

## **Case study**

### **Promotion of fish production and doubling farmers income through inculcating the spirit of scientific fish farming among Scheduled Caste fish farmers in Nagaon district of Assam, India- a case study**

**Comment [o1]:** Rephrase this title so that it is clear what the study is all about  
How will you measure the spirit?  
/

#### **Abstract**

Aquaculture plays an important role in supporting livelihoods worldwide and also forms an important source of diet for over one billion people. The inland fisheries are of particular importance to the rural poor accounting for about fifteen percent of total global employment. Besides employment, it caters to the nutritional need of the rural poor. Being an agrarian economy, fish farming is one of the important livelihood activities in Assam. Though "Kaibartta" is the main fishing community in Assam, however, fishing is no more their primary livelihood. Fishing, rather, has been taken over by the immigrant Muslim people in various districts of the state. Nevertheless, Scheduled Caste people living in the rural areas have their own ponds at the back of their houses and culture fish for domestic consumption. It is observed in most cases that rural farmers don't have any exposure to scientific fish farming and this may be considered one of the reasons for low production and productivity. Thus, looking into the huge potentiality of the sector and its associated problems, a small intervention in the form of uplifting the skill of the fish farmers belonging to Schedule Caste was undertaken. Twenty percent of three villages belonging to Schedule Caste in the Nagaon district were selected randomly for the interventions to be made. The paper embodies to provide greater emphasis on the improvement of the knowledge and skill of the SC farmers and thereby enhances the household income and nutritional security in a sustainable manner.

**Comment [o2]:** What was the intervention?

Keywords: Fish production, Kaibartta, SC population, Assam, Livelihood security

#### **Introduction:**

Agriculture is the most important occupation of the rural population. Among various farm activities fishery is considered to be a sector catering to employment needs besides producing nutritious food for the undernourished population (Nandeesh, 1992). Fishery plays an important role in supporting livelihoods worldwide and also forms an important source of diet for over one billion people. It is recognised as a powerful income source and employment generator as it stimulates the growth of a number of subsidiary industries and is a source of cheap and nutritious food besides being a foreign exchange earner (Sarma et al., 2022). The inland fisheries are of particular importance to the rural poor accounting for about 15 percent of total global employment (FAO, 2000).

**Comment [o3]:** Support with statistics

India has extensive floodplain wetlands, defined as low-lying areas bordering large rivers, which are seasonally inundated by the spill over from the main river channels. India is the second largest fish-producing country in the world and accounts for 6.3 percent of the global production (MoEA-GoI, 2019). Fish production in India has reached an all-time high of 14.16 million metric tons during 2019-20. The fishery sector contributes 1.24 GVA and 7.28 percent to the agricultural GVA (ES, 2020-21). The livelihood opportunities provided by this sector have been instrumental in sustaining the incomes of over 28 million people in India, which was 12 million in 2008-09 (Manasi et al. 2009), especially the marginalised and vulnerable communities and have promoted meaningful socio-economic development (ES, 2020-21).

Assam, the heart of North-East India, is located between 21.570° N – 29.30° N latitude and 89.460° E – 97.30° E longitude with an area of 78,438 sq. Km. Assam is the second largest state of the North Eastern Region which has been blessed with vast and varied aquatic resources in the form of riverine, flood plain wetlands, low lying paddy field which supports a sizable variety of freshwater fishes (Gogoi et al, 2015). Out of the total geographical area of Assam, 10.5% area is occupied by surface water bodies, of which 6503 sq km is held by all the river systems including the mighty Brahmaputra and 1748 sq. km by natural wetlands including seasonal and permanent waterlogged, marshy areas and both natural and man-made reservoirs, ponds and tanks of size more than 2.5 ha (ASTECC, 2007).

