CHAPTER-2

REVIEW OF LITERATURE

Available literature on economic aspects of aquaculture is very few as limited studies have been done so far on this aspect. Most of the studies have been done mainly on the zoological aspects of aquaculture. Some of the studies done on this aspect are *Fishery Science and Indian Fisheries* (Srivastava, 2002); *Inland Fisheries of India and Adjacent countries* (volume -1 and 2) (Talwar and Jhingran 1991); *Fish Culture in India* (Alikunhi, 1957), *Fish and Fisheries of India* (Jhingran, 1982); *An introduction to Fishes* (Khanna, 1988); *Fishes* (Chand, 1991 and *Fishes of the world* (Nelson, 1984) etc.

Haque and Dey (2017) in their article entitled "Impacts of community based fish culture in seasonal floodplains, food security and employment in Bangladesh" has made an examination on the impact of community based fish culture in seasonal floodplains on production of fish, consumption, income and food security of the participating households in Bangladesh. From the three projects and control floodplains in Bangladesh, 46 percent households were randomly selected to perform the analysis. Longitudinal surveys were used on a seasonally, quarterly and monthly basis for the years 2007, 2008 and 2009 for the purpose of data collection. It was found that fish production, income and food security of the participating households went on improving as a result of the adoption of an equitable and inclusive multi-stake holder approach introduced by the project. Average fish production found to be increased from 124kg/ha/yr to 464 kg/ha/yr. Compared to the control sites 3.74 times more fish income for households in the project sites was generated as a result of the introduction of community based fishculture approach. Per capita monthly consumption of fish was found to increase from 1.26 kg to 2.31 kg in the project sites, which was 32 per cent higher than that of the control sites. Vulnerability of local beneficiaries, particularly of the landless and poor fishermen was reduced as project implementation had created additional fishing opportunity for up to six (6) months of the year. Thus, promotion of community based fish culture in seasonal floodplains may be useful to bring about hopeful changes in the overall

floodplain productivity and livelihood gains for the disadvantaged poor people of Bangladesh.

There has been a diverse impact of community based fish culture in season floodplains across and within floodplains. The results depicted that there is potential to increase fish culture system in the place of capture fishery activity floodplain areas. This can lead to an increase in fish production, vital nutritional support to poor households and go for improving the overall welfare of the low-income and resource- poor households. Introduction of this approach has had a significantly hopeful impact on income, employment and nutrition for adopter households. However, there were no major differences between project beneficiaries and controls in terms of socio-economic parameters, such as size of the household, floodplain size, experience in collective action etc. At the same time, there were no other projects that took place during the same time period. So, it can be concluded that all beneficial achievements, in terms of fish production, consumption, generation of employment and overall food security during the project period was mainly due to project implementation. The use of the innovative idea of community based approach to fish culture in floodplains have widely been adopted in Bangladesh by different institutions (including the Department of Fisheries, Government of Bangladesh), as well as in other countries of Asia also. The community based fish culture system has huge potential benefit because of the fact that a large number of people depend for their livelihood upon the 2.8 million hectares of floodplains. Implements in floodplain productivity and ecosystems services are apparently important, as are the addressing issues of governance for how to manage floodplains and make the ecosystem work. Thus, promotion of community based fish culture in seasonal floodplains may be one of the strong useful tools in bringing about dramatic hopeful changes in trends of overall productivity and livelihood gains for disadvantaged poor people in Bangladesh.

Janko, Assefa Mitike (2014) in one of his papers “Fish Production, Consumption and Management in Ethiopia” made an attempt to analyze the fish production, consumption and management trends in Ethiopia. Both primary as well as secondary data were collected for his study. However, the data used for his analysis were mostly secondary data. Following Eritrea’s secession from

Ethiopia in 1993 and the resultant loss of its coastline, Ethiopia has left with inland freshwater capture fisheries only. Presently, there are 180 different species of fish in Ethiopia of which 30 are native to the country. There are about 7,000 to 8,000 kms. total area of lakes and reservoirs and the important rivers stretch over 7,000 kms. the contribution of fishery sector to GDP of the country is very low. The potentiality of fish production of the country is estimated at 51,000 tones. People go to consume fresh fish in the vicinity of the lakes. Excluding these areas, the domestic fish market is small. Inappropriate fishing practice leads to over exploitation of fishery production and the potential of fish was underdeveloped. The federal and regional level management rules and regulations to control the devastation was very poor.

