



Research Article

# Choice of Small-scale Catfish Farmers for Rearing System in Oyo State, Nigeria: A Comparative Analysis of SEAP Beneficiaries and Non-beneficiaries

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## Abstract

The choice of rearing systems has important implications for productivity, profitability, and sustainability among small-scale fish farmers. This study analyses the determinants of rearing system choice among small-scale catfish farmers in Oyo State, Nigeria, with particular emphasis on the role of institutional support through the Self-Reliance Economic Advancement Programme (SEAP). Using cross-sectional data from 248 farmers (124 SEAP beneficiaries and 124 non-beneficiaries), we examine farmers' choices among earthen, concrete, and collapsible ponds/other systems, using a multinomial logit model. The results indicate that access to credit, fish farming income, SEAP participation, farming experience, marital status, and primary occupation significantly influence the choice of rearing system. Farmers with greater access to credit and higher incomes are more likely to adopt capital-intensive systems, such as concrete and collapsible ponds, rather than earthen ponds. In contrast, more experienced and married farmers tend to remain with earthen ponds, reflecting risk considerations and path dependency. The findings underscore the importance of institutional and financial support for intensifying catfish farming and provide policy-relevant insights to inform the design of credit and extension programs for small-scale fish farmers.

## Keywords

Aquaculture Systems, Catfish Farming, Multinomial Logit, Rearing Systems, Nigeria, SEAP

## 1. Introduction

Aquaculture is crucial for Nigeria's food security and economic growth. Catfish farming is prominent in aquaculture due to its high demand, rapid expansion, and adaptability across various farming systems [1]. Small-scale catfish farming especially helps improve food security and provides income for rural and urban households [2]. However, the choice of rearing system greatly impacts productivity, profitability, and sustainability. Small-scale farmers mainly use three rearing systems:

earthen ponds, concrete tanks, and collapsible ponds. Each has different strengths and weaknesses regarding capital costs, management needs, and environmental suitability. The factors that influence farmers' choices for these systems are complex and often shaped by socioeconomic, institutional, and financial conditions.

Many small-scale farmers encounter obstacles that limit their production, including reduced access to capital [3], technical know-how [4], land [5], and environmental conditions

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[6]. An effective rearing system can boost productivity and profitability [7]. Various government and non-governmental programs have been launched to improve farmers' access to financing, technical training, and business sustainability [8]. One notable initiative is the Self-Reliance Economic Advancement Programme (SEAP), established in 1998 and officially registered in 2000. SEAP is a non-profit, non-political, and non-religious organization that aims to promote sustainable livelihoods for marginalized communities. Its primary goal is to economically empower underprivileged groups, build capacity, and enhance the socioeconomic conditions of impoverished individuals. SEAP has played a vital role in supporting small and medium-sized enterprises in developing viable, market-oriented business frameworks [9]. The Self-Reliance Economic Advancement Programme (SEAP) promotes fisheries and aquaculture by advancing financial inclusion, providing enterprise support, and building capacity for small-scale entrepreneurs. SEAP Microfinance Bank offers micro-credit and savings services to fish farmers, processors, traders, and input suppliers without access to formal banking services. These services help producers invest in inputs such as fish-ponds, fingerlings, feed, and equipment, thereby boosting production and sustainability. SEAP also supports women in fish processing and marketing via group lending and cooperative financing, reducing risks and encouraging collective participation. It provides training in entrepreneurship and financial literacy to improve business skills and market engagement. Collaborations with organizations such as the World Bank, the International Fund for Agricultural Development (IFAD), and the United Nations Development Program (UNDP) support broader livelihood programs by strengthening value chains through increased access to finance, fostering entrepreneurship, adding value, and boosting income for smallholder fish farmers and related businesses.

