CHAPTER-1

INTRODUCTION

Fish has been living in water for a long time, for at least 400 million years. In their long history, they have become adapted to life in all sectors of the aquatic world-the sunlit open and its black depths, the washing surf, placid tropical rivers and mountain torrents. The end products of this evolutionary history are some 20,000 species of fish of remarkably varied shapes, sizes, and habits (Lanham, 1962). Rearing of fish and other aquatic organism is called aquaculture. Aquaculture has become the worlds' fastest growing food producing sector with an annual growth rate of 10 per cent since 1981. Asia contributes about 91 per cent of the worlds' total aquaculture production with China, India, Japan, Republic of Korea, the Philippines, Indonesia, and Thailand as top contributors (Abraham, *etal*, 2010).

Fishculture, a part of aquaculture can be divided into two parts-from production of eggs to fingerlings and from fingerlings to eatable table fish. The first part consists of digging of pond, clearing of ponds, production of eggs through eco hatchery (those who possesses), rearing of seed fish up to fingerlings. The second part consists of rearing of table fish and their marketing.

Fishculture can also be divided between inland fishery (also known as fresh water fishery[1]) and marine fishery (also known as salt fishery). Inland fishery means rearing of fish in ponds, tanks, *beels*, etc while marine fishery includes catching of fish in sea and ocean.

1.2 PRODUCTION OF FISH IN THE WORLD:

Fishes are reared and produced all over the world. Perhaps there is not a single country where fishes are not produced and consumed. As per FAO statistics 2016, India is the 3rd largest producer of fish as a whole in 2015 next to

[1] Inland waters are defined by the Food and Agriculture Organization of the United Nations (FAO) as lakes, rivers, streams, canals, reservoirs, and other land-locked waters (FAO 2014). While inland is generally synonymous with freshwater, inland waters do include land-locked saline water bodies such as the Caspian Sea (FAO 2014). Inland waters comprise approximately 0.01% of the total volume of water on earth (Stiassny 1996).Inland fishes reside in these waters. They comprise approximately 40% of all fish species and 20% of all vertebrate species (Helfman *et al.* 2009).

China and Indonesia with 5.97 per cent share in total production of fish and 2nd in inland fish in the world and 9th position in marine fish.

Inland fish serve as a major source of protein, essential fats, and micronutrients for hundreds of millions of people, particularly in rural communities (Thilsted *etal.* 1997; Roos *etal.* 2007; Youn *etal.* 2014). More than 60 million people in low income countries rely upon inland fisheries as a source of livelihood and women represent over half the individuals in inland fisheries supply chains (FAO 2014*b*). While still a large number, this is widely accepted to be an underestimate given the difficulties with reporting in the sector (Bartley *etal.* 2015).

Production of fish (both inland and marine) in the world and percentage contribution of India to world production of fish during 1950 to 2014 is shown in Table-1.1.

Table-1.1
Contribution of India to World Fish Production (in '000 Tonne)

	World Production			**Contribution of India**		
Year	Total	Marine	Inland	% of India to World Total Production	% of India to World Marine Fish Production	% of India to World Inland Fish Production
1950	19755	17521	2234	3.70	2.97	9.40
1955	28641	24968	3673	2.93	2.39	6.62
1960	36691	32665	4026	3.17	2.69	7.00
1965	51229	46141	5088	2.60	1.79	9.96
1970	67280	61277	6003	2.61	1.77	11.21
1975	68341	61481	6860	3.32	2.41	11.44
1980	75586	67953	7633	3.24	2.29	11.67
1985	91553	80888	10665	3.10	2.16	10.24
1990	103590	88997	14593	3.74	2.58	10.79
1995	116411	96220	20191	4.25	2.86	10.88
2000	130433	101831	28602	4.36	2.80	9.92
2005	142691	103401	39290	4.67	2.90	9.32
2009	144599	96210	48389	5.43	3.41	9.42
2014 *	93.4	81.549	11.9	10.7	4.28	5.53

Sources: (1) FAO; (2) Ministry of Agriculture, Government of India.
Notes: (1) Total may not tally due to rounding off.
(**2)*** World production both marine and inland fish are in Million metric tonnes.