As already mentioned, the per capita consumption of fish is very low in Ethiopia. However, there is a steady growth in demand due to population increase, rising incomes and a shift in consumer preferences. Adis Ababa, the capital of Ethiopia, and the population and towns close to the main fish production areas are the main areas of fish consumption. There is a strong link of fish consumption with the fasting traditions of the Ethiopian orthodox Church having the belief that fish can be taken on those days where meat is not permissible (Wednesdays, Fridays and during the fasting months). Practice of aquaculture creates new jobs, assures food security and protects wild fish. Adopting fish production systems to current changes in climate help billions of people around the world to secure nutritional support with sufficient protein supply which is particularly true in Africa. Fisheries management in Ethiopia would have great contribution to the Gross Domestic Product of the country. Fisheries provide food, employment and income. Inappropriate fishing practice leads to overexploitation of fishery production with underdeveloped fish potential. Both at federal as well as regional level, management rules and regulations to control devastation was very poor which shows poor government attention for fish management.

Hossain e*tal* (2015) had explained that three million hectares of medium and deep flooded areas of land in Bangladesh are in use for rice production during dry season whereas these lands remain unutilized or underutilized for a long period because of flooding. Recently, as a case study,

Community Based Fisheries Management (CBFM) has been introduced to practice rice and fish culture in dry and flooding seasons in the areas of Kalmina Beel, Fulbaria, Mymensingh and Angrar Beel. The introduction of such a practice will go for the assessment of the challenges and problems of these beels aiming at helping the implementation of this practice in other floodplain areas of Bangladesh utilizing land and other water bodies providing a good source of food, employment and better income to poor people. To have a better understanding of the challenges of implementation of CBFM, assessment of the challenges and problems was conducted on Beel Mail at Rajshahi in Bangladesh as a case study. This study was mainly based on focus group discussion where village leaders, landowners, landless fishermen, other beneficiaries of beel, Department of Fisheries (DoF) and World Fish Staffs had participated. World Fish staffs were the official organizer of the meeting to arrange it in office of Upazila Fisheries Officer with participation of community leaders and executive group members. The conclusion drawn in the meeting was that lack of skills, education, technical know-how, and conflict among the stakeholders may be identified as the main internal constraints whereas lack of coordination among the government agencies, inadequate marketing facilities, lack of infrastructure, limited financial services, and environmental externalities may be identified as major external constraints for successful implementation of CBFM. To overcome these constraints and to have a proper and better management of CBFM in Bangladesh, the meeting advocated several policy implications. They advocated raise of stocking density in the Beel Mail to ensure enhancement of total fish production as well as to maintain fingerlings weight to increase fish production during short period of flooding. Their policy prescription also included the conservation of the brood of small indigenous fish species (SIS) sanctuary and the development of nursery pond to promote timely stocking of these water bodies with good quality fingerlings. At the same time, application of fertilizers is also prescribed to ensure food availability at all level of water bodies for optimum growth of fish. As a supplementary fish feeding, organic fertilizers like rice husk, duck weed can also be used in water bodies. To overcome financial constraints in the way of fish production, easy and soft fund should be arranged by the Government for the CBFM community. Micro credit facilities at lower rate of interest may also be provided for inland open water

