household's spatial position along the urban-to-rural gradient and directly indexes exposure to land-conversion pressure, rising land values, and the loss of agricultural livelihoods that accompanies outward urban expansion (Saqib et al., 2024). Migrant status of the household head, by contrast, captures a compositional dimension of urbanization: migrant households are disproportionately drawn into the same peri-urban labor colonies precisely because these settlements offer relatively low-cost housing near industrial employment, so migrant status proxies a household's degree of integration into, and dependence on, the urban labor market rather

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than the agrarian economy it displaced. Both measures follow the operationalization used in prior household-level food security research in Punjab (Bashir & Schilizzi, 2013, 2015), which similarly treated locational and migration-status variables as joint indicators of urbanization exposure at the household level.

Table 1. Stratification and data collection

Stratum	Christian Town	Ashrafabad	Nalka Kohala	Kamalpur
Distance from city center (km)	2–5	5–8	8–11	11–14
Number of respondents	40	40	40	40

Note. Strata are ordered by increasing distance from the Faisalabad city center.

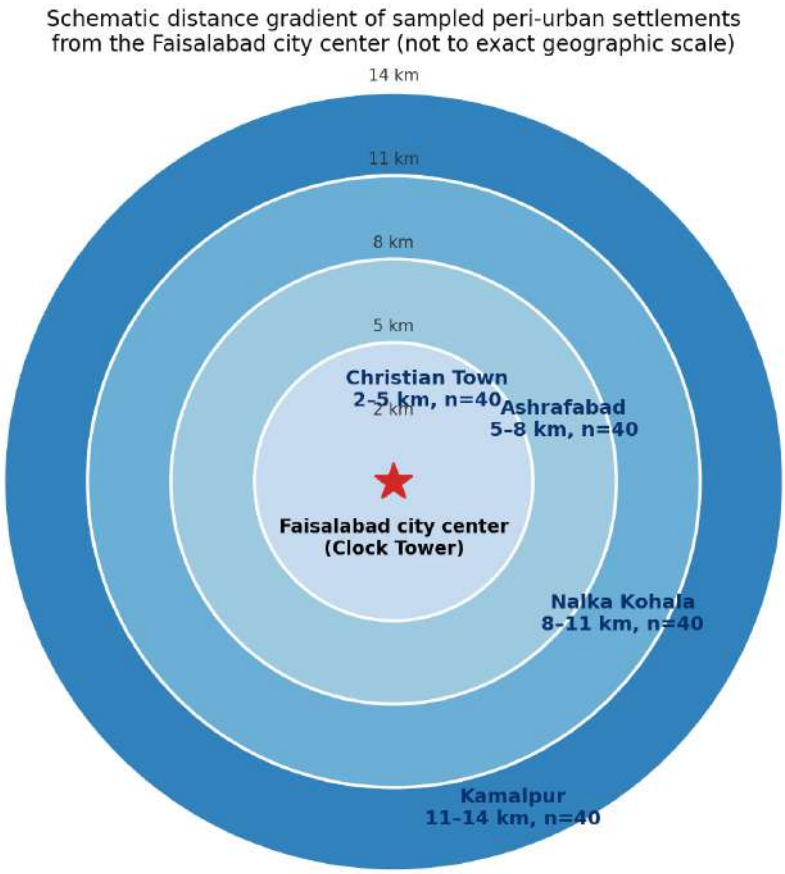

Figure 1. Schematic distance gradient of the four sampled peri-urban settlements from the Faisalabad city center.
Distances (km) were measured along the road network from the Faisalabad Clock Tower, the city's conventional zero-point for distance measurement, using City District Government Faisalabad records; the figure is a schematic representation of the sampling gradient and is not drawn to precise geographic (GIS) scale.

