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Nutritional Value and Economic Importance of Small Indigenous Fish Species in Bangladesh: A Narrative Review

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ABSTRACT

Small indigenous fish species (SIS) are vital to Bangladesh's food and nutritional security, as fish supply nearly 60% of the country's daily animal protein intake. Although aquaculture now contributes more than half of national fish production, SIS remain crucial for low-income and nutritionally vulnerable populations. Over 150 species inhabit ponds, beels, haors, baors, rice fields, and floodplains. Consumed whole head, bones, and viscera, SIS provides dense nutrition, rich in protein, polyunsaturated fatty acids, calcium, vitamin A, iron, and zinc, which help combat widespread micronutrient deficiencies and malnutrition. Their regular consumption enhances dietary diversity, maternal and child health, and overall community nutrition. Economically, SIS supports millions of rural households through fishing, trading, and post-harvest processing, often involving women, thereby strengthening rural livelihoods. However, SIS resources are under threat from habitat degradation, pollution, overfishing, climate change, and the expansion of intensive aquaculture, all of which have reduced wild populations. Seasonal water fluctuations, poor policy attention, and lack of integration into mainstream aquaculture further limit their potential. To ensure sustainability, efforts are needed to conserve habitats, promote responsible harvesting, and develop breeding and culture technologies suited to smallholder contexts. This narrative review synthesizes existing knowledge on the nutritional and economic importance of SIS in Bangladesh, emphasizing its role as an affordable solution to malnutrition and poverty reduction. It also underscores the urgent need for ecological restoration, institutional reform, and technological innovation to secure these valuable species for future generations.

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Introduction

Global malnutrition remains one of the most critical public health challenges, serving as a primary contributor to immunodeficiency and affecting infants, children, the elderly, and pregnant and lactating women worldwide (Reza et al., 2024; Sharma et al., 2016). In 2022, approximately 148.1 million children suffered from wasting-related stunting, while around 45 million children under five experienced impaired growth and development as a direct consequence of malnutrition (UNICEF, 2022). Rapid population growth has intensified pressure on global food production systems, positioning aquaculture as a vital sector for ensuring food and nutritional security (Gras et al., 2023; Fantatto et al., 2024; Mahmud et al., 2025). Over the past few decades, aquaculture has emerged as the fastest-growing source of animal protein, supplying essential nutrients to millions of people worldwide (Alfiko et al., 2022; Daniel, 2018). Since 1990, global aquaculture production has expanded more than sixfold, an increase of over 650% reaching 130.9 million metric tons (MT) in 2022, of which 94.4 million MT comprised aquatic animals. Asia dominates this production, contributing more than 91% of the global total (FAO, 2024; Mahmud and Haque, 2025).

Bangladesh has played a significant role in this global aquaculture boom. In 2022–23, the country's total fish production reached 4.91 million MT, with aquaculture accounting for about 58% of the total output (DoF, 2023). Over the last three decades, inland aquaculture production has risen remarkably from 1.006 million MT in 2007–08 to 2.852 million MT in 2022–23 (DoF, 2023; Haque and Mahmud, 2025). Fish now contribute nearly 60% of the daily animal protein intake in Bangladesh, with per capita consumption averaging 67.8 g/day in 2022 (DoF, 2023). The country's aquaculture growth is primarily driven by Indian major carps, exotic and indigenous carps, catfish, tilapia, and SIS. The diverse inland water resources, including ponds, beels, haors, baors, rice fields, and floodplains, support a rich aquatic biodiversity and provide favorable conditions for breeding and rearing. Approximately 4.27 million rural households maintain small homestead ponds covering around 266,259 hectares (Belton and Azad, 2012; Little et al., 2007), which play a crucial role in ensuring food security and household nutrition (Mahmud et al., 2025). Most of these ponds are managed under extensive or improved extensive polyculture systems, dominated by fast-growing species such as tilapia and carp; yet, they also harbor a variety of SIS that are commonly consumed in rural diets (Hossain et al., 2024). More than 150 SIS species inhabit Bangladesh's freshwater ecosystems (Saha et al., 2020). Unlike larger cultured fish, SIS are typically consumed whole, including the head, bones, and viscera, allowing for the full intake of essential macro- and micronutrients. These small fish are rich in protein, essential fatty acids, vitamins, and minerals, and provide substantial amounts of calcium, vitamin A, iron, and zinc (Belton and Thilsted, 2014; Siekmann et al., 2003). Such nutrient-dense properties make SIS particularly valuable in improving the diets of low-income and nutritionally vulnerable populations. Despite remarkable progress in national food production and self-sufficiency, malnutrition and micronutrient deficiencies persist in Bangladesh. Over six million children remain chronically malnourished, primarily due to poverty and limited access to nutrient-rich foods (Ahmed et al., 2012). Micronutrient deficiencies, particularly in vitamin A, iron, and zinc, continue to be a significant public health concern. The nutrient-dense profile of SIS positions them as an effective tool for diversifying diets and reducing dependence on terrestrial animal-sourced foods, particularly in rural and coastal regions. However, the nutritional composition of SIS, especially in terms of minerals and fatty acid profiles from coastal and homestead pond ecosystems, remains inadequately studied. Furthermore, their potential in aquaculture has been underexploited, as small-scale SIS farming has not received adequate policy or research support. This review synthesizes the most comprehensive data available on the nutritional composition and health benefits of key small indigenous species in Bangladesh. It examines the role of essential nutrients, including iron, zinc, iodine, calcium, and vitamin complexes, in promoting human health and nutritional security. Moreover, it highlights the untapped potential of SIS in nutrition-sensitive aquaculture, emphasizing their crucial role in combating malnutrition and enhancing food system resilience in Bangladesh. It also highlights the urgent need for ecological restoration, institutional strengthening, and technological advancements to ensure the long-term sustainability of these valuable species for future generations.