fisheries sector. Initiation should be taken by the Government for infrastructural development and monitoring the market. For a successful growth of inland open water fisheries sector, leasing contract period should also be extended. Finally, for successful implementation of CBFM, initiation should be taken to involve both the landowners and landless people. Getting benefits from fishculture, landowners will go for promoting fishculture in rainy season instead of going confrontation with fishermen. In this way, the rice cultivators will be acknowledged and motivated for the practice of natural pest control technique in rice fields which will protect detrimental effect of pesticides on fish culture. Gradual empowerment of original fishermen can be ascertained by strengthening the social bonding among the group members which will establish their right in this common property. If the mentioned policy measures are successfully introduced to overcome the constraints, the CBFM in Beel Mail will become one of the successful stories. Abu Hayat *etal* (2015) in their paper "Adoption and impact of Integrated Rice-Fish Farming System (IRFFS) in Bangladesh" made a discussion on the active participation of different national and international organizations for the promotion of integrated rice-fish farming system as a potential technique for the eradication of poverty, food and nutritional security in different parts of Bangladesh, since 1990s. However, they incorporated a little rigorous empirical research for the determinants of adoption and welfare impact of such technologies, especially in marginalized people's settings. Such a research gap had been addressed by them through the use of the care of indigenous small-scale IRFFS farm household's cross-sectional survey data from northern and north-western region of Bangladesh. Double hurdle model had been used for the determination of the factors that affected IRFFS adoption and the intensity of adoption in the first stage. Propensity Score-Matching (PSM) method had been used for the analysis of the casual impact of IRFFS adoption on welfare aspects of marginalized indigenous farm households in Bangladesh in the second stage. They found out the first stage study findings that the key determinants of adoption are gender of the household head, access to irrigation, education and conflict with villagers. The results also indicated that the size of the farm and access to credit play a vital role in the extent of adoption, implying land and credit constraints, resulting the difficulty for land and credit constrained farmers to extend the adoption of the technology. In the

second stage, the study revealed that IRFFS had a straightforward positive and significant impact on farm household welfare measured in terms of household annual income, farm income, quantity and frequency of fish consumption. They were provided with evidential proof that promoting IRFFS technology was important to improve welfare of rural people, particularly for marginalized poor indigenous small scale rural farm households in Bangladesh. However, necessary interventions were of urgent need to overcome the obstacles for widespread adoption of this promising technology.

Shinoj e*tal* (2009) did not collect any primary data and by using secondary data only they analysed the changing pattern, composition of fish and fishery export products of India during 1995-96 to 2006-07. Their findings held that fish and fishery products reserved the prime status among the various commodities exported from the country. Among the exported items, frozen shrimp and fin fish are the highest, the primary destinations being European Union (EU), Japan and USA. However, the supreme status of Japan being the largest Indian seafood market has got largely worn away over the last decade. They also established that India's export basket has been diversified with show of a dent towards low value exports routed to South East Asian and Middle East countries at the expense of premium priced shrimp which used to have market to be a preferred destination for the shrimp exports. However, the Sanitary and Phytosanitary Agreement and the agreement on technical barriers to trade has been acting as one of strong non-tariff barriers to marine exports from developing countries like India. There exist so many examples of Indian fishery consignments which are being rejected by USA, EU and Japan. Reflections through these incidents may be summed up as the inadequacy of infrastructure, processing, packaging and grading facilities and lack of proper interest and attention towards hygienic practices etc.

Kumar (2004) in his study made an analysis of the export performance of Indian Fisheries on the basis of secondary data only. In his analysis it was found that there has been a major change in the composition of exports and imports of Indian fisheries products during 1987 to 2000. Regarding growth rates of export of fishery products, it was found significant both in terms of volume and value except five (5) nos. of fish. During the period between 1983

to 2000, there was a variation in percentage share of fisheries exports to total agricultural exports from 14 to 20 per cent. He also found it that the share of merchandise exports of India floated around three (3) to four (4) per cent while Japan, USA, EU, etc. were the major fishery product importing countries. Besides, he discussed about the introduction of WTO rules and regulations related to health and hygiene and the challenge the fishery product exporters of India have to face in recent years as a result of the enforcement of such fish rules and regulations.