Measuring household food security

Household food security was measured using the Dietary Intake Assessment (DIA) method, based on a seven-day recall of household food consumption (Riely et al., 1999). Reported quantities were converted to caloric intake using the food composition tables of the Allama Iqbal Open University (AIOU, 2001), and per-capita calorie intake was adjusted for age and gender composition using adult equivalent units following the National Sample Survey Organization (NSSO, 1995) scale. A household whose per-adult-equivalent calorie intake equaled or exceeded the national threshold of 2,350 kcal per day (GOP, 2003) was classified as food secure; households falling below this threshold were classified as food insecure. This threshold-based, energy-adequacy approach is one of several complementary ways of operationalizing food security (Coates, 2013) and was selected for consistency with the national benchmark used in prior Punjab-based food security assessments (Bashir & Schilizzi, 2013, 2015). A binary (1/0) dietary-energy-adequacy indicator was preferred over alternative proxies such as multi-item food-insecurity experience scales or dietary diversity scores for three reasons. First, it is directly anchored to Pakistan's own national calorie-adequacy benchmark (GOP, 2003), which allows the resulting food-insecurity prevalence to be compared against other Pakistan- and Punjab-based studies that use the same threshold (Bashir & Schilizzi, 2013, 2015). Second, dietary-recall-based energy adequacy measures, while requiring more intensive data collection than experience-based scales, are less susceptible to the psychosocial and recall-framing biases that can affect self-reported food-insecurity experience modules (Coates, 2013). Third, a binary outcome is directly compatible with the binary logistic regression framework used in comparable household-level food security studies in Pakistan and the wider

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South Asian literature (Hailu et al., 2007; Hailu & Nigatu, 2007), facilitating direct comparison of odds ratios across studies.

Analytical framework

Because the dependent variable, household food security status, is binary ("food secure" = 1, "food insecure" = 0), a binary logistic regression model was applied to identify its determinants, consistent with standard practice in the food security literature (Hailu et al., 2007; Hailu & Nigatu, 2007). Following Burns and Burns (2008), the general form of the logistic regression equation is:

$$\text{Logit}(\wp i) = \beta 0 + \Sigma \beta i s x i s \qquad (1)$$

where $\wp i$ denotes the probability that household i is food secure, xis is the vector of socio-economic and locational covariates, β0 is the intercept, and βis are the coefficients to be estimated. The independent variables included in the model, household migrant status and distance from the city center (the two urbanization proxies), monthly net income, household size, family structure, household head's education and age, and the number of earning members are summarized in Table 2, together with their expected signs based on the literature reviewed in Section 2 (Babatunde et al., 2007; Bashir et al., 2012; Hailu & Nigatu, 2007; Onianwa & Wheelock, 2006).

Table 2. Description of independent variables

Variable	Description	Unit / coding	Expected sign
FS	Food security status (dependent variable)	Binary (1 = food secure, 0 = otherwise)	—
Urb1 (X6)	Migrant status of household	Dummy (1 = migrant, 0 = otherwise)	+ / −
Urb2 (X7)	Distance from the city center	Kilometres	+ / −
MI (X8)	Monthly net household income	Categorical (PKR)	+
THM (X4)	Total household members (family size)	Number	−
Fst (X1)	Family structure	Dummy (0 = nuclear, 1 = joint)	+
Edu (X3)	Household head's education level	Categorical (years of schooling)	+
Tear (X5)	Total earning members in household	Number	+
HHHA (X2)	Household head's age	Categorical (years)	−

Equation (1) is estimated in its general vector form. Written out in full, with each covariate replaced by its acronym and coding as defined in Table 2, the estimated model — Equation (2) — is:

$$\text{Logit}(FS) = \beta_0 + \beta_1 Urb1 + \beta_2 Urb2 + \beta_3 MI + \beta_4 THM + \beta_5 Fst + \beta_6 Edu + \beta_7 Tear + \beta_8 HHHA + \varepsilon^i \qquad (2)$$

where FS is household food security status (1 = food secure, 0 = food insecure); Urb1 is migrant status of the household head; Urb2 is distance from the city center (km); MI is monthly net household income category; THM is total household members (family size); Fst is family structure (0 = nuclear, 1 = joint); Edu is household head's education level; Tear is total earning members in the household; HHHA is household head's age category; and ε^i is the model's error term. Equation (2) is thus the fully specified, variable-labeled form of the general logistic model in Equation (1), with Urb1 and Urb2, the two urbanization-exposure proxies, entered jointly with the socio-economic covariates listed in Table 2.

