Diffusion and Adoption of Shrimp Farming Technologies

Kumaran. M, Ponnusamy. K and N. Kalaimani

Central Institute of Brackishwater Aquaculture(CIBA),
75, Santhome High Road, Chennai-600 028, India.

Shrimp culture has had a long tradition in India and began with the tidal stocking of shrimp in paddy fields and lagoons along the backwaters and subsequent holding of them until harvest. Known locally as shrimp/prawn filtration, this traditional farming method is still practiced as a major cultural activity in the states of Kerala and West Bengal and also in limited areas in Karnataka and Goa with a production of 150-200kg/ha for sustenance[1]. Congenial conditions such as availability of unutilized coastal land, successful transfer of hatchery technology, increased export demand and opening up of the economy in 1990s led to the rapid expansion of commercial intensive shrimp aquaculture. Shrimp farming area increased from 65,100 ha in 1990-91 to 145,906 ha in 2000-2001 and correspondingly production of shrimp increased from 35,500 tonnes to 97,096 tonnes (Table 1) during the same period[2].

Shrimp aquaculture suffered a serious setback in the mid 1990s due to viral disease that caused heavy losses and the industry is in the process of reviving. Farmers need timely advice for the maintenance of proper water and soil conditions to ensure the survival and growth of shrimp and also in disease management. To understand the nature of diffusion and adoption of shrimp farming practices, an investigation was taken up in Nagapattinam district of Tamil Nadu, India that is one of the shrimp farming "hot spots" along the east coast. Tamil Nadu is blessed with 56,000 ha of potential land for brackishwater aquaculture.

A sample of 30 farmers was proportionally selected from three creeks in the study area viz., Vettar, Kaduviar and Vellaiyar creeks for the study. Open-ended questions were used to find out the diffusion process. Seventeen farming practices were included covering the entire gamut of shrimp farming as suggested by the Subject Matter Specialists to study adoption. Adoption Quotient and Extent of Adoption as a whole for each individual practice were calculated by using the following formulae.

$$\text{Adoption Quotient} = \frac{\text{No. Practices adopted by the respondent}}{\text{Total No. Practices}} \times 100$$

$$\text{Adoption} = \frac{\text{No. respondents who had adopted the practice}}{\text{Total number of respondents}} \times 100$$

Ten socio-personal variables were studied to understand the profile of farmers and the extent of adoption. The data were collected by employing a well-structured and pre-tested interview schedule. Mean, percentage and correlation statistics were used for analysis and interpretation.

Profile of shrimp farmers

The findings of the study reported in Table 3 revealed that majority of the respondents (57%) were less than 40 years of age and two thirds had collegiate and above level of educational status (67%). The innovative and high profit nature of the enterprise could have attracted young and highly educated people. Most of the respondents (67%) had other occupations in addition to shrimp farming possibly due to the risk and cost intensive nature of shrimp enterprise. About eighty per cent had a farm size of less than four hectares. More than half of the respondents (57%) had at least five years of farming experience. Almost all the farmers were practicing improved extensive farming of *Penaeus monodon* (Tiger shrimp) with a stocking density of 3-5 post larvae/m^2.

The annual income of most of the respondents was less than Rs. 25,000 due to failure of culture in earlier crops because of disease outbreak. The majority of the respondents (60%) availed credit from banks or private moneylenders. Farmers were aware of extension agencies of organizations associated with shrimp aquaculture, but most of the respondents had limited contacts with them. Most had a medium to high degree of mass media exposure. They were of the opinion that aquacultural programmes are very rare in mass media channels. Most of the respondents were members of the Nagapattinam Aqua Farmers Association (NAFA). Fellow farmers and feed company representatives were the prime sources of information. Similar findings are reported by others[4].

Diffusion of shrimp farming practices

About 80% of the respondents said that fellow farmers were their primary source of information due to their familiarity, easy accessibility and trustworthiness. Feed retailers/ representatives were the most important source of information (67%) for all technical matters like seed and stocking, feed and supplementary feeding, water quality management, health, harvest and marketing. The input dealers/traders employed biology graduates as field technicians/assistants who had undergone training in shrimp farming. These field technicians regularly visited their customer shrimp farms to provide all necessary technical assistance.

Studies on mariculture practices and extension needs of shrimp farmers conducted in Kerala and Andhra Pradesh respectively revealed similar findings[5].