The economy of Assam is predominantly an agrarian one with more than 86% of the population living in rural areas (Census, 2011). Besides agriculture, fish farming is one of the main occupations of the people of Assam. The fishery sector occupies a very important place in the socio-economic development of Assam. It has been recognised as a powerful sector both for income and employment generation. The Fishery sector contributes more than 2 % of State GDP and plays an important role in providing livelihood to a significant proportion of the population in the state (Deka, 2021). The contribution of the fishery sector to the State Domestic Product (at constant 2011-12 prices) was Rs. 4414.30 lakhs (with a growth rate of 6.86 percent) as per provisional estimates 2013-14 which increased to 4721.19 lakhs (with a growth rate of 4.68 percent as per quick estimates 2015-16 (ESA, 2016-17)).

Fish forms an integral part of the cuisine and culture of the people of Assam (Baruah, 2015; Gogoi et al., 2015; Gupta & Mithra, 2015). It is an important part of the daily meal. Fish is highly preferred and largely consumed in the state. Fisheries sector development is also very important for the state's economic development, as a livelihood issue, for the provision of the required nutrition, employment and income to its people and is traditionally interwoven in their everyday life. Over the last two decades, the fisheries sector has been able to achieve remarkable growth. It has also been taken up as a commercial activity and has ushered in a silent revolution of progress and prosperity throughout the length and breadth of the state. The fishery resources of Assam in percentage are represented in Figure 1. The trend of fish production in Assam and Nagaon district is given in Figure 2. Figure 3 symbolizes the quantity of fish imported for the state of Assam and particularly the Nagaon district (SBA, 2019).

