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Economic Analysis of Public Sector Sponsored Fisheries Enterprises in Jharkhand, India

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Key words
CCVASY, RFFY, SGY, Economic analysis, Constraints

ABSTRACT

Jharkhand is one of the developing states in fisheries that have just started getting popular. The beneficiaries (fish farmers) of the selected state government schemes viz., Cage Culture Vistar Avum Sudradhikaran Yojana (CCVASY), Riverine Fish Farming Yojana (RFFY) and Matsya Bij Utpadako Ko Matsya Bij Utpan Hetu Anudan (SGY) in Ranchi, Hazaribagh and Khunti districts of Jharkhand were selected to study the economics and constraints during the year 2022. Primary data was collected from 141 fish farmers by using a structured survey schedule. Economic analysis revealed that the Benefit Cost Ratio (BCR) for CCVASY, RFFY and SGY was 1.98, 2.24, 2.04, respectively stating the economic viability of the schemes for adoption by the fish farmers of Jharkhand for sustainable fish production and livelihoods.

INTRODUCTION

The fisheries and aquaculture sectors have been increasingly recognized for their essential contribution to global food security and nutrition in the twenty-first century (FAO, 2022) with a total inland fish production of India 121.21 lakh tonnes during 2021-22 (Anon, 2022). Among the 29 states of India, Jharkhand with a total of 401 reservoirs (1.21 lakh ha area), 1, 16,305 private tanks (50,586 ha), 16,719 Government tanks (15,762 ha), 1184 check dams and Aahars (4570 ha), 1741 coal pits and mines (9880 ha), 1800 km rivers, 1, 26, 000 MGNREGA wells and 2,04,000 Dobhas are the major water resources and the state ranks 11th position in inland fish production (2.57 lakh tonnes). Rise in production has grown since years and is still growing with good pace with the intervention of various culture technologies by the Department of Fisheries in Jharkhand (DoF, 2022).

The development and adoption of new technologies can increase the production and profitability of fish farming in Maithon reservoir, Jharkhand, India (Karnatak *et al*., 2021). Devi *et al*. (2017) reviewed on water quality parameters in freshwater cage fish culture and found that freshwater cage culture is an important industry as it provides a source of protein and fulfills the high market demand for freshwater fishes. The Santa Cruz reservoir's cage-based Nile tilapia production was determined to have some potential for sustainability overall. It was deemed economically sustainable but less so in terms of the environment and social aspect (Moura *et al*., 2016). Cage fish farming is a high-yield, low impact farming method with enormous potential for job creation and income creation for the coastal population in the country (CMFRI, 2020). The livelihood security index is better in the case of cage fishers as it has enhanced their livelihood, an evidence from Jharkhand state of India (Pandit *et al*., 2019). According to Kappen *et al*. (2018), the constraints that are most crucial to the farmers in adoption of cage aquaculture in Ernakulam District, Kerala were inadequate good quality seeds (technical constraint), high feed cost

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(economic constraint) and absence of sufficient and timely seed delivery (infrastructure/ administrative constraints).

The transformation of Haribhanga beel from a low productive beel to a high productive beel in Assam has been achieved through adoption of stock enhancement measures through pen culture and due to the risk bearing capacity of the fishers of Haribhanga wetland (Chandra *et al*., 2010). Borah *et al*. (2023) revealed that the development of pen culture protocols in floodplain wetlands for indigenous fish species with a high demand across regions could contribute towards better economic gains in the tropical floodplain wetland of the Northern Eastern Region, India. Considering the importance of aquaculture practices in Jharkhand, the economic viability of CCVASY, RFFY and SGY schemes and the constraints faced by the beneficiaries were estimated in the present study.

