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TILAPIA (*OREOCHROMIS NILOTICUS*) PRODUCTION CONSTRAINTS IN BANGLADESH: B. TECHNOLOGICAL CONSTRAINTS

Eleventh Work Plan, Sustainable Development and Food Security Research 2B (11SDFR2B)
Final Report

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ABSTRACT

Tilapia was introduced to Bangladesh in 1954. Culture of this species is still in its infancy compared to neighboring countries, including Indonesia, the Philippines, Thailand, and Vietnam. Despite many positive culture attributes of tilapia, culture in Bangladesh may be constrained by different technical, socio-economic, and institutional factors. Some attempts have been made by the Department of Fisheries, Bangladesh Fisheries Research Institute, and Bangladesh Agricultural University over last decades to develop production technology and disseminate this through their own channels. However, production levels failed to increase despite reasonably high prices for tilapia. In order to better understand the causes of this problem, we reviewed published literature on tilapia in Bangladesh and conducted a nation-wide survey of farmers. The survey was designed to identify factors that constrain adoption of this species. Results indicated several technological and socioeconomic constraints impeding the adoption of tilapia culture in this country. Among the technological constraints, the perceptions were that this is difficult technology, there is not appropriate technical information and technical support, there is poor quality of seed, seed is limited in availability and high price, and that feed is also limited in availability.

INTRODUCTION

In Bangladesh, the current stock of Nile tilapia was introduced by the UNICEF in 1974, and later, in 1987 by the Bangladesh Fisheries Research Institute (BFRI), from Thailand (Gupta et al., 1992). Despite several attempts made by BFRI, Department of Fisheries (DOF) and Bangladesh Agricultural University (BAU) during the last two decades, adoption of this species has not expanded. Routine field monitoring indicates that low performance in the adoption of tilapia could be explained by a number of technical, socioeconomic, and institutional constraints.

This study was an attempt to identify the underlying technical and socioeconomic constraints to the adoption of tilapia, as well as to help formulate appropriate policy guidelines for promotion of this species.

The objectives of this study were to:

1) Map the geographic pattern of tilapia production;

2) Identify specific constraints impeding tilapia production; and

3) Formulate appropriate policy guidelines and suggest research priorities to reverse the identified constraints.

METHODS AND MATERIALS

Farm households were taken as primary sources of data, and sample households were selected from five major fish growing geographic locations of the country. The locations included Mymensingh, Dhaka, Chittagong, Jessore, and Patuakhali.

A combination of data collection techniques was adopted, which included literature review, observational tours, key informant interviews, group discussion, and a questionnaire survey. The whole study was divided into three phases: exploratory, qualitative, and quantitative.

The exploratory study phase was begun by extensive literature search and observational tours to map the geographic extent of tilapia production. Review of relevant reports, project documents, and journals helped determine the impact of different interventions on tilapia production. Several observational tours to the Ministry of Fisheries and Livestock, DOF, BFRI, BAU, major carp and tilapia hatcheries, private tilapia seed firms, and tilapia production areas helped identify key actors and issues to be explored during the qualitative study phase.

The qualitative study phase involved in-depth interviews and group discussions with key informants from relevant institutes as well as tilapia farmers. Checklists were developed and used to guide interviews and discussions, which covered important issues such as existing status of tilapia research, seed production and distribution, development and dissemination of production technology, input supply, marketing mechanisms, and linkages between formal and informal knowledge networks in relation to tilapia production. An institutional survey was also conducted by mailing a semi-structured questionnaire to all District Fishery Officers of the country in order to obtain their perception on relevant issues, particularly those related to successes and constraints for tilapia production under existing technological and socioeconomic contexts.

The quantitative study phase used a questionnaire to quantify the findings of the qualitative phase. A semi-structured questionnaire was developed covering a wide range of variables including demographic and socioeconomic characteristics of respondents, farm production and management practices (particularly those related to fish farming), linkage of respondents to relevant public and private sectors, perceived potentials and constraints faced by the respondents, and suggestions for improvements. The questionnaire was revised and finalized through pre-testing in selected locations. A total of 30 households from each study location was selected and 150 households were used for analysis. In each of the five study locations, selection was intentionally done to include 15 households each from peri-urban (within 10 km of the district headquarters) and rural (beyond 15 km of the district headquarters) areas. The 15 households were also divided into three categories: tilapia producers in 2003, former tilapia producers who had abandoned culture by 2003, and non-tilapia producers (Table 1).