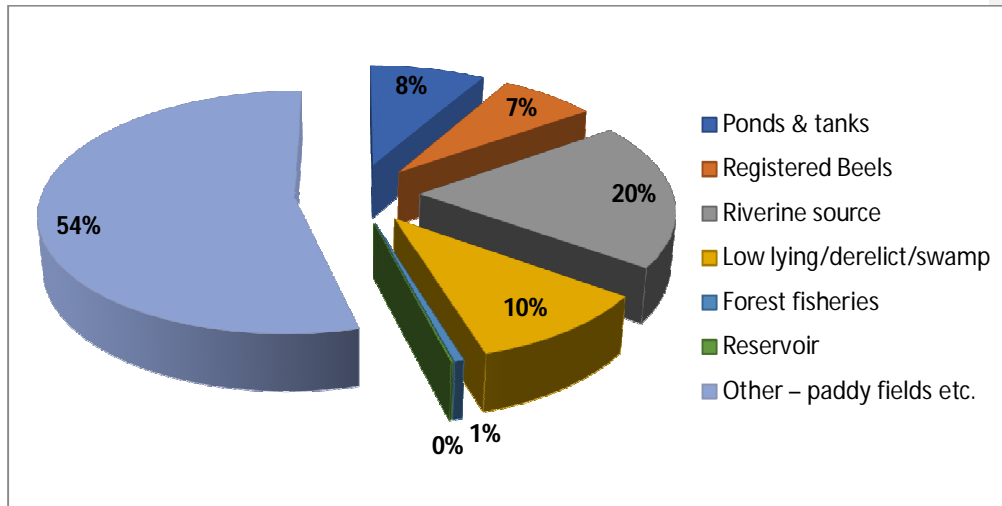


Fig.1 Fishery resources of Assam, India

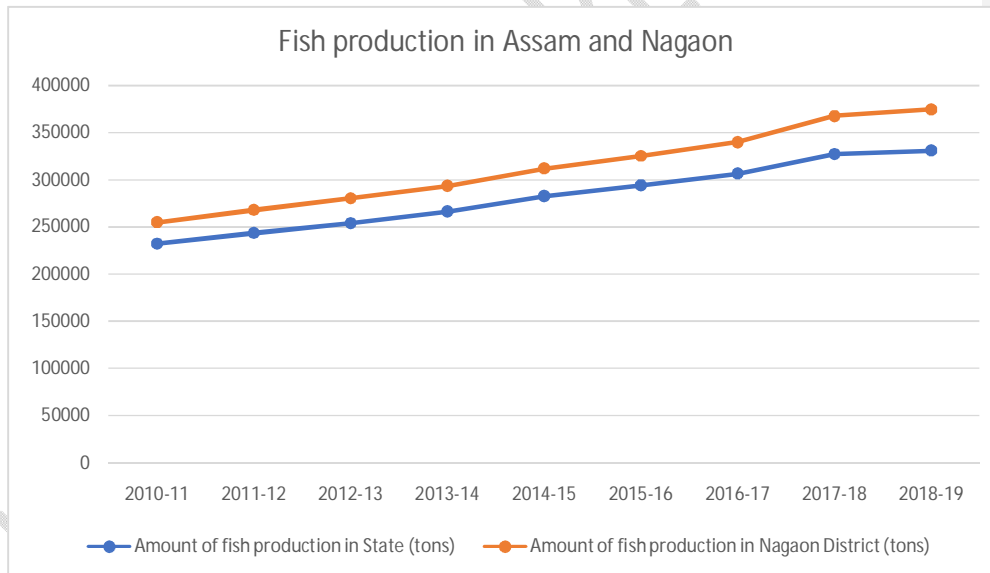


Fig.2 Trend of fish production in Assam and Nagaon

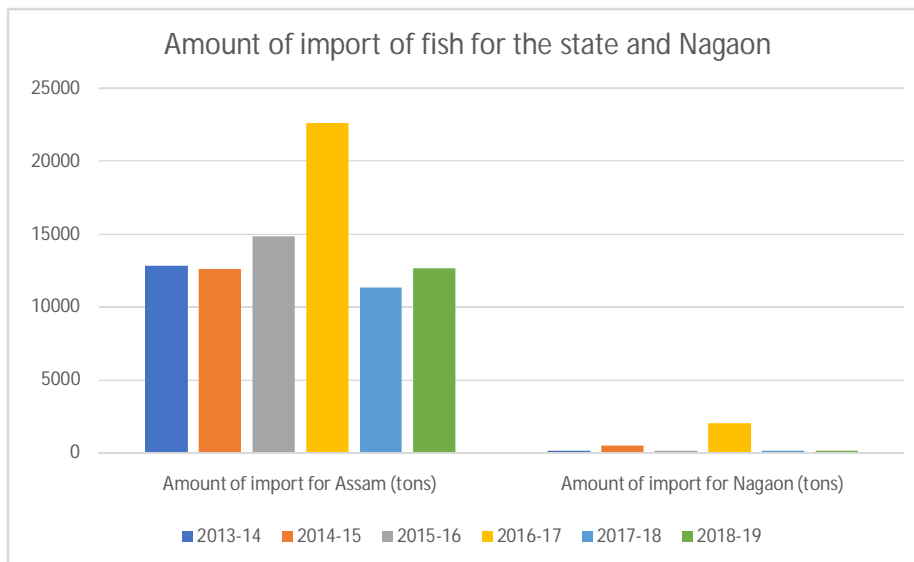


Fig.3 Import of fish for Nagaon and Assam, India

Contextual to this, it is an utmost necessity to increase the production of fish by utilizing the rich water resources and available production systems of the state. To satisfy the domestic demand, non-conventional aquaculture techniques have to be adopted and proper utilization and management of available resources have to be ensured (Gogoi et al., 2015). There is an excellent scope to produce more fish by adequate control of beels (Baruah et al., 2000). The productivity from beels can be enhanced through culture-based capture fisheries with community participation.

The Schedule Caste people are the main fishermen community in the state. There are sixteen notified SC communities in Assam. Out of these sixteen, Kaibartta and Namasudra are the two major SCs consisting of 31.8 and 30.4 percent respectively of the total SC population of the state (Census of India, 2001). Kaibartta is the main fishing community among all SCs in Assam though fishing is no more their primary livelihood (Sarma, 2005). Most of the Kaibartta people are now engaged in different livelihood activities and primarily cultivation and fishing have been taken over mostly by the immigrant Muslim people in the state (Sarma, 2005). The Schedule Caste people living in rural areas have ponds at the back of their houses to culture fish for domestic consumption. However, it is worth noting that in most of the cases these poor people don't have any exposure to scientific fish farming practices, and thereby the production and productivity are very low.