Methodology

This review employed a narrative synthesis approach, similar to that used by Ndebele-Murisa et al. (2024), to compile and analyze the literature on the nutritional and economic dimensions of small indigenous fish species in Bangladesh. A comprehensive literature search was conducted across multiple databases, including Google Scholar, PubMed, Scopus, and ScienceDirect, using combinations of keywords such as "small indigenous fish species," "nutritional benefits," "economic value," "Bangladesh fisheries," "aquaculture," "sustainable aquaculture," and "fish market dynamics." The search encompassed peer-reviewed journal articles, review papers, technical reports, theses, government publications, conference proceedings, and institutional research related to the nutritional composition, economic importance, and market dynamics of small indigenous fish species in Bangladesh. The inclusion criteria emphasized the relevance of small indigenous fish species to nutritional properties, economic contributions, and market demand within Bangladesh's aquaculture sector. Studies included in this review were published between 2000 and 2025 to ensure the inclusion of the most recent data. The selected literature underwent a thematic analysis, during which key themes were identified and categorized, including nutritional benefits, economic impact, sustainable farming practices, and market trends. This narrative review synthesized data from studies to highlight prevailing trends, research gaps, and emerging opportunities for enhancing the sustainability of small indigenous fish species in Bangladesh. This study is limited by its reliance on secondary data and the absence of empirical field research. Therefore, the conclusions drawn are based on the synthesis of existing data rather than primary research.

Results and Discussion

Proximate Composition of SIS

Fish are among the most nutrient-dense foods available, providing an excellent source of proteins, lipids, carbohydrates, vitamins, and minerals that are essential for maintaining human health. The macronutrients protein, fat, and carbohydrate serve as the principal energy-yielding components, while vitamins and minerals, though required in smaller quantities, play vital roles as micronutrients in numerous physiological processes (Pegu et al., 2023). The proximate composition, amino acid, fatty acid, and micronutrient profiles of several SIS of Bangladesh have been widely studied. For instance, *Puntius sophore* has been reported to contain moisture, crude fat, crude protein, and ash values of 72.02%, 3.55%, 16.2%, and 5.36%, respectively (Mahanty et al., 2014). These findings indicate that SIS, such as *P. sophore*, provide superior-quality animal protein compared to larger food fishes like Indian major carps and catfish. Similarly, Kamal et al. (2007) and Sinha et al. (2022) found that the mean proximate composition of *Clarias batrachus*, *Heteropneustes fossilis*, *Anabas testudineus*, *Notopterus notopterus*, *Channa punctatus*, and *Mystus vittatus* ranged from 14.87 ± 0.63 to 19.63 ± 0.50% for protein, 69.27 ± 1.04 to 76.06 ± 2.24% for moisture, 3.45 ± 0.92 to 7.90 ± 1.91% for fat, and 3.15 ± 0.25 to 6.81 ± 0.94% for ash, confirming their high nutritional value. Islam et al. (2020) further reported that the protein content among ten common SIS *Colisa fasciatus*, *Amblypharyngodon mola*, *Puntius ticto*, *P. sarana*, *Macrognathus aculeatus*, *Mystus tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* ranged from 13.18 ± 0.57% in *C. punctatus* to 17.3 ± 1.74% in *M. aculeatus*. The corresponding lipid content varied from 1.55 ± 0.11% (*C. fasciatus*) to 3.10 ± 0.23% (*C. batrachus*). These results demonstrate substantial interspecific variation in proximate composition, reflecting differences in feeding habits, habitat, and physiology. Mazumder et al. (2008) also evaluated six SIS species: *A. mola, Gudusia chapra, P. chola, Channa nama, Pseudambassis atherinoides*, and *Ailia coila*, and found protein contents of 18.46%, 15.23%, 14.08%, 18.26%, 15.84%, and 16.99%, respectively. Fat content ranged between 1.53% (*C. nama*) and 5.41% (*G. chapra*), while moisture content was highest in *C. nama* (78.62%) and lowest in *A. coila* (65.88%). Ash content varied from 1.55% (*G. chapra*) to 3.92% (*C. nama*).

