



Development of pisciculture as a source of livelihood: A case study in no. 4 Borghuli Village of Nagaon District, Assam (India)

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Abstract

Being a riverine state, the rearing of fish is a crucial economic activity in the land of Assam. Its rich water resources in the form of wetlands, beels, ponds, tanks, extensive two major river systems the Brahmaputra and the Barak can be a focal point for the development of pisciculture. Fisheries have a great economic value due to its contribution towards strengthening the local economy by providing immense employment opportunities for unemployed youths. In this regard, a geographical attempt is made through this paper to study about the development of pisciculture with special reference to economic and livelihood pattern of the fishermen of No.4 Borghuli village of Nagaon district. GIS and GPS techniques are used to observe the various factors that affecting the development of pisciculture in the study area. An estimated 50% dwellers engaged in the pisciculture is a positive sign towards socio-economic development of the study region. Along with its favourable factors if the study area gets the benefits of the Govt.'s schemes in proper way then there is no second thought that it will become a hub of fish production in near future within the state of Assam.

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Introduction

In simple words 'pisciculture' refers to the rearing of fish for commercial purpose. The term 'pisciculture' is the synonym of the term 'fish farming' and more appropriately it could be said as 'aquaculture'.

Fish farming is performed from the historical era when people living in a community started to capture fast growing fishes from ponds, lakes, rivers and streams etc. And slowly the development of various early civilizations near the giant rivers, the population learned to capture fish as their source of food. Fishes are the most traded food commodities and they are vital for national, regional and global food security and nutritional strategies which have a key part to play in transforming food systems and eliminating hunger and malnutrition across the world. The increase of global demand for the dietary fish protein has resulted in widespread of overfishing in the fisheries and rivers, which results the significance decrease in fish stocks and complete extinction or depletion in some regions. So, for the sustainable yields, the establishment of artificial fishes with sufficient feeding, high sustainable production of fish seeds, traditional construction of fisheries along with high technique machines used for pisciculture, protection from competitive threat, the concept of pisciculture emerged.

Under the 2030 Agenda of Sustainable Development, was launched by United Nations at September 2015 in order to determine to take bold and transformative steps to shift the world into a more sustainable and resilient path, the pisciculture sector has much to contribute for securing all the sustainable goals, but is at the core of SDG 14 – 'Conserve and Sustainably use the oceans, seas and marine resources for the sustainable development'(2020 the state of world fisheries and Aquaculture Sustainability in Action). Pisciculture has expanded fish availability to regions and countries with otherwise limited or no access to the cultured species, often at cheaper prices, leading to improved nutrition and food security. Global fish production is established to have reached about 179 million tones in 2018, overall total of 156 million

tones were used for human consumption. Pisciculture accounted for 46 percent of the total production and 52 percent of fish for human consumption. (<https://thefishsite.com/articles/a-new-high-for-global-aquaculture-production>). Fish farming is dominated by Asia, which has produced 89 percent of the global total in the last 20 years; the shares of Africa and the Americas have increased, while those of Europe and Oceania have decreased slightly. Several major producing countries including Bangladesh, Chile, Egypt, India, Indonesia, Norway and Vietnam have consolidated their shares in the world aquaculture production to varying degrees over the past two decades. China has produced more farmed aquatic food than the rest of the world combined since 1991. However, because of government policies introduced since 2016, fish farming in China grew by only 2.2 percent and 1.6 percent in 2017 and 2018, respectively. But, recently China's share in world aquaculture production declined from 59.9 percent in 1995 to 57.9 percent in 2018 and is expected to decrease further in the coming years (FAO/ Fisheries and Aquaculture).

Pisciculture started in India between 1970 and 1980 due to the demonstrated high production levels of 8 to 10 tonnes/hectare/year. Slowly later in 80s the pisciculture in India developed and transformed this practice into more modern enterprises. This culture practice is greatly depended on the input available in a particular region and on the investment capabilities of the farmers. The rank of India is second in aquaculture and third in fisheries production, thus fishing is a major industry employing 14.5 million people. 'In India, there are 2.36 million hectares of ponds and tanks, 0.798 million hectares of flood plain lakes, 195,210 kilometers of rivers and canals, and 2.907 million hectares of reservoirs that might be used for aquaculture' (<https://krishijagran.com/featured/all-about-fish-farming-in-india/>). The Ministry of Fisheries, Animal Husbandry and Dairying are in charge of designing, supervising, and funding many centrally sponsored fisheries and aquaculture development projects in all Indian states.

There are about 697 *Krishi Vigyan Kendras* (Farm Science Centres) in the country which is operated through the State Agricultural Universities, ICAR (Indian Council of Agricultural Research) Research Institutes, NGOs and most of which also undertake aquaculture development within their scope of activities.

Assam is the highest fish-producing state in the North-east. Being a riverine state Assam is predominantly a fish-eating state with 90 percent of its population consuming fish and its products. The fisheries of Assam play an important role in the socio-economic development of the rural poor. Assam produced 190 tonnes of fish in 2007-08 which increased to 294 tonnes in 2016-17 but not able to meet the state's demand; fishes are imported from the leading fish producing states such as Andhra Pradesh. The state has 4,820km of rivers and canals and 1.35 lakh hectares of water bodies including tanks, ponds and floodplain and derelict water bodies which can be the focus areas of development of pisciculture.