Ethical limitations and considerations

Household participation was voluntary, and respondents were informed of the purpose of the survey prior to data collection; no personally identifying information is reported in this manuscript. Two limitations of the design should be noted for the interpretation of the results. First, the sample of 160 households, while adequate for the stratified comparison undertaken here, is modest relative to the province-wide samples used in some comparable Punjab food security studies (e.g., 1,152 households in Bashir & Schilizzi, 2013), and the coefficient estimates particularly for categories with few observations, such as the 10+ household-size group should be interpreted with corresponding caution. Second, the underlying fieldwork reflects conditions in the peri-urban strata as originally surveyed; given the pace of land-use change documented in more recent Faisalabad studies (Wajid & Bashir, 2026), the results are best read as a household-level econometric benchmark against which subsequent, updated surveys of the same corridor can be compared, rather than as a real-time snapshot of current conditions.

4. RESULTS

Food security situation

Based on the 2,350 kcal per adult equivalent per day threshold, 26% of the sampled households were classified as food insecure (Table 3). Food insecurity was most prevalent in Ashrafabad, the second-nearest stratum to the city center, where 12 of the 25 percentage points allocated to that stratum were food insecure, the highest rate among the four strata, followed by Christian Town, the stratum closest to the city center, at 6 percentage points. Nalka Kohala and Kamalpur, the two more distant strata, recorded the lowest food insecurity rates.

Table 3. Food security situation by stratum

Stratum	Food secure (%)	Food insecure (%)	Total (%)
Christian Town	19	6	25
Ashrafabad	13	12	25
Nalka Kohala	22	3	25
Kamalpur	20	5	25
Total	74	26	100

Table 3. Age and Education Profile by Irrigation System

Demographic Variable	Overall (N=240)	Diesel Engine (n=80)	Electric Motor (n=80)	Solar System (n=80)
Age, Mean (SD), years	43.09 (9.57)	43.35 (11.17)	42.69 (8.25)	40.02 (8.95)
Age range (Min–Max)	25–71	25–71	28–65	25–66
Illiterate, n (%)	15 (6.3)	11 (13.8)	2 (2.5)	2 (2.5)
Primary, n (%)	40 (16.7)	16 (20.0)	12 (15.0)	12 (15.0)
Middle, n (%)	55 (22.9)	21 (26.3)	16 (20.0)	18 (22.5)
Matric, n (%)	103 (42.9)	29 (36.3)	38 (47.5)	36 (45.0)
Intermediate, n (%)	21 (8.7)	3 (3.8)	10 (12.5)	8 (10.0)
Graduate, n (%)	6 (2.5)	0 (0.0)	2 (2.5)	4 (5.0)
Total, n (%)	240 (100.0)	80 (100.0)	80 (100.0)	80 (100.0)

Note. Age reported as Mean (SD) and Range; education reported as Frequency (%). $\chi^2(10, N = 240) = 21.31$, $p = .019$, Cramér's V = 0.21, confirming a statistically significant association between irrigation-system type and education level.

This association is consistent with the technology-adoption literature, which links formal education to greater willingness to absorb the upfront cost and technical learning curve associated with PV systems (Agrawal & Jain, 2018; Hussain et al., 2023). It also echoes a broader pattern documented for Punjab agriculture more generally: in a 100-farmer study of climate-adaptation behavior across the province, Shakeel et al. (2026) found education to be the single most consistent positive determinant of adaptive practices, including the adoption of water-efficient irrigation methods, ahead of farm size or climate awareness. Economically, the pattern indicates that information and capability constraints, not only capital constraints, partly explain the age and education gradient in adoption, reinforcing the case for awareness-focused interventions discussed in Section 6.

