

RESEARCH NOTE

Technical Efficiency of Different Fish Farming Practices in Assam

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ABSTRACT

This study was designed to assess technical efficiency of fish farming practices of the central Brahmaputra valley zone, Assam. Estimates of technical efficiency were done based on the primary data collected through a sample of 150 progressive farmers of CBV zone during 2010-11. The study revealed that there were three models of composite fish culture system-existing in the region. The existing models were single stocking single harvesting (SSSH), single stocking multiple harvesting (SSMH) and multiple stocking multiple harvesting (MSMH). Cobb- Douglas production function model was used to determine the technical efficiency. Technical efficiency of fish production in CBV zone ranges from 35.9% to 95.2% when farmers are classified as marginal, small and large and technical efficiency was found to be 40.3% to 76.8% when farmers were grouped according to farming systems.

Key words: SSSH; SSMH; MSMH; Technical efficiency;

Being one of the major representatives of fish consuming states in the country, Assam produces 76% of the total fish demanded by the state (*Economic survey, 2010*). 2.19 lakh tons of fish were produced by the state during 2009-10 (*GOI, 2010*) out of total local fish demand of 2.9 lakh tons calculated on the basis of minimum nutritional requirement of 11 kg per capita (*FAO, 2007*). As Assam is a land locked state so fish comes mainly from inland resources like rivers, beels and ponds. At present Assam has 38767 ha ponds and is the major contributor of total fish produced by the state. Resource wise 13.46% of total aquatic resources of the state is covered by central Brahmaputra valley zone and produced 15% of total fish and a mammoth 44% of total fish seeds of the state (*DoF, Assam, 2010*).

Composite fish culture is the most popular and dominant fish culture practice of Assam. With the development of multiple cropping fish culture system the scenario is changing at the field level. It was found that multiple cropping of carp resulted in higher production compared to single cropping of carp (*Jena et al. 2002*).

A small number of studies have been carried out to estimate the economic efficiency in fresh water

aquaculture sector at all India level (*Dey et al., 2005*). Moreover, *Singh et al. 2009* studied the economic and technical efficiency of fish production in Tripura but there is no such study carried out in Assam where a number of recently evolved carp culture techniques are being practiced.

Based on the observations above, our present study addressed a) the different forms of composite fish culture models followed in CBV zone, Assam and b) the efficiency of culture practices adopted by the farmers of CBV zone, Assam.

METHODOLOGY

Primary data collection was done during the period of October 2010 to March 2011 in Central Brahmaputra valley (CBV). Central Brahmaputra valley is situated in between latitudes 25°47'N to 26°50'N; longitude 92°E to 95°05'E and constitutes with Nagaon and Morigaon district. This zone is bounded by North bank plain in North, Upper Brahmaputra valley in East, Hills in South and Lower Brahmaputra valley in West.

Based on discussions with the District Fishery Development Officer of each district, fish farming pockets were identified for collection of data. Fish farming pockets indicates the areas where fish farming

practices are going in a commercial scale. A total of 10 fish farming pockets were selected out of which 6 from Nagaon district namely Zuria, Nilbagan, Batadrawa, Rupohee, Kaliabor, Raha and 4 from Morigaon district namely Okarabori, Habi-borongabari, Baropuzia, Chabukdhara. After selection of 10 fish farming pockets fifteen fish farmers from each pocket were taken for primary data collection. The data on practicing fish farmers of the selected fish farming pockets were collected from the concerned extension officer. Out of 30-40 fish farmers from the each pocket, 15 fish farmers were selected on the basis of simple random sampling techniques. Thus a total of one hundred and fifty fish farmers were taken as respondents for detailed primary data collection. These 150 respondents were grouped into three categories according to the size of farm for the study. They were marginal, small and large size groups respectively. Farms of size ≤ 0.4 ha were classified as marginal, farm size between 0.4 and 1 ha were small and the large farm included those farms more than 1 ha in water spread area.

Multiple linear regression analysis was carried out to determine the technical input-output relationship of various fish farming practices. The following multiple linear regression function was specified in the present study:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$$

Where,

Y = Production of fish in kilograms

X_1 = Number of seed stocked

X_2 = Amount of lime used in culturing fish in kilograms

X_3 = Amount of fertilizer used in culturing fish in Kg.

X_4 = Amount of manure used in culturing fish in kilograms

X_5 = Amount of feed used in culturing fish in kilograms

X_6 = Number of labour (man days) used in fish culture.

e = Random error;

The coefficients of the model were estimated by the method of least squares.

