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PERCIEVED CONSTRAINTS OF FISH FARMERS IN ADOPTION OF COMPOSITE CARP CULTURE IN ASSAM, INDIA

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ABSTRACT
The study was conducted in six districts of Assam representing all six agro climatic zones of the state to find out the perceived constraints of the fish farmers in adoption of composite carp culture practice. The level of agreement in relation to 32 identified constraints in adoption of composite carp culture were collected from 240 randomly selected fish farmers using 5 point Likert scale. Four major constraints had been identified with respect to production of fish through factor analysis. These were 'support system constraints', 'infrastructural constraints', 'financial and technical constraints', and 'societal constraints'. Some strategies had been formulated to solve the perceived constrains such as supply of quality fish seed on time, strengthening of research and extension mechanism, organizing training and demonstration programmes for farmers, establishment of 'One stop Aqua Shop'(OAS) by naming as '*Matsya Sewa Kendra'* as single outlet in strategic locations to make available all inputs required for carp culture, better provision of institutional credit, establishment of Fish Health and Extension Service Center at least one in each block with necessary infrastructure and manpower, formation of fish producer's consortium *etc*.

KEYWORDS: Perceived constraints, composite carp culture, agro-climatic zones, strategies.

INTRODUCTION

Fisheries and aquaculture play important role in rural development through food and nutritional security, employment and livelihood support among rural people. Indian fisheries sector has made significant contribution during the last six decades showing twelve fold increases, from 0.75 million tonnes in 1950-51 to 10.79 million tonnes in 2015-16, comprising 7.21 million tonnes from inland and 3.58 million tonnes from marine resources. Carps constitute the significant dominant group of fishes in the domestic market accounting for about 85% of total inland freshwater aquaculture production of the country for which India is called as a "Carp country" (DAHDF, 2016). Fishery sector is considered as an important economic activity in the socio-economic context in Assam. It is blessed with inland water bodies covering about 4.8 lakh ha in the form of rivers (2.05 lakh ha), *beels* (1.0 lakh ha), ponds and tanks (0.6 lakh ha), derelict water bodies (1.16 lakh ha), forest fisheries (0.05 lakh ha) and reservoir fisheries (0.03 ha) having a greater potentiality. But, the production of fish is only 0.294 million tonnes during 2015-16 against an annual demand of 0.33 million tonnes which is calculated on the basis of minimum nutritional requirement of 11kg per capita per annum as recommended by WHO and considering 95% of the state's population is fish eaters (Economic Survey, Assam 2016-17). The gap between present production and estimated requirement (0.05 million tonnes) is partially met by importing fish from other states. The composite carp culture with three species of Indian major carps: Rohu (*Labeo rohita)*, Catla (*Catla catla)*, and Mrigal (*Cirrihnus mrigala*) and three exotic carps: Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella)* and Silver carp (*Hyophthalmicthys molitrix*) have been developed during 70s, adding a great deal in increasing the yield from 600 kg/ha/year under traditional practices to the national average of 2200 kg/ha/year from FFDAs ponds. The productivity can easily go up to 5000 kg/ha/year depending upon the use of appropriate technology package (Kumar *et al.*, 2009). Many farmers and entrepreneurs in states like Andhra Pradesh, West Bengal, Punjab and Haryana have already achieved a production level of 5000-6000 kg/ha/year (DAHDF, 2016). But, the present average fish production under semi-intensive composite fish culture in Assam is only 3000 kg/ha/year. Despite rapid advancement in carp culture technology, farmers have faced some problems in adoption of carp culture practice in different parts of India. Identification of potential constraints is important for growth and development of fisheries sector.

