PERCEPTION OF ATTRIBUTES OF SHRIMP FARMING TECHNOLOGIES BY SHRIMP FARMERS

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During the last decade, shrimp aquaculture has become a major sector of fish farming in terms of space occupied and of market value. In India, commercial shrimp farming started gaining roots only during the mid eighties. The boom period of commercial scale shrimp culture in India started in 1990 and the bust came in 1995-96, with the outbreak of viral disease.

Most of the important technologies in shrimp farming such as feed management, water management and health management were developed in the mid 1990's and were transferred to the target community only after 1995.

The adoption of technological innovations in shrimp farming have an important say in contributing to increased and sustained shrimp production in the country. The attributes of a given innovation act as a stimuli and their perception by individual influences his adoption behaviour (Rogers, 1962). Whereas there is no dearth of literature on the attributes influencing the adoption of agricultural innovations, similar studies in fisheries particularly in shrimp farming sector are lacking. Hence the present study was undertaken with the following objectives.

1 To study the adoption behaviour of shrimp farmers.

2 To study the perceived attributes with respect of shrimp culture technologies.

Materials and Methods

The research work was carried out in the Nellore district of Andhra Pradesh State. Out of the three blocks selected in Nellore district, two villages from each block were selected randomly. Employing random sampling procedure 10 shrimp farmers from each village were selected to form a total sample of 60 shrimp farmers. The sampling method followed was multi stage random sampling.

A total of 12 attributes of innovation were selected using judges ranking. The selected 12 attributes of innovations were used as independent variables in order to study the perception of the shrimp farmers of these attributes with respect to the adoption of each of the 12 selected shrimp culture technologies. The perception of all the 12 attributes with respect to each shrimp culture technology was measured by assigning the scores of 5,4,3,2,1 for positive criteria and a score of 1,2,3,4,5 for negative criteria, based on the responses received from the shrimp farmers on a five-point continuum ranging from strongly agree to strongly disagree.

The dependant variable studied was the adoption behaviour of the shrimp farmers for selected 12 shrimp farming practices starting from pond preparation till harvest. The adoption behaviour was measured using the adoption quotient developed by Balasubramaniam (1988).

$$\text{Adoption quotient} = \frac{\sum_{j=1}^{m} \left\{ \frac{ej}{Ej} x\, Wj \right\}}{\sum_{j=1}^{m} Wj} x\, 100$$

ej= Extent of adoption of jth practice in terms of magnitude

Ej= Potentiality for adoption of jth practice in terms of magnitude

Wj= Weightage assigned to jth practice

M= Number of applicable practices

Σ = Summation

Step wise multiple regression analysis (Step down procedure) was used to find out the attributes which were found to influence the extent of adoption of each shrimp culture technology most, in order of their priority.

Results and Discussion

It could be observed from Table 1 that practices such as Harvesting, Pond bottom conditioning, and Pond bottom sterilization accorded a high rate of extent of adoption, in the order of 98.90, 98.30 and 98.30 per cent respectively. Next in order of extent of adoption was Acclimatisation and stocking of fry (92.30%), followed by Liming of pond (90.00%).

Table 1
Adoption behaviour of shrimp farmers

(n = 60)

S.No.	Shrimp farming practices	Adoption quotient (in %)
1	Pond bottom conditioning	98.30
2	Pond bottom sterilization	98.30
3	Measurement of soil pH	49.60
4	Liming the pond	90.00
5	Use of predator eradication	87.20
6	Manures and fertiliser application	73.60
7	Acclimatisation and stocking of fry	92.30
8	Water management	61.30
9	Soil management	74.80
10	Feed management	86.10
11	Health management	65.30
12	Harvesting	98.90

Adoption of predator eradication and feed managment was done by 87.20 percent and 86.10 percent farmers respectively.

These findings are in agreement with the findings of Kumaran *et al.* (2003) who reported that cent percent of the farmers had adopted pond preparation, stocking of hatchery produced disease, checked seed and application of quality pelletted feed practices as these were pre requisite for successful culture. It was further observed from the table that 74.80 percent of the respondents were adopting soil managment practices and 73.60 percent of the respondents were adopting manure and fertiliser application.

Health management and water management was adopted by 65.30 percent and 61.30 percent of the respondents. Among the practices which accorded a very low rate of adoption (49.60%) was measurement of soil pH. This might have been attributed to the reason that measurement of soil pH was taken up mostly in new farms.