Determinants of food security

Table 4 presents the results of the binary logistic regression, with exact Wald test p-values and 95% confidence intervals for each odds ratio. The Cox and Snell R^2 for the model was 0.372. Urbanization proxies. Both proxies for urbanization exposure were negatively associated with the odds of food security, in the direction hypothesized (H1, H2), though neither reached conventional statistical significance in this sample. Migrant households (Urb1) had 0.466 times the odds of being food secure relative to non-migrant households (95% CI: 0.162–1.340, p = 0.156), and each unit increase in distance from the city center proxy (Urb2) was associated with 0.680 times the odds of food security (95% CI: 0.226–2.051, p = 0.494). The wide confidence intervals, which include 1, indicate that the sample of 160 households did not provide sufficient statistical power to distinguish these estimates from a null effect, even though their direction is consistent with the pattern reported by Onianwa and Wheelock (2006) that urban-proximate households faced a higher likelihood of severe food insecurity. Within the sample, food security was comparatively more prevalent in Kamalpur and Nalka Kohala, the two strata farthest from the city center, than in Christian Town and Ashrafabad (Table 3), a descriptive pattern that motivates further investigation with a larger sample rather than a statistically confirmed effect.

Household income. Net household income was strongly associated with food security. Relative to the zero-income reference category, households earning up to PKR 35,000 per month had 12.629 times the odds of being food secure ($p = 0.003$), and those earning PKR 35,001–50,000 had 13.626 times the odds ($p < 0.001$). Households earning PKR 50,001–80,000 did not differ significantly from the reference category ($\text{Exp}(\beta) = 2.130$, $p = 0.533$), while those earning PKR 80,001+ again showed significantly higher odds ($\text{Exp}(\beta) = 9.767$, $p = 0.034$). This non-monotonic pattern, with the PKR 50,001–80,000 band dipping below both its neighboring categories, departs from the broadly monotonic income–food-security gradient reported in comparable studies (e.g., Babatunde et al., 2007) and may reflect the small number of households in that band and the highest income categories in this sample (see Section 3.5); it should be treated as indicative rather than conclusive without a larger sample to test the income–food security relationship across the full income range.

Household size. Household size showed a generally negative relationship with food security, though the strength of evidence varied by category. Relative to households with up to three members, households of 4–6 members had lower odds of being food secure that fell just short of conventional significance (Exp(β) = 0.047, p = 0.077), while the 7–9 member category showed a statistically significant reduction in odds (Exp(β) = 0.043, p = 0.032). The 10+ member category had a very low point estimate (Exp(β) < 0.001) but, because only a small number of households fell into this category, its standard error was large and the association was not statistically significant (p = 0.238; 95% CI: 0.000–180.563). Taken together, the pattern is consistent with larger households facing a persistently higher risk of food insecurity as the number of dependents rises relative to income and earning capacity, as reported in Nigeria and Ethiopia (Babatunde et al., 2007; Hailu et al., 2007), but the imprecision of the largest-household estimate means it should be interpreted cautiously pending a larger sample.