Choosing an appropriate rearing system provides significant benefits to catfish farmers, especially through improved water quality management, leading to healthier fish and a lower disease risk [10, 11]. Well-designed systems, such as Recirculating Aquaculture Systems (RAS) or properly managed ponds, create optimal environmental conditions that promote faster growth, improved feed efficiency, and reduced mortality [12, 13]. Consequently, farmers can achieve higher yields, greater profitability, and more efficient use of resources, including water conservation. Additionally, effective rearing systems enhance disease control and biosecurity, supporting more sustainable and environmentally responsible aquaculture practices [14, 15].

Careful selection and management of rearing systems are vital to the success of catfish farming. Empirical research is urgently needed to understand the factors shaping small-scale farmers' choices in Nigeria. Small-scale fish farming boosts food security, income, and employment [2]. Demographics such as gender, age, education, and access to resources influence decisions about rearing systems [2]. Farmers face challenges, including limited resources, poor infrastructure, and a

lack of technical knowledge. Choosing between pond, cage, or pen culture critically affects productivity, profitability, and sustainability [16, 17].

This study contributes to the aquaculture economics literature by analyzing the determinants of rearing system choice among small-scale catfish farmers in Oyo State, Nigeria, and by comparing SEAP beneficiaries and non-beneficiaries. Using a multinomial logit framework grounded in profit-maximization theory, the paper examines how socioeconomic characteristics, institutional participation, and financial access shape technology choices in small-scale aquaculture. The findings will inform the development of customized extension services, credit facilities, and other support programs to improve productivity and profitability in small-scale catfish farming in the area [18]. This research could influence policies supporting small-scale fish farming in Oyo State, Nigeria, by deepening the understanding of farmers' choices of rearing systems. This understanding can guide targeted interventions to address sector challenges and promote sustainable, efficient practices. Consequently, it can enhance productivity, profitability, and sector sustainability, guiding effective policies for growth across Nigeria.

## 2. Materials and Methods

### 2.1. Theoretical Framework

This study is grounded in profit-maximization theory, which assumes that farmers select production systems that maximize expected profits subject to resource and institutional constraints [19, 20]. In catfish farming, producers choose among alternative rearing systems by comparing expected revenues and costs, including initial investment, operating expenses, and risk exposure. Capital-intensive systems, such as concrete and collapsible ponds, typically require higher upfront investment but may offer higher yields and better control over production conditions [12, 21]. Conversely, earthen ponds entail lower fixed costs but may yield lower productivity and pose greater environmental risk. Institutional interventions, such as access to credit and development programs, can alter farmers' feasible choices by easing liquidity constraints and reducing information gaps. These factors affect fish growth, size, health, marketable output, and prices [22]. For example, improved water management in controlled environments can produce healthier, faster-growing fish, increasing revenue. Farmers must also consider market demand for different catfish sizes and types when selecting profitable systems. Risk assessment is crucial, as challenges such as disease, water quality, and market price fluctuations can impact outcomes [23]. The chosen rearing system shapes these risks. Intensive systems may increase production but also raise the risk of disease transmission if left unmanaged. Farmers balance these risks against potential profits to optimize gains and reduce losses. Governmental and NGO initiatives, such as

SEAP, can support farmers by providing information and resources for profit-oriented, sustainable practices. The multinomial logit model used in this study captures these trade-offs by estimating the probability that a farmer selects a particular rearing system relative to a base category.

## 2.2. Study Area

Oyo State is one of the leading agricultural states in southwestern Nigeria, with a strong presence in aquaculture, particularly catfish farming. Geographically, it lies between latitudes 7°N and 9°N and longitudes 2.5°E and 5°E, covering approximately 28,454 km<sup>2</sup>. It borders Osun, Ogun, Kwara, and Ondo, making it a strategic location for fish production and marketing. The state has a tropical climate with distinct wet and dry seasons, creating an ideal environment for fish farming. Oyo State is rich in water resources, including rivers, streams, and reservoirs, which provide a vital foundation for aquaculture. Major fish-producing regions include Ibadan, Oyo, Ogbomoso, Iseyin, and Saki, where small-scale farmers contribute significantly to fish production. Catfish farming is widely practiced, with farmers using earthen ponds, concrete tanks, and tarpaulin ponds to meet rising demand in both urban and rural markets. Market access, feed supply chains, and extension services influence farmers' choice of rearing systems. Oyo State is bordered to the north by Kwara State for 337 kilometers, to the southeast by Osun State for 187 kilometers, partially along the River Osun, to the south by Ogun State, and to the west by the Republic of Benin, spanning 98 kilometers. The economy of Oyo State is predominantly agricultural, with significant production of crops such as cassava, maize, cocoa, catfish, and tobacco.

