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Assessing GIFT adoption potential among aquaculture farmers in Nasarawa and Kwara States, Nigeria

Citation

This publication should be cited as: Manyise Timothy, Lozano Lazo Denise, Olaniyi Ajibola, Siriwaderna Sunil, Rossignoli Cristiano. 2024. Assessing the willingness to adopt GIFT among aquaculture farmers in Nasarawa and Kwara States, Nigeria. Penang, Malaysia: WorldFish.

About WorldFish

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We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

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Acknowledgments

Funding support for this work was provided by the Bill & Melinda Gates Foundation through the project Aquaculture: Increasing Income, Diversifying Diets and Empowering Women in Bangladesh and Nigeria [INV009865]. This work was undertaken as part of the CGIAR Initiatives on Aquatic Foods. The program is supported by contributors to the CGIAR Trust Fund.

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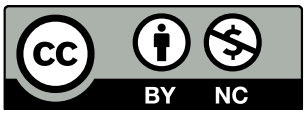

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Front cover, Mann Stevie

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List of acronyms

GIFT	Gnetically Improved Farmed Tilapia
LGAs	Local Government Areas

Executive summary

This study examines the adoption potential of Genetically Improved Farmed Tilapia (GIFT) among grow-out fish farmers and hatchery operators in selected regions of Nigeria. Despite the proven benefits of GIFT, including faster growth rates, disease tolerance, and high yield, a knowledge gap exists among farmers regarding the strain. Initially, a few farmers were aware of GIFT, but after receiving brief introductions, the majority expressed interest in adopting it. Key factors influencing interest include faster growth rates, disease tolerance, high yield, and market preference. Based on these findings, several recommendations are proposed to enhance GIFT adoption. Increasing awareness through targeted education campaigns using workshops, extension services, and accessible media platforms is essential. Providing hands-on training on GIFT production and management practices will help bridge the knowledge gap and build confidence. Facilitating access to quality GIFT fingerlings and broodstock through public-private collaboration will support farmers in their adoption efforts. Emphasizing the economic benefits of GIFT adoption through success stories and case studies can motivate others. Continuous technical support and extension services should be offered to optimize farming practices, and strengthening farmer associations will create supportive networks for knowledge exchange and resource access. By implementing these recommendations, GIFT adoption can be accelerated, fostering sustainable aquaculture practices and enhancing the livelihoods of small-scale farmers in Nigeria.

Introduction

The adoption of genetically improved farmed tilapia (GIFT) has emerged as a transformative opportunity in aquaculture, offering enhanced growth rates, disease resistance, and improved yields compared to traditional fish strains (Ponzoni et al., 2011; Tran et al., 2021). In regions where aquaculture plays a significant role in livelihoods and food security, such innovations are critical for boosting productivity and meeting the growing demand for high-quality fish products (Dey, 2000; Hamilton et al., 2022). This study explores the adoption potential of GIFT and other improved strains among grow-out farmers and hatchery operators in Kwara and Nasarawa States, Nigeria, regions with unique aquaculture practices and challenges. Kwara and Nasarawa are among the states with vibrant aquaculture sectors, contributing significantly to local economies and nutrition security (Subasinghe et al., 2021). However, both states face constraints such as limited access to improved fish seed, suboptimal farming practices, and market-related challenges (Kaleem & Bio Singou Sabi, 2021; Omoyinmi & Ezeri, 2011). These issues have heightened the need for innovations like GIFT, which offer solutions to many of the inefficiencies in the aquaculture value chain.

To understand the adoption potential of GIFT, this study was designed to evaluate farmers' and hatchery operators' awareness, interest, and motivations for integrating improved strains into their operations. By gathering data through surveys and analysing these insights, the findings will inform strategies for promoting sustainable aquaculture practices and enhancing productivity in these regions.

This report presents the key findings, and implications of the study, providing a comprehensive overview of the adoption landscape for GIFT in Kwara and Nasarawa States. It aims to guide policymakers, development agencies, and industry stakeholders in fostering the growth of aquaculture through targeted dissemination of improved fish strains, including GIFT.

Methodology

Study design

The study was conducted in Kwara and Nasarawa states (**Figure 1**), following a standardized protocol in both locations. In Kwara, data collection took place between November and December 2022, while in Nasarawa, the study was carried out between August and November 2023. Before the main surveys, scoping studies were conducted by the respective country office to gather information on policies, the aquaculture value chain, farming practices, challenges, and opportunities specific to each state (Subasinghe et al., 2021). These scoping studies also provided lists of registered grow-out farmers and hatcheries, categorized as either individuals or members of clusters.

Figure 1. Map of Nigeria showing study locations

Sampling

For grow-out farmers, a multistage stratified random sampling method was applied. The total sample size for each state was determined using the population size from the provided lists, with a 95% confidence level and a 5% margin of error, plus an allowance for dropout respondents. This resulted in sample sizes of 400 farmers for Kwara and 250 farmers for Nasarawa.

