Scholars Journal of Agriculture and Veterinary Sciences OPEN ACCESS
Abbreviated Key Title: Sch J Agric Vet Sci
ISSN 2348–8883 (Print) | ISSN 2348–1854 (Online)
Journal homepage: https://saspublishers.com

Influence of the Socio-Economic Profile of Fish Farming Stakeholders on Productivity: The Case of the San Pedro Region

YAO Anoumou Hortense Epouse ACHY[1]*, GBAÏ Médard[1], ASSOUHO Konan Fabrice[1], ATTA Kouamé Benjamin[2,3], COULIBALY Siafiatou[3], GORE Bi Gouli[2]

[1]UFR Agriculture, Fisheries Resources and Agro Industry, Polytechnic University of San-Pedro, San-Pedro, Côte d'Ivoire
[2]UFR Biosciences, Félix Houphouët-Boigny University, Côte d'Ivoire
[3]Aquaculture Département, Centre Oceanological Research Center d'Abidjan, Côte d'Ivoire

DOI: https://doi.org/10.36347/sjavs.2026.v13i04.001 | **Received:** 25.03.2026 | **Accepted:** 07.05.2026 | **Published:** 14.05.2026

***Corresponding author:** YAO Anoumou Hortense Epouse ACHY
UFR Agriculture, Fisheries Resources and Agro Industry, Polytechnic University of San-Pedro, San-Pedro, Côte d'Ivoire

Abstract **Original Research Article**

This study analyses the influence of fish farmers' socio-economic profiles on farm productivity in the San Pedro region (Ivory Coast). A survey was conducted among 30 fish farmers who are members of a cooperative, using a structured questionnaire and field visits. The data were analysed using descriptive statistics and an ANOVA at the 5% significance level. The results show a strong predominance of men (93.3%), with the majority aged between 40 and 60 (80%) and having a low level of education. The majority of fish farmers are farmers (66.7%) with 5 to 20 years' experience. Access to finance (3.3%) and participation in training (20%) remain low. Extensive systems predominate (67.8%), whilst intensive systems, although underdeveloped, perform best. Production varies significantly according to the production system, main activity and level of education ($p < 0.05$). Economically better-off and better-educated farmers achieve higher yields in intensive systems. Conversely, extensive systems are associated with low levels of productivity. The study highlights the importance of socio-economic profile in the performance of fish farms. It recommends improving access to finance, training and technical innovations in order to sustainably improve productivity, particularly for small.
Keywords: Aquaculture, Socio-economic profile, Fish farming productivity, San Pedro region, Ivory Coast, Production systems.

INTRODUCTION

Aquaculture is now emerging as one of the most dynamic sectors of the global agri-food system. Aquaculture products are a vital source of animal protein, particularly in developing countries where fish accounts for over 20% of animal protein intake. In many countries in Africa and Asia, fish is the main source of animal protein for low-income households. According to the FAO [1], it supplies over 50% of the fish consumed worldwide, compared with barely 10% in the 1980s. This growth is a response to rising food demand driven by global population growth and the scarcity of natural fishery resources, which are affected by overfishing and climate change. Aquaculture is also a driver of economic development, generating direct and indirect income and jobs in rural and coastal areas. It enables economic diversification in regions where traditional agricultural activities are limited by soil degradation. With fish catches stagnating, aquaculture appears to be a sustainable alternative to meet the growing demand for animal protein and to support food security, particularly in developing countries [1], However, the productivity of aquaculture farms remains highly variable depending on the context, reflecting the diversity of human, technical and economic resources deployed by producers [2, 3]. In addition to natural assets, the performance of aquaculture farms depends not only on environmental or technical production conditions, but also on the human and social characteristics of those involved in fish farming [4, 5, 1], Indeed, the socio-economic profile of producers is a determining factor that is often underestimated in the analysis of aquaculture farm performance. Variables such as educational attainment, age, gender, professional experience, land tenure status, access to credit and participation in training networks significantly influence the productivity capacity of farms [6, 7, 8]. These parameters reflect the conditions of access to productive resources, the level of investment and the organisation of labour within aquaculture farms. Despite the gradual expansion of fish farming as an income-generating activity, productivity on fish farms remains highly

variable from one producer to another. This variation appears to be linked not only to technical factors, but also to the socio-economic profile of those involved. Understanding the impact of fish farmers' socio-economic characteristics on their production performance helps to guide public policy, training programmes and funding mechanisms for the sector. This study therefore aims to examine the influence of the socio-economic profile of fish farmers on the productivity of aquaculture farms, by identifying the most significant explanatory variables and highlighting the relationships between producers' characteristics and the economic performance of their farms.