It is in this context, a scientific study was conducted on the selected SC fish farmers in three villages of the Nagaon district of Assam to identify the constraints of the existing backyard fish farming system and to provide suggestive measures for uplifting the livelihood and socio-economic status through the dissemination of critical technical inputs, awareness, training and skill development.

## **Materials and Methods**

### **Profile of the study area**

The studied villages, i.e., Sukotipota, Lomati, and Rangalumukh are located between latitude 26°219' N to 26°229' N and longitude 92°675' E to 92°686' E. The three villages selected for the study is an old settlement. Around 70-80 years back people from surrounding areas migrated to settle in these villages. There are both push and pull factors responsible for such local migration. The push factors are those that compel a person to leave that place and go to some other place. On the other hand, the pull factors are those which attract the migrants to an area (Kainth, 2009). The push factors are those life situations in one's present homeland that generate dissatisfaction, such as poverty, unemployment, rapid population growth, low social status, etc. In contrast, the pull factors that makes migration appealing are well-being, job opportunities, education, etc. (Zanabazar et al., 2021). In the case of the present study, the push factors are found to be lack of land in the place of origin as a result of the increased size of family and fragmentation of joint family while the pull factor is the fertile land of the present location. There are 207 households (HHs) in all the three villages studied according to the 2011 census. The total population is 959 out of which 475 are female which shows a female-male ratio of as high as 981. The literacy rate is estimated to be 77 percent. The people living in these villages depend primarily on agriculture for their livelihood. Winter and Bao paddy, mustard, sugarcane, and various seasonal vegetables are grown on a large scale for their livelihood. The study was carried out during 2020-22.

### **Primary data**

Secondary data was not sufficient related to the study; therefore, emphasis was given to collecting the primary data for a proper analysis of the situation. A Rapid Rural Appraisal (RRA) was administered to select the villages and understand the field condition. The primary data has been collected by the authors by adopting other Participatory Rural Appraisal (PRA) methods. PRA is a way of enabling local people to analyse their living conditions, to share the outcomes and to plan their activities (Sontakki et al., 2019). The PRA tools administered for the present study are such as observation, questionnaire and Focus Group Discussion. A semi-structured questionnaire was designed and administered to elicit the required data and information regarding the socio-economics of the villages. A flow chart was prepared to represent the detailed methodology undertaken for the study (Fig.4).

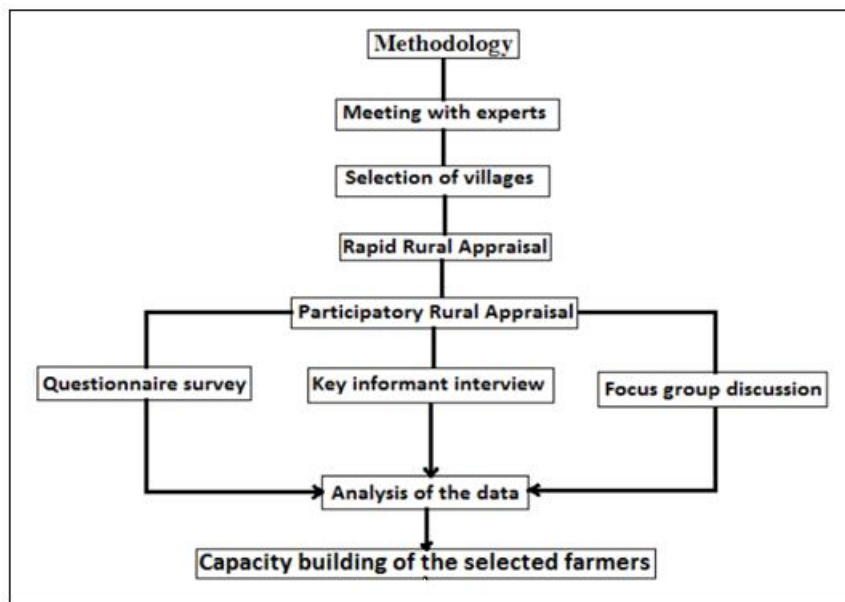


Fig. 4 Flow chart prepared for the methodological framework

### Secondary data

Secondary data for the paper has been collected from various sources like books, journal papers, and various reports such as the economic survey of India, Assam, and the statistical handbook of Assam.

