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Exploring Consumer Decision-Making and Preferences for *Haor*-Captured Fish in North-Eastern Bangladesh

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ABSTRACT

Haor fish are one of the significant food items in Bangladeshi consumers' diets. This study aimed to explore consumers' purchasing preferences for *haor* fish and interviewed 200 respondents from eleven northeastern fish markets through convenience sampling. The ordered logit model was applied to determine the factors behind consumers' preferences. Results revealed that 58% of consumers highly preferred to buy *haor* fish, while 35% and 7% showed moderate and low preferences, respectively. The statement "*haor* fish are a great source of protein" received the highest consumer variation (1.96), while the lowest variation (0.10) was for the statement "premium quality *haor* fish are not sold locally." Monthly income, expenditure on *haor* fish, average price of *haor* fish, freshness, and taste were found to affect consumer preferences significantly. On average, 77% of consumers lessened their consumption when the price increased, while 23% continued their consumption irrespective of the price rise. Despite having strong preferences for *haor* fish, nearly 45% of consumers' consumption has significantly reduced above 10% from their usual level, due to the Covid-19 pandemic. However, 74% of consumers responded about the extreme use of chemical inputs, premature harvesting of fish using prohibited nets, illegal occupying of *haor* lands and excavation, and destroying natural sources of fish food as responsible factors for the reduced market supply of *haor* fish. Extension services can be provided to fisherman regarding sustainable *haor* fish production and restore wetland ecosystem. Also, authorized marketing agencies may arrange regular market monitoring to ensure affordable purchasing power for consumers.

Keywords: Bangladesh; Consumer preferences; Covid-19; Haor fish; Likert scale; Ordered logit model

1. Introduction

Aquatic biodiversity and wetland resources are valued as essential elements for the ecosystems of any territory. The availability of vast aquatic resources and species provide adequate support to Bangladeshi's fisheries potential (Uddin *et al*., 2019; Shamsuzzaman *et al*., 2017). The Fisheries sub-sector of Bangladesh contributes 3.50% to its GDP and 25.72% to the agricultural GDP (Hasan *et al*., 2021; DoF, 2019). Over 12% of the country's total population is employed in it, both on a permanent and temporary basis. This sub-sector improves the country's food security by delivering safe, high-quality animal protein. As expected, this sub-sector has grown by 5.43% during the past decade (Shamsuzzaman *et al*., 2020). During 2018-19, Bangladesh exported almost 73.17 thousand MT of fish and fishery products, earned BDT 4250.31 crore (DoF, 2019). Inland capture, culture, and marine fisheries are the three sub-groups of the country's fisheries resources, which include approximately 260 freshwater fish species (DoF, 2019 & 2018). Also, Bangladesh has rich and diversified freshwater fisheries resources, which can be found in *rivers,*

estuaries, flood plains, beels, lakes, ponds, ditches, baors and haors, etc. (Alam *et al.*, 2014; Rahman, 2005).

Haor is a floodplain depression in the shape of a bowl or saucers with some deeper areas that physically resemble an inland sea during the monsoon season and segregate into *beels* throughout the dry season (Pandit *et al.*, 2021; BHWDB, 2012). It is a very low-lying river basin area, like swamp land, covered by water for almost six months of the year, starting from the monsoon season. The *haor* basin's identical hydro-ecological and socio-economic traits have created abundant opportunities, which help differentiate it from the surrounding hilly land. It is an extremely productive natural resource and an essential carrier of unique biodiversity. In Bangladesh, 373 *haors* with an area of approximately 8,59,000 ha are in the north-east, northern, and eastern parts, accounting for 43% of the total areas of *haor* districts. Out of these 373 *haors*, 217 are in the north-eastern part, which accounts 25% of the country's northeast wetland basin, significantly contributing to the country's economy by producing freshwater fish (Pandit *et al.*, 2015; BHWDB, 2012). Although, *haor* and wetlands are used for various economic activities, fishing accounts the majority (i.e., 32%) (Rana *et al.*, 2010). Fishing communities in the *haor* areas can secure their livelihoods through capturing and trading fish, drying fish, and weaving nets.

A typical dish among Bangladeshis is rice with fish, because fish supplements make up about 60% of daily protein intake (Hasan *et al.*, 2021), giving rise to the proverb "Maache-Bhate Bangali" (i.e., "Bengali is made of fish and rice") (Ghose, 2014). The per capita consumption of fish intake is 37 gm, and this trend is gradually increasing over time among people throughout the country (Ahmed *et al.*, 2020; Rahman *et al.*, 2020; Akter *et al.*, 2019). It can aid in the resolution of the problem of low-calorie and low-nutrient-dense diets because it holds a unique position in terms of specific nutritional values (such as iodine, calcium, selenium, and vitamins A and D) (Oken *et al.*, 2012), which have anti-inflammatory properties as well as the ability to protect against chronic disease (EFSA, 2014; Cole *et al.*, 2010; Wall *et al.*, 2010). Regular fish consumption may help lower the prevalence of micronutrient deficiencies, cardiovascular disease, heart failure, stroke, obesity or overweight, and other non-communicable diseases (Jayedi & Bidar, 2020; Bogard *et al.*, 2019). The presence of vital proteins and sufficient micronutrients improves health when eaten twice a week (Burger & Gochfeld, 2009; Mozaffarian & Rimm, 2006; Verbeke *et al.*, 2005).

Consumers now-a-days are becoming increasingly concerned about the health risks, and economic benefits associated with food intake (Verbeke *et al.*, 2005). In this context, understanding consumer purchasing behavior and factors affecting their decision to purchase is essential for the market actors and policy makers (Peighambari *et al.*, 2016). Consumer behavior describes individual, groups, and organizations' purchase, uses, and disposals of goods and services. Also, it highlights household and commercial customers' mental and physical behaviors influencing their payment and utilization of goods and services (Cole, 2007). Economic theories states that several factors affect consumers' food choices, with costs generally playing a significant role. Moreover, socio-economic and psychographic factors also affect the consumer's purchasing and consumption of various food products (Martinho, 2020; Gempesaw *et al.*, 1995). That's why this study attempted to investigate the various factors that may affect consumers' preferences to buy *haor* fish, realizing its importance in the diet and economy.