The findings confirmed that *A. mola* and *C. nama* had the highest protein levels, while *G. chapra* exhibited the highest fat content. In terms of energy values, "Baim" contained 381 kJ, with 17.9 g protein, 1.7 g fat, 78.6 g moisture, and 1.0 g ash per 100 g of edible portion. "Jat Punti" (*P. sophore*) provided 541 kJ, with 15.7 g protein and 7.2 g fat, while "Kakila" had 311 kJ, 15.2 g protein, 1.8 g fat, 78.0 g moisture, and 2.0 g ash (Table 1). These values demonstrate the high energy and protein density of SIS relative to other freshwater species. Mustafa et al. (2015) analyzed the total fat and fatty acid composition of commonly consumed SIS, *A. mola*, and *P. sophore* identified twenty-one fatty acids in total. Fatty acids were categorized into saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA). While SFAs and MUFAs can be synthesized endogenously, PUFAs, such as ω-3 and ω-6, must be obtained through the diet. The predominant SFAs were palmitic acid (C16:0) and stearic acid (C18:0), while the main MUFAs included palmitoleic (C16:1 ω7) and oleic acid (C18:1 ω9). The key PUFAs were docosahexaenoic acid (DHA, C22:6 ω3) and eicosapentaenoic acid (EPA, C20:5 ω3). Total ω-3 fatty acids ranged between 4.28% and 17.86%, while ω-6 ranged between 4.08% and 23.12%, resulting in ω-3/ω-6 ratios of 0.35 to 1.50. The study concluded that regular consumption of *A. mola*, *P. sophore*, and *S. sarana* could substantially contribute to human requirements for essential ω-3 and ω-6 PUFAs. Omega-3 fatty acids, particularly DHA and EPA, play a crucial role in cognitive and neurological development. They are abundant in the human brain and essential for memory, learning, and visual function. Deficiency in ω-3 fatty acids during pregnancy can impair fetal nervous system and visual development.

In adults, this deficiency may lead to fatigue, poor memory, mood disorders, cardiovascular issues, and poor circulation (Pegu et al., 2014; Choo et al., 2018). Since humans cannot synthesize these long-chain ω-3 fatty acids de novo, α-linolenic acid from dietary sources must be converted into EPA and DHA through metabolic processes. These fatty acids play a role in modulating vascular function; for instance, EPA-derived thromboxane A3 is a weak vasoconstrictor compared with thromboxane A2 produced from arachidonic acid, thus contributing to cardiovascular protection. Bogard et al. (2015) further reported that the total saturated fatty acid content among various SIS ranged from 42.66% to 63.37%. The highest SFA level was observed in *A. mola* (63.37%), while *A. testudineus* exhibited the lowest (42.66%). The principal SFAs identified were myristic acid (C14:0), palmitic acid (C16:0), and stearic acid (C18:0), with the highest proportions recorded in *A. mola* and *P. sarana*. Hossain et al. (2024) corroborated these findings, reporting that SIS are rich sources of palmitic, linoleic, oleic, stearic, myristic, palmitoleic, and linolenic acids. The total SFA content varied between 42.66% (*A. testudineus*) and 63.37% (*A. mola*), while MUFA content ranged from 26.49% (*A. mola*) to 46.12% (*P. sarana*). Total PUFA content ranged from 5.7% in *A. mola* to 16.54% in *H. fossilis*, indicating species-specific variation in lipid quality. These results collectively confirm that SIS constitute a significant source of high-quality proteins and essential fatty acids, particularly ω-3 and ω-6, which are vital for human health and disease prevention.

SIS as a Source of Essential Minerals and Vitamins

Malnutrition remains one of the most widespread health challenges globally, affecting individuals across all age groups. Approximately 1.9 billion adults are overweight or obese, while 462 million adults are underweight. Among children under five years, an estimated 52 million suffer from wasting, a condition characterized by low weight-for-height (WHS, 2019). In Bangladesh, malnutrition and micronutrient deficiencies persist as major public health concerns, with more than six million children chronically malnourished (WFP, 2016; Save the Children, 2015). One in every three children under five years is stunted or underweight, while one in five adult women remains undernourished. Many children under 15 years experience multiple nutritional deficiencies, and millions of people continue to suffer from inadequate intake of essential micronutrients (NIPORT, 2016; Fiedler et al., 2014).