### Sampling

Following Sing (2016), a two-stage stratified sampling design is prepared and followed for conducting an in-depth investigation. In the first stage, sample villages are selected based on Schedule Caste concentration in a cluster. Thus, three villages under Tulashideuri Panchayat of the Nagaon district, Assam, India have been selected in the first stage. In the second stage, a Rapid Rural Appraisal (RRA) was conducted. Looking into the homogenous characteristics of the households, 40 fish farmers have been selected randomly from the selected villages. The parameters such as the size of the pond, cleanliness of the water surface area of the pond, exposure to the sunlight, etc. are considered while selecting the households. The key informant was of great help in selecting the households and eliciting other required information.

Comment [o4]: Check grammar use past tense consistently

### Questionnaire

The collection of qualitative and quantitative data in the field requires an understanding of the social nuances that exist in a study region. This knowledge is essential in the planning phase around which the semi-structured interview is based (Ellis and Chen, 2013). Following Keefe et al. (2016) and Fallon, (2008), a semi-structured questionnaire was designed and

administered to obtain information from the sample households regarding their socio-economic condition besides assessing their fishing practices. The field survey was conducted between December 2020 and May 2021. The questionnaire has three parts general information, household information, and information related to fishing practices. The general information deals concisely withdrawing the very basic information of the respondents such as their names and addresses. On the other hand, household information deals largely with the socio-economic and demographic information of the respondent's family. This part consists of questions relating to land and other resources of the households, details of human and cattle populations, etc. The third part of the questionnaire is meant for assessing primarily their existing fishing practices. Questions are asked to obtain information on household size, their education, employment, and unemployment scenario, land and livestock holdings, size of the pond, years of practicing fishery, species rear in their pond, source from where they procure the seed, quality of feed, growth of the fish, etc.

### Method demonstration

The respondents informed during the primary survey that they were not being able to procure quality seed, feed, and, other fishing equipment, etc. It was understood from the analysis of the survey that the scientific methodology of fish farming was not known by the respondents. They were also not able to earn a profit because of constraints of the market, not having a proper harvesting net, etc. The growth of fish, for most of the farmers, was very slow. The analysis of baseline data put much-needed light on the constraints and it was found that hand-holding in the form of providing scientific knowledge and quality inputs could make a huge difference in the field of fish production in these villages and thereby their income. Based on the above primary information, a method demonstration was designed and implemented. The selected farmers were provided critical inputs like seed, feed, fertilizer, nets, etc. including technical demonstration based on the methodology of Das (2006). Water quality analysis, regular monitoring of growth in every two months and health checks up were carried out during the demonstration for one year (APHA, 1989).

Comment [o5]: Use correct grammar

### Results and Discussion

Demographic details of the selected 40 fish farmers were analysed based on the primary survey conducted during the study and presented in Table- 1.

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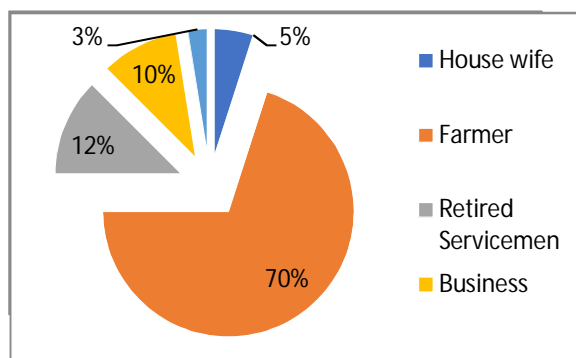
Total households	40
Total population	212
Total male	109
Total female	103
Female per 1000 male	944
Total literate population	209
Average household size	5.3

