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RESOURCE MANAGEMENT OF INLAND FISH BREEDING-CUM-REARING FARMS IN ANDHRA PRADESH

In a developing country like India, though marginally surplus in foodgrain production at present, the problem of protein gap is acute. At present, about 40 per cent of the world's population and 70 per cent of the population of India are seriously suffering from malnutrition and protein deficiency. In our country where the per capita intake of meat and milk is small, fish assumes an important place as protein supplement where the protein content in fish on an average is 17 per cent.

Fish seed production is considered as an obstacle to aquacultural development. Apart from riverine collections, methods of induced breeding, dry and wet bund breeding have been developed. This new system of induced breeding increases the survival of eggs to spawn more than 80 per cent. The inland fish seed production comprises the production of eggs through induced breeding of Indian major carps and rearing of hatchlings to fry and fingerlings depending on their size. The present study exclusively refers to the production of fish fry of the size 20 to 40 mm. in 15-25 days' duration through induced breeding with two or three rearings per season.

The absence of identified suitable low lying areas, the high capital cost due to escalation of prices and inadequate knowledge about sources of credit have prevented the development of fish seed farms. Further, the research in relation to the economic aspects of inland fish seed farms is meagre. Keeping in view the above gaps, the present study makes an attempt (1) to evaluate the cost of production and return per unit area/quantity of fish breeding-cum-fry rearing farms and (2) to estimate the elasticity of production of important inputs, their optimal allocation and to suggest suitable resource adjustments.

TECHNIQUE

The four coastal districts of Andhra Pradesh, *viz.*, Guntur, Krishna, West Godavari and East Godavari have been purposively selected as they are representative. There are 25 Government fish seed farms in this region and the area covered under these farms is 18.65 hectares (ha.) with a production of 245 lakhs of fish fry. In this selected region, two clusters from each district, *viz.*, Bapatla and Tenali in Guntur, Gudivada and Kaikalur in Krishna, Tadepalligudem and Tanuku in West Godavari and Balabhadrapuram and Rayavaram in East Godavari were selected based on probability proportional to the area under the activity. The reference year of the study is 1981-82.

The pisciculturists who do breeding and fry rearing activity of these clusters were listed and further classified into size-groups of less than one hectare as small and more than one hectare as large farms. In all 30 farms were selected for the study.

TABLE I. DISTRIBUTION OF FISH BREEDING-CUM-REARING SAMPLE FARMS

District/ Size-group	Guntur	Krishna	West Godavari	East Godavari	Total
Small	4	1	5	6	16
Large	2	2	3	7	14
Pooled	6	3	8	13	30

This classification was adopted based on the assumption that one hectare farms are efficient and also convenient for management.

The survey method has been adopted for the collection of data. To evaluate the efficiency of the resource, the conventional farm management analysis and the production function analysis have been adopted.

REVIEW OF LITERATURE

The work done by certain earlier research workers relating to the fish fry seed production is reviewed for better understanding. Due to scarcity of pure variety of inland fish seed, the scientists have been forced to find a way to breed the fish artificially by injecting fish pituitary glands which is known as induced breeding. For the first time in India, Chaudhuri and Alikunhi (1957) succeeded in their efforts.

Bhowmick (1975) estimated the operational expenditure of induced breeding of Indian major carps for producing one crore of spawn at Rs. 9,856 while the gross returns were at Rs. 12,000. Bhuyan (1968) had made an attempt to work out the input-output relationship of fry production in Kausalya-Ganga Fishery Farm, Orissa. The cost of fry produced per thousand numbers worked out to Rs. 5.54 with a net income of Rs. 14.46 per thousand fry. In a study of economics of nursery fry rearing, Lakshmanan (1975) observed a net profit of Rs. 3,865/0.04 hectare in a period of two months. Sinhababu *et al.* (1980) made a study on fish fry production and estimated the cost of production of rearing of 1,000 fry at Rs. 10 and the net income at Rs. 40,155/hectare. Dwivedi and Sinha (1980) worked out the economics for models of one hectare and two hectare seed farms and concluded that a one-hectare farm would give a surplus of Rs. 19,000 while a two-hectare farm would give Rs. 77,700.

In an interesting study, Somalingam (1980) explained the details of pre-and post-spawn stocking and nursery management. After 15 days of nursery management of spawn it would attain fry stage of 20-27 mm. in size and then transferred to rearing ponds. In about a month's time the fry will attain the fingerling stage of 75-125 mm. in size. Ghosh (1980) suggested that the preferred size of nurseries is around 0.01-0.4 hectare of a rectangular shape having a depth of about 1.0 to 1.25 metres and brood ponds around 0.2 to 1.0 hectare having a depth of 2.0 to 5.0 metres. Natarajan *et al.* (1980) reported that nursery tanks built of brick and cement above the ground level would be preferred as it reduces the mortality of fish fry. A study of private fish seed farms around Balabhadrapuram and Andhra Pradesh indicated that the average seed production per hectare was 3.067 lakhs fry and the highest production per acre being 10 lakhs. This was quite a remarkable achievement during 1980-81.

