



Evaluation of factors contributing to adoption of management practices productivity and net income in shrimp farming in Gujarat, India

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ABSTRACT

A study was conducted to identify the factors contributing to productivity and net income of shrimp farming in four districts of South Gujarat by randomly interviewing 129 shrimp farmers. The variables were identified hypothetically to arrive at the relationship between factors affecting the adoption of management practices, productivity and net income in shrimp farming. The data was analysed using analysis of variance (ANOVA), Pearson's correlation coefficients and multinomial logistic regression analysis. The fit of logistic regression was good for adoption and productivity. Cox and Snell pseudo R^2 for adoption and productivity were 32 and 42%, respectively. For adoption, likelihood ratio of education, social participation and use of own credit were significant. Use of own credit is the only factor responsible for a shift between low and high adoption score categories. The model predicted correct group of adoption score in only 61% of the cases with poor fit observed in high adoption score category. The results of the study indicate that higher productivity is possible only through infusing large credit flow and motivation to adopt better management practices.

Keywords: Adoption, Credit, Net income, Productivity, Social participation

Introduction

India with its vast brackishwater resources and congenial climatic conditions has good scope for increasing its annual shrimp production. The area under shrimp culture was observed to be stagnant during 1997 to 2007 at around 1,40,000 to 1,50,000 ha. In 2008-2009, the culture area drastically reduced to about 1,00,000 ha. Shrimp culture is an enterprise of small and marginal farmers with < 2 ha of farm size. About one lakh farmers in the country provide employment to over a million families. Higher wages aided increased family income and food security which led to socio-economic upliftment of coastal poor (MPEDA, 2006). Global consumption of seafood is increasing whilst the amount of fish captured is stable or declining, and it is aquaculture that is filling the shortfall (FAO, 2009). The success of shrimp farming depends on influence of various bio-physical socio-economic factors. The farmers invariably are concerned with higher productivity and net income which is possible only through adoption of better management practices. In this backdrop, a study was carried out to understand the critical factors influencing the productivity,

net income and adoption of management practices in shrimp aquaculture.

Materials and methods

The study was conducted in four districts of South Gujarat namely Valsad, Navsari, Surat and Bharuch during November-December 2009. About one-fifth (129) of the total shrimp farmers (612) were taken as respondents for conducting the study. The respondents were randomly selected and data were collected using pre-tested interview schedule. The variables were identified hypothetically to arrive at the relationship affecting the productivity (P), net income (NI) and adoption of farming practices.

The dependent or response variables studied were productivity, net income and adoption score derived from application of various management practices in tiger shrimp (*Penaeus monodon*) farming. The productivity and net income are direct quantitative variables while adoption score (AS) is derived from the adoption level in practices such as water filtration, use of reservoir pond, lime and manure application, water exchange, use of aerator and probiotics. The independent variables

considered under the study were age and education of farmer, farming experience, use of own credit, social participation, farm area owned and history of number of crop failures. The continuous independent variables have been converted to categorical variables by defining a class interval for continuous scale. ANOVA was used to study the significance of the influence of categorical socio-economic variables and adoption of farming practices on continuous dependent variables. The influence of only socio-economic factors was studied for adoption score.

In order to understand the influence of explanatory variables on the grouping of ponds into different categories of productivity, net income and adoption score, a multinomial logistic regression was carried out. The explanatory variables used for logistic regression were education level of farmer, nature of farm ownership, farm area, social participation, use of own credit, training undergone and information seeking from different sources. Age and farming experience were also considered as covariates.

Results and discussion

Average productivity of shrimp in Gujarat was only 377.80 kg ha⁻¹ in 1991-92. In 2009-10, shrimp culture was being undertaken in 3600 ha with an average productivity of 1645 kg ha⁻¹. The shrimp production from 1998 to 2009 is depicted in Fig. 1.

The productivity and net income are the direct outputs of adoption of different sets of management practices. These dependent variables in fact determine sustenance of shrimp farming. The highest productivity level recorded was 3500 kg ha⁻¹ (Ponnusamy *et al.*, 2010). With technological support from Brackishwater Fish Farmers Development Agency (BFDA) and facilitation of critical inputs like seed and feed, the production increased from 176 t in 1998-1999 to 3032 t in 2008-2009, registering a 17 fold increase during the past 11 years (Fig. 1).