MATERIALS AND METHODS

Study area

Three districts *viz.,* Ranchi, Hazaribagh and Khunti where the scheme beneficiaries of Cage Culture Vistar Avum Sudradhikaran Yojana (CCVASY), Riverine Fish Farming Yojana (RFFY) and Matsya Bij Utpadako Ko Matsya Bij Utpan Hetu Anudan (SGY) exists were selected to study the economics and constraints faced by the fish farmers. While CCVASY and RFFY is a group scheme wherein a minimum of ten members get enrolled and benefitted, SGY is diverted to individual farmer having sufficient water resources with proper knowledge, training and experience in fish seed production. It is clearly evident that, the farmers prevailing any of the said schemes must undergo a three-days training program in Fish Farmer Training center (FFTC) at Salimar, Dhurwa in Ranchi, where the farmers get registered before availing the scheme. Before the installation of the infrastructures for CCVASY and RFFY, the water of the reservoir is properly inspected by the concerned authorities to assess the suitability of the water resources for taking up the culture practices.

Tools of analysis

By adopting the simple random sampling technique, primary data was sourced from the selected scheme beneficiaries in the respective districts with a total sample size of 141 (CCVASY - 77; RFFY- 50; SGY - 14) fish farmers. Information related to state and district profiles, state schemes and other details pertinent to the objectives of the study was collected through various online and published sources. The demographic factors like age, education, experience, family size, family type, gender, category, and occupation were assessed through descriptive statistics. Simple costing techniques were used to estimate the economic performance of the selected fisheries enterprises. Capital cost for cage include the cost of supplying, fitting and fixing of all the materials for the installation of one battery (one cage - 12 x 8 m). Depreciation of capital assets @ 12%, interest @ 8% and repairs and maintenance were considered for estimation of fixed cost. The expenditure towards feed, seed, labour, transport, brooders, fertilizers, medicines, fuel and miscellaneous items were considered as variable cost items. Gross income was calculated by multiplying the quantity produced by the corresponding pricing. Net income is the amount remaining after all expenses, including the fixed and variable costs. In this study, profitability was estimated and inferred for the individual scheme beneficiary, though the cage and RFF units are operated in groups. The constraints (long-term and short-term) faced by the scheme beneficiaries were ranked by using Garrett ranking technique (Kumar *et al*., 2009). The ability to convert the rankings of constraints and benefits into numerical scores is provided by this technique. The constraints are ranked according to respondents' priority which means that different ranks may have been assigned to the same number of responses on two or more criteria for which the formula is given below:

$$\text{Per cent position} = 100 \times (R_{ij} - 0.5)/N_j$$

where, R_{ij} is the rank given for the i^{th} factor by the j^{th} respondent and N_j is the number of factors ranked by the j^{th} respondent.

RESULTS AND DISCUSSION

Demographic profile of scheme beneficiaries

The results revealed that the average age of CCVASY, RFFY and SGY farmers was 37, 33 and 40 years, respectively. The study on livelihood security through adoption of cage culture in Jharkhand also reported that the average age of cage farmers was 37 years (Pandit *et al*., 2019). While the SGY was exclusively managed by male farmers, only 6.49% and 18% of women got involved in CCVASY and RFFY, respectively. It is observed that 50% of the SGY beneficiaries were up to graduate level, whereas, 38.96% and 32.35% of the cage and RFF farmers had inter level school education. Kumari and Sharma (2022) also reported that majority of the cage farmers of Chandil reservoir were educated up to secondary level followed by primary, higher secondary and graduation. Since many years, the seed growers are practicing the fisheries activities, on the other hand, the cage and RFF farmers have started gaining experience only during the adoption of culture practices as it is a new technology.

Economic analysis

The costs and returns were estimated for the selected fisheries enterprises and the results are as follows.

CCVASY

Cage culture technology is capital as well as production intensive. The average capital cost, fixed cost and variable cost for cage culture was estimated as ₹ 3,56,199.32, ₹ 72,736.32 and ₹ 55,187.66, respectively (Table I). Among the variable cost items, feed (₹ 30,012.99) and seed (₹ 17,493.51) accounted the major share. The mean total returns and net returns was calculated as ₹ 2, 53,364.94 and ₹ 1,25,440.95, respectively. The selling price of the fish (*Tilapia* and *Pangasius* sp.) ranges between ₹ 110 - 120/kg with the mean value of ₹ 118.44/kg. Though the fishers start the culture from March to November (eight months) during which they grow the fishes up to the size of 0.75-1.00 kg, harvesting is done after six months of culture when the fishes reach up to a size of 0.5kg. It was found that the average production of fishes from each battery is2143.25 kg. The benefit cost ratio (BCR) for cage culture was estimated as 1.98 which coincides with the findings of Kumari and Sharma (2022) in which the BCR was recorded as 1.46 in four chambered galvanized iron (GI) cage in Chandil Reservoir, Jharkhand.

