

Small Indigenous Freshwater Fish Species in Nutrition of Ethnic Population of North East India

Bibha Chetia Borah*

Principal Scientist and Officer in Charge, Fisheries Research Centre, Assam Agricultural University, Assam, India

***Corresponding Author:** Bibha Chetia Borah, Principal Scientist and Officer in Charge, Fisheries Research Centre, Assam Agricultural University, Assam, India.

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Abstract

The North East India, comprising of eight states, is known for magnificent natural beauty, splendid natural wealth, rich biodiversity, enormous industrial potential and available human resources. In spite of having vast potential for growth, the region portrays a paradoxical picture with socio-economic backwardness due to various reasons, out of which malnutrition or under nutrition among the population is the one. Importance of fish as a source of easily available essential nutrition for has been globally recognized. Majority of the population of NE Region are non vegetarian with particular preference for fish. Fish is an integral part of not only of their daily diet, but also of different traditional and social activities. With 90-100% fish eating population in different states, there is substantial demand for fish in both fresh and preserved form in NE India. The region has a rich biodiversity of small indigenous freshwater fish species (SIFFS). The role of SIFFS in nutritional and livelihood security is quite significant for the ethnic population of the region, where these species inhabit the natural water resources abundantly and are preferred for their unique taste and food value and are consumed in fresh, dried or fermented form. Commonly consumed SIFFS were known to contain moisture 75-81%, Ash 1.95-4.31%, protein 13-15%, fat 1.18-5.78%, energy 52.14-114.02 Kcal/g, Potassium 78.29-501.47mg/100g, Sodium 124.85-581.92mg/100g, Calcium 76.59-1984.32 mg/100g, Magnesium 81.55-148.16 mg/100g, iron 0.31-15.95 mg/100g, zinc 13.15-27.06mg/100g, Manganese -0.02-6.34mg/100g. These fishes serve can as easily available source for essential nutrition like vitamins, calcium, iron, other minerals and micronutrients as these are generally consumed along with their head, bones and viscera by the ethnic people of the region. As such conservation vis a vis propagation of the SIFFS is important eliminating malnutrition of resource poor population of the region. The paper highlights the importance of SIFFS as source for securing nutrition and livelihood for the ethnic population of NE India.

Keywords: North East India; Ethnic Population; Malnutrition; Small Indigenous Freshwater Fish Species; Essential Nutrition; Propagation

Introduction

Malnutrition, according to the World Health Organization (WHO) refers to imbalances or deficiencies in the intake of nutrients or energy. Importance of fish in fighting hunger and securing nutrition for the growing population is globally recognized and extensively demonstrated. As per assessment of Food and Agriculture Organization (FAO) of United Nation, more than 3.1 billion people depend on fish for at least 20% of their total animal protein intake and a further 1.3 billion people for 15% of animal protein intake. Often referred as 'Brain food', fish consumption is known to play an important role in neurodevelopment in growing children. Besides being a rich source of easily digestible high quality protein and a wide variety of vitamins and minerals, fish is a unique source of essential nutrients including long chain

Omega- 3 fatty acid, iodine, vitamin D and Calcium. The demand for fish and fish products has been increasing continuously due to population growth, as well as other factors like growing awareness about health benefits of eating fish, taste preference and increasing purchasing capacity of people throughout the world. Global consumption of fish has been increased substantially from 9kg per capita in 1961 to approximately 20kg per capita at present. In many developing countries of the globe, fish is the major source of animal protein and is essential for providing micronutrients to the vulnerable population. As per the report of National health and family survey and WHO, the rate of malnutrition among adolescent girls, pregnant and lactating women and children are alarmingly high in India [1]. With several government programs in place, India although has reduced malnutrition considerably over the last

decade, there still remains need for effective location specific steps to address malnutrition in vulnerable regions. The North East India is one such region that requires specific attention in this aspect [2].