The present study is linked to the findings of some previous studies to a certain extent. Kresic *et al.* (2022) confirmed that predicting fish consumption was influenced by a person's level of subjective knowledge and satisfaction with product qualities, whereas objective knowledge influenced product information. The quality of the product, nutrition, price, and retail market channels were the major influencing factors in purchasing fish products (Ibrahim *et al.*, 2021). Hoque & Alam (2020) found that consumers' subjective knowledge (SK) favorably influenced their attitude toward farmed fish, whereas objective knowledge did not statistically affect their buying intention. Lack of information and uncertainty did not affect consumers' attitudes regarding farmed fish. Rahman & Islam (2020) explained the impact of different socio-demographic features, such as income, education, and age, on fish consumption in Bangladesh. According to Tanuja *et al.* (2020), nutritional prospects, product price, hygiene aspects, and price were the important attributes influencing consumers to purchase value-added fish products. Attitude, subjective norms, PCB (perceived behavioral control), information,

knowledge, and habit were identified by Arsil *et al*. (2019) as important fish consumption drivers. While analyzing fish consumption patterns, Kizilaslan (2019) established life motivation, economics, and nutritional benefits as the responsible factors. Can *et al*. (2015) observed that fish consumption frequency was positively and significantly associated with overall meat consumption, income, and education. Pricing was the most important factor in the Thai consumer's fishery product purchase decision, whereas product strategy had less impact (Kessuvan *et al*., 2015). Obiero *et al*. (2014) found that quality, flavor, and availability influenced the consumers' preferences most. The country of origin, sourcing technique (wild-farmed sea fish), storage condition (chilled-frozen), and pricing affected consumers' perceptions of marine fish selection (Claret *et al*., 2012). Ahmed *et al*. (2011) reported about Malaysian consumers' buying of fresh fish based on demographic factors, flavor, and nutritional value. Pieniak *et al*. (2011) introduced different geographic, social, and cultural variables behind fish preferences, and frequency of consumption. Favorable attitudes, social norms, and perceived behavioral control influenced fish consumption decisions. Taste was one of the significant factors in eating fish, whereas bones and prices were negative attitude elements that did not necessarily diminish behavioral intention (Verbeke & Vackier, 2005). Palash (2004) uncovered increased monthly per capita fish and meat consumption among Bangladeshi consumers along with increased income. Gheyas *et al*. (2003) observed consumers' strong preference for local fish species such as *Shing, Magur, Hilsha, Mola*, and *Dhela* compared to various carp and exotic species. Bangladeshi consumers favor pangas and tilapia fish due to their affordable market pricing and year-round availability. Additionally, pangas fish purchase intention was impacted by freshness, income, and color, while tilapia fish purchase intention was driven by price, freshness, and flavor (Uddin *et al*., 2019).

The above literature evaluates the diversity of purchasing behavior and consumption of fish and fishery products. However, little research has been conducted on fish preferences in South and Southeast Asian markets (Alam & Alfnes, 2020). Additionally, studies on *haor* fish have received little attention in Bangladesh. In fact, available past research of this region mainly focused on status, profitability, and problems of *haor* fish (Begum *et al*., 2018; Pandit *et al*., 2015; Rana *et*

al., 2010). However, there is no comprehensive research on how people in northeast region of Bangladesh perceive buying captured *haor* fish. Realizing this research gap, present study would generate excellent findings by addressing the following research questions: Why do Bangladeshi consumers prefer to purchase *haor* fish? And what factors influence them to do so? The precise objectives of this study are: (1) to analyze the consumers' preferences for *haor* fish; and (2) to investigate the major influencing factors towards purchasing *haor* fish. By doing so, this study enriches literature by uncovering several factors behind consumers' purchase intension of *haor* fish, which ultimately lead to the development of fisheries and fishery products tailored to meet specific consumer demands.

This study is organized into five sections. The first section emphasizes the significance of wetland ecosystems and fisheries resources and highlights the novelty of the research. The second section outlines the detailed methodology. The third section presents the study's results and discussions. The next section concludes by recommending some policy measures. The final section reveals the study's strengths and limitations.

2. Materials and Methods

2.1. Study area, sample size and data collection

Fish consumers are extending all over the countryside in Bangladesh. This study was conducted among the respondents in Sunamganj and Sylhet districts. By following convenience sampling, 200 consumers were taken from 11 selected fish markets in Sunamganj (6 markets) and Sylhet (5 markets) districts. The study mainly utilized field-level primary data. Necessary information was collected from the respondents through the face-to-face interviewing method using a semi-structured interview schedule. The preliminary interview schedule was pre-tested before confirmation, and the actual academic goals were clearly stated to the respondents. Information regarding the consumer's socio-economic profile, income and expenditure pattern, fish consumption behavior, preference and attitude towards *haor* fish, and influencing factors for purchasing *haor* fish were incorporated into the interview schedule.

2.2. Analytical techniques

The collected data were edited to remove ambiguities, errors, and internal inconsistencies.

Descriptive statistics (frequency and percentage) were used to describe the respondents' demographic traits and fish consumption behavior. The Likert scaling technique was employed to identify the consumer's preferences for *haor* fish. The ordered logit model was used to determine the factors influencing consumers' preferences towards purchasing *haor* fish However, the problems of multicollinearity and heteroscedasticity were checked.

2.2.1. Likert Scale

Consumers' preferences for *haor* fish were analyzed using a Likert scale. They responded according to some pre-determined statements. Each statement was assessed using a five-point Likert scale consisting of the following response options: strongly agree, agree, neutral, disagree, and strongly disagree, where weights of 5, 4, 3, 2, and 1 were assigned for favorable items and reversed weights were assigned for unfavorable items. For determining discriminating power, the following formula was used (Nachmias & Nachmias, 2008).