From Table-1.1, it is observed that production of fish in the world has increased from 19,755 thousand tonnes in 1950 to 93.4 million tonnes in 2014. In case of marine fish production, production has increased from 17,521 thousand tonnes in 1950 to 11.9 million tonnes in 2014 while in case of inland fish production, production has increased from 2,234 thousand tonnes in 1950 to 81.54 million tonnes in 2014. Percentage contribution of India to world fish production (both marine and inland) has increased from 3.70 in 1950 to 10.7 in 2014 with slight fall in the middle years. In case of marine fish, contribution of India to world marine fish production increased from 2.97 per cent in 1950 to 4.28 per cent in 2014. However, in case of inland fish, India's contribution to world inland fish production has declined from 9.40 per cent in 1950 to 5.53 per cent in 2014.

1.3 PRODUCTION OF FISH IN INDIA:

India is rich in water resources. In India, production of fish can be broadly divided into two groups, viz. inland fishery and marine fishery. India is home to more than 10 per cent of global fish biodiversity with 2,200 species of fish and shellfish in the marine and inland water (Ayyapan, 2007). India ranks second in the production of inland fish in the world next to China. With water resources in terms of 29,000 km of rivers, 3.15 million hectares of reservoirs, 2.35 million hectares of ponds and tanks and 0.2 million hectares of floodplains wetlands, the potential production levels are estimated at over 4.5 million metric tonnes annually (Ayyapan, 2007). In India, fishery sector provides employment to about 1210.19 million as fishermen and fishery related activities in 2011 (*Handbook on Fisheries Statistics 2011*). That is, about one per cent of the total population of India depends upon fishery sector in India. Production of inland and marine fish in India from 1950-51 to 2016-17 is presented in Table-1.2.

From table-1.2, it is observed that the rate of growth of inland fish is much higher than that of marine fish in India during 1950-51 to 2016-17. While production of marine fish increased by nearly seven times, inland fish increased by nearly 32 times during the same period of time. Inland fish production in India depends mainly on carp culture that account for around 80 per cent of the total inland fish production and proved sustainable at different levels of production over the years.

Table-1.2 Production of Inland and Marine Fish in India since 1950-51 to 2016-17

Year	Marine (in lakh Tonnes)	Inland (in lakh Tonnes)	Total (in lakh Tonnes)	% of Marine to Total	% of Inland to Total
1950-51	5.34	2.18	7.52	71.01	28.99
1960-61	8.80	2.80	11.60	75.86	24.14
1970-71	10.86	6.70	17.56	61.85	38.15
1980-81	15.55	8.87	24.42	63.68	36.32
1990-91	23.00	15.36	38.36	59.96	40.04
2000-01	28.11	28.45	56.56	49.70	50.30
2010-11	32.50	49.81	82.31	39.48	60.52
2011-12	33.71	52.95	86.66	38.89	61.11
2012-13	33.20	57.20	90.40	33.73	66.27
2013-14	34.43	61.36	95.74	35.94	64.06
2014-15	34.91	65.77	100.69	34.67	65.33
2015-16	36.00	71.6	107.6	33.65	66.92
2016-17 (P)	36.40	77.6	114.0	31.93	68.07

