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A Techno- Economic Analysis of Improved Fish Seed Rearing Practice through Application of Seaweed Extract

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Abstract:
The present study was carried out with the objective of comparing various technical parameters and profitability in the adoption of traditional and improved methods of carp seed rearing practices. While cow dung was used as manure in traditional method, it took fourteen days for plankton development with a formation of 0.5 feet sludge and black soil. On the other hand, in the improved method of seed rearing practice, the pond fertilized with seaweed extract, a composition of extract of seaweed and few microbial combinations and probiotics resulted in plankton development within four days with no incidence of black soil and ammonia formation. Moreover, considerable amount of water along with electricity charges were also saved in improved method. The stocking density and crop cycles per year was increased from 10 to 30 lakhs seeds and 3 to 5 cycles respectively. The improved method had 30% increase in production and the estimation of profitability showed a higher BCR (1.60:1) over the traditional method, (1.08:1) ultimately resulting in higher profit margin for the farmers.

Keywords: *Carp seed rearing, seaweed extract, profitability, return on investment*

1. Introduction

With the available scarce resources, river and ground water become insufficient to meet the needs of Agriculture, Aquaculture and other daily human activities. As, we are facing seasonal changes like lack of rainfall, drought etc., switching over to alternative fish culture practices becomes the need of the hour; otherwise, we could face countless problems in future. Previously, fish culture practice in Thanjavur region was carried out with canal water, but recently fish farmers are opting for borewell, which exerts a pressure to use electric motors or oil engines to pump the water resulting in high power consumption. To reduce the pressure on ground water utilization, we are in need of finding out a new technology with low water utilization. In this context, the present study was carried out to compare techno-economic performance of carp seed rearing practice adopting traditional and improved methods with the following objectives.

- To catalogue the general characteristics of the farm.
- To analyze and compare the effect of various technical parameters on survival and production in traditional and improved methods of seed rearing activity.
- To estimate the profitability of the rearing practices over two methods.

2. Materials and Methods

A private aqua farm with a total area of 3.25 acres of land yielding three crops per year was selected for the study located in Thanjavur district of Tamil Nadu. A combination of survey techniques was adopted for primary data collection. Through a series of personal interviews and observation of daily farming activities, the data were recorded. The interviews covered all aspects of fish seed rearing operations like culture practices, pond preparation, feeding, harvesting, disease outbreak, human resources, input usage and economics of the same. Direct field observation was accomplished in order to get the additional information on the rearing practices and to justify cost-benefit aspects.

2.1. Tools of Analysis

Simple tools of analysis like percentage and tabular analysis of costs and returns were made to estimate the economics of fish seed rearing practice over two methods. Cost was ascertained under different circumstances using the costing principles such as fixed cost, variable cost, total cost and unit cost of production. The profitability was estimated by Benefit-Cost Ratio (BCR) (Shang, 1990).

3. Results and Discussion

The selected aqua farm adopted traditional method of seed rearing activities of Catla, Rohu, Mrigal, Common Carp and Silver Carp through application of cow dung as manure of since 1996. By the year 2014, cow dung was replaced by application of seaweed extract for fertilizing the ponds (Improved method). The basic information pertaining to the farm is detailed in Table 1.

