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INCOME DIVERSITY AND FOOD SECURITY STATUS OF HAOR POPULATION IN SELECTED AREAS OF NETROKONA DISTRICT, BANGLADESH

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ABSTRACT

The haor region of Bangladesh faces persistent challenges of poverty, food insecurity, and limited livelihoods due to wetland ecosystems and seasonal flooding. This study examined socio-economic conditions, income diversification, and food security in Mohanganj and Khaliajuri upazilas of Netrokona district. Data were collected from 120 randomly selected households between October and December 2024, using structured interviews. Income diversification was measured using Simpson and Shannon indices; food security was assessed by the Direct Calorie Intake method. Results showed agriculture (26.67%), small business (23.33%), and day labour (21.67%) as primary income sources, with average monthly income (Tk 17,758) far below the national rural average. Diversification across respondents was high (Simpson index: 0.81; Shannon equitability: 0.88), but 45% of households had no occupational diversity among family members. Food insecurity was widespread: 23.33% of households were ultra poor and 29.17% were hardcore poor. Major constraints included poor sanitation, unsafe water, limited access to education and healthcare, and natural disasters. Development initiatives must promote sustainable income diversification, improved public services, and resilient infrastructure.

Keywords: *income diversification; food security; calorie intake; Simpson index; haor; Bangladesh.*

INTRODUCTION

Bangladesh is predominantly a rural and agrarian society in which the majority of the population depends on agriculture for its livelihood. Agriculture in Bangladesh, however, is highly sensitive to climatic variability: the country experiences frequent floods, riverbank erosion, cyclones, variable rainfall, droughts, and saline intrusion because of its geographic location (Alam et al., 2019). These environmental stresses repeatedly disrupt agricultural productivity and expose rural communities to economic risk. Income diversification is therefore regarded as an essential strategy for building livelihood resilience in risk prone areas. By engaging in multiple income generating activities, households can mitigate the effects of crop failure, market volatility, and health shocks, stabilise income flows, and reduce dependence on any single sector (Hossain, 2024; Mahedi et al., 2024). Empirical studies in Bangladesh and elsewhere have consistently linked broader income portfolios to improved household welfare and food security (Dev et al., 2017; Ahmed and Hossain, 2021).

Nowhere is this more relevant than in the haor basin of northeastern Bangladesh. Haors are large bowl-shaped wetland depressions that remain submerged for a substantial part of the year. The basin covers about 858,460 hectares across seven districts and contains 373 haors (Table 1), of which Netrokona district alone holds 52. Communities in these areas live with recurrent flash floods, wave erosion, and a single crop production system. Therefore, access to land and fishing resources is restricted and livelihoods are highly seasonal. Poverty, undernutrition, and weak public services are persistent features of haor life.

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Table 1: Haor regions of Bangladesh

District	Total area (ha)	Haor area (ha)	Number of haors
Sunamganj	367,000	268,531	95
Sylhet	349,000	189,531	105
Habiganj	263,700	109,514	14
Maulvibazar	279,900	47,602	3
Netrokona	274,400	79,345	52
Kishoreganj	273,100	133,943	97
Brahmanbaria	192,700	29,616	7
Total	**1,999,800**	**858,460**	**373**

Source: BBS (2022).

Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs. It rests on four pillars: availability, access, utilisation, and stability. In the haor environment each pillar is threatened, because production is concentrated in a single boro rice season, incomes are low and irregular, nutrition knowledge is limited, and floods repeatedly destroy crops and homesteads. Understanding how income diversification relates to food security in this setting is therefore of direct policy relevance.

Against this background, the present study pursued four objectives: (i) to assess the socioeconomic characteristics of sample households; (ii) to estimate their income diversity status; (iii) to measure the calorie intake of household members; and (iv) to identify the problems and constraints faced by the households. The paper condenses the findings of an MS thesis completed at Bangladesh Agricultural University and presents them in a form intended for a wider research and policy audience.