Within given areas, household surveys were done using the random walk method, and households were interviewed at certain fixed intervals in order to optimize the representation in desired categories. The survey was conducted from the second week of November 2003 until the last week of February 2004.

Both qualitative and quantitative data were collected from primary and secondary sources. Interpretation was carried out by content analysis (Holsti et al., 1968). Quantitative data were analyzed using Statistical Package for Social Science (SPSS), Version 11.0 software.

Demographic, socioeconomic, and farm-related variables, such as age, household size, gross annual income, total landholding size, farming experience, and major components of farming systems were recorded in numerical terms, then converted into categorical variables suitable for statistical tests. Some variables, including perceptions about constraints, were recorded as categories using a Liken scale. In correlation analysis, categories were converted into scores to fit ratio scales from zero to one (Shivakoti et al., 1999).

RESULTS

Tilapia research studies have been conducted with *Oreochromis mossambicus*, *Oreochromis niloticus*, red tilapia (mutant of *O. mossambicus* x *O niloticus*) and Genetically Improved Farmed Tilapia (GIFT). Studies have examined the distribution of tilapia (Ireland et al., 1999), extensive and semi-intensive culture of tilapia (Hussain et al., 1989; Gupta, 1992; Islam et al., 1992; Kohinoor et al., 1996), integrated rice-fish farming (Haroon et al., 1992; Ali et al., 1999), integrated poultry-fish farming (Ali et al., 1995; Samsuzzaman, 2002), cage culture (Haque et al., 1984; Hasan et al., 1985; Shahjahan et al., 1998; Hussain et al., 2000), culture with marine fish (Hossain et al., 1997), comparative performance among tilapias (Kohinoor et al., 1999; Hussain et al., 2000), comparative performance with other fish species (Haroon et al., 1992; Hasan et al., 1997; Sayed et al., 1999), fertilization and feeding in tilapia culture (Gupta, 1992; Islam et al., 1992), genetic evaluation (Hussain et al., 2000), and proximate composition of tilapias (Ahmed et al., 1981).

Seventeen major technical and socioeconomic constraining factors were identified for tilapia adoption. These were grouped into five major categories—physical resources, technology, support services, market and financial, and environmental constraints. From these five categories eight factors were included in the techni-

cal category (Table 2). As expected, TAT had significant negative correlations with technological difficulty, lack of technical information, lack of technical support, poor quality seed, limited availability and high price of seed, poor quality of feed, limited supply of feed, and high price of feed.

The majority of fish farms (85%) reported some difficulty with tilapia production technology, ranging from "to some extent" to "very important" (Table 3). Only 15 percent of fish farms reported that tilapia production was "not at all" difficult. There was a significantly high and negative correlation between TAT and difficult tilapia production technology in all of Bangladesh as well as in peri-urban and rural settings. Hence, difficulty associated with tilapia technology was identified as one constraining factor for TAT.

DoF, BFRI, and BARC were the main agencies involved in production and distribution of extension materials on extensive and semi-intensive tilapia culture. Farmers had difficulty understanding extension materials for tilapia. This has resulted in 64% of farms adopting traditional production technology and 48% of farms using subsistence and commercial technology (Table 4).

The majority (60%) of fish farms used non-formal sources of information, such as private hatcheries or neighbors and relatives to obtain technical information, whereas only 19–29% of farms used formal sources such as DOF and BFRI (Table 5). Formal sources of technical information were not used by most fish farms (71–81%). There was a negative and statistically significant association between TAT and limited availability of technical information in entire and peri-urban Bangladesh ($P < 0.01$; Table 2). However, the availability of technical information was a less significant factor in rural Bangladesh. This may be due to recent public and NGO focus on rural areas as targets for available technical information and services.

More than 81% of fish farms reported lack of technical support as an important or very important constraining factor for TAT (Table 6). There was also a negative and highly significant correlation between TAT and lack of technical support in entire, peri-urban and rural Bangladesh (Table 2).