Table 1. Proximate Composition of Major SIS in Bangladesh (Adapted from Bogard et al. 2015)

SIS	Energy (kJ)	Protein (g)	Fat (g)	Moisture (g)	Ash (g)
Baim	381	17.9	1.7	78.6	1.0
Bele, Bailla	292	16.6	0.4	81.8	1.0
Boro Kholisha	354	15.2	2.5	77.0	5.2
Chanda	400	15.2	3.8	73.0	3.5
Chapila	385	15.5	3.8	78.4	3.4
Chela	345	15.3	2.8	78.4	2.0
Darkina	384	15.5	3.2	77.1	4.2
Dhela	387	14.7	3.2	77.1	4.2
Ekthute	360	17.9	1.7	76.7	1.7
Foli	368	17.0	1.6	76.7	3.6
Golsha	479	19.2	6.8	70.4	2.6
Guchi	394	17.9	2.6	77.7	2.2
Gutum	372	17.0	0.9	78.7	1.6
Jat Punti	541	15.7	7.2	73.2	3.5
Kachki	319	15.0	1.3	80.6	1.2
Kajuli	751	17.1	12.6	70.0	0.7
Kakila	311	15.2	1.8	78.0	2.0
Koi	737	15.5	12.8	70.5	1.0
Magur	326	16.5	1.3	81.3	1.1
Meni, Bheda	330	16.7	1.7	81.0	0.9
Modhu Pabda	419	16.2	9.5	73.9	0.9
Mola	415	17.3	3.7	75.3	1.0
Mola (cultured)	460	17.1	3.5	74.9	1.2
Rani, Bou	654	14.9	10.6	73.4	3.0
Shing	374	16.3	1.7	80.7	1.2
Taki	306	18.3	0.6	80.7	2.1
Tara Baim	318	15.2	0.9	80.4	1.2
Tengra	428	15.1	4.6	76.6	3.7
Tit Punti	538	15.4	3.7	75.9	3.3
Gojar	286	17.1	0.3	82.6	1.0
Ilish	1020	16.4	18.3	60.2	1.4
Jatka Ilish	618	19.0	7.7	71.8	2.1
Shol	310	18.7	0.3	81.0	1.2