Among the institutional sources available, the Brackishwater Fish Farmers Development Agency (BFDA) (53.33%) and Marine Products Export Development Authority

Table 1: Shrimp farming by State in India: Area under culture and production

State	Estimated Potential Area (ha)		90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01
West Bengal	4,05,000	A	33,815	33,918	34,050	34,150	34,400	34,660	42,605	42,525	42,067	41,980	42,210
		P	12,500	13,800	16,300	16,500	25,000	23,445	19,949	15,121	18,326	21,780	21,079
Orissa	31,600	A	7,075	7,417	7,760	8,150	8,500	11,000	11,332	11,332	8,000	9,000	7,423
		P	4,100	3,800	4,300	3,300	4,800	6,000	6,805	5,000	6,000	3,400	7,360
Andhra Pradesh	1,50,000	A	6,000	8,100	9,500	19,500	34,500	50,000	80,249	88,290	71,000	83,930	74,226
		P	7,350	9,700	12,800	26,000	34,000	27,140	30,577	34,075	44,856	46,270	53,100
Tamil Nadu	56,000	A	250	480	530	1,050	2,000	2,879	640	670	1,087	1,882	2,537
		P	450	700	1,100	2,000	3,000	1,092	1,129	1,197	1,820	2,940	3,792
Pondicherry	800	A	Neg.	Neg.	Neg.	Neg.	Neg.	37	22	22	22	-	-
		P	Neg.	Neg.	Neg.	Neg.	Neg.	10	27	20	27	-	-
Kerala	65,000	A	13,000	13,145	13,400	13,860	14,100	14,657	14,658	14,595	14,705	14,470	14,743
		P	8,925	9,500	9,750	11,500	12,000	9,000	8,225	7,290	7,660	7,150	7,327
Karnataka	8,000	A	2,500	2,542	2,570	2,600	3,500	3,500	3,500	3,540	3,564	3,635	2,975
		P	1,000	1,100	1,500	1,500	2,500	2,050	2,300	2,640	2,690	2,890	2,733
Goa	18,500	A	525	525	550	575	600	650	650	650	650	770	929
		P	245	300	350	400	450	550	580	590	590	840	966
Maharashtra	80,000	A	1,800	1,869	1,980	2,180	2,400	716	929	970	426	533	422
		P	800	930	1,050	300	400	740	523	700	409	390	315
Gujarat	3,76,000	A	125	231	360	475	700	884	997	997	316	447	442
		P	125	170	200	500	700	546	572	235	256	340	424
Total	11,90,900	**A**	**65,100**	**68,227**	**70,700**	**82,540**	**100,700**	**118,983**	**135,582**	**141,591**	**141,837**	**156,647**	**145,906**
		P	**35,500**	**40,000**	**47,000**	**62,000**	**82,850**	**70,573**	**70,686**	**66,868**	**82,634**	**86,000**	**97,096**
Average kg/ha			**545**	**586**	**665**	**751**	**823**	**593**	**521**	**472**	**583**	**549**	**666**

Source: MPEDA A=Area under culture in ha P = Estimated production in MT Neg. = Negligible

Table 2: Shrimp farming in Tamil Nadu

Name of district	Area (ha)	Production (t)
Thiruvallur	353	100
Kancheepuram	133	150
Villupuram	97	135
Cuddalore	815	535
Nagapattinam	1483	1585
Tiruvarur	75	150
Thanjavur	514	235
Pudukkottai	230	140
Ramanathapuram	978	485
Thoothukudi	488	50
Tirunelveli	16.35	3
Kanyakumari	6.11	3
Total	**5,193**	**3,571**

Source : Report, Department of Fisheries, Government of Tamil Nadu[3].

Table 3: Personal profile of farmers (Variables) (% of Farmers, n=50)

Age	
Up to 40 years	57
Above 40 years	43
Education	
SSLC/H.Sc	33
Graduate and above	67
Occupation	
Aquaculture alone	33
Aqua+Others	67
Farm Size	
Up to 4ha	80
Above 4 ha	20
Experience	
Upto 5 years	57
Above 5 years	43
Annual income	
< Rs. 25,000	93
> Rs. 25,000	7
Credit	
Obtained	60
Not Obtained	40
Extension contact	
Low	40
Medium	40
High	20
Mass media exposure	
Low	13
Medium	60
High	27
Social participation	
Low	7
Medium	33
High	60

(MPEDA) (40%) were the better-utilized sources. This may be because of the fact that MPEDA is the promoter of shrimp farming and provider of subsidies and training in the initial stages of commercial shrimp farming and BFDA is the extension agency of the state department of fisheries located in the study area and it is the nodal agency to prepare projects, study its feasibility, help in site selection, farm construction and recommend for subsidies/insurance provided by the government & banks and arrange for license issued by the Aquaculture Authority. Some progressive farmers were subscribers of aquaculture journals like Aqua Star, Fishing Chimes, reports /guides from feed companies etc., and they in turn become the source of information to others (40%). Around one fifth of the respondents reported that research institutions (20%) and consultants (16.67%) were their information sources. The farmers were of the view that the research institutions and government departments were difficult to access hence they were unable to utilize them effectively for technical information.