## 2.3. Sampling Procedure and Sample Size

A multi-stage sampling procedure was used in this study. In the first stage, six Local Government Areas (LGAs) were purposively selected from the ten SEAP-beneficiary LGAs in Oyo State. These included Ido, Atiba, Egbeda, Oluyole, Akinyele, and Iseyin, chosen for their active small-scale catfish farming. Two fish-farming communities were purposively selected from each LGA, yielding a total of 12 communities in the second stage. A reconnaissance survey with SEAP officials identified loan beneficiaries in these areas. The Slovenian formula was used in the final stage to determine the sample size. A total of 248 farmers were randomly selected, comprising 124 SEAP beneficiaries and 124 non-beneficiaries. This approach ensures balanced representation by systematically comparing the factors influencing small-scale farmers' preferences across different catfish-rearing systems.

## 2.4. Source of Data

Primary data were collected using a semi-structured questionnaire administered through face-to-face interviews. The questionnaire consisted of closed-ended questions (multiple-

choice and categorical responses) capturing socioeconomic characteristics, farm structure, institutional access, and production decisions. Limited open-ended questions documenting farmers' production constraints and management experiences. Information collected included: demographic characteristics (age, sex, education, marital status); farm characteristics (experience, farm size, stock size, income); institutional variables (credit access, extension services, agricultural training, cooperative membership); participation in the Self-Reliance Economic Advancement Programme (SEAP); and type of rearing system adopted. The questionnaire was pre-tested in a non-sampled community to ensure clarity and reliability before full deployment.

## 2.5. Methods of Data Analysis

Descriptive and inferential statistics, including tables and frequencies, were used to achieve the study's objectives. Descriptive statistics were used to analyse the socioeconomic characteristics of catfish farmers. A multinomial logistic regression model was used to assess factors influencing catfish farmers' preferred rearing system. The multinomial logit regression model is appropriate when the dependent variable is nominal and has more than two categories that cannot be meaningfully ordered. The multinomial logit model was applied to represent the various rearing system categories among rice farmers in the study area. The values 1, 2, and 3 correspond to rented or leased land, personal land, and inherited land, respectively.

Therefore, this study categorised the types of rearing systems commonly adopted into three;

- 1) Earthen ponds
- 2) Concrete ponds
- 3) Collapsible and others

Following [24] and [25], the probability that a farmer  $i$  chooses system  $j$  is given by:

$$P(Y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{k=1}^2 \exp(X_i\beta_k)}, j = 1, 2 \quad (1)$$

where  $X_i$  is a vector of explanatory variables including socioeconomic, institutional, and farm-level characteristics. For  $j = 1, 2, \dots, (k-1)$ , the model parameters are estimated by the method of multinomial logit.

*Note:* In estimating the multinomial logit model, the collapsible pond system was designated as the reference (base) outcome category. This choice was motivated by its relatively low adoption rate compared with earthen and concrete pond systems, which dominate aquaculture production in the study area. Selecting the least frequently chosen alternative as the base category enables meaningful comparison of farmers' relative probabilities of adopting more established rearing systems and improves the interpretability of marginal effects and coefficient estimates.

$P$  = the number of explanatory variables included in the model.

In practice, when estimating the model, the coefficients for the reference group are normalized to zero [24-27]. This is because the probability for all choices must sum to unity [26]. Hence, for three choices, only (3 - 1) distinct parameter sets can be identified and estimated. Taking the natural logarithm of the odds ratios in equations (1) and (2) yields the estimating equation [26] as:

$$P(Y_i = j) = \frac{e^{X_i\beta_j}}{\sum_{k=0}^J e^{X_i\beta_k}} \quad (2)$$

where  $X_i$  as a vector of explanatory variables including socio-economic and institutional characteristics, and  $\beta_j$  as a vector of parameters to be estimated.

