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Adoption of Improved Aquaculture Technologies in Tripura, India

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Abstract

The study was undertaken in the state of Tripura to identify the constraints in adoption of improved fish culture practices under aqua-model village scheme implemented by Department of Fisheries, Govt. of Tripura during 2004-05 to 2010-11. By using multistage stratified random sampling, data were collected from 80 farmers each from the adopted and non-adopted villages respectively. It was found that the extent of adoption of improved practices in aquaculture farms of adopted villages was significantly more than that of non-adopted villages. Correlation and regression analysis between socio-economic parameters and adoption indices revealed that education and training played an important role in adoption of improved aquaculture technologies. Using Rank Based Quotient (RBQ), constraints faced in adopting the improved aquaculture technologies were also documented.

Keywords: Aqua-model village, adoption index, fish culture, constraints, RBQ

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Introduction

It is a well established fact that improvements in efficiency are more cost effective than introducing new technology if the producers are not efficient in the use of the existing technology (Dey et al., 2000). If the producers are reasonably efficient, then new inputs and technology would be required to shift the production frontier upward (Ali & Chaudhary, 1990; Ali & Byerlee, 1991). Fish production can be increased either by increasing area under fish culture or by increasing productivity or by both. Scope for horizontal expansion by means of expanding area under fish culture is relatively less practicable in the small hilly state like Tripura. Besides, average fish productivity in the state during 2004-05 from culture fisheries was very low (about 2324 kg ha^{-1} yr^{-1}) in comparison to potential yield of 3000 kg ha^{-1} yr^{-1} (Government of Tripura, 2011a). This indicates the existence of opportunity to increase fish production by improving the efficiency in fish production. For the purpose, the state developed an area based comprehensive fisheries development programme in the name of aqua-model village scheme to improve the efficiency in fish production and launched it during 2004-05 to make the state self-sufficient in fish production by 2011-12 (Government of Tripura, 2008). Under this scheme, at least one aqua-model village was proposed to be developed in each rural development block of the state. It was aimed at improving efficiency in fish culture by imparting improved fish culture technologies to fish farmers. By the end of 2010-11, 42 villages were developed in the state as aqua-model village by the Department of Fisheries (Government of Tripura, 2011b). Under the scheme, farmers were mobilized and made aware about the improved scientific package of practices through a series of awareness and training programmes. The technologies were demonstrated in their ponds to convince them about the benefits of improved technologies. The extent of adoption of those practices is a matter of great concern for the authorities or policy makers in the state. This paper aimed to analyse the extent of adoption of improved aquaculture technologies under the scheme and constraints if any faced by farmers in adopting those practices.

Materials and Methods

From all the four districts of Tripura, West Tripura district was selected purposively for the study, as the district accounted for the highest number of (17 out of total 42) aqua-model villages developed and also because of the highest area (40.48% of total) developed under the scheme in the state. From the district, two sub-divisions having highest area under fish culture were selected and from each of the selected sub-division, two blocks having highest area under fish culture were selected using 'with' and 'without' concept, *viz.*, from each of the selected block, one aqua-model village and one non aqua-model village was selected. The villages in which aqua-model village scheme was implemented will be mentioned as adopted villages and others as non-adopted villages in the paper. While selecting the adopted villages, care was taken to select those villages where the scheme was started in initial years in order to ensure adequate time for the adoption of practices. Non-adopted villages were selected in such a way that villages were similar as far as aquaculture was concerned and at least 10 km away from the adopted villages so that there was no impact of the scheme in the area, as control to compare with the adopted villages. A sample of 20 fish farmers was selected from each of the selected (adopted and non-adopted) villages. Thus, a total of 80 farmers each were selected from the adopted and non-adopted villages respectively which made a total of 160 sample farmers. The primary data related to practices followed by fish farmers were collected through personal interview method using specially structured and pre-tested questionnaires. The data pertained to the agriculture year 2010-11.