DP = Q$_1$ - Q$_3$

Where, DP= Discriminating Power

Weighted total = Score × Number of people who checked that score

Weighted mean = weighted total / number in group

2.2.2. Ordered logit model

An ordered logistic model was utilized to investigate the determining factors of consumers' preferences towards purchasing *haor* fish. The model (Mohammadi *et al*., 2015) is specified as follows:

$$y_i * = \beta' X_i + \varepsilon_i \quad -\infty < y_i *< -\infty \dots \dots (1)$$

Equation indicates,

$y_i *$: Intensity of preferring

β_i: Estimated vector parameter

X_i: A vector of non-random independent variables describing i^{th} individual

ε_i : Error of residual that follows logistical distribution

If y_i is a discrete and observable variable that represents people's preference intensity, the ordered logit model develops the link between latent variable $y_i *$ and observable variable y_i :

$$y_i = 1 \ if -\infty \leq y_i *< \mu_1, i = 1 \dots \dots n,$$

$$y_i = 2 \ if \ \mu_1 \leq y_i *< \mu_2, i = 1 \dots \dots n,$$

$$y_i = 3 \ if \ \mu_2 \leq y_i *< \mu_3, i = 1 \dots \dots n, \dots \dots .. (2)$$

$$y_i = J \ if \ \mu_{j-1} \leq y_i *< +\infty, i = 1 \dots \dots n,$$

In which 'n' represents the sample size. 'μ' and 's' are used to estimate thresholds for observed discrete variables. The following relation calculates $y_i = j$ probability:

$$P_r(y_1 = J) = P_r(y_1 \geq \mu_{j-1}) = P_r(\varepsilon_1 \geq \mu_{n-1} - \beta X_1) \dots \dots \dots \dots \dots \dots \dots \dots .. (3)$$

$$F(\beta X_1 - \mu_{j-1})$$

The sum of the probabilities expression uses an ordered logit model to predict the likelihood of individual 'i' being at level 'jth' or lower (1,…, j-1). In an ordered logit model, answer groups are ordered. The equation of the ordered logit model is:

$$log\left[\frac{\gamma_{j(x_i)}}{1-\gamma_{j(x_i)}}\right] = \mu_j - [\beta_1 X_{1i} + \beta_2 X_{2i} \dots . \beta_k X_{ki}] \dots \dots \dots \dots \dots .. (4)$$

j = 1,…, J;   while, i = 1,…, n

In which 'Y_j' sum of probability which denotes as:

$$\gamma_j(X_i) = \gamma\left(\mu_j - \beta' X_i\right) = P\left(y_i \leq j \ |X_i\right). \dots (5)$$

The column vector β_i and X_i represent the parameters $\beta_1, \beta_2, \dots, \beta_k$ and explanatory variables, respectively. μ_j dependsonly on category probability, not explanatory variables.

Moreover, the crisp part

$$\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} \dots \dots \dots \dots \dots \dots (6)$$

It is the explanatory variables of the category. These two features represent that the answers groups together are ordered.

$\mathcal{X}^2$ statistic in parallel regression test is calculated as follows:

$$\mathcal{X}^2 = -2 \ LogLikelihood \ C_m - (-2Loglikelihood \ G_m) \dots \dots (7)$$

Where, C_m and G_m indicates the present and general models, respectively. If the calculated $\mathcal{X}^2$ is more than $\mathcal{X}^2$ in the table, it rejects the null hypothesis, which represents that the present

model is estimated correctly. Parameters are estimated by the maximum likelihood estimation method.

$$L(y|\beta; \mu_1, \mu_2, \ldots, \mu_{j-1})$$
$$= \Pi_{i=1}\Pi_{j=0} \, [\Upsilon(\mu_j - \beta'X_i)$$
$$- \gamma(\mu_{j-1} - \beta'X_i]^{Z}ij \ldots (8)$$

Where 'Z_{ij}' is a binary variable equal to 1 when the observed group for person 'i' is 'j', and when they are not equal, it equals to zero.

It should be mentioned that coefficients are not directly interpreted in this model. The marginal effect of one unit change in X_k predictor on the probability of 'j' category is as follows:

$$\frac{\partial P\,(y_i=j\,|\,xi)}{\partial x_k} = \left[\frac{\partial \gamma\,(\mu_j-\beta'x_i)}{\partial x_k} - \frac{\partial \gamma\,(\mu_{j-1}-\beta'x_i)}{\partial x_k}\right] \ldots (9)$$

$$= [\lambda(\mu_{j-1} - \beta'x_i) - \lambda\,(\mu_j - \beta'x_i)]\beta_k$$

In which, $\mu_j = +\infty$, $\mu_0 = -\infty$, $\lambda_j(x_i) = \frac{\partial \gamma_j(xi)}{\partial x_k}$

The marginal effect is not direct on binary variables, but it can be obtained by comparing two probabilities.

3. Results and discussion

3.1. Socioeconomic characteristics of the consumers

The socio-economic traits of the respondents are presented in Table 1. The average family size of the respondents was 5.8, which was higher than the national average of 4.1 (HIES, 2016). Most consumers (72.5%) fell into the age group of 25-55 years. It was the most prevalent age group in the region, followed by 19.5% above 55 years (Uddin *et al.*, 2019) and 8% between 18-24 years. In the context of total respondents, 98% were male and only 2% were female. Education is an index of social advancement and usually plays an influential role in accepting anything. Approximately one third (32 %) of consumers had literacy above higher secondary level. Around 52.5% respondents were businessman whereas, 18% and 15% consumers were private employees and government employees, respectively. About 11.5% of respondents were engaged in other occupational activities and only 3% were students. Out of the total respondents surveyed, 32% had a monthly income between 10,001 to 20,000 Tk. Besides, above a quarter of the respondents' 27.5%) monthly income was between 20,001 to 30,000 Tk. and 14.5% of respondents' monthly income was between 30,001 to 40,000 TK., respectively. It was also observed that, only 10% of respondents had a monthly income up to 10,000 Tk. however, 16% had a monthly income above 40,000 Tk.