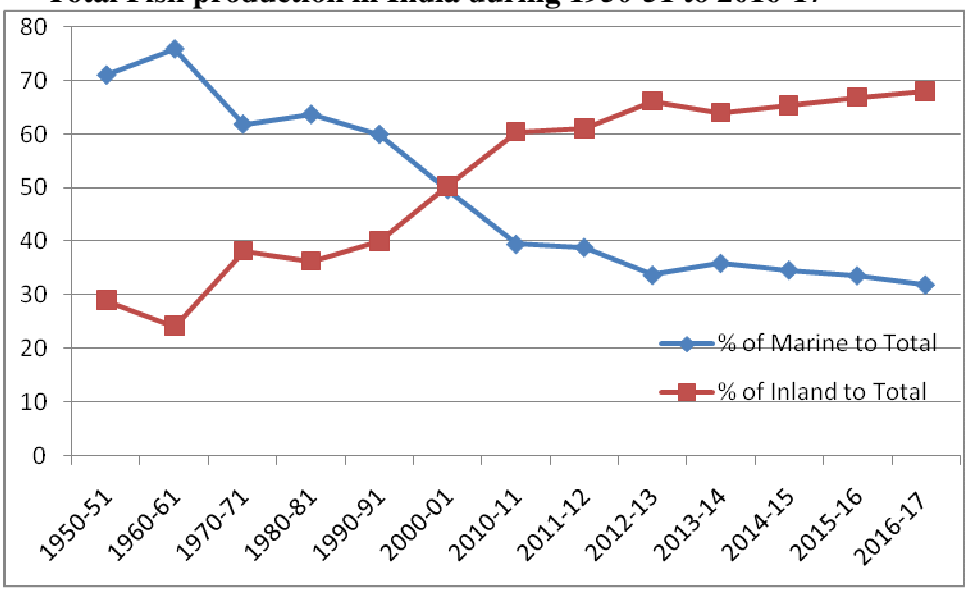
Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, New Delhi

Notes: (1) Total may not tally due to rounding off.
(2) P indicates that the figures are provisional.

In India, percentage contribution of marine fish to total fish production has declined continuously from 71.01 per cent in 1950-51 to 31.93 per cent in 2016-17 with marginal rise in 2013-14. In other words, percentage contribution of inland fish to total fish production has increased from 28.99 per cent in 1950-51 to 68.07 per cent in 2016-17 (also shown in diagram-1.1). In the year 2000-01, percentage contribution of inland fisheries to total fish production has surpassed marine fish

production and since then the gap has been widening. It is due to acceptance of scientific rearing of fish especially carp fish by large number of educated youth in the states of West Bengal, Andhra Pradesh, Assam, etc.

Diagram-1.1
Changes in the Percentage of Inland and Marine Fish production to Total Fish production in India during 1950-51 to 2016-17



1.4 FISH PRODUCTION IN NORTH-EAST INDIA:

North-East India consists of eight states, namely, Assam, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland, Sikkim and Tripura. Flanked by hills and with the mighty Brahmaputra river slashing a central path between its north and south, the NE India is bounded by the states of Manipur, Meghalaya, Mizoram, Nagaland, Tripura with Assam comprising the heart. Arunachal Pradesh lies to its north and Sikkim a little away in the North West bordering China and Bhutan. Bangladesh and Myanmar lie to its southwest and east. The torrential Brahmaputra deposits its rich alluvial silt along the banks of the plains of Assam. Tropical rain forest, rich in flora and fauna, spread their arms across Arunachal Pradesh into

Assam. It is a land where tea is an industry, handicrafts a major occupation and martial arts a favoured sport.

The western side of the North East is connected to the eastern part of the Indian subcontinent by a narrow land corridor, sometimes referred to as the Siliguri Neck or "Chicken's Neck". The eight states that comprise the region reflect ecological and cultural contrasts between the hills and the plains; there are also significant elements of continuity. Available medieval and modern records indicate interdependence and interaction between the hills and plains. The NE India is one of the most bio-diverse regions in the world. The forest cover varies but average 65 per cent is government owned. Village communities, individuals and chiefs own the rest. The area can be divided into three geographical divisions-the Shillong Plateau, the North Eastern hill Basin and the Brahmaputra Valley.

The economy of NE India has got its definite identity due to its peculiar physical, economic and socio-cultural characteristics. The NER of India covers an area of 2.62 lakh sq. km. which is 7.9 per cent of total geographical area of the country. With a total population 4.55 crores (2011, *Census of India*), it accounts for 3.76 per cent of total population of India.