For  $j = 1, 2, \dots, (k-1)$ , the model parameters are estimated by the method of multinomial logit.

The following sets of independent variables were put in the model.

- $X_1$  = Sex (Male=0, Female=1)
- $X_2$  = Age (Years)
- $X_3$  = Marital Status (Married=0, 1=Otherwise)
- $X_4$  = Education Level (Years)
- $X_5$  = Household (Number)
- $X_6$  = Farming experience (Years)
- $X_7$  = Primary occupation (Fish farming=0, 1=otherwise)
- $X_8$  = Total fish income (Naira)
- $X_9$  = Amount of credit received (Naira)
- $X_{10}$  = Cooperative association membership (Yes=0, No=1)
- $X_{11}$  = Access to extension (Yes=0, 1=No)
- $X_{12}$  = Access to Agricultural Training (Yes=0, No=1)
- $X_{13}$  = Participation in SEAP (Yes=0, 1=No)
- $X_{14}$  = Livelihood index
- $X_{15}$  = Farm size (Ha)

### 3. Results and Discussion

#### 3.1. Socioeconomic Characteristics of SEAP Beneficiaries and Non-beneficiaries

The socioeconomic characteristics of the small-scale catfish farmers are presented in Table 1. It reveals key structural features of aquaculture production in Oyo State and provides context for understanding farmers' choices of rearing systems. The results show that catfish farming in Oyo State is predominantly male-dominated, with males accounting for 89.52% of SEAP beneficiaries and 87.90% of non-beneficiaries. Female participation remains relatively low, reflecting ongoing gender-based barriers to accessing resources, including land, capital, and aquaculture infrastructure. The similar gender composition across both groups indicates that program participation does not significantly change existing gender dynamics but operates within current institutional structures. These findings align with those of [2], who reported that fish farming is predominantly male in the study area. The low presence of

women in small-scale fish farming can be linked to their involvement in off-farm activities, such as food vending, hair-dressing, tailoring, and petty trading.

The age distribution reveals that farmers are mainly within the economically active population, with average ages of 41 and 43 years for beneficiaries and non-beneficiaries, respectively. Most respondents fall within the 31–50 age range, indicating sufficient physical capacity and managerial maturity needed for aquaculture operations. The similar age structures of the two groups suggest that demographic factors alone are unlikely to explain differences in production decisions; instead, institutional and economic conditions may have a greater influence. This supports the assertion in [28] that fish farmers in the study area are predominantly middle-aged and active. It indicates that the industry comprises energetic, capable individuals who can effectively handle the physical demands of farm work. This bodes well for the sector's sustainability and growth in the study area.

Marital status patterns further reveal that aquaculture is primarily practiced by household heads, with over 70% of respondents in both groups being married. Marriage may influence investment behaviours by increasing household responsibilities and risk considerations, potentially encouraging farmers to adopt production systems perceived as stable and less risky. This aligns with [28], who found that most small-scale fish farmers were settled family members with responsibilities. It also supports [29], who reported that most loans were given to married small-scale fish farmers. Educational attainment among farmers is relatively high, with most holding secondary or tertiary education. This suggests that farmers generally have the mental capacity to process technical information and adopt improved aquaculture methods when conditions such as finance and training are available. [29] found that all respondents had some form of formal education and that educational level affected their awareness of modern fish farming practices.

Household sizes are relatively small, with most respondents reporting four or fewer members and an average of about two people per household. This explains the high dependence on hired labour seen among farmers, confirming the increasingly commercial nature of small-scale aquaculture in the area. In fact, hired labour accounts for over 80% of farm work among beneficiaries and nearly 80% among non-beneficiaries, indicating that fish farming extends beyond subsistence activities. This pattern suggests a potentially negative trend, highlighting the need for more hired labour, which contrasts with [30], who argued that larger family sizes are linked to a higher likelihood of sustainable labour, as family members contribute to the workforce.