RESULTS AND DISCUSSION

Farm Size and Asset Structure

The farm size in terms of net water spread area is taken for this study as it is a rational measure for farm size. The investment on total farm assets like ponds, buildings, machinery and equipment, etc., is presented in Table II. The data in the table are self-explanatory. Large farms invested more than small farms because of the investments on cement or masonry, high cost hatcheries, electricity and fencing. The huge investment on large farms is due to heavy expenditure on sophisticated and costly hatcheries and some Government farms are included in the large size-group, where the investment is very high.

TABLE II. SIZEWISE ASSET POSITION (STRUCTURE) OF FISH BREEDING-CUM-REARING FARMS

Size-group	Sample size	Total area (hectares)	Farm size (hectares)	Fixed investment (Rs.)	
				Per farm	Per hectare
Small	16	9.02	0.564	34,783.31	61,699.89
Large	14	32.00	2.286	1,73,557.64	75,931.47
Pooled	30	41.02	1.367	99,544.67	72,802.05

Production Cost Components of Fish Breeding-cum-Fry Rearing Farms

The production cost components of fish breeding farms presented in Table III indicate that the total cost of production worked out to Rs. 50,461/hectare on small farms whereas it was Rs. 44,722/hectare in the case of large farms and for the combined farms it was Rs. 44,424/hectare. The fixed capital which included land revenue, depreciation, interest on fixed capital and the rental value of land ranged from 42 per cent on small farms to 46 per cent on large farms. In both the size-groups, the share of human labour varied from 24 to 27 per cent of the total variable cost with Rs. 12,108/hectare on small farms and Rs. 12,287/hectare on large farms. Further analysis revealed that the next important component is the cost of breeders with a share of 15.67 per cent on small farms, 11.04 per cent on large farms and 12.58 per cent for the combined size-group. On per hectare basis, it was Rs. 7,907, Rs. 4,936 and Rs. 5,590 for the corresponding size-groups.

TABLE III. COST STRUCTURE OF FISH BREEDING-CUM-REARING FARMS

(*Rs./hectare*)

	Farm size / Cost components	Small	Large	Pooled
I.	Cost of breeders	7,907.00 (15.67)	4,936.37 (11.04)	5,589.59 (12.58)
	Human labour	12,107.54 (23.99)	12,287.03 (27.47)	10,687.35 (24.06)
	Maintenance of nursery ponds ...	1,218.47 (2.41)	787.28 (1.76)	882.20 (1.99)
	Preparation of nurseries...	411.83 (0.82)	289.27 (0.65)	316.22 (0.71)
	Water pumping charges	1,586.01 (3.14)	1,193.86 (2.67)	1,280.09 (2.88)
	Manures and supplementary feeds ...	4,251.65 (8.43)	3,587.36 (8.02)	3,733.43 (8.40)
	Interest on working expenses	1,834.60 (3.64)	1,262.42 (2.82)	1,388.24 (3.12)
(A)	Total variable cost	29,317.10 (58.10)	24,343.59 (54.43)	23,877.12 (53.75)
II.	Land revenue	207.73 (0.41)	146.25 (0.32)	159.77 (0.36)
	Depreciation	6,577.22 (13.03)	4,770.24 (10.67)	5,167.67 (11.63)
	Interest on fixed capital	6,169.99 (13.03)	7,574.71 (16 94)	7,265.82 (16.36)
	Rental value of farm land	8,188.47 (16.23)	7,887.69 (17.64)	7,953.83 (17.91)
(B)	Total fixed cost	21,143.41 (41.90)	20,378.89 (45.57)	20,547.09 (46.25)
Total cost (A+B)		50,460.51 (100.00)	44,722.48 (100.00)	44,424.21 (100.00)

Note:—Figures in the parentheses indicate percentages to the respective total.

Preparation, maintenance and water pumping charges for breeding and rearing accounted for Rs. 3,216/hectare with a share of 6.37 per cent on small farms and Rs. 2,270.41/hectare with a share of 5.08 per cent on large farms. The cost of manures and supplementary feeds amounted to Rs. 4,251.65/hectare in the small size-group while it was Rs. 3,587.36/hectare in the large size-group and for the combined size group it was Rs. 3,733/hectare. Even though it accounted for over 8 per cent in all the categories, it has greater influence on productivity. It is observed that the total cost of production decreased as the farm size increased, probably due to economies scale.

Resource Returns

Relevant data on resource returns are presented in Table IV.