Deficiencies in key micronutrients such as vitamin A, iron, and zinc represent critical nutritional gaps in Bangladesh (Harika et al., 2017). In this context, the SIS of fish is a vital yet underutilized resource for enhancing nutritional security. These fish are commonly consumed whole, including the head, bones, and viscera, which ensures maximum intake of essential minerals and vitamins. According to Bogard et al. (2015), SIS can provide more than 25% of the recommended dietary intake of iron (Fe), zinc (Zn), calcium (Ca), iodine, vitamin A, and vitamin B12 for pregnant and lactating women, as well as infants. Among the essential minerals, calcium plays a critical role in bone development and metabolic regulation. In Bangladesh, calcium deficiency remains a significant concern, affecting approximately 550,000 children with rickets and many women and children failing to meet their daily calcium requirements (Islam et al., 2023). Hossain et al. (2024) reported that the Ca content in SIS ranged from 16.45 to 35.78 mg/g, with an average of 26.71 ± 5.98 mg/g. The highest concentration (35.51 ± 0.23 mg/g) was found in *A. testudineus*, while the lowest (16.63 ± 0.17 mg/g) was observed in *Ompok pabda*. The elevated calcium levels are primarily attributed to the consumption of bones, which are rich in this mineral. Thus, SIS represents a highly bioavailable dietary source of calcium in rural and low-income diets. Mg concentrations in SIS collected from homestead ponds ranged between 2.38 and 4.94 mg/g, averaging 3.32 ± 0.76 mg/g (Hossain et al., 2024) (Table 2). Fe levels varied from 0.13 to 0.39 mg/g, with a mean of 0.25 ± 0.09 mg/g. The highest Fe content (0.38 ± 0.02 mg/g) was recorded in *H. fossilis*. Fe is predominantly concentrated in fish heads and viscera, contributing to hemoglobin synthesis and oxygen transport within the human body (Mohanty et al., 2013; Lall et al., 2021). Dietary iron deficiency remains the most prevalent micronutrient deficiency globally, leading to iron-deficiency anaemia. The World Health Organization (WHO) estimates that 37% of pregnant women, 40% of women aged 15–49 years, and 40% of infants aged 6–59 months are anemic worldwide (Reza et al., 2024; Gedfie et al., 2022). Phosphorus (P) content in SIS has been reported to range from 11.78 to 37.31 mg/g (Hossain et al., 2024). According to FAO/INFOODS (2013), species consumed with bones tend to have higher phosphorus concentrations, ranging from 110 to 1000 mg/100 g of edible portion. Zn concentrations also vary considerably among SIS, from 0.6 to 4.7 mg/100 g, with a mean of 1.9 mg/100 g, while iron ranges between 0.34 and 19 mg/100 g, with an average of 2.6 mg/100 g (Bogard et al., 2015) (Table 2). These findings highlight the remarkable mineral density of SIS compared with larger cultured fish. Selenium (Se), another essential micronutrient, is present in both inorganic (free) and organic (amino acid–bound) forms. Selenium supports the maintenance of healthy skin, hair, and nails, and plays a crucial role in antioxidant defense, immune regulation, and thyroid hormone metabolism (Mohanty et al., 2013). Regular consumption of small fish, particularly for individuals with thyroid disorders, is highly recommended because selenium helps improve thyroid function and reduce oxidative stress. Selenium also helps prevent cancer, cardiovascular disease, and chronic inflammation (Mohanty et al., 2013). The selenium content of SIS varies widely, ranging from 5 to 110 mg/100 g, consistent with values reported for other fish species globally (FAO/INFOODS, 2013). In addition to these minerals, magnesium, sodium, potassium, and manganese are also present in substantial amounts. FAO/INFOODS (2013) reported that magnesium content in fish ranges from 21 to 57 mg/100 g, sodium from 26 to 110 mg/100 g, and potassium from 58 to 350 mg/100 g, all of which fall within the levels observed in SIS species of Bangladesh. Manganese content ranged from 0.010 to 2.8 mg/100 g, slightly higher than levels reported in many other aquatic species. Overall, these findings demonstrate that SIS of Bangladesh are nutrient-dense foods rich in bioavailable minerals, including calcium, iron, phosphorus, selenium, and zinc. Their whole-body consumption ensures the retention of critical micronutrients that are often lost in larger, filleted fish. The regular incorporation of SIS into daily diets, especially for women, children, and nutritionally vulnerable groups, could therefore play a pivotal role in reducing micronutrient deficiencies and combating hidden hunger in Bangladesh.

Table 2. Several SIS are found in nearby tiny or shallow freshwater lakes and contain various nutritional trace elements (mg/100 g raw edible parts) (Modified from Bogard et al. 2015; Roos et al. 2003)

SIS	Fe (mg)	Zn (mg)	Ca (mg)	I (µg)	Se (µg)	P (mg)	Mg (mg)	Na (mg)	K (mg)	Mn (mg)	S (mg)	Cu (mg)
Tit Punti	3.4	3.8	1480	19	10	–	47	61	187	–	–	–
Rani, Bou	2.5	4.0	1300	25	31	820	45	48	160	1.5	170	0.094
Jat Punti	2.2	2.9	1042	20	9.5	–	39	53	203	–	–	–
Darkina	12	4.0	891	81	12	–	38	110	200	–	–	–
Boro Kholisha	4.1	2.3	1700	20	26	910	44	61	210	2.0	190	0.046
Guchi	2.7	1.3	491	19	45	–	34	52	294	–	–	–
Meni, Bheda	0.84	1.6	1300	23	29	810	44	68	250	1.4	210	0.029
Taki	1.8	1.5	766	18	15	–	35	47	260	–	–	–
Koi	0.87	0.6	85	–	19	160	21	31	260	0.052	190	0.052
Chela	0.84	4.7	1000	19	32	590	39	28	85	0.60	170	0.052
Kajuli, Bashpata	0.82	1.2	110	7.1	27	140	22	26	130	0.17	200	0.059
Tengra	4.0	3.1	1093	28	24	–	36	57	203	–	–	–
Foli	1.7	1.6	230	–	22	270	34	53	280	0.078	260	0.058
Chapila	7.6	2.1	1063	13	13.4	–	41	57	281	–	–	–
Baim	1.9	1.1	449	13	12	–	35	47	322	–	–	–
Mola (cultured)	19	4.2	1400	33	19	700	49	31	58	1.9	160	0.047
Magur	1.2	0.74	59	22	22	210	26	61	350	0.021	180	0.050
Tara Baim	2.5	1.2	457	13	15	–	34	46	290	–	–	–
Dhela	1.8	3.7	1200	9.5	29	660	39	37	110	0.60	170	0.046
Mola	5.7	3.2	853	17	5	–	35	39	152	–	–	–
Shing	2.2	1.1	60	–	31	220	37	54	300	0.038	230	0.057
Kachki	2.8	3.1	476	6.0	7.5	–	26	38	134	–	–	–
Chanda	2.1	2.6	1153	24	22	–	45	61	206	–	–	–
Kuli, Bhut Bailla	0.79	2.0	980	31	49	580	39	55	190	0.29	210	0.030
Gutum	3.3	2.5	950	16	36	650	57	45	240	0.46	190	0.054
Bele, Bailla	2.3	2.1	790	25	31	520	38	56	210	2.3	200	0.030
Kakila	0.65	1.9	610	37	29	450	35	49	190	0.47	240	0.046
Estate	1.5	3.6	1300	11	28	770	51	52	140	0.73	240	0.030
Golsha	1.8	1.3	120	13	41	180	26	33	210	0.22	220	0.039
Modhu Pabda	0.46	0.90	91	7.0	27	150	23	47	230	0.073	190	0.042