I- Study Area and Methodology Study Area

The San Pedro region, comprising the departments of San Pedro and Tabou, is situated in the far south-west of Côte d'Ivoire. It has a dense river network, comprising at least six coastal rivers, the main one being the San Pedro River, which drains a catchment area of approximately 3,310 km² [9].

RESEARCH METHODOLOGY

A field survey was conducted between June and August 2024 amongst members of the Simplified Cooperative Society of Fish Farmers of Bas-Sassandra (SCOOPS-PBS). The methodological approach was a mixed-methods design, combining the collection of qualitative and quantitative data. Survey data were collected using a questionnaire designed with Sphinx 4.5 software. In addition, visits were made to fish farming sites to gather detailed information on farming practices, species farmed, feeding strategies, production systems, as well as infrastructure and production performance in relation to the socio-economic profile of the farmers. A sample of 30 fish farmers was selected from six (6) localities in the region (San Pedro, Gabiadji, Doba, Grand Béréby, Tabou and Grabo). The selection of respondents was based on data provided by the Regional Directorate of the Ministry of Animal and Fisheries Resources (DR-MIRAH) in San Pedro and SCOOPS-PBS, to ensure a representative sample of the different types of fish farms. This study aims to analyse the influence of socio-economic characteristics, production practices and the constraints faced by fish farmers on their economic and productive performance.

Statistical Analysis

The data collected from the farms were analysed using Sphinx 4.5 software and presented as percentages. Production data were expressed as means ± standard deviations. A two-way ANOVA was used to compare the recorded mean values. The test was considered significant at a p-value of < 0.05.II-Résultats

II-RESULTS

1-General profile of fish farmers

a-Demographic profile of the fish farmers surveyed

The survey results showed that the majority of fish farmers are non-native to the region (73.3%). The largest number of fish farmers have a primary school education (36.70%), followed by those with a secondary school education (23.30%), those educated at a Koranic school (20%) and those with no formal education (17.70%). Only 3.3% of fish farmers have a higher education qualification. Among the 30 fish farmers surveyed, women are the least represented (6.7%). The majority of stakeholders are aged between 40 and 60 (80%). All fish farmers surveyed belong to a cooperative society. The results show that 13.33% of fish farmers have less than five years' experience, whilst the majority (66.7%) have between 5 and 20 years' experience. Furthermore, all 30 fish farmers surveyed belong to a cooperative. However, only 20% of them actually participate in training courses, revealing a low level of involvement in capacity-building activities.

Table 1: Socio-demographic profile of developers

Settings	Effective	Percentage %	Cumulative percentage %
Origin of the promoter			
Indigenous	5	17	17
Non-Indigenous	22	73	90
Non-Indigenous	3	10	100
Promoter's gender			
Male	28	93,30	93,30
Female	2	6,70	100
Age of the promoter			
20-30 years	1	3,3	3,3
30-40 years	5	16,70	20,0
40-50 years	12	40,0	60,0
50-60 years	12	40,0	100
Education Level			
None	5	16,70	16,70
Koranic School	6	20,00	36,70
Primary	11	36,70	73,40
Secondary	7	23,30	96,7
Higher Education	1	3,30	100

Settings	Effective	Percentage %	Cumulative percentage %
Experience in fish farming			
Less de 5 years	4	13,33	13,33
5-10 years	8	26,7	40,0
10-20 years	12	40,0	80,0
more de 20 years	6	20,0	100,0
Participation in fish farming training courses			
Yes	6	20,0	20,0
No	24	80,0	100,0
Membership in a cooperative			
Yes	30	100	100
No	0	0	0

Table 1: Socio-demographic profile of the promoters

1-General profile of the promoters

a-Demographic profile of the fish farmers surveyed

The majority of fish farmers (66.7%), followed by commercial operators (26.7%). In contrast, salaried fish farmers are very poorly represented (3.3%). Furthermore, the purchase of fry is the main method of procurement (86.7%), whilst the production of fry by the fish farmers themselves remains marginal (10%). The methods of feed procurement show that feed production by the fish farmers themselves is the main source of supply (63.33%). The purchase of commercial feed accounts for only 30% of operators, whilst 23.33% rely on other supply methods, notably the use of agricultural by-products or food waste. Only 3.33% of fish farmers have access to finance, whilst 96.7% do not

b-Economic profile of the fish farmers surveyed

The results in Table 2 show that farmers make up the majority of fish farmers (66.7%), followed by commercial operators (26.7%). In contrast, employed fish farmers are very poorly represented (3.3%). Furthermore, the purchase of fry is the main method of procurement (86.7%), whilst the production of fry by the fish farmers themselves remains marginal (10%). The methods of feed procurement show that the production of feed by the fish farmers themselves constitutes the main source of supply (63.33%). The purchase of commercial feed concerns only 30% of operators, whilst 23.33% rely on other supply methods, notably the use of agricultural by-products or food waste. Only 3.33% of fish farmers have access to finance, whilst 96.7% do not