Table 1: Socio-economic features of the consumers

Particulars	Category	Information on particulars
Family size (mean)		5.8
Age (% of respondents)	18-24 years	16 (8.0)
	25-55 years	145 (72.5)
	Above 55 years	39 (19.5)
Sex (% of respondents)	Male	196 (98.0)
	Female	4 (2.0)
Education (% of respondents)	Illiterate	24 (12.0)
	Primary (1-5 years)	40 (20.0)
	Secondary (6-10 years)	43 (21.5)
	Higher secondary (11-12 years)	29 (14.5)
	Above higher secondary	64 (32.0)
Occupation (% of respondent)	Govt. employee	30 (15.0)
	Private employee	36 (18.0)
	Student	6 (3.0)
	Businessman	105 (52.5)
	Others	23 (11.5)
Monthly income (% of respondent)	Up to 10,000 Tk.	20 (10.0)
	10,001-20,000 Tk.	64 (32.0)
	20,001-30,000 Tk.	55 (27.5)
	30,001-40,000 Tk.	29 (14.5)
	Above 40,000 Tk.	32 (16)

Figures within parentheses indicate the percentage

3.2. Haor fish consumption behavior

Almost all the respondents showed their preference for purchasing *haor* fish. About 58% of consumers highly preferred to buy *haor* fish, while 35% and 7% of consumers showed moderate and low preference towards *haor* fish, respectively (Figure 1). Most consumers (70%) purchased *haor* fish 1-2 times a week, while 20% and 10% of consumers purchased 1-4 times and 1-5 times in a month, respectively (Figure 2). Maximum consumers stated that *haor* fish is natural in color, more palatable, and looks fresh compared to other fish. Approximately 53% of consumers spent more than 10% of their total income on purchasing *haor* fish. Additionally, 38% and 9% of consumers spent 5-10% and 0-5% of their income on buying different types of *haor* fish, respectively (Figure 3).
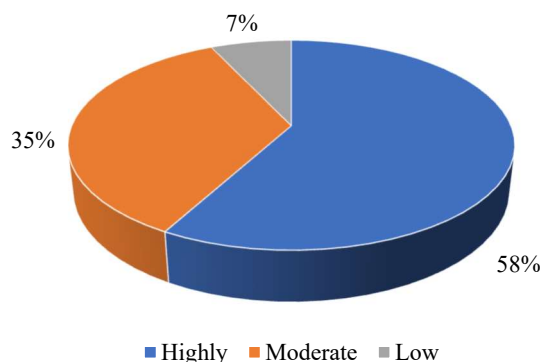
Figure 1. *Haor* fish purchasing preference
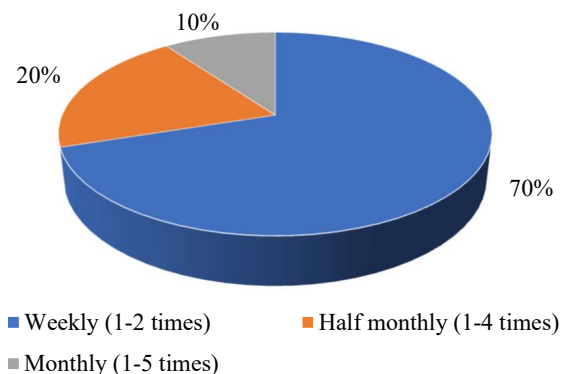
Figure 2. Frequency of purchasing *haor* fish
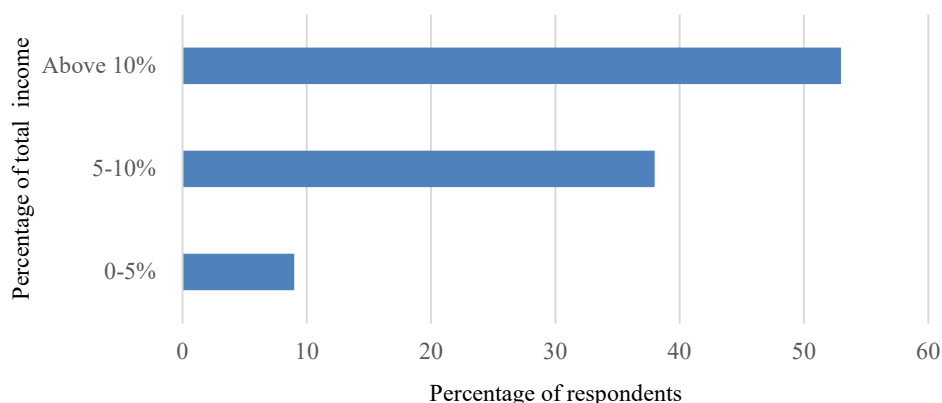
Figure 3. Income spent on *haor* fish

In the study areas, consumers had preferences for different species of *haor* fish such as: *golsa, tengra, ayre, chitol, boal, shol, gojar, kalbaus, kaila, ghoinna, darkina, chingri, veda, koi, chela, khoilsa, keski, pabda, rui, shing, chapila, mola, magur, puti, baim, etc*.

3.3. Consumer preferences for haor fish
Consumer preference reflects the individual tastes and happiness usually measured by utility, which permit them to rank various bundles of goods according to their satisfaction (Lambardo, 2018; Guleria & Parmar, 2015). A psychometric response scale along with ten statements was considered for determining the consumers' agreement or disagreement, following rank order.

Table 2 shows the responses of the total number of respondents for ten statements on five scales. Maximum segments of consumers "strongly agreed" with the 1st, 7th, and 8th statements. It is also evident that the 3rd, 5th, and 6th statements gained the highest "agree" responses from the consumers. Among negative statements, "*haor* fish are expensive" received the highest responses under the "strongly agree" category. The 4th and 9th statements had the highest "disagree" and "agree" responses, respectively. The largest segments of consumers "strongly disagreed" with the statement that "*haor* fish have a bad smell."