The district which is the leading producer of fishes within Assam is Nagaon, situated at the centre of the state with 29610 tonnes fish production in 2014-2015 increased to 31485 tonnes in 2015-2016 (Department of Animal Husbandry, Dairying and Fisheries, 2017). As per the report of Directorate of Fisheries, Govt. of Assam 2016-2017 Nagaon has 40 Registered Beel Fisheries and 12 Registered River Fisheries.

The livelihood pattern of the pisciculture depends on the economic status and earnings through fishery sector that determines the living standard of the fisherman also. The study area falls under Nagaon District which is the floodplain situated just towards the south bank of the giant river Brahmaputra.

There are enormous numbers of beels, wetlands, fisheries which provide abundance of fishes to the whole district and the state.

The Solong Fish Market is one of the largest fish wholesale hub markets of Assam, located at the study

site and the fisheries plays a great role in the development of this practice and towards the development of socio-economic condition of the people at the study site. Thus, an attempt is made to study about the role of pisciculture as a source of livelihood among the dwellers of No.4 Borghuli village of Nagaon District, Assam.

This study includes the following objectives

- a) To study about the development of pisciculture in the study area.
- b) To analysis the economic and livelihood profile of the fisheries in the study area.

Materials and methods

Study area

The study area falls under Kaliabor, the small sub-division town in Nagaon district of Assam. It is situated at a distance of 48 km east of Nagaon town and 177 km from the state Capital, Dispur. Its geographical extension lies in between 26°30'0"N and 26°37'00"N latitude and 92°45'00"E and 93°00'00"E longitude. By covering 567 km² it is located in the Brahmaputra floodplain, therefore the soil is mainly influenced by fertile alluvial plain and the favorable climatic conditions, which is rich in agricultural activities. There are numerous wetlands along with the floodplain of the river Brahmaputra, which is just beside, on the northern part of the study area.

The dynamic ecological characteristics and the low gradient are the characteristics of the rich wetlands in the area where the active piscicultural practices occur. This type of water bodies and the practice of rearing fishes support livelihood to the people of the area through the economic activities practiced for commercial fisheries. The climate of the area is favorable for the growth of numerous fisheries in the study site. The favorable monsoon, its abundant water bodies in the form of natural wetlands, marshy areas, man-made reservoirs and the availability of suitable amount of precipitation lead to the increase of fishing practices as commercial economic activity within the study area.