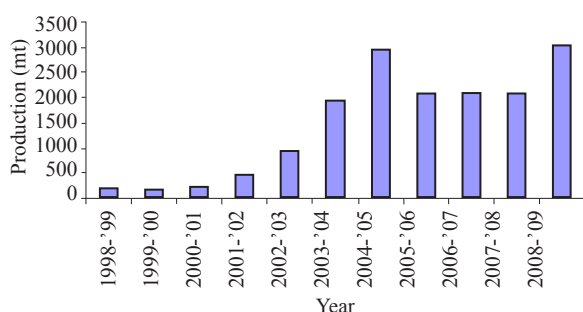


Fig. 1. Shrimp production in Gujarat from 1998 to 2009

Out of the total area of 89340.91 ha brought under shrimp farming, about 1.34 lakh t shrimp was produced at the rate of 1.5 t ha⁻¹ from one crop in a year. The higher tidal amplitude existing throughout the year and with well defined land lease policy and supportive approach of the state government, adoption of planning tools for the orderly growth of the sector, compliance to the guidelines of the Coastal Aquaculture Authority (CAA) and investment from private companies/entrepreneurs, Gujarat was able to progress well in the development of coastal aquaculture in a systematic manner to achieve sustainable growth.

Correlation coefficients were estimated among the continuous independent variables and dependent variables to understand the relationship existing between them (Table 1).

Table 1. Correlations among the continuous explanatory and response variables

Variables	Productivity	Net income	Adoption score
Age	-0.063	-0.125	0.024
Farm area	-0.015	0.030	-0.013
Distance from water source	0.193*	-0.098	0.051
Experience	0.062	-0.024	-0.047
Stocking density	0.160	0.024	0.169
Water exchange (DOC)	0.038	0.054	0.119
Productivity	1.00	0.141	0.235**
Net income	0.141	1.00	0.082

A positive and significant correlation was observed between productivity and distance from water source ($p < 0.05$) as well as adoption score ($p < 0.01$). Other variables such as age, farm area, experience of farmers, stocking density and net income did not show any influence on the identified response variables.

Higher shrimp productivity is possible by proper utilisation of various factors of production namely good drainable pond, quality seed, feed and additives and skilled labour. However, net income is determined by success of full crop and steady international market. Adoption of proper management practices help in achievement of higher productivity. These dependent variables are also subject to variation due to interplay of factors specific to regions, farming systems and incentives available for production.

Overall, the explanatory variables such as education level of farmer, nature of farm ownership, farm area, social participation, use of own credit, training undergone and information seeking from different sources gave a good fit for productivity and adoption score whereas the same explanatory variables gave a poor fit for net

income than null model. The stocking density upon successful crop provided reasonable net output. The higher productivity realised can be attributed to adoption of proper management practices.

It is inferred that, farmers holding larger area are likely to go for higher stocking density and intensive farming practices. Those availing credit for farming got significantly lower productivity which might be due to the low availability of funds for critical inputs of farming. In contrast, farmers with own strong credit base were more risk prone and were able to make high investments to increase the productivity. Similarly, the net income of those farmers using own funds was also high (Table 2). Adoption of various management practices was significantly influenced by farm area, use of own credit and social participation. Adoption score was significantly higher with farmers holding larger farm area and using own credit for farming. Incremental credit is in fact benefitting the same set of already credit-worthy farmers with new borrowers still struggling to secure credit. Most of these farmers are predictably big farmers with multiple sources of income, not relying wholly on risk-prone shrimp production. Therefore it may be concluded that, farmers with own credit for farming would be adopting more management practices which in turn lead to higher productivity and net income.

It is again inferred that risk taking and risk absorption of these farmers would contribute to higher productivity. Ganthimathi and Vanitha (2010) revealed that the financial institutions neglected small scale farmers due to fear of repayment. Hence, the repayment capacity of the farmers needs to be properly assessed, irrespective of the size of landholding. Adequate amount of investment loan has to be provided to the marginal farmers. Therefore institutional

finance like banks should be properly sensitised to provide indirect lending for aquaculture as they are doing for supportive infrastructure such as warehouses, cold storage, irrigation and rural electrification in agriculture.

Adoption studies in fish/shrimp production technology indicated that techno-socio-economically robust and obligatory technologies were willingly adopted (Gupta and Rab, 1994). The extent of knowledge possessed by farmers and successful demonstrations had directly aided in adoption of aquaculture technologies (Ahmed *et al.*, 1995; Gupta *et al.*, 1998) and inadequate information and farm management skills prevented the adoption of farm management practices (Pretty, 1995). Studies have proved that effective and coordinated extension of best management practices helped to enhance the sustainability of aquaculture (Christopher *et al.* 2003; Bolorunduro *et al.*, 2004) and socio-economic factors were found to have maximum influence on the adoption of shrimp culture technologies (Betru, 1997; Carlson and Dillmon 1998; Meeran, 2000; Swathilekshmi *et al.*, 2005).