Table 2: Test of consumers' preferences by using a Likert scale

Statements	SA	A	N	DA	SDA	Total
Haor fish are more delicious (Kizilaslan, 2019)	142	56	0	0	2	200
Haor fish are expensive (Rahman & Islam, 2020)	96	92	6	2	4	200
Haor fish are available all year round (Kresic *et al*., 2022; Uddin *et al*., 2019)	53	91	16	39	1	200
Premium quality *haor* fish are not sold locally (self-constructed)	26	52	18	82	22	200
Haor fish have easy access to distance markets (Uddin *et al*., 2019)	69	125	2	3	1	200
Haor fish are the great sources of protein (Kizilaslan *et al*., 2019; Uddin *et al*., 2019)	53	90	20	33	4	200
Haor fish is free from health hazards (Verbeke *et al*., 2005)	145	53	1	1	0	200
The freshness of *haor* fish is better than that of other fish (Uddin *et al*., 2019)	136	62	0	0	2	200
Fraud is possible in choosing *haor* fish (self-constructed)	17	67	23	66	27	200
Haor fish have a bad smell (Uddin *et al*., 2019)	0	8	2	76	114	200

Note: SA: strongly agree, A: agree, N: neutral, DA: disagree, and SDA: strongly disagree.

3.4. Determination of the discriminative power

After calculating the total score for each respondent, it was arranged in descending order. Thereafter, high 25% and low 25% scores were selected. The discriminative power (DP) value was computed with the aim of item analysis. With item analysis, each item is subjected to a measurement of its ability to differentiate clearly positive attitudes from clearly negative attitudes. This is termed the discriminative power (DP) of the item (Nachmias & Nachmias, 2008).

A higher DP value denotes more strongly agreeing weights in the top 25% compared to the bottom 25% summated scores. It also indicates the best discrimination among the individual's attitudes towards various statements of *haor* fish. The DP value for the first two statements was 0.62 and 0.16, respectively, meaning that the consumers showed less variation about these (Table 3). The consumers were somewhat different regarding the

year-round availability of *haor* fish, as evident from its DP value of 1.48. Consequently, they showed less variation about the sales of premium quality *haor* fish locally (DP 0.10). From the DP value of 0.62 indicates that, *haor* fish have easy access to distance markets, and the consumers of those markets can easily purchase it. Although, a good source of protein has been motivating consumers to purchase *haor* fish, the greatest difference (DP 1.96) between the two end points was observed. In the context of "health hazard by *haor* fish" (DP 0.44) and "freshness of *haor* fish" (DP 0.50), consumers have shown lesser variation. *Haor* fish are usually fresh, pure, and assuming to be free of health hazards. The respondents expressed dissenting attitudes about the possibility of fraud in choosing *haor* fish. Hence, there was greater preferential variation (DP 1.62) among the consumers. *Haor* fish usually have a good smell.

The estimated DP value of 0.68 is proof against the bad smell of *haor* fish.

Table 3: Calculation of discriminative power (DP)

S.N.	Group	Number	5	4	3	2	1	Weighted total	Weighted mean	DP (Q_1-Q_3)
1	High (25 %) Q_1	50	49	1	0	0	0	249	4.98	0.62
	Low (25%) Q_3	50	24	24	0	0	2	218	4.36	
2	High (25 %) Q_1	50	4	1	2	11	32	84	1.68	0.16
	Low (25%) Q_3	50	0	1	0	23	26	76	1.52	
3	High (25 %) Q_1	50	31	15	4	0	0	227	4.54	1.48
	Low (25%) Q_3	50	3	20	5	21	1	153	3.06	
4	High (25%) Q_1	50	9	12	1	21	7	145	2.90	0.10
	Low (25%) Q_3	50	2	19	5	15	9	140	2.80	
5	High (25%) Q_1	50	37	12	0	1	0	235	4.70	0.62
	Low (25%) Q_3	50	8	40	0	2	0	204	4.08	
6	High (25%) Q_1	50	32	16	2	0	0	230	4.60	1.96
	Low (25%) Q_3	50	3	10	7	26	4	132	2.64	
7	High (25%) Q_1	50	47	3	0	0	0	247	4.94	0.44
	Low (25%) Q_3	50	28	20	1	1	0	225	4.50	
8	High (25%) Q_1	50	43	7	0	0	0	243	4.86	0.50
	Low (25%) Q_3	50	24	24	0	0	2	218	4.36	
9	High (25%) Q_1	50	22	19	4	4	1	207	4.14	1.62
	Low (25%) Q_3	50	1	15	5	17	12	126	2.52	
10	High (25%) Q_1	50	41	9	0	0	0	241	4.82	0.68
	Low (25%) Q_3	50	20	23	1	6	0	207	4.14	

3.5. Selecting the scales

Statements with the highest DP value were selected because these statements best discriminate the consumers' attitude regarding *haor* fish consumption. All the statements are placed according to the descending order of the DP value (Table 4).

In the case of two or more statements having the same DP value, the statement with a greater weighted mean of quartile one (Q_1) was placed at the top of the ranking (Haque *et al*., 2020).

Table 4: Statements ranked according to DP value

S.N.	Statements	DP value	Ranked by DP value
6	*Haor* fish are the great sources of protein	1.96	1
9	Fraud is possible in choosing *haor* fish	1.62	2
3	*Haor* fish are available all year round	1.48	3
10	*Haor* fish have a bad smell	0.68	4
1	*Haor* fish are more delicious	0.62	5
5	*Haor* fish have easy access to distance markets	0.62	6
8	The freshness of *haor* fish is better than that of other fish	0.50	7
7	*Haor* fish is free from health hazards	0.44	8
2	*Haor* fish are expensive	0.16	9
4	Premium quality *haor* fish are not sold locally	0.10	10

3.6. Factors influencing consumers' preferences towards purchasing haor fish

Table 5 briefly specifies the variables used in the estimated model.

Table 5: Illustration of the variables

Variables	Description
Intensity of preferring *haor* fish (dependent variable)	Low prefer = 1, moderately prefer = 2, highly prefer = 3
Age	18-64 years = 0, 65 years and above = 1
Education	Literate = 1, illiterate = 0
Occupation	Government employee = 1, Non-government employee = 0
Monthly income	Above 20,000 Tk. = 1, up to 20,000 Tk. = 0
Income spent on *haor* fish	Above 10% of total income = 1, 0-10% of total income = 0
Household size	Continuous (number)
Average price of *haor* fish	Continuous (Tk./kg)
Average price of other fish	Continuous (Tk./kg)
Freshness of *haor* fish	Presence = 1, otherwise = 0
Taste of *haor* fish	Tasty = 1, otherwise = 0

Considering the ordered nature of intensity to purchase, ten independent variables were included in the ordinal logit model, and the results are exhibited in Table 6.

