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Review Article

Fish production in North East India address food and nutritional security of the region?

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ABSTRACT

More than 90 % of people in North-East (NE) Indian states are fish eaters. But the total fish production registered during 2013-14 was only 3.77 lakh tonnes while the total demand for fish consumption during the year was 4.05 lakh tonnes. This shows that about 90,000 tonnes of fish are required to meet the fish consumption needs of NE Indian states. This paper attempts to assess the fishery resource distribution, growth, consumption trends of fish and strategies for increasing fish production and nutritional security in NE India. The analysis is based on unit record data on fish consumption obtained from National Sample Surveys (NSS) rounds 38, 51, 60, 66 and 68. The results indicate that there is immense scope for increasing fish consumption in NE Indian states ensuring near optimum nutritional standards prescribed for the nutritional security in absolute terms though not necessarily at the individual level.

INTRODUCTION

Ten billion people are expected to be living on earth by 2050. It is necessary to generate sufficient and nutritious food to feed this growing population. Food systems must produce and supply enough calories and protein and also provide important micro-nutrients such as iron, zinc, omega-3-fatty acids and vitamins. Golden *et al.* (2016) estimate that 17 % of the global population is zinc deficient. They estimate that 845 million people (11 % of current global population) are poised to become deficient in zinc, iron and Vitamin A. Fish are crucial sources of micro-nutrients. According to FAO (2016) world per capita apparent fish consumption increased from an average of 9.9 kg in 1960's to 14.4 kg in 1990's and 19.7 kg in 2013, with preliminary estimate for 2015 indicating further growth exceeding 20 kg.

Comprehensive studies detailing the various aspects of nutritional status and security of North East (NE) Indian people is conspicuous by its absence. Several micro studies are available in respect of overweight, persistent high burden of thinness (Sikdar, 2012; Singh and Devi, 2013), iodine deficiency (Chandra *et al.*, 2006), nutrition status of children (Rao *et al.*, 2004), health and nutrition status of Tripura. Ninety five percent of the population of the NE India consume fish. Cat fishes are popular in NE India. Chital, Pabda, Koochamachli and Singhi are protein rich while Singhi is high in respect of calcium, phosphorus, iron and carbohydrates (Safder, 2015). Eleven percent of the babies born in Meghalaya were with low birth weight (less than 2.5 kg). But none of the infants exhibited any nutritional deficiencies. The overall prevalence of underweight, stunting and wasting was 21 %, 44 % and 5 % respectively, which were lower than the national figures (NIN, 2014).

The North East region of the country comprises many important fishery resources in the country and in fact ranks 6th among the top 25 biodiversity hotspots in the world (Kottelat and Whitten, 1996; Gurumayum and Choudhury, 2009). The fisheries sector in the NE region of India holds an important position in the socio-economic and the cultural context of the people in the region. However the contribution of NE region to the fisheries sector in spite of the presence of vast fisheries resources in the region is only 5.9 % (DAHDF, 2013).

A cursory examination of the data of fish production at the national level clearly indicates the disparity in total fish production, the potential of the same in a given area and demand for fish. This paper attempts to access the fishery resource distribution, growth of fish production in NE India, fish consumption trends in NE and strategy for increasing

fish production for meeting the consumption demand and nutrition security of fish in NE India.

MATERIALS AND METHODS

Fish production statistics of North Eastern Development Corporation Limited were used for the study. Compound growth rate were estimated using the standard Cobb-Douglas function $Y=AX_i^{bi-1}$ and r=antilog (β-1)*100.

Fish consumption statistics for the eight NE states of India were collected from various National Sample Survey Reports on household consumption on various goods and services in India for the rounds 1986-87, 1993-94, 2004-05, 2009-10 and 2011-12. Data on fish consumption were analysed for both rural and urban population in different states of NE India.