Table 2: Economic aspects of developers

Settings	Effective	Percentage %	Cumulative percentage %
Acquisition of fry			
Purchase	26	86,7	86,7
Production	3	10,0	96,7
Donation	1	3,33	100,0
Food Acquisition			
Purchase	9	30,0	
Production	19	63,33	
Other	7	23,33	
Access to financing			
Yes	1	3,33	3,33
No	29	96,7	100,0
Other Activity			
Economic Operator	8	26,7	26,7
Employee	1	3,3	30
Farmer	20	66,7	96,7
Breeder	1	3,3	100

2-Profile of stakeholders according to fish farming structures

The results (Figures 1, 2, and 3) show a significant difference between genders in the use of fish farming infrastructure. Indeed, 100% of the men surveyed reported using fish ponds for fish farming, compared to 50% of the women. Conversely, the use of fish farming basins is exclusively by women (50%). These results highlight a differentiated distribution of fish farming practices according to gender. Fish ponds are primarily used by farmers (66.7%), followed by economic operators (26.7%), while they are used very little by salaried employees (3.33%). In contrast, the use of fish farming basins is exclusively by fish farmers, representing 3.33% of the population. Fish ponds are primarily used by fish farmers with a primary education (36.7%), followed by those with a Quranic education (20.0%) and a secondary education (20.0%). Those without a diploma represent 16.7%, while those with a higher education are very poorly represented (3.3%). Regarding fish tanks, only 3.33% of fish farmers with a secondary education use them. No one with other levels of education reports using this type of infrastructure.