Table 6: Results of the ordered logit model

Variable	Coefficient	Standard error	Z statistic
Age	-0.523	0.531	-0.99
Education	-0.205	0.479	-0.43
Occupation	0.429	0.475	0.90
Monthly income	0.619*	0.343	1.81
Income spent on *haor* fish	0.709**	0.337	2.11
Household size	0.090	0.069	1.32
Average price of *haor* fish	0.009***	0.003	3.54
Average price of other fish	-0.003	0.004	-0.64
Freshness of *haor* fish	1.339**	0.631	2.12
Taste of *haor* fish	0.643*	0.385	1.67

Number of observations (N) = 200, Wald chi^2 (10) = 30.47, Prob> chi^2 = 0.0007, Pseudo-R^2 = 0.138 (Cox and Snell = 0.215, Nagelkerke = 0.260, McFadden = 0.139), Log pseudo likelihood = -149.775
*, ** and *** indicate the significance level at 10%, 5% and 1%, respectively

The specified ordered logit model, which fits well with the data as measured by Pseudo-R^2 (Cox and Snell, Nagelkerke, and McFadden). The values of Pseudo-R^2, which are 21.5%, 26%, and 13.9%, respectively, for Cox and Snell, Nagelkerke, and

McFadden, indicate good predictive ability of the model. Thus, the independent variables included in the fitted model describe a large proportion of variation in intensity to purchase.

The results of the Pearson and Deviance tests with the null hypothesis of good estimation by the model are presented in Table 7. However, the chi^2 statistic obtained from these tests ascertained the justness of the null hypothesis.

Table 7: Estimate goodness indicators

Statistic	Chi-Square	Significance level
Pearson	352.189	0.891
Deviance	296.719	1.000

A parallel regression test was used to examine whether the general model might have made considerable progress in estimation relative to the current model. The result (Table 8) indicates the logicality of the hypothesis of equal parameters across all the response categories. Taking into consideration the significance level of chi^2, we can agree that the values of parameter status for all response classes are the same and fixed which provides a strong basis for the estimated ordered logit model.

Table 8: Results of parallel regression test

Model	-2Log likelihood	Chi-Square	Significance level
Current model	298.106	12.001	0.285
General model	286.105		

By observing these tests, it can be mentioned that the results from the estimated model are sufficiently dependable. Table 9 reveals the marginal effects of the ordered logit model.

The result of the marginal effect shows the consumers' dissimilation of preferring *haor* fish at low, moderate, and high intensity levels. Aged consumers are believed to be wise and experienced. It positively and insignificantly affected consumers' low and moderate preference levels for *haor* fish. Several studies (Arthatiani *et al*., 2021; Kashem *et al*., 2021; Haque *et al*., 2019; Devadawson *et al*., 2015; Onurlubas, 2013; Perez-Cueto *et al*., 2011) also observed a positive association between age and fish consumption. Being well informed about fish market traits, older consumers were interested in purchasing

diversified fish species instead of relying only on *haor* fish. Consequently, with an increase in age from the active working range (18-64) to the non-active working range (65 and above), consumers' higher preference for *haor* fish was decreased by 10.21%. Another probable reason is with the increasing age people may follow prescribed balanced diets. Rahman *et al*. (2020), Can *et al*. (2015), and Kaimakoudi *et al*. (2013) revealed similar findings.

Education assists consumers in obtaining better access to information and making rational decisions. Educated consumers are well informed about the nutritional quality of *haor* fish, which influenced them to show either a low or moderate preference level of 1.19% and 2.72% respectively, compared to the illiterate. This result is in line with Abdikoglu *et al*. (2020), Qasim *et al*. (2020), Rahman *et al*. (2020), Fu *et al*. (2019), Islam et al. (2018), Ahmad *et al*. (2016), Can *et al*. (2015), Onurlubas (2013), Barberger-Gateau *et al*. (2005), and Myrland *et al*. (2000). At the same time, highly literate consumers in north-eastern regions wanted to diversify their consumption habits. As a result, their higher preferences for *haor* fish decreased by 3.91% compared to illiterate consumers. Our findings correspond with Burger *et al*. (1999). In contrast, Colakoglu *et al*. (2006), and Verbeke & Vackier (2005) found no meaningful effect of literacy level on fish consumption frequency.

In Bangladesh, government employees have a permanent source of income. With the increase in potential employment in government jobs, consumers' preferences for *haor* fish have shifted from low to high. They had demonstrated a high desire to buy *haor* fish, despite its higher price than other fish. It was observed that, consumers' higher preferences for *haor* fish increased by 8.18% with their switch to government jobs. Fu *et al*. (2019) reported the same result. However, Rahman *et al*. (2020), and Can *et al*. (2015) observed no substantial fish consumption difference among various professionals.

Consumers' income level greatly influenced their preferences for fish consumption (Li *et al*., 2000). With high income, they tend to show a high preference for haor fish compared to low and moderate preferences. Their high preference was significantly increased by 12.65% with an increase in income level above 20,000 Tk. Several studies (Abdikoglu, 2020; Qasim et al., 2020; Rahman et al., 2020; Haque et al., 2019; Lee &

Nam, 2019; Uddin *et al*., 2019; Mugaonkar *et al*., 2017; Zhou *et al*., 2015) reported the same association between consumers' income and their fish consumption. Due to the aforementioned reason, low and moderate preferences for *haor* fish were found to be negatively correlated with monthly income. The result is consistent with Arthatiani *et al*. (2021), and Onurlubas (2013).