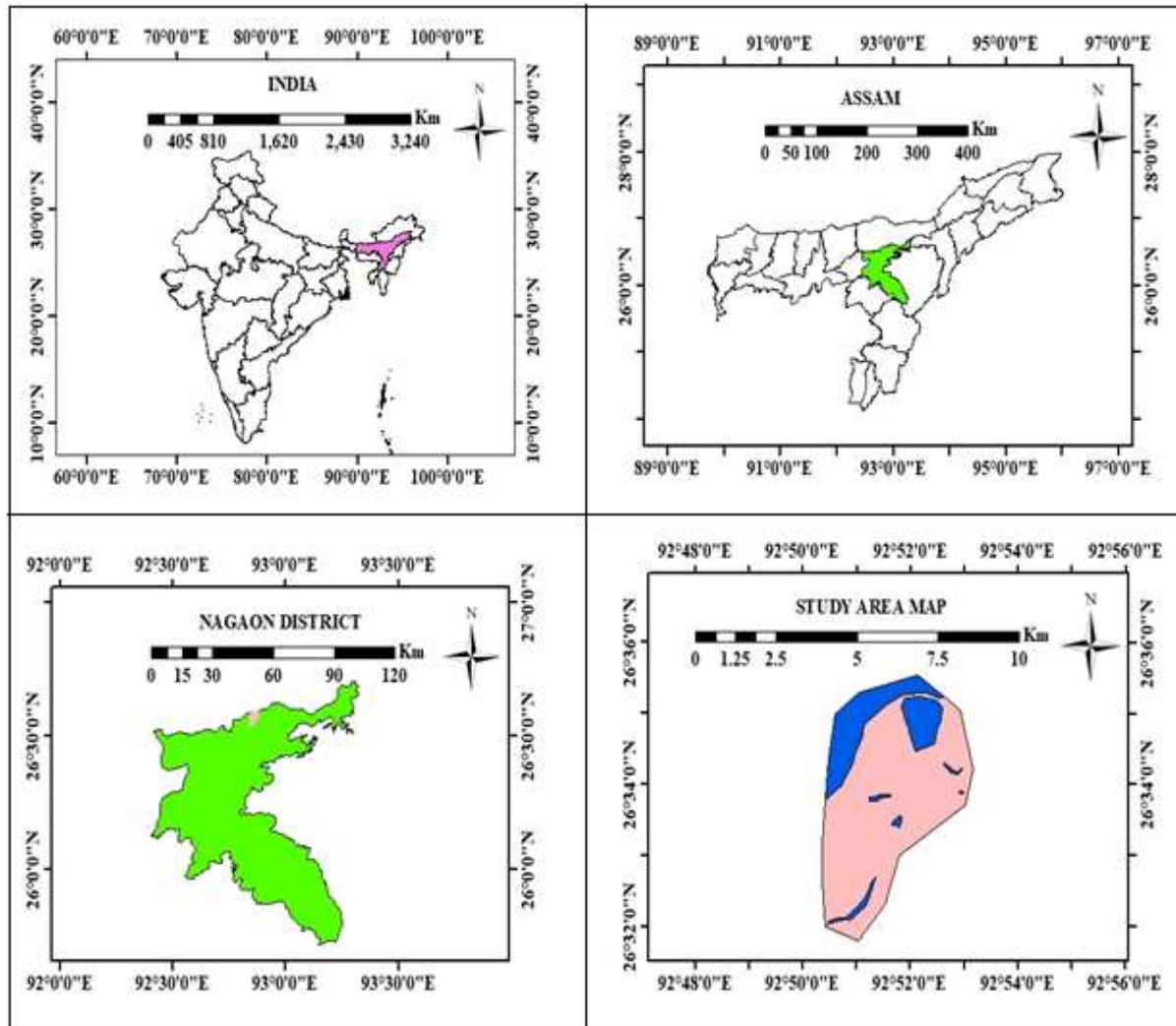


Fig. 1. Location Map of the Study Area.

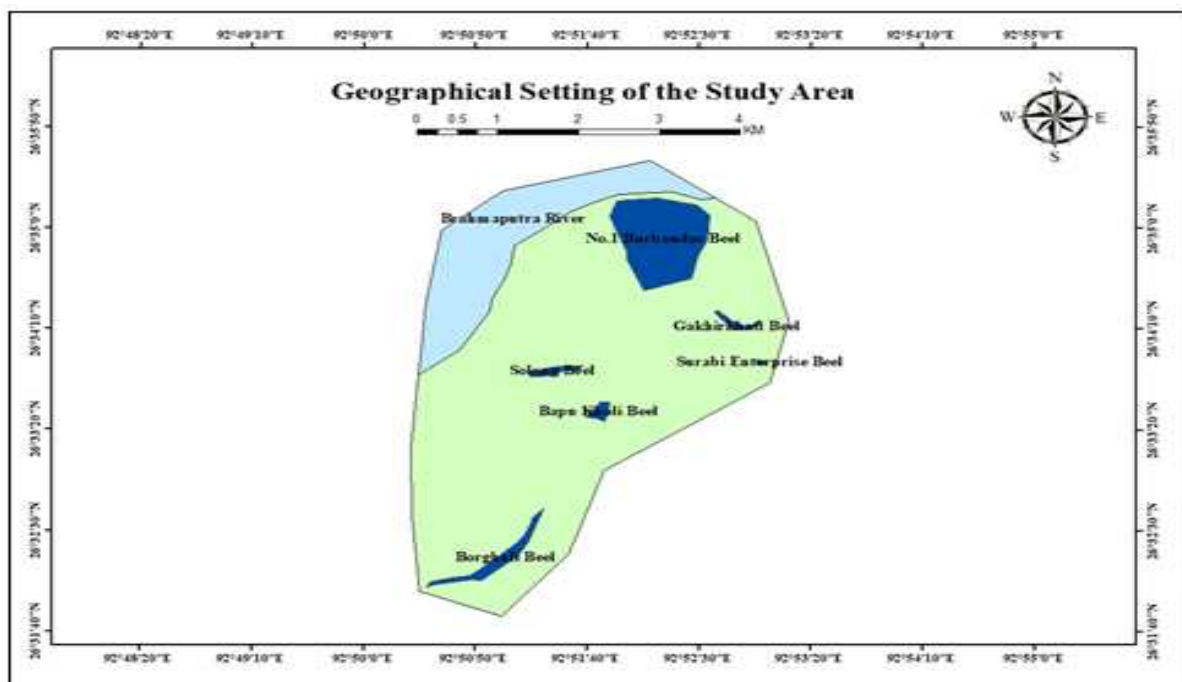


Fig. 2. Wetlands or Beels of the Study Area.

Pre-field phase

The pre-field phase comes before the field study which includes all the planning right from the selection of area to data collection methods and techniques. Firstly, data regarding the study area is obtained through literature review and personal observation for better understanding of area before the field study. Secondly, objective based questions are prepared in a well-defined survey schedule to use it as a tool for collecting first-hand data.

Field Study phase

In the study area, the data are collected from the households by using both interview and survey schedule method after selecting the households by simple random sampling technique. Out of 130, 60 households are visited in order to collect the raw data.

Post-field phase

The post field phase involves the handling of the data up to the interpretation and analysis in which GIS and GPS techniques are also applied for map making.

Firstly, all the collected data are compiled together in tabulation form and analyzed and represented by using suitable cartograms to meet the primary objectives.

Results and discussion*Development of pisciculture in the study area*

Pisciculture is an emerging industry in Assam's economy. This cultural practice plays a key role in socio-economic development and employment generation in the study area with the increase in large employment potential.

Table 1. Area of land allotted to different Fisheries.