Comment [o7]: What do you mean Include the headings for the table

**Table 1- Demographic details of beneficiary households**

The total population of the sample households is 212 out of which 51.4 percent are male and 48.5 percent are female. Analysis of the demographic data elicited during the questionnaire survey showed that the average size of the household is 5.3 with a minimum family size of 2

members and a maximum of 13 members. The ratio of females per 1000 males is below the state average of 958 (national average of 944) according to the 2011 census. The occupational pattern of household heads was analysed during the period through a primary survey of the population and presented in Fig. 5. From the analysis it was revealed that 70% of the household heads report agriculture as their primary occupation. Further, 12% of the household heads have retired from the government service, and 10% of the sample heads manage their livelihood from the petty business. The main point that emerged from the survey was that the members of most of the families resort to more than one livelihood activity which is a positive sign in terms of reducing the risk.



**Fig.5 Occupational pattern of households**

The working population of the selected respondents who are economically active and express their willingness to work was documented through primary survey of the study in Table-2. The term referred as the people above 15 years of age but less than 65 years who wish to work as working population. The results indicated that 72% of the total population of the sample households are working population, i.e., in the age group of 15 – 65.

Working population		Dependent population			
Male (age 15 – 65)	Female (age 15 – m 65)	Male (age 1 – 14)	Female (age 1 – 14)	Male (age 65+)	Female (age 65+)
82	72	19	28	8	3

**Table-2 Working and dependent population of the SC villages**

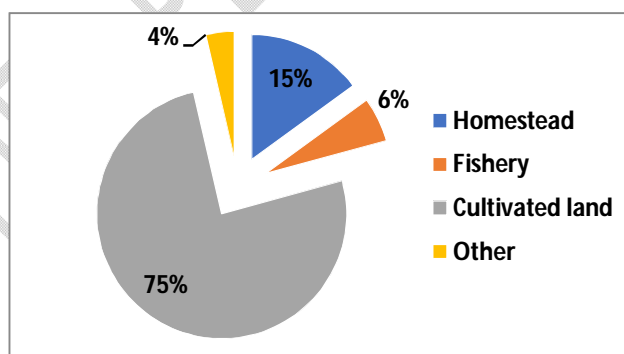
The farmers in the study area have a practice of taking and giving land on lease and therefore, it was pertinent to observe their size of operational holding which determines the production of various crops grown. The distribution of the households according to their operational land holding was documented through a primary survey and presented in Table 3. It is evident from the study that the distribution of land holding of the selected SC fish farmers is much skewed (the range being 0.16 hectares to 7.3 ha). The results showed that 35 percent of the sample households account for 61.7% of the total operational holdings. On the other hand, 40% of the sample households possess 29.6% of the operational holding whereas 25% of households possess only 8.5% of the total operational holding. The average land holding is 2.12 ha highest being 7.3 ha. The analysis of the primary survey also inferred that the entire lands of the sample households were under various

agricultural activities. There were no fallow or wastelands as multiple cropping are very much prevalent in the study area. Winter paddy and Bao paddy is predominant crop for the sample households followed by the mustard. Apart from paddy people also grow a variety of vegetables such as potato, brinjal, lady's finger, bean, bitter gourd, cabbage, cauliflower, peas, etc. *Jika* and *Toro* produced in this area are very high in demand in the market and thus almost all households grow both these vegetables in ample amount.

Category	No of Households	Amount of land (ha)
Marginal (Below 1 hectare)	10	7.3
Small (1 – 2 hectares)	16	25.16
Medium (2 – 10 hectares)	14	52.48
Average land holding size	40	2.12
Highest land holding size	40	7.3
Smallest land holding size	40	0.16

**Table-3 Operational land holding of the sample households**

The available land of the farmers was used generally for four different purposes. 75 % of the household land was under agriculture. While homestead area consists of 15 %, fishery comprises only 6 % of the total land use of the beneficiary (Fig.6). All the forty households were practicing fishery activities for the last several years. However, some households were relatively new to the fishery activity. 22 households were practicing fishery activities for the last five years only, while 11 households were practicing it for the last 6 to 10 years. The remaining 7 households were practicing it for a quite a long time, i.e., around 15 to 20 years. Though the households were practicing it for quite some time, however, they were lacking in the scientific methodology of fish culture.