With respect to Health management, the use of chemicals such as immunostimulants was adopted by a negligible percent of respondents, on account of its high cost.

In order to find out the attributes which influence the extent of adoption of shrimp culture technologies most, in order of priority, the step wise multiple regression analysis was done and the results are presented in the following tables.

It could be observed from Table 2 that of the 12 attributes studied the attributes such as multiple advantage, cost and immediacy of returns were found to exert a positive and significant influence on the extent of adoption of pond bottom conditioning.

Table 2

Step-wise multiple regression analysis of perception of attributes with the extent of adoption of pond bottom conditioning (Technology I)

(n = 60)

S.No.	Explanatory variable attributes	Regression co-efficient	Standard error	t-value
1	Multiple advantage (X12)	0.617	0.021	2.90**
2	Cost (X7)	0.149	0.047	3.197**
3	Immediacy of returns (X3)	0.07	0.027	2.574*
4	Constant	2.423	0.114	21.31**

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 15.33^{**}$ $R^2 = 0.45$

$\hat{Y} = 2.423 + 0.617 X 12 + 0.149 X 7 + 0.07 X 3$

With respect to the attribute, Multiple advantage, it is observed that the adoption of the technology namely pond bottom conditioning has multiple advantages such as eradication of predators, degradation of organic matter in the pond soil and promotion of plankton growth.

With respect to the attribute immediacy of returns it was observed that adoption of pond bottom conditioning promoted overall health

and hygiene of the pond, contributing to a healthy crop and ensuring immediacy of returns.

With respect to perception of cost, it was observed that an increase in cost would in turn lead to an increase in adoption of this technology. It might be because pond bottom conditioning is a practice which is routinely used for proper maintenance of health and hygiene of the pond, and hence farmers' extent of adoption of this technology namely pond bottom conditioning would continue to increase, despite an increase in the cost.

Further it could be observed from the table that the R^2 value was 0.45 and that the f value was highly significant. This thereby means that the three selected attributes namely multiple advantage, cost and immediacy of returns together were able to explain 45 percent of variation in the extent of adoption of pond bottom conditioning by shrimp farmers of Nellore.

A perusal of Table 3 shows that the regression co-efficient was positive and significant for the perception of the attributes namely immediacy of returns and input availability. Use of pond sterilization materials such as burnt lime kills pathogenic organisms ensuring a healthy disease free crop which fetches immediate returns. Besides easy availability or

Table 3

Step-wise multiple regression analysis of perception of attributes of technology on the extent of adoption of pond bottom sterilization (Technology II)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Immediacy of returns (X3)	0.181	0.045	4.024*
2	Input availability (X8)	0.119	0.051	2.330*
3	Constant	1.709	0.277	6.167**

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

F = 112.061** R^2 = 0.30

$\hat{Y} = 1.709 + 0.181 X 3 + 0.119 X 8$

pond sterilization input materials such as lime influences the adoption of the technology namely pond bottom sterilization. Further it could be seen from the table that the R^2 value was 0.30 and that the f value

was highly significant. Thus the two selected attributes were able to explain 30 percent of the variation in the extent of adoption of pond botton sterilisation. Thus it could be inferred that the extent of adoption of pond bottom sterilisation could be positively influenced by increasing the perception of the attributes namely immediacy of returns and input availability.

It would be observed from Table 4 that of the 12 attributes studied only one attribute namely feasibility was found to exert a positive and significant influence on the extent of adoption of measurement of soil pH. This might have been due to the fact that for measurement of soil pH materials such as pH paper are relatively easier to obtain, the possibility of getting more expensive instruments such as the pH meter by small and marginal farmers is lesser when compared to big and corporate shrimp farmers.

Table 4

Step-wise multiple regression analysis of perception of attributes of technology with the extent of adoption of measurement of soil pH (Technology III)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Feasibility (X2)	0.204	0.031	6.665**
2	Constant	0.692	0.123	5.167**

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 44.424^{**}$ $R^2 = 0.434$

$\hat{Y} = 0.692 + 0.204 X 2$

Further it could be seen that the R^2 value was 0.434 and that the f value was highly significant. Further the atrribute feasibility explained 43.40 percent of the variation in the extent of adoption of measurement of soil pH.