Institutional access indicators show modest but meaningful differences between the two groups. Access to credit is slightly higher among SEAP beneficiaries, reflecting the program's financial support to improve farmers' investment capacity. This contradicts the claim of [31], who reported that most small-scale fish farmers lacked access to credit due to a

scarcity of loanable funds. Instead, this study indicates that beneficiaries had better access to credit, possibly due to their participation in the program. Access to extension services remains moderate and similar across groups, suggesting that public advisory services are broadly available to farming communities rather than being specific to the program. Cooperative membership is also common among the farmers, emphasizing the importance of social networks in facilitating access to information, credit, and production inputs. These findings support [28]'s assertion that most small-scale farmers in the study area are members of a cooperative society.

Differences in farming experience suggest that SEAP participation may attract relatively newer entrants into aquaculture. While a significant proportion of beneficiaries have 10 years or less of farming experience, non-beneficiaries are more concentrated in the 11–20 years' experience category. This pattern indicates that institutional support programs may play an important role in lowering entry barriers for emerging farmers seeking to expand production. Occupational structure further reinforces this observation, as a higher proportion of beneficiaries identify fish farming as their primary occupation. In contrast, non-beneficiaries show greater livelihood diversification through civil service and other activities. This result contradicts the assertion of [32], who affirmed that most aquaculture farmers in the study area were part-time fish farmers, highlighting the diversity of experience among small-scale fish farmers.

Land ownership patterns show relatively secure tenure arrangements, with most farmers working on land they own or have inherited. Secure land access reduces investment uncertainty and promotes the long-term development of aquaculture infrastructure. Production indicators also reveal clear differences between groups. Although average stock sizes are similar, beneficiaries earn higher incomes from fish farming, with their average annual earnings significantly surpassing those of non-beneficiaries. This income gap suggests that participating in the program may boost financial performance by improving access to capital and investment in production. Results further indicated that most beneficiaries (86.29%) and non-beneficiaries (79.84%) primarily used hired labour for farm work. This contradicts the findings of [31], who claimed that a household size of 5 people would make farming less labour-intensive due to the division of labour.

Overall, the socioeconomic profile shows that differences between SEAP beneficiaries and non-beneficiaries are influenced more by institutional access, commercialization levels, and financial capacity than by demographic traits. Beneficiaries exhibit greater involvement in aquaculture as their main livelihood and higher incomes, factors that likely influence the technology choices discussed in the following econometric analysis. These results emphasize the significance of targeted financial and institutional support in guiding production decisions among small-scale aquaculture farmers.

**Table 1.** Socioeconomic Characteristics of Oyo State SEAP Small-Scale Fish Farmers.

Variables	Beneficiaries		Non-beneficiaries	
	Frequency	Percent	Frequency	Percent
Sex				
Female	13	10.48	15	12.10
Male	111	89.52	109	87.90
Age of the farmers				
≥ 30	24	19.35	13	10.48
31–40	45	36.29	42	33.87
41–50	28	22.58	33	26.61
51–60	20	16.13	26	26.97
≥ 70	07	5.65	10	8.06
Mean	41		43	
Min	27		28	
Max	70		70	
Marital status of the farmers				
Not married	14	11.29	12	9.68
Married	88	70.97	94	75.81
Divorced	18	14.52	15	12.09