Gini co-efficient were used for determining the inequality in fish consumption across rural and urban population in the eight NE states of India (Here the Gini coefficient has been estimated for average value of fish consumption across the 8 NE states. Therefore these estimates are indicative only). The general form of Gini coefficient (G) is given by (Lavanya and Kumar, 2015),

$$G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i - x_j|}{2n\sum_{i=1}^{n} x_i}$$

where, x_i is the fish consumption of person i, and there are 'n' persons.

Fresh fish consumption across the 8 NE Indian states were also estimated on the basis of statistics of disposition of fish catch by these states during 2008-12 (DAHDF, 2014). Forecasting was done using SPSS version 16 through time series expert modeller with ARIMA, Simple, Holt and Brown models and Microsoft Excel-2007.

RESULTS AND DISCUSSION

Resource availability

North-eastern states of India abound with pristine water bodies whose potential for fish production has been barely tapped. The potential of fish production in NE states of India is estimated to be 4.88 lakh t. A total of 5.63 lakh ha of water spread area is available for fish production in the eight NE states of India excluding the riverine resources (Table 1). This comprises 0.33 lakh ha of reservoir water spread area, 3.71 lakh ha of water spread in tanks and ponds and 1.59 lakh ha of flood plains and derelict water bodies. Among the eight NE states of India, Arunachal Pradesh alone has 3.18 lakh ha of water spread area followed by Assam with 1.35 lakh ha. The riverine resources alone comprise 20,875 km of water resources (Table 1). Meghalaya has 5600 km of rivers followed by Assam (4820 km) and Manipur (3360 km).

Table 1: Fishery resources of the NE states of India

State	Reservoirs (lakh ha)	Tanks and ponds (lakh ha)	Flood plain lakes and derelict water bodies (lakh ha)	Total water bodies (lakh ha)	Rivers and canals (Km.)
Arunachal Pradesh	0.00	2.76	0.42	3.18	2000
Assam	0.02	0.23	1.10	1.35	4820
Manipur	0.01	0.05	0.04	0.10	3360
Meghalaya	0.08	0.02	0.00	0.10	5600
Mizoram	0.00	0.02	0.00	0.02	1395
Nagaland	0.17	0.50	0.00	0.67	1600
Sikkim	0.00	0.00	0.03	0.03	900
Tripura	0.05	0.13	0.00	0.18	1395

Source: NEDFI Databank, 2013

Fish production in NE India

The NE states contributed 4.11 lakh t of fish during the period 2015 - 2016 (Table 2). This signifies a substantial increase in fish production in the region by more than 1 lakh t over a period of 10 years and yield increases from 438 Kg to 731 Kg in 2015-16. It can be seen from Table 2 that the total fish production was only 2.5 lakh t in the region during 2006-2007. The extent of disparity in the performance of fish production across the eight states is evident from the fact that around 72% of the total fish production is from Assam, while Tripura contributes 16 %and the other six states together contributed only 13 %.

Table 2 gives the trends in fish production and productivity in the eight NE states of India during 2006-2016. The data excludes the output from riverine systems. It can be seen that productivity is maximum for Tripura with an output of 3531 kg per ha of water spread area (WSA), followed by Mizoram with 3270 kg and Manipur with 3127 kg. One of the major issues in analyzing data for fish production in NE states of India is the fact that there appears to be substantial discrepancies and inconsistencies in the available data.

Table 2: Fish production and productivity in NE states of India (000 t)