The NE region has been practicing pisciculture since time immemorial. But its production falls short of its demand. As a result, it imports 90,000 tonnes of fish from outside the area like West Bengal, Andhra Pradesh, etc. annually. As it does not possess any marine water, therefore, production of fish is considered only in terms of inland fish.

From Table-1.3, it is clear that percentage contribution of NE India to total production of inland fish of India has been declining over the years. Although production of inland fish production in NE India has increased around two times

during 2000-01 to 2016-17, percentage contribution has declined from 7.78 per cent in 2000-01 to 5.56 per cent in 2016-17. It is because of higher growth rate of production of inland fish in the states of West Bengal, Andhra Pradesh, etc. Among all the NE Indian states, Assam is the dominant state in the production of inland fish during 2000-01 to 2016-17. It contributed around 71 per cent to total NE India's production of fish in 2000-01 to 2016-17. It is because of larger conducive area for rearing of fish and engagement of larger population in this culture. Sikkim is the lowest producer of fish among the states. It is because of hilly region of most of the part of the state as well as tiny geographical size and engagement of few people of the state in this activity.

Table-1.3 Production of Fish in NE Region during 2000-01 to 2016-17 (in tonnes)

State	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	NE Total	All India Inland Fish Production	% of NEI to Total
2000-01	250	15862	1605	618	286	550	14	2942	22127	284500	7.78
2001-02	260	16145	1645	497	315	520	14	2945	22341	312600	7.15
2002-03	260	16552	1660	537	325	550	14	2952	22850	321000	7.12
2003-04	265	18100	1760	515	338	556	14	1798	23081	345800	6.67
2004-05	270	18631	1780	563	368	490	14	1983	24099	352588	6.83
2005-06	275	18801	1822	412	375	550	15	2387	24637	375558	6.56
2006-07	277	18148	1861	549	376	580	15	2863	24669	384489	6.42
2007-08	283	19032	1864	400	376	585	18	3624	26182	420700	6.23
2008-09	288	20615	1880	396	289	618	17	3600	27703	463800	5.97
2009-10	265	21882	1920	433	325	636	17	4228	29706	489400	6.07
2010-11	315	22724	2020	456	290	659	18	4923	31405	498100	6.30
2011-12	330	22862	2221	476	292	684	28	5333	32226	529500	6.08
2012-13	371	25427	2450	542	543	713	4	5746	35796	572000	6.26
2013-14	61	26670	2854	575	594	747	4	6195	37700	613600	6.14
2014-15	400	28270	3050	604	639	784	44	6516	40307	657700	6.12
2015-16	405	29420	3204	1134	683	822	40	6906	42614	716000	5.95
2016-17 (P)	411	30660	3200	10	763	861	40	7245	43190	776000	5.56

Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, New Delhi.
Notes: (1) Total may not tally due to rounding off. (2) P indicates that the figures are provisional.

1.5 FISH PRODUCTION IN ASSAM:

Assam is the largest state among all the NE states of India in terms of population with 3.12 crores population which is 2.57 per cent of Indian population. Here, 85.91 per cent live in rural area in 2011 (2011, *Census of India*). Agriculture is the main source of livelihood of majority of people of the state. Aquaculture is one prime occupation of most of the rural people along with agriculture. Assam is a land of 216 species of fish. The most important thing is that 76 species of fish of Assam are considered as ornamental fish and most of them are able to establish demand in the international market (Das and Biswas, 2008). Among the fish farming environments in state, semi-intensive polyculture is the dominant system practiced. Basically, Assam fishculture is carp-oriented and the contribution of other species is marginal. Major culturable species are Indian carps, viz. Rahu, Catla, Mrigal, Calbasu, Kurhi, Bhangon and exotic carps viz. Grass carp, Silver carp and Common carp. Introduction of other species like Chital, Magur, Sol, Kawoi, freshwater prawn etc. in the culture system has also been coming up (Department of Fisheries, 2015). Among all the states and union territories of India, Assam ranked 11th position in the production of fish in 2014-15. However, Assam stood 6th in the production of inland fish among all the states and union territories in the same year (Government of India, 2015-16). In Assam, there are two main rivers (Brahmaputra and Barak) and 53 tributaries with 4,820 km water spread areas. There are 430 registered beels and 767 unregistered beels with 60,215 hectares and 40,600 hectares water spread area respectively. There are also 71 forest fisheries with 5,017 hectares water area; two reservoir fisheries with 2,553 hectares water area; 3,61,393 individual ponds with 55,089 hectares water area; 6,308 community tanks with 5,141 Ha water area and 3,887 derelict water bodies/swamps/low-lying covering an area of 1,16,444 hectares of water bodies in 2012-13 (Map-1.1) which are highly useful for aquaculture in Assam (Department of Fisheries, Government of Assam, 2013-14). In spite of large scale production, supply of fish falls short of its demand. As a result, Assam has to import fish 20,000 tonnes of fish every year from West Bengal, Andhra