3.1. Traditional Method Vs Improved Method

The various technical parameters were compared over the two methods and the results are presented in Table 2. The results revealed that in traditional method, cow dung was used as organic fertilizer @ 5 tonnes/acre/year and inorganic fertilizer like Urea, Super phosphate and Potash @ 500kg/acre/year which took 14 days for plankton development after fertilization involving a cost of Rs. 0.23 lakhs/year. Moreover, application of cow dung resulted in 0.5feet sludge formation with black bottom soil leading to the formation of Hydrogen sulphide (H_2S). Since, water exchange was carried out 3-4 times per year, annual electricity charges were also paid at a higher rate of Rs. 1.40 lakhs. The stocking density and number of crops per annum was accounted to 10 lakhs seeds and 4 crops, respectively with a production status of 0.10 lakhs per year. In case of improved method, cow dung was replaced with seaweed extract and mineral mixture @ 60kg/acre/year and 10kg/acre/year respectively as biofertilizer in addition to probiotics with an average cost of Rs. 17,828/year. The plankton development was observed within four days from the date of fertilization. The results envisaged that water was added only to compensate the evaporation loss throughout the year i.e., no water exchange was carried out after initial filling of the pond. Hence, considerable amount of water was saved in addition to power and electricity charges (Rs. 0.60 lakhs per year). Moreover, the application of seaweed extract resulted in the formation of about 0.2 feet sludge only with no incidence of ammonia and Hydrogen Sulphide (H_2S) leading to less maintenance charges towards pond preparation for the next crop. We also noticed that there is no incidence of diseases in the seaweed fed fishes. Nisha et al (2014) suggested that U. reticulata could be included as an ingredient of gold fish diet up to 8% owing to the presence of disease resistance imparting antibacterial substances in the algae which remained gold fish active and healthy and were free from bacterial infections. Saini et al (2014) reported that feeding of supplemented diets containing probiotics resulted in significantly lower mortality (10-30%) against the pathogens Aeromonas hydrophila compared with the control group (90%) in Labeo rohita fingerlings. Through zero water exchange and application of biofertilizers and probiotics, the stocking rate of seed was increased to 30 lakhs seeds/year and the number of crops from 4 to 7 per year, thus threefold increase in revenue and yield was observed. Impact of three different types of seaweed diets on growth, feed utilization and nutrient digestibility of L. rohita was studied (Bindhu and Shoba, 2004). The results suggested that good food conversion ratio, food assimilation efficiency, protein efficiency ratio and better nutrient digestibility were recorded for seaweed diet fed fishes; especially, Ulva based diet showed comparatively higher growth and weight increment. Ulva fasciata, Spiridia insignis and Sargassam wightii were recommended as partial substitute for fish meal in formulated diets of L. rohita. The use of biofertilizer and probiotics in the culture systems not only enhanced the water and soil quality, but also the production of fish seeds @ 2.4 lakhs per year. Additionally, this method enhanced the production of aerobic and probiotic bacteria resulting in increased oxygen content which helped to reduce more pressure in pumping the ground water. Diler et al (2007) suggested that the dietary Ulva meal inclusion of 5 to 15% replacing white meal in carp diets showed the highest growth performance ($p>0.05$).

3.2. Cost-Benefit Analysis

The cost-benefit analysis was carried out by adopting simple tabular and percentage method (Table 3). It was found that the capital cost was estimated to Rs. 8.05 lakhs for both practices. The capital items include land, pond construction, bund construction, farm accessories and farm structures. Total fixed cost includes estimation of depreciation value for machineries, farm structures, farm equipments and farm accessories @10%, interest on capital cost (10%) and variable cost (8%) and repairs and maintenance. The variable cost incorporates that the cost towards pre-stocking and post stocking management practices. Among the variable items, labour, electricity charges and seed occupied the major portion in both practices. Behera et al (2000) analysed the economics of fry to advanced fingerling rearing enterprise in Cuttack district of Orissa. The operational cost structure revealed that feeding expenses accounts more than 55% of the total cost of production. The percentage of net return over operational cost in all the ponds varied between 60 - 63%. The input cost for carp seed rearing was nearly half in Indonesia (US$ 2720/ ha) than that in India (US $ 6460/ha) and Bangladesh (US $ 4076/ha). Spawn constituted major share in the total cost of seed rearing which was highest in India (68%) followed by Indonesia (34.2%) and Bangladesh (22.7%). Moreover, the average cost of producing one thousand fingerlings was also estimated as highest in India (US $ 3.94) when compared to Bangladesh (US $ 2.18), and Indonesia (US$ 0.64). It was much below the fingerling price, and resulted in 22 percent returns to variable cost in India, 41 per cent in Bangladesh and 14 percent in Indonesia (Kumar et al, 2008). The total cost (TC) was found higher in traditional method (Rs.7.80 lakhs) than improved method (Rs.6.87 lakhs) of adoption. Improved method recorded an annual profit of Rs. 4.17 lakhs. Shivakumar et al (2014) assessed the BCR ratio in 50 days reared catla (1.59), rohu (2.91), common carp (2.05) and grass carp (3.4) and found that the return on investment (RoI) is high in grass carp (2.61) followed by rohu (2.32), common carp (1.81) and catla (1.52). From the analysis, it is clear that, BCR for traditional and improved method of seed rearing activity was found as 1.08 and 1.60 respectively. Also, when compared to the traditional method, the

improved method showed 30% increase in production ultimately resulting in higher returns for the farmers. Hence, adoption of improved practice could be followed for better economic development of the farmers involving in seed production of carps.