Economic Importance of SIS in the Context of Bangladesh

SIS holds substantial economic importance in Bangladesh's small-scale and homestead aquaculture systems. Their culture requires low production inputs, simple management practices, and minimal environmental modification, making them ideally suited for integration into homestead ponds, rice–fish systems, and gher-based aquaculture. This adaptability enables resource-poor and land-constrained farmers to engage in SIS production without requiring intensive inputs or specialized technology. Consequently, SIS culture serves as an entry point for rural households, particularly women and marginalized communities, to aquaculture-based livelihoods. The sale of SIS provides a consistent household income, particularly during lean agricultural periods when other income opportunities are scarce. Women often play a vital role in harvesting, post-harvest processing (drying, sorting, and marketing), and local trade of SIS, thereby enhancing their economic participation and empowerment in rural economies. The relatively short production cycle and rapid turnover of SIS ensure quick cash returns, while surplus production supports rural food supply chains and contributes to poverty alleviation and income diversification. Market demand for SIS in Bangladesh remains consistently strong due to its distinct flavour, cultural preference, and high nutritional value. Prices vary depending on the species, size, season, and locality. Premium SIS species, such as *A. mola*, *Chela cachius* (chela), and *Salmostoma bacaila* (baim) fetch high market prices, ranging from 400–800 BDT/kg, reflecting strong consumer demand and a perceived nutritional quality. Moderately priced species such as *Esomus danricus* (darkina) and *Osteobrama cotio* (dhela) are traded at 250–400 BDT/kg, making them affordable for middle- and low-income consumers while maintaining stable market turnover. Species such as *Ailia coila* (batasi) and *Clarias batrachus* (magur) command the highest market prices, ranging from 800–1400 BDT/kg, owing to their delicate texture, medicinal value, and preference in traditional cuisine. Similarly, *H. fossilis* (shing) maintains a high consumer preference and trades between 400–600 BDT/kg (Table 3), with a market status ranging from medium to high, depending on the region and season. In contrast, *O. pabda* is moderately priced (300–550 BDT/kg) but remains in steady demand across both urban and rural markets due to its taste and year-round availability. Overall, these species are highly valued in domestic markets and contribute significantly to the rural economy through small-scale trade networks, local employment generation, and household-level nutrition security. The increasing market integration of SIS has also encouraged the development of small-scale value chains involving fish collectors, vendors, and processors, many of whom are women, thereby strengthening inclusive rural aquaculture economies. With growing urbanization and increasing consumer awareness of the nutritional benefits of SIS, demand for these species is expanding in urban markets and among health-conscious consumers. This trend presents new opportunities for commercial SIS aquaculture, integrated rice–fish farming, and community-based production systems. Scaling up SIS culture could therefore serve as a dual strategy for income generation and nutrition enhancement, supporting national goals of food security, gender equity, and rural economic resilience in Bangladesh.

Table 3. Status of market price of some SIS species in three different riverine areas of Bangladesh (Source: Case studies at the field level)

Scientific name	Local name	Retail price (BDT/kg)			Supply status in fish market	Retailing status
		Tangail (Jamuna river area)	Rajshahi city (Padma river area)	Chandpur (Meghna river area)		
A. mola	Mola, Moya, Moilla	400-470	600-800	350-400	H	LC>MC>HC
Chela cachius	Chhep chela	500-650	700-800	300-350	M-L	HC>MC
Esomus danricus	Darkina,	250-300	-	-	L	LC>MC
Osteobrama cotio	Dhela, Mou Mach,	300-400	-	250-300	M	LC>MC
Salmostoma bacaila	Chela,Narkali chela, Katari, Narkoli chela	600-650	-		M	HC>MC
Aspidoparia jaya	Jaya, Peali, Peashi	800-1000	1000-1200	-	L	HC
Barilius vagra	Khoksa, Vagra	800-1000	500-550	250-350	M	HC
Garra annandalei	Ghor Poa	-	-	600-700	M	HC>MC

Table 3. Status of market price of some SIS species in three different riverine areas (Contd.)