Nongmaithem and Ngangbam (2014) in their article "Socioeconomic conditions and cultural profile of the fishes in India- a review" found it out that socioeconomic conditions of the fisherman in India are very low. Fisherman generally has less education and lives under unhygienic and improper housing conditions. Fishers had to support a large family with low income from fishing and as a result they are compelled to borrow credit for fulfilment of their basic needs leading them inside the vicious circle of poverty. India is a country with cultural diversity and there is a reflection of it in their fishing activities also. It was also found out that training programmes and scientific orientations were availed at heterogeneous manner in most of the places of India. So, a proper fishery management policy with effective input supply associated with technical and social support may go for improving livelihood and living conditions of fishers which will ultimately increase the overall fisheries productivity of India. Moreover, it can also be concluded that for the overall socioeconomic and cultural development of the fishers, scientist and policy makers should be more focused on the backward and forward linkages development. For effective transfer of technologies, development of a proper and suitable extension linkages mechanism is a prime need between the extension personnel and fishers. Participation of maximum number of fishers should also be ensured while organizing such training programmes at the village level. Multi-disciplinary and inter-sectoral studies should better be adopted with a view to problem solving while inter-sectoral studies with a collaborative effort between biological and social scientists should be realized in the area of fisheries. It is call of the time to apply 21st century science where social scientists are integrated along with other non-social scientists, i.e. use of trans-disciplinary

science rather than sectoral science to provide long lasting solutions to the problems confronted by the fisheries sector.

Bagchi, A. and Jha, P. (2011) in their paper entitled "Fish and Fisheries in Indian Heritage and Development of Pisciculture in India" made an analysis of fish and fisheries in Indian heritage. Their analysis found it that fish becomes an inseparable part of Indian people. Through empirical observations fish found to be proved the food of high nutritional value. The practice of casting a decorative fish figure on coins or stone sculptures and seals, or use of fish patch in flags by ancient Hindus and Muslims rulers in medieval period of India or the use of fish as a symbol of fortune and an object of literature and folksongs may be treated as a proof that fish transcended the narrow limits of cultural segmentation. The growth of cities with changing food habits has created an increased demand for large-scale fish culture in the 20th century. The trend of fish production from natural water bodies stopped downwards during the later decades of the 20th century. However, the revolution of induced breeding and polyculture has had its positive impact on freshwater pisciculture sector over the last 50 years reflecting an excellent growth of Indian fish production from 0.75 metric tonnes in 1950 to 6.3 metric tonnes in 2002. Pisciculture may play a vital role for the solution of the problems of increasing need for food diversity and decline in per capita protein nutrition of the Indian populace in the years to come.

Kumar *etal* (2009) had made an analysis of the cost, revenue and profitability of inland fish production and for this they collected primary data from 30 fish farmers of eastern dry region of Karnataka during April-May, 2003-04. It was found out by them that the working cost of fish farming constituted 80 per cent of the total cost. Major items of the cost in fish farming included fish seed, feed and labour. It was also found out that the return per rupee of investment was greater compared to many of the field crops grown by the farmers in that region. The discounted benefit- cost ratio in fish production was calculated at 1.30 with Net Present Value (NPV) of Rs. 1,27,156.00 and Internal Rate of Return (IRR) was calculated at 39.21 per cent which indicated the financial viability of the investment in inland fishery sector. Another thing found out by them was that fish through channel-I (farmer to consumer)

realizing 95 per cent of consumer price directly whereas the farmers who followed channel-II (farmer to retailer cum wholesaler to consumer) could realize only 57 per cent of consumer price. They also found out the main constraints faced by the farmers which were mentioned as inadequate supply of quality fingerlings, insufficient loan facility, high costs of feeds, seeds, labour, risk factors in marketing and high fish catch cost.

Pazhani and Isabella (2009) analysed the nature of wage and employment of labourers involved in fishing by collecting 100 sample families from Tirunelvelli district of Tamil Nadu. They found it out that employment in the fishing activity was seasonal. Several natural, social, economic and political factors determine the level of employment in this sector. Factors like bad weather, cyclone etc. may be natural while availability of credit, fuel and workshops, crafts etc. may be categorized as economic and factors like marriage, festivals, literacy etc. may be categorized as social. It was found out by them that fishermen earn their income from fishing and only insignificant number of fishermen earns their income from non-fishery resources. They also found it that the income of the fishermen is mostly influenced by the seasonal nature of activity, occurrence of fish famines, type of fishing, number of fishing days, rate of interest of capital invested etc..Significantly, they found it that 86 percent fishing households were living below poverty line.