RESULTS AND DISCUSSION

Different forms of composite fish culture models followed in CBV zone, Assam : The Composite fish culture system is a technology developed in India by the Indian Council of Agricultural Research in the 1970s, where 5-6 species of both local and imported fish species are cultured in a single fish pond (Dutta, 2011) Species

are selected according to feeding habits, so that they do not compete for food among themselves. As a result, the food available in all the parts of the pond can be utilized. Major species used in this system include catla and silver carp as surface feeders, rohu as column feeder and mrigal as well as common carp as bottom feeders.

There were three models of composite fish culture practiced in the study area. They are (a) Single stocking single harvesting (SSSH), (b) Single stocking multiple harvesting (SSMH) and (c) Multiple stocking multiple harvesting (MSMH).

In SSSH model fishes are stocked once in a culture year and harvesting is also done once. The culture period is during May to January approximately for a period of 8-9 months and then ponds are prepared for the next season. Water depth is the determining factor for SSSH model. Fish need good depth of water for growth but during the winter month water depth in the fish ponds are naturally less so the farmers completely harvest the fish.

In SSMH model, stocking is done once but harvesting is done several times in a year throughout the culture period. For this culture practice, fishes are overstocked (@10000 seed/ha) initially with different sizes of seeds in the culture pond and harvesting of those fishes are done when they attain table size (500 gm) after culturing 6-7 months. In this model, farmers try to maintain the water depth of the pond so that they able to culture fish year round the year with the technique mentioned above.

In MSMH model stocking as well as harvesting is done more than once a year. Important measures adopted for MSMH are stocking of yearlings by stunting the growth of fish seed during first year, restocking and performing multiple harvesting after the fishes attain a size of nearly 250-500 grams (Anon, 2010). In this form, fish farmers constantly maintain good water depth as well as water quality year round. Culture cycle starts during June-July months and partial harvesting of fish is done during October-November when fish attain a marketable size. After harvesting, same numbers of seeds are stocked in the pond. Again harvesting of fish of marketable size during February-March, restocking is done and cultured till next June-July.

Efficiency of culture practices adopted by the farmers of CBV zone, Assam : Multiple regression analysis to determine the technical efficiency of each

of the systems of farming practices were performed on the input-output relationships as practiced by marginal, small and large farmers. Besides these categories pooled analysis of all farming systems are discussed separately.

Marginal farmer: The results of the multiple regression analysis for different cultural system of marginal farmers are presented in the Table1.

Single stocking single harvesting : The model described 78.6% of the variation in the input-output relationship. Manure (0.434) was found to be contributing significantly and positively to increased production. Manuring enhances natural productivity which would enhance gross output and total income. The significance could also mean that within the existing input output relationships, amount of feed could be experimentally reduced to observed changes in gross output, thus indirectly contributing to lower costs and enhance income.

Single stocking multiple harvesting : The coefficient of multiple determinations (R^2) was 0.816 indicating that 81.6% of the variations in dependent variable are accounted for by the explanatory variables used in the model. The high R^2 with none of the independent variables being significant could be mean that the overall combination of the inputs contributes to gross output and thereby to income. An ideal production system could probably suggest such a relationship. But the fact that

the model itself is linear in nature limits the scope of this interpretation.

Multiple stocking multiple harvesting: The model explained 91.1% of the variation in the input-output relationship. A 1% increase in application of manure leads to a drop in gross output by 0.32% with manure use being significant at 5% level. A judicious use of manure could tone up total output to its ideal maximum in the given biophysical relationship with other inputs.

Small farmer: The results of the multiple regression analysis for different systems of fish culture of small farmers are presented in the Table 1.

Single stocking single harvesting: Owing to insufficient sample size of small farms adopting SSSH, the input-output relationships were not examined in a functional framework.

Single stocking multiple harvesting: The model described 49.7 per cent variation in the input-output relationship. Therefore as a system of culture among marginal farmers, the system yielded high R^2 , discussed above, considering the same as a system of culture as practiced by small farmers yielded only a low R^2 , therefore a larger sample of small farmers practicing SSMH could yield better results.