A perusal of Table 5 revealed that only one attribute namely the cost of technology had a negative and significant influence on the extent of adoption of lime. This might be due to the fact that of all the inputs used in shrimp culture, the input lime was relatively cheapest among the other inputs like seed, feed and chemicals. This finding reveals that the extent of adoption of lime would continue to increase, despite an increase in its price, since lime is the cheapest of inputs and it is

also indispensable for maintaining the health and hygiene of the culture pond. Besides it could be further observed from the table that the R^2 value was 0.08 and that the f value was highly significant. Thus the attribute namely cost of technology was able to explain eight percent of the variation in the extent of adoption of lime.

Table 5

Step-wise multiple regression analysis of perception of attributes of Shrimp culture with the extent of adoption of lime application (Technology IV)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Cost of technology (X7)	0.211	0.094	2.252
2	Constant	1.764	0.420	4.204

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 5.073^{**}$ $R^2 = 0.080$

$\hat{Y} = 1.764 + 0.211 X 7$

An observation of Table 6 reveals that the attributes physical compatibility and cost of technology had influenced the extent of adoption of predator eradicators. Predator eradication consists of screening of water through sluice gates and application of chemicals in the pond to kill the predators. This technology was found to be consistent with the past experiences and present needs of the farmer. Hence physical compatibility was found to influence the extent of adoption of predator eradicators.

Table 6

Step-wise multiple regression analysis of perception of attributes of technology with the extent of adoption of predator eradicators (Technology V)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Physical compatibility (X10)	0.287	0.095	3.027*
2	Cost of technology (X7)	0.280	0.131	2.145
3	Constant	2.454	0.265	9.245**

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 5.073^{**}$ $R^2 = 0.140$

$\hat{Y} = 2.454 + 0.287 X 10 + 0.280 X 7$

With respect to the cost of the technology it may be explained that predator eradicators are relatively costly and hence an increase in the cost of this technology would result in a corresponding decrease in the extent of its adoption. Besides the incidence of occurrence of predator eradicators was lesser in the study area. Further it could be inferred that these two variables explained 14 percent of the variation in the extent of adoption of predator eradicators. It could be seen from Table 7 that only two attributes namely feasibility and trialability were found to have a positive and significant influence on the extent of adoption of manures and fertilizers. This could be attributed to the easy availability of inputs such as fertilizers which are easily available with the feed dealers who were adequately distributed in the study area. Hence the feasibility or possibility of getting manures and fertilizers was very high for the shrimp farmers. Besides this technology was also found to be trialable, and permitted the experimentation of the manures and fertilizers on an limited basis.

Table 7

Step-wise multiple regression analysis of perception of attributes of technology with the extent of adoption of manures and fertilizers (Technology VI)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Feasibility (X2)	0.535	0.068	7.829**
2	Trialability (X11)	0.247	0.109	2.260**
3	Constant	-0.976	0.487	-2.005

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 38.131^{**}$ $R^2 = 0.572$

$\hat{Y} = 0.976 + 0.535\ X2 + 0.247\ X11$

It could be further seen that the attributes feasibility and trialability were able to explain 57.2 percent of the variation in the extent of adoption of manures and fertilizers.

A perusal of Table 8 revealed that only three attributes namely multiple advantage, cost of technology and immediacy of returns were found to influence the extent of adoption of acclimatisation and stocking of fry.

It could be observed that the perception of the attribute namely immediacy of returns was found to maintain a negative and significant

influence on the extent of adoption of acclimatisation and stocking of fry. The adoption of this technology ensures a successful crop harvest only at the end of the harvest and hence the returns obtained by adoption of this technology is not immediate. With respect to the attribute multiple advantage it was observed that the technology of acclimatisation and stocking of fry has multiple advantages such as maintenance of proper growth of shrimp, elimination of competition for space, feed and oxygen, helps to maintain a clean condition of the pond and also helps to keep diseases under check.

Table 8

Step-wise multiple regression analysis of perception of attributes of Technology with the extent of adoption of acclimatization and stocking of fry (Technology VII)

(n = 60)

S.No.	Explanatory variable attributes	Regression co-efficient	Standard error	t-value
1	Multiple advantage (X12)	0.062	0.021	2.898*
2	Cost of technology (X7)	0.149	0.049	3.197*
3	Immediacy of returns (X3)	0.070	0.027	-2.574*
4	Constant	2.423	0.114	21.312**

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 15.33$ $R^2 = 0.451$

$\hat{Y} = 2.423 + 0.062 \times 12 + 0.149 \times 7 - 0.070 \times 3$

Similarly an unit increase in the perception of the attribute, cost will lead to an corresponding increase in the extent of adoption of this technology since farmers would continue to adopt the technology, as it is a pre requiste for obtaining a sucessful crop.

