Socio-Economic Determinants of Women's Food Insecurity: A Case Study of Majhardiar Island, Rajshahi District, Bangladesh

Sumaiya Akter[1], Md Atiqul Islam[1*]

Department of Economics, University of Rajshahi, Rajshahi 6205

[*]Corresponding Author

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ABSTRACT

Food insecurity remains a pressing challenge in rural Bangladesh. Particularly, women who reside in geographically isolated and climatically vulnerable island (riverine island) areas. Despite evidence on the socio-economic dimensions of food insecurity at the national and rural level, empirical studies focusing on women's food insecurity in island regions remain limited. This study aims to identify the socio-economic determinants of women's food insecurity in Majhardiar Island, Rajshahi District, Bangladesh. A cross-sectional household survey was conducted with 100 women selected through a simple random sampling technique. Food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS). A Probit regression model with average marginal effects was employed to identify significant determinants of women's food insecurity. Approximately 92% of surveyed women were classified as food insecure. The Probit model revealed that age, education, household income, and land ownership significantly reduced the probability of food insecurity. In contrast, staple food production and flood exposure significantly increased it. Marginal effects indicated that land ownership reduced the probability of food insecurity by 62.9 percentage points, and flood exposure increased it by 67.3 percentage points. Targeted policy interventions are urgently needed, focusing on education, income generation, land access, and flood-disaster risk reduction to improve food security for women in these marginalised communities.

Keywords: Food Insecurity, Women, Island, Bangladesh

INTRODUCTION

Food security is defined as the state in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2023). It remains one of the foremost development challenges over the years. Despite remarkable progress in global agricultural production and poverty reduction, food insecurity continues to disproportionately burden populations in low- and middle-income countries, particularly women, children, and those living in geographically marginalized settings (Smith & Subandoro, 2007; FAO, 2023).

Bangladesh has achieved notable success in poverty alleviation, agricultural expansion, and social sector development over the past three decades. Nevertheless, chronic food insecurity persists as a formidable public health and development concern. According to the Global Hunger Index 2023, Bangladesh is identified as having 'moderate' levels of hunger, where rural households and climate-vulnerable communities face substantially elevated risks of food insecurity (IFPRI, 2023; Ria et al., 2025). Ecologically and socioeconomically vulnerable communities in Bangladesh are those who inhabit riverine island areas. They are characterized by recurrent flooding, riverbank erosion, geographic isolation, inadequate physical and social infrastructure, limited market access, and restricted availability of public services like education, healthcare, and social safety nets (Al Mamun et al., 2023; Sarker et al., 2019). Therefore, these constraints severely undermine agricultural productivity and income generation, causing them to be recognized as food insecure. Specifically, climate-induced disasters like flooding, cyclones, and sudden erosion events disrupt livelihoods and household assets.

Women in island areas face an additional and compounding layer of vulnerability that heightens their susceptibility to food insecurity. In many rural Bangladeshi communities, women's access to productive resources such as land, credit, and income-generating employment remains structurally constrained by prevailing gender norms and patriarchal household decision-making arrangements. Lower levels of educational attainment, restricted mobility, and limited participation in formal labour markets. It further diminishes women's capacity to respond effectively to food shortfalls and economic shocks (Haque et al., 2024). Previous research has identified education, household income, land ownership, access to credit, and dietary diversity as important determinants of food security and nutritional outcomes among women in rural Bangladesh (Mitu et al., 2022). Nonetheless, the specific socio-economic and vulnerability-related pathways through which these factors shape women's food insecurity in island environments remain insufficiently theorized and empirically documented. Despite a growing body of literature on food insecurity in Bangladesh, empirical fieldwork-based studies focusing specifically on women's food insecurity in island areas of northwestern Bangladesh remain sparse. More broadly, the study contributes to advancing the scholarly discourse on the intersecting dimensions of gender, geography, and food insecurity in the country's riverine contexts and provides insights relevant to the achievement of Sustainable Development Goal 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG 13 (Climate Action).

The specific objectives of this study are as follows:

1. To assess the prevalence and severity of food insecurity among island women using the Household Food Insecurity Access Scale (HFIAS).

2. To identify the socio-economic, demographic, and vulnerability-related determinants of women's food insecurity.

3. To provide evidence-based policy recommendations for improving food security among women in island areas of Bangladesh.