To assess the impact of aqua-model village, adoption indices of recommended aquaculture practices were developed using the procedures given by Raheja et al. (1987). To identify the factors influencing adoption of improved package of practices, correlation and regression analysis was carried out (Talukdar, 2000). In the analysis, overall adoption index was taken as dependent variable, while age, education, occupation, training, training duration, experience in fish culture, land holding and annual income were taken as independent variables. Constraints faced by farmers were ranked using the formula given by Sabarathnam (1988).

Results and Discussion

To know the extent of adoption of the recommended scientific fish culture practices, composite adoption indices were estimated and presented in Table 1. It is evident from the table that the composite adoption index was 66.05 for adopted villages which was significantly higher than that of the non-adopted villages (43.15). This indicates that the farmers of adopted villages were more aware about the scientific aquaculture practices than the non-adopted villages. This may be also due to the fact that farmers of adopted villages were more endowed with resources for adopting scientific fish culture practices. Further, it becomes clearer when practice-wise indices were compared that in adopting most of the improved aquaculture practices like liming, application of cow dung, urea, single super phosphate and mustard oil cake, farmers of adopted villages were far ahead of the farmers of non-adopted villages. This reflects the impact of the scheme on adoption of different practices across the farms of adopted villages. Adoption indices show that adoption was the highest for seed stocking (109) followed by mustard oil cake (86.1), urea (61.79), cow dung (59.29), liming (57.36), pond preparation (33.75), single super phosphate (26.81 and pelleted feed (8.55).

Table 1. Composite adoption indices of recommended aquaculture practices

Practices	Adopted villages	Non-adopted villages
Pond preparation	33.75**	23.75
Seed stocking	109*	114.90
Liming	57.36**	38.12
Cow dung	59.28*	12.73
Urea	61.79*	23.10
Single super phosphate	26.81*	3.17
Pelleted feed	8.55^{NS}	4.03
Mustard oil cake (MOC)	86.10*	28.89
Composite adoption index	66.05*	43.15

**significant difference at 1% level of significance; *significant difference at 5% level of significance and ^{NS} non-significant difference

Adoption indices of different practices in non-adopted villages shows that adoption was highest for seed stocking (114) followed by liming (38.12), mustard oil cake (28.89), pond preparation (23.75), urea (23.1), cow dung (12.73), pelleted feed (4.03) and single super phosphate (3.17). The adoption indices for seed stocking was found more than 100 in both the cases, which might be due to the fact that stocking of fish seed was more than recommended in both adopted and non-adopted villages. Comparison of seed stocking by farmers of both the villages indicate, improved adoption of fish seed stocking in adopted villages. Besides, there was improvement in adoption of all the practices in adopted villages over non-adopted villages. This may be also due to the fact that under the aqua-model village scheme, farmers were trained and mobilized which resulted in better adoption of improved aquaculture technologies in adopted villages compared to non-adopted villages. This finding is in conformity with the results reported by Biswas et al. (1991).

In both the adopted and non-adopted villages, occupation, experience, land holding and annual income showed non-significant association with level of adoption of improved package of practices whereas education, training and training duration were positively and significantly correlated (Table 2). Only the age of farmers was found to have negative and significant correlation with the adoption level of farmers in both the villages. Education enables the farmers to have an effective understanding of the improved technology and finally leads to adoption of the technology. The positive and significant relationship of education with level of adoption is in consonance with the findings of Mercikutty (1997) and Balasubramaniam et al. (2009). Training of farmers for longer duration and exposure to improved technologies will increase the level of adoption. Observation of Singh et al. (2002) and Kappen & Thomson (2009) also confirm the above findings.

The R^2 value of regression indicated that all the eight variables taken together caused only 63% and 73% of variation in the adoption level in adopted and non-adopted villages respectively (Table 2). The 'F' value in the multiple regression analysis for both the cases revealed the overall significance of influence of eight independent variables when taken together in explaining the extent of adoption of improved fish culture practices by the fish farmers of both adopted and non-adopted villages. It can be predicted that keeping other factors constant, one unit change in the independent variable of education, training and training duration found to have significant role in the adoption of the scientific fish culture practices in both the cases. Further, the analysis revealed that a unit change in the 'education' level, *ceteris paribus*, would result in corresponding change in the level of adoption of improved package of practices by farmers of adopted villages by 0.118 units and in the case of non-adopted villages by 0.124 units. Thus unit change in training and training duration will lead to corresponding change by 0.516 and 0.040 in the case of adopted villages and for non-adopted villages, this corresponding change will be 0.339 and 0.165 respectively. These results also support the study of Talukdar & Sontaki (2005) wherein they have concluded that, education and training play significant role in adoption of composite fish culture