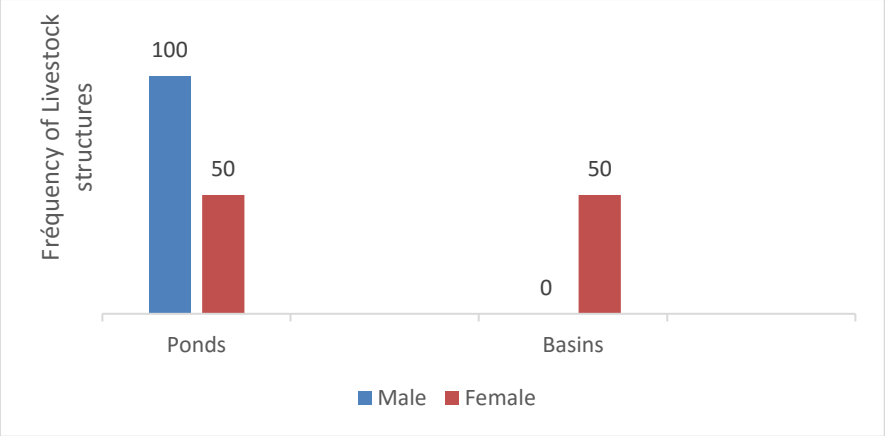

Figure 1: Frequency of use of facilities according to gender

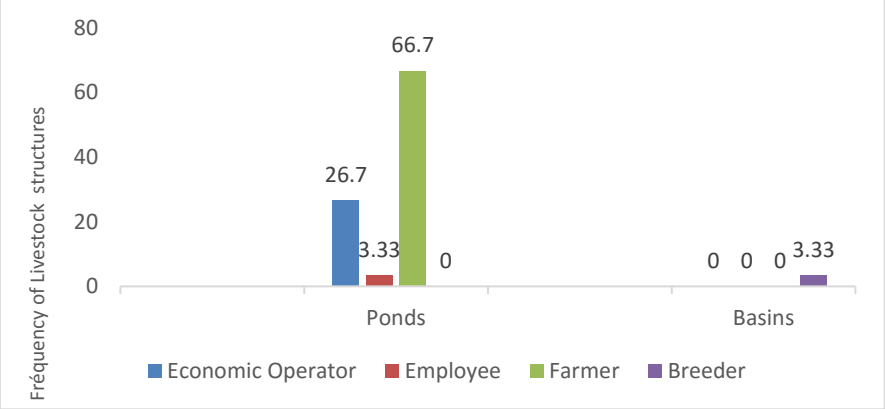

Figure 2: Frequency of use of structures according to the promoter's activity

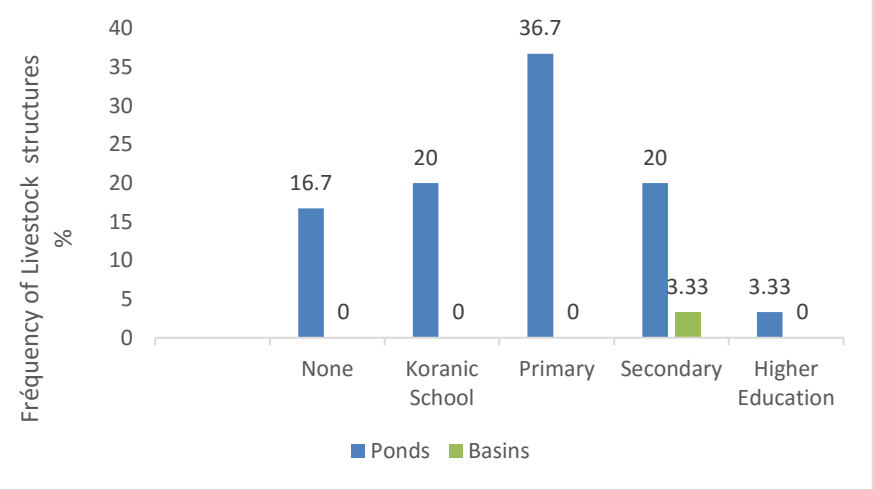

Figure 3: Frequency of use of facilities according to the level of education

3-Profile of Actors According to Production Systems

The analysis of the profile of actors according to production systems (Table 4) shows that among the 28 men surveyed, 67.8% practice the extensive system, 21.43% the semi-intensive system, and 10.71% the intensive system. In contrast, among the two women surveyed, 50% use the extensive system and the remaining 50% practice the intensive system. None of them reported using the semi-intensive system. The extensive system is primarily used by farmers (50%), followed by economic operators (16.7%). As for the semi-intensive system, it is adopted by a smaller proportion of actors, notably farmers (16.7%) and economic operators (3.33%). Intensive fish farming is primarily practiced by economic operators (6.7%), followed, to a lesser extent, by employees (3.33%) and livestock farmers (3.33%). Extensive fish farming, on the other hand, is mainly adopted by fish farmers with a primary education (26.7%), followed by those with a

secondary education (20.0%). Fish farmers with no formal education represent 13.33%.

Table 4: Profile of fish farmers by production system

Variables	Productions systems					
Gender	**Extensive**		**Semi-intensive**		**Intensive**	
	Effective	**Percentage (%)**	**Effective**	**Percentage (%)**	**Effective**	**Percentage (%)**
Male	19	67.86	6	21,43	3	10,71
Female	1	50	-	-	1	50
Other Activity						
Economic Operator	5	16,7	1	3,33	2	6,7
Employee	-	-	-	-	1	3,33
Farmer	15	50,0	5	16,7	-	-
Livestock Farmer	-		-	-	1	3,33
Education Level						
None	4	13,33	-		-	-
Koranic School	2	6,7	4	13,33	1	3,33
Primary	8	26,7	2	6,7	1	3,33
Secondary	6	20,0	-	-	1	3,33
Higher Education	1	3,33	-	-	1	3,33

4- Profile of fish farmers by feed type

The frequency of use of different feed types according to the profile of fish farmers is shown in Table 5. The results indicate that the majority of men produce their own feed (60%). Of these, 20% use commercial feed, 16.7% use agri-food by-products, whilst 3.33% combine commercial feed with by-products. In contrast, female farmers use exclusively commercial feed (3.33%) and locally produced feed (3.33%). Furthermore, the frequency of feed use on farms varies according to the promoter's main role. On fish farms, 46.7% of farmers and 16.7% of business operators produce their own feed. The use of commercial feed is mainly limited to economic operators (13.33%), whilst it is very low among employees, farmers and livestock breeders (3.33% each). The use of by-products is limited to economic operators (6.7%) and farmers (10%). The combination of commercial feed and by-products is uncommon and is limited to economic operators (3.33%) and farmers (3.33%). Furthermore, the frequency of feed use on fish farms varies according to the promoter's level of education. Commercial feed is mainly used by fish farmers who are. Commercial feed is mainly used by fish farmers who have attended a Koranic school (10%), followed by those with a primary school education (6.7%). Fish farmers with a secondary school education or higher use it only marginally, with identical usage rates of 3.33% each. Farmers with primary education (23.33%) produce the feed, followed by those with secondary education (16.7%). Fish farmers with a Koranic school education and those with no formal Commercial feed is mainly used by fish farmers who have attended a Koranic school (10%), followed by those with a primary school education (6.7%). Fish farmers with a secondary school education or higher use it only marginally, with identical usage rates of 3.33% each. Farmers with primary education (23.33%) produce the feed, followed by those with secondary education (16.7%). Fish farmers with a Koranic school education and those with no formal education each produce 10% of the feed used for fish farming. The combination of commercial feed with by-products remains very rare and is practised exclusively by promoters with a primary school education.