State	Water spread area (WSA) (lakh ha)	2006-07	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Arunachal Pradesh	3.18	2.77(8.7)	2.65(8.3)	3.035(9.5)	3.3(10.4)	3.71(11.6)	0.61(1.2)	4(12.6)	4.41(13.9)
Assam	1.35	181.5(1344)	218.8(1621)	227.2(168)	243.9(1806)	254.3(1883)	266.7(1976)	282.7(2094)	291.7(2161)
Manipur	0.1	18.6(1861)	19.2(1920)	20.2(2020)	22.2(2222)	25.0(2499)	28.5(2854)	30.52(3052)	31.27(3127)
Meghalaya	0.1	5.5(549)	4.2(421)	4.6(456)	4.8(477)	5.4(542)	5.8(575)	5.89(589)	6.14(614)
Mizoram	0.02	3.8(1880)	3.0(1520)	2.9(1450)	2.9(1465)	5.4(2715)	5.9(2970)	6.39(3195)	6.54(3270)
Nagaland	0.67	5.8(87)	6.4(95)	6.6(98)	6.8(102)	7.1(106)	7.5(111)	7.84(117)	7.84(117)
Sikkim	0.03	0.2(50)	0.2(57)	0.2(60)	0.3(93)	0.5(163)	0.4(140)	0.44(147)	0.44(147)
Tripura	0.18	28.6(1591)	42.3(2348)	49.2(2735)	53.3(2963)	57.5(3192)	62(3441)	63.56(3531)	63.56(3531)
Total	5.63	246.7(438)	296.7(527)	313.9(558)	337.6(599)	358.9(637)	377.4(670)	401(712.9)	411.9(731)

Source: NEDFI Databank, 2013(2007-10) (excluding riverine production) and DAHD&F various issues (2011-14). Figures in parenthesis are yield.

It is expected to increase to 4.9 lakh t in the year 2017, indicating an absolute increase in fish production by as much as 80,000 t (Fig. 1).

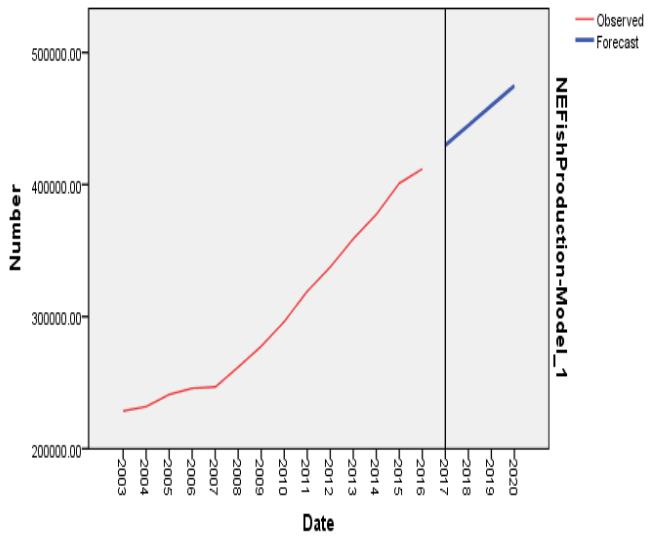
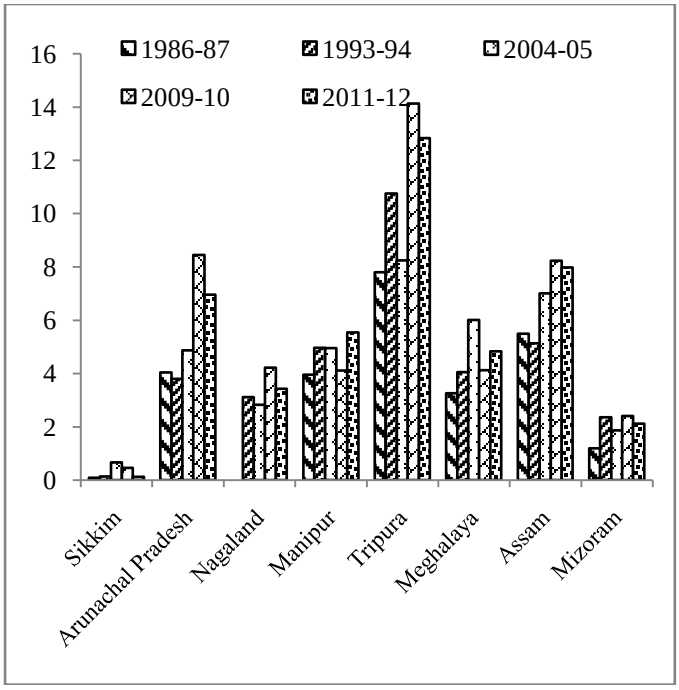