Goyal and Saran (2009) analyzed the cost (including both fixed cost and variable cost), revenue and profitability of fish farming for the state of Punjab during 2005-06. They took the sample of 30 fish farmers from the six agro climatic zones of Punjab for the same period. Their cost components composed of the cost of evacuation, tube well, equipments, interest charged for capital invested, depreciation, lime, farm yard manure, poultry manure, super phosphate, fish seed, transportation cost, urea and feed, electricity charges, diesel price, petrol price, waste cattle feed, oil cake, rice bran, labour cost etc. The gross return per hectare per annum was Rs.91.760/- against the returns of Rs. 36,090.87 for the same. They also got in their study that the fish yields in kg. per hectare per annum were to the tune of Rs. 2,960/-. However, one of the most important drawbacks in their study is the non-inclusion of the subsidiary income of the fish farms in the estimation of revenue.

Sharma *etal* (2008) made a study about the fish production in Nagaland especially for the constraints and its prospects. Paddy cum fish culture is found to be one of the most common practices in Nagaland. However, domestic supply of fish falls short of the demand for fish in Nagaland. Due to this shortfall, the state has to import fish from other states of India like Assam, West-Bengal, Andra Pradesh etc. to fill up the gap. Their study also revealed that Fishculture in the state of Nagaland has to face so many problems like shortage of water, nitrification of lake ponds, aquatic weeds, weed fishes, non-availability of seed fish etc. In their study, they took the sample of 30 fish farmers, of which 60 per cent faced the problem of water availability 73.33 per cent faced the problem of proper supply of inputs and 83.33 per cent faced marketing problem.

Hapke (2001) analysed the impact of mechanization and commercialisation of small scale fish trade in Kerala on the basis of primary data collected from Trivandrum district between June 1993 and December 1994. He attributed special emphasis on gender and the impact of economic transformation on women fish traders. He systematically investigated the relationship of women's work in distribution to production and how it had changed with capitalist development. He explored that ecological crisis of overfishing and declining incomes from fishing in the artisanal sector are the concomitants of mechanisation of the fishing sector which had placed an increased burden on women for financial support of their families through work in fish marketing.

Sharma and Khajuria (2009) made an analysis of the consumption behaviour of fish consumers in Udaipur of Puruliya district, West Bengal during 2005-06. They collected data from 300 fish consumers of different socio-economic groups of the society in Udaipur. In their study, they applied chi-square method and found out that higher income group people (Rs. 10,000 per month) goes for consuming more fish than the middle (Rs. 2,500-Rs.10,000) and lower income groups (<Rs.2,500). In their findings, they also got it that maximum (44.66 per cent) fish consumers belonged to service sector (government or private) followed by business (27 per cent) in all the three income groups. On the basis of religion, they got it that 76 per cent fish consumers were Hindus followed by Muslims having 12.66 per cent. On the

basis of caste, they found that maximum fish consumers (45.66 per cent) belonged to general caste followed by scheduled tribes (23.33 per cent).On the basis of family size, they got it that about 53 per cent fish consumers were having larger family size (>5 members). In regards to preference of fish, fresh water fishes, Rahu was the most preferred and in case of marine fish, Prawns dominated over the others while fish curry was the most preferred fish form.

Samal *etal* (2011) made a study on the diverse impact of coastal shrimp aquaculture on different communities of Orissa. For the study, they collected primary data from 50 shrimp farming households in the five villages in Ersamma during January to October, 2004. Their findings reflected that shrimp farming had played an important role in employment generation and raising per capita income. As a result of it, dependence of people on agriculture and artisan fisheries for food and income had decreased. However, they also found it that the development of shrimp farming has had a detrimental impact on coastal ecosystems. Due to environmental degradation and concerns of shrimp farming practices threat has emerged on the long term viability of shrimp farming.