LITERATURE REVIEW

Theoretical Perspectives on Gender and Food Insecurity

Food security literature increasingly recognizes that household-level food adequacy does not guarantee equitable access for all household members. Intra-household allocation is shaped by gendered decision-making authority, so women's individual food insecurity can diverge from household-level measures (Smith & Subandoro, 2007). In patriarchal rural settings, women's structurally limited control over income, land, and productive assets constrains their bargaining position and their capacity to convert household resources into personal food security. This theoretical grounding is reinforced by more recent evidence: Moon (2024), in a systematic review on climate change and women's food security, concludes that floods, droughts, and other climate-related disasters disproportionately increase women's food insecurity by reducing agricultural production, income, and access to nutritious food. It indicates that gender vulnerability and environmental vulnerability compound rather than operate independently. Sarker et al. (2024) surveyed 480 rural women in southern Bangladesh, and found that women's empowerment, access to productive resources, and social support significantly improve household food security. While the absence of these resources leaves women disproportionately exposed. Together, this literature motivates the woman-level focus of the present study and frames female food insecurity in char areas as arising from the intersection of gendered resource access and environmental precarity.

Determinants of Food Security in Rural Bangladesh

A substantial body of empirical work has examined the socio-economic correlates of food security among Bangladeshi households. Mitu et al. (2022) analyzed the 2016 Household Income and Expenditure Survey (HIES) across Bangladeshi divisions. The study identified considerable heterogeneity in dietary quality and economic vulnerability, and confirmed education, income, land ownership, and household size as significant determinants of food security among rural women. Ria et al. (2025) estimated moderate food insecurity at approximately 51% nationally and identified poverty, land ownership, educational attainment, and high household dependency ratios as key risk factors. Several more recent studies reinforce and extend these findings.

Haque et al. (2024), using primary survey data from 350 farming households, showed that higher educational attainment improves women's food security through better resource management, improved nutritional knowledge, and stronger household decision-making, while land ownership emerges as a major determinant of food security in agrarian settings.

Harris-Fry et al. (2015) identified socio-economic determinants of household food security and women's dietary diversity. Jubayer et al. (2023), using the Bangladesh Integrated Household Survey (BIHS 2018–2019), found that education, electricity access, sanitation, livestock ownership, household assets, and food expenditure significantly reduce food insecurity, while larger family size increases it. Using a much larger sample of more than 15,000 households nationally, Tariqujjaman et al. (2023) confirmed that higher education of household heads and caregivers, greater household wealth, and improved socio-economic conditions significantly reduce food insecurity. Salman et al. (2023) surveyed 350 rural farming households in Bangladesh using the HFIAS and found that education, land ownership, savings, larger farm size, remittance income, and homestead gardening significantly reduced food insecurity, whereas larger household size increased it. Shuvo et al. (2024), examining rural households in southwestern Bangladesh, likewise identify low income, unemployment, limited education, and poor household assets as significant determinants of food insecurity. However, Asset ownership in particular receives sustained attention in the literature. Shifat et al. (2025) identified that ownership of productive assets significantly improves food security by increasing household calorie consumption and strengthening income-generating capacity. Vulnerability is not confined to rural populations alone: studying adolescents in urban slums during the COVID-19 pandemic, Yasmin et al. (2023) investigated that low household income, unemployment, and poor coping capacity significantly increased food insecurity, indicating that the underlying socio-economic drivers identified in rural studies extend to other structurally disadvantaged populations as well.

Climate Vulnerability and Food Security in Island Communities

Char areas sit at the sharpest edge of Bangladesh's climate vulnerability. Al Mamun et al. (2023) applied the Livelihood Vulnerability Index (LVI) to 262 households across char communities in Bangladesh, and found that flood inundation, riverbank erosion, and lack of basic services constitute the major components of livelihood vulnerability in these settings. Parvez et al. (2022) investigated the aftermath of the haor flood in northeastern Bangladesh. It documented significant post-flood food insecurity driven by crop loss severity, income loss, and reduced dietary diversity, illustrating the concrete mechanisms through which flooding erodes food security that are echoed in the flood-related findings of the present study.

Despite the extensive literature on food security in Bangladesh, empirical studies specifically examining women's food insecurity in char areas of northwestern Bangladesh remain notably absent. Most existing research relies on national household surveys that aggregate across diverse contexts and cannot capture the unique vulnerabilities of isolated island communities. The present study addresses this gap by conducting primary fieldwork in Majhardiar Island to investigate the socio-economic determinants of women's food insecurity in this ecologically and geographically vulnerable setting.

METHODOLOGY

Study Area

The study area was the riverine island Majhardiar in the Rajshahi district of the northwestern part of Bangladesh, shown in Figure 1. Rajshahi district is an agriculture-based region. The Padma River flows through the district. Thus, its floodplains are seasonally dominated, and islands arise along the river. Majhardiar Island is one of them with limited physical connectivity to urban opportunities. They lack access to modern facilities, including education, healthcare, electricity, and transportation, due to a water barrier. Households' livelihoods mainly depend on agriculture and livestock. The Island environment experiences flooding from June to September every year during the monsoon. Floods and riverbank erosion are common occurrences that result in agricultural land loss and household displacement.