Table 4. Results of the binary logistic regression

Variable	β	S.E.	Exp(β)	p	95% CI for Exp(β)
Urb1 (migrant)	-0.764	0.539	0.466	0.156	[0.162, 1.340]
Urb2 (distance from city center)	-0.385	0.563	0.680	0.494	[0.226, 2.051]
Family structure (ref.: nuclear)					
Joint	1.210	0.673	3.353	0.072	[0.897, 12.542]
Age of headship, years (ref.: up to 35)					
36–45	-1.301	0.875	0.272	0.137	[0.049, 1.513]
46–55	-3.872	1.214	0.021**	0.001	[0.002, 0.225]
56+	-3.891	1.401	0.020**	0.005	[0.001, 0.318]
Education of headship (ref.: illiterate)					
Primary	1.800	0.793	6.050*	0.023	[1.279, 28.625]
Middle	1.762	0.792	5.824*	0.026	[1.233, 27.504]
Metric	1.124	0.780	3.077	0.150	[0.667, 14.194]
Intermediate	1.313	0.962	3.717	0.172	[0.564, 24.496]
Graduation	3.012	1.231	20.328*	0.014	[1.821, 226.957]
Master and above	3.653	1.317	38.590**	0.006	[2.920, 509.954]
Household size (ref.: up to 3)					
4–6	-3.064	1.731	0.047	0.077	[0.002, 1.389]
7–9	-3.147	1.465	0.043*	0.032	[0.002, 0.759]
10+	-7.883	6.673	0.000	0.237	[0.000, 180.563]
Total family earners (ref.: 1)					
2	2.113	0.648	8.273**	0.001	[2.323, 29.461]
3	2.875	1.532	17.725	0.061	[0.880, 356.994]
4+	1.893	0.961	6.639*	0.049	[1.009, 43.666]
Net income, PKR/month (ref.: zero)					
Up to 35,000	2.536	0.865	12.629**	0.003	[2.318, 68.814]
35,001–50,000	2.612	0.714	13.626**	<.001	[3.362, 55.226]
50,001–80,000	0.756	1.213	2.130	0.533	[0.198, 22.954]
80,001+	2.279	1.072	9.767*	0.034	[1.195, 79.848]

*Note. Exp(β) = e^β. p-values are exact two-tailed Wald test p-values, p = 2(1 - Φ(|β/S.E.|)), computed from the reported β and S.E.; 95% CI for Exp(β) computed as exp(β ± 1.96 × S.E.). ** significant at p <0 .01; * significant at p < 0.05. N = 160. Cox & Snell R^2 = 0.372. β = regression coefficient; S.E. = standard error; ref. = reference category.*

Family structure. Households with a joint family system had 3.353 times the odds of being food secure relative to nuclear-family households, a difference that approached but did not reach conventional statistical significance (p = 0.072; 95% CI: 0.897–12.542). The direction is consistent with the pooling of income across a larger number of adult earners typically associated with joint family arrangements in Punjab, though the findings should be treated as suggestive rather than confirmed.

Education of household head. Household head's education was positively associated with food security across most categories: households with a primary-educated head had 6.050 times the odds of a food-secure outcome relative to the illiterate reference category (p = 0.023), rising to 5.824 for middle education (p = 0.026), 20.328 for graduate education (p = 0.014), and 38.590 for a master's degree or above (p = 0.006). The metric and intermediate categories were positive but not statistically significant (p = 0.150 and p = 0.172, respectively). This gradient is consistent with Babatunde et al. (2007), who found household head's education to be a significant positive predictor of food security in a comparable rural Nigerian sample.

Number of earners. The number of earning household members was positively associated with food security, though the strength of the association varied across categories. Households with two earners had 8.273 times the odds of food security relative to single-earner households (p = 0.001). Three-earner households showed a larger point estimate (Exp(β) = 17.725) but, reflecting the smaller number of households in this category, the association fell short of conventional significance (p = 0.061); four-or-more-earner households had 6.639 times the odds, a difference that was significant but close to the conventional threshold (p = 0.049). One possible interpretation of this overall pattern is that additional earners diversify household income up to a point, after which households with four or more earners

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in this sample may be more likely to be engaged in low-skilled, low-wage labor within larger joint-family arrangements, which could moderate the marginal food security benefit of each additional earner; this explanation is offered as a plausible interpretation rather than a tested mechanism, since household members' occupational composition was not directly modeled here.

Age of household head. Headship age showed the clearest and most statistically robust pattern in the model. Relative to the youngest reference category (up to 35 years), the 36–45 age group had lower odds of food security (Exp(β) = 0.272), but this difference was not statistically significant (p = 0.137). The 46–55 and 56+ age groups, by contrast, showed strong and highly significant reductions in the odds of food security (Exp(β) = 0.021, p = 0.001; and Exp(β) = 0.020, p = 0.006, respectively). This step-change pattern, in which the association strengthens sharply from age 46 onward, is broadly consistent with Onianwa and Wheelock (2006), who found age to be negatively associated with food security among older household heads in the southern United States, reflecting reduced earning capacity and higher dependency ratios in older households.

