Ascertainment of technical efficiency of fish farmers of Kamrup district of Assam

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Abstract

The water resources of Assam are not optimally utilized by the fishery sector, which creates a lack of capabilities to meet the needs of fish within the state itself. Despite the available water resource, Assam imports fish from other states to supply fish to the local demands of the state itself. There is a lack of studies on technical efficiencies of the fish farmers in Kamrup district of Assam. The objective of this study is to measure the technical efficiency of the fish farmers of Kamrup district. The result of this study shows that maximum numbers of fish farmers of the study area are technically efficient. The number of fingerlings introduced to the pond and other costs in fish farming have significant impact on the quantity of fish produced by the fish farmers of kamrup district.

Keywords: Production; Technical efficiency; Fish farming; Assam

Introduction

The fishery sector of India plays a significant role in developing the socio-economic condition of the citizens of the country. Although the fishery sector of India is acknowledged as an important source of income and employment as it encourages establishment as well as the growth of subsidiary industries, it is also a cheap source of nutritious food and foreign currency generator (Department of Animal Husbandry and Dairying, 2010). Fish farming is made of both fishery and hatcheries activities. Where fishery activities include harvesting, rearing, and growing fish in tanks and ponds, beels (lake like wetland), and other water bodies, and on the other side hatcheries are associated with activities like artificial breeding, hatching, and rearing of fish spawns. The Indian fisheries sector holds a diverse collection of water resources starting from the Himalayas to the Indian Ocean. With the existence of different fishery resources, there are different ecosystems where dissimilar species prevail. These fisheries serve livelihood to millions of people. The need for protein and nutritious food is increasing with the climbing `rate of population emerges the need for sustainable developments of aquatic resources (National Fisheries Policy,2020). Assam is one of the North-Eastern states of India, Assam covers an area of 78,438 Sq. Km from 24007′ N- 28000' N latitude and 89042'E – 96002'E longitude. The biggest river of the state Brahmaputra flows from East to West and another significant river of the state is the Barak River. Other than these two big rivers there are 53 tributaries (Gogoi, 2017). Along with being a widely consumed food item, fish is also related to the social life of people of North East India esp. Assam (Saikia & das, 2023). Assam is the wealthiest state in terms of water resources among the other North-Eastern states. Water resources encompassed by Assam are diverse, it includes beels (1.0 lakh ha) which is a natural pond with static water and the term beel is used in Indian states like West Bengal, Assam and in the country Bangladesh. Ponds and tanks (0.6 lakh ha) which are water bodies created by human for aquaculture, derelict water bodies (1.16 lakh ha) which are unutilized water bodies like canals, forest fisheries (0.05 lakh ha) which includes natural water resource like lakes and reservoir fisheries (0.03 ha) is a man-made lake or water body built by impounding river water with the help of dam in order to store water, rivers (2.05 lakh ha). Although Assam has sufficient freshwater resources, Assam is not able to be self-reliant in terms of fish production and meeting the demands (Bhuyan et al.,2017). Assam is the home for 265 species of native ornamental fish which has a demand in the global market. Integrated fish farming supplies great livelihood opportunities to the rural population of the state. The abundant water resources in the state need to be utilized carefully with scientific fish farming to ensure increased productivity. The fish farmers of Assam are not practicing the new alternate feed supplements as being used in developed countries (Ostrenko et al, 2021). The rural economy can be improved with the enhancement of small culture fisheries (Gogoi et al., 2015). The tropical climate of Assam is a blessing for the fishery sector but with the change in the consumption habits, technological developments, and emerging market drivers, the fishery sector of Assam is going under transformation. Kamrup district of Assam is an administrative district of the state which has its headquarter at Amingaon. The size of the doistrict is 2740 sq.km which a population of 1,517,542 as per 2011census (Government of Assam, 2022.) Kamrup district holds the 9th position in fish production among another districts of Assam and has a great potential to increase the position upwards (NEDFi, 2023), (Saikia & Das, 2023). The sole objective of this article is to ascertain the technical efficiency of the fish farmers of Kamrup District of Assam.

Materials & Methods

The technical efficiency can be computed by adopting numerous approaches, a huge number of previously conducted researches in this area have used stochastic frontier production technique to compute efficiency of production in the fisheries and aquaculture in different regions (Edward et al., 2009). One of the most widely adopted functional forms of production function is Cobb-Douglas production function (Bukenya et al., 2013). Technical efficiency of the fish farmers of Kmarup district will be measured with the help of stochastic production frontier model and this model requires a functional form of production function to be applied. Here, Cobb-Douglas production function is considered for estimation of stochastic production frontier (Kareem et al., 2008).
The empirical stochastic frontier production function used for this study is described below:

$$\boldsymbol{Ln\,Y = \beta o + \beta 1\,Ln\,X1 + \beta 2\,Ln\,X2 + \beta 3\,Ln\,X3 + \beta 4\,Ln\,X4 + \beta 5\,Ln\,X5 + \beta 5\,Ln\,X6 + V - U}$$