It could be further observed from the table that the selected attributes namely multiple advantage, cost of technology and immediacy of returns were able to explain 45.10 percent of the variation in the extent of adoption of acclimatization and stocking of fry.

With respect of Table 9, it could be observed that of the 12 attributes studied, the attributes such as feasibility, perceived risk and profitablity have influenced the extent of adoption of the technology namely water management. The technology of water management is perceived as feasible since the source of water used for shrimp culture in the study area is mainly bore water which is relatively free of disease born

organisms and the water management becomes more easier. The profitability of this technology was also found to influence the extent of adoption of water management, since failure to maintain good water quality results in shrimps becoming stressed and vulnerable to diseases, which would inturn reduce the overall possibility of profits to be obtained by the shrimp farmers.

Table 9

Step-wise multiple regression analysis of perception of attributes of technology with the extent of adoption of water management (Technology VIII)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Feasibility (X2)	0.204	0.035	5.758*
2	Perceived Risk (X4)	-0.127	0.040	3.174*
3	Profitability (X5)	0.168	0.056	3.024*
4	Constant	0.107	0.240	0.447

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 38.357^{**}$ $R^2 = 0.673$

$\hat{Y} = 0.107 + 0.204\ X2 - 0.127\ X4 + 0.168\ X5$

It could be noticed from the table that the attribute namely perceived risk was negatively influencing the extent of adoption of water management. This could be because the recommended frequency of water exchange once in 10 days from the third month of culture onwards has the increased risk of spread of disease, through water pumped from the creek (water source) and hence this possibly explains the resultant decrease in the extent of adoption of water management.

Further it could be seen from the table that these three attributes were able to explain 67.30 percent of the variation in the extent of adoption of water management.

A perusal of Table 10 revealed that only two attributes namely immediacy of returns and cost of technology have a positive and significant influence on the extent of adoption of soil management. Soil management is an important technology which is essential for conditioning of soil, maintenance of soil pH and ensuring the cleanliness of pond which are essential for healthy growth of shrimps. Hence adoption of this practice ensures immediacy of returns, at the end of

the crop harvest. Further, it could be observed from the table that these two attributes together explained 31.01 percent of the variation in the extent of adoption of soil management.

Table 10

Step-wise multiple regression analysis of perception of attributes of tehnology with the extent of adoption of soil management (Technology IX)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Immediacy of returns (X3)	0.151	0.042	3.572*
2	Cost of technology (X7)	0.143	0.042	3.418*
3	Constant	1.101	0.226	0.226*

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

F = 12.870** R^2 = 0.311

$\hat{Y}$ = 1.101 + 0.151 X3 + 0.143 X7

It could be observed from Table 11 that out of the 12 attributes studied the attributes such as feasibility, efficiency, cost of technology, and physical compatibility had a positive and significant influence on the extent of adoption of feed management.

Table 11

Step-wise multiple regression analysis of perception of attributes of technology with the extent of adoption of feed management (Technology X)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Feasibility (X2)	0.436	0.088	4.975*
2	Efficiency (X1)	0.302	0.104	2.905*
3	Cost of technology (X7)	0.3745	0.119	3.140*
4	Physical compatibility (X10)	0.176	0.081	2.177*
5	Constant	2.165	0.578	3.746

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

F = 19.547** R^2 = 0.587

$\hat{Y}$ = 2.165 + 0.436 X2 + 0.302 X1 + 0.3745 X7 + 0.176 X10

Feeds in the form of imported feed, imported with Indian collaboration, as well as purely Indian feed are available with a large number of feed

dealers which makes the feed easily available to the shrimp farmers, and hence this attribute namely feasibility has influenced the extent of adoption of feed management.

The effectiveness of feed management as perceived by the shrimp farmers has influenced the adoption of this technology since it involves the use of feeding charts, feeding trays, and bio estimation methods. It could be observed from the table that cost was found to positively influence the extent of adoption although shrimp feed constitutes 70 percent of the investment in shrimp culture. This might have been due to the fact that shrimp feed is given to farmers on a credit basis by the feed dealers.

Besides the attribute physical compatibility was perceived by the shrimp farmers to positively influence the adoption of the technology as this technology was perceived to be consistent with the past experiences and the present needs of the shrimp farmers.

Besides it could be observed that all the four attributes together explained 58.70 percent of the variation in the extent of adoption of feed management.

