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ECONOMIC EFFICIENCY AND PROFITABILITY OF FISH HATCHERY ENTERPRISES IN OSUN STATE, NIGERIA

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Abstract
The study examined the economic efficiency and profitability of fish hatchery enterprises in Osun State, Nigeria. Primary data were obtained from 189 fish hatchery farmers with the aid of a well-structured questionnaire, using simple random sampling technique. Data collected were analysed by the use of descriptive statistics, stochastic frontier profit function and budgetary analysis. Results showed that mean age, household size and years of experience of the fish hatchery farmers were 46 years, 6 persons and 9 years respectively. The study also found that the age, educational qualification, household size, fish hatchery experience and membership of cooperative society were factors affecting farm-level profit efficiency in the use of resources. Economic efficiency of fish hatchery enterprise ranged from 0.30 to 0.99, with average efficiency level of 0.85. This implies that, on the average, farmers are able to obtain 85% of potential profit from a given mix of inputs. Results show that net farm income was ₦86,940.74, and benefit cost ratio of 1.58. Although the enterprises were found to be profitable, young individuals should be motivated either by provision of soft loans without or low interest rate to venture into the enterprise for sustainable fish production.

Keywords: Fish, hatchery, profitability, stochastic profit function, and economic efficiency

Introduction

Nigeria commands a place of pride in fish production in Africa, ranked 64th among other countries in fish consumption (Ashley-Dejo *et al*., 2019), and second to Egypt in terms of fish production (FAO 2020). This advance in fish production has been possible due to substantial increase in inland fish production, particularly pond aquaculture, which is considered as the fastest growing fishery subsector in Nigeria (Ashley-Dejo *et al*., 2019). Bolorunduro, (2016), observed that Nigeria is the largest aquaculture producer in south of the Sahara. The country fishery industry is a huge employer of labour with almost 2.08 million people as service providers (Oluwatayo and Adedeji, 2019). Fisheries sector contribute about 1.2 million metric tonnes, amounting to 0.48% to Agriculture Gross Domestic Product (GDP), and contribution of Agriculture to GDP (2014) was 20.24% (Oluwatayo and Adedeji, 2019). They noted that by 2020 its contribution to GDP should reach 5.0%, with this, there will still be short fall in domestic production because of rapid population growth.

Various attempts by government to expand the supply of fishery products in the country through importation failed, therefore, prompting Government to initiate various programs. Some of the programs initiated include: Presidential Initiative on Fisheries and Aquaculture Development; Aquaculture and Inland Fishery Project; National Accelerated Fish Production Project; Fishing Terminal Projects; Fisheries Infrastructure Provision/Improvement; Presidential Initiative of Aquaculture, to mention a few (Oladeji *et al.,* 2002). Despite government efforts to boot fish production, there still exist a wide gap between demand for fish and domestic supply in Nigeria (Ashley-Dejo *et al*., 2017a; Ogunmefun and Achike, 2018). Fish catch and production are not keeping pace with growing demand due to rapid population of about 200 million people. The country is witnessing great shortage of fish production and this condition is increasing daily due to rapid growth of human population. To salvage this

situation, development of fish production trough aquaculture is mandatory. In order to achieve such a target, efficiency in fish hatchery production needs to be improved.

Fish hatchery efficiency can be improved through introduction of improved technology or full utilization of existing innovations which drive profit frontier upward. Although, boarding on new technologies might be meaningless, if fish farmers are found tardy,as regards adoption of a new technology (Kumar *et al*., 2005; Katiha *et al*., 2005). Using the stochastic frontier profit function model, profit efficiency is defined as the ability of a farm to achieve the highest possible profit given the prices and levels of fixed factors of that farm, and profit inefficiency, in this context, is defined as loss of profit for not operating on the frontier (Alli and Flin, 1989). Fish farming is one of the essential sectors of agriculture in Osun State since the establishment of Olupona fish farm in the 90's. It has gained popularity till date, coupled with abundant land and water resources that can support fresh water fish culture. The hydrographic conditions of the state have made fish farming enterprise a thriving agribusiness investment. Although, several authors have carried out series of studies on the economics and profitability of fish farming in many States, Osun State inclusive. Not many of such studies have focused on the profit efficiency and profitability of fish hatchery enterprise in the State. This is the gap that the study intends to fill. The specific objectives of this study therefore are to: describe the socio-economic characteristics of fish hatchery farmers; determine economic efficiency and assess the profitability fish hatchery enterprise.