Variables	Beneficiaries		Non-beneficiaries	
	Frequency	Percent	Frequency	Percent
Separated	04	3.23	05	4.03
Level of education of the farmers				
No formal education	01	0.80	00	0
Primary education	05	4.03	05	4.03
Secondary education	63	50.81	62	50.00
Tertiary education	55	44.35	57	45.97
Household size of the farmers				
≤ 4	123	99.19	122	98.39
≥ 8	01	0.81	02	1.61
Mean	2		2	
Min	0		0	
Max	6		6	
Access to credit				
No	11	8.87	15	12.10
Yes	113	91.13	109	87.90
Access to extension services				
No	52	41.94	56	45.16
Yes	72	58.06	68	54.84
Member of a farmers' cooperative society				
No	57	45.97	54	43.55
Yes	67	54.03	70	56.45
Years of fish farm experience				
≤ 10	50	40.32	34	27.42
11-20	50	40.32	66	53.23
21-30	11	8.87	22	17.74
≥ 40	13	10.48	02	1.61
Mean	14		14	
Min	6		7	
Max	40		40	
Primary occupation				
Fish farming	42	33.87	28	22.58
Civil service	32	25.81	36	29.03
Artisan	24	19.35	32	25.81
Farming	24	19.35	31	25.00
Others	02	1.61	01	0.08
Source of land				
Personal land	56	45.16	58	46.77

Variables	Beneficiaries		Non-beneficiaries	
	Frequency	Percent	Frequency	Percent
Sex				
Inherited	52	41.94	47	37.90
Rented/leased	16	12.90	19	15.32
Stock size (stock density)				
Mean	4,762		4,762	
Min	200		200	
Max	75,000		75,000	
Primary Sources of Farm Labour				
Family	17	13.71	25	20.16
Hired	107	86.29	99	79.84
Total Income from Fish Farming (₦)				
Mean	2,145,714.00		1,178,671.00	
Min	200,000.00		150,000.00	
Max	18,000,000.00		5,000,000.00	
Total	124	100	124	100

Source: Field survey, 2024

### 3.2. Types of Rearing System Adopted by the Farmers

Figure 1 shows the types of rearing systems adopted by farmers. Regarding production technologies, earthen ponds remain the primary system for both groups, used by over 80%

of beneficiaries and more than 70% of non-beneficiaries. However, the adoption of concrete tanks is slightly higher among non-beneficiaries, while collapsible ponds remain a minor but emerging system. The continued use of earthen ponds underscores their affordability, lower risk, and familiarity among small-scale farmers, while the gradual adoption of alternative systems indicates ongoing but uneven technological change within the aquaculture sector.

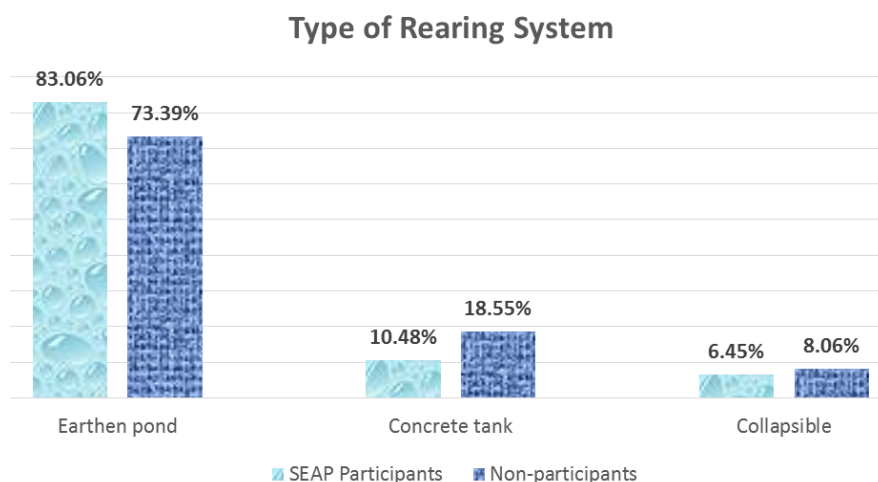


Figure 1. Types of Rearing System Adopted by the Farmers.

### 3.3. Factors Influencing the Choice of Rearing System Among Catfish Farmers in Oyo State, Nigeria

A multinomial regression model was used to examine the factors influencing the choice of rearing system among catfish farmers in Oyo State, Nigeria. A pseudo-R-squared of 0.254 indicates that the model's independent variables explain approximately 25.4% of the variation in the choice of rearing system. Although it is lower than the R-squared in linear regression, it indicates a reasonable model fit for this type of analysis [33]. The chi-square test ( $\chi^2 = 87.444$ ,  $p < 0.000$ ) examines the null hypothesis that all the coefficients in the model are zero. The highly significant p-value ( $p < 0.000$ ) indicates that the model is significantly better at predicting the choice of rearing system than a null model with no predictors. Importantly, coefficients from the multinomial logit model capture changes in relative log-odds rather than marginal probability effects. Therefore, interpretations are framed in terms of likelihood relative to the base category, avoiding causal claims.