An observation of Table 12 revealed that attributes such as feasibility and multiple advantages were found to influence the extent of adoption

Table 12

Step-wise multiple regression analysis of perception of attributes of tehnology with the extent of adoption of health management (Technology XI)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Feasibility (X2)	0.285	0.063	4.540*
2	Multiple advantage (X12)	0.278	0.086	3.253*
3	Constant	1.206	0.325	3.707*

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 26.664^{**}$ $R^2 = 0.483$

$\hat{Y} = 1.206 + 0.285\ X2 + 0.278\ X12$

of health management. Health management practices such as screening of shrimp seeds for presence of virus using polymerase chain reaction are easily available in private hatcheries as well as those of

the government like MPEDA (Marine Products Export Development Authority). Hence the feasibility of this technology namely health management has influenced its extent of adoption.

It could be inferred from the table that an increase in perception of multiple advantage would in turn increase the extent of adoption of health managment. This was because the technology namely health management combines the use of several other technologies such as the incorporation of feed supplements, and water management. Further it could be seen that these two attributes together explained 48.30 percent of variation on the extent of adoption of health managment.

Further perusal of Table 13 indicates that the attribute observability exerts a positive and significant influence on the extent of adoption of the technology namely harvesting. This might be due to the visibility of the results of scientific harvesting methods. For harvesting full moon/ new moons period is not recommended, as harvesting during this time produces soft shelled shrimps which fetches a low price in the market. Besides adoption of improved methods such as the Drain capture method produces shrimps which are uniform. Further it is seen that the attribute observability explained 19.80 percent of the variation in the extent of adoption of health management.

Table 13

Step-wise multiple regression analysis of perception of attributes of tehnology with the extent of adoption of harvesting (Technology XII)

(n = 60)

S.No.	Explanatory attributes	Regression co-efficient	Standard error	t-value
1	Observability (X6)	2.622	0.091	3.785*
2	Constant	2.067	0.072	28.703*

* Significant at 5% level, ** significant at 1% level

NS = Non Significant

$F = 26.664^{**}$ $R^2 = 0.198$

$\hat{Y} = 2.622 + 2.622\ X6$

The results of the step wise regression analysis (Table 14) of the perception of attributes of technology with the extent of adoption of shrimp culture technologies draw similarities with the study of Arul Raj (1984) who found out that the attributes of technology such as feasibility and physical compatibility were some important attributes

which influenced the innovation, decision on C0671 Sugarcane variety. Further the results of the study were also in conformity with the findings of Fields (1986) and Gagliardi (1995) who stated that the attributes such as compatibility, trialability, observability and perceived risk emerged as good predators of the adoption of technological innovations.

Table 14
Matrix showing the perceived attributes option culture technologies by shrimp farmers of Nellore

(n = 60)

S.No.	Attributes	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	Efficiency (X1)										PS		
2	Feasibility (X2)			PS			PS		PS		PS	PS	
3	Immediacy of returns (X3)	PS	PS					-S		PS			
4	Perceived risk (X4)								-S				
5	Profitability (X5)								PS				
6	Observability (X6)												PS
7	Cost (X7)	PS			S	-S		PS		PS	PS		
8	Input availability (X8)		PS										
9	Complexity (X9)												
10	Physical compatibility (X10)					PS					-S		
11	Trialability (X11)						PS						
12	Multiple advantage (X12)		PS					PS				PS	

PS = Positively significant, -S = Negatively significant

Conclusion

It could be inferred from the above study that the perceived attributes such as multiple advantage, immediacy of returns, input availability, feasibility, physical compatibility, trialability, multiple advantage, profitability and observability were found to have a positive and significant influence on the extent of adoption of shrimp culture technologies, attributes such as perceived risk, was found to have a negative and significant influence on the extent of adoption. The attribute namely cost of technology was found to have both positive and negative influence on the extent of adoption, since for certain

technologies such as lime application an increase in the cost of technolgy was found to lead to an increase in the extent of adoption, since lime was the cheapest input and also because of the fact that it was a much needed input for the maintenance of the health and hygiene of the culture pond. Since the adoption of an innovation is influenced by the perceived attributes of the technology, scientists and researchers should incorporate these attributes during the process of technology generation and technology refinement. Besides the knowledge of those attributes which exert a positive or negitive influence on the extent of adoption of technologies would help the extension agents to take appropriate actions to minimize the time lag between the introduction of an innovation into a social system and its adoption by the farming community.

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