Adoption of Shrimp farming practices

Among the 17 practices covered, it was observed that the farmers of Nagapattinam were following the scientific practices at a higher adoption level (Table 4). About 87% of the farmers had high adoption while only about 13% had low or medium level of adoption. This is mainly due to their awareness and technical guidance from the input dealers. Excluding the non-adoption of effluent treatment plants owing to their small size of holdings other practices have been variedly adopted. All farmers had adopted pond preparation, stocking of hatchery produced and disease checked seed, sampling and biomass estimation and application of quality pelleted feed practices. This may be due to the fact that the above-mentioned practices are prerequisite for successful culture. Barring a few most of them (87%) had adopted improved

Table 4: Extent of adoption of shrimp farming practices

Extent of Adoption	Percentage of farmers
Low	6.67
Medium	6.67
High	86.66

extensive farming. Most did not measure pond parameters such as temperature, PH, transparency, biological oxygen demand and dissolved oxygen regularly. They were of the view that is not necessary to measure these parameters strictly with lower stocking densities (3-5 larvae/square meter).

Most of the farmers adopted the recommended water quality management measures (80%), molting precautions (73.33%), application of probiotics (76.67%), precautions to prevent diseases (76.67%) and post harvest operations (90%) like icing and grading and had contacts with institutional organizations promoting shrimp farming (63.33%). The farmers (93.33%) had not adopted discharge water treatment plants (Table 5). Practices with lesser adoption included site selection and pond construction, optimum pond parameters, duties of a responsible farmer and contact with institutional sources of information because of lack of technical help and service laboratories. It is evident that the farmers were very receptive to the technological advancements and refinements. But there is a general lack of technological support from the government agencies mainly due to inadequate field level staff. The farmers were fully dependent on feed technicians of feed companies who may sometimes mislead the farmers due to their business interests.

Correlation analysis

In order to understand the nature of relationships between farmers' profile characteristics and their extent of adoption correlation analysis and Student T Test was conducted (Table 6). Out of 10 variables taken for analysis social participation alone had a significant (at 5% level) positive relationship with farmers' extent of adoption. It is obvious that the farmers who were members of local institutions like NAFA will have the opportunity to interact with farmers of adjacent shrimp farming area and members of various organizations working with shrimp farming and know more about shrimp farming practices. Therefore, it is understood that the profile characteristics of shrimp farmers (age, education, occupation, farm size, farming experience and contact with extension agency) had no obvious influence over their extent of adoption of farming practices.

Suggestions for improvement and conclusion

This study reveals that the shrimp farmers surveyed in Nagipattinam relied on their peers and feed retailers/ technicians for technical information. They had adopted most of the improved shrimp farming practices that are indispensable. They depend on feed technicians whose motivation is mainly to sale of their products. In general the farmers are very receptive for adoption but there is a general lack of dissemination of information from government agencies. Based on these findings the following suggestions are made for strengthening institutional Transfer of Technology (TOT) systems and sustainable shrimp production:

- Evolution of a transfer of technology mechanism involving R & D systems and extension system of the state governments and farming community is the need of the hour since research institutions may not able to reach all the clients (Research - Extension (State Departments of Fisheries) - Clients) effectively like the state fisheries personnel due to their location and minimum staff strength.
- Organizing farmers into vibrant groups, that take care of forward inputs and backward assistance for their members. Even credit, insurance and licenses may be issued only to the group, which is responsible for everything and facilitates sustainable aquaculture in multiple aspects. Financial assistance may be given to such groups for developing infrastructure like constructing wastewater treatment plants, storage facilities etc.
- Areas suitable for shrimp farming in coastal belts may be converted as aquaculture parks or estates with active private sector involvement in line with the industrial parks

or estates with all forward (seed, inputs, credit, health clinic, labs, training) and backward (market, processing, storage) linkages.
- Education of farmers on responsible aquaculture employing personal, group and mass contact extension methods. Adequate attention may be given for Mass Media in TOT.
- Formulation of an aquaculture policy that regulates as well as promotes sustainable aquaculture.

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Table 5: Adoption of Shrimp farming technologies

Practices	% of farmers adopted
Site selection and Pond construction	57
Pond preparation (Liming, manuring etc.)	100
Type of farming	87
Stocking of hatchery seed	100
Stocking of disease checked seed	100
Optimum pond parameters	40
Water quality management	80
Sampling and biomass estimation	100
Molting precautions (Feed & water)	73
Quality feed	100
Feed quantity estimation based on biomass	60
Application of pro biotic (Feed, Water & soil)	76
Discharge water treatment plant	7
Precautions of white spot virus disease	77
Duties of a registered shrimp farmers	27
Post harvest operations	90
Contact with institutional information sources	63

Table 6: Relationship between farmers' personal profile and their extent of adoption

Variable	Correlation coefficient
Age	0.0328
Education	0.0184
Occupation	-0.0355
Farm size	-0.0516
Farm type	-0.0274
Credit behaviour	0.2474
Annual income	0.0649
Mass media exposure	0.2023
Extension agency contact	0.0531
Social participation	**0.3548 ***