*Agricultural Training:* The coefficient for agricultural training was significant at the 10% level ( $p < 0.1$ ). This suggests that farmers with access to agricultural training are more likely to prefer earthen ponds over concrete or collapsible ponds. Agricultural training can inform farmers about the benefits and management of different rearing systems, potentially leading them to adopt more modern and intensive systems [2].

*Amount of Credit:* The coefficient on credit is positive and statistically significant for capital-intensive systems relative to earthen ponds. This indicates that increased access to credit raises the likelihood of choosing concrete or collapsible ponds, consistent with the expectation that liquidity constraints limit adoption of capital-intensive technologies [2] and [25].

*Fish farming income:* Higher income significantly increases the probability of selecting concrete ponds over earthen ponds, consistent with evidence that profitability and reinvestment capacity influence upgrading of production systems [34, 35]. This suggests that profitability and reinvestment capacity play a central role in system upgrading.

*Participation in SEAP:* SEAP participation is statistically significant in the concrete pond equation with a negative sign

relative to earthen ponds. This implies that, holding other factors constant, SEAP beneficiaries are less likely to choose concrete ponds than earthen ponds. This result should be interpreted with caution: it does not imply that SEAP discourages intensification, but rather that program design, loan size, or risk considerations may favor incremental upgrading over the immediate adoption of concrete systems. This aligns with the findings of [36, 37].

*Farming experience:* The negative, statistically significant coefficient in the concrete pond equation indicates that more experienced farmers are less likely to adopt concrete ponds than earthen ponds. This reflects path dependence and risk aversion among experienced producers who have accumulated knowledge and infrastructure tied to traditional systems [38, 39].

*Marital status:* Married farmers are significantly less likely to choose concrete ponds relative to earthen ponds. This may reflect household risk preferences and competing financial obligations that constrain investment in capital-intensive systems. Those who are married may enjoy greater access to resources and labour, whereas single or divorced individuals may face limitations in these aspects. [39] emphasised the importance of gender in their study.

*Primary occupation:* The coefficient was highly statistically significant ( $p < 0.001$ ). Farmers whose primary occupation is non-farm employment are significantly more likely to choose concrete ponds relative to earthen ponds, suggesting that off-farm income relaxes capital constraints and facilitates the adoption of intensive systems. Concrete ponds may be perceived as requiring less land or being more manageable alongside other primary occupations. Alternatively, off-farm income may provide the necessary capital to invest in concrete ponds. Farmers' primary occupation is a motivating factor influencing their managerial ability [35, 39].

*Income:* The income coefficient was statistically significant ( $p < 0.05$ ). Higher total income is associated with a significantly increased likelihood of preferring concrete ponds over earthen ponds. This suggests that farmers with higher incomes from fish farming are less likely to prefer earthen ponds and more inclined to favour concrete or collapsible ponds. The marginal effects indicate that farmers with fish income are less likely to choose earthen ponds and more likely to choose concrete ponds. This finding aligns with those of [34].

**Table 2.** Multinomial regression model of factors influencing the preference for the Rearing Systems among Catfish farmers in Oyo State.