Sampling Strategy and Data Collection

Primary data were collected using a structured household questionnaire survey. The study followed a simple random sampling method considering the island as a case study area. Island Majhardiar was selected for its environmental vulnerability, climate shocks, and food insecurity. The sample size was 100 island women, aged 18 years and above. The sample size of 100 was determined using the finite population correction formula for simple random sampling. This yields the maximum required sample size under conditions of unknown population variance. For the Probit regression model, the resulting ratio of 9.1 observations per estimated parameter (100 observations divided by 11 explanatory variables) exceeds the minimum of 5–10 observations per parameter recommended for logistic and probit regression (Hosmer et al., 2013), supporting the adequacy of the sample for reliable coefficient estimation and limiting the risk of overfitting.

The sampling frame was constructed from the most recent household list maintained for Char Majhardia. The households were selected using simple random sampling. One adult female respondent was selected from each household who cooked for the household. The interviews were collected based on specific characteristics of the respondents. The questionnaire was organised with socio-demographic characteristics, economic characteristics, livelihood characteristics, shock exposure, health condition, and women's dietary diversity, using the HFIAS indicator. Ethical considerations were upheld. Before the interview, the respondents consented to give selective information about themselves. Moreover, no personal information was collected throughout the data collection process.

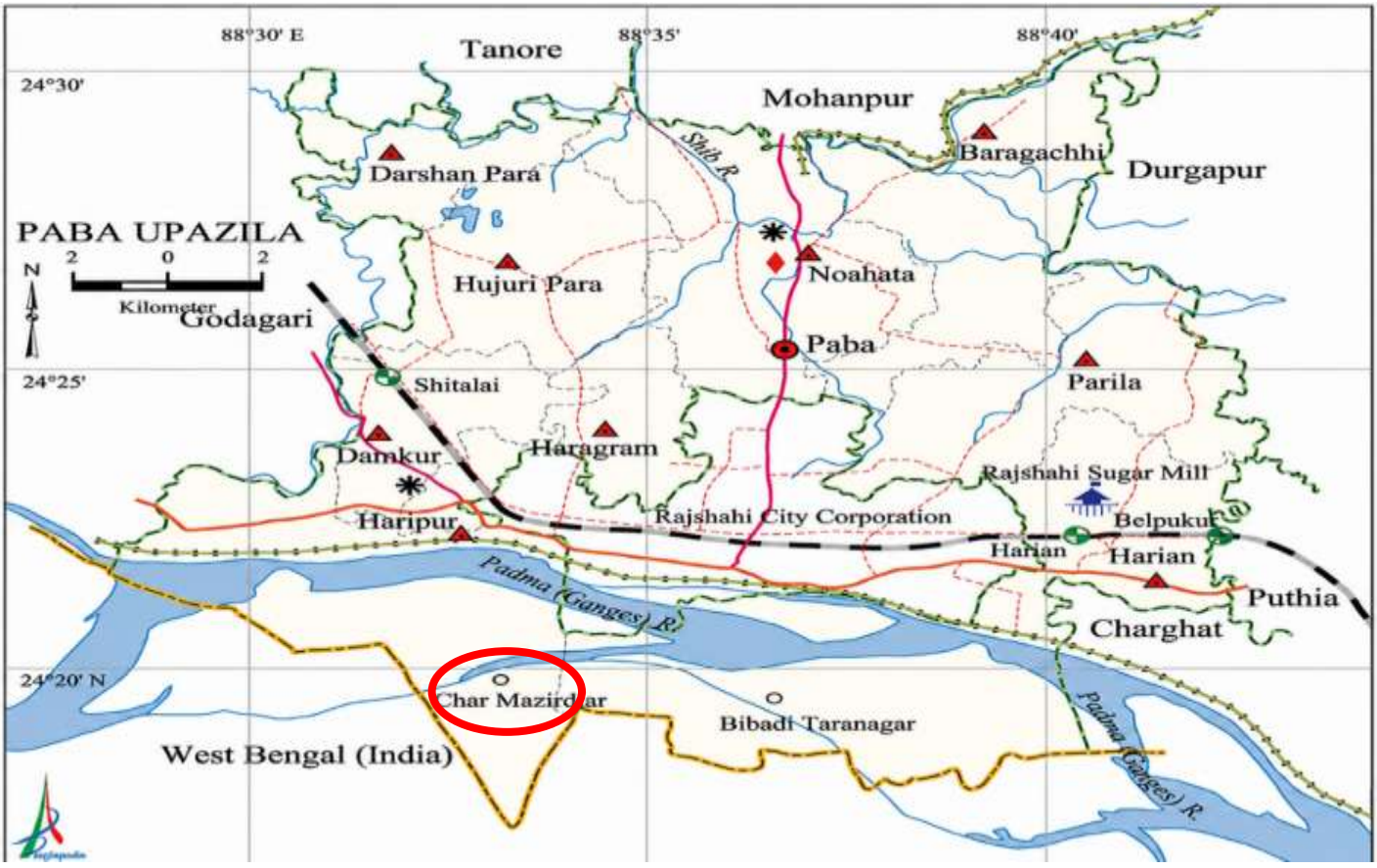

Figure 1: Study Area map, Source: Banglapedia (no date)

Measurement of Food Insecurity

The Household Food Insecurity Access Scale (HFIAS) was used to estimate household food insecurity. HFIAS was developed by the USAID-funded FANTA project and documented in Coates et al. (2007). It is a widely validated experience-based indicator for analysing food insecurity. It has nine standardised questions that cover the behavioural and psychological conditions associated with inadequate diet over the past four weeks. It captures three sections: (1) anxiety and uncertainty of food access, (2) inadequate food, and (3) insufficient food

amount. Every question was scored: 0 = Never, 1 = Rarely (once or twice), 2 = Sometimes (three to ten times), and 3 = Often (more than ten times). A possible range for the HFIAS score is 0 to 27 for every respondent. Higher scores demonstrate a greater scale of food insecurity, and lower scores indicate a lower severity of food insecurity. After that, a binary food insecurity indicator was created for applying the Probit regression analysis. Whereas an HFIAS score of 4 or below is considered food security.

Econometric Model

A probit regression model was specified to identify the socio-economic determinants of women's food insecurity. The Probit model is appropriate when the dependent variable is binary and ensures that predicted probabilities remain within the [0, 1] interval by employing a standard normal cumulative distribution function as the link function (Greene, 2012).