MATERIALS AND METHODS

Study Area, sampling and data

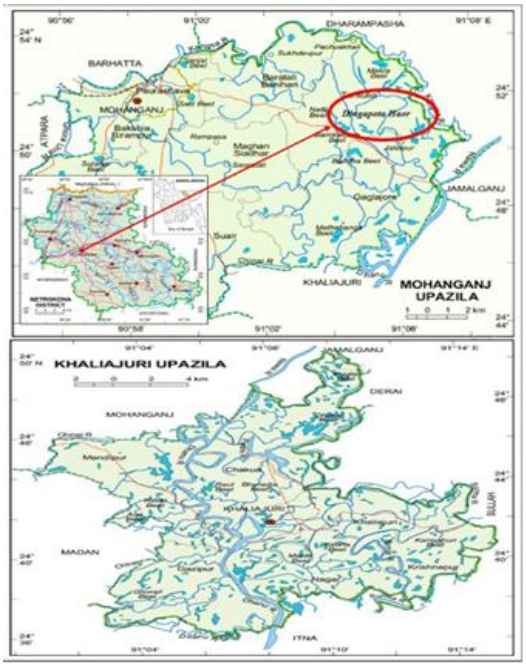

Fig. 1: Map of Mohanganj and Khaliajuri upazilas of Netrokona District

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The study was conducted in four villages, Boldoshi, Rampasha, Baniapara, and Kistopur, located in Mohanganj and Khaliajuri upazilas of Netrokona district along the Dingaputa haor. These upazilas are among the most vulnerable parts of the district in terms of flooding and erosion. A simple random sampling procedure was used to select 120 households, without focusing on any particular occupational group, so that all types of residents whose subsistence is influenced by the wetland system could be represented. Primary data were collected by the researcher through in person interviews using a structured questionnaire during home visits from October to December 2024. Respondents were informed of the purpose of the study before the interviews. Supplementary information was obtained from teachers and community representatives, and secondary data were drawn from the Bangladesh Bureau of Statistics, published reports, and related literature.

Analytical techniques

Data were entered into Microsoft Excel, checked, and analysed mainly through tabular techniques based on averages and percentages. Income diversification was measured with two complementary indices. Following Culas and Mahendrarajah (2005), Minot et al. (2006), and Ibrahim et al. (2009), the Simpson Index of Diversity (SID) was computed as —

$$SID = 1 - \Sigma \frac{n(n-1)}{N(N-1)}$$

where n is the number of income earners in an individual income source and N is the total across all sources. SID ranges from 0 (a single income source) to 1 (maximum diversification). Households were classified into five diversification categories on the basis of SID values drawn from the literature and expert consultation (Sarker et al., 2020); the class boundaries are reported together with the results in Table 6.

For robustness, the Shannon diversity index, widely applied to income and crop diversity by Di Falco and Perrings (2005) and Asfaw et al. (2017), was also estimated as

$$H = -\Sigma pi_i ln(pi_i)$$

where p_i is the share of income source i. The associated Shannon equitability index,

$$EH_H = \frac{H}{ln(S)}$$

with S the number of distinct income sources measures the evenness of the distribution of earners across sources and ranges from 0 to 1, where 1 indicates complete evenness.

Food security was assessed with the Direct Calorie Intake method. Household food consumption was recorded, converted to per capita daily calorie intake, and compared with recommended daily allowances of 2,394 kcal for men and 2,142 kcal for women (Heck et al., 2010). Households were then classified as ultra poor, hardcore poor, absolute poor, or nonpoor using the thresholds of the Bangladesh Economic Review (BER, 2012), which are reported with the results in Table 8.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the sample households

Table 2 summarises the demographic and social profile of the respondents. The overwhelming majority of households (93.33 percent) are headed by men; households headed by women, mostly widowed or divorced, account for only 6.67 percent and are typically more vulnerable both socially and economically. Most respondents (77.5 percent) belong to the working age group of 30 to 64 years. Educational attainments are strikingly low: 23.33 percent of respondents have no schooling, 35.83 percent completed only primary education, and a mere 3.33 percent hold graduate degrees. This is far below the national literacy rate of 74.0 percent (HIES, 2022) and constitutes a structural barrier to occupational mobility, health awareness, and participation in community decision making.