TABLE IV. PRODUCTION EFFICIENCY MEASURES

Size-group	Input (Rs./ha.)	Output (Rs./ha.)	Net returns (Rs./ha.)	Input-output ratio	Net return per rupee investment (Rs.)
Small	50,460.51	94,474.89	44,014.38	1:1.87	0.87
Large	44,772.48	61,572.77	16,800.29	1:1.37	0.37
Pooled	44,424.11	68,807.70	24,383.59	1:1.55	0.55

From the above analysis, it is seen that all the ratios are positive in both the size-groups. The highest net returns were observed on small farms and hence they were efficient. It is found that the input-output ratio ranged from 1.37 on large farms to 1.87 on small farms for every rupee invested. Thus, this ratio also supported that small farmers were efficient.

Productivity and Unit Cost of Production and Returns

The productivity, unit cost of production and returns data are presented in Table V.

TABLE V. PRODUCTIVITY AND UNIT COST AND RETURNS

Size-group	Physical returns in 1,000 Nos./ha.	Cost of production/ 1,000 Nos. seed	Gross price received per 1,000 Nos. seed (Rs.)	Net returns per 1,000 Nos. seed (Rs.)
Small	1,442.57	34.98	65.49	30.51
Large	983.16	43.45	62.63	19.18
Pooled	1,084.18	40.97	63.47	22.50

It is seen that productivity of fish seed was 14.43 lakhs on small farms compared to 9.83 lakhs on large farms. It can be inferred that the productivity was more on the small than on the large farms. Thus, the net returns per thousand seed are the highest on small farms with Rs. 30.51 and the lowest being Rs. 19.45 on large farms.

Break-even Analysis

The break-even analysis indicated that at the existing costs of inputs and output price, a minimum of 4.90 lakhs of fish seed must be produced, as the profits will accrue beyond this level. The percentage of break-even output over the total is 45.2.

Functional Analysis

The results of functional analysis are presented in Table VI.

Water spread area (X_1): Though the utilization of area exhibited positive production elasticities for small and pooled groups, these were not significant. In respect of large farms the production elasticity was negative and significantly different at 5 per cent level, representing excessive utilization. This indicates that a one per cent increase in area would decrease the gross returns by 0.96 per cent.

Cost of breeders (X_2): On small farms, the cost of breeders was negatively significant at one per cent level, indicating their excessive use. Thus, an increase in the cost of breeders on small farms by one per cent, keeping other resources constant, would result in a reduction of gross income by 0.55 per cent.

Human labour (X_3): The production coefficients were significant at one per cent level for both the size-groups. This revealed that a one per cent increase in human labour input, keeping other factors at their geometric mean level, would increase the gross returns by 1.14 per cent, 0.87 per cent and 0.34 per cent for small, large and combined farms respectively.

Manures and feeds (X_4): The partial regression coefficients of manures and supplementary feeds were positive and significantly different at one per cent level. This indicated that an increase of one per cent of these inputs would result in an increase of gross returns by 0.66, 1.16 and 0.61 per cent in small, large and combined size-groups respectively. Thus, these played a very significant role in increasing the output irrespective of the size.

Scale Returns

It is observed from Table VI that the scale returns were 1.5342 and 0.8177 for the small and large farms respectively while the same was 0.9771 on combined farms. When tested, the small size-group was significantly different from unity at 10 per cent level, indicating increasing returns to scale while others showed constant returns to scale.

Ratios of Marginal Value Products (MVPs) to Opportunity Cost

The measure of efficiency of the resource use is estimated through comparison of MVPs to opportunity costs (Table VII). It is seen that the water spread area is more than one on small farms which suggests that more profits can be obtained only by increasing the farm size. In the large size-group the negative ratio indicates the indiscriminate and inefficient use of the resource. In respect of pooled farms, the ratio is less than one, indicating too much use of the resource, hence to be adjusted to bring it closer to unity. The negative ratios observed in the expenditure on breeders in both the size-groups and on combined farms suggest the resource use inefficiency. For human labour, manures and supplementary feeds,

all the ratios are more than one, hence the use of these inputs is to be increased. Thus, the use of these resources is to be adjusted to unity depending upon the ratios to achieve maximum efficiency.