The latent variable specification is:

$$Y^* = \alpha + \beta_1 age_i + \beta_2 hhsize_i + \beta_3 edu_i + \beta_4 lnincome_i + \beta_5 land_i + \beta_6 credit_i + \beta_7 staple_i + \beta_8 flood_i + \beta_9 loss_i + \beta_{10} sick_i + \beta_{11} wdds_i + \varepsilon_i$$

where Y* is an unobserved latent variable representing the propensity for food insecurity; the observed binary outcome Y = 1 if Y* > 0 (food insecure) and Y = 0 otherwise; $\beta_1 \dots \beta_{11}$ represents the corresponding vector of parameters to be estimated; and ε_i is the error term assumed to follow a standard normal distribution. Accordingly, average marginal effects (AMEs) were calculated to quantify the change in the probability of food insecurity associated with a one-unit change in each continuous explanatory variable, or the discrete change from 0 to 1 for binary variables. AMEs provide a more interpretable and policy-relevant summary of the regression results (Cameron & Trivedi, 2010).

Table 1: Description of Variables

Variables	Definition	Measurement
Dependent Variable		
Food insecurity	HFIAS score	Binary
Independent variable		
Age	Age of the respondent	Category
Household Size	Number of members in the household	Continuous
Education	Educational attainment of the respondent	Category
Income	Monthly household income (BDT)	Continuous
Land	Land ownership	Binary
Credit	Access to credit	Binary
Staple Food	Production of staple food	Binary
Flood	Flood exposure	Binary
Loss	Seasonal income loss	Binary
Sick	Illness in last 1 month	Binary
WDDS	Women's Dietary Diversity Score (WDDS)	Continuous

Variable Specification

The dependent variable is a binary indicator of food insecurity (1 if food insecure, 0 if food secure), derived from the HFIAS score as described above. The independent variables were selected based on theoretical relevance and prior empirical literature. They are described in Table 1.

RESULT

HFIAS Indicator Responses

Table 1 highlights the nine HFIAS indicator responses that were used among 100 surveyed women in Island Majhardiar. This result exposes a high prevalence of moderate food insecurity. On the other hand, The Women's Dietary Diversity Score (WDDS) was calculated from a 24-hour dietary recall of consumption across ten food groups: (1) grains, white roots and tubers; (2) pulses and beans; (3) nuts and seeds; (4) dairy products; (5) flesh foods (meat, fish, poultry); (6) eggs; (7) dark green leafy vegetables; (8) vitamin A-rich fruits and vegetables; (9) other fruits and vegetables; and (10) oils and fats. This ten-group classification is a modified adaptation of the standard FAO Minimum Dietary Diversity for Women (MDD-W) framework, which typically uses nine food groups for non-pregnant, non-lactating women; oils and fats were retained here as a distinct group to capture an additional dimension of dietary quality relevant to this setting. Scores range from 0 to 10, with higher scores indicating greater dietary diversity.