Table 2. Correlation and regression analysis between the socio-economic variables and composite adoption indices of the fish farmers

Variables	Adopted villages				Non-adopted villages			
	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
Age	-0.441*	0.008	0.007	1.148	-0.394*	0.007	0.004	1.101
Education	0.323*	0.118	0.053	2.218*	0.351*	0.124	0.063	2.414*
Occupation	0.014^{NS}	0.209	0.163	1.284	0.173^{NS}	0.091	0.087	1.450
Training	0.452*	0.516	0.139	3.726*	0.510*	0.339	0.102	3.308*
Training duration	0.253**	0.040	0.015	2.738*	0.243**	0.165	0.008	1.962*
Experience	0.139^{NS}	0.000	0.008	0.062	0.016^{NS}	0.007	0.007	0.916
Land holding	0.118^{NS}	-0.122	0.110	-1.101	0.137^{NS}	-0.140	0.084	-1.668
Annual income	-0.023^{NS}	0.451	0.323	-1.396	-0.059^{NS}	-0.336	0.138	-2.429*

For adopted villages R^2=63% ; F= 4.93* and for non-adopted villages R^2=73%; F= 5.30*
**significant at 1% level of probability and *significant at 5% level of probability; S.E = standard error, ^{NS} non-significant

practices. The regression value of annual income for farmers of non-adopted villages indicates that one unit increase in annual income, *ceteris paribus*, would result decrease in level of adoption by 0.336 unit and vice-versa. This might be due to the fact that when their annual income increases, their profession divert from agriculture based towards business oriented.

Six major constraints were identified and that constraints in stocking was the major constraint faced by fish farmers in both the adopted (83.95%) and non-adopted (77.91%) villages (Table 3). In adopted villages, constraints in stocking was followed by constraints in feeding (78.54%), management (55.41%), pond preparation (51.66%), pond construction (48.75%) and others (31.66%) whereas, in non-adopted villages, constraints in stocking was followed by constraints in pond preparation (64.58%), feeding (61.66%), pond construction (60.00%), management (55.41%) and others (29.58%). These major constraints were further investigated in detail for better understanding.

Construction of pond as per recommendation (size of 1 acre and minimum 1.5 meter depth) is important to enhance the fish productivity. Constraints faced in adopting the package of practices for pond construction by the famers in adopted and non-adopted villages are shown in Table 4. Farmers of adopted villages, ranked topography of the land (60.00%) as major constraint in pond construction, while in non-adopted villages, the situation was different, and farmers faced lack of credit facilities (70.62%) as the major constraint. Mohanty et al. (2011) and Talukdar & Sonatki (2005) also ranked the topography of land and poor economic condition of fish farmers as the major constraints faced by fish farmers during construction of new ponds.

Every year, pond preparation requires sun drying, liming and manuring for obtaining optimum yield. In adopted villages, major constraints faced by the farmers in adopting these practices was lack of time (66.45%) followed by high cost (62.91%), whereas the major constraints faced by farmers of non-adopted villages was lack of knowledge (77.50%), followed by possibility of losing present stock available in pond (64.58%). Mohanty et al. (2011) also identified lack of knowledge as major constraint under pond preparation. In case of adopted villages, it was observed that lack of knowledge of farmers was not the major constraint under pond preparation which may be the result of adequate training in the area under the scheme.