Goswami (2009) made an analysis for the involvement of rural women in coastal fishery sector of West Bengal. For the purpose, he collected primary data from four villages inside two blocks, namely Kakdwip and Namkhana in South Parganas district of West Bengal. He used nine variables in his analysis and found that only two variables, namely, annual income and decision making process had significant and positive correlation with annual income, utilization of information sources and decision making process of fisher women. Education, Annual income and decision making process had positive and significant association with the quantity of fish sold by fisher women. In regard to fish harvesting, just annual income had significant and positive association with the quantity of fish harvested by fisher women. While annual income, utilization of information sources had positive and significant association; size of the family, family type and areas of land had negatively significant association with decision making process of fisher women.

Gangwar, Saran and Kumar (2013) in their work entitled “Integrated Poultry-Fish Farming Systems for Sustainable Rural Livelihood Security in

Kumaon Hills of Uttarakhand" discussed on the socioeconomic impact of poultry based farming system on farmers for their livelihood security and empowerment of women. They made the analysis on the basis of data collected from 95 poultry farmers selected from three hill districts of Kumaon region of Uttarakhand for two production years of 2011-12 and 2012-13. The observation made by them was that for popularizing integrated poultry-fish farming, the key role has been played by the farmers engaged in day-old chicks (DOCs) / fish fingerlings. The study also revealed that the efficient input supply system has a positive impact on the promotion of poultry-based farming activities, food and nutritional security and empowerment of women in the study area. Their study also revealed that the contractual arrangement for day-old chicks rearing have been found successful in minimizing mortality up to five (5) per cent during the early phase of brooding. Women farmers purchase the grown-up chicks and they rear them in small flocks of 5-20, depending upon space availability and their financial capacity to purchase. The economics of existing poultry production system has revealed that the poultry could by successfully reared as backyard as well as intensive forms. The integrated poultry-cum fish farming is in a position to provide additional employment opportunities at least for 45 labour days and at the same time livelihood securities to BPL families. It has been indicated by economic analysis that the backyard poultry could add an average income of Rs.11,470/- per annum from two batches. The small size pond of 30-50 sqm produces 40-50 kg of fish per year. The net additional profit arises from this farming system is Rs. 5,000-6,000 per annum. Commercial production of broilers can also be successfully undertaken in the remote hills while the farm capacity ranges from 500 to 5,000 per batch having 7.55 per cent mortality of the total cost 72.0 per cent is the feed cost followed by 21.5 per cent cost of DOC. The calculated average rearing cost of broiler has been found to be Rs. 99 while gross returns and net profit are Rs. 110 and Rs. 11 respectively. They calculated benefit-cost ratio of intensive broilers production if found to be 1.11 which reflects a very thin profit margin. For the adoption of integrated poultry farming, there are so many constraints and high cost of DOC and feed has been identified as one of the major constraints. However, such integrated poultry-fish farming system has become successful in addressing women empowerment, equity and livelihood security. The suggestions made by the study have been

mentioned as to make proper efforts to supply superior fish fingerlings/chicks, poultry feed, effective technical knowledge for fish ponds/poultry house designing, disease management and to diversity backyard supply to mitigate production risks. Finally, the study concludes that special subsidy should be provided by the government for the promotion of integrated poultry-fish farming for sustainable development of the Kumaon region and at the same time it should also be linked with other rural development schemes/programmes/activities sponsored by various agencies.

Kacha (2016) in his paper entitled "Paddy-Cum-Fish Culture: Employment Opportunities in Arunachal Pradesh (India)" made an analysis of rice-fish integration farming activities in Arunachal Pradesh collecting both primary and secondary data for the purpose. It was found out that integrated farming within a managed ecosystem provides for better income to the farmers in terms of rice and fish production than that of the single crop farmers. The Ziro valley in Arunachal Pradesh has been considered as one of the most suitable areas for fish culture in Paddy fields with their choice strains of paddy though there has been no price regulating mechanism for both government as well as private farm owners. It was also found out that the price of the fish seed especially fingerling varies from farm to farm depending upon the size and its availability. The attempt of the paper was to make an analysis of the practice of paddy –cum- fish culture and employment opportunities available in the state of Arunachal Pradesh.