Fisheries	Area (km ²)
Surabi enterprise	0.006724
Gakhirkhathi beel	0.045496
No1 Burbandar beel	1.26344
Solong beel	0.058454
Borghuli beel	0.199815
Bapu Kholi beel	0.050952

Source: Field Survey.

Through this practice nutrition is provided to the people and it eliminates the malnutrition by providing the rich protein, vitamins, minerals and fatty amino acids. Geographical setting of the area, availability of land, labour, market facility, transport and communication are some key factors behind the growth of this cultural practice in the study area. Natural wetlands, marshy areas, man-made reservoirs constitute rich numerous wetlands in the study area; along which the floodplain of the river Brahmaputra, favourable climate and sufficient

amount of precipitation lead to the growth of active piscicultural practices in the study area.

The study area is irrelevant for paddy cultivation as there is minimum rainfall and sandy soil compared to rest of the northern part of Assam, the artificial irrigation system is performed for variety of rice cultivation in both the seasons. So, most of the people opt to fisheries or beels instead of investing in rice cultivation. Every household has at least 10 to 15 bighas of land or more within the village.

Table 2. Annual Income of the Households through Pisciculture.

Annual Income (in Rupees)	No. Of Households
Below 1 Lakh	23
1-3 lakhs	16
3-5 lakhs	7
More than 5 lakhs	2

Source: Field Survey

The development of NH infrastructure near the study area into 4 lanes made the site rich in fisheries and pisciculture as the soil is dug from the cultivated land or barren land for the 4 lane and for development of 2nd Kaliabhomoraguri Bridge by offering the fisheries to the owner of land without costing any amount of penny. As the study site is near the giant Brahmaputra River there are abundance number of wetlands and marshy areas. Some of these wetlands

are converted into beels or fisheries with more than 2 or 3 owners. Apart from fishery lands, there is availability of vegetable cultivated lands for commercial purposes.

Areas of land allotted to different fisheries are shown in sq km through the tabulation and the graphical representation by the data collected through the cut Polygon features in G.I.S. software.

Table 3. Expenditures of the Households.

Annual Expenditure	No. of Households
Below 80000	17
80000- 2 lakhs	24
2 lakhs- 4 lakhs	5
More than 4 lakhs	2

Source: Field Survey.

Available of cheap labour around the study site made the Pisciculture more profitable. On the other hand, due to more fisheries there is less flow of workforce rather they actively work as a fisherman for around 10 to 12 hours per day during the season. The illiteracy, their hard work and a large number of family capacity leads to available of active and good amount of

labour. Absence of big industries and factories near the site or around 50 km within the area, there is minimum occurrence of labour drive; they better choose to work near or in their place itself. There is abundance of workforce engaging in marketing system, importing and exporting the fishes to all over the state and outside the state.

Table 4. Profit level of the Households through Pisciculture.

Profit Percentage	No. of Households
Below 20%	23
20% - 40%	10
40% - 60%	9
More than 60%	6

Source: Field Survey.

The nearby market is one of the biggest markets of the district and the state itself which is known as Solong Daily Bazar at 1-2 km far from the study site. It is the fish and vegetable wholesale market where most of the fishes are imported from Andhra Pradesh and Karnataka in a huge amount. Numerous number of nearby fisheries and beels now start to play a vital role in the growth of the market. Transporting cost is very low as the fisheries of the study area is located just 1-2 km far from the market, therefore there is high profit from the fisheries. A huge amount of workforce around the area helps to run the market

smoothly with proper management community along with the president and the secretary of the market. This wholesale market is made with better infrastructure, proper management and proper facilities for preserving the fishes and exporting them to different markets around the district and the state. The huge market facility near the study area compels the local people to engage themselves in fishing cultivation in which Pisciculture is practiced as their livelihood as the most profitable commercial economic activities and to compete with the imported fish production from Andhra Pradesh and Karnataka.

Table 5. Annual Income, Expenditure and Profit level from various Fisheries of No.4 Borghuli village.

Name of the Fisheries	Annual Income	Expenditure	Profit in %	
Private Fisheries	Surabhi Enterprise Fishery	Below 5 lakhs	Below 2.5 lakhs	50%
	Babu Kholi Beel	5 - 7 lakhs	2.5 - 4 lakhs	43%
Community Fisheries	Gakhirkhati Beel	7 - 9 lakhs	4 - 7 lakhs	30%
Government Fisheries	Borghuli Beel	40 - 50 lakhs	25 - 30 lakhs	45%
	Solong Beel	15 - 30 lakhs	8 - 15 lakhs	40%
Wildlife wetland	No.1 Bhurbandar Beel	9 - 15 lakhs	4 - 5 lakhs	65%

Source: Field Survey.