The North East India

The North East India is comprised of eight states viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim that lies between longitude 21°57' to 29°3'N and latitude 84°46' to 97°3'E. The Region covers a total of 2.62 lakh sq.km area that accounts for 7.97% of total land area of the country. The land locked states of North East India are connected to the rest of the country through a narrow corridor known as "Chicken's neck" (Figure 1). The region is bordered by four Asian countries, Bhutan, China, Myanmar and Bangladesh, and differs significantly from other parts of the country owing to its unique physiographic, agro-climatic, demographic and socio-economic features. The region as a whole is known for magnificent natural beauty, splendid natural wealth and rich biodiversity, enormous industrial potential and available human resources. Besides drastic variation in climatic condition, representing tropical, sub-tropical, temperate and alpine zones in different locations, the region is also characterized by high annual average rainfall of 2068mm (1577mm-6002mm), making it one of the highest rainfall receiving region of the planet [3]. The wettest places of the world, Mawsynram with an annual average rainfall of 11,873mm, followed by Cherrapunji with an average annual rainfall of 11,430 mm (according to the Guinness World Record), are situated in the state of Meghalaya. The high rainfall and high relative mean humidity to the tune of 70-85% [4] along with other characteristics like acidic soil and water (pH 4.0-6.0), spectacular variation in environmental temperature (sub-zero to 39°C) have helped to create an unique biodiversity.

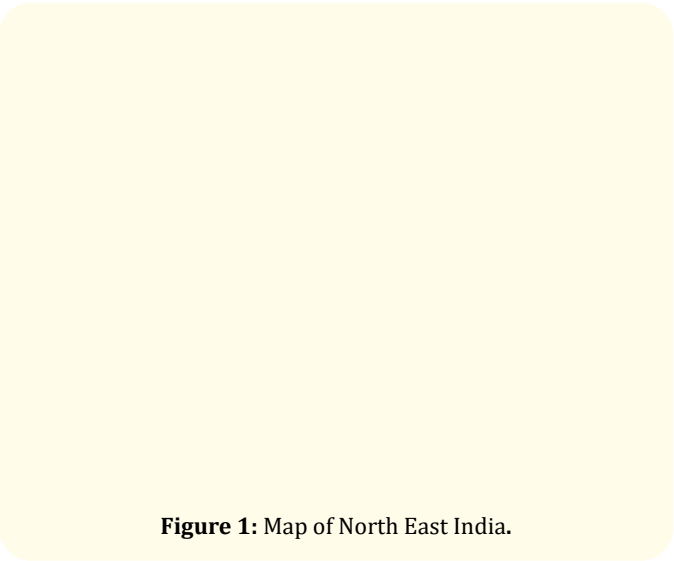


Figure 1: Map of North East India.

As per the census, 2011, the total population of the region is 45,587,982 that accounts for around 4% of the country's total. Total female population of the Region is 22,278,817, which is around 48.87% of the total population of the Region. The region represents a lower population density of average 159 per sq km, against country's average 368 per sq km with the state of Arunachal having lowest population density of 17 nos. per kilometer (Table 1).

State	Area (sq km)	Population	Density/ km	Sex ratio (F/ 1000male)
Arunachal Pradesh	83,743	1382611	17	920
Assam	78,483	31,169,272	397	954
Manipur	22,327	2721756	122	987
Meghalaya	22,429	2964007	132	986
Mizoram	21,081	1091014	52	975
Nagaland	16,579	1980602	119	931
Sikkim	7096	607688	86	889
Tripura	10462	3671032	350	961
Total NE India	2.62 lakh	45587982	159	950

Table 1: Area and population of states of NE India as per Census 2011.

Multiplicity of ethnic population has been the unique demographic characteristics of the Region with as many as 130 major ethnic groups each with distinctive traits accounting a total population of around 13.8 million. According to System Registration System, 2011, all the states of the region except Tripura have a higher population growth rate than the countries' average. Meghalaya reports the highest and Tripura the lowest natural growth rate of 16.6 and 9.9 per 1000 population respectively. The infant mortality rate (IMR) is lower than the country's average of 47 deaths per 1000 live births in all states except in Assam (58) and Meghalaya (55). As per the report goes the state of Manipur has the lowest IMR in the region with 14 deaths per 1000 live births [1]. The economy of the region depends basically on agricultural and allied activities with paddy centric agriculture as the major occupation for rural population. Rice is the staple food for the population of the NE India.