The parameter estimates for education and use of own credit were positive implying that higher education and not availing credit increases the likelihood of a case falling under higher productivity category compared to low productivity category. Higher education of respondents would lead to high level of information seeking from different sources. Shrimp farming is such an occupation where adequate investment would provide better returns. The key variable influencing the adoption of the aquaculture technologies is the extent of knowledge possessed by farmers. Farmers who were better informed and those with a higher level of understanding of the aquaculture technology had greater chances of adopting the technology. The strategy that has emerged to be effective in promoting the adoption of aquaculture

Table 2. p-values from ANOVA performed to study the significance of the influence of independent variables on dependent variables

Independent variables	Productivity	Net income	Adoption score
Age	0.797	0.336	0.833
Education	0.053	0.557	0.869
Experience	0.176	0.669	0.840
Use of own credit	0.002	0.035	0.005
Social participation	0.582	0.762	0.006
Farm area	0.008	0.375	0.026
Water filtration	0.175	0.171	-
Reservoir	0.952	0.213	-
Lime	0.946	0.211	-
Manure	0.386	0.185	-
Water exchange	0.418	0.265	-
Aerator	0.052	0.350	-
Probiotic	0.226	0.561	-
Failure of crops	0.065	0.505	0.147

technologies is to develop a technology relevant to the needs and resources of the farm households through onfarm research and consultation with farmers, which must further be supported by intensive information dissemination and training schemes (Ahmed *et al.*, 1995).

Productivity is significantly influenced by all the explanatory variables taken in the model except education level of farmer and social participation. The present data set could not explain significant amount of variability within the response variable, net income (Table 3). The net income as explained earlier is direct outcome of prevalent international market. The pseudo R² values for productivity, net income and adoption score were 42.4, 19.2 and 31.8% respectively.

score categories respectively were predicted correctly by the explanatory variables fitted in the regression model. A large number of cases in low and medium adoption score categories could be predicted to correct category whereas cases in high adoption score category were assigned to correct group with little success. Use of own credit is the only variable that significantly influenced the assignment of a case to low or high adoption score categories. The parameter estimate for use of own credit was positive implying that not availing credit increases the likelihood of a case falling under higher adoption score category compared to low adoption score category. It is again proved that a farmer is to be supported with capability to invest in farm operations in order to facilitate him to adopt most of the management practices for achieving

Table 3. Influence of explanatory variables on productivity, net income and adoption

Explanatory variables	Likelihood ratio test (p-value)		
	Productivity	Net Income	Adoption score
Age	0.005	0.433	0.325
Farming experience	0.010	0.175	0.168
Education level of farmer	0.092	0.694	0.030
Nature of farm ownership	0.006	0.191	0.600
Farm area	0.026	0.381	0.309
Social participation	0.735	0.566	0.010
Use of own credit	0.021	0.119	0.049
Training undergone	0.049	0.171	0.524
Information seeking	0.047	0.538	0.823
Cox and Snell Pseudo R ² value (%)	42.4	19.2	31.8
Likelihood ratio test for model fit (p-value)	0.000	0.490	0.008
Prediction of correct group membership	58.9 %	-	61.2 %

About 66, 51 and 61% of the cases in low, medium and high productivity categories respectively were predicted correctly by the explanatory variables fitted in the model. The cases in high productivity category have got higher chances of correct prediction than medium and low productivity categories. The variables *viz.*, education, farm area and use of own credit have got significant influence in shifting a case between low and high productivity categories. The parameter estimate for farm area was negative indicating that possessing low farm area (<5 ha) decreases the likelihood of a case falling under high productivity category against low productivity category.

Adoption score is significantly influenced by education level of farmer, social participation and use of own credit as evidenced by significant likelihood ratio test statistic. Successful adoption often depends on a favourable confluence of technical, economic, institutional and policy factors (CIMMYT, 1993; Feder, *et al.*, 1985; Ponnusamy and Gupta, 2006). About 67, 79 and 18% of the cases in low, medium and high adoption

higher productivity. Since most of the farmers in India belong to small and medium category, their investment has to be further strengthened with support from sources of institutional finance. A strong policy support in this direction is required to motivate the farmers.

Credit emerged as a prime factor for getting higher productivity in view of its significant role to invest in quality seed and feed, adoption of bio-security measures and farm infrastructure. Net income of a farmer is highly volatile subject to successful crop and international market price for shrimp produce. It is necessary to infuse large amount of finance including insurance in order to attain higher productivity and adoption of proper management practices. Aquaculture being an allied enterprise to agriculture, it can be treated at par with agriculture in terms of credit, taxation of income, energy charges and water tariff due to the similar characteristics of resource use pattern and importance in providing food and nutritional security to coastal poor. The unregulated growth in shrimp farming has led to many ecological and socio-economic problems in the coastal regions. Policy encouragement is needed

for adoption of better management practices (BMPs) and other guidelines through appropriate incentive structures in conjunction with training, monitoring and enforcement of regulations. Planners can give adequate support for integration of aquaculture development planning with rural development to achieve multi-sectoral development of coastal regions. The farmers club model of National Bank for Agriculture and Rural Development (NABARD) and cluster based commodity groups model of Agricultural Technology Management Agency (ATMA) should be encouraged to adopt better farming practices and to enable the small scale aqua farming groups to get loan and avail insurance wherein the public sector banks can monitor these groups as part of the institutional mechanism.

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