Materials and Methods

The study area

This study was carried out in Osun State, South-West Nigeria. The state lies within latitudes 6° and 9°N of the equator and approximately between longitudes 2° and 7°E of Greenwich meridian (Anamayi, *et al.,* 2010). It is one of the land-locked states of the Federal Republic of Nigeria. It covers an estimated area of 8,062 square kilometres (Ashley-Dejo, 2016). The State runs an agrarian economy with a vast majority of the populace taking to farming. The state is a typical rain forest with mean annual rainfall varying between 880mm and 2600mm and is characterized by the forest vegetation. It is limited to freshwater fisheries (Ashley-Dejo, 2016).

Sampling procedure and data collection

Respondents were drawn from all the three agricultural zones from the state, Iwo, Osogbo and Ife/Ijesha zones. List of registered fish hatchery farms were collected from the State Agricultural Development Programme. The list comprises of three hundred and thirty eight (338) fish hatchery farmers. Simple random sampling technique was employed to select 60% of registered fish hatchery farmers, giving a total of two hundred and three (203) fish hatchery farmers sampled. Primary data were obtained from fish hatchery farmers using a structured questionnaire, which comprise of open and close ended questions. The questionnaire consists of different sections with respect to the specific objectives of the study. However, due to non-response and inadequate information, fourteen (14) copies of the questionnaire were discarded and data from one hundred and eighty nine (189) fish hatchery farmers were used for the analysis. Data were analysed using descriptive, inferential statistics and profitability analysis. Location of fish farmers were obtained from the State Ministry of Agricultural, Fisheries Department.

Stochastic profit frontier function

The stochastic function model was proposed by Aigner *et al*. (1997) on measurement of efficiency in which productive efficiency is defined as the ability of a firm to produce a given out put level at a lower cost. Production efficiency has two major components: Technical efficiency and Economic/Allocative efficiency. In recent time, combination of both measure are most preferred because it will enable more efficient estimates to be obtained simultaneously (Wang *et al.,* 1996). The most used approach in measuring technical efficiency is the use of frontier production function, but this approach has been argued that production function approach in measuring efficiency may not be appropriate since farmers are faced with different prices and have different factors affecting their production (Ali and Flinn, 1989). As a result of this, application of stochastic profit function model is used to estimate efficiency of farms directly. The profit function method makes use of technical and allocative efficiencies concepts in the profit relationship, and any errors in the production result are anticipated for to be interpreted into lower profit or income for the producer (Ojo, 2003).Therefore, profit efficiency is defined as the capability of a farm to realise the utmost likely profit given the prices and fixed variables of that farm. Profit inefficiency is described as profit loss for not operating on the frontier (Ali and Flinn, 1989). If the stochastic production frontier model is extended, the inefficiency effects can be expressed as a linear function of explanatory variable which reflect farm specific characteristics (Battese and Coelli, 1995). The programme of this model is that, it permits the assessment of farm specific efficiency scores and the factors explaining the efficiency differentials among farmers simultaneously in a single stage estimation procedure. This study adopts the Battese and Coelli (1995) model by postulating a profit function. The stochastic profit function is expressed thus;

$$Y_i = f(X_i, \beta) + e_i \text{----------(1)}$$

Where,
Y_i = net farm income
X_i = vector of actual input quantities used by the fish hatchery farmer
β = vector of parameters to be estimated
e_i = composite error term denoted as Coelli (1994)

$e_i = v_i - u_i$ ---------- (2)

Where,
v_i = symmetric error term and it is independently and identically distributed
u_i = the inefficiency component of the error term

The symmetric component (v_i) of the error terms which is independently and normally distributed as N (O, ∂v^2). A one sided component (u_i>O) shows economic inefficiency relative to the stochastic frontier. Hence, if u_i = 0, production lies below the frontier and u_i is assumed to be independently and identically distributed and truncated at zero with the variance ∂u^2 (N 0, ∂v^2). The parameter estimators (β) and the variance parameters were obtained by the maximum likelihood estimation methods.