Table 2. HFIAS indicator responses

Risk perception attributes	Not at all (0)	Rarely (1)	Sometimes (2)	Often (3)
1. Did you worry about not having enough food?	8	30	46	16
2. Could you not eat preferred foods due to a lack of money/resources?	8	23	58	11
3. Did you eat a limited variety of food due to a lack of resources?	4	38	50	8
4. Did you eat unwanted foods because you had no other choice?	18	42	33	7
5. Did you eat smaller meals than needed due to a lack of food?	9	47	36	8
6. Did you eat fewer meals in a day due to a lack of food?	12	45	40	3
7. Was there ever no food at all in your household?	47	49	4	0
8. Did anyone sleep hungry because there was not enough food?	88	12	0	0
9. Did anyone go a whole day and night without eating?	92	8	0	0

Note: The number of respondents reporting each frequency category for each HFIAS question. Questions scored: 0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Often.

Regarding food access anxiety, 46% of respondents reported being sometimes concerned about not having sufficient food, and 16% reported facing this concern often. 58% of respondents reported being unable to consume their preferred dietary items, and 11% described this as often. Limited dietary variety was reported sometimes by 50% and often by 8% of the respondents. Respondents' responses: 36% sometimes about reducing meal size, and 8% often. Besides, responses about daily meals were 40% sometimes and 3% often. Conversely, extreme food insecurity was comparatively low, with only 4 households reporting not having enough food at home to consume. Moreover, household members reported sleeping hungry due to insufficient food (12%), and 8% reported that a household member did not eat throughout the day and night. After investigation, these dietary patterns suggest that the study area does not have extreme food insufficiency but rather moderate-to-severe limitations in food availability.

Descriptive Statistics

Table 3 shows descriptive statistics of all explanatory variables. The average age of the respondent was 30–39 years old. The mean household size was 4.29 members. Educational attainment was low, as most respondents had no formal education and had only attained primary schooling. This outcome ensures that girls in the island

areas are deprived of basic secondary-level education. The average monthly income of the island people was BDT 7,480. Agricultural land was owned by 47% of households. Only 25% had access to formal or informal credit facilities, indicating a lack of financial services due to the community's geographic isolation.

Staple food production was reported by 54% of households. Floods affected 72% of households in the past 12 months. Approximately 68% reported experiencing seasonal income loss or employment loss. 62% of respondents reported having an illness. In addition, the reported WDDS of 5.31 out of 10 food groups indicates moderate dietary diversity, indicating that women consume from different food groups. Moreover, the value of the food insecurity score indicates that 92% of the surveyed women experienced food insecurity.

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev. (%)	Min	Max
Age	100	30-39	-		
Household size	100	4.29	1.76	2	8
Education	100	1.63	.734	1	3
Income	100	7480	7547.801	3000	80000
Land ownership	100	Yes	(47)		
Credit access	100	Yes	(25)		
Staple crop production	100	Yes	(54)		
Flood effect	100	Yes	(72)		
Flood loss	100	Yes	(68)		
Sick	100	Yes	(62)		
WDDS	100	5.31	1.419	2	9
Food insecure	100	Yes	(92)		

Probit Regression Results

Table 4 presents the results of the Probit regression model estimating the determinants of women's food insecurity in Majhardiar Island. The overall model demonstrated strong statistical significance and high explanatory power, while indicating that the selected covariates collectively account for a substantial proportion of the variation in women's food insecurity status. Six determinants, including age, education, household income, land ownership, staple food production, and flood exposure, were statistically significant at the 1% level. First, the coefficient of age was negative and statistically significant. Age was associated with a lower likelihood of food insecurity, with older women exhibiting lower food insecurity than younger women. It possibly reflects accumulated social capital, stronger household decision-making authority, experience with food management strategies, and more stable kinship. Similarly, education was significantly and negatively associated with food insecurity. Educated women are better positioned to access nutritional information, engage in income-generating activities, make informed food purchasing decisions, and participate meaningfully in household resource allocation processes.