Poor seed quality was considered a constraining factor to TAT by nearly all respondents (98%; Table 7). The problem with seed quality was also evidenced by a negative and significant correlation between TAT and seed quality in entire, peri-urban, and rural Bangladesh (Table 2). Poor quality seed might be due to difficulty associated with pre-stocking management in seed production.

Private hatcheries were the main sources of tilapia seed (Table 8). Few fish farms obtained seed from government hatcheries and a few used seed from their own farms. Non-availability of seed was identified as a highly significant constraining factor for TAT (Table 2), indicating that private hatcheries were not keeping pace with demand.

The majority of fish farmers reported high seed price as one constraining factor for TAT (Table 9). About 73 percent of fish farms reported seed price as an important to very important factor in their choice to culture tilapia. A Chi-square test showed significant differences among the importance of seed prices for various categories of fish farms.
Fish farmers' also reported that high seed price constrained TAT. Farmers generally spent between 100 and 200 Tk per kg of seed, with 63% of fish farms listing their prices between 100 and 150 Tk (Table 10). Correlation between TAT and high seed price was negative and highly significant (Table 2).

DISCUSSION

Bangladesh has potential for tilapia culture but currently is far behind many other countries in production. Several technical constraints to production were identified by our analysis. Similar constraints may prevail in other countries in South Asia. One perceived constraining variable to tilapia adoption was difficult technology. The perception that tilapia culture is difficult may be due to the knowledge among farmers that neighboring countries obtain higher production levels than Bangladeshi farmers. However, production technology for tilapia is relatively simple, and extension of current knowledge should be able to resolve this dilemma.

Lack of adequately trained extension services has led to the perceived constraint in lack of technical support. Moreover, reluctance of DOF to support tilapia culture has contributed to the slow pace of technology adoption. If the production is to increase, there needs to be greater support from public institutions not only to provide technical services but also research studies to adapt this technology to Bangladesh.

Tilapia are prolific breeders. Quantity of seed has not been a problem, but quality of seed from hatcheries has been questioned. Poor seed quality could be due to poor stock management and crossbreeding with *O. mosambicus*. Poor quality seed was identified as a significant constraining factor in entire and rural Bangladesh. Quality seed is important to good tilapia production. Poor quality seed is invariably linked with the lack of technical knowledge in seed production procedures. Hatchery operators in Bangladesh need to learn about tilapia, since they are quite different from major carps that hatcheries have traditionally cultured.

Limited availability of seed does not mean lack of quantity but rather lack of availability when needed. Early spring is when seed is in high demand in Bangladesh. Lack of seed during this time prevents farmers from stocking ponds. During this time, price of seed climbs several fold higher than at other times of year. This could be the reason for their perception that high price of seed is an obstacle to stocking tilapia. While monosex tilapia is desirable, even the best hatcheries claim only 60–80% males. Slow growth due to overpopulation is likely another reason for dissatisfaction with the quality of seed.

Skill training as well as contacts with private hatcheries, DOF and BFRI for technical information could have a significant influence on TAT. Such training should be encouraged to enhance tilapia production. Private hatcheries were the most commonly used source for technical information. Arrangements could be made to strengthen private hatcheries through technical backstopping on innovations, establishing a functional linkage with research centers, and making provisions for regular refresher training.

In a resource-limited country, there will always be shortage of ingredients for quality fish feed. However, in semi-intensive systems, tilapia do not require feeding. Therefore, feed should not be limiting factor to semi-intensive tilapia production in Bangladesh. When supplementary feeding is necessary, plant protein sources could be used, with major ingredients from agricultural wastes and feed. CRSP experiences with optimum production models for tilapia using fertilizers and supplemental feed need to be evaluated in Bangladesh.

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Table 1. Distribution of sample households.

Location	Number of Households						
	Pre-Urban			Rural			
	Tilapia Producer	*Former Producer*	*Non-Tilapia Producer*	*Tilapia Producer*	*Former Producer*	*Non-Tilapia Producer*	*Total*
Mymensingh	5	5	5	5	5	5	30
Dhaka	5	5	5	5	5	5	30
Chittagong	5	5	5	5	5	5	30
Jessore	5	5	5	5	5	5	30
Patuakhali	5	5	5	5	5	5	30
Total	25	25	25	25	25	25	150

Table 2. Correlation between tilapia adoption trend and technological constraints.