Fig. 1: Predicted fish production in the NE region of India



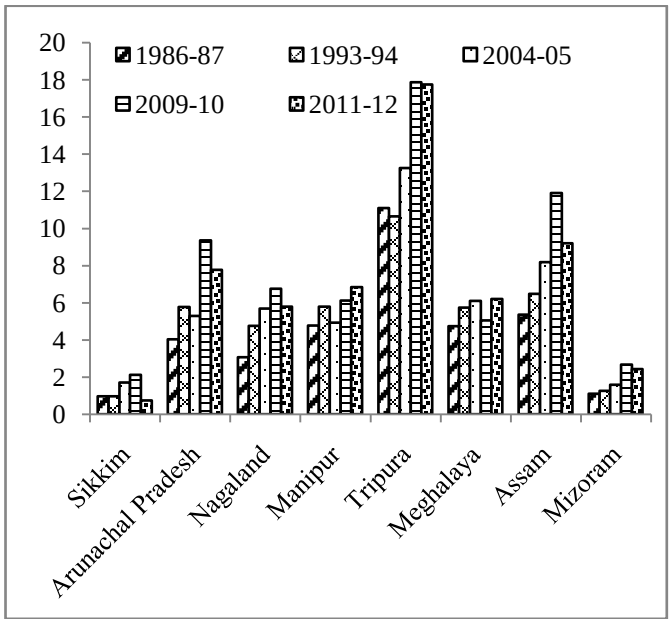
Source: Various NSS Reports.

Fig. 2: Per-capita annual fish consumption in North East India – Rural

Trends in fish consumption in NE India

Figure 2 gives the per capita annual fish consumption of NE Indian states (Rural) across the 5 NSS rounds 1986-87, 1993-94, 2004-05, 2009-10 and 2011-12. It can be seen from the figure that Tripura has the highest consumption of fish among NE Indian states (Rural). This remains the same across the 5 NSS rounds on fish consumption that has been considered here. Fish consumption was almost 8 kg per capita per year in rural Tripura in 1986-87 and has risen over 13 kg/capita/year in 2011-12. Fish consumption per capita in rural Sikkim is very low. It has remained below 1 kg/capita/year across the 5 NSS rounds considered here.

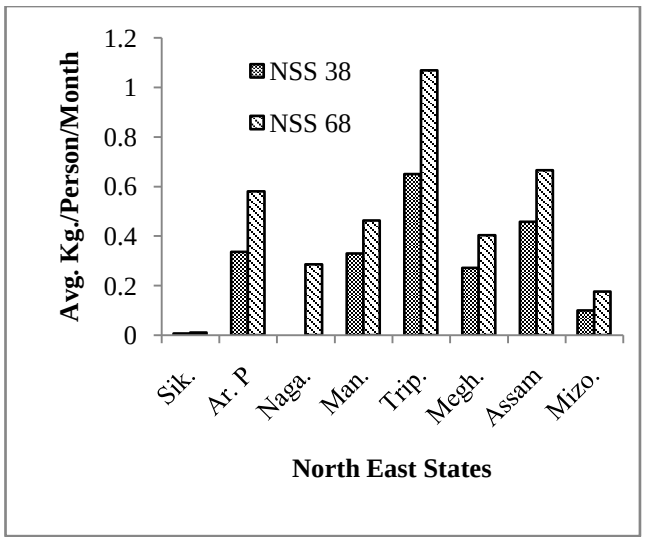
As far as per capita annual fish consumption in the 8 NE Indian states (Urban) are considered (Figure 3),it can be seen that similar to rural, the urban fish consumption per capita per year was highest in Tripura among all other states in NE India. It was as much as 11 kg/capita/year in 1986-87 and has risen up to 18 kg/capita/year in 2011-12. Though the per capita consumption of fish in urban Sikkim was low compared to other NE Indian states, it was better than fish consumption in rural Sikkim. The performance of urban Mizoram was almost equal to that of Sikkim.



Source: Various NSS Reports.