Table 4. Determinants of Women's Food Insecurity

Food insecure	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Age	-1.232	.461	-2.67	.007***	-2.136	-.329
Household size	.173	.181	0.96	.338	-.181	.527
Education	-1.319	.415	-3.18	.001***	-2.133	-.505
Income	-5.802	1.797	-3.23	.001***	-9.325	-2.279
Land ownership	-16.018	4.133	-3.88	.000***	-24.119	-7.918
Credit access	-.443	.665	-0.67	.506	-1.746	.861
Staple crop production	16.902	4.472	3.78	.000***	8.136	25.667
Flood effect	17.149	4.42	3.88	.000***	8.485	25.813
Flood loss	-.174	.605	-0.29	.774	-1.36	1.012
Sick	.387	.681	0.57	.570	-.948	1.722

WDDS	.03	.254	0.12	.907	-.469	.528
Constant	56.707	16.309	3.48	.001***	24.742	88.672

Mean dependent var	0.920	SD dependent var	0.273
Pseudo r-squared	0.737	Number of obs	100
Chi-square	184.158	Prob > chi2	0.000
Akaike crit. (AIC)	38.679	Bayesian crit. (BIC)	69.941

Note: Dependent variable: Food Insecure (1 = food insecure if HFIAS > 4; 0 = food secure). Robust standard errors in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Household income was also significantly and negatively associated with food insecurity. Higher income directly enhances households' food purchasing capacity, greater asset accumulation, and precautionary saving. On the other hand, land ownership was significantly and negatively associated with food insecurity. Households that owned agricultural land were substantially less likely to be food insecure. It indicates land's dual role as a source of home-produced food and a productive asset. Counterintuitively, staple food production was positively and significantly associated with food insecurity. Households engaged in staple crop production were more likely to be food insecure than non-producing households. This seemingly paradoxical finding reflects the distinctive agro-ecological context of island areas. Flood exposure was also strongly and positively associated with food insecurity. This is consistent with greater vulnerability to food shortages among flood-affected households. Because flood exposure is measured here as a binary indicator, the large estimated effect should be interpreted as the average impact across the range of flood experiences reported in the sample, rather than the effect of any single level of flood severity. Given the near-annual recurrence of flooding in char areas, repeated exposure may also carry cumulative effects on household food security that a single binary indicator cannot fully capture. Therefore, it leads to high climate-related production risks, low yields, limited market access for selling output, and high input costs relative to earnings in agricultural production. Staple-producing households in islands often belong to the smallholder and near-landless strata. Therefore, they remain food insecure despite cultivation due to poor productivity and production shocks.

Lastly, Flood exposure indicates that households affected by flooding in the past 12 months were significantly more likely to be food insecure. Flooding in island areas destroys standing crops, inundates homestead land, displaces livestock, damages stored food stocks, disrupts transport and market access, and forces temporary displacement, all of which severely undermine household food security. However, household size, credit access, seasonal income loss, illness, and WDDS did not exhibit statistically significant associations with food insecurity in the full multivariate model. The non-significance of WDDS is noteworthy given the established relationship between dietary diversity and food security documented elsewhere. One plausible explanation is limited variation within this sample. This is because 92% of surveyed households were classified as food insecure; most respondents may already be consuming from a similarly restricted set of food groups regardless of their other socio-economic characteristics. While these variables may individually influence food security in bivariate analyses, their independent effects were attenuated after controlling for the more dominant socio-economic determinants.

Average Marginal Effects

Table 5 presents the average marginal effects, which quantify the change in the predicted probability of food insecurity associated with a unit change in each explanatory variable.

Table 5. Average Marginal Effects from Probit Model

Food insecure	dy/dx	Std. error	z	P>z	95% conf. int	
Age	-0.048	0.020	-2.410	0.016***	-0.088	-0.009
Household size	0.007	0.008	0.870	0.382	-0.008	0.022
Education	-0.052	0.019	-2.680	0.007***	-0.090	-0.014
Income	-0.228	0.083	-2.750	0.006***	-0.390	-0.065

Land ownership	-0.629	0.218	-2.890	0.004***	-1.055	-0.202
Credit access	-0.017	0.028	-0.630	0.529	-0.072	0.037
Staple crop production	0.663	0.232	2.860	0.004***	0.208	1.118
Flood effect	0.673	0.237	2.830	0.005***	0.208	1.138
Flood loss	-0.007	0.023	-0.290	0.771	-0.053	0.039
Sick	0.015	0.027	0.560	0.579	-0.038	0.069
WDDS	0.001	0.010	0.120	0.908	-0.019	0.021

Note: Marginal effects are evaluated at sample means of all variables. For binary variables, dy/dx represents the discrete change in probability from 0 to 1. Significance: *** p<0.01, ** p<0.05, * p<0.1.

