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RESEARCH ARTICLE OPEN ACCESS

RESOURCE-USE EFFICIENCY OF COMPOSITE FISH CULTURE IN SIVASAGAR DISTRICT OF ASSAM

***Pratibha Mohan and Dr. Durga Charan Kalita**

Dept. of Rural Development and Agricultural Production, North Eastern Hill University, Tura, Meghalaya

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****Corresponding author: Pratibha Mohan,***

ABSTRACT

The present study attempts to assess the resource-use efficiency in Composite Fish Culture in Sivasagar District of Assam. The study was based on primary data collectedthrough personal interview method of sampling by interviewing 150 samples borrowers and 150 non-borrowers from three size groups (based on pond size)being selected through cumulative root frequency rule. The results showed that the among borrowers,the result of economic or allocative efficiency (r) of inputs in group I and group II such as land (0.0451) and (0.109), fingerlings (0.089) human labour (0.025) and (0.015), machinery (0.102) and (0.011) and marketing (0.024) and (0.025) has been found over-utilized, technically lesser than 1 unit (<1). But in group size I the used of fertilizer (1.025) has been found under-utilized and in group II, fingerlings (-0.258) and fertilizer (-0.038) has been found negative MPV value which inducates inefficient utilization of resource. Similarly among non-borrowers inputs such as land (0.0125), fertilizer (0.025), human labour (0.005) and marketing (0.015) in group I has been found over-utilized, technically lesser than 1 unit (<1). Fingerlings (-0.051) and machinery (-0.025) has been found negative MPV /MFC which showed inefficient utilization of resource.The over-all return to scale was 1.1208 among borrowers and 0.6073 among non-borrowers, which showed an increasing return to scale for but borrowers were found higher return to scale than non-borrowers.

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INTRODUCTION

From the pre-historic time, fish has been considered as the most nutritious food due to containing high amount of protein, fats and Minerals. India, the second largest populated country in the world, where consumption of fish always was in huge demand. The increasing demand forced the fish farmers to catch fish in a large scale which results in over-exploitation of fishes in the Oceans and Seas. To mitigate the problems, in 1970, the researchers and scientist had adopted a scientific method of fish farming popularly known as Composite Fish Culture. It is defined as the culture of fast growing, compatible species of fish of different feeding habitats in the same pond to occupy the same ecological niches and where phytoplankton and aquatic weeds are effectively utilized to maximize fish production' (Sarker 2002). This new fishing technology requires huge investment and the farmer can attend huge profit if the resources such as fingerlings, feed, fertilizers, land, human labour, mechinary, marketing etc. has beenutilized in an efficient manner. With this motive, the paper tried to find, weather the resources were efficiently utilized or not.

MATERIALS AND METHODS

The Cobb-Douglas production function of (monetary value) used to measure the resource use efficiency in composite fish culture.

The equation was given below:

$$y = a^{0} x^{i} a^{1}$$

Where,

Y = Level of output
X^i = Level of input
a^0,a^1 = constant represent efficiency parameter and the production elasticity's of respective input variables.

Input use efficiency has been examined by using equimarginal principle which was explained by allocative efficiency and measured by the following ratio.

Allocative efficiency = MPV/MFC

Where,
MPV= Marginal value product
MFC= Marginal factor price (price of input)

$MVP=MPP_{xi}.P_0$

P_o =Price of output (fishery)
MPP = the marginal physical product of resource input used

$MPP_{xi} = bxi. \frac{y}{x_i}$

Where,
bxi = elasticity co-efficient of xi^{th} independent variable
Y = Geometric mean of output
X_i = Geometric mean of xi inputs
b_{xi} was estimated from Cobb-Douglas production function using Ordinary Least Square (OSL) approach after converting it into log linear form. The estimated form of the equation is given below:

$\text{Ln } Y = \text{Ln } a + b_1 \text{ Ln } x_1 + b_2 \text{ Ln } x_2 + \ldots\ldots\ldots\ldots + b_n \text{Ln} x_n$

Where, a = intercept
$b_1 \ldots\ldots b_n$ = parameter to be estimated
$x_1 \ldots\ldots x_n$ = inputs

Determination of Economic Efficiency of Resource Use:
The following ratio was used to estimate the relative efficiency of resource use (r)

r = MPV/MFC

Where,
MFC = cost of one unit of a particular resource
MPV = value added to wetland rice output due to the use of an additional unit of input calculated by multiplying the MPP_{xi} x P_o

calculate the rate of return to scale which is a measure of a firm's success in producing maximum output from a set of input (Farrel 1957).