The NE region can be proud of having a higher sex ratio (950/1,000) than the national average (943/1,000) and higher literacy rate among women (67.27-89.40%) than the national average (65.46%) in all the states except in Arunachal Pradesh (59.57%). As per the Census, 2011, the gender gap in literacy rate in all the NE states is spectacularly lower (3.39-14.12%) than the

country’s average (16.68%). The list of the topper states in literacy rate in India led by Kerala, two states are from North East Region viz. Mizoram (91.33%, 3rd position) and Tripura (87.22%, 5th position). In September 2013, the State Govt. of Tripura claimed that the state surpassed Kerala as the most literate state in India with literacy rate of 94.65%. Prevailing Matriarchal societies is one of the unique features of NE region. Among the world’s 8 Matriarchal societies, two are from NE region viz. the *Khasi* community of Meghalaya and *Garo* community of Tripura, in which women are regarded as the head of the family and the heir for the paternal property. In patriarchal societies also, women in NE region enjoys a higher status in comparison to the other parts of the country as reflected by less dowry death and girl foeticide in the Region, with Mizoram having least (zero) female foeticide instance as per UNI report.

In spite of having vast potential for growth, the region portrays a paradoxical picture with socio-economic backwardness due to various reasons, out of which malnutrition or under nutrition among the population is the one. Malnutrition among the population of the NE region, particularly among the children and the adolescents have been reported by several authors [5-8].

Importance of fish and fisheries in NE Region

Majority of the population of NE Region are non vegetarian with particular preference for fish. Fish is an integral part of not only of their daily diet, but also of different traditional and social activities. With 90-100% fish eating population in different states, there is substantial demand for fish in both fresh and processed form. In addition to high demand for fish and fish products, the North Eastern Hill Region of India possesses unique potential for fisheries development in terms of vast and varied water resources and rich freshwater fish biodiversity which along with export potentiality and favorable agro-climatic condition offer tremendous scope for developing fisheries as a major sector for socio- economic growth of the region. The fishery resources of the region include 20050 km of rivers, 188760 ha reservoirs and 143740 ha of beels and lakes (Sugunan, 2003) in addition to 62289 ha ponds and mini-barrages. The region is blessed with 56 notable rivers/tributaries and large number of small rivulets/hill streams. Three major rivers systems Brahmaputra, Barak and Tista along with their tributaries, myriads of rivulets, beels, flood plain wetlands, lakes constitute the major components of natural fishery resources in the region.

The fish production trend however depicts a paradoxical picture amidst vast potentiality. The domestic fish production from this region is lagging far behind the demand for fish to feed the

growing fish eating population. The per capita consumption of fish in all the states of the region except in the state of Tripura, is much below the WHO’s recommendation as well as the national average. Although fish is a much preferred food item, insufficient domestic production *vis a vis* availability of fish and poor accessibility and affordability are the main reasons for low per capita consumption in these states. To meet the demand, every year a substantial quantity of fish is imported to the states of the region from different developed states of the country as well as neighboring countries like Bangladesh.

Being situated in one of the highest precipitated zones of the world, the hilly states of the region are characterized with innumerable streams, rivulets, lakes and a variety of aquatic micro habitats, which along with other biotic and abiotic components and suitable climatic condition have attributed to create one of the world’s richest repository of fresh water fish biodiversity in the region. Owing to the plentifully diverse flora and fauna, the Conservation International (USA) has included this region in two of the richest biodiversity hot spots of the world, the Indo Burma Hot spot and the Himalayan Hot spot. The region has the unique richness in freshwater fish germplasm resources for which it is regarded as one of the ‘hot spots’ for freshwater fish biodiversity [9]. Drastic variation is observed in available fish biodiversity, from warm water species to cold water species and from torrential species to species inhabiting marshes. Although there are different school of opinions regarding fish biodiversity of the NE region [10], a more recent report enlisted 422 fish species from NE Region of India, belonging to 133 genera and 38 families [11]. This accounts for about 62.81% of total fish species inhabiting the fresh water resources of India. The state wise fish biodiversity showed that the state of Manipur has the highest number of fish species followed by Assam (Table 2). It has been observed that the fish biodiversity of this hotspot has been facing serious threats due to a variety of

Sl. No	State	Total no. of fish	Food fish	Ornamental fish
1	Assam	311	131	180
2	Arunachal Pradesh	271	112	159
3	Meghalaya	231	95	136
4	Manipur	325	142	183
5	Mizoram	202	97	105
6	Nagaland	210	94	116
7	Sikkim	194	95	99
8	Tripura	199	101	98

Table 2: State wise fish biodiversity of North East India (Goswami *et al*, 2012).

anthropogenic and natural reasons resulting in catastrophic loss of the rich diversity. The conservation status reveals that out of the 422 fish species available in the region, 48 endangered, 69 near threatened, 103 vulnerable, 153 least concerned, 23 data deficient and 26 not evaluated [11].