RFFY

Riverine fish farming isthe reinvented form of pen culture, otherwise known as RFF. Installation cost of the set-up depends upon the area under culture. The total cost (fixed cost - ₹ 12,853.20; variable cost - ₹ 11, 629.00), total returns and net returns was calculated as ₹ 54,985.11, ₹ 30,502.91, respectively, on an average (Table I). Mainly, the Indian Major Carps (IMCs) are being cultured in RFF and the selling price of fishes ranges between ₹ 110-150/kg. Stocking is done during March and harvested in November. The average production of fish was 407 kg with the total annual earnings of ₹ 54,985.11 for a beneficiary. The estimated BCR (2.24) of RFF clearly indicates that the fish farmers could take up this economic activity. Borah *et al*. (2023) in his study stated that the benefit-cost ratio of pen was 1.42 that enhanced the income of farmers in the tropical floodplain wetlands of North Eastern Region, India.

Table I. Economics of fisheries enterprises in selected districts of Jharkhand. The values given below are in Indian currency

Particulars		CCVASY (n= 77)	RFFY (n=50)	SGY (n=14)
I.	**Variable cost**			
a.	Feed	30,012.99 (23.46)	5,300.00 (21.65)	20,683.67 (9.75)
b.	Seed	17,493.51 (13.67)	2,820.00 (11.52)	--
c.	Brooder	--	--	19,785.71 (9.33)
d.	Labour	3,478.57 (2.72)	1,610.00 (6.58)	6,428.57 (3.03)
e.	Transport	2,662.34 (2.08)	740.00 (3.02)	5,857.14 (2.76)
f.	Manure	--	605.00 (2.47)	--
g.	Fertilizers	--	290.00 (1.18)	
h.	Fuel	--	--	10,296.73 (4.85)
i.	Synthetic hormones	--	--	3,828.57 (1.80)
j.	Miscellaneous	1,540.26 (1.20)	264.00 (1.08)	1,992.86 (0.94)
Total variable cost (I)		55,187.66 (43.14)	11,629.00 (47.50)	68,873.27 (32.46)
II.	**Fixed cost**			
a.	Interest on CC @ 12%	42,743.92 (33.41)	7,327.92 (29.93)	78,553.96 (37.02)
b.	Depreciation @ 8%	26,669.28 (20.85)	4,885.28 (19.95)	62,843.17 (29.62)
c.	Lease	245.00 (0.19)	--	--
d.	Repairs and maintenance	3,077.92 (2.41)	640.00 (2.61)	1,985.71 (0.94)
Total fixed cost (II)		72,736.32 (56.85)	12,853.00 (52.50)	143,301.21 (67.54)
Total cost (I + II)		127,923.98	24,482.20	212,174.47
Total returns		253,364.94	54,985.11	253,176.53
Net returns		125,440.95	30,502.91	41,002.06
$BCR_{(TC)}$		1.98	2.24	2.03

Note: Values in the parentheses indicate percentage.

Table II. Constraints analysis of fish farmers in selected districts of Jharkhand.