$\partial^2 = \partial v^2 + \partial u^2$ ---------- (3)

$\gamma = \frac{\partial u}{\partial^2}$ ---------- (4)

Where,
I-γ = Inefficiency
γ = the variance ratio parameter (Gamma) and by Batesse and Coelli (1995), γ = (0≤ γ ≤I). The variance ration parameter (γ) has two important characteristics:
When ∂v^2 tends to zero, it is the predominant error terms in Equation 3 implying that the profit of the sampled farmers differs from the maximum profit mainly because of the difference in economic efficiency. When ∂v^2 tends to zero, v is the predominant error terms in Equation 3 and so γ tends to zero, thus differences between farmers profit and the efficiency profit can be determined based on the value of γ (Kalirajan, 1981).

Empirical Model
Cobb-Douglas functional method was designated for this study. According to Ogundari *et al.* (2006), this method has been used by a lot of empirical studies, mainly those connecting to agriculture in industrialized and developing countries and those that functional procedures meet the requirement of being self-dual (permitting economic efficiency examination). Moreover, this functional method fits well in cases where there is occurrence of high frequencies of observations (Tusec*et al*., 2012).

The Cobb-Douglas stochastic profit frontier function is as expressed thus;

$LnY = \beta_o + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + v_i - u_i$ -----(5)

Where,
Y = net farm income
X_1 = normalized average price of hatchery tanks/through in m^2
X_2 = normalized average price of feed in Naira (ratio of cost of feed to output price)
X_3 = normalized average price of drugs/medications in Naira (ratio of cost of medications to output price)
X_4 = normalized average price of labour ((ratio of cost of labour to output price)
$\beta_o - \beta_4$ = unknown parameters to be estimated
v_i = Random error which are assumed to be independently and identically distributed as N (0, $\sigma^2 v$)
u_i = non-negative profit inefficiency effects which are assumed to be half normal (because catfish farmers are assumed rational in their production behavior and hence negative profit is not expected) and independently distributed of V_i.

The presence of economic inefficiency effects were tested using the generalized likelihood ratio test (λ), which is defined by

$\lambda = -2(L_R - L_U)$ ----------(6)

Where,
L_R=log likelihood of the restricted model (Model 1)
L_U=log likelihood of the unrestricted model (Model 2)
λ has a chi-square distribution with degree of freedom equal to the number of parameters excluded in the unrestricted model. The null hypothesis was that the restricted Cobb-Douglas profit frontier model is the same as the unrestricted Cobb-Douglas Stochastic profit model.

Inefficiency Model
The $u_i$are the profit inefficiency effects and for this study, they are defined as

$u_i = \partial_0 + \partial_1 Z_1 + \partial_2 Z_2 + \partial_3 Z_3 + \partial_4 Z_4 + \partial_5 Z_5$ ----------(7)

Where,
Z_1 = age of fish hatchery farmers in years
Z_2 = years of educational attainment of fish hatchery farmers
Z_3 = household size
Z_4 = farming experience of catfish farmers in years
Z_5 = membership of cooperative society (dummy: training=1; no training=0)
$\partial_0, \partial_1, \partial_2, \partial_3, \partial_4, \partial_5$, = parameters to be estimated.
The unknown parameters of the models β's and ∂'s and the variance parameter were simultaneously estimated thus;
$\sigma^2 = \sigma^2_\mu + \sigma^2_v$ ---------- (8)
$\gamma = \sigma^2_\mu / (\sigma^2_\mu + \sigma^2_v)$ ---------- (9)

The value of γ indicates the relative magnitude of the variance, associated with the distribution of the inefficiency effects, u_i. If u_i in the stochastic frontiers are not present or alternatively, if the variance parameter, γ, associated with the distribution of $u_i$has value zero, then σ^2_u in the frontier model is zero and the models reduce to the traditional response model in which the variables age, education, household size, experience and membership of cooperatives are included as explanatory variables in the frontier function (the inefficiency effects are not stochastic).

Profitability of fish hatchery enterprise
The profitability was estimated using economic indicators as described by Ashley-Dejo *et al.,* (2017a) and Oluwatayo and Adedeji, (2019).