5. DISCUSSION

The central finding of this study is that both migrant status and proximity to the Faisalabad city center are negatively associated with household food security, in the hypothesized direction, though neither association reached conventional statistical significance once the socio-economic covariates were controlled for (Urb1: p = 0.156; Urb2: p = 0.494). This directional, if not statistically confirmed, evidence adds household-level, spatially disaggregated data points to a growing body of work suggesting that urbanization in Pakistan has, on balance, been associated with declining rather than improving food security at the peri-urban margin. This directional consistency echoes the negative urbanization coefficient found by Farrukh et al. (2022) using national time-series data spanning nearly five decades, and it is broadly consistent with the mechanism identified more recently by Wajid and Bashir (2026) in the same district: peri-urban households in Faisalabad who sold agricultural land often under financial distress rather than as a planned investment subsequently reported declining food adequacy and dietary quality. The present results are directionally consistent with a similar pattern extending beyond households that have directly sold land: as a descriptive gradient across the whole peri-urban corridor, households situated closer to the expanding urban core, where land conversion pressure and cost-of-living increases are greatest, tended to be less food secure than otherwise-similar households farther from the city center, although this study's sample size was not large enough to establish that gradient as statistically significant once other household characteristics were controlled for.

This spatial pattern is potentially important for policy because it suggests that urban proximity itself, and not merely land transaction status, may act as a food security risk factor in this setting, though this study's non-significant urbanization coefficients mean that possibility should be treated as a hypothesis for further testing rather than an established result. It is directionally consistent with international peri-urban evidence from Ghana and Ethiopia, where farmland loss at the urban fringe reduced household access to food production even where formal urban employment opportunities existed nearby (Sumbo et al., 2023; Tufa & Megento, 2022). It also aligns with the broader argument advanced by Bashir and Schilizzi (2012, 2013) that food security policy in Punjab has often been formulated on the basis of insufficiently disaggregated evidence: a province-wide or even city-wide food security statistic would mask the substantial variation this study finds across strata only a few kilometers apart (26% food insecurity overall, ranging from 12 percentage points in Ashrafabad to 3 in Nalka Kohala; Table 3). Not all comparable evidence points in the same direction, however: some peri-urban and urban-fringe studies elsewhere find that proximity to urban labor markets can improve food security where non-farm employment and remittance income more than offset the loss of farmland, particularly when formal safety nets or wage employment are accessible (Cohen, 2006). The present results, together with Wajid and Bashir's (2026) Faisalabad-specific evidence, suggest that in this particular corridor the loss of agricultural livelihood and rising cost-of-living pressures at the urban fringe have outweighed any such labor-market gains, but this balance is likely to be context-specific and should not be generalized to peri-urban settings with stronger formal-employment absorption.

The socio-economic determinants identified here (household size, income, number of earners, family structure, and household head's education) are broadly consistent with the wider development economics literature (Babatunde et al., 2007; Hailu & Nigatu, 2007; Onianwa & Wheelock, 2006) and reinforce that urbanization does not act in isolation: its food security effects are moderated by household demographic composition and human capital. Notably, the strong positive association between education and food security suggests that peri-urban households with more educated heads may be better positioned to diversify income away from agriculture as farmland is converted, buffering the food security shock that land conversion otherwise appears to impose (Wajid & Bashir, 2026). This points toward human-capital investment and non-farm livelihood diversification as complementary policy levers alongside land-use regulation.

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Two caveats temper these conclusions. First, as noted in Section 3.5, several categories in the logistic regression including the higher household-size and income brackets are estimated from a relatively small number of observations, and the resulting odds ratios, while informative directionally, warrant replication with a larger and more recent sample before being used to calibrate specific policy thresholds. This same sample-size constraint is the most likely explanation for why the two urbanization proxies (Urb1 and Urb2), despite showing the hypothesized negative direction, did not reach statistical significance: with 160 households distributed across four strata and a binary outcome, the model has limited statistical power to detect moderate effect sizes for any single covariate, and the wide confidence intervals around the urbanization coefficients (Table 4) are symptomatic of this. Second, because the analysis is cross-sectional, it identifies association rather than establishing the direction of causality between urban proximity and food insecurity with certainty; households already facing economic precarity may also be more likely to remain in, or be pushed toward, the urban-proximate strata where land values and living costs are rising fastest. Panel or repeated cross-sectional data following the same peri-urban corridor over time, together with a substantially larger sample, would help disentangle these pathways, establish whether the urbanization association reaches significance with adequate statistical power, and would also allow the findings reported here to be updated against current land-use and price conditions in Faisalabad's peri-urban fringe.