**Fig. 6 Land use of the sample households**

The farmers were provided fish seed @ 10000/ha based on the water spread area available with them, feed @ 1-2 % of the body weight (Godrej generic feed) one drag net, dry cow dung @ 3000 kg/ha/year. The evaluation was carried out after one year among all the beneficiary households to assess the production and productivity, total income, and net profit from the fish stocked by all the households, and the result of the same is presented in Table 4.

Name of SC farmers	Amount of land	Type of fishes stocked ( Fingerling, 8-10 cm)	Initial stocking size in gm for all the fishes separately (species-wise)	Final weight gain in gm for all the fishes separately (species-wise)	Total production in kg/yr. (round figure)	Total profit in the previous year* (Rs.)	Total income in the studied year (Rs.)	Netprofit in the studied year (Rs.)
pu Das	0.4 ha	Rohu ( <i>Labeorohita</i> ), Catla		Rohu	686 kg	20,000	102900	72030
n Das	1.0 ha	( <i>Catlacatla</i> ), Mrigal (		(600-800gm)	1653 kg	24,000	247950	173565
aloti Das	0.4ha	<i>Cirrhinus</i> mrigala), Bhangon			580 kg	15,000	87000	60900
ongkong	0.5 ha	( <i>Labeobata</i> ),			760 kg	33,000	114000	68400
as		Grass carp (		Catla				
ishnamoni	1.0 ha	<i>Ctenopharyngodonidella</i> andKaliajar		(1300-1500gm)	1250 kg	19,000	187500	93750
azarika		( <i>Labeocalbasu</i> )						
arlav Das	0.5 ha				825 kg	20,000	123750	74250
dmakanta	1.0 ha			Mrigal	1435 kg	26000	215250	129150
as				(600-700gm)				
arayan Das	0.4 ha				625 kg	22000	93750	65625
mal Das	2.5 ha				3000 kg	100000	450000	225000
omi Das	0.6 ha			Bhangon	830 kg	32000	124500	62250
na Das	0.8 ha			(150-170 gm)	622kg	30000	93375	56025
ebakanta	0.8 ha				900 kg	40000	135000	81000
as								
hanakanta	0.4 ha			Grass carp	640 kg	36000	96000	57600
as				(1200-1500 gm)				
amaleswar	0.6 ha				895kg	32000	134250	80550
as								
nju Das	0.3 ha				250 kg	10000	36750	25725
olap Das	0.6 ha			Kaliajar	700 kg	22000	105000	52500
khikanta	1.0 ha			(400-500 gm)	1244 kg	30000	186600	93300
as								
n Das	0.6 ha				595 kg	20000	89250	53550
pamoni	0.5 ha				600 kg	14000	90000	45000
as								
ram Das	0.6 ha				810 kg	24000	129000	64500
kul Das	1.2 ha				1640 kg	30000	246000	123000
nola Das	0.4 ha				448 kg	16000	67200	40320
arala Das	1.4 ha				1400 kg	30000	210000	105000
omeswar	1.2 ha				1200 kg	24000	180000	90000
as								
ebakanta	1.0 ha				1100 kg	24000	195000	97500
as								
byajyoti	1.5 ha				1360 kg	28000	204000	102000
as								
kul Das	1.0 ha				1124 kg	18000	168600	84300
niram Das	0.6 ha				865 kg	14000	129750	64875