Constraints	CCVASY		RFFY		SGY	
	Mean score	Order of merit	Mean Score	Order of merit	Mean score	Order of merit
Short term constraints						
Labour scarcity	35.82	VII	60.80	II	--	--
High feed cost	72.30	I	57.82	III	--	--
Non-availability of quality seed	63.38	II	35.52	VIII	--	--
Lack of credit	61.64	III	68.16	I	46.57	III
Difficulty in transportation of inputs	45.71	V	44.30	VI	35.57	V
Lack of knowledge	27.78	VII	38.86	VII	62.14	I
Non-availability of feed	53.91	IV	46.30	V	--	--
Non-availability of storage facility	41.47	VI	50.06	IV	49.71	II
Non-availability of quality brooders	--	--	--	--	41.00	IV
Long term constraints						
Lack of availability of good quality water	33.45	IV	34.08	IV	57.28	II
Disease infection	57.47	II	39.82	III	66.14	I
Climatic condition	40.35	III	59.85	II	40.85	III
Poaching	64.27	I	62.47	I	36.71	IV

SGY

SGY is one of the individual schemes provided to Jharkhand farmers which incur high investment. Gawa *et al*. (2017) observed that the trout seed production is a capital-intensive business, with high cost involved in the establishment of fixed inventories. While the hatchery operates six times a year, on an average, breeding of IMCs is done four times and twice in the month of November or December for common carp breeding. The average capital cost and variable cost were recorded as ₹ 7,85,539.58 and ₹ 68,873.27, respectively (Table I). The average production of spawn is 88.62 liters per cycle and 427.86 liters spawn annually with an annual income of ₹ 248,261.73 and BCR of 2.04 which is lucrative.

Constraints faced by the scheme beneficiaries

The constraints faced by the fish farmers were broadly categorized into long term constraints and short-term constraints for all the three schemes. Among the short-listed eight short-term constraints, high cost of floating feed (72.30) ranks first followed by non-availability of quality seed (63.38), lack of credit (61.64), non-availability of feed (53.91), transportation difficulty (45.71), non-availability of storage facility (41.47), labour scarcity (35.82) and lack of knowledge (27.78) in cage culture. In RFF farming practices, lack of credit (I) and labour scarcity (II) were identified as the major constraints followed by high price of feed (III), non-availability of storage facility (IV), non-availability of feed (V) etc. A total of five short term constraints were faced by the seed growers, among which lack of knowledge (62.14) was the predominant constraint followed by non-availability of storage facility (49.71), lack of credit (46.57), non-availability of quality brooders (41.00) and transportation difficulty (35.57). While considering the long-term constraints (four), poaching (64.27) was the prime constraint of the cage farmers, followed by infection of disease (II), climatic condition (III) and lack of availability of good quality water (IV). Like cage culture, in RFF also, poaching (I) was identified as the predominant constraint. Other constraints include climatic condition (II), infection of disease (III) and lack of availability of good quality water (IV). Infection of disease (I), lack of availability of good quality water (II), climatic condition (III) and poaching (IV) were the long-term constraints faced by the seed growers (Table I). Kappen *et al*. (2018) also found that the major constraints faced by the cage farmers in Ernakulam District, Kerala were the unavailability of good quality seeds (technical constraint), high feed cost (economic constraint) and the absence of prompt and sufficient supply of seeds (infrastructure/ administrative constraints). Gawa *et al*. (2017) revealed that lack of skilled labour was the predominant challenge of the trout seed producers in Jammu and Kashmir followed by poor seed demand (II), and unavailability of equipment (III).

CONCLUSIONS AND RECOMMENDATIONS

The main motto of the Jharkhand government for the implementation of the schemes is to provide employment and livelihood security to the rural people of Jharkhand. The study results concluded that all the three schemes have its own importance with the BCR of 1.98 (CCVASY), RFF (2.24) and SG (2.04). Among the said three schemes, CCVASY has immense potential for employment generation and exploitation of more area for intense production. Though RFF was found to have relatively high BCR, the production was less and moreover not suitable in all reservoirs. Since the production cycle is restricted to only 2 to 3 months for SGY and comparatively, with high investment, cage culture is considered as one of the most viable technologies to the Jharkhand farmers. Reduction in feed cost could be ascertained through establishment of feed mills and use of locally available raw materials for feed manufacturing and provision of skill development trainings, workshops and awareness programmes on viable aquaculture practices to the farmers will indulge the farmers for inclusive fish business.

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IRB Approval

Approval has been given for the research manuscript by the members of the Advisory Committee.