6. CONCLUSION AND POLICY IMPLICATIONS

This study set out to examine the association between urbanization and household food security in the peri-urban areas of Faisalabad, Pakistan. Using dietary-intake-based food security measurement and binary logistic regression across four strata spanning a 2–14 km urbanization gradient, it finds that 26% of sampled households were food insecure, and that both migrant status and proximity to the city center were negatively associated with household food security, net of income, household size, family structure, education, and headship age, although these two urbanization associations did not reach conventional statistical significance in this sample of 160 households. Several socio-economic covariates, particularly household heads' age, education, and income, showed strong and statistically significant associations with food security. These findings are directionally consistent with, and add household-level granularity to, recent national-level and peri-urban Faisalabad-specific evidence that unplanned urban expansion in Pakistan is undermining household food security (Farrukh et al., 2022; Wajid & Bashir, 2026), while also indicating that a larger sample is needed to establish the urbanization proxies themselves as statistically significant predictors net of household characteristics.

Read together with this recent literature, the results support several policy directions:

1. Agricultural land-use zoning. Legally binding zoning frameworks that restrict the conversion of productive peri-urban farmland to housing, together with mandatory food-security impact assessments for large land-use conversions, would directly address the land-conversion pathway identified in Faisalabad (Wajid & Bashir, 2026) and align with international farmland-protection practice (Saqib et al., 2024).

2. Spatially targeted social protection. Because food insecurity in this sample was concentrated in specific peri-urban strata rather than distributed evenly, safety-net and food-subsidy programming would be more cost-effective if targeted geographically, toward urban-proximate, high-conversion-pressure settlements, rather than allocated at the city or district level.

3. Livelihood diversification and skills training. Given the positive association between household head's education and food security, vocational and technical training programs in peri-urban labor colonies would help households transition from agriculture-dependent to diversified non-farm income sources as farmland is lost to urban expansion.

4. Land governance and tenure protection. Registration and regulation of housing societies, together with stronger tenure protections for tenant farmers displaced by land conversion (Saqib et al., 2025), would reduce the distress-driven land sales identified as a key mechanism of food security decline in the district.

5. Investment in peri-urban agricultural productivity. Continued investment in irrigation, inputs, and market access for the agricultural land that remains in production would help sustain local food supply even as the cultivated area contracts.

6. Distance-graduated food-support targeting. Given that food insecurity in this sample was concentrated in the 2–8 km band (Christian Town and Ashrafabad), the City District Government could pilot a distance-graduated eligibility rule for existing food-subsidy and cash-transfer programs (e.g., the Benazir Income Support Program) that gives priority weighting to households in peri-urban settlements within roughly 8 km of the city center, using the same union-council household listings employed for sampling in this study as a low-cost targeting frame.

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7. Migrant-household outreach. Because migrant status showed a negative point estimate for food security net of income and household structure, even though it did not reach statistical significance in this sample, municipal social-welfare offices in labor colonies could pilot intake points specifically for newly arrived migrant households to register them for existing nutrition and income-support schemes, rather than relying on programs that assume settled, long-resident populations, while treating this recommendation as precautionary rather than as evidence-confirmed targeting.

8. Future research should extend this analysis with a larger, updated household sample and, where feasible, panel data that can track the same peri-urban households as urban expansion proceeds, in order to more precisely identify the causal pathways and the most cost-effective points of policy intervention linking urbanization to household food security in Pakistan's rapidly growing secondary cities.

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