This was given as:

E_p = MPP/APP

Where,
E_p = Elasticity of production
MPP = marginal physical product (change of output)
APP = Average physical product (change of input)
If
$\sum E_p = 1$: constant return to scale
$\sum E_p < 1$: decreasing return to scale
$\sum E_p > 1$: increasing return to scale (Choudhury 2019)

RESULTS AND DISCUSSION

Table 1 Production elasticity and allocative efficiency of resource use of Borrowers in composite fish culture across size groups. The Production elasticity and allocative efficiency (r) of both borrowers and non-borrowers has been presented in the table 1 and 2. Among borrowers the Coefficient of multiple determination (R^2) of production function was 0.54 in group size I, 0.45in group size II and 0.58 in group size III. Which showed 54 percent, 45 percent and 58 percent of variation in productivity among group I, group II and Group III which was represent by independent variables. The overall coefficient was 0.53which mean 53 percent of overall income was depend on these independent variables. The sum of technical efficiency or elasticity coefficient ($\sum Ep<1$) of inputs such as land, fingerling, fertilizer, human labour, marketing and machinery has been found 1.79, 0.42and 1.14 among group I, group II and group III respectively. The over-all return to scale was 1.1208 which showed an increasing return to scale.

Table 1. Production elasticity and allocative efficiency of resource use of Borrowers in composite fish culture across size groups:

Size Groups								
	Group I		Group II		Group III		All	
variables	Coefficient	MPV/MFC	Coefficient	MPV/MFC	Coefficient	MPV/MFC	Coefficient	MPV/MFC
Constant	4.2689		2.2562		3.05018		3.1367	
Land	0.2456	0.0451	0.2068	0.109	0.3158	0.052	0.4698	0.236
Fingerlings	0.2368	0.089	-0.2566	-0.258	0.3573	1.806	0.5694	0.456
Fertilizer	0.0159	1.025	-0.0256	-0.038	0.2459	1.056	0.4592	2.569
Human labour	0.0126	0.025	0.2561	0.015	-0.2458	-0.012	0.3458	0.543
Machinery	0.2546	0.102	0.0158	0.011	0.1258	0.128	0.2583	2.431
Marketing	1.025	0.024	0.2283	0.025	0.3481	2.0582	1.102	2.305
Return to scale	1.7905		0.4248		1.1471		1.1208	
R^2	0.54		0.45		0.58		0.53	

Decision rule

If $r = 1$, resource is efficiently utilized
$r > 1$, resource is under-utilized while
$r < 1$, resource is over utilized

Economic optimum has been taken place where MPV = MFC. If r is not equal to 1, it is recommended that resource was not utilized efficiently. Adjusment could be therefore, be made in the quantity of input used and cost in the production process to restore r = 1.

Determination of Technical Efficiency of Resource Use:

The elasticity of production which is the percentage of change in output as a ratio of a percentage change in input was used to

The result of economic or allocative efficiency (r) of inputs in group I and group II such as land (0.0451) and (0.109), fingerlings (0.089) human labour (0.025) and (0.015), machinery (0.102) and (0.011) and marketing (0.024) and (0.025) has been found over-utilized, technically lesser than 1 unit (<1). But in group size I the used of fertilizer (1.025) has been found under-utilized and in group II, fingerlings (-0.258) and fertilizer (-0.038) has been found negative MPV value which showed inefficient utilization of resource. In group III the variable input such as land (0.052), and machinery (0.128) has been found over-utilized as the MPV/MFC was found lesser than 1 unit (<1) and fingerlings (1.806), fertilizer (1.056) and marketing (2.0582) were found under-utilized, technically 'MPV/MFC ' was greater than 1 unit (>1).