Small Indigenous freshwater fish species

Small Indigenous freshwater fish species (SIFFS) is an important fish group of India comprising of around 450 species. Various schools defined SIFFS differently. While some schools defined SIFFS as those fish species that grow to a length of maximum of 25 cm at maturing stage [12], Sarkar and Lakra (2010) defined SIFFS as the fishes which grow to a maximum size of 25-30cm in mature or adult stage of their life cycle. These fish species inhabit widely diverse natural ecosystems ranging from rivers,

tributaries, streams, flood plains, wet lands, lakes, low lying paddy fields, swamps and seasonally inundated low lying areas. Maximum diversity of SIFFS has been recorded from North East Region of India followed by Western Ghats and Central India (NBFGR, 2011). Based on assessment of NBFGR, about 23% species of the Small Indigenous fish Species (104 species) are commercially important as food fish (62 species) and ornamental fish (42 species).

The role of SIFFS in nutritional and livelihood security is quite significant for a considerable section of population of India, more particularly for the population of the NE Region, where these species inhabit the natural water resources abundantly. The SIFFS are preferred by ethnic population of the region for their unique taste and food value and are generally consumed in different forms like fresh, dried and fermented. Different need based technologies and tools for harvesting, preparation and preservation of small

Figure 2 and 3: Catching small fish species by traditional traps and gears in natural resources.

indigenous fish species have been evolved traditionally in the region. Catching variety of wild SIFFS by traditional traps and gears made of locally available bamboo and cane, in natural habitats like swamps, beels etc. is a common scenario in rural areas of NE India (Figure 2 and 3).

Nutritive value of small indigenous fish Species

The small fish species available in North East India have big nutritive value as these are rich sources of not only protein but also a variety of vitamins, minerals and essential macro and micronutrients. The content of proximate and selected composition of common small indigenous freshwater fish species have been reported by several authors [13,14]. Commonly consumed SIFFS were reported to contain moisture 75-81%, Ash 1.95-4.31%, protein 13-15%, fat 1.18-5.78%, energy 52.14-114.02 Kcal/g, Potassium 78.29-501.47mg/100g, Sodium 124.85-581.92mg/100g, Cal-

cium 76.59-1984.32 mg/100g, Magnesium 81.55-148.16 mg/100g, iron 0.31-15.95 mg/100g, zinc 13.15-27.06mg/100g, Manganese -0.02-6.34mg/100g [14]. These fishes serve as a easily available source for vitamins, calcium, iron, other minerals and micronutrients as these are generally consumed along with their head, bones and viscera by the ethnic people of the NE region of India (Majumdar, *et al.* 2008). Small fish has been playing an important role in eliminating malnutrition of resource poor population of developing countries like Bangladesh, as these are accessible, less expensive and are preferred traditionally and culturally [12]. Due to the rich mineral content of the SIFFS, these are grouped as high Mineral content group of commonly consumed fishes [14]. According to National Health Service (NHS, 2007), the daily requirements of major minerals by human body are Ca 700mg, Na 2400mg, K 3500mg, Mg 300mg, Mn <0.5mg and trace minerals like Fe 8.7mg and Zn 9mg. The nutrient content of some common small fish species available