Multiple stocking multiple harvesting: Economies of scale seem to be an important factor especially in a MSMH environment. The intensity of operations

Table1. Determination of input-output relationship of the farming systems of the study area

	Marginal farmer			Small Farmer		Large farmer	Pool data		
	SSSH	SSMH	MSMH	SSMH	MSMH	SSMH	SSSH	SSMH	MSMH
Constant	0.675	2.73	3.066	5.4	0.526	0.346	0.322	0.580	0.410
Seed	0.00105 (0.178)	-0.109 (0.155)	0.039 (0.280)	-0.067 (0.175)	0.060 (0.096)	0.447* (0.203)	0.0037 (0.043)	0.016 (0.067)	0.024 (0.063)
Lime	-0.09624 (0.163)	0.014 (0.332)	-0.764 (0.414)	-0.106 (0.239)	0.333 (0.308)	-0.021 (0.152)	-0.057 (0.162)	0.239* (0.117)	-0.250 (0.169)
Fertilizer	0.0739 (0.07)	-0.041 (0.055)	-0.009 (0.095)	0.060 (0.112)	-0.083 (0.222)	0.030 (0.038)	0.241** (0.065)	-0.019 (0.036)	0.053 (0.104)
Manure	0.434* (0.021)	0.774 (0.039)	-0.316* (0.142)	0.182 (1.114)	0.042 (0.221)	0.200 (0.182)	-0.203* (0.094)	0.131 (0.095)	0.087 (0.098)
Feed	-0.1613 (0.192)	0.323 (0.223)	-0.191 (0.308)	-0.103 (0.119)	0.275 (0.307)	-0.211 (0.229)	0.151 (0.199)	0.046 (0.122)	0.242 (0.205)
Labor	1.529 (0.872)	1.359 (1.218)	1.487 (1.307)	-1.005 (1.716)	0.535 (1.388)	0.262 (0.238)	1.827** (0.464)	0.785* (0.272)	1.047* (0.473)
R^2	0.786	0.816	0.829	0.497	0.359	0.952	0.768	0.885	0.403
Multiple R	0.887	0.903	0.911	0.705	0.599	0.975	0.876	0.941	0.635
Regression MS	0.22989	0.05370	0.16654	0.019	0.056	0.257	0.938	1.729	0.285
Residual MS	0.03754	0.02423	0.03424	0.016	0.050	0.016	0.070	0.047	0.082
Adjusted R^2	0.658	0.448	0.659	0.066	0.039	0.893	0.710	0.861	0.287

Note: Parentheses indicates the respective Standard Error MS = Mean Square

* = Significant at 5% level of significance

** = Significant at 1% level of significance

requires a management of production activities at a professional level. In addition to the inadequacy of sample size, inclusion of non parameters would lend greater credence to the model. Here the overall relationship is explained only to the extent of 36 per cent which is unacceptable for a system evaluation.

Large farmer: Seed (0.447) emerged significant and positive in a SSMH system among large farmers. It can be seen that 95.2 per cent of the relationships are explained by the model. This underwrites our earlier contention that large farms enjoy economies of scale and are functionally more efficient in a management regime that demands intensive supervision and management to enable higher levels of efficiency.

Pooled analysis of all farming systems: The pooled analysis was performed for all farming systems irrespective of size of farms.

Single stocking single harvesting: The results indicate that 77 per cent of the variations in dependent variables were explained by the exogenous variables indicating a good fit of the model. The results obtained by multiple regression analysis in terms of data of the fish farmers of culture system followed in single stocking single harvesting revealed that fertilizer (0.241) and labor has highly positive significant impact on the production system at 1 per cent level.

Single stocking multiple harvesting : For SSMH the coefficient of multiple determinations (R^2) was 0.580 indicating that 58 per cent of the variations in independent variable are accounted for by the explanatory variables used in the model. Lime (0.239) and labor (0.785) had

positive coefficients and have significant impact on production system at 5 per cent level.

Multiple stocking multiple harvesting : This model for MSMH does not yield good results. Only 40 per cent of the variation in the gross output is explained by the independent variables. Under circumstances, labor is positive and significant at 5 per cent and contributes positively to total output. Since only 40 per cent of variation in output was described by the given independent variables so it can be concluded that a better relationship could emerge if more numbers of other independent variables are incorporated in the production function.

CONCLUSION

The results of the study revealed that technical efficiency of fish production in CBV zone ranges from 35.9 per cent to 95.2 per cent when farmers are classified under groups as marginal, small and large. Moreover, technical efficiency is found to be 40.3 per cent to 76.8 per cent when farmers were grouped according to farming system. In any case it is clear that there are substantial opportunities to increase productivity and income through more efficient utilization of productive resources. The study revealed that labour and fertilizer are positive significant factors influencing production in the CBV area. An effective allocation of labour and fertilizer will increase the productivity in case of different culture system.

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