Net Farm Income (NFI) = TR – TC ---------- (10)
Benefit Cost Ratio (BCR) = TR/TC ---------- (11)
Rate of Returns to Investment (RORI) = (NFI/TC) x 100 ------- (12)
Net Profit Margin (NPM) = NFI/TC ----------(13)
Profit percentage = ((TR - TC)/TC) x 100----------(14)

Where,
TR = Total revenue (product of output and unit price of output)
TVC = Total variable Cost
TFC = Total fixed Cost
NFI = Net Farm Income
TC = Total cost (sum total of both variable and fixed cost)
BCR = is one of the concepts of discount method of project evaluation. As a rule of thumb, any business with BCR greater than one indicates it is profitable (Olagunju *et al*., 2007). Depreciation values of fixed items were used for calculation. Depreciation was calculated using a Straight Line Method (SLM), which assumed salvage value of zero.
DS = (OC - SV)/L

Where,
DS = Annual depreciation
OC = Original Cost
SV = Salvage Value
L = Expected or Useful Life Span (Years)

Results and Discussion

Socio-economic characteristics of fish hatchery farmers

The socio-economic characteristics (Table 1) revealed that age of fish hatchery farmers ranged between 25 to 67 years with a mean age of 46 years. Many (52.4%) are within the age range of 41-50years. Several authors describe this age (41 – 50 years) as productive and economically active age range (Oladoja and Adeokun 2013; Alawode and Jinad, 2014; Oke and Kehinde, 2019). This age range tends to have great influence on farmer's resource allocation, reasoning and management ability. Age is an important determinant of human reasoning, decision- making and responsibilities, it is also refers to the phase of individual development. Fish hatchery farmers in the study area were in their prime age, therefore economically active. Based on gender, the result showed that both male and female were actively involved in fish hatchery enterprise. Males were more dominant (82.5%) than their female counterparts, indicating that fish hatchery enterprise is mainly dominated by men. This finding is in agreement with the study of Oladimeji *et al.,* (2017); Olaoye *et al*., (2017); Folayan and Folayan (2017), that fish farming enterprise is dominated by men. Majority (89.4%) of the respondents were married. This finding is in line with the observation of Fawehinmi *et al.,* (2017) and Ashley-Dejo*et al.,* (2017a), who reported that majority of individuals in fish farming enterprise are married people saddled with family responsibilities.

From literacy point of view, education can be described as the number of years that an individual spent in formal school or as formal training obtained by individual. It was observed that all the respondents were educated. This is a healthy situation because through education, people could acquire skills and knowledge which are important in accessing and analysing relevant information on fish hatchery production, thereby increasing their social and economic wellbeing. Education also regulates to the quality of services of any agribusiness enterprise, resource allocation, information and technology utilization. Household size could be related to the role played by each member as sources of labour in agribusiness. The household size ranged from 1 to 13persons, with mean of 6personsper household. This implies that respondents with large household size are more likely to adopt and participate in improved technology compared to those with less.

Years of experience is the duration (years) which an individual has spent on a business/enterprise. This could be likened to maturity in understanding the enterprise as regards to fish hatchery management (selection, care of brood stocks/parent stock, latency period, striping, care of hatchelling etc) in an attempt to make profit. The average fish hatchery experience was 9 years, which suggest that respondents in the study area can be described as experienced in fish hatchery business. Majority (65.6%) of the fish hatchery farmers belong to cooperative society, while 34.4% do not. The massive participation in cooperative society was a reflection of support/assistance derived from the group which could enhance their daily operation.

Table 1: Socio-economic characteristics of fish hatchery entrepreneurs

Variables	Freq	%	Mean
Age			
21 – 30	3	1.6	
31 – 40	42	22.2	
41 – 50	99	52.4	46 years
51 – 60	32	16.9	
61 & above	13	6.9	
Gender			
Male	156	82.5	
Female	33	17.5	
Marital Status			
Single	9	4.8	
Married	169	89.4	
Divorced	11	5.8	
Educational level			
Primary Education	26	13.8	
Secondary Education	63	33.3	
Tertiary Education	100	52.9	
Household size			
1 – 3	33	17.5	
4 – 6	86	45.5	6 person
Above 6	70	37.0	
Years of experience in fish hatchery			
1 – 3	57	30.2	
4 – 6	71	37.6	9 years
Above 6	61	32.3	
Membership of cooperative society			
Yes	124	65.6	
No	65	34.4	

Source: Field Survey Data, 2016

Technical efficiency of fish hatchery enterprise

Table 2 presents the results of the maximum likelihood estimate (MLE) of the stochastic profit function used to determine the influence of specific input on fish hatchery profit and the effect of fish hatchery farmer's socio-economic characteristics on economic efficiency. The estimated sigma square (δ^2) value (0.46) was significant at 1% level of probability, suggesting a model of good fit and the correctness of the specified distributional assumptions. The gamma (γ) coefficient implies that 73% of shortfall below the frontier output of fish hatchery enterprise was due to economic inefficiency of the fish hatchery farmers in the study area.