De Roy (2012) in his paper "Impact of fish farming on employment and household income: Evidence from a village study in west Bengal" made an analysis of the primary data collected from 244 households from Tentultala, 34 km away from Calcutta city and found it that prawn and fish farming is one of the important sources of livelihood for the local people of Sunderban region in West Bengal leading to dynamism in the local economy of the area. He also got it that the impact of this development has been skewed, whereby a small section of the population with access to capital has enjoyed maximum benefits. Only 2.9 percent of households comprised of big farmers of fish but they enjoyed 33.5 per cent of income which reflects that they are benefited from the development of prawn farming leaving the others. Thus, he analyzed the impact of prawn

farming on employment and income on different sections of population living in Sunderban region.

De Roy (2013) in his paper "Impact of Fish Farming on Land Relations: Evidence from village study in West Bengal" made a discussion on land relations in prawn farming in the state of West Bengal based on primary data collected from 244 households. The sample households were from a village Tentultala in the Sunderban estuarine region and the survey had been done in the year 2006. The analysis made in the study regarding the structure of ownership holdings reflected that there was inequality in the distribution of land in Tentultala showing the Gini coefficient of distribution of ownership holdings at 0.66. It was also found in the study that fish farming had led to concentration of land among the big players of fish in Tentultala having 70 per cent of total operated area showing the Gini coefficient of distribution of operational holdings at 0.93 while the livelihood security of small land owners and *bargadars* had been enhanced by the development of a land lease market. In this way, prawn farming had led to improvement in livelihood security for a section of poor people who had ownership and cultivating rights over land.

Goswami *etal* (2004) discussed the economic efficiency of the rice-fish culture in Kamrup and Nagaon districts of Assam. For the purpose, they randomly selected 50 sample farmers from each district of Kamrup and Nagaon. On the basis of the collected data from sample farmers, costs and returns and maximum profitability of the farming system were worked out. Interpretation of input-output relationship of the system was made by using Cobb-Douglas production function and they found that major operational cost items were labour, seed, feed and cow manure.

Gogoi *etal* (2015) explored that Assam has an excellent sub-tropical climate for the growth of fresh water fish culture in 3.91 lakh hectares of water area in addition to 1.58 lakh hectares of paddy field area. Assam is endowed with valuable fishery resources comprising of two major river systems (Brahmaputra and Barak), several beels, lakes, tanks, ponds and swamps. Fish production and employment opportunities can be increased through the use of sustainable utilization of available resources with the approach of appropriate

farming system. They focused mainly on the potentialities and possibilities of resource utilization as fishery based livelihood through diversified system of farming.

They also stressed that the state's vast fishery resources are needed to be exploited properly and carefully adopting scientific fish farming which are still underutilized. Proper exploitation of the fishery potential of these resources will increase productivity and, hence, aquaculture reforms must address issues in the area for sustainable livelihood to the rural farmers from both capture and culture fisheries. Their study showed that the capture fishery shares 36 percent of total state fish production and it plays a vital role in socioeconomic development and livelihood security of the poor fishermen. However, the productivity from capture fisheries shows a declining trend over the past few years. Hence, the involvement of large numbers of farmers in culture fisheries can only keep pace with the demand for fish production in the state. They were of the view that the fish production of about 1,800 kg/ha/yr could be achieved from small seasonal homestead ponds through integrated use of locally available biological resources. This infers a golden opportunity for developing rural economy through the growth of small-scale fish culture enterprises. New approaches for employment generation can be created through the development of ornamental fish trade and for this poorly explored native ornamental fish resources will have to be explored properly. The integrated fish farming and the rice-fish culture in particular, may give the provision of better livelihood for the farmers in 2.3 million hectares seasonally flooded low laying areas. Bringing with improvised technologies by the state and central governments to the farmers and other stake-holders will bring about a holistic development of the fishery sector while sustainable utilization of available land and water resources through mass participation of farmers in aquaculture would go for improving the socio-economic condition of the farmers in the state.

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