Variable	Coef.	St.Er.	t-value	p-value
Earthen Pond				
Participation in SEAP	0.082	0.595	0.14	0.891
Livelihood index	-0.137	0.296	-0.46	0.643
Sex	0.706	0.881	0.80	0.423
Age	0.031	0.061	0.51	0.608

Variable	Coef.	St.Er.	t-value	p-value
Earthen Pond				
Education level	-0.044	1.681	-0.01	0.995
Marital status	-0.673	1.150	-0.59	0.558
Household size	0.32	0.551	0.58	0.561
Access to Agric Training	1.311*	0.718	1.82	0.068
Cooperative association	-.0485	0.832	-0.58	0.560
Farming experience	-0.119	0.097	-1.23	0.220
Pry occupation	1.132	0.858	1.32	0.187
Credit amount	0.000**	0.000	2.26	0.024
Farm size	0.000	0.000	0.80	0.422
Access to extension	-1.106	0.772	-1.43	0.152
Total income	0.000**	0.000	1.97	0.049
Constant	0.418	1.682	0.00	0.996
Concrete pond				
Participation in SEAP	-1.199*	0.706	-1.70	0.090
Livelihood index	-0.470	0.369	-1.27	0.203
Sex	0.144	0.985	0.15	0.884
Age	0.115	0.077	1.50	0.132
Education level	-2.366	0.619	-0.00	0.999
Marital status	-2.487**	1.26	-1.97	0.048
Household size	0.727	0.634	1.15	0.252
Access to Agric Training	1.303	0.806	1.62	0.106
Cooperative association	-1.269	0.976	-1.30	0.194
Farming experience	-0.296**	0.128	-2.31	0.021
Pry occupation	1.882**	0.955	1.97	0.049
Credit amount	0.000	0.000	1.60	0.109
Farm size	0.000	0.000	0.65	0.518
Access to extension	-0.617	0.912	-0.68	0.499
Total income	0.000	0.000	-0.18	0.861
Constant	2.704	0.621	0.00	0.999
Pseudo r-squared	0.254			
Chi-square	87.444			
Prob > Chi2	0.000			

Source: Computation from Stata. Note \*\*\* p<.01, \*\* p<.05, \* p<.1

#### 4. Conclusion and Recommendations

The study demonstrates that the choice of rearing system

among small-scale catfish farmers in Oyo State is strongly shaped by financial capacity, institutional participation, and household characteristics. Access to credit and higher income facilitate the adoption of capital-intensive systems such as

concrete and collapsible ponds. At the same time, experience and marital status are associated with continued reliance on earthen ponds.

From a policy perspective, the findings highlight the importance of tailoring credit and development programmes to farmers' risk profiles and investment capacities, consistent with evidence from aquaculture development programmes in sub-Saharan Africa [8, 17]. Strengthening access to appropriately sized loans and complementary training could accelerate the sustainable intensification of catfish production without excluding risk-averse producers. Programmes such as SEAP can play a critical role in this process if aligned with farmers'

production realities and long-term investment pathways.

*Annex*

*Post-estimation (Multicollinearity Test)*

The Variance Inflation Factor (VIF) results indicate no significant multicollinearity among the explanatory variables in the model. VIF values range from 1.040 to 6.130, with an average of 2.530, which is below the common multicollinearity threshold of 10. Additionally, the tolerance values (1/VIF) are all above 0.10, confirming that the independent variables are not highly correlated. Overall, the results indicate that the model is free of serious multicollinearity and that the regression estimates are reliable.

**Table 3.** Variance Inflation Factor (VIF).

Variable	VIF	1/VIF
Participation in SEAP	6.130	0.163
Livelihood index	5.070	0.197
Sex	4.050	0.247
Age	3.630	0.275
Education level	3.270	0.306
Marital status	3.110	0.322
Household size	1.780	0.561
Access to Agric Training	1.420	0.704
Cooperative association	1.400	0.714
Farming experience	1.180	0.850
Pry occupation	1.170	0.854
Credit amount	1.080	0.929
Farm size	1.060	0.945
Access to extension	1.040	0.964
Mean VIF	2.530	

## Abbreviations

IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
NGOs	Non-governmental Organisations
RAS	Recirculating Aquaculture Systems
SEAP	Self-Reliance Economic Advancement Programme
UNDP	United Nations Development Program
VIF	Variance Inflation Factor

## Author Contributions

**Olanipekun Oluwabunmi Adegboyega:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

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## Conflicts of Interest

The authors declare no conflicts of interest.

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