Table 2. Production elasticity and allocative efficiency of resource use of Non-Borrowers in composite fish culture across size groups

Size Groups								
	Group I		Group II		Group III		All	
variables	Coefficient	MPV/MFC	Coefficient	MPV/MFC	Coefficient	MPV/MFC	Coefficient	MPV/MFC
Constant	1.0125		1.3982		2.0258		2.9820	
Land	0.1287	0.0125	0.3085	0.008	0.4201	0.080	0.2365	0.112
Fingerlings	-0.0258	-0.051	-0.2048	-0.128	0.5876	1.023	0.2587	0.128
Fertilizer	0.0059	0.025	-0.0158	-0.108	0.1258	1.025	0.2008	1.054
Human labour	0.0258	0.005	0.1358	0.011	-0.2238	-0.109	0.2548	0.256
Machinery	-0.2102	-0.025	0.0245	0.103	0.1109	0.028	0.1582	1.059
Marketing	0.2485	0.015	0.1253	0.019	0.2549	1.254	0.5897	1.305
Return to scale	0.1729		0.3735		1.2755		0.6073	
R^2	0.45		0.41		0.54		0.45	

The utilization of human labour (-0.012) has been found negative MPV value which showed the resource was inefficiently utilized. The overall MPV/MFC value all the three size group of water has been found inefficiently utilized as the land (0.236), fingerlings (0.456) and human labour (0.543) were found over utilized, i.e 'MPV/MFC ' was lesser than 1 unit (<1) and fertilizer (2.569), machinery (2.431) and marketing (2.305) has been found under-utilized as the 'MPV/MFC ' was greater than 1 unit (>1). Although the return to scale on an average has been found greater than 1 unit (>1), the value was (1.1208), which indicates that the fish farming remains in a profitable business. The over-all finding thus revels that the all the beneficiaries in the fish farming were not utilizing the resources optimally, but remains in a profitable business. In case of Non-borrowers the Coefficient of multiple determination (R^2) of production function was 0.45 in group I, 0.41 in group II and 0.54 in group III. Which showed 45 percent, 41 percent and 54 percent of variation in productivity among group I, group II and Group III which was represent by independent variables. The overall coefficient was 0.45 which mean 45 percent of overall income was depend on these independent variables.

The sum of technical efficiency or elasticity coefficient ($\sum Ep<1$) of inputs such as land, fingerling, fertilizer, human labour, marketing and machinery was found 0.172, 0.37 and 1.27 among group I, group II and group III respectively. The over-all return to scale on an average has been found 0.6073 which showed an increasing return to scale. The result of economic or allocative efficiency (r) of inputs such as land (0.0125), fertilizer (0.025), human labour (0.005) and marketing (0.015) in group I has been found over-utilized, technically lesser than 1 unit (<1). Fingerlings (-0.051) and machinery (-0.025) has been found negative MPV /MFC which showed inefficient utilization of resource. In group II, land (0.008), human labour (0.011), machinery (0.103) and marketing (0.019) has been found over-utilized as MPV/MFC is lesser than 1 unit (<1), but fingerlings (-0.128) and fertilizer (-0.108)has been found negative MPV which indicates inefficient resource utilization. In group III, land (0.080) and machinery (0.028) were found over-utilized as MPV/MFC is lesser than 1 unit (<1), whereas fingerlings (1.023), fertilizer (1.025) and marketing (1.254) has been found under-utilized as 'MPV/MFC ' was greater than 1 unit (>1). Human labour (-0.109) has been found negative MPV value which showed inefficient utilization of resource. The overall MPV/MFC value all the three size group has been found inefficiently utilized as the land (0.112), fingerlings (0.128)and human labour (0.256) were found over utilized, i.e 'MPV/MFC ' was lesser than 1 unit (<1) and fertilizer (1.054), machinery (1.059) and marketing (1.305) has been found under-utilized as the 'MPV/MFC ' was greater than 1 unit (>1).

The return to scale on an average has been found lesser than 1 unit (>1), the value was (0.6073), which indicates that the fish farming among non-borrowers remain in loss. The over-all finding thus revels that both the beneficiaries and the non-beneficiaries in the fish farming business were not utilizing the resources optimally, hence borrowers has been found in gaining profit rather than the non-borrowers. Thus the result showed that the Coefficient of multiple determination (R^2) of production function among borrowers remains 0.54 in group I, 0.45 in group II and 0.58 in group III which showed 54 percent, 45 percent and 58 percent of variation in productivity which was represented by independent variables. Among non-borrowers also the Coefficient of multiple determination (R^2) of production function was 0.45 in group I, 0.41 in group II and 0.54 in group III which showed 45 percent, 41 percent and 54 percent of variation in productivity. The result thus indicates the variation of productivity has been found higher among borrowers than non-borrowers. The technical efficiency or elasticity coefficient ($\sum Ep<1$) of inputs among borrowers showed an increasing return to scale than the non-borrowers. The findings also revealed inefficient utilization of different resources among borrowers and non-borrowers, although borrowers has been found profitable outcome than non-borrowers.

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