Table 9: Marginal effects for different intensity of *haor* fish purchasing

Variable	Low prefer	Moderately prefer	Highly prefer
Age	0.0374	0.0647	-0.1021
Education	0.0119	0.0272	-0.0391
Occupation	-0.0230	-0.0588	0.0818
Monthly income	-0.0365	-0.0900	0.1265*
Income spent on *haor* fish	-0.0433*	-0.0954**	0.1387**
Household size	-0.0055	-0.0119	0.0174
Average price of *haor* fish	-0.0006***	-0.0012***	0.0018***
Average price of other fish	0.0002	0.0003	-0.0005
Freshness of *haor* fish	-0.1241	-0.1345***	0.2587**
Taste of *haor* fish	-0.0446	-0.0814*	0.1261*

*, ** and *** indicate the significance level at 10%, 5% and 1%, respectively

With sufficient income levels, consumers with moderate preferences were interested in exploring diversity in fish consumption. When above 10% of income was spent, consumers' low and moderate preferences for *haor* fish significantly decreased by 4.33% and 9.54%, respectively, at the10% and 5% significant levels, compared to the below 10% income spent category. Along with the practice of diversification consumption, consumers at higher level of preference could show increasing preferences toward haor fish. As usual, their high preference was significantly increased by 13.87% when they spent more than 10% of their total income compared to below 10% income spent on *haor* fish.

Household size negatively influenced the low and moderate preferences for *haor* fish. Mainly, low- or middle-income consumers preferred to buy

haor fish either at a low or moderate level. But when their household size increased, they had hardly been able to purchase *haor* fish as before owing to its high price. As a result, their low and moderate preferences levels decreased, respectively, by 0.55% and 1.19% with the increase in household size. Qasim *et al*. (2020), and Uddin *et al*. (2019) identified a negative impact of family size on fish intake. On the other hand, fish demand increases with the rise of household size, and for having good income sources, consumers of high preference level didn't need to worry much about the high price of *haor* fish. Consequently, their higher preferences for *haor* fish increased by 1.74%. A similar observation was uncovered by Arthatiani *et al*. (2021), Uddin *et al*. (2019), and Onurlubas (2013).

Consumers with low and moderate preferences for *haor* fish usually belong to low and middle-income groups. The increase in *haor* fish price significantly reduced their low and moderate preference levels respectively, by 0.06% and 0.12%. Qasim*et al*. (2020), and Uddin *et al*. (2019) reported similarly. When consumers have a higher preference, they don't reduce their intensity to buy *haor* fish. Therefore, their higher preferences for *haor* fish were significantly increased by 0.18% despite the price rise. Price is among the most influential factors in purchasing fishery products (Kessuvan *et al*., 2015). The price of other fish available in the market also influences the purchase intensity of *haor* fish. Consumers of moderate preference levels were interested in consuming diverse types of fish, but when the price of other fish increased, they had to rely only on *haor* fish. With the increase in other fish prices, consumers' preferences for *haor* fish increased by 0.02% and 0.03%, respectively at the low and moderate levels. But it reduced their higher preference level by 0.05%. Our result is consistent with Uddin *et al*. (2019).

Freshness significantly increased the consumers' higher preference for *haor* fish by 25.87%. It reveals that the probability of high preference was more significant for freshness presence in haor fish than others. The positive influence of freshness on consumers' fish consumption was also uncovered by Mitra *et al*. (2021). Can *et al*. (2015) observed that approximately 98% of consumers preferred to purchase fresh fish over processed fish. Consumers of moderate preference were looking for other available fish at a lower price than *haor* fish. Although, they had a good preference for *haor* fish, they could not always

consider the vital trait of freshness owing to the high price. Consequently, their preference to buy *haor* fish was significantly reduced by 13.45%.

Haor fish are naturally tasty, and when consumers realize it, they become interested and show a high preference for this fish. Therefore, their higher preference intensity for *haor* fish increased by 12.61% compared to other fish. Li *et al*. (2000) found that food attributes such as taste had higher odds of preference for fish. Thong & Olsen (2012), and Pieniak *et al*. (2008) also highlighted the significance of taste on attitudes towards fish. But due to the high price of *haor* fish, consumers of low and moderate preference levels could not utilize this. However, consumers at low and moderate preference levels would like to consider other low-priced fish, and accordingly, they shifted towards purchasing those. It is also evident from the negative values of the marginal effect for low (-0.0446) and moderate (-0.0814) preference levels.

3.7. Consumers' perceptions of price and income variation

An increase or decrease in price affects consumers' behavior in various ways. As price creates different perceptions for different consumers, it might have a positive or negative effect on the consumers' buying and consuming *haor* fish. Consumers of various income groups were asked how price changes influenced their consumption of *haor* fish. For it, they were considered under five income groups: up to 10,000 Tk. (I), 10,001-20,000 Tk. (II), 20,001-30,000 Tk. (III), 30,001-40,000 Tk. (IV), and above 40,000 TK. (V).

Overall, 77% of consumers responded that, they would decrease their purchase of *haor* fish if the price increased, while 23% disclosed that they wouldn't decrease their purchase despite the price rise (Table 10). About 34.55% and 50% of respondents, from the income groups of 20,001-30,000 Tk. and above 40,000 Tk. showed strong preference towards *haor* fish consumption compared to others, as they responded 'no decrease in purchase' to the question of price rise. Maximum consumers from all income groups reported the increasing purchase trend of *haor* fish in cases of price decrease. Some consumers were offended by the high price of *haor* fish, but eventually they shifted towards purchasing it compared to other fish when the price decreased. A similar scenario was also seen in the case of income growth. Nearly 43.50% of consumers responded negatively to the question of *haor* fish purchase with the rise in income level. We found diversification fish consumption habits as a possible explanation for it. Above half of the consumers (56.50%) consented to increased *haor* fish consumption with increased income levels. Moreover, approximately 39% of consumers were interested in paying an additional 10% to 20% over the present market price to obtain services like dressing, grading, packaging, and freezing while purchasing *haor* fish.