In Assam, several government programmes have been implemented for increasing fish production through adoption of composite carp culture among rural farmers, but the objectives of increasing fish production to attain self-sufficiency, employment generation and improvement in food security and protein nourishment have not been achieved at par with other pisciculture states of the country (Bhuyan and Dutta, 2009). The constraints of production and marketing of fish had been examined by a number of researchers in different time and place (Padhy, 1994; Das and Goswami, 2002; Abraham *et al.*, 2010). The most important problems faced by the farmers in adopting

recommended package of practice of composite carp culture towards continuance of the technology were identified as high cost of inputs, occurrence of weed fishes and weeds, fish disease, poaching and poisoning of fish crop, high rent of water body, lack of follow up action, non-availability of subsidy and finance, multi-ownership of water body, stagnancy of capital for a year, lack of expected result, unremunerative price, lack of transportation, tied sale and spoilage (Chakraborty,1991; Bhaumik and Saha, 1995, Sasmal, *et al.* 2006). Problems experienced as impediments for development of fish culture in the state have been reviewed (Bhuyan and Dutta, 2009, Kalita *et al*., 2001, Goswami and Sathiadhas, 2000) and found that no adequate attention has been paid on systematic analysis of perceived constraints of farmers on adoption of fish culture technologies in Assam. With this back drop the study was conducted to find out perceived constraints of fish farmers in adoption of composite carp culture and to formulate strategies for improvement of composite fish culture.

MATERIALS & METHODS

The study was conducted in six different agro-climatic zones of Assam. One district from each of the agro-climatic zone had been selected based on fish production potential following judgement sampling. Thus, six districts - Sonitpur district from the North Bank Plain zone**,** Nagaon district from the Central Brahmaputra valley zone, Dibrugarh from the upper Brahmaputra valley zone, Metro Kamrup district from the lower Brahmaputra valley zone, Cachar from the Barak valley zone and Karbi Anglong from the Hill zone were selected for the study. Again, one development block from each of the district had been randomly selected. From each of the selected blocks a list of fish farmers who had been cultivating carps had been prepared in consultation with fishery officials of those respective blocks. Out of the prepared list, 40 farmers from each of the selected blocks had been finally selected through simple random sampling. Altogether 240 carp farmers had been selected as sample from all the six agro climatic zones.

A pilot survey was also conducted among 60 farmers following judgment sampling (Kothari, 2004) with an open ended questionnaire to identify their constraints of carp culture so that selected constraints could be incorporated into the final questionnaire for knowing their degree of seriousness. A structured questionnaire was designed after identifying probable constraints as perceived by the farmers and finally 32 constraints were considered following a Focus Group Discussion (FGD) among fisheries officials of the department of fisheries, scientists, academicians and fish farmers. The degree of seriousness of each constraint in adoption of composite fish culture was measured by using a 5-point Likert scale with responses Strongly Agree (SA), Agree (A), Neither agree nor disagree (NAND), Disagree (D) and Strongly Disagree (SD) and value assigned to each of these responses were 2, 1, 0, -1 and -2 respectively. The reliability test of the questionnaire containing questions in interval scale was carried out by applying Cronbach's Alpha method (Kothari, 2004) using SPSS software. The Cronbach's Alpha value of 32 interval scaled measured statements relating to constraints of production and marketing of fish as perceived by the farmers was 0.884 indicating a good internal consistency of results.

The relevant data collected were tabulated and analyzed using different statistical tools of SPSS package (Version-16). Factor analysis was applied after testing adequacy of data using KMO and Bartlett's test of sphericity (homogeneity of variance) for analyzing the constraints faced by the fish farmers/producers to reduce the number of variables (constraints). To identify the respondent's (farmers/producers) perception towards different statements related to constraints of production and marketing of fish so as to group them into specific factors, factor analysis was done using principal component analysis of SPSS. The Eigen values greater than 1 (Kaiser's criteria) were considered for retaining the variables (constraints). On the basis of factor loading greater than 0.5, factors had been identified (Lahiri and Samanta, 2010). Rotated component matrix had been observed to get the factors that can be named specifically and interpreted (Reddy and Ramesh, 2007).