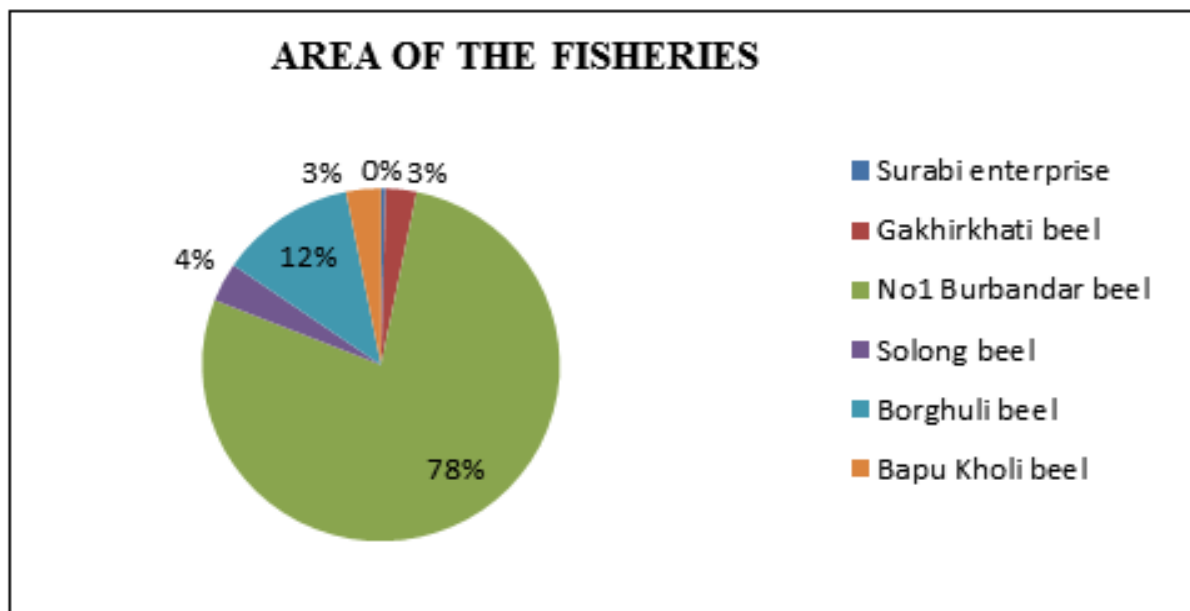
There is better facility of transport and communication as the study area has the good infrastructure of roads connecting to the NH 37A. There is the good infrastructure of metal roads connecting the fisheries with the market, which is located just next to NH 37A.

This helps smooth plying for trading, exporting and importing purposes. The two and four wheelers goods carrying vehicles are engaged in transporting fishes to the market and fish seeds to the fisheries for more production. The market facility located beside the highway made access to travellers travelling through the National Highway; and for traders and

retailers of nearby markets. All the above mentioned factors provide a strong base for the dwellers to choose pisciculture as a source of livelihood.

Economic and Livelihood Profile of the Fisheries in the Study area

Income and expenditure are two sides of a coin. Annual income one earns depends on the class of working force, types of fishing, and size of fisheries. The tabulation is performed through the primary collection of data, where out of 60 sample households 48 samples are engaged in piscicultural activities. So, annual income data of 48 households are shown in the table given below.

**Fig.3.** Graphical Representation of the Fisheries.

An estimated 80% sample houses are engaged in piscicultural activities; 47.91% earn below 1 lakh, 33.33% earns around 1 to 3 lakhs, 14.58% earns around 3 to 5 lakhs and 4.16% earns above 5 lakhs annually from piscicultural activities. During field

survey, it can be observed that, more numbers of labours are engaged in fisheries than the owner itself as the percentage of households are more below the 1 lakh annual income category. The following table depicts the scenario of expenditure in the

maintenance of the fisheries in the study area. The maximum expenditure i.e. more than Rs. 4 lakhs are made by only 4.16% sample households who earns higher annual income also while 10.41% make their expenditure around Rs.2 lakhs to Rs.4 lakhs and 50% dwellers expend the amount of Rs. 80,000 to Rs.2 lakhs in the maintenance of the fisheries in the field of fish seeds, techniques, labour and transportation

etc annually. Profit describes the financial benefit that exceeds the amount spent in buying, operating or producing something involved in sustaining the activity. The table 4 gives an idea regarding the profit level of the sampled households engaging in the piscicultural activity. Here, the profit data has been calculated with the help of annual Income and the expenditures data of sampled households.