Sl. No.	SIS	Energy (k)	Protein (g)	Fat(g)	Moisture(g)	Ash (g)
1	<i>Mastacembelus armatus</i>	381	17.9	1.7	78.6	1.0
2	<i>Glossogobius giuris</i>	292	16.6	0.4	80.3	3.1
3	<i>Collisa fasciata</i>	354	15.2	2.5	77.0	5.2
4	<i>Pseudambasis ranga</i>	400	15.5	3.8	76.2	4.7
5	<i>Gudusia chapra</i>	385	15.5	3.8	78.4	3.4
6	<i>Chela cachius</i>	349	15.2	2.4	79.4	2.9
7	<i>Esomus danricus</i>	384	15.5	3.2	77.1	4.2
8	<i>Osteobrama cotio cotio</i>	387	14.7	3.8	78.1	3.7
9	<i>Notopterus notopterus</i>	384	20.5	0.6	76.7	1.4
10	<i>Mystus cavasius</i>	479	16.8	5.1	76.8	1.0
11	<i>Mastacembelus pancalus</i>	394	17.9	2.6	77.7	2.2
12	<i>Puntius sophore</i>	541	15.7	7.2	73.2	3.5
13	<i>Ailia coila</i>	751	17.1	12.6	70.0	0.7
14	<i>Xenentodon cancila</i>	329	17.1	1.2	80.2	1.8
15	<i>Anabas testudineus</i>	737	15.5	12.8	70.5	1.0
16	<i>Clarias batrachus</i>	326	16.5	1.3	81.3	1.1
17	<i>Nandus nandus</i>	338	16.7	1.7	78.5	3.6
18	<i>Ompok pabda</i>	619	16.2	9.5	73.9	0.9
19	<i>Amblypharyngodon mola</i>	445	17.3	4.5	75.6	3.5
20	<i>Botia dario</i>	654	14.9	10.6	70.8	3.2
21	<i>Heteropneustes fossilis</i>	374	19.1	1.9	79.2	1.0
22	<i>Channa punctatus</i>	306	18.3	0.6	80.7	2.1
23	<i>Macrogathus aculeatus</i>	387	17.2	2.6	79.4	2.3
24	<i>Mystus vittatus (Tengra)</i>	428	15.1	4.6	76.6	3.7
25	<i>Puntius ticto</i>	385	15.4	3.4	77.5	3.8

Table 3: Nutrient content (Per 100gm of raw edible parts) of some common SIFFS (Bogard *et al*, 2015).

in the region (Table 3) indicates the important role played by these fishes in meeting the nutritional requirements particularly in embryonic growth, bones formation, teeth and muscle formation, neural and brain development, intelligence in young children and milk production in lactating mothers [15].

Among the fish species reported from NE region, 250 species are recognized as having ornamental value with export potentiality in the international market. Majority of these ornamental fish species belong to the SIFFS group. The indigenous small fish species with attractive body shape, beautiful body color, bright stripes, spots, attractive body movement, eating/preying habit, small size, hardness, adaptability to confined condition of aquarium or tank and other unique attractive properties are recognized as having ornamental potential (Figure 4-6). Around 200 ornamental fish species are exported from India to international market, out of

Figure 4: *Colisa lalia*.

Figure 5: *Colisa fasciata*

Figure 6: *Amblypharyngodon mola*

which around 85% species are being exported from the NE region with specific trade name [16]. The market demand for indigenous ornamental fish species of NE region has been increasing in recent years in international market. Mahapatra., *et al.* [17] reported that 157 fish species, collected from natural resources of NE region are being exported to the international market.

This indicates that the existence of small fish species population has been becoming vulnerable in this region because of their exploitation in their natural habitat both as food as well as ornamental fish. However, not much effort has been taken specifically for conservation and propagation of the small indigenous fish population. For sustainability of the trade, as well as for conservation of different small fish species, breeding, propagation and culture of these fish population under captive condition are important steps that should be initiated immediately.

Traditional preservation technology for small fish species

The NE Region is a treasure house for indigenous knowledge systems pertaining to agriculture and allied activities. The ethnic population of the region has developed unique traditional technique for preservation of small fishes that are abundantly available in the natural resources of the region. A number of ethnic fish products like Shidal, Namsing, Ngani, Hentak, Tungtap, Hukoti etc, with unique taste, nutritional and medicinal value prepared traditionally (Figure 5 and 6) by different tribes/communities of the region have been reported [18-21]. Fermented products prepared by using a variety of small fish have been occupying a special place in the day to day nutrition and traditional activities of the ethnic population of the region. The technique of fermentation is said to be evolved as an answer to inconvenience in drying of the highly perishable commodity due to high humidity and prolonged period of heavy rainfall during summer and low temperature and short sunshine hours during winter. However there are variations in fermentation process among different tribes as well as variation in product name. The Ngari is indigenous to Manipur, which is prepared by fermentation of a commonly available small fish species *Puntius sophore* after sun drying and keeping in earthen