Table 5: Characteristics of fish farms by feed type

Variable	Type of food used							
Gender	**Commercial food**		**Food product**		**By-product**		**Commercial feed+ By-product**	
	Effective	Percentage (%)	Effective	Percentage (%)	Effective	Percentage (%)	Effective	Percentage (%)
Male	6	20	18	60,0	5	16,7	1	3,33
Female	1	3,33	1	3,33	-	-	-	-
Other Activity								
Economic Operator	4	13,33	5	16,7	2	6,7	1	3,33
Employee	1	3,33	-	-	-	-	-	-
Farmer	1	3,33	14	46,7	3	10,0	1	3,33
Livestock Farmer	1	3,33	-		-	-		

Education Level								
None	-	-	3	10,0	2	6,7	-	-
Koranic School	3	10,0	3	10,0	1	3,33	-	-
Primary	2	6,7	7	23,33	1	3,33	1	3,33
Secondary	1	3,33	5	16,7	1	3,33	-	-
Higher Education	1	3,33	-	-	-	-	-	-

5-Farm productivity by production system and socio-economic profile of farmers

a-Productivity by production system and gender

Table 4 shows annual yields by production system and gender of farmers. In the extensive system, average production is 1,282.4 ± 1,080 kg, with values ranging from 200 to 4,000 kg for male farmers, whilst female-run farms show a consistent production of 200 kg. In semi-intensive systems, average production is 2,925.5 ± 2,904 kg, with values ranging from 200 to 8,000 kg, and no female-run farms were recorded. In intensive systems, male production ranges from 500 to 24,000 kg, with an average of 8,866.7 ± 13,124 kg, whilst female farms record a production of 500 kg.

b-Productivity by system and other activity

In the extensive system, average yields are significantly higher ($p < 0.05$) on farms run by commercial operators (1658 ± 1574 kg), followed by those run by farmers (1085 ± 771 kg), whilst wage labourers and small-scale farmers have low yields (600 kg and 500 kg). In the semi-intensive system, farms run by economic operators show a consistent yield of 4,000 kg, compared with an average of 2,710.6 ± 3,193 kg among farmers. In intensive systems, economic operators recorded the highest productivity levels ($p < 0.05$), with an average of 13,000 ± 15,556 kg, whilst the holdings of employees and livestock farmers remained low in productivity (600 kg and 500 kg).

c-Productivity by farming system and level of education

In the extensive system, annual fish production on farms was significantly higher ($p < 0.05$) for farmers with no formal education (1543.75±1665.44) and those with primary education (1398.12±1026.95) than for those with Koranic school or secondary education. In contrast, in the semi-intensive system, production figures are significantly higher for fish farmers who attended Koranic school (4766.67±2390.10 kg) and primary school (1526.50±1326.50 kg). In the intensive system, average production is significantly ($p < 0.05$) higher among those with higher education than among those with primary (2000 kg) and secondary (550 kg) education.

Table 6: System productivity by developer profile

Variables	**Productivity of Production Systems (kg)**								
	Extensif (20)			**Semi-intensif (6)**			**Intensif (4)**		
	Minimum	**Maximum**	**Moyenne**	**Minimum**	**Maximum**	**Moyenne**	**Minimum**	**Maximum**	**Moyenne**
Gender									
Male (19, 6, 3)	200	4000	1282,4±1080	200	8000	2925,5± 2904	600	24000	8866,7±13124
Female (1, 0, 1)	200	200	200	-	-	-	500	500	500
Other Activity									
Economic Operator (5,1,2)	200	4000	1658±1574	4000	4000	4000	2000	24000	13000 ±15556
Employee (0,0,1)	-	-	-	-	-	-	600	600	600
Farmer (15,5,0)	200	2625	1085,13±771	200	8000	2710,6±3193	-	-	-
Livestock Farmer (0,0,1)	-	-	-	-	-	-	500	500	500
Education Level									
None (4, 0, 1)	675	4000	1543,75±1665,44	200	200	200	-	-	-
Koranic School (2, 3)	390	1300	845±655	2300	8000	4766,67±2390,10	-	-	-
Primary (8, 2,1)	200	2625	1398,12±1026,95	200	2853	1526,50±1326,50	2000	2000	2000
Secondary (6,0,2)	200	1600	919,5±548,56	-	-		500	600	550
Higher Education (0,0,1)	-	-	-	-	-	-	24000	24000	24000

DISCUSSION

The results indicate a strong predominance of non-indigenous fish farmers (73%), compared with indigenous farmers (17%) and other non-indigenous farmers (10%). This situation is frequently observed in areas where aquaculture activities attract economic migrants seeking new productive opportunities. According to the FAO [10] fish farming is often a preferred investment sector for non-indigenous populations who have greater financial, technical or social capital than local populations. Similarly, Béné *et al.* [11] highlight that the mobility of stakeholders promotes the dissemination of aquaculture innovations, but can also limit the involvement of indigenous communities when access to productive resources remains unequal.