Pradesh, etc. spending around Rs 200 crs annually (Barua, 2010). Production of fish in Assam during 1995-96 to 2014-15 is shown table-1.4.

Table-1.4
Production of Fish in Assam during 1995-96 to 2016-17

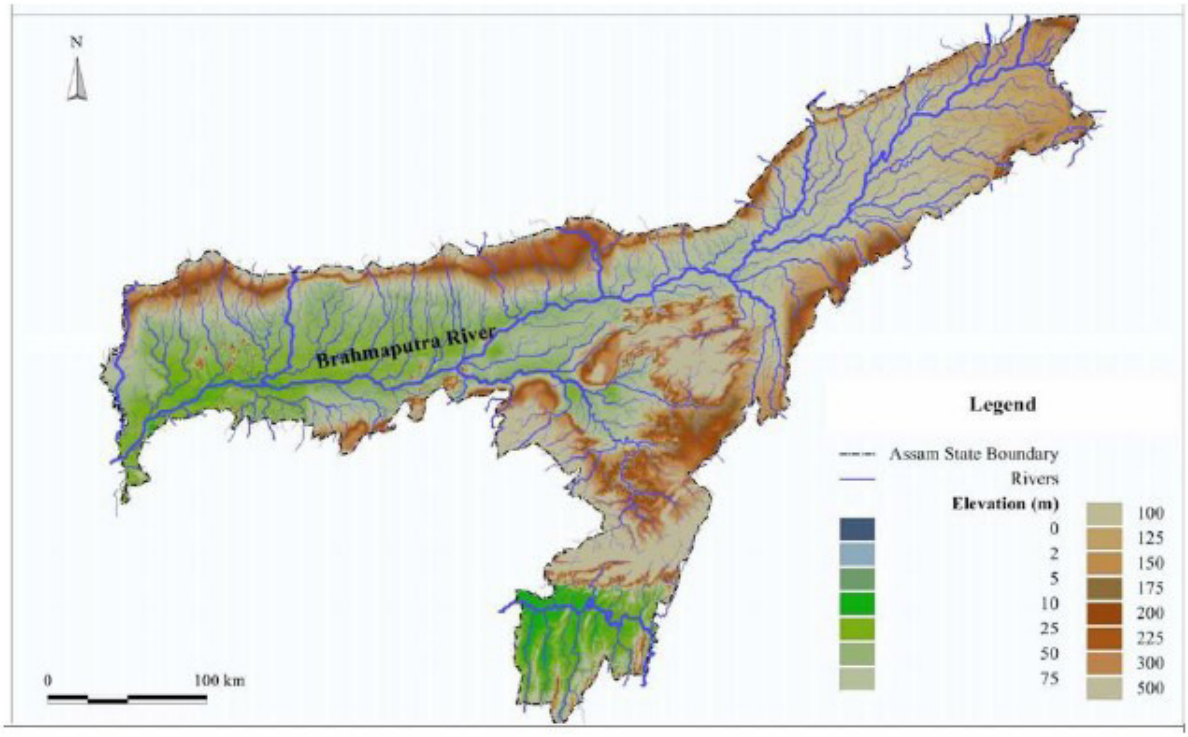
Year	Production of Fish in Assam (in Lakh Tonnes)	Production of Inland Fish in India (in Lakh tonnes)	Production of Fish in India (in Lakh Tonnes)	% of Assam to India's Inland Fish Production	% of Assam to India's Fish Production
1995-96	1.55	22.42	49.49	6.91	3.13
1996-97	1.54	23.81	53.48	6.47	2.88
1997-98	1.55	24.38	53.88	6.36	2.88
1998-99	1.56	26.02	52.98	6.00	2.94
1999-00	1.59	28.23	56.75	5.63	2.80
2000-01	1.58	28.45	56.56	5.55	2.79
2001-02	1.62	31.26	59.56	5.18	2.72
2002-03	1.66	32.10	62.00	5.17	2.68
2003-04	1.81	34.58	63.99	5.23	2.83
2004-05	1.86	35.26	63.05	5.28	2.95
2005-06	1.87	37.56	65.72	4.98	2.85
2006-07	1.82	38.45	68.69	4.73	2.65
2007-08	1.91	42.07	71.26	4.47	2.68
2008-09	2.06	46.38	76.37	4.44	2.69
2009-10	2.18	48.94	79.98	4.45	2.73
2010-11	2.27	49.81	82.31	4.56	2.75
2011-12	2.28	52.95	86.66	4.31	2.63
2012-13	2.54	57.20	90.40	4.44	2.81
2013-14	2.67	61.36	95.79	4.35	2.78
2014-15	2.83	65.77	100.69	4.31	2.81
2015-16	2.94	71.6	107.60	4.11	2.73
2016-17 (P)	3.06	77.6	114.00	3.94	2.68