cured pot along with other ingredients for around 6 months. Similar product is also prepared in Assam, known as Shidol (Figure 7) and in other states of the region like Tripura, Mizoram, Arunachal Pradesh, Nagaland and is known by different names. The Mising community of the state of Assam prepares the fermented product *Namsing* (Figure 8) by using small fish varieties like *Puntius* species, *Amblypharyngodon mola*, *Colisa* sp. etc. and addition of varieties of locally available herbs (*Colocasia* sp. etc.) and keeping in cylindrical container made of bamboo (*bahorchunga*) for fermentation process [19]. The Deori community of Assam also prepares dry fish product known as *nadubasiyan* (small indigenous fish salted and sun dried or smoke dried) and fermented fish product, known as *Chucha* by using different kinds of dried small fish mixed and fermented with different kinds of herbs and stuffed in bamboo cylinder and kept for

Figure 7: *Shidal*, a fermented small fish product (Muzaddadi and Basu, 2012).**Figure 8:** *Namsing*, a fermented small fish product.

Sl. No	Product	Moisture %	Protein%	Fat %	Ash %	PH	Reference
1	Shidol/Ngari	33.44	38.35	20.31	7.19	6.1	Kakoti and Goswami (2013)
2	Namsing	38.65	34.27	14.5	14.5	6.8	Kakoti and Goswami (2013)
3	Hentak	44.26	22.84	6.19	14.36	6.4	Kakoti and Goswami (2013)
4	Tungtap	35.40	32.0	12.0	18.9	6.2	Thapa and Pal [22]
5	Lona fish	54.35	2.81	9.41	16.73	5.66	Majumdar and Basu (2010)

Table 4: Nutritive value of traditional fermented fish products of NE India.

3-4 months for fermentation and become ready for consumption [22]. In addition to preservation, the fermentation process has some added benefits like enhancing flavor, improving nutritive and therapeutic value and digestibility. The nutritive value of some of the most common fermented products prepared traditionally by using locally available small fish species with their nutritional value are given in Table 4.

Data available indicates that these much preferred traditional fish products of the region if produced on commercial level can

contribute substantially to the day to day nutrition of the people of the region. Steps for standardization, hygienic preparation and quality packaging for enhancing shelf life and value addition for enhanced nutritive value and quality maintenance would pave the way for developing sustainable commercial enterprises on these ethnic fish products. This would also enhance nutritional security of the tribal population through easy and assured availability of the