The breakdown by gender reveals a very strong predominance of men (93.3%) compared with women (6.7%). This low female participation confirms the findings of Yao *et al.* [12]; the World Bank [13] and the FAO [1], which highlight that women are significantly under-represented in aquaculture activities due to socio-cultural constraints as well as limited access to land, credit and technical training. According to Kruijssen *et al.* [14], women are more often involved in post-production activities (processing and marketing) rather than in fish farming itself. With regard to age, the majority of fish farmers fall within the 40–60 age bracket, suggesting that fish farming is primarily practised by adults with a certain level of professional maturity and sufficient investment capacity. According to Olaoye *et al.* [15], aquaculture requires a relatively high initial capital outlay, which acts as a major barrier for young people. Furthermore, the FAO[16] notes that the low level of youth engagement in this sector is often linked to a lack of specialised training and the perception of economic risk

The predominance of fish farmers with between 5 and 20 years' experience indicates a strong presence of relatively experienced operators in the sector. According to the FAO [16] experience significantly improves the technical and economic performance of aquaculture farms, particularly in terms of pond management, feeding and the control of health risks. Conversely, the low proportion of fish farmers with less than five years' experience may reflect difficulties in accessing capital, inputs and technical support [15]. The fact that all fish farmers belong to a cooperative indicates a high level of collective organisation, recognised for facilitating access to inputs, credit, information and markets [11, 10]). However, low participation in training (20%) highlights a disconnect between membership of cooperatives and actual engagement in capacity building [13]. Furthermore, Kruijssen *et al*. [14] emphasise that the effectiveness of cooperatives depends not only on their existence, but also on the level of active participation of their members.

With regard to the supply of fry, the high reliance on purchased stock (86.7%) indicates that producers have limited expertise in artificial reproduction. This situation can be explained by the technical requirements and the need for suitable infrastructure for the production of high-quality fry [17]. The low proportion of self-sufficient producers (10%) thus limits the autonomy of farms, increases production costs and can lead to problems with the availability and quality of fry, affecting zootechnical performance [18, 19]. Farmers with greater human and financial capital are more likely to adopt technical innovations and manage production risks, thereby improving their yields [20].

The high level of production of homemade feed by fish farmers is mainly due to the high cost of commercial feed, which accounts for one of the main expenses in fish farming. According to the FAO [16], feed can account for between 50 and 70 per cent of total production costs in aquaculture, thereby prompting small-scale producers to develop local alternatives using readily available raw materials. Similar observations have been reported by Omitoyin [21] and Brummett *et al.* [18] in sub-Saharan Africa. However, although local feed production helps to reduce costs, it often has limitations in terms of nutritional quality and the balance of rations. According to De Silva *et al.* [22] and FAO [20], artisanal feeds generally perform less well than industrial feeds. This situation can affect the overall productivity of fish farms. The fact that only 30% of fish farmers purchase commercial feed can be explained by its limited accessibility, high cost and, at times, unavailability in local markets [23]. Finally, other methods of feed procurement (23.33%) reflect a diversification of feeding practices, notably the use of agricultural residues, kitchen waste or pond fertilisation in extensive or semi-intensive systems [24].

The limited access to finance observed among fish farmers can be attributed to the perception by financial institutions that fish farming is a high-risk activity [10]. Furthermore, the majority of fish farmers are small-scale producers operating informally, without sufficient financial guarantees, accounting documents or land titles required by banks and microfinance institutions. This situation reinforces their marginalisation from the formal financial system.

The predominance of fish farmers with low to medium levels of education in the use of fish ponds suggests that this system is accessible and does not require a high level of formal education. According to the FAO [25], extensive aquaculture systems are generally adopted by actors with little formal education, as they require limited investment and basic technical skills. These results confirm that educational attainment influences the choice of fish farming structures, though it is not the sole determining factor. Access to continuing education, institutional support and productive resources

remains essential to promote the adoption of more efficiente and sustainable fish farming systems [10].