Fig. 3: Per-capita annual fish consumption in North East India - Urban

Figure 4 depicts the comparison of average fish consumption across rural NE states. The average fish consumption of NE states per month across the 2 NSS rounds 38 and 68 showed that the average fish consumption per capita per month was highest around 0.7 kg in rural Tripura in NSS 38 round. The average fish consumption per capita per month remained highest for rural Tripura at almost 1.1 kg/person/month in NSS round 68. It may be seen that fish consumption has been increased per capita per month across all NE Indian states across NSS 38 and 68 rounds. The very low per capita consumption per month in rural Sikkim could be because of preference for other non vegetarian food items.

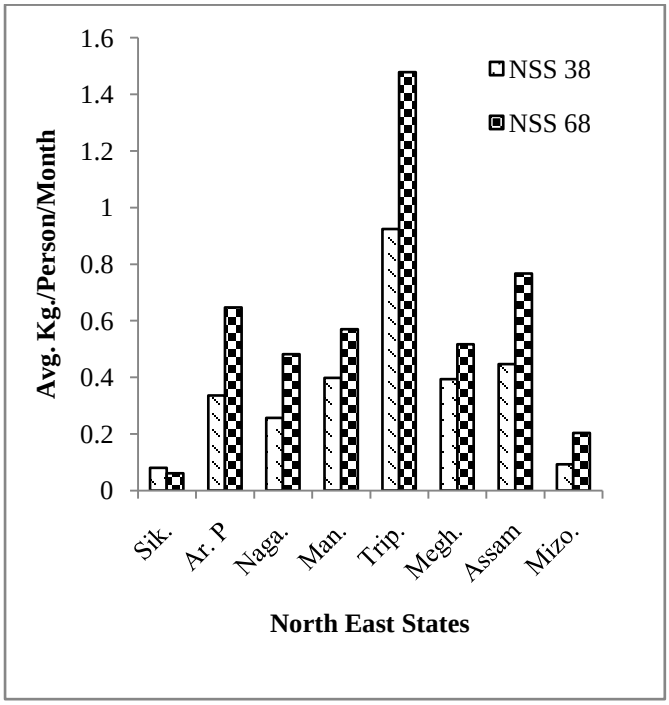


Source: Own calculations based on NSS data

Fig. 4: Comparison of average fish consumption across North East States and NSS rounds (in Kg/Person/Month) – Rural

As far as average fish consumption of NE states in urban areas across NSS 38 and 68 round is concerned, Tripura is way ahead of the rest with as much as 1.5 kg/person/month in NSS round 68. Tripura also registered the highest average fish consumption per person per month at 0.9 kg in urban areas in NSS round 38. It is heartening to note that the average fish consumption per capita per month of the urban Sikkim was better than the rural counterpart (Fig. 5).

Table 3 showed the relative ranking of fish consumption of NE states across NSS rounds 38 and 68. It can be seen from the table that Tripura has remained the number one fish consuming states among all NE Indian states across the NSS rounds 38 and 68. The percentage change in quantity of fish consumed in rural Tripura was as much as 39 % across NSS rounds 38 and 68. As far as other states are concerned rural Nagaland registered 100 % increase in quantity of fish consumed over the 2 NSS rounds considered. It jumped from the last position to the 6th position across these 2 NSS rounds. Fish consumption across the 2 NSS rounds increased in rural Mizoram (44 %), Arunachal Pradesh (42 %), Meghalaya (33 %), Assam (31 %), Sikkim (30 %) and Manipur (29 %).



Source: Own calculations based on NSS data.

Fig. 5: Comparison of average fish consumption across North East States and NSS rounds (in Kg/Person/Month) – Urban

As far as urban ranking of fish consumption among NE Indian states is concerned Tripura retained its 1st position across the two NSS rounds. It registered as much as 37 percent increase in fish consumption across the two NSS rounds. Fish consumption across the NSS rounds increased in urban Mizoram (55 %), Arunachal Pradesh (48 %), Nagaland (47 %), Assam (42%), Sikkim (31 %), Manipur (30 %) and Meghalaya (24 %).