RESULTS & DISCUSSION

General profile of the fish farmers

The average age of respondents was 39.1 years. Out of the total respondents, the majority (35.4%) belonged to General caste, followed by Scheduled Tribes (24.2%), Other Backward Caste (22.5%) and Scheduled Caste (17.9%). As regards educational status, 46.2% of respondents have qualification up to 10+ standards, 17.5% graduates, 31.7% below 10+, and 4.6% up to primary level. The nuclear type of family system exists among 58.8% respondents. The average size of the family was 6.18. Out of total respondents, 27.5% have taken fish culture as their primary occupation while 72.5% have taken it as secondary source of occupation. As regards operational holding, the fish farm area varies from 0.02 ha to 4.0 ha and the average was estimated at 0.55 ha. Average annual fish production ranges from 500 to 7500 kg/ha/year and average was estimated at 2050 kg/ha/year. All the respondents (100%) in the study area cultivate Indian Major Carps (IMC) and 94.6% of farmers culture exotic carps along with IMC in composite fish culture system. Other minor carps such as *Kurhi, Bhangon, Koliajara* and *Java puthi* are also cultured along with major carps and exotic carps.

Most of the farmer respondents (95%) had procured fish seed from private farm and only 5% of respondents from the Government farm. About 72% of the respondents took the seed at pond site from hawkers (vendors) and 28% respondents carried the seed from seed production centre on their own. Fish feeds (mainly, rice bran and mustard oil cake) and fertilizers were procured by respondents from local markets (more than 85%). Only 28 farmers (11.7%) received fund from different banks, NGOs and Department of Fisheries.

As regards selling of fish, the respondents sold fish through different marketing channels. Majority of farmers (55.8%) sold their produce through the marketing channel Producer→Village trader/Retailer→Consumer, followed by Producer→Wholesaler →Village trader/Retailer→ Consumer (43.8%), Producer→Village Trader→

Wholesaler→ Village trader/ Retailer → Consumer (43.8%), and Producer → Consumer (11.2%).

Constraints of fish production as perceived by the farmer

The data collected from farmers during the preliminary survey through the open ended questionnaire were analyzed by descriptive statistics. It was found that lack of good quality fish seeds (fry/fingerlings) of required size and number at the time of stocking was perceived as the most serious problem by all the respondents followed by high cost of inputs like feed, inorganic fertilizer, and medicine. A total of 32 constraints have been identified. In the final survey respondents were asked to express their level of agreement in relation to the identified constraints in adoption of fish culture using 5 point Likert scale and the respondents were asked to indicate their perceived seriousness of the constraints. The result is presented in Table 1.

TABLE 1: Farmers perception on constraints of fish culture

Sl.No	Constraints	SA	A	NAND	D	SD	Mean
1	Lack of good quality fish seeds of required size and number at the time of stock	58.3	32.9	1.2	6.2	1.3	1.52
2	Difficult to identify good quality fish seed	42.1	46.2	2.1	8.8	0.8	1.20
3	Unavailability of formulated feed	38.3	47.1	2.1	11.2	1.2	1.10
4	Difficult to get good brooders during breeding	29.0	45.1	19.1	6.2	0.6	0.96
5	Initial cost of digging out new pond is high	45.4	50	2.1	2.1	0.4	1.38
6	Lack of fishery input supplier in the locality	22.2	58.2		17.6	1.3	0.82
7	Lack of facilities for soil and water testing	53.3	35.4	1.7	7.9	1.7	1.31
8	Growth of fish is less	26.2	52.1	5.0	14.6	2.1	0.86
9	Cost of fingerlings/carried over seeds is high	36.4	54.4	2.5	6.7	-	1.21
10	Cost of fish medicine is high	43.5	4..99	7.5	1.7	0.4	1.31
11	Cost of fishing net is more	21.2	56.2	13.8	8.8	-	0.90
12	Selling price at farm front is low	22.9	50	11.7	14.2	1.2	0.79
13	Lack of fund	40	50		7.9	1.2	1.20
14	Difficult to get institutional credit	54	34.3	5.4	5.0	1.3	0.35
15	Lack of proper distribution channel	17.6	45.8	3.8	30.3	2.5	0.46
16	Exploitation by middlemen	25	46.7	10.8	16.2	1.2	0.78
17	Difficult and expensive to carry fish for selling to the distant market where price of fish is more	38.8	54.9	3.0	3.0	0.4	1.28
18	Inadequate training programme on fish culture	32.5	53.3	0.4	11.7	2.1	1.02
19	Inadequate visit of extension personnel to farm site	25.4	5.1	4.6	17.1	0.8	0.84
20	Lack of follow up action by extension workers	27.6	56.1	5.0	10.5	0.8	0.99
21	Lack of expected result from fish culture	20.9	30.1	5.9	35.1	7.9	0.21
22	Lack of proper knowledge on pond management	37.7	44.8	1.7	14.6	1.3	1.03
23	Lack of technological knowhow	24.8	53.4	2.9	18.5	0.4	0.84
24	Lack of standard technology for composite fish culture	59.6	36.7	1.7	0.8	1.2	0.20
25	Lack of suitable temperature for growth of fish throughout the year	21.8	41.8	13.8	20.9	1.7	0.61
26	High acidity of soil	10.9	28.2	35.7	22.3	2.9	0.22
27	Water retention capacity of soil is low	13.8	30	3.8	42.1	10.4	- 0.05
28	Monsoon is irregular	10.5	43.5	11.8	29.1	5.1	0.25
29	Occurrence of flood	14.6	15.5	1.3	51.5	17.2	- 0.41
30	Outbreak of disease	32.1	53.8	1.2	12.5	0.4	1.05
31	Poaching of fish	2.5	17.5	5.0	56.7	18.3	- 0.71
32	Poisoning the water body.	1.7	14.3	3.8	56.3	23.9	- 0.87