Oreichthys cosuatis	Kosuati punti, Kosua punti, Tit punti	200-250	400-450	150-200	H	LC>MC
Puntius chola	Chola Punti	240-260	-	250-350	M	LC>MC
Puntius puntio	Punti	300-400	350-400	250-300	H	LC>MC>HC
Systomus sarana	Sarpunti, Sharputi	250-350	300-350	250-400	H	MC>LC>HC
Puntius sophore	Jat Punti, Vadi Punti	280-320	550-650	350-450	H-M	HC>MC
Pethia ticto	Tit punti	160-220		200-220	H	LC>MC
Botia dario	Rani Mach, Bou Mach	800-1200	-	-	L	HC
Botia rostrata	Rani Mach	650-750		550-600	L	HC
Notopterus notopterus	Foli, Haila	700-800	500-600	500-550	M	MC>HC
Glossogobius giuris	Baila, Bailly, Bele	500-700	800-1000	500-600	M	HC>MC
Channa marulius	Gajar, Gajal, Sal, Gajori	450-550	-	400-450	L	MC>LC
Channa punctatus	Taki, Lata, Chaitan	400-500	400-500	250-350	H	LC>MC>HC
Channa striatus	Shol	400-600	600-800	500-550	H-M	MC>HC>LC
Chanda nama	Nama Chanda, Chanda	200-250	350-450	150-180	H	LC>MC
Parambasis ranga	Gol chanda, Chanda, Chandu	260-340	300-400	150-200	H-M	LC>MC
Nandus nandus	Bheda, Meni, Roina,	400-550	800-900	250-300	M-L	MC>HC>LC
Anabas testudineus	Koi	600-700	600-800	500-700	M	HC>MC>LC
Trichogaster lalius	Baicha, Lal Khailsha	400-500	400-550	250-300	H-M	MC>LC
Trichogaster chuna	Chuna khaiisha, Baicha	-	350-450	350-400	M-L	MC>LC
Xenentodon cancila	Kankila, Kaikya, Kakila	350-450	500-600	250-300	M	MC>HC
Eutropiichthys vacha	Bacha, Garua Bacha	900-1000	600-700	500-600	M-L	HC>MC
Batasio batasio	Batasi	1000-1200	1200-1400	800-900	M-L	HC
Mystus bleekeri	Tengra, Golsha-Tengra, Gulsha Tengra	450-550	600-800	600-650	M-L	HC>MC
Mystus gulio	Nuna-tengra/ Guillya/ Penchgula	400-450	400-600	350-400	M	MC>HC
Mystus tengara	Bajari Tengra, Bujuri	250-350	450-550	200-300	H-M	LC>MC
Mystus vittatus	Tengra Tengra	400-600	500-700	450-550	H	MC>HC
Ompok pabda	Madhu pabda, Pabda, Paibba	300-450	450-550	400-450	L	HC>MC
Ailia coila	Kajuli, Bashpata	800-1000	1200-1400	400-450	L	HC>MC
Clarias batrachus	Magur, Mosqur, Mojgor, Jiol	800-900	800-1000	750-850	H	HC>MC
Heteropneustes fossilis	Shing, Jiol, Shinghi, Jill Shinghi	400-600	500-600	400-500	H	MC>HC>LC

Table 3. Status of market price of some SIS species in three different riverine areas (Contd.)

Macrognathus aculeatus	Tara Baim	1000-1200	1000-1200	950-1150	L	HC>MC
Mastacembelus armatus	Baim, Sal Baim	800-1000	700-800	450-650	L	HC>MC