Table 4 gives the Gini coefficient of fish consumption of NE Indian states. It can be seen from the estimates that the inequality in the consumption of fish in rural NE states from NSS round 38 to NSS round 68 has declined. The Gini coefficient declined as much as -19.24 % over the 2 rounds.

Table 3: Relative ranking of fish consumption in North East States across NSS rounds

States	Rural				Urban			
	Cons. Rank - NSS 38	Cons. Rank - NSS 68	Rank Δ (NSS 38 - NSS 68)	Percent Δ in Qty. Cons.	Cons. Rank - NSS 38	Cons. Rank - NSS 68	Rank Δ (NSS 38 - NSS 68)	Percent Δ in Qty. Cons.
Sikkim	7	8	-1	30	8	8	=	-31
Arunachal Pradesh	3	3	=	42	3	3	=	48
Nagaland	8	6	2	100	4	6	-2	47
Manipur	4	4	=	29	5	4	1	30
Tripura	1	1	=	39	1	1	=	37
Meghalaya	5	5	=	33	6	5	1	24
Assam	2	2	=	31	2	2	=	42
Mizoram	6	7	-1	44	7	7	=	55

Source: Computed from NSS 38 and 66 rounds

.

Table 4: Ginicoefficients of fish consumption in North East States of India

	GiniCoeff.		Gini Index		Percent change in GiniCoeff.
	NSS 38	NSS 68	NSS 38	NSS 68	
Rural	0.44	0.369	44.00	36.90	-19.2412
Urban	0.348	0.351	34.80	35.10	0.854701

The estimate of the Gini coefficient for urban fish consumer of NE Indian states across NSS rounds 38 and 68 has increased. In the case of urban fish consumer the increased has been to the extent of 0.85 %. Therefore the Gini coefficient indicates a healthy trend in the fish consumption pattern in NE Indian states.

The Department of Animal Husbandry Dairying and Fisheries give the total disposition of fish catch by states and union territories (DAHDF, 2014). In the present context and in the context of fish sold in NE Indian states, the data on the total volume of fresh fish sold in the markets of NE Indian states has been computed for 2008, 2009, 2010, 2011 and 2012. Since NE Indian states are high consumer of fish the data on fish sold in these states, depicted here does not necessarily mean that they are locally produced. Substantial quantity of fish sold in NE Indian states originate from other states of India like West Bengal and Andhra Pradesh.

Table 5: Marketing of fresh fish in North East States of India (in tonnes)

	2008	2009	2010	2011	2012
Arunachal Pradesh	2550(0.99)	2360(0.88)	2900(0.97)	3250(1.01)	3375(0.99)
Assam	195813(75.64)	199526(74.44)	226900(75.54)	236690(73.40)	247010(72.59)
Manipur	17585(6.79)	17955(6.70)	18734(6.24)	20019(6.21)	22640(6.65)
Meghalaya	3945(1.52)	3836(1.43)	3945(1.31)	4697(1.46)	5389(1.58)
Mizoram	338(0.13)	342(0.13)	340(0.11)	5065(1.57)	5340(1.57)
Nagaland	5209(2.01)	5339(1.99)	5458(1.82)	5626(1.74)	5823(1.71)
Sikkim	150(0.06)	160(0.06)	180(0.06)	180(0.06)	180(0.05)
Tripura	33293(12.86)	38525(14.37)	41910(13.95)	46948(14.56)	50507(14.84)
NE total	258883	268043	300367	322475	340264
All India Total	5804723	5955482	6118826	5364193	5811575
NE Contribution in %	4.46	4.50	4.91	6.01	5.85

Source: Handbook of Fisheries Statistics, 2014. Figures in parenthesis are percentage

The total quantity of fish sold in NE Indian markets in the years addressed here shows that the total quantity of fish sold has increased from 2.59 lakh tones in 2008 to 3.40 lakh tones in 2012 (Table 5). Therefore an additional 10 lakh tonnes of fish were sold in NE Indian states during this period. It may also be seen that the NE Indian states provide a market in the range of 4.46 % to 6.01 % of the market for fresh fish in India.