(Note:A=Strongly Agree, A=Agree, NAND=Neither Agree Nor Disagree, D=Disagree, SD=Strongly Disagree. All the figures are percentage of responsiveness against the statement except the mean value).

The mean value of the Likert point scale indicated that lack of good quality fish seeds of required size and number at the time of stock (1.52) is the biggest problem as perceived by the farmers followed by high initial cost of digging out new pond (1.38), difficulties in getting institutional credit (1.35), lack of facilities for soil and water testing (1.31), high cost of medicine (1.31), difficulties and expensiveness of carrying fish to sell in distant market (1.28), high cost of fingerlings/carried over seeds (1.21), difficulties of identifying good quality fish seed (1.20), lack of fund (1.20), non-availability of formulated feed (1.10), lack of proper knowledge on pond management (1.03), and inadequate training programme on fish culture (1.02). The findings of the study were found similar to certain extent with the findings of the studies carried out by Bhaumik and Saha, 1995; Sasmal *et al.* 2006, Abraham *et al.* 2010, Mohanty *et al.*,2011, Pandey *et al.*, 2014; Inaotombi and Mahanta, 2015 in different parts of the country.

Factor analysis and Strategies formulation

Since there was large number of variables (constraints), factor analysis was carried out to reduce the number of variables. The factor analysis revealed that 9 factors extracted together accounted for 65.7% of the total variance (information contained in the original 32 variables).

TABLE 2: Total Variance Explained

	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.473	23.354	23.354	7.473	23.354	23.354	3.954	12.357	12.357
2	2.944	9.200	32.554	2.944	9.200	32.554	2.718	8.493	20.850
3	2.290	7.157	39.711	2.290	7.157	39.711	2.556	7.987	28.838
4	1.832	5.723	45.434	1.832	5.723	45.434	2.422	7.567	36.405
5	1.656	5.173	50.608	1.656	5.173	50.608	2.375	7.421	43.826
6	1.385	4.329	54.937	1.385	4.329	54.937	2.239	6.997	50.823
7	1.312	4.099	59.036	1.312	4.099	59.036	2.006	6.270	57.093
8	1.114	3.481	62.516	1.114	3.481	62.516	1.513	4.727	61.819
9	1.017	3.179	65.696	1.017	3.179	65.696	1.240	3.876	65.696
10	.937	2.928	68.624						
11	.884	2.761	71.385						
12	.850	2.658	74.042						
13	.775	2.421	76.464						
14	.747	2.335	78.799						
15	.674	2.107	80.906						
16	.641	2.005	82.911						
17	.595	1.858	84.769						
18	.530	1.656	86.425						
19	.482	1.507	87.932						
20	.462	1.443	89.375						
21	.416	1.299	90.674						
22	.382	1.193	91.867						
23	.374	1.169	93.036						
24	.345	1.077	94.112						
25	.317	.990	95.102						
26	.308	.964	96.066						
27	.274	.855	96.921						
28	.250	.780	97.700						
29	.214	.670	98.370						
30	.197	.616	98.987						
31	.179	.560	99.547						
32	.145	.453	100.000						

Extraction Method: Principal Component Analysis.