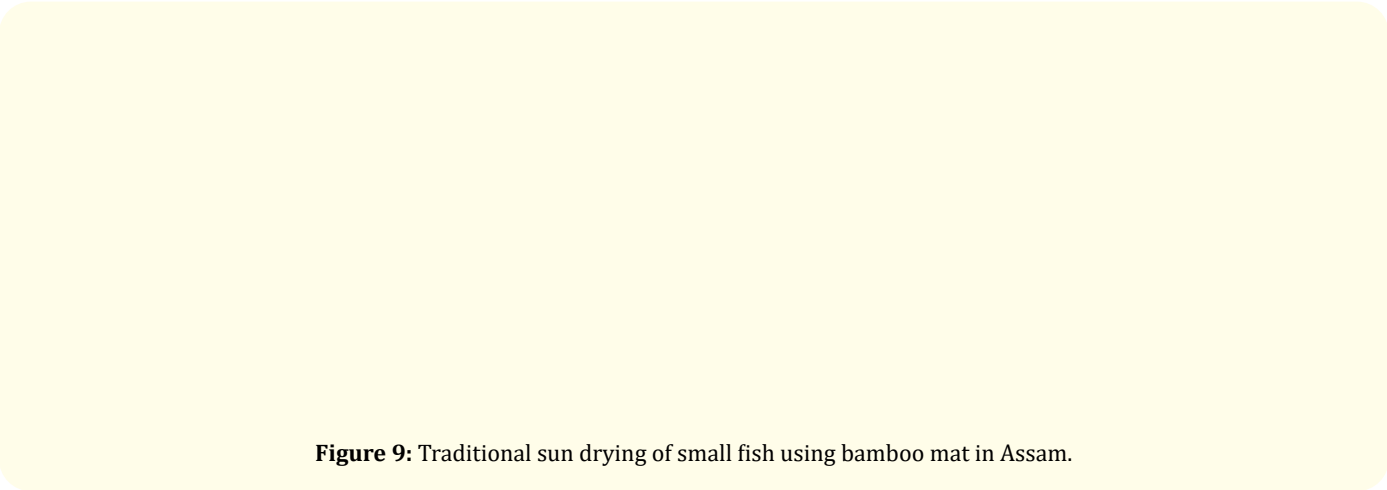


Figure 9: Traditional sun drying of small fish using bamboo mat in Assam.

much preferred food product.

Sun drying and smoke drying of small fish is also common among different ethnic communities of the region [22,24]. The traditional dried small fish products prepared using specifically evolved techniques (Figure 9) by ethnic people are known by different names and have unique taste and high nutritive value. However standardization and commercialization of the ethnic products is still lagging behind.

It is worth mentioning that although Asia’s biggest market for dry fish is situated in Jagiroad, a small industrial town in the Morigaon district of central Assam, development of commercial enterprise on dry fish/value added product is still infancy in the region due to a variety of reasons out of which lack of initiative, lack

of proper infrastructure hygienic production of dry fish product including power supply, lack of required financial investment, lack of skill development and awareness among ethnic people on entrepreneurship development are some of the issues that need to be addressed.

Way ahead for conservation and propagation of Small fish species of NE India

Major sources for SIFFS are the natural resources of the region like rivers, floodplain wetlands, swamps, inundated paddy fields and other low lying areas that get inundated during rainy season. The market demand for these species is very high in the region often fetching higher price than the carps (Figure 10). The higher market price, very high demand (both in fresh as well as preserved