3.8. Covid-19 impact on haor fish purchase and consumption

The Covid-19 pandemic has adversely affected the purchase and consumption of *haor* fish. Nearly 70% of the consumers' income has dropped during the pandemic. Approximately 64% of consumers did not get any kind of support, either

Table 10: Change in *haor* fish purchase in response to price and income variation

Monthly income group and sample no.	Decrease in purchase relation to price rise		Increase in purchase relation to price fall		Increase in purchase relation to income rise	
	Yes	No	Yes	No	Yes	No
I (20)	20 (100.0)	0	14 (70.00)	6 (30.00)	9 (45.00)	11 (55.00)
II (64)	54 (84.38)	10 (15.62)	45 (70.31)	19 (29.69)	34 (53.13)	30 (46.87)
III (55)	36 (65.45)	19 (34.55)	41 (74.55)	14 (25.45)	32 (58.18)	23 (41.82)
IV (29)	28 (96.55)	1 (3.45)	18 (62.07)	11 (37.93)	18 (62.07)	11 (37.93)
V (32)	16 (50.00)	16 (50.00)	13 (40.63)	19 (59.37)	20 (62.50)	12 (37.50)
Total respondent (200)	154 (77.00)	46 (23.00)	131 (65.50)	69 (34.50)	113 (56.50)	87 (43.50)

Figures within parentheses indicate the percentage

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in cash or kind. Supply disruption, falling income levels, and travel restrictions were significant factors behind the reduced *haor* fish consumption during that outbreak.

It was evident that, nearly 45% of consumers had curtailed their purchase and consumption of *haor* fish above 10% of their usual level due to Covid-19. Moreover, 44.16% of the consumers were also coerced to drop their purchase and consumption levels between 5 to 10% (Table 11). In addition, respondents discussed *haor* fish production disruption and market supply fluctuation during the interview. Around 74% of consumers responded that there were several reasons for reducing fish in *haor* areas. Extreme use of chemical inputs, premature harvesting of fish, catching mother fish, illegal occupying of *haor* lands, destroying natural sources of fish food and living places, seasonal dryness of *haor*, fishing using prohibited nets, *haor* land excavation, and degradation of water quality are some of the identified reasons behind supply reduction.

Table 11: *Haor* fish consumption reduction for Covid-19

Reduction in purchase and consumption	Percentage
Less than 5%	11.04
5-10%	44.16
Above 10%	44.80

4. Conclusion

Wetland and *haor* fish are directly contributing to Bangladesh's national economy. *Haor* fisheries are becoming a crucial part of our country to achieve sustainable food security for all citizens. This study assessed consumers' preferences towards *haor* fish and traced the factors responsible for their purchase intensity. Maximum consumers (58%) highly preferred to purchase and consume *haor* fish. For a strong preference, nearly 70% of consumers purchased *haor* fish 1-2 times weekly. Over half of the interviewed consumers (53%) spent more than 10% of their total income only on purchasing *haor* fish. The highest DP value (1.96) was found for the statement "*Haor* fish are great sources of protein" while the lowest DP (0.10) was found for the statement "Premium quality *haor* fish are not sold locally." The variables of monthly income, income spent on

haor fish, average price of *haor* fish, freshness, and taste significantly affected the consumers' preferences to purchase *haor* fish, either at a low, moderate, or high level. Above one third of respondent's are willing to pay more than present market price if they get value adding services like dressing, grading and packaging etc. Despite having a strong preference, Covid-19 significantly reduced peoples' purchase and consumption of *haor* fish. This outbreak has decreased nearly 45% of consumers' fish consumption above 10% of their usual level.

Approximately 74% of respondents highlighted several issues behind the disrupted production and market supply of *haor* fish. Extreme use of chemical inputs, *haor* land excavation, illegal occupying of *haor* lands, premature harvesting of fish, fishing using prohibited nets, degradation of water quality, destroying natural sources of fish food and living places, seasonal dryness of *haor*, etc. were some of the major responsible factors. Due to increased population pressure, habitat destruction, and natural interference, Bangladesh's overall aquatic ecosystems are rapidly being degraded.

In light of this, the Department of Fisheries (DoF), under direct supervision from the Ministry of Agriculture (MoA), should take required steps to discourage the general populace and fishermen from using prohibited nets and excavating *haor* lands. Releasing more hatchlings in *haor* wetlands under the fisheries department can help to increase the local fish population. Most importantly, different NGOs and government authorities can initiate an extensive advertising campaign focusing on the significance of the *haor* ecosystem and *haor* fish. Additionally, different fish processing farms and retail outlets can provide different value-adding services like dressing, grading, packaging, etc. to attract *haor* fish preferred customers and increase sales. Regular market monitoring is needed through authorized marketing agencies to ensure the local availability of premium quality *haor* fish at affordable prices for sustainable consumption.

5. Limitation and strength

Due to time and resource constraints, this research had to be carried out within a manageable limit. A field study was performed among the consumers of 11 convenient fish markets in Sunamganj and Sylhet districts. Covering a wide range of geographical areas would have produced more

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representative results. Still, this study uncovered some excellent findings regarding consumers' preferences for *haor* fish and influential determinants of purchase. The present study can be a wonderful reference for future research and formulating time-demanding policies.

Authorship contribution statement

Swarup Barua: Conceptualization, Methodology, analyzed data, Writing - original draft, review & editing, Validation, Supervision. Dabasis Sharma: Methodology, Resources, Analyzed and interpreted data, Writing - original draft, review & editing, Validation, Investigation. Bishwajit Sarker: Conceptualization, Methodology, Resources, Validation, Supervision. Md. Shaikh Farid: Methodology, Writing - review & editing, Validation. Subrata Koiry: Methodology, Writing - review & editing, Validation. Dilshad Zahan Ethen: Methodology, Writing - review & editing, Validation.

Conflicts of interest

The authors of this manuscript declare no conflicts of interest.

Data availability

Data is available upon request.

Consent statement

Oral consent was taken from the respondents before data collection. We only considered those respondents who gave their consent to answer all questions of interview schedule.

Ethical statement

This research was conducted following the ethical approval from the Research Ethics Committee of Sylhet Agricultural University (SAU) (Memo no: SAU/Ethical committee/AUP/20/25; Protocol: #ARP202025), Sylhet-3100, Bangladesh.

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