The Eigen values greater than 1 (Kaiser's criteria) were considered here for retaining the 9 factors. A factor loading of 0.5 has been used to determine the cut-off point for assessing variables of factors (Hulya and Aliye, 2011). From the total variance explained in Table-2, it can be inferred that 23.35% variance is explained by Factor-1, 9.20% by Factor-2, 7.16% by Factor-3, 5.72% by Factor-4, 5.17% by Factor-5, 4.32% by Factor-6, 4.09% by Factor -7, 3.48% by Factor-8 and 3.18% by Factor-9. The rotated component matrix (Table-3) has been observed to get the factors that can be named specifically and interpreted.

Factor-1: It was comprised of six original variables (which had factor loading more than 0.5 found from rotated component matrix table) –

i. Inadequate visit of extension personnel to farm site (0.755)
ii. Lack of follow up action by extension workers (0.711)
iii. Inadequate training programme on fish culture (0.675)
iv. Unavailability of formulated feed (0.657)
v. Lack of expected result from fish culture (0.571)
vi. Lack of knowledge of soil and water quality management (0.571)

This factor-1 was named as 'Extension Support System Constraint'. Pandey *et al.,* (2014) also mentioned the poor extension support system as a constraint in transfer of aquaculture technologies in Manipur.

TABLE 3: Rotated component matrix table

	Component								
	1	2	3	4	5	6	7	8	9
Lack of quality fish seed of required size and no. at the time of stock	.224	.071	-.029	.655	.080	.012	-.051	.315	.347
Difficult to identify good quality seed	.366	.404	-.128	.602	.048	-.074	-.193	.189	.004
Unavailability of formulated feed	.657	-.045	.237	.092	.104	.119	.076	.062	-.113
Difficult to get suitable brooders during breeding	.260	.660	.038	.217	-.050	-.094	-.174	-.010	-.066
Initial cost of digging out new pond is more	.025	.264	.446	.138	-.152	.027	.299	.225	.133
Lack of fishery inputs suppliers in the locality	.266	.596	.093	.207	.144	.339	.005	.031	-.097
Lack of facilities for soil and water testing	.484	.090	-.087	.069	-.367	.158	.079	.363	.261
Growth of fish is less	.496	.350	.049	.269	.033	.167	.043	-.011	.161
Cost of fingerling is high	.101	.023	.183	.067	-.152	-.019	.762	.001	-.012
Cost of medicine is high	.076	.473	.467	.019	-.255	.023	.175	.268	.106
Cost of fishing net is more	.156	.588	.323	-.034	-.085	-.040	.259	-.204	.058
Selling price at farm front is low	.184	.358	.210	.139	.151	.545	-.066	.166	-.158
Lack of fund	.223	.222	.165	.589	-.027	.112	.201	-.344	-.211
Lack of institutional credit	.171	.122	.187	.747	.059	.261	.216	-.075	-.085
Lack of proper distribution channel	-.024	.525	.047	.296	.325	.326	.372	-.025	.154
Exploitation by middleman	-.081	.561	.052	-.016	.271	.206	.501	.056	.045
Difficult and expensive to carry fish for selling to the distant market	.251	.116	.609	.154	-.120	.070	.182	-.076	-.155
Inadequate training programme in fish cultute	.675	.148	.004	.203	.069	.185	-.028	-.109	.098
Inadequate visit 0f extension personnel to farm site	.755	.135	.046	.064	.030	.028	.088	.120	.047
Lack of follow up action by extension worker	.711	.147	.151	-.001	-.047	-.141	.136	.250	.118
Lack of expected result from fish culture	.571	.291	-.029	.136	.093	.459	.146	-.221	.172
Lack of knowledge of soil and water quality management	.571	-.010	-.150	.354	.021	.165	.276	-.184	.102
Lack of technological know how	.336	.033	.045	.037	.169	-.086	.666	-.011	.054
Lack of standardized technology for composite fish culture	.124	-.025	.073	.010	.032	.108	.006	.825	-.180
Lack of suitable temperature for growth of fish	.003	.147	.692	-.095	.056	.116	.144	.015	.214
High acidity of soil	-.124	.045	.395	.153	.241	.682	.044	.169	.113
water retention capacity of soil is low	-.004	-.010	.519	.408	.466	.005	-.074	-.013	-.070
Monsoon is irregular	.069	-.064	.676	.004	.371	.298	-.152	.004	-.123
Regular occurrence of flood	.295	-.022	.050	.027	-.086	.786	-.042	-.003	-.038
Occurrence of disease	.258	-.013	.080	.002	.043	-.031	.059	-.163	.808
Poaching of fish	.061	-.017	.006	.009	.811	.057	.109	-.050	.071
Poisoning the water body	.090	.112	.021	.065	.853	.071	-.058	.079	.002