4. Conclusion and Recommendations

There is a general consensus that fish culture requires high quantity of water for exchange at the rate of 4 to 5 times through the culture period. Moreover, fertilization with cow dung and inorganic fertilizers like Super Phosphate is compulsory for pond fertilization before introduction of seeds. But, contrary to this general belief, this attempt of seed rearing with zero water exchange and use of biofertilizers and probiotics is worth consideration at this juncture of water scarcity. Seed rearing requires more water than compared to grow out systems, and also requires intensive care during fertilization, water quality management, feeding and other routine maintenance. But, contrary to this, through use of seaweed as biofertilizers, the improved method is found effective in rearing higher quantity of seeds with limited water resource and higher revenue generation against the given backdrop of observation. It could be confirmed that seed rearing with use of biofertilizers and probiotics with zero water exchange is not only an apt method of rearing practice, but also economically a mandatory option. Through this study, it is concluded that higher profitability could be obtained through use of seaweed extract in carp seed rearing practices.

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Annexure

Sl. No	Parameters	Traditional and Improved method
1	Total area (in acres)	3.25
2	Fish seeds reared	Indian Major Carps, Common Carp and Silver Carp
3	Total days of culture	12 months
4	Water depth	3-5 feet

Table 1: General characteristics of the farm

Sl. No.	Parameters	Traditional method (Control)	Improved method (Treatment)
1	Application of organic fertilizers	Cow dung	Seaweed extract with mineral mixture and probiotics
2	Application of inorganic fertilizers	Urea, Super PO_4 and Potash	Not applied
3	Labour	Two	One
4	Sludge formation	0.5 feet/year	0.2 feet/year
5	Formation of NH_4 / H_2S	Observed	Not observed
6	Water exchange	3-4 times per year	Required only to compensate the evaporation loss
7	Pond depth after culture	About 0.5feet depth reduction was observed	Not observed
8	Disease outbreak / Mortality	Observed due to parasitic incidence	Not observed
9	Dissolved Oxygen problem	Observed	Not observed
10	Type of stocking and harvest	Single stocking and single harvest	Multiple stocking and multiple harvest
11	Survival rate	60 %	80 %
12	Application of Probiotics	Not adopted	Adopted
13	Total no. of days to get fingerling size	60 days	45 days
14	Harvest	Complete / Total harvest	Batch/Partial harvest
15	Manpower	5hrs/day	1hr/day
16	Type of culture	Single tier system	Two tier system

Table 2: Observations of technical parameters in traditional and improved carp seed rearing practices

Sl.No.	Particulars	Traditional method (Control)	Improved method (Treatment)
A	Capital items		
1	Land	2,50,000	2,50,000
2	Pond construction	50,000	50,000
3	Bund construction	10,000	10,000
4	Farm structures	4,50,000	4,50,000
5	Farm accessories	45,000	45,000
	Total	8,05,000	8,05,000
B	Fixed cost		
1	Depreciation @ 10% per annum for farm structures, farm equipments and farm accessories	55,000	55,000
2	Interest on a. Capital cost @ 10% b. Variable cost @ 8%	 80,500 45,900	 80,500 39,770
3	Repairs and maintenance	25,000	15,000
	Total Fixed Cost (TFC)	2,06,400	1,90,270
C	Variable cost		
1	Pond preparation	33,000	33,000
2	Manuring	16,250	15,828
3	Inorganic fertilizer	6,500	--
4	Probiotics	--	2,000
5	Feed	50,000	32,000
6	Seed	1,00,000	2,00,000
7	Electricity charges	1,40,000	60,000
8	Labour	2,16,000	1,44,000
9	Medicines	2,000	300
10	Miscellaneous	10,000	10,000
	Total Variable Cost (TVC)	5,73,750	4,97,128
	Total cost (TC)	7,80,150	6,87,398
D	Total returns	8,50,000	11,05,000
E	Net returns	69,850	4,17,602
F	Benefit-Cost Ratio (BCR)	1.08	1.60

Table 3: Economics of fish seed rearing practice