The marginal effects results corroborate the directional findings of the Probit regression and provide quantitatively interpretable estimates of practical significance. The results show that moving from one age category to the next was associated with an approximately 4.8-percentage-point lower probability of food insecurity. Likewise, higher educational attainment was associated with a 5.2-percentage-point lower likelihood of food insecurity. Household income also played a substantial role: a one-unit increase in the natural logarithm of monthly income was associated with a 22.8-percentage-point lower probability of food insecurity. Furthermore, land-owning households were associated with a 62.9-percentage-point lower probability of food insecurity relative to non-landowning households. Agricultural land ownership was associated with the largest negative marginal effect among protective factors. It shows that households owning land were 62.9 percentage points less likely to be food insecure than landless households. The marginal effects further reveal that staple food production was associated with a 66.3-percentage-point higher probability of food insecurity relative to non-production. Flood exposure was associated with a 67.3-percentage-point higher probability of food insecurity. These large marginal effects of food insecurity indicate food vulnerability in the island environment.

DISCUSSION

The findings of this study reveal acute and pervasive women's food insecurity in Island Majhardiar, with 92% of surveyed women classified as food insecure based on HFIAS scores. This prevalence substantially exceeds Bangladesh's national estimates of rural food insecurity. It reflects the compounding effects of geographic isolation, recurrent environmental shocks, asset poverty, and gender-differentiated access to productive resources in the island environment (Al Mamun et al., 2023; Ria et al., 2025). The significant and negative effects of age and education on food insecurity are consistent with prior empirical evidence from Bangladesh and comparable South Asian settings. The age-protective effect likely reflects the accumulation of social capital, decision-making experience, and household authority over the life course, enabling older women to deploy more effective food coping strategies (Haque et al., 2024).

The education effect corroborates the human capital theory of food security, wherein higher educational attainment equips women with the knowledge, confidence, and economic capabilities to improve household food provisioning (Harris-Fry et al., 2015; Mitu et al., 2022). The finding that most respondents in the study area had either no education or only primary schooling highlights the structural educational deficit in island communities and underscores the urgent need for expanded educational access in these settings. The powerful income effect on food insecurity reflects the overriding importance of economic purchasing power in determining food access in market-integrated rural economies. This aligns with the wealth gradient documented by Ria et al. (2025) at the national level in Bangladesh and with international evidence linking economic poverty to vulnerability to food insecurity (Ogunniyi et al., 2021). Land ownership emerged as the strongest protective factor against food insecurity. This finding is in close agreement with the broader literature identifying land as a foundational productive asset in rural food systems (Harris-Fry et al., 2015). In the island context, land ownership is particularly significant because it enables both home food production and asset-backed borrowing. Island-area households that have lost land through erosion effectively face a double jeopardy of reduced food production capacity and weakened economic resilience.

Rather than reflecting a straightforward paradox, the positive association between staple food production and food insecurity likely reflects a compositional effect: households that engage in staple food production in this

island area are disproportionately small-scale, near-landless, or newly resettled households with minimal productive capacity, poor access to inputs, and high exposure to production shocks (flooding, pests, post-harvest losses). These households may cultivate food out of necessity in the absence of alternative livelihood options. This interpretation is consistent with evidence from comparable flood-prone agricultural settings in Bangladesh (Parvez et al., 2022), where subsistence-oriented farming does not guarantee food security without complementary income sources and risk-management capacity. It highlights the need for productivity enhancement, improved market access, and agricultural risk management support for island-area farming households.

The large positive effect of flood exposure on food insecurity confirms that flooding is the dominant environmental driver of food insecurity in Majhardiar island. Floods in island areas cause multiple compounding food security shocks: destruction of standing and stored crops, loss of livestock, damage to housing and productive assets, disruption of agricultural wage employment, temporary household displacement, and impaired market access (Ahmed, 2024; Al Mamun et al., 2023; Parvez et al., 2022). The near-annual nature of flooding in this setting means that affected households have limited time to fully recover their food security status before the next flood event.

Study Limitations

While the Probit model controls for observed confounders, the cross-sectional nature of the data limits the ability to draw causal inferences. Unobserved factors such as household-level unmeasured characteristics, community-level influences, or measurement error may affect both the explanatory variables and food insecurity outcomes. Reverse causality is also plausible for variables such as income and land ownership, since food insecurity may itself contribute to asset depletion and income loss through distress sales of land or livestock and reduced labour productivity. Future longitudinal research is needed to establish the causal pathways through which these determinants affect women's food security.

Overall, several limitations of this study should be acknowledged. First, the cross-sectional design precludes causal inference and does not capture seasonal or inter-annual variation in food security, which may be substantial given the seasonality of floods and agricultural cycles. Second, the relatively small sample size (n = 100) and focus on a single char limit the generalizability of the findings to other char communities, although the detailed description of the study context facilitates comparison with similar settings. Third, the use of self-reported HFIAS data may be subject to recall bias and social desirability bias, particularly for sensitive questions about household food shortages. Fourth, the analysis includes only a limited set of environmental variables and does not directly measure other potentially important factors such as market access, social networks, and intra-household food allocation patterns. Despite these limitations, the study provides valuable empirical evidence on the determinants of women's food insecurity in a highly vulnerable and under-researched setting.