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization

Strategy: Providing more extension support to fish farmers

Methods/Tactics for fulfilling this strategy: Adequate number of specialized training and demonstration on various aspects of fish production such as water quality management, fish health management, methods of calculation and application of proper dose/rate of fishery inputs, and recent advancement of fish production and marketing systems should be organized for farmers as well as for fishery extension workers by the State Fisheries Department. Baruah *et al.* (2013) reported the importance of training need for fish grower of Assam to aware about the technological know-how to increase fish production. Formulated fish feed should be made available to farmers. This can be done through establishment of Fish Feed Mill with initiation from the government with involvement of entrepreneurs/NGOs/SHGs or on public-private-partnership (PPP) mode.

State Fish Laboratory established at the Directorate Complex, Guwahati for testing of soil and water quality parameters does not have easy access for farmers from remote areas. The provision for testing soil and water quality parameter should be made available at close reach of the farmers to enable them to use proper dose of lime, manures, inorganic fertilizer, medicines etc. in their ponds based on the result of these tests. Provisions of Fishery Clinic with soil and water testing facilities, disease diagnostic facilities, fish medicines etc. at block level can help the farmers in this regard.

The Department of Fisheries, Government of Assam should have provisions for rewarding efficient Extension Officers and the measures for maintaining accountability should be made stringent. There should be financial and non-financial incentive to extension workers to motivate them to render their sincere service for more diffusion and adoption of fish culture by fish farmers. Necessary facilities to work effectively in remote areas should be provided to the extension workers. Suitable transportation, audio-visual aids and financial provision for demonstration purpose are to be made available at right time.

Factor -2: Factor-2 is combination of 5 variables

i. Difficult to get good brooders during breeding (0.660) ,
ii. Lack of fishery input supplier in the locality (0.596),
iii. Cost of fishing net is more (0.588),
iv. Exploitation by middlemen (0.561) and
v. Lack of proper distribution channel (0.525).

Cronbach's alpha value of these factor was found 0.726 indicating good internal consistency.

Factor-2 is named as 'Infrastructural Constraints". Das and Goswami (2002) also mentioned the lack of efficient marketing structure as a major constraint perceived by the fish farmers of Nagaon and Morigaon districts of Assam

Strategy: Providing infrastructural support to farmers

Methods/Tactics for fulfilling the strategy: The state department of fisheries should establish brood bank to assure quality seed production in different potential location of the state so that hatchery owners or those who engaged in seed production can get brooders at ease.

Fish producers' consortium as well as Community Resource Center (CRC) should be formed to provide a suitable delivery system of fishery inputs to the fish farmers in time as well as participate in the distribution channel. This will reduce the cost of production and distribution. This would also help the farmers to get the advantage of use of costly items like fishing nets, water pump etc. This type of organized marketing of fish would be helpful in stabilizing the price which will benefit both producers and the consumers as well as reduce the exploitation by middlemen.

'One stop Aqua Shop'(OAS) should be established as single outlet in strategic locations keeping all fishery inputs so that farmers can get all inputs required for fish culture such as fish seed, fish feed, fertilizer, chemicals etc. along with technological information brochures. This OAS can be named as '*Matsya Sewa Kendra.*'

Factor-3: Factor -3 was combination of four variables

i. Lack of suitable temperature for growth of fish throughout the year (0.692)
ii. Monsoon is irregular (0.676)
iii. Difficult and expensive to carry fish for selling to the distant market where price of fish is more (0.609)
iv. Water retention capacity of soil is low (0.519).