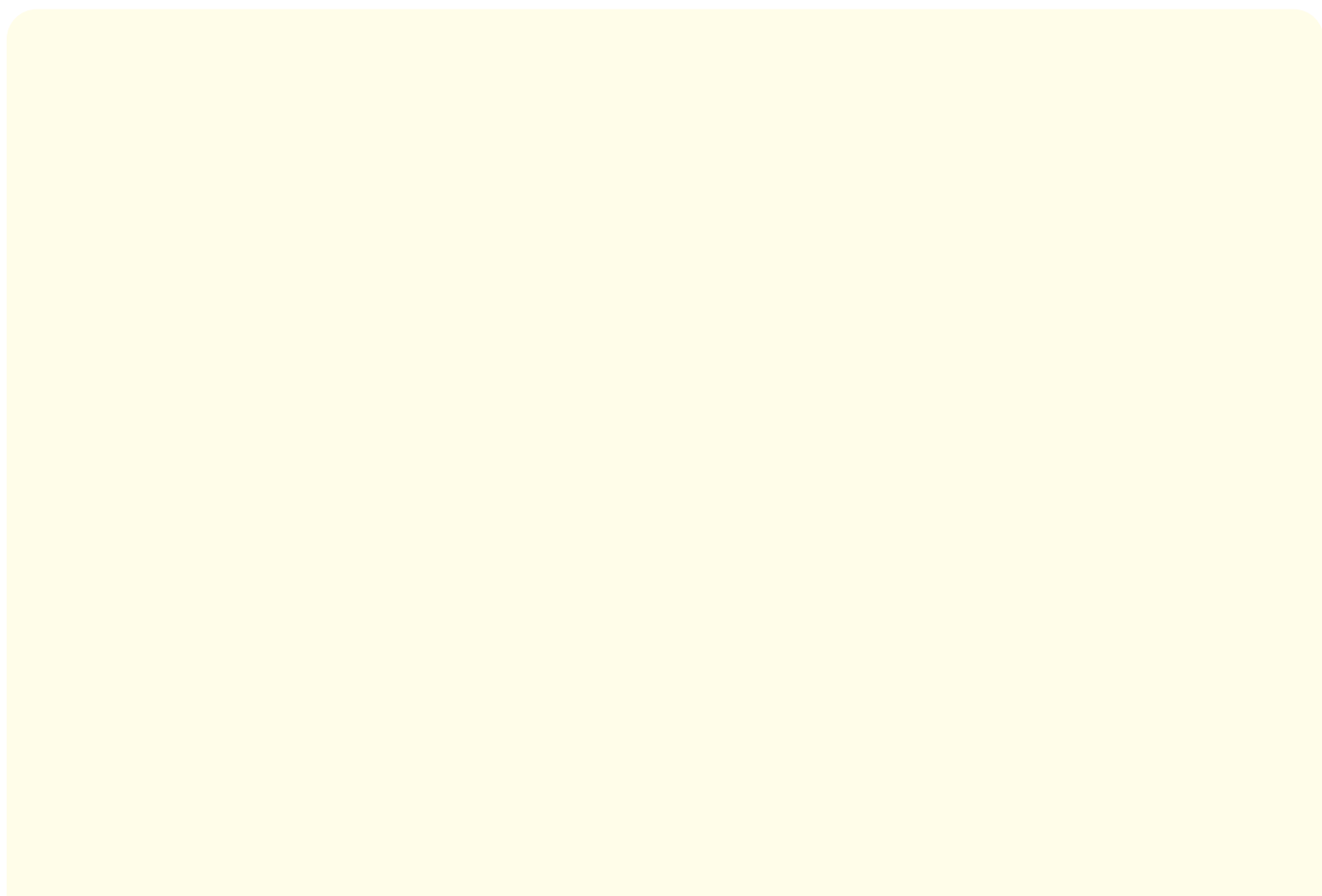


Figure 10: SIFFS at road side market in Assam.

form) along with importance of majority of small fish species as ornamental fish in the international and domestic market enhances the vulnerability of the small fish species for being over exploited in the natural resources. Therefore it is high time to take necessary steps specifically to conserve and propagate small fish species so as to sustain nutritional security to the ethnic population of the region as well as other trades for sustenance. Propagation through breeding and culture under controlled condition is one of the most important steps towards achieving this.

Successful induced breeding under captive condition have been reported for several small fish species like *Mystus vittatus*, *C. batrachus*, *Anabas*, Murrels, *Mastacembelus*, *H. fossilis*, *Ompok pabda*, *Colisa fasciata*, *Macrogathus* species, *Danio* species etc [10,25-27]. While breeding biology of several small nutritious fish species like, *Puntius* sp., *Anabas testudineas*, *Amblypharyngodon mola*, *Gudusia chapra*, *Chela cachius*, *Notopterus notopterus* etc. were studied in different locations [26,28]. With the available technologies and with development of right kind of infrastructure and market-

ing channel, the production and marketing of indigenous small fish fauna cannot only open promising agribusiness enterprise for the region, but also help in conservation and restoration of the small indigenous fish fauna thereby sustaining much needed nutrition for the population.

Myriads of small ponds either seasonal or perennial are available in the homesteads as well as in paddy fields of the NE States. The state of Assam has this unique distinction of having traditionally managed family farm in the homestead of almost all rural households. Locally known as *Bari*, this family farming system generally includes different horticultural crops, plantation crops, livestock and small to medium sized pond that as a water reserve for the family, harvesting rain water for irrigation and other domestic use. Majority of these ponds are suitable sources for production of several small nutritionally important fish species and can be an ideal solution for securing protein nutrition for resource poor farm families [26,28-31]. Initiation of specific plan and policy for conservation and propagation of these SIFFS along

with massive awareness among the people is the need of the hour. Research emphasis need to be oriented to breeding and mass scale production of the SIFFS under controlled condition, restoration and propagation of the population in natural habitat as well as judicious utilization of the available resources [32-35].

Conclusion

In the light of the above review it can be concluded that the importance of SIFFS in the life of the ethnic population of the NE India as a source of essential nutrition and sustenance is well established. High demand of the small fishes both as food as well as ornamental fish makes these species vulnerable to over exploitation in their natural habitat, which along with other anthropogenic and natural factors has been leading to degradation of the rich SIFFS Biodiversity of the region. As such urgent necessary steps need to be taken to conserve and propagate as well as to restore the natural population for a sustainable nutritional security of the population.

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