Source: Directorate of Economics and Statistics, Government of Assam *Statistical Handbook*, various issues.

From table-1.4, it is observed that production of fish in Assam has increased from 1.55 lakh tonnes in 1995-96 to 3.06 lakh tonnes in 2016-17. Although production of fish has increased in Assam, percentage contribution of Assam to total production of India's fish production has declined from 3.13 per cent in 1995-96 to 2.68 per cent in 2016-17. However, its contribution to total inland fish production of India is relatively better. In case of inland fish also, its contribution has declined from 6.91 per cent in 1995-96 to 3.94 per cent in 2016-17. It is due to higher growth

rate of production of inland fish in other states of India like West Bengal, Andhra Pradesh, etc.

Map-1.1
Map of Assam showing Topographic Features and River Network



1.6 OBJECTIVES:

The prime objectives of the study are

(1) to explain the importance of fishculture in the economy of Assam especially in the generation of employment and income.

(2) to examine spatio-temporal variation in the production of both seed and table fish in Assam

(3) to find out the role of government and different financial agencies in the promotion of fishculture in Assam

(4) to find out the present problems faced by this sector and solutions for its future prospects.

1.7 RATIONALE BEHIND UNDERTAKING THE STUDY:

Fishculture has been playing an important role in the development of the economy of Assam since time immemorial. Its contribution to income, employment and domestic trade has been significant. Also, over time growth of production of fish has been significant. During 1995-96 to 2014-2015, production of fish has increased from 1.55 lakh metric tonnes to 2.83 lakh metric tonnes while production of seed fish increased from 2,547.54 million to 4,555.72 million (Directorate of Economics and Statistics, Government of Assam). It has been increasing because of intensive and extensive culture of fish in the state.

In spite of the importance of fishculture in Assam, there has been no systematic study about the economic aspects of this activity in India or in the state of Assam in specific and thus the literature in this field is scanty. Although there is sufficient study on the zoological aspects of it, there is no systematic analysis of economics of fishculture in Assam and thus there is much scope to do research on its economic aspects. A careful study in this field would provide some useful insights that may help in policy formulation towards the proper growth of fishculture in Assam.