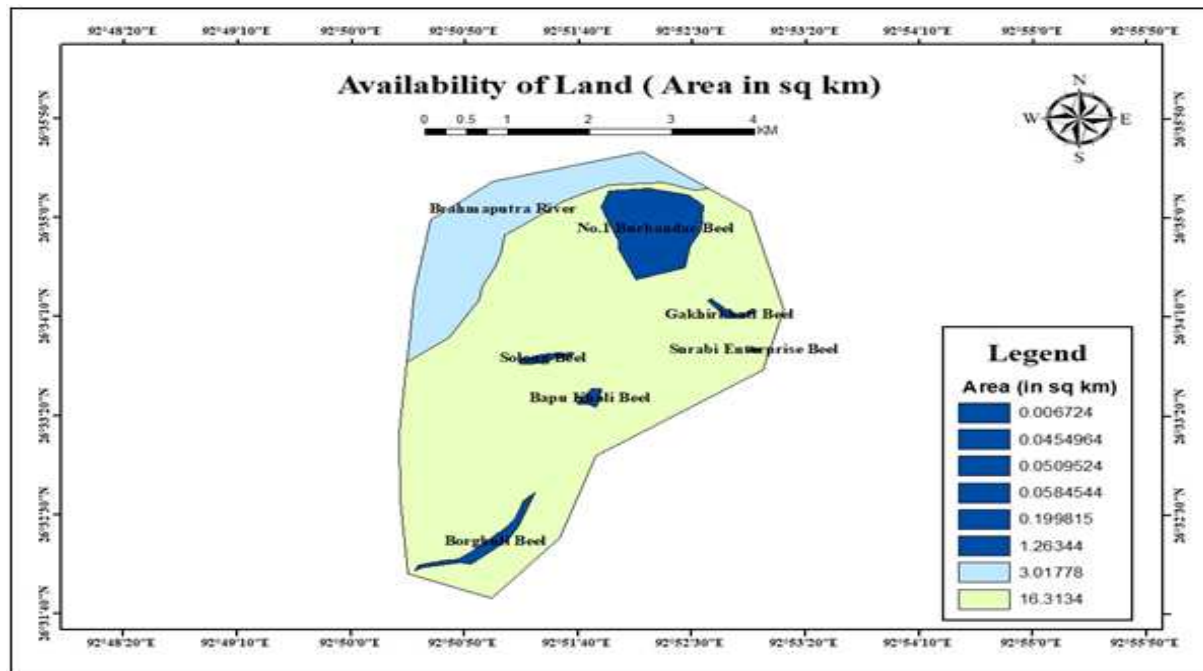


Fig. 4. Area of the Fisheries (km²) in the Study Area.

Highest percentage of the profit in the field of pisciculture are obtained by less number of respondents as an estimated 12.5% households gained the profit range more than 60% in the study area. Similarly, 47.91% households are related with the gaining of below 20% profit annually. Profit level totally depends on the annual income and the expenditure; by observing the profit level from the above table the livelihood pattern of the respondents depending on Pisciculture could be known.

During the period of survey it is found that in the study site most of the emphasis is given on six fisheries which falls under the Private, Community, Government sector and wildlife wetland. So, annual income, expenditures and profit margin also vary according to the fishery size, distance from the market, number of workforce are being engaged, use

of fishing techniques, investment on fish seeds (puna) and the collection of amount of revenues from Governmental Fisheries. The following table gives a glimpse of annual income, cost and profit margin of the major fisheries of the study site.

Wildlife wetland sector's beel is able to get maximum profit based on its annual income and expenditure. It is one of the wildlife wetlands where fishing can be done only with the permission of the Kaziranga Wildlife otherwise Pisci Culture sector of the area may access the license to perform the Fishing activity. There is no expenditure on fish seeds as during the monsoon or floody season most of the fishes enter from the giant Brahmaputra nearby to the No. 1 Bhurbandar beel. Gakhirkhati beel under community fisheries sector gains the lowest level of profit (30%). By giving the revenues to the Govt. Borghuli and

Solong beels gain the profit percentage as 45% and 40% respectively depending on their size.

The employment structure of the respondents is one of the important parameters determines the income level. It is found that majority of the respondents are

engaged in fishing as their primary occupation but they also have other sources of income including agriculture, small business and daily wage earner. The following cartogram shows the pattern of occupation engagement of the dwellers of No. 4 Borghuli village.