Coefficients of the variables in the estimated profit function exhibited positive signs and significantly ($p<0.1$) influenced profit level of fish hatchery farmers in Osun State. The coefficients of number of fish hatchery tanks/troughs (1.07), cost feed (0.32), cost of drugs and medications (0.22) and labour (0.19) had positive values which corroborate their direct relationship with farm profit. This implies that 1% increase in these factor prices will bring about a marginal increase in farm profit by 1.7%, 0.32%, 0.22% and 0.19% respectively.

Table 2 further revealed the estimated coefficients of each of the socio-economic variables. It was observed that educational qualification (0.09), household size (0.07), fish hatchery experience (0.75) and membership of cooperative society (0.23) are positive, except age (-0.05) and significant though at different probability levels. This implies that, these variables are directly related to economic or profit efficiency of fish hatchery farmers in Osun State. This implies that increase in these variables will result in increase in profit efficiency of fish hatchery farmers. The finding from this study was in agreement with the study of Ogundari and Ojo (2007), for education, Olasunkanmi *et al*., (2013) for household size, Ogundari (2007) and Afolami and Ogungbenro (2017) for farming experience. The coefficient of age was negative and significant. This implies that profit efficiency decreases with the farmers' age. This could be because as farmers age increase, their efficiency decreases.

Table 2: Maximum likelihood estimates of parameters of stochastic frontier profit function for fish hatchery farmers

Variable	Parameter	Coefficients	Standard error	T-ratio
Production model				
Constant	β_o	-7.46	0.83	-8.99
Price of hatchery	β_1	1.07	0.16	6.69***
Price of feed	β_2	0.32	0.06	5.33***
Price of drugs/medications	β_3	0.22	0.07	3.14***
Price of labour	β_4	0.19	0.04	4.75***
Inefficiency model				
Constant	∂_0	-1.85	0.99	-1.87*
Age (years)	∂_1	-0.05	0.01	-5.10***
Educational qualification	∂_2	0.09	0.03	3.00***
Household size	∂_3	0.07	0.04	1.75*
Fish hatchery experience (years)	∂_4	0.75	0.29	2.59**
Membership of cooperative society	∂_5	0.23	0.07	3.29***
Sigma-squared (σ^2) = $\sigma^2_\mu + \sigma^2_v$		0.46	0.13	3.54***
Gamma (γ) = $\sigma^2_\mu /(\sigma^2_\mu + \sigma^2_v)$		0.73	0.11	6.64***

Source: Field Survey Data, 2016; ***Significant at 1%, **Significant at 5%, *Significant at 10%

Frequency distribution of Economic efficiency among fish hatchery farmers

Table 3 presents the summary of economic efficiency of fish hatchery farmers. The values of profit efficiency ranged from 0.31 to 0.94, with mean estimate of 0.85. Majority (60.3%) of the respondents had profit efficiency range of 90 – 99%, while 11.7% had below 70%. This implies that fish hatchery farm could increase profits by 15% by improving their economic efficiency. This result is in consonance with the findings of Oladeebo and Oluwarnati (2012), who stated that profit efficiency ranged between 20% and 91%, with mean profit efficiency level of cassava farmers as 79%. It also agrees with the findings of Olasunkami *et al*., (2013), who reported mean profit efficiency level of 0.72 (range 11 to 97%). The result obtained also agrees with the findings of Tsue *et al*. (2012) in their study on profit efficiency among catfish farmers in Benue State Nigeria. Their findings revealed that profit efficiency ranged between 23% and 99%, with mean efficiency of 0.84, which suggest an estimated 16% loss in profit due to combination of both technical and allocative inefficiencies.