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Occupationally, agriculture remains the single most important source of livelihood (26.67 percent) of household heads, followed closely by small business (23.33 percent) and day labour (21.67 percent). Salaried employment is nearly absent, with government and non-government jobs together accounting for only 5 percent. The prominence of casual and informal work reflects the repeated loss of agricultural land to floods and riverbank erosion, which pushes households out of farming and into rickshaw or van pulling, petty trade, handloom work, and seasonal migration. Housing conditions mirror this economic fragility; 45 percent of families live in tin houses and 21.67 percent in kaccha structures, while only 10.83 percent occupy brick-built homes. Residents deliberately choose cheap construction materials because dwellings can be damaged by flooding at any time.

Table 2: Socio-economic characteristics of the sample households (n = 120)

Characteristic		Number of respondents	Percentage (%)
Gender of household head	**Male**	112	93.33
	Female	8	6.67
Age group (years)	**15 to 29**	21	17.50
	30 to 64	93	77.50
	65 and above	6	5.00
Level of education	**Illiterate**	28	23.33
	Primary	43	35.83
	Secondary	39	32.50
	Higher secondary	6	5.00
	Graduate and above	4	3.33
Main occupation	**Agriculture**	32	26.67
	Small business	28	23.33
	Day labour	26	21.67
	Rickshaw or van puller	13	10.83
	Nongovernment job	4	3.33
	Government job	2	1.67
	Unemployed	4	3.33
	Others	11	9.17
Housing pattern	**Kaccha**	26	21.67
	Tin	54	45.00
	Semi brick	27	22.50
	Brick	13	10.83

Source: Field survey (2024).

Table 3 relates family size to household income. The average family size of 5.10 persons exceeds the national average of 4.26 (HIES, 2022), a pattern common among poor riverside communities where children are viewed as future labour and family planning services are weak (Johara et al., 2016). While small family size can cushion households against economic shocks by lowering consumption needs (Parvin and Haque, 2017), larger families in the study area partly compensate through additional earners: households with more than six members report the highest average monthly income (Tk 22,540). Even so, the overall average income of Tk 17,758 per month falls far below the national rural average of Tk 26,163 (HIES, 2022), confirming the depressed living standards of haor communities.

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Table 3: Family size and monthly income of the sample households

Family size category	Number of respondents	Percentage (%)	Total members	Average monthly income (Tk)
Small (1 to 4)	50	41.67	195	16,350
Medium (5 to 6)	53	44.17	289	14,380
Large (above 6)	17	14.17	124	22,540
All households	**120**	**100.00**	**608**	**17,758**

Source: Field survey (2024). Average family size is 5.10 persons.

Access to facilities and services

Access to basic amenities is uneven (Table 4). Electrification is universal and mobile phone use nearly so (97.5 percent), reflecting the reach of national infrastructure programmes. Safe drinking water, however, is available to only 79.2 percent of households, irrigation to 65 percent, and institutional credit from formal, semiformal, or informal sources to 47.5 percent. Training opportunities in agriculture, women's empowerment, and youth development reach just 30 percent of households; respondents reported that such programmes and credit facilities are often captured by locally influential groups, leaving many of the neediest households excluded.

Women's economic participation is particularly restricted; only 25 percent of households provide an environment in which female members can earn income, and several of these are households headed by women that have no alternative earner. Rural women perform extensive unpaid work in livestock care, food processing, water collection, and caregiving, yet these contributions carry no recognised economic value (Sharmin et al., 2016). Expanding women's access to credit, education, and training is widely seen as central to empowerment and poverty reduction (Khanum et al., 2022; Akter, 2022). Healthcare seeking behaviour shows encouraging signs: 63.33 percent of households consult qualified MBBS physicians, although 30 percent still rely on village doctors and 6.67 percent on traditional healers, mainly because of financial constraints and limited awareness.