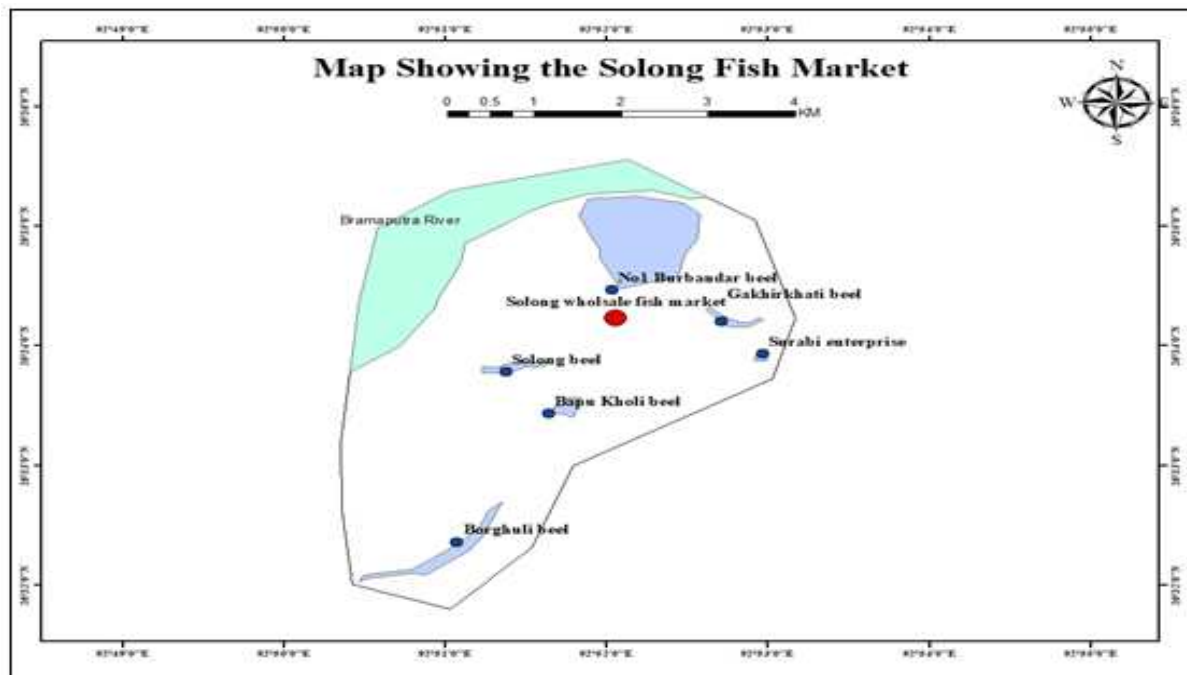


Fig. 5. The Solong Wholesale Fish Market.

Through this cartogram, it can be analyzed that 53% of the respondents dwelling in the study area depends mainly on fisheries for their source of livelihood; 25% of respondents are engaged in agricultural sector for their earnings. Business becomes the main source of income to 15% of the respondents. Very less number of respondents with only 7% is engaged in Govt. Services. Thus, the study site earns the most of the economy from the fisheries or from pisciculture which helps the population to sustain a smooth livelihood. It is important to mentioned here that though 53% villagers are directly involved in the activities of fishing but a few ones from other economic sectors are indirectly involved in the piscicultural activities as an alternative source of livelihood.

Problems faced by the Fishermen in the Study area

The fishery plays a key role in the socio- economic development of the villagers in the study area by

providing a source of income to them. During the field survey period, several problems related to Pisciculture have been identified, as the respondents dealing with fishery sector are affected by some problems which even sometimes hampers their livelihood pattern.

Marketing problem

The transportation and communication system is much better and very nearby to the market. Marketing connectivity and marketing network is the main cause of growth of this activity and its production capacity. The use of preservative and ice bars is very necessary for perishable product like fish. The local fish traders, the market intermediaries carry fish by bicycle or through motor vehicles.

Thus the basic infrastructure of fish market is not properly maintained which fails to cover the entire fish production centers of the study area.

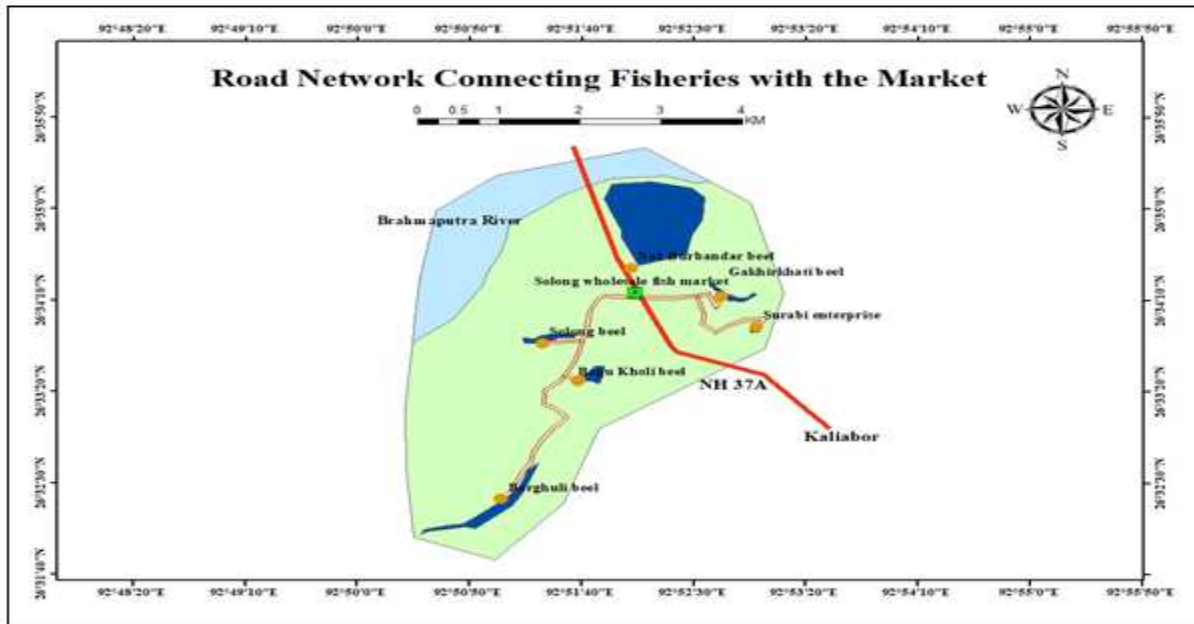


Fig. 6. Road Network Connectivity in the Study Area.