Fishery sector plays an important role in rural economy of the Barpeta district. Rice and fish is the staple food of the people of the region. For about 95 per cent of the district's population, fish is an important source of dietary protein offering the crucial "nutritional security". The contribution of Barpeta district to total production of fish of Assam is not so low. At present, its position stands at 5th among all the districts of Assam. Although North Cachar Hills, Nagoan, Karimganj and Kamrup districts stand ahead of Barpeta district in a descending order in the production of fish in 2013-14. But Barpeta has ample scope for raising production and productivity of fish considering the presence of beels, swamps, rivers, large water bodies etc in the district. There are 18 revenue beels covering 2,342 hectares water area, 10 rivers with 3,017 hectares water area (1,460 km) and 5 seed farms in the district. Besides these, the district has broad prospects for development of inland fisheries in low laying areas[2]. Production of fish in the district has increased from 9,528 metric tonnes in 1995-96 to 19,730 metric tonnes in 2015-16 (Directorate of Economics and Statistics, Government of Assam). It is also reported that 60 per cent of the total production of fish is contributed by capture from rivers, perennial beels and ponds and rest 40 per cent is contributed by private pond fisheries. However, due to preponderance of non-vegetarian food habit of the majority population in the district the requirement of fish for local consumption far exceeds the production. Thus, in the present study a special attention will be given to the district of Barpeta.

1.8 PROFILE OF THE DISTRICT:

The district of Barpeta is enlisted as least backward district of Assam at 23 rank with composite index of 18.1 in the year 2011-12[3]. The district is the fifth

[2] NABARD (2006-07), *Potential Linked Credit Plan*, Assam Regional Office, p-47.
[3] Directorate of Economics and Statistics, Assam, *Statistical Handbook Assam 2013,* Table-29.01, p-328.

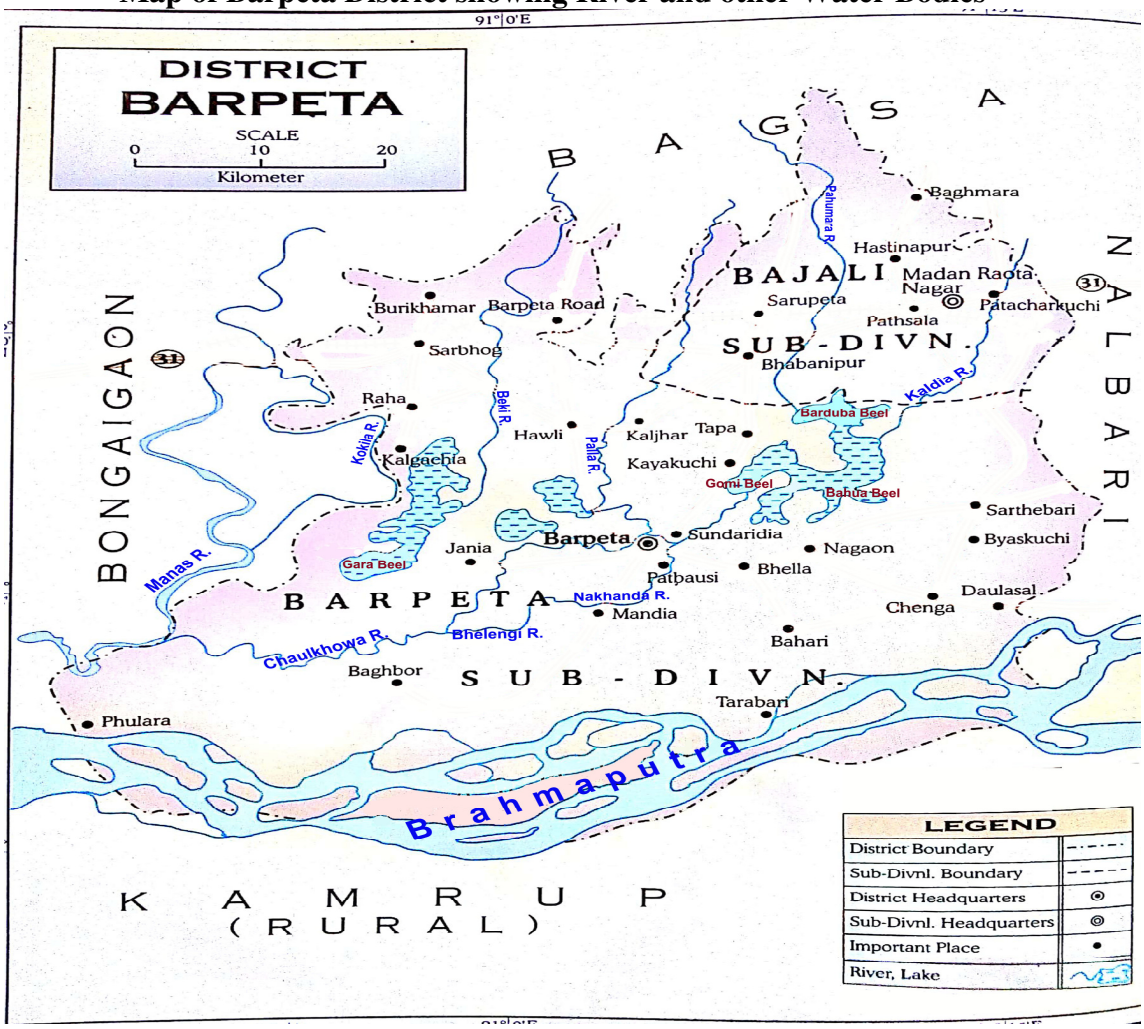
populous district in the state of Assam with population of 16.93 lakh which is 5.43 per cent of population of the state covering an area of 2,282 square kilometres. The decadal growth rate of population of the district was 21.43 per cent which was much higher than the state of Assam, i.e. 17.07 per cent during 2001-2011. Here, 5.63 and 1.62 per cent of its population belonged to Schedule Castes and Schedule Tribes respectively. Again, 70.73 per cent population of the district were Muslim. The density per square kilometre in the district was 742 and the sex ratio figured at 953. But the literacy rate was 63.81 per cent while rural literacy rate was only 61.47 per cent and urban literacy rate was 86.28 per cent (2011, population census). As per population census 2011, total worker of the district was 5,61,824 out of which 4,39,453 were main workers and 1,22,371 were marginal workers.