Table 4: Household access to basic facilities, women's income generation, and medical care. (n = 120)

Items		Yes (No.)	Yes (%)	No (No.)	No (%)
Basic facilities	**Electricity**	120	100.0	0	0.0
	Mobile phone	117	97.5	3	2.5
	Safe drinking water	95	79.2	25	20.8
	Irrigation facility	78	65.0	42	35.0
	Training facilities (agriculture, women's empowerment, youth development)	36	30.0	84	70.0
	Loan facility	57	47.5	63	52.5
Income generating facilities for women	**Women engaged in income generation**	30	25.0	90	75.0
Usual source of medical treatment (distribution of households)	**MBBS or specialised doctor**	76		63.33	
	Village doctor	36		30.00	
	***Kabiraji* (traditional healer)**	8		6.67	

Source: Field survey (2024).

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Income diversity status

Rural households in disaster prone economies diversify income to reduce risk and smoothen consumption (Sultana et al., 2015). Table 5 presents the occupational composition of the sample together with the aggregate diversity indices. The Simpson index of 0.81 exceeds the 0.75 threshold for very high diversification, and the Shannon equitability index of 0.88 indicates that earners are spread relatively, though not perfectly, evenly across income sources. At the community level, therefore, the haor economy is highly diversified: alongside '*Boro*' rice cultivation, households engage in fishing during the monsoon, duck rearing and small poultry enterprises, petty trade, handloom work, transport services, and seasonal labour migration to nearby upland areas.

Table 5: Income diversity of the respondents in the study area

Occupation	Number of respondents	Percentage (%)	Simpson index	Shannon equitability index
Agriculture	32	26.67	0.81	0.88
Small business	28	23.33		
Day labour	26	21.67		
Rickshaw or van puller	13	10.83		
Others	11	9.17		
Nongovernment job	4	3.33		
Unemployed	4	3.33		
Government job	2	1.67		

Source: Field survey (2024). Index values are computed over all income sources of the sample.

A markedly different picture emerges within households (Table 6). In 45 percent of families, all earning members share the same occupation, so there is effectively no diversification inside the household, while only 28 percent of households show very high internal diversification. The explanation is structural: households impoverished by erosion cannot afford hired labour, so family members work together in the same farm plot, loom, or small enterprise, minimising cash outlays. Diversification is therefore high between households but low within them, particularly among poorly educated, low-income families. Because all earnings from a single activity move together; such households remain exposed to sector specific shocks despite the apparent diversity of the wider community; and their capacity to save and invest is severely constrained.

Table 6: Distribution of households by level of income diversification within the household

Category of diversification	SID value	Percentage (%) of households
No diversification	Below 0.01	45
Low level diversification	0.01 to 0.25	12
Medium level diversification	0.26 to 0.50	15
High level diversification	0.51 to 0.75	20
Very high-level diversification	Above 0.75	28

Source: Field survey (2024). Category boundaries follow Sarker et al. (2020)

Food consumption and calorie intake

Table 7 compares daily per capita food intake in the study area with national averages. Consumption is heavily tilted toward rice, at 500 g per person per day against a national average of 328.92 g, while fish (91.84 g) and eggs (17.14 g) also exceed national levels, reflecting the wetland resource base. In contrast, intakes of vegetables, pulses, oil, meat and poultry, and milk all fall below national averages. The diet is thus calorie dense but nutritionally unbalanced, dominated by staples and lacking diversity in protective and protein rich foods.

Table 7: Daily per capita food intake compared with the national average (g per person per day)

Major food item	Study area intake	National average intake	Difference
Rice	500.00	328.92	171.08
Potato	71.42	69.70	1.30
Vegetables	171.42	201.92	−30.50
Pulses	14.28	17.15	−2.87
Oil	28.57	30.85	−2.28
Meat and poultry	42.86	52.78	−9.92
Egg	17.14	12.73	4.41
Milk	31.42	34.10	−2.68
Fish	91.84	67.83	24.01

Source: Field survey (2024); national averages from HIES (2022).