iniram Das	1.0 ha				950 kg	26000	142500	85500
pa Das	0.4 ha				360 kg	14000	54000	37800
nil Das	1.3 ha				1440 kg	24000	216000	108000
amoni Das	1.1 ha				1000 kg	22000	150000	75000
abita Das	0.8 ha				750 kg	20000	112500	56250
ahlad Das	0.6 ha				1400 kg	20000	105000	52500
ren Das	1.0				1000 kg	36000	150000	75000
nil Kr Das	0.4 ha				400 kg	16000	60000	36000
mi	0.8 ha				980 kg	30000	147000	73500
azarika								
atikanta	0.6 ha				900 kg	36000	135000	67500
as								
olap Das	0.6 ha				810 kg	26000	121500	60750
afulla Das	1.0 ha				1050 kg	20,000	157500	

Comment [o8]: Should be put as an appendix

**Table-4** Production and productivity, total income and net profit of the demonstrated scientific fish farming in the selected SC fish farmers

In the present study Rohu, Catla, Mrigal, Bhangon, Grass carp, and Calabasu were selected as suitable species and stocked in the ponds of the farmers based on the availability of quality seeds in nearby locations and also the demand of the particular fish for human consumption. Based on the growth of the selected fishes recorded during the study, it can be found that the selected species performed well in that climatic conditions and can be considered as candidate fishes for the backyard farming practices of the region. Pond management was done based on the standard protocol of scientific fish farming. The farmers utilized 40-50% of their land available for agriculture in fish farming and sold the fish at @Rs.150/kg in a wholesale market. The productivity obtained from the stock pond was 2000-3000kg/ha. The total cost of production incurred varied from 30-50% due to the land holding size, input management and unforeseen error that occurred during the period of fish farming for the first time in a scientific method. However, the net profit earned by each of the 40 farmers was 2-4 times higher than the previous year. During the study, it was also observed that the fingerling stocked in the farmer's pond registered an encouraging growth in the pond environment as recorded in Table 4. *Catla* registered the maximum growth in that particular environment.

The water quality analysed during the study period was found to be more or less in optimum condition due to proper management of the pond in a regular manner by the respondents following the standard protocol (APHA, 1989). The water quality parameters were ranging from Temperature: 24-35°C, DO: 4.5-6 mg/L, p<sup>H</sup>: 6.5-7.5, Total Alkalinity: 140-200mg/L, Total Hardness: 120-180 mg/L. One of the main causes of low fish production before the intervention was inadequate maintenance of water quality of the ponds. The p<sup>H</sup> was acidic, DO was less than 4 mg/L, Total alkalinity and Total Hardness was less than 80 mg/L which effect the low productivity of the pond as well as feed intake and lower metabolism of the fishes. This also impairs the movement of the fishes giving more opportunity to the pathogens to attack the fishes creating different fungal, parasitic and bacterial diseases ultimately effecting the total production and income of the farmers. The scientific management carried out by the selected farmers in a routine manner help them to achieve higher production and income by reducing all the risks.

## Conclusion

It is of utmost necessity that the vast fishery resources of the state spreading across the villages need to be properly and meaningfully exploited to contribute significantly to the total fish production of the state and to augment the income of the small and marginal farmers in the line of doubling farmers' income policy of the central government. It is observed from the present study that increased fish production and income may play a pivotal role in ensuring a sustainable livelihood for the small and marginal farmers.

Comment [o9]: This sentence is too long

In Assam majority of the people love to eat fish and therefore traditionally most of them have a small pond in their backyard. It is the prime source of nutritious food for the household. But the fishing practices here are unscientific and faulty in terms of stocking more or fewer fish seedlings, application of no lime and fertilizers to maintain water quality, and no surveillance for disease monitoring and control through regular netting, etc. Besides, lacks of capital and critical inputs, knowledge gap, and information asymmetry are some of the major constraints the farmers confront. Notwithstanding the above factors, it can be said that there are ample scopes to help farmers convert these traditional and low-yielding ponds into profitable ventures. It needs a simple and efficient hand-holding in terms of inculcating a scientific knowledge base to attain such a goal.

Comment [o10]: Use correct grammar

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