There are 835 villages in total in 129 Gaon Panchayats in the district under 11 community development blocks within two subdivisions Barpeta and Bajali. The total number of households in the district was 3,37,929 out of which 3,06,434 were in rural area and 31,495 in urban area. There were 43 eco-hatchery and 268 hapa breeders in 2014-15. Apart from that there is one government farm and one training centre for the fish culturists. There are 23 beel fisheries and 24,068 ponds and tanks with an area of 6,299 hectares and 3,874 hectares of land respectively in 2014-15. There are 11 forest fisheries with 131 hectares of land and 160 derelict water bodies/swamps covering an area of 6,119 hectares in 2014-15. There are 9 (nine) rivers covering an area of 2,823 hectares.[4] River and other water bodies like lake, Beels etc of Barpeta district are shown in Map-1.2.

[4] Official Statistical Report (2016), District Fishery Development Office, Barpeta.

Map-1.2

Map of Barpeta District showing River and other Water Bodies



1.9 HYPOTHESES:

The following hypotheses have been tested in the present study:

(i) Production of fish has grown significantly in Assam since 1995-96.

(ii) Fishculture in Assam is very effective in the generation of employment.

1.10 CHAPTERISATION:

- The whole study is divided into eight chapters.

Chapter-I: Introduction

Chapter-II: Review of literature

Chapter-III: Methodology and Collection of Data

Chapter-IV: Fishculture as a Means of Employment and Income in Assam

Chapter-V: District wise Variation in Fishculture in Assam

Chapter-VI: Role of Different Financial Agencies and Government in Developing Fishculture in Assam

Chapter-VII: Problems of Seed and Table Fishculture and Its Solutions in Assam

Chapter-VIII: Summary of Observations and Policy Conclusions and Recommendations.

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