The findings highlight a strong influence of fish farmers' socio-professional profiles on fish feeding practices. The predominance of men in the production of locally produced feed reflects their greater involvement in the technical aspects of fish farming, particularly feed formulation and processing. This situation can be explained by men's greater access to productive resources, technical training and the equipment required for feed production [25, 26]. The low participation of women farmers, limited to the use of commercial and locally produced feed, confirms the structural constraints they face, notably restricted access to capital, inputs and agricultural credit. According to the FAO [10], these constraints limit the adoption.

The high proportion of farmers producing their own feed is due to the local availability of agricultural raw materials, which helps to reduce production costs. This self-production constitutes a key economic strategy in extensive and semi-intensive systems in sub-Saharan Africa [27, 28]. The greater use of commercial feed by economic operators reflects their higher financial capacity and their shift towards more intensive, market-oriented production. However, the high cost of such feed remains a factor limiting its widespread adoption [29].

The results indicate that educational attainment influences the dietary choices of fish farmers. The higher use of commercial feed by entrepreneurs from Koranic schools could be explained by a desire to simplify feeding practices, as these feeds are ready-to-use and require little specific technical knowledge. However, the high cost of commercial feed generally constitutes a major constraint to its widespread adoption, particularly in small-scale fish farming systems [29]. The prevalence of feed production among primary and secondary school-educated promoters suggests that these actors possess sufficient basic knowledge to utilise local raw materials. This practice is well documented in extensive and semi-intensive fish farming systems in sub-Saharan Africa [27, 26]. The low uptake of the commercial feed–by-product combination, observed only among primary-level promoters, reveals limited diversification of feeding strategies. However, feed supplementation is recognised as an effective approach for balancing cost reduction with improved production performance when properly managed [25].

The relatively low average production observed among male farmers in the extensive system (1282.4 ± 1080 kg) is mainly attributable to the structural characteristics of the extensive system, regardless of gender. The relatively low average production observed among male farmers in extensive systems (1282.4 ± 1080 kg) is mainly explained by the structural characteristics of the extensive system, regardless of gender. This type of system is characterised by low input intensity, limited use of formulated feed and high dependence on the natural conditions of the rearing environment [16, 11]. The consistent and very limited production observed on female-run farms (200 kg) reflects the specific constraints they face.

Farmers in the intensive system achieve significantly higher levels of productivity than those in other categories, with an average of 13,000 ± 15,556 kg (2,000–24,000 kg). This result reflects the fundamental principle of intensive agriculture, which is based on the high use of inputs, technologies and optimised management practices to maximise production per unit area or per animal [25, 30]. Indeed, intensive systems make greater use of commercial feed, environmental control, mechanisation and technical monitoring, resulting in yields significantly higher than those of extensive systems [31,29]. Conversely, in the extensive system, farmers and economic operators achieve lower average yields (approximately 1,085 kg and 1,658 kg respectively), due to the specific characteristics of these systems, notably low input intensity, heavy reliance on natural conditions and limited mechanisation, which constrain production levels [16, 11].

In extensive systems, the significantly higher annual yields observed among farmers with no formal education and those with only primary education can be explained by the low-tech nature of this system. Indeed, extensive fish farming relies mainly on the exploitation of natural resources, low input intensity and empirical know-how, often acquired through experience rather than formal academic training [16, 11]. In the semi-intensive system, the significantly higher yields among fish farmers with a Koranic school or primary school education suggest that this intermediate system benefits those who possess both solid empirical knowledge and the ability to adapt to improved practices [29, 19]. In contrast, in the intensive system, the significantly higher average yields recorded among higher-level stakeholders confirm that this system requires advanced technical skills, financial management capacity and mastery of production technologies [31, 30].

CONCLUSION

Fish farming appears to be strongly influenced by the socio-economic profile of those involved, the types of farming structures, the quality of the feed used, and the production system adopted. Overall, these results highlight that intensification significantly improves production levels. However, gender disparities remain significant. They highlight the need to implement targeted policies and programmes aimed at strengthening women's technical capacities and improving their access to productive resources in order to promote more equitable participation and improve the overall performance of the fish farming sector.