TABLE VI. PRODUCTION ELASTICITIES OF RESOURCES WITH THEIR STANDARD ERRORS OF FISH BREEDING FARMS

Particulars	Small	Large	Pooled
Number of farms	16	14	30
Constant 'a'	1.65	2.474	43.96
Production elasticities			
Water spread area (ha.) (X_1)... ...	0.2848 (0.1587)	—0.9602* (0.3872)	0.1092 (0.2095)
Cost of breeders (Rs.) (X_2)	—0.5500** (0.1118)	—0.2597 (0.2161)	—0.0897 (0.1304)
Human labour (Rs.) (X_3)	1.1442** (0.1825)	0.8732** (0.2052)	0.3440* (0.1287)
Manures and feeds (Rs.) (X_4)... ...	0.6552** (0.1044)	1.1644** (0.1992)	0.6136** (0.1572)
Scale coefficient	1.5342 (0.2826)	0.8177 (0.4158)	0.9771 (0.3196)
R^2	0.9640**	0.8653**	0.8545**
'F' value ... ... d. f.	73.0303 (4,11)	14.4217 (4,9)	36.8276 (4,25)
Marginal value products of inputs			
Water spread area	—	—59521.17** (16098.36)	—
Cost of breeders	—7.3927– (2.2584)	—	—
Human labour	7.9334** (1.6009)	7.1798 (4.6217)	2.6660 (0.8774)
Manures and feeds	12.0198** (3.6684)	21.0356* (3.5661)	11.3351** (2.8652)

** Significant at 1 per cent level.
* Significant at 5 per cent level.
Figures in brackets indicate standard errors.

TABLE VII. MVPs TO OPPORTUNITY COST RATIOS

Resource particulars	Small	Large	Pooled
Water spread area (ha.) (X_1)	2.87	—7.55	0.92
Cost of breeders (Rs.) (X_2)	—7.39	—3.49	—0.96
Human labour (Rs.) (X_3)	7.93	7.18	2.58
Manures and supplementary feeds (Rs.) (X_4)	12.02	21.04	11.18

SUMMARY AND CONCLUSIONS

The study on inland fish breeding farms of Indian major carps has been attempted in the coastal districts of Andhra Pradesh with the objective of evaluating the productivity and resource use efficiency. The fish seed refers to fry of 20 to 40 mm. in size. The average farm size in terms of water spread area ranged from 0.56 hectares to 2.29 hectares on small and large farms respectively with an average fixed investment of Rs. 72,802/hectare on farm assets like ponds, buildings and machinery. The total cost of production worked out to Rs. 50,461/hectare and Rs. 44,722/hectare with 58.1 per cent and 54.43 per cent of operational expenses on small and large farms respectively. The corresponding net returns were Rs. 44,014 and Rs. 16,800 per hectare. The productivity of fish fry seed was 14.43 lakhs and 9.83 lakhs with input-output ratios of 1.87 and 1.37 on small and large farms respectively. Thus, the study revealed that the small farms are most efficient and viable. The break-even analysis indicated that a minimum of 4.90 lakhs of fish fry seed must be produced with a break-even output of 45.2 per cent.

Cobb-Douglas production function analysis revealed that the water spread area on large farms and proportionate cost of breeders on small farms exhibited negatively significant production elasticities. Since the increase of these resources decreased the gross returns, their use may be curtailed. But human labour and manures and feeds showed positively significant elasticities in both the size-groups. With a one per cent increase in these inputs, the increase in the gross returns was by 1.14 per cent and by 0.87 per cent in respect of human labour and by 1.16 per cent and by 0.61 per cent in respect of manures and feeds on small and large farms respectively. Increasing returns to scale operated on small farms while constant returns to scale on large farms. The marginal value product to opportunity cost ratios suggest that more profits can be obtained by increasing the small farm size. It is also suggested that the resource use by way of expenditure on breeders on both the size-groups may be curtailed.

POLICY IMPLICATIONS

Based on the above study, the policy implications are as follows:

1. The fixed investment which is at a higher level on the large farms is associated with the construction of pucca buildings and breeding and nursery ponds due to high cost materials like cement and also stone revetment. Use of low cost materials for these constructions, if developed, shall reduce the fixed investment on large farms.

2. Care on preparation and maintenance of nursery ponds through reclamation and eradication of weeds and insect pests are to be taken along with steps to reduce the cost of production of seed per unit to increase the physical returns and profitability on the large farms. Further, the use of the most productive resources, *viz.*, manures and supplementary feeds should be increased substantially.

3. Since on the small farms there is under-utilization of produced spawn leading to a wasteful expenditure and high cost of breeders, it is necessary that this expenditure will have to be minimized by maintaining the optimum number of breeder sets.

4. On small farms, the ratio of marginal value product to marginal cost is more than one and this indicates that the farm size can be increased for optimizing the utilization of the productive resources.

5. The production function analysis exhibited negative relation between farm size and returns and this necessitates reduction in the farm size.

6. Since farmers are not fully aware of the practices of fish seed production, extension and training programmes may be introduced.

7. Proper arrangements should be made through commercial banks for providing adequate finance.

8. As marketing is generally done by the farmers themselves, the State Government has to provide proper storage, transport and marketing facilities.

9. District Level Fish Farmers Development Agencies, if initiated, may promote activities of fish seed production.

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