Factor	Correlation Coefficient		
	Whole Country (n=150)	*Peri-Urban* (n=75)	*Rural* (n=75)
PRODUCTION TECHNOLOGY			
-Difficult Technologies	-0.650**	-0.853**	-0.479**
-Lack of Technical Information	-0.859**	-0.935**	-0.882**
-Lack of Technical Support	-0.750**	-0.757**	-0.866**
-Poor Quality Seed	-0.759**	-0.721**	-0.871**
-Limited Availability of Seed	-0.780**	-0.817**	-0.867**
-High Price of Seed	-0.836**	-0.869**	-0.875**
TILAPIA FEED			
-Poor Quality Feed	0.121	0.091	0.168
-Limited Supply of Feed	-0.253**	-0.357**	-0.176
-High Price of Feed	-0.560**	-0.624**	-0.589**

**Significant at 0.01 confidence level; * Significant at 0.05 confidence level

Table 3. Farmers' response on the difficulties in technology for tilapia culture.

Farm Category	Number of Respondents					Percent
	Not At All	*To Some Extent*	*Important*	*Very Important*	*Total*	
Current Tilapia Producers	16	34	0	0	50	33.3
Former Tilapia Producers	3	27	20	0	50	33.3
Non Tilapia Producers	3	6	16	25	50	33.4
Total	22	67	36	25	150	100
Percent	14.7	44.7	24	16.7	100	

Table 4. Levels of production technology adopted by the tilapia farmers.

Production	Number of Farms	Percent	Categorical Percent
PRODUCTION TECHNOLOGY			
Traditional	32	21.3	64.0
Semi-Intensive	18	12.0	36.0
Total	50	33.3	100.0
PRODUCTION MODE			
Subsistence and Commercial	24	16.0	48.0
Commercial	26	17.3	52.0
Total	50	33.3	100.0

Table 5. Sources of technical information available to the tilapia farmers.

Source	Frequency	Percent
DEPARTMENT OF FISHERIES		
No	106	70.7
Yes	44	29.3
BANGLADESH FISHERIES RESEARCH INSTITUTE		
No	121	80.7
Yes	29	19.3
PRIVATE HATCHERY		
No	62	41.3
Yes	88	58.7
NEIGHBOR OR RELATIVES		
No	60	40
Yes	90	60

Table 6. Farmers' response to importance of the lack of technical support.

Farm Category	Number of Respondents				Percent
	To Some Extent	*Important*	*Very Important*	*Total*	
Current Tilapia Producers	26	22	2	50	33.3
Former Tilapia Producers	3	43	4	50	33.3
Non Tilapia Producers	0	1	49	50	33.4
Total	29	66	55	150	100
Percent	19.3	44	36.7	100	

Table 7. Tilapia producers' opinions toward problems with poor quality seed.

Farm Category	Number of Respondents					Percent
	Not At All	*To Some Extent*	*Important*	*Very Important*	*Total*	
Current Tilapia Producers	3	24	22	1	50	33.3
Former Tilapia Producers	0	0	42	8	50	33.3
Non Tilapia Producers	0	0	7	43	50	33.4
Total	3	24	71	52	150	100
Percent	2	16	47.3	34.7	100	

Table 8. Farmers' main access to various sources of tilapia seed.

Source	Frequency	Percent
LOCATION		
Others	38	76
Own Farm	12	24
Total	50	100
HATCHERY OWNERSHIP		
Private	38	76
Government	12	24
Total	50	100

Table 9. Farmers' responses to the high seed price categorized by type of farmer.

Factor	Current Tilapia Producers	Former Tilapia Producers	Non Tilapia Producers	Total	Percent	Chi-Square Value
Not At All	6	0	0	0	0	187.283**
To Some Extent	39	2	0	41	27.3	
Important	11	45	7	63	42	
Very Important	0	3	43	46	30.7	
Total	50	50	50	150	100	

** Significant at 0.01 confidence level.

Table 10. Farmers' perception regarding seed prices for tilapia.

Price (Tk/kg)	Frequency	Percent	Valid %
<100	15	10	32.6
100-150	29	19.3	63
>150	2	1.3	4.3
Total	46	30.7	100

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