High=H, Moderate=M, Low=L, High class=HC, Middle class=MC, Lower class=LC

Current Challenges and Constraints in SIS Utilization

SIS in Bangladesh faces multifaceted challenges that threaten their conservation, production, and nutritional potential. Habitat degradation and loss remain the most pressing issues. The conversion of wetlands, floodplains, and beels for agriculture, settlements, and infrastructure has significantly reduced natural breeding and nursery grounds for aquatic species (Mahalder et al., 2025). Pollution from industrial effluents, agrochemical runoff, and household waste further deteriorates aquatic environments. In addition, river regulation structures such as dams, embankments, and sluice gates have fragmented aquatic ecosystems, disrupting the natural flow, migration, and spawning of many SIS species. Over-exploitation and indiscriminate fishing exacerbate the decline in SIS diversity. The capture of broodfish and juveniles during breeding seasons using fine-meshed nets, dewatering of floodplains, and unregulated fishing activities drastically reduce recruitment and population regeneration. Many SIS species, once abundant, have now become rare or locally extinct in several regions. The lack of breeding and seed production technology poses another critical constraint (Siddique et al., 2022). Reliable induced breeding techniques for many SIS species are still underdeveloped, and hatchery infrastructure is limited. Dependence on wild fry collections creates seasonal scarcity and threatens natural populations. Poor broodstock management, genetic erosion, and inbreeding have further lowered seed quality and growth performance, hindering the expansion of SIS aquaculture (Mahmud et al., 2025). Institutional and governance barriers further limit progress. National fisheries policies and development programs largely focus on commercial species such as carps, tilapia, and pangasius, leaving SIS outside mainstream aquaculture development. Enforcement of fishing bans, size limits, and sanctuary regulations remains weak due to limited manpower and poor coordination among relevant agencies, including the DoF, and local cooperatives. Socioeconomic and awareness constraints also hinder sustainable utilization. Farmers often perceive SIS as a low-value species with limited market potential, and there is a lack of technical knowledge on culture systems suited for SIS. Poor post-harvest handling, drying, and storage facilities result in substantial quality losses, particularly for women who dominate the small-scale fish processing and trading sector. Additionally, consumer awareness of the nutritional superiority of SIS remains low, limiting demand in urban markets. Climate change and environmental variability add further pressure. Increasing water temperature, erratic rainfall, salinity intrusion, and recurrent floods in the southern and coastal districts are altering breeding cycles, reducing species richness, and shifting the geographic distribution of SIS (Haque et al., 2025; Aziz et al., 2022). These stressors compound the vulnerability of poor households that depend on natural SIS for food and income. Ultimately, research and information gaps persist, continuing to constrain evidence-based planning. Comprehensive data on the biology, population dynamics, and nutritional composition of many SIS species are limited. There is an inadequate genetic characterization and documentation of local strains, which poses a risk of losing genetic resources. Furthermore, integration of nutritional, ecological, and socioeconomic data into fisheries management remains weak, and extension services for SIS culture are still underdeveloped.

Conclusion and Future Perspectives

SIS are an invaluable component of Bangladesh's aquatic biodiversity and food system, offering rich sources of highly bioavailable micronutrients, including calcium, iron, zinc, selenium, and vitamin A. Despite their proven nutritional significance and socio-economic potential, SIS remain underrecognized in national aquaculture development and nutrition strategies. Over the past decades, habitat degradation, overfishing, pollution, and climate-induced stresses have caused alarming declines in SIS diversity and availability. In addition, inadequate hatchery technologies, weak policy integration, and low public awareness have constrained their large-scale utilization and conservation. To ensure the sustainable management and mainstreaming of SIS, a paradigm shift is needed from capture-based exploitation to culture-based conservation and production systems. Future initiatives should focus on developing reliable breeding and seed production technologies for key SIS species such as *A. mola*, *P. sophore*, *H. fossilis*, and *C. fasciata*. Establishing community-based hatcheries and sanctuary networks in floodplain ecosystems could simultaneously enhance biodiversity conservation and local livelihoods. Integration of SIS into polyculture and rice–fish farming systems offers a promising pathway to improve productivity, resilience, and dietary diversity for smallholders. Research and extension programs should emphasize nutrient-sensitive aquaculture, linking SIS production with public health and nutrition goals, particularly for women and children in rural households. Strengthening value chains and post-harvest processing, including low-cost drying, preservation, and packaging technologies, can enhance market opportunities and empower women who play critical roles in small fish marketing and processing. From a policy perspective, SIS should be mainstreamed into national aquaculture, biodiversity, and food security frameworks. The DoF, BFRI, universities, and NGOs can collaborate to promote species-specific research on nutrition profiling, genetic improvement, and climate resilience. Incorporating SIS into the country's nutrition action plans, school feeding programs, and dietary guidelines could also help combat micronutrient deficiencies nationwide. Looking forward, climate-smart and ecosystem-based management approaches, including wetland restoration, adaptive breeding programs, and community-led co-management, will be critical to safeguard SIS diversity under changing climatic conditions. By bridging nutrition, livelihoods, and ecosystem sustainability, SIS can play a transformative role in achieving Bangladesh's SDG targets on zero hunger (SDG 2), good health (SDG 3), and life below water (SDG 14).

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