Consent for publication

After going through the manuscript, all the authors have agreed to submit it for publication.

Statement of conflict of interest

The authors have declared no conflict of interest.

REFERENCES

Anon, 2022. *Handbook of fisheries statistics*. Department of Fisheries, Ministry of Fisheries. Animal Husbandry and Dairying, Government of India.

Aswathy, N., Joseph, I., Ignatius, B. and Joseph, S., 2020. Economic viability of cage fish farming in India. *CMFRI Special Publication No. 134*. ICAR-Central Mar. Fish. Res. Inst., Kochi, pp. 36.

Borah, S., Das, B.K., Bhattacharjya, B.K., Karnatak, G., Yadav, A.K., Pandit, A., Parida, P.K., Roy, A., Sahoo, A.K., Behera, B.K. and Das, A.K., 2023. Standardizing pen culture of small indigenous fish *Labeo bata* in the tropical floodplain wetland of the North Eastern region, India: A step towards sustainable fisheries management. *Sustainability*, **15**: 4423. https://doi.org/10.3390/su15054423

Central Marine Fisheries Research Institute, 2020. Partners. Available at http://eprints.cmfri.org.in (accessed on 20 June 2023)

Chandra, G., 2010. Impact of adoption of pen culture technology on well-being of fishers of Haribhanga Wetland in Assam. *Indian Res. J. Ext. Educ.*, **10**: 61-65.

Department of Fisheries Jharkhand, 2022. *Partners.* Available at https://jharkhandfisheries.org (accessed on 23 June 2023).

Devi, P.A., Padmavathy, P., Aanand, S. and Aruljothi, K., 2017. Review on water quality parameters in freshwater cage fish culture. *Int. J. appl. Res.*, **3**: 114-120.

Food and Agriculture Organization of the United State, 2022. *Partners.* Available at https://www.fao.org (accessed on 23 June 2023).

Gawa, S., Kumar, N.R., Mahida, N. and Hatte, V.M., 2017. Livelihood option through trout seed production in Jammu and Kashmir: An economic analysis. *Fish. Technol.*, **54**. https://doi.org/10.31018/jans.v9i4.1542

Kappen, D.C., Dinesh, K. and Divya, N.D., 2018. Constraints in the adoption of cage aquaculture practices in Ernakulam District, Kerala. *J. Ext. Educ.*, **30**. https://doi.org/10.26725/JEE.2018.4.30.6165-6172

Karnatak, G., Das, B.K., Mishal, P., Tayung, T., Kumari, S., Sarkar, U.K., Das, A.K. and Ali, Y., 2021. Impact of stocking density on growth, feed utilization and survival of cage reared minor carp, *Labeo bata* (Hamilton, 1822) in Maithon reservoir, India. *Aquaculture*, **532**: 736078. https://doi.

org/10.1016/j.aquaculture.2020.736078

Kumar, B.G., Sendhil, R., Venkatesh, P., Raja, R., Jayakumar, V. and Jeyakumar, S., 2009. Socio-economic impact assessment of livelihood security in agriculture, animal husbandry and aquaculture on the tsunami-hit lands of Andaman. *Agric. Econ. Res. Rev.*, **22**: 483-494.

Kumari, S. and Sharma, A., 2022. Socio-economic status of fishers and fish production trends from cage culture in Chandil reservoir, Jharkhand. *J. Krishi Vigyan*, **10**: 290-294. https://doi.org/10.5958/2349-4433.2022.00051.4

Moura, R.S.T., Valenti, W.C. and Henry-Silva, G.G., 2016. Sustainability of Nile tilapia net-cage culture in a reservoir in a semi-arid region. *Ecol. Indicat.*, **66**: 574-582. https://doi.org/10.1016/j.ecolind.2016.01.052

Pandit, A., Debroy, P., Chandra, G., Roy, A., Chakraborty, L., Das, B.K. and Biswas, D.K., 2019. *Adoption of cage farming has enhanced livelihood security of the reservoir fishers: Evidence from Jharkhand state of India*. https://doi.org/10.47780/JIFSI.51.2.2019.106504