Table 3: Frequency distribution of Economic efficiency of fish hatchery farmers

Efficiency Range	Frequency	Percentage
30 – 49	6	3.2
50 – 69	16	8.5
70 – 89	53	28.0
90 – 99	114	60.3
Total	189	100.0
Mean	0.85	
Minimum	0.46	
Maximum	0.93	

Source: Field Survey Data, 2016

Costs and returns of fish hatchery enterprise

The results of the costs and returns analysis in fish hatchery enterprise are shown in Table 4. On average, total fixed and variable cost was ₦103,980.79 and ₦44,810.91 respectively, with total fixed cost of about 70.0% of production cost. The Benefit cost ratio (1.58), Rate of Return (0.58), Net profit margin (0.37), and Profit percentage (58.43%), were used to establish the level of profitability of fish hatchery enterprise. It was observed that BCR was greater than 1, which implies that for any N1.00 invested in the enterprise, there is a positive return of N1.58 on investment. The finding in this study compares favourably with study of Akarue and Aregbor (2015), who examined the socio-economic analysis of fish farmers in Uvwie South LGA and reported BCR of 1.75. This finding is also in line with the study of Folayan and Folayan (2017), Inoin *et al*. (2017), Ashley –Dejo *et al.* (2017a) and Ashley-Dejo *et al.*(2017b).

Table 4: Cost structure and profitability analysis of fish hatchery farmers (6 weeks gestation period)

Cost of items	Amount (₦)	% of Total Cost
Fixed Costs		
Land purchase/Rent	14,964.29	10.05
Tanks/Troughs	1,978.52	1.33
Pumping machine	10,522.83	7.07
Water source (Deep well / Bore hole)	14,456.72	9.71
Water reservoir (Overhead tanks)	2,124.00	1.42
Plumbing materials and pipes	2,964.24	1.99
Building/shed	6,323.73	4.25
Tools (shovel, cutlasses)	1,425.52	0.95
Weighing scale	8,428.89	5.66
Generator	13,908.68	9.35
Scoop net	987.73	0.66
Permanent labour	17,326.08	11.64
Counting table and Grader	673.78	0.45
Wheel barrow	6,221.86	4.18
Plastic spoons, Pair of scissors and Bowls / buckets	1,673.92	1.12
Total Fixed Cost	103,980.79	69.88
Variable Costs		
Brood stock	5,175.44	3.48
Feed	14,128.77	9.50
Hormone and Injector (needle and syringe)	1,835.96	1.23
Saline water	247.27	0.17
Fuel	16,675.64	11.21
Industrial salt and drug	630.45	0.42
Hand towels and tissue paper	210.74	0.14
Transportation/handling charges	2,864.00	1.92
Kakaban, razor blade and knife	300.64	0.20
Others	2,742.00	1.84
Total Variable Cost	44,810.91	30.12
Total Cost	148,791.70	100.0
Total Revenue	235,732.44	
Gross Margin (TR - TVC)	190,921.53	
Net Farm Income (GMI - TFC)	86,940.74	
Benefit Cost Ratio (TR/TC)	1.58	
Rate Of Return (ROR) (NFI/TC)	0.58	
Net Profit Margin (NPM) (NFI/TR)	0.37	
Profit Percentage [(TR-TC/TC) x100]	58.43%	

Source: Field Survey Data, 2016; Note: $1 = ₦334:56 at the time of the study

Conclusion

The study examined economic efficiency and profitability of fish hatchery enterprise in Osun State, Nigeria. Maximum likelihood estimates of the specified Cobb- Douglas profit function and economic efficiency model revealed that farmer's efficiency varied between 0.46 and 0.93. with an average of 0.85. It was further revealed that profit efficiency deviated from the efficiency frontier which can be increased by 15% by adopting improved technologies. Age, educational qualification, household size, fish hatchery experience and membership of cooperative society were significant factors affecting profit efficiency. The study therefore recommends that government, development institutions, stakeholders and individuals should organise empowerment programmes mainly for fish hatchery farmers to acquire adequate skills in fish seed propagation. Furthermore, young individuals (educated and illiterate) should be motivated to venture into the enterprise to ensure the availability of quality fish seed throughout the year. Also, soft loans with minimal or no interest rates should be made available to fish hatchery farmers to enhance profitability. Although more than half of the farmers belong to cooperatives, others should be encourage to join, to enable them benefit directly from government intervention in terms of subsidized farm inputs and other programmes.

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