Farmers of both adopted and non-adopted villages faced several constraints in adopting stocking with seeds of appropriate quality, size and number. The major constraint faced by the farmers was lack of quality seed (71.66% in adopted and 71.25% in non-adopted villages). In the case of adopted villages, this was followed by high mortality (65.00%), and transportation difficulty (61.80%), whereas in non-adopted villages, lack of quality seed (71.25%) was followed by non availability of local source of seed (68.33%). Use of manufactured feed in aquaculture indicates modernization or advancement of aquaculture practices. Farmers of both the adopted and non-adopted villages faced several constraints in adopting recommended practices for feeding. Lack of quality feed (74.28%) was the major constraint followed by transportation (71.25%), in adopted villages whereas, in non-adopted villages, lack of proper knowledge about feed (72.67%) was the major constraint followed by high price (66.42%).

In addition to the constraints listed above, farmers also reported several other constraints. Under this

Table 3. Rank of constraints identified by farmers in adopting package of practices across adopted and non-adopted villages

Constraints in relation to	Adopted village		Non-Adopted village	
	RBQ	Rank	RBQ	Rank
Pond construction	48.75	V	60.00	IV
Pond preparation	51.66	IV	64.58	II
Stocking	83.95	I	77.91	I
Feeding	78.54	II	61.66	III
Management	55.41	III	55.41	V
Others	31.66	VI	29.58	VI

Table 4. Frequency of RBQ value and rank for constraints related to each practices

Problems	Adopted village		Non-adopted village	
	RBQ	Rank	RBQ	Rank
Pond construction				
Lack of credit facilities	58.33	III	70.62	I
Scarcity of labour	58.95	II	55.62	III
Topography of land	60.00	I	51.25	IV
High cost	53.33	V	57.29	II
Poor economic condition	53.75	IV	44.79	V
Pond preparation				
Lack of knowledge	51.87	IV	77.50	I
Ponds being rain-fed	45.00	V	42.50	V
Lack of time	66.45	I	52.50	III
High cost	62.91	II	45.00	IV
Possibility of losing present stock available in pond	62.70	III	64.58	II
Stocking of fish seed				
Lack of quality seed	71.66	I	71.25	I
Local source of seed	47.63	VI	68.33	II
High mortality of seed	65.00	II	62.77	III
Distance of source	49.72	V	36.80	VIII
Price fluctuation	50.41	IV	54.72	V
Transportation difficulty	61.80	III	42.91	VII
Non availability of appropriate size	46.25	VII	57.36	IV
Timely availability of seed	44.58	VIII	46.25	VI
Feeding				
Lack of quality feed	74.28	I	65.53	III
High price	49.64	V	66.42	II
Lack of proper knowledge	44.46	VI	72.67	I
Distance of feed industry	62.50	IV	36.25	VII
Transportation	71.25	II	51.60	V
Local availability of feed	65.53	III	59.28	IV
Poor economic condition	32.32	VII	48.21	VI
Management				
Poaching	66.25	I	64.44	III
Poisoning	63.61	II	76.38	I
Weed infestation	61.66	III	65.97	II
Poor extension services	57.63	V	50.83	IV
Disease	58.33	IV	50.13	V
Scarcity of labour	53.75	VI	48.75	VI
Poor productivity of ponds	39.86	VIII	47.08	VII
Lack of time	45.83	VII	40.27	VIII
Others				
Poor marketing facilities	75.31	I	64.37	II
Non availability of finance	64.68	II	52.81	III
Lack of sufficient training	47.18	III	72.50	I

category, poor marketing facilities (75.31%) was reported as the major constraint followed by non availability of finance (64.08%) and lack of sufficient training (47.18) in adopted villages whereas, in non-adopted villages, lack of sufficient training (72.50%) was the major constraint followed by poor marketing facilities (64.37%) and non availability of finance (52.81%). The constraint regarding training is more severe in non-adopted villages which may be due to fact that farmers of adopted villages were more trained compared to farmers of non-adopted villages. Abraham et al. (2010) ranked disease incidence as major problem in management, as perceived by the farmers of Andhra Pradesh and West Bengal.

The study showed that the aqua-model village scheme has improved farmers' awareness on improved package of aquaculture practices. Das (2012) has also observed the same while working on impact of aqua-model village scheme of Tripura on fish production. If the constraints are effectively resolved, it is expected to reap full potential of aquaculture in the state. The capacity building of hatchery owners and seed producers in quality seed production will go a long way in enhancing the quality of fish seed and ultimately fish production in the state.

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