Where, Y is annual fish production of each farm; X1 is number of annually introduced fingerlings by each farm; X2 is the annually expenditure on interest, lease rent, transportation, drug, depreciation in rupees; X3is the annual total labour expenditure, X4 is the annual total expenditure on fish feed, X5 is the annual total expenditure on

fertilizer. V and U are random variables. The inefficiency element shows different features that represents inefficiency. In simple words inefficiency is a function of fish farm specific factors. Such farm specific variables which may influence the efficiency of the fish farmers of Kamrup district of Assam. The model for diffrent operational and farm-specific variables anticipated to impact fish farmers' technical inefficiencies. Here other costs includes, electricity costs, transportation costs, pond maintenance costs, disease control costs and other costs made by specific farmers. To demonstrate the link between efficiency and farm specific features, the following is the technical inefficiency model:

$$\boldsymbol{Ui = \delta 0 + \delta 1 z1 + \delta 2 z2 + \delta 3 z3 + \delta 4 z4 + \delta 5 z5 + \delta 6 z6 + wi}$$

Z1= Age of the fish farmer, Z2= gender of the fish farmer, Z3= Education level of the fish farmer, Z4= Fish farming experience, Z5= Size of household of the fish farmer, Z6= Pond area.
In the inefficiency model wi is a random error term δ0= constant and δ1, δ2, δ3, δ4, and δ5are coefficient of variables assumed to influence inefficiency that are to be estimated. 100 fish farmers were selected randomly for this study.

The result of above mentioned theoretical approach for technical efficiency and inefficiency of the fish farmers are calculated with the help of Frontier 4.1software and results of the stochastic production frontier are stated and discussed below.

Results and Discussion

From the results of the table 1, it can be stated that only fingerlings cost is significant at 1% level of significance and 1% increase in fertilizer cost can increase 0.88% fish production. The other cots of fish farming has showed negative elasticity, which implies that increase in other costs will lead to decreased fish production. Other variables were found not to be significant. The value of Gamma is found to be 0.053 which is statistically significant at 1% , which shows that 53% of the variability in production due to technical efficiency in the fish farming technique and 47% of variations due to random noises. The likelihood ratio is found to be 16.8 which is lesser than the critical chi square value given by (Kodde & Palm, 1986) at 1% level of significance. Hence, the null hypothesis of technical inefficiency is rejected. The value of Sigma-squared is significant at 1% level of significance i.e. 5.37, which represents the goodness of fit. With increase in 1% in output there will be 0.17% increase in the technical efficiency in the production technique of the fish farmers.

The result of inefficiency model shows that increase in pond area by 1% will result in 26% reduction in inefficiency of the production technique of fish farmers of Kamrup district of Assam. Increase in age by 1% will decrease 0.6% technical inefficiency of the fish farmers' production technique. On the other hand increase in house hold members will increase the technical inefficiency by 0.22%. The other variable are found to be statistically insignificant.

It is evident from the results of efficiency test that most of the fish farmers of Kamrup district of Assam are technically efficient i.e. 76% of the fish farmers are with above 80% level of technical efficiency. 20% remains within the category of 80% to 60% level of technical efficiency. The mean value of technical efficiency of the fish farmers of the study area are found to be at 87.5% level.

Number of fingerlings introduced on the pond has a positive impact on the overall quantity of fish produced. Whereas, other costs in fish farming has a negative relation with the quantity of fish produced and indicates that increase in cost in fish farming will not necessarily increase the quantity of fish produced by the fish farmers. Increase in the area of pond reduces the inefficiency of the fish farmers and increase in number of household members in the farmer's family increases the inefficiency which may be due to lack of cooperation among the family members toward their works. The growth in fish production by the state is not sufficient enough to meet the demands. For meeting the fish demand of the state, the import of fish from other states has played a vital role (Debroy et al.,2016), (Haque et al.,2021), (Hazarika,2021), (Yadav et al.,2020). Proper emphasis on above stated factors of fish production may help in meeting the demands of fish within Assam without importing from other states.

Earlier studies have showed that Fishery Sector of Assam is a male dominating sector (Pegu et al.,2019), (Phukan & Barman,2015), and according to Baruah, (2016) women are not involved in the major operations within the fishery sector, they are mostly involved in secondary activities like taking care of things but the results of this study has showed that gender is not a significant variable contributing towards fish production. Hence, women of the study area also can take part in major activities in fish farming. The fishery sector of Assam has great potential for generating employment for the population of the state especially for women (Das et al., 2024).

Table 1: Summarized result of Maximum likelihood Estimation

Variables of production function	Coefficient	Standard Deviation	T- ratio
Constant	7.8	0.99	0.8
Labour (Rs)	0.069	0.12	0.56
Fingerlings (Rs)	0.88***	0.25	3.56
Feed (Rs)	0.29	0.15	1.86
Fertilizer (Rs)	-0.17	0.11	-1.54
Other costs (Rs)	-0.69***	0.22	-3.2
Output (Kg)	0.17	0.14	1.22

Table 2: Results of inefficiency model

Variables of Inefficiency Model	**Coefficient**	**Standard Deviation**	**T- ratio**
Constant	0.53	1.1	0.49
Pond area (ha)	-0.26***	0.054	-4.79
Age	-0.6***	0.1	-5.97
Gender	0.43	0.81	0.53
Household member	0.22***	0.87	2.54
Education level of the fish farmer	0.56	0.35	1.66
Experience	-0.131	0.23	-0.58

Table 3: Technical efficiency levels of fish farmers of Kamrup district of Assam acquired from stochastic production frontier model

Efficiency level %	**Frequency**	**Percentage**
100-80	76	76
80-60	20	20
60-50	4	4

C**onclusion**

Analysis of technical efficiencies of fish farmers in Kamrup district of Assam is not a very common area of study. This study has showed that irrespective of inefficiencies existed among the fish farmers, most of them are technically efficient. Very few variables are having significant influence over the quantity of fish produced by the fish farmers.

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Conflict of Interest: None

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