The calorie-based poverty classification in Table 8 reveals the depth of food insecurity. Nearly a quarter of households (23.33 percent) are ultra poor, consuming on an average only 1,435.52 kcal per day, and a further 29.17 percent are hardcore poor at 1,720.65 kcal. Another 21.67 percent fall in the absolute poor class, leaving only 25.83 percent of households above the 2,122-kcal threshold that marks the nonpoor. In total, roughly three quarters of the sample consume less than the recommended allowances of 2,394 kcal for men and 2,142 kcal for women (Heck et al., 2010). Importantly, undernourishment is not solely a problem of purchasing power: many respondents with the means to buy food lacked knowledge of nutritional value and balanced diets, so poor dietary choices persisted even where access existed. Nutrition-education therefore deserves attention alongside income support.

Table 8: Distribution of households by daily per capita calorie intake

Category	Calorie threshold (kcal)	Number of respondents (%)	Average intake (kcal per person per day)
Ultra poor	Below 1,600	28 (23.33)	1,435.52
Hardcore poor	1,600 to 1,804	35 (29.17)	1,720.65
Absolute poor	1,805 to 2,122	26 (21.67)	2,089.46
Nonpoor	Above 2,122	31 (25.83)	2,178.25

Source: Author's estimation from field survey (2024); thresholds from BER (2012).

Problems and constraints faced by the households

Respondents identified a wide range of constraints (Table 9). Sanitation is the most frequently reported problem (38.33 percent), followed by lack of safe drinking water (29.17 percent); together these expose the population to diarrhoea, cholera, skin infections, and other waterborne diseases, a paradox in a region surrounded by water for much of the year. Educational deficits (26.67 percent) and inadequate health services (21.67 percent) constrain human capital formation, while housing problems (15.83 percent), food insecurity (13.33 percent), security concerns (10.83 percent), and electricity shortages (7.5 percent) reflect broader infrastructure and governance gaps. Households also devote a large share of annual income to repairing flood damaged homes, which further erode their capacity to invest in productive assets.

Table 9: Problems and constraints faced by the respondents in the study area

Problem or constraint	Number of respondents	Percentage (%)
Sanitation	46	38.33
Safe drinking water	35	29.17
Education	32	26.67
Health	26	21.67
Housing	19	15.83
Food	16	13.33
Security	13	10.83
Electricity	9	7.50
Others	4	3.33

Source: Field survey (2024). Multiple responses were allowed.

CONCLUSION AND POLICY RECOMMENDATIONS

The haor region of Netrokona represents a complex social and ecological system marked by recurrent environmental hazards, persistent poverty, and food insecurity. This study documents low educational attainment, informal and unstable employment, household incomes far below the national rural average, and restricted access to safe water, sanitation, training, and credit. Income diversification across the community is very high, confirming its role as the central coping strategy against floods and erosion, yet diversification within households is limited. Therefore, many families remain vulnerable to shocks that strike their shared occupation. Despite abundant fish and rice availability, roughly three quarters of households consume less than recommended calorie levels, and dietary quality is poor, indicating that food insecurity in the haor is driven jointly by low incomes, seasonality, and weak nutrition knowledge.

Income diversity nevertheless matters for food security: households with multiple, independent income streams are better able to maintain food access when crops fail or markets fluctuate, and can afford more varied diets and healthcare. Policy should therefore aim to deepen diversification within households rather than merely across them. Four priorities emerge from the findings. First, safe drinking water, hygienic latrines, and basic health services should be extended through coordinated public and NGO efforts, supported by hygiene awareness campaigns, since sanitation and clean water emerged as the leading constraints. Second, adaptive income sources and early warning systems for floods should be strengthened to reduce livelihood disruptions from floods and riverbank erosion. Third, education and vocational training should be prioritised so that individual family members can enter different occupations, raising diversification inside the household. Fourth, targeted food assistance, balanced diet campaigns, and community-based nutrition interventions should be implemented, with particular attention to flood prone seasons.

The study is subject to limitations. The sample of 120 households may not represent the entire haor population; respondents kept no written records, and local measurement units complicated data conversion. Additionally, the three-month survey window could not capture full seasonal variation in income and food security. Future research using panel data across seasons and explicitly modelling the causal link between within-household-diversification and calorie intake, would strengthen the evidence base for haor development policies.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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