Again it can be seen from the data that Assam consumed maximum quantity of fish in the range of 72-76 % of the total fresh fish sold in NE Indian states. This was followed by Tripura which consumed 12-15 % of fresh fish in this region. Even though there are vast fishery resources across the whole North-eastern region of India, the opportunities to harness and utilize these resources are still untapped in many of the states (Sarkar and Ponniah, 2006). It is again a matter of fact that sustainable utilization of these resources requires that the constraints crippling the NE region including inadequacies in infrastructure, communications, technology and transportation need to be sorted out. This would enhance and strengthen the institutional functioning and networking in fisheries. Further, there is a dire need to attract private investments in the fisheries sector in the region for sustainable utilization of resources, replenishment of stocks wherever overexploited, proper functioning of the present hatcheries and stopping destructive fishing methods. Table 6 gives fish production, consumption and requirements in NE Indian states during 2012. This exercise has been undertaken to highlight the gap if any between fish production and consumption. The high level of fish consumption is obvious. From the table we see that total fish production is 3.27 lakh tonnes while fish consumption is 4 lakh tonnes. These figures reinforce the inflow of inter-state fish into NE Indian states. Total fish requirement in NE Indian states in order to meet the nutritional requirement is 5 lakh tonnes which is more than total production of about 1.7 lakh tonnes. The existence of such wide acceptance of fish as a regular item in the dietary routine among the NE Indian population itself suggests higher levels of nutritional security compared to several other parts of India. This study needs to be extended to compare the benchmark values of nutritional security of a given population with the levels of their actual consumption of the required nutrients through food items that yield maximum nutritional satisfaction at lowest cost.

CONCLUSIONS

Fish in India should command high priority in the solution of India's long term food problem (Kent, 1987). The government of India aims at enhancing fish production from the current level of 10.79 million tonnes (2015-16) to 15 million tonnes at the end of 2019-20. According to Indian Council of Agricultural Research (ICAR), the national recommendation of fish consumption is 11 kg per capita annum (Meenakumari, 2012). The per capita fish consumption has increased over the years (NSSO rounds) for all states in NE India. Though the per capita consumption increased over the years, per capita consumption was below the ICAR recommendation level except state Tripura. The production- consumption gap of fish in NE India is about 70,000 tons annually, while the production-requirement gap of fish is more than 1.7 lakh ton annually. This gap in supply and demand for fish attracted fish producers and fish traders from other states like Andhra Pradesh, and West Bengal and even from the neighboring country Bangladesh (Nandeesha, 2008). So, we can conclude that in NE region fish production could not able to meet the food and nutritional security of the region. In order to fill the gap Government of India have a daunting task of achieving a per capita availability of 15 kg in the region with a total production of about seven lakh tonnes by 2020. The task would also mean that the region has to double its fish production in another eight years. The NE states with a total of 14,648 km of riverine fisheries resources in the forms of rivers, reservoirs, lakes and ponds, streams and floodplains, wetland fish species are "ideal environment". Expanding of fishery resources, both horizontally and vertically could open up vast opportunities in aquaculture development. But nevertheless, the production- consumption relationship of fish in NE India suggests growing and positive contribution towards the nutritional security of the local population. This positive trend is likely to continue with the Government of India paying special attention to NE India on all fronts.

Table 6: Fish supply, consumption and requirements in North East Indian States (2012)(tonnes)

State	Total Population	Production	Total Consumption	Nutritional requirement (T) @ 11 kg per capita
Sikkim	607688	300	185	6684
Arunachal Pradesh	1382611	3300	11013	15208
Nagaland	1980602	6800	9067	21786
Manipur	2721756	22200	18017	29939
Tripura	3671032	53300	57781	40381
Meghalaya	2964007	4800	16894	32604
Assam	31169272	2439000	283395	342862
Mizoram	1091014	2900	2773	12001
Total NER	45587982	327060	399125	501467

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