The reliability test of these variables indicates lower internal consistency (Cronbach's alpha value 0.605). Hence, these constraints are not considered for strategy formulation.

Factor-4: Factor-4 is combination of variables

i. Difficult to get institutional credit (0.747)
ii. Lack of good quality fish seeds of required size and number at the time of stock (0.655)
iii. Difficult to identify good quality fish seed (0.602)
iv. Lack of fund (0.589).

Cronbach's alpha value was found 0.700 from reliability test of these variables. These constraints together have been named as 'financial and technical constraint.'

Strategy: Providing financial and technical support to the farmers

Methods/Tactics for fulfilling the strategy: Institutional credit package to support growth of culture fisheries in the State should be made available to farmers. Institutional credit should be made available at lower rate of interest and its procedure should be simple for the farmers. After confidence building of the farmers through practical training by the Government, members of the banking sector should be invited to offer a single window loan provision in the form of loan mela where the less educated farmers be assisted in availing a loan.

Formation of SHG by farmers can generate fund by themselves through collection of monthly premium from members and giving it to members at low rate of interest which will ultimately help the farmers to meet the necessary expenses of fish culture to certain extent.

The government should make an attempt to provide better quality fish seed at pond site to farmers through judicious carp breeding and hatchery management and proper distribution system. As quality of seed is the key element in successful fish farming, it is important to regulate the fish seed market through a mechanism that helps the farmers to get an assured supply of quality seed. Certification of hatcheries could be an option that can be considered to ensure that quality of the seed is regulated at the production stage. Assam Fish Seed Act, 2005 which was amended in 2010 should be strictly followed which provides guidelines for quality seed production and management.

Factor-5: It was the combination of 2 variables

i. Poisoning of pond (0.853) and
ii. Poaching (0.811).

Cronbach's alpha value was found 0.814 from reliability test of these two variables indicating good internal consistency. It is interpreted as 'societal constraints'.

Strategy: Constant monitoring and community based management

Methods/Tactics for fulfilling the strategy: Social fencing through community participation can reduce these social constraints. Poaching can also be reduced through installation of substrates which not only create hurdle to poach inside ponds but also help in growth of periphyton.

Providing fishery insurance coverage can help mitigating the problem of poaching and poisoning.

Factor-6: It was a combination of three variables

i. Occurrence of flood (0.786),
ii. High acidity of soil (0.682) and
iii. Selling price at farm front is low (0.545).

Since these constraints show low internal consistency (Cronbach's alpha=0.601) these constraints are not considered for strategy formulation.

Factor-7: It is the combination of two variables

i. Cost of fingerling is high (0.762) and
ii. Lack of technological knowhow (0.666).

These two constraints are also not considered for strategy formulation due to low internal consistency (Cronbach's alpha=0.405)

Factor–8: It consists of only one variable only- lack of standardized technology for composite fish culture (0.825).

Factor–9: It is also consisted of one variable – occurrence of diseases (0.808).

No specific names are given to Factor- 8 and Factor - 9 as they contain only single variable.

CONCLUSION

The study identified four major constraints of composite carp culture through factor analysis. These were 'support system constraints', 'infrastructural constraints', 'financial and technical constraint', and 'societal constraints'. The implementation of some relevant strategies such as supply of quality fish seed on time, strengthening of research and extension mechanism, organizing training and demonstration programmes for farmers, establishment of 'One stop Aqua Shop'(OAS) as single outlet in strategic locations to make available all inputs required for fish culture, better provision of institutional credit, establishment of Fish Health and Extension Service Center etc would not only help in enhancing fish production through better adoption of composite fish culture but also increase the employment avenues as well as income of the farmers. The valuable contribution by applied research for refinement of carp culture technology, and adoption of other management issues like community based co-management practice in fish farming can improve the present scenario of composite carp culture in the state. As a policy option, it is suggested that fish production can be enhanced through successful implementation of strategies for which developmental projects, programmes and budgets have to be framed, implemented, monitored and managed scientifically.

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