CONCLUSION AND POLICY IMPLICATIONS

This study identified the prevalence and socio-economic determinants of women's food insecurity in Majhardiar Island, Rajshahi District. It is one of the geographically isolated and climatically vulnerable riverine islands. Using the HFIAS indicator and Probit regression with average marginal effects, we found that 92% of surveyed women in Majhardiar Island experienced moderate food insecurity. The determinants of women's food insecurity, age, education, household income, land ownership, staple food production, and flood exposure, are statistically significant in this study. The likelihood of food insecurity is significantly reduced by older age, higher educational attainment, higher household income, and agricultural land ownership. However, staple food production and flood exposure significantly increase food insecurity. This study found that structural poverty, asset destruction, and environmental vulnerability are the primary drivers of food insecurity in island areas. This study provides empirical evidence on the socio-economic determinants of food insecurity in the vulnerable island community in Bangladesh. This case study is a methodologically robust fieldwork-based analysis that explains a gap in the literature on women's food insecurity in island areas. The results have policy implications for achieving women's food security among the most vulnerable women's communities.

The following policy recommendations are derived from the empirical findings of this study:

Expanding Educational Access in Island Areas

Infrastructural development is necessary to improve the quality of education in island areas, such as the construction of flood-resilient school buildings. Besides incentives for school enrolment, adult literacy programmes have to focus on targeting and expanding food and nutritional knowledge to reduce food insecurity among women in island areas.

Income Generation and Livelihood Diversification

Income is an essential determinant of protection against food insecurity within island areas. Sustainable livelihoods are a fundamental means of generating income in island areas and help reduce food insecurity. Several income-generating activities should take place, such as those that are resilient to seasonal flooding, including non-farm and off-farm employment, handicraft production, homestead gardening, aquaculture, and poultry rearing. In addition, skill development programmes for women have to be implemented. Besides the government, the Department of Women Affairs and the NGO should take the initiative to collaborate.

Securing Land Rights for Island Households

Policies need to be taken to improve land tenure security for island households. The government should intervene by implementing strengthened and systematic programmes for island land allocation and title registration, including reserved allocations for women-headed and landless households.

Flood Disaster Risk Reduction and Food Security Safety Nets

A disaster risk reduction initiative is necessary to mitigate flood hazards in island areas. There are several strategies to reduce flood risk, including constructing and maintaining river embankments, building high-rise dwellings, improving flood-prevention systems, and making information accessible to the island people. Furthermore, promote the regulation of climate-resilient agricultural inputs (flood-tolerant crop varieties, raised seed beds). During floods, quick humanitarian food assistance and cash transfer programmes should be expanded to protect against the disaster. Another provision to be taken is Vulnerable Group Development (VGD) and Vulnerable Group Feeding (VGF) schemes to ensure food security among island women.

Improving Agricultural Productivity and Market Access

Island people face agricultural production constraints and lack access to purchase raw materials or sell goods in the market. Island farmers face unexpected situations in their staple food production and food insecurity. Advanced agricultural practices through extension services, flood-resistant crops, and post-harvest management strategies should be improved. Besides, seasonal bridges, subsidies for boat transportation, and mobile market services would improve island farmers' ability to supply inputs and sell outputs in markets. Thus, the farmers' conditions in the island areas will improve.

Gender-Responsive Programming

Gender is a crucial issue for evaluating food insecurity. Policies should adopt a gender-responsive approach, which is valuable for identifying food insecurity among women. Especially in the island areas, women are extremely vulnerable to getting basic facilities. There are several inequalities across areas such as education, land rights, economic opportunity, and household decision-making. Policy should focus on women's education and treatment, and on ensuring basic opportunities. Food security programmes should be properly monitored and observed to ensure there is no disparity between males and women.

Given the resource constraints facing both government and non-governmental actors, the following prioritization is recommended: (1) immediate, short-term interventions should focus on flood disaster risk reduction and emergency food assistance, given the overwhelming impact of flooding on food insecurity; (2) medium-term interventions should prioritize securing land rights and expanding access to education, as these are foundational determinants with large protective effects; and (3) long-term interventions should address income generation, agricultural productivity, and gender-responsive programming to build sustainable resilience. This phased

approach ensures that the most pressing threats are addressed first while building the structural conditions for sustained food security improvement. Implementing these recommendations will face significant challenges, including limited institutional capacity in remote island areas, political economy constraints in land reform, and the need for coordination among multiple government and NGO actors. Overcoming these challenges will require sustained political commitment, adequate resource allocation, and community participation in programme design and implementation.

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