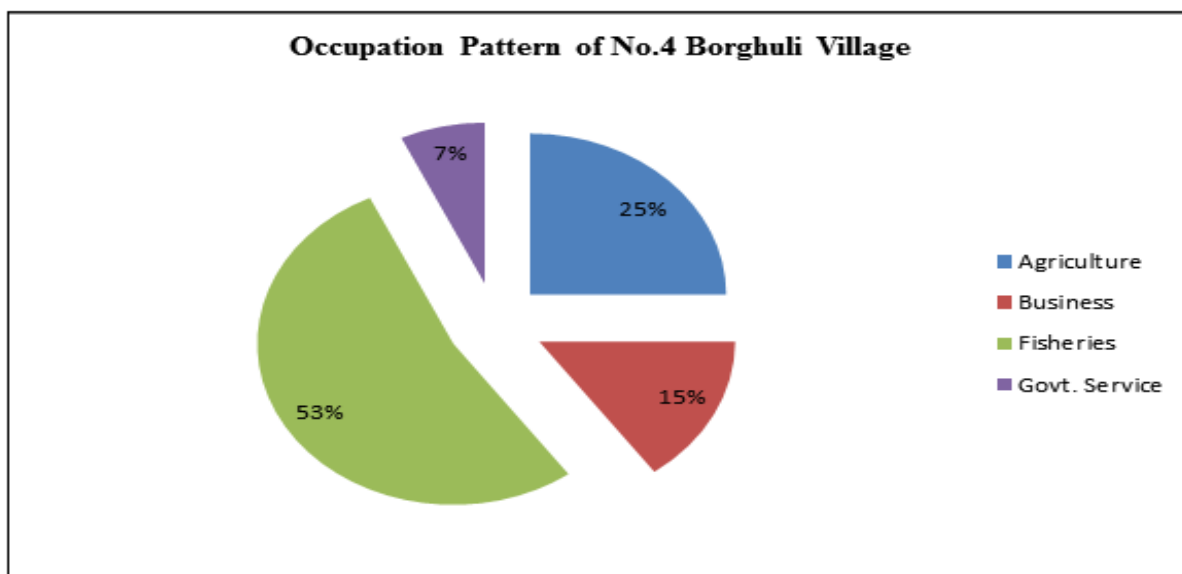
Problem of price fluctuation

Price fluctuation is also seen among the fishermen as it totally depends on the demand and supply of fish. Usually, there is a seasonal variation of price as production varies from season to season. Various causes like ban period of fishing and demand of fish in some holistic and festive occasions lead to increase of price. Transportation cost, cost of production, profit margin of producer, market rent, infrastructural facilities and storage cost etc. directly or indirectly influence the price fluctuation of the fish.

Lack of modern technology

Technological use in fishery sector is a great challenge as the fishing activity in the study area is fully practiced in traditional way.

The fishermen unable to use the machine boat and other modern technology for fishing due to the lack of finance and modern technology. Thus, most of the respondents clearly opine that due to the technological problem the fishery sector could not grow at a faster pace that it should be.



Source: Field Survey

Fig. 7. Occupational Pattern in the Study Area.

Fish sickness or fish disease problem

One of the serious problems in beels and fisheries of the study area is the sickness or fish disease. The fishing sector has taken different preventive steps so far, but they have failed to get success.

The flow of water during the winter season is totally blocked; even some species of fish are destroyed in the natural fisheries in the study area. Sometimes this problem compelled the fishermen to leave the fishing occupation or pisciculture activity due to scarce and decrease the quantity of fish. During the period of survey most of the causes of the sickness of fish in the beels and fisheries are figure out as follows:

1. Use of chemicals and fertilizers in the agricultural field deteriorates the nearby fisheries and beels, causing water pollution and lead to the extinct of most of the indigenous species of fish.
2. Use of urea, fertilizers for fast growth of fishes and production may degrade the quality of fish causing a huge problem for pisciculture in near future.

Role of government

The Govt. of Assam has already taken up several measures in order to address different constraints in the field of piscicultural economic activity; Assam Fishery Rules, 1953 amended as Assam Fish seed Act in 2005 and Assam Fish seed Rules in 2010, Matsya Jagaran-Ghare Ghare Pukhuri Ghare Ghare Maach, Seed Bank Programme, Selection of Matshya Mitra etc. are important one. Even United Nations' SDG's (sustainable development goals) have significance relevance with fishery by creating livelihood option for the rural poor; Chief Minister's Samagra Gramya Unnayan Yojna (MSGUY) has kept fishery as a priority area to minimize poverty and hunger. But here a question arises regarding its implementation.

During the survey period it is observed that most of the fishermen are not familiar with the aforesaid schemes and unable to get its benefits in which their lack of knowledge plays a vital role.

Conclusion

The study emphasizes on the livelihood of the population dealing with the piscicultural activity, reveals that the fishery is considered as the important source of income for the villagers of the study area. The ultimate aim of this study is to put emphasize on the economic status of the fisherman by highlighting the various problems and issues; with this it able to show the path of potentialities and opportunities for enhancing the economic value of the fisheries through the development of pisciculture sector in the study area. The availability of the fisheries and beels; and their resources in the study area need to be examined properly and maintained carefully in order to address its various constraints. However, engagement of around more than 50% dwellers in pisciculture activity is a positive sign towards strengthening the local economy of the study area. It may also able to bring a positive vibe among the unemployed youths to become self-sufficiency by engaging themselves in this sustainable means of livelihood in near future.

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