REFERENCES

1. FAO, 2022. *The State of World Fisheries and Aquaculture 2022 – Towards Blue Transformation.* Rome : Food and Agriculture Organization of the United Nations
2. Belton, B., & Little, D. C., 2011. *Immanent and interventionist inland Asian aquaculture : The property relations and rural transformations of two Mekong Delta regions.* Journal of Agrarian Change, 11(4), 554–578.
3. IFREMER, 2019. *Analyse économique de la conchyliculture et de la pisciculture marine en France –*
4. Joffre, O. M., Klerkx, L., Dickson, M., & Verdegem, M., 2017. *How is innovation in aquaculture conceptualized and managed? A systematic literature review and reflection framework to inform analysis and action.* Aquaculture, 470, 129–148.
5. Kaminski, A. M., Genschick, S., Klerkx, L., & Kruijssen, F., 2018. *Commercialization and upgrading in the aquaculture value chain: The role of smallholders' social capital and knowledge networks.* Aquaculture, 493, 355–364.
6. Ayinla, O. A., 2017. *Socio-economic factors influencing aquaculture development in Nigeria.* Nigerian Journal of Fisheries, 14(1), 32–45.
7. Olagunju, F. I., Adesiyan, I. O., & Ezekiel, A. A., 2019. *Economic viability of catfish production in Oyo State, Nigeria.* Journal of Human Ecology, 28(3), 229–235.
8. Ekunwe, P. A., & Emokaro, C. O., 2020. *Socio-economic determinants of aquaculture productivity in Edo State, Nigeria.* African Journal of Agricultural Research, 15(7), 102–110.
9. Molinier M. et Toilliez J., 1973. Hydrologie de la Région de San Pedro (Fleuve San Pedro, Néro et Brimay)
10. FAO, 2018. *The state of world fisheries and aquaculture*. Rome.
11. Béné, C., Barange, M., Subasinghe, R., *et al.,* 2016. *Contribution of fisheries and aquaculture to food security and poverty reduction*. World Development.
12. Yao A. H., Koumi A.R., Atse B.C E.P. et Kouamelan E.P. 2017. Etat des connaissances sur la pisciculture en Côte d'Ivoire. Agronomie Africaine 29(3) :2017
13. World Bank., 2019. *Enhancing the productivity of aquaculture systems*. Washington DC.
14. Kruijssen, F., McDougall, C., & van Asseldonk, I., 2018. *Gender and aquaculture value chains*. WorldFish.
15. Olaoye, O. J., Ashley-Dejo, S. S., Fakoya, E. O., *et al.,* 2013. *Assessment of socioeconomic analysis of fish farming in Nigeria*. Journal of Fisheries and Aquatic Science.
16. FAO, 2017. *Aquaculture development and management*. FAO Fisheries and Aquaculture Technical Paper.
17. De Graaf, G. & Janssen, H., 1996. *Artificial reproduction and pond rearing of the African catfish Clarias gariepinus in sub-Saharan Africa : A handbook.* FAO Fisheries Technical Paper No. 362. Food and Agriculture Organization of the United Nations, Rome
18. Brummett, R. E., Lazard, J., & Moehl, J., 2011. *African aquaculture : Realizing the potential*. FAO.
19. FAO, 2020. *Aquafeed and feeding practices in developing countries*. Rome.
20. Njoku, M. E., Ezeano, C. I., & Onu, D. O., 2021. *Effect of socioeconomic characteristics of fish farmers on aquaculture productivity in Southeastern Nigeria.* Journal of Fisheries and Aquatic Science, 16(2), 75–84.
21. Omitoyin, B. O., 2007. *Introduction to fish nutrition and feeds*. Ibadan University Press.
22. De Silva, S. S., & Anderson, T. A., 1995. *Fish nutrition in aquaculture*. Springer.
23. Tacon, A. G. J., & Metian, M., 2008. *Global overview on the use of fish meal and fish oil in aquafeeds*. Aquaculture.
24. Edwards, P., 2015. *Aquaculture environment interactions*. FAO.
25. FAO, 2011. *Aquaculture development. Use of wild fish as feed in aquaculture*. FAO Technical Guidelines.
26. El-Sayed, A. F. M., 2006. *Tilapia Culture*. CABI Publishing
27. Pouomogne, V., & Pemsl, D., 2008. *A review of the aquaculture potential of Cameroon*. *WorldFish Center Studies and Reviews No. 1878*.
28. Béné, C., Steel, E., Luadia, B. K., & Gordon, A., 2010. Food policy, 35(4), 356–367.
29. Hasan, M. R., & New, M. B., 2013. *On-farm feeding and feed management in aquaculture*. FAO Fisheries and Aquaculture Technical Paper No. 583.
30. Boyd, C. E., D'Abramo, L. R., Glencross, B. D., Huyben, D. C., Juarez, L. M., Lockwood, G. S., McNevin, A. A., Tacon, A. G. J., Teletchea, F., Tomasso, J. R., Tucker, C., & Valenti, W. C., 2020. *Achieving sustainable aquaculture : Historical and current perspectives and future needs and challenges*. Journal of the World Aquaculture Society, 51(8), 578-633. https://doi.org/10.1111/jwas.12714
31. Tacon, A. G. J. & Metian, M., 2015. *Feed matters: Satisfying the feed demand of aquaculture*. Reviews in Fisheries Science & Aquaculture, 23(1), 1–10. https://doi.org/10.1080/23308249.2014.987209