Next, the most representative local government areas (LGAs) in terms of farmer population were identified for data collection. In Kwara, the selected LGAs were Offa, Ilorin West, Edu, Oyun, Asa, Ilorin South, Isin, Irepodun, and Ifelodun, while in Nasarawa, the chosen LGAs were Lafia, Akwanga, Nasarawa Egon, Karu, Keffi, and Doma. Due to the prevalence of farmer clusters in Kwara, the sample was further stratified into 60% cluster farmers and 40% individual farmers, reflecting the farmer population distribution. Participants within each stratum were then randomly selected. For hatchery surveys, the limited number of hatcheries necessitated a census approach, covering 16 hatcheries in Kwara and 50 hatcheries in Nasarawa.

Data Collection and Analysis

The study primarily sought to assess the interest of farmers and hatchery operators in adopting Genetically Improved Farmed Tilapia (GIFT) and other improved fish strains. To achieve this, data collection was conducted in person using mobile devices equipped with a structured questionnaire, developed and deployed on the Kobo Toolbox platform. This digital approach ensured efficient data capture and reduced errors associated with manual data entry.

The questionnaire covered a range of topics, including awareness of improved strains, motivations for adoption, and preferred characteristics of fish strains. Responses were gathered directly from participants during face-to-face interactions, ensuring clarity and accuracy in understanding their perspectives.

For data analysis, basic statistical inference techniques were employed to summarize and interpret the findings. The results were then systematically presented using tables, pie charts, and graphs, allowing for clear visualization and easy comprehension of key trends and patterns. This approach provided a structured framework for examining the adoption potential of GIFT and identifying factors influencing farmers' and hatchery operators' decision-making processes.

For the grow-out farmer survey, after data collection and validation, a total of 375 valid responses from Kwara and 227 valid responses from Nasarawa were analyzed. For hatcheries, all 16 in Kwara and 50 in Nasarawa were included in the analysis

KWARA STATE

Grow Out Farmers in Kwara

Socio-demographic and general household characteristics in Kwara

The first aspect that was investigated was the general characteristics of the farmers involved in the study. **Figure 2** presents information about the gender, age, education, and main occupation of household heads in Kwara. As it is commonly observed in similar contexts, more than 80% of the households' heads were men. In terms of age almost half of the sample had ages between 31 and 40 years old. Regarding education, almost 30% of the sample did not have any tertiary education, with only a secondary education level completed or less. While all households dedicated to grow out farming activities, around 36% of the household heads indicated other type of activities as their main occupation.

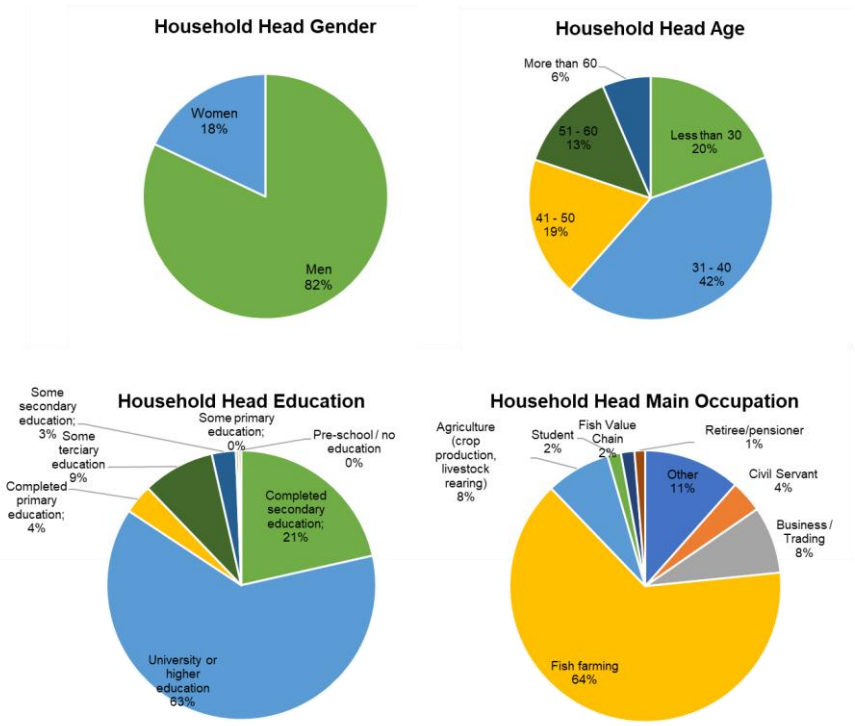

Figure 2. Socio-demographic and general characteristics of grow-out farmers

In relation to the characteristics of the household as a whole, **Table 1** displays information related to the household size, food consumption score (FCS), and other food consumption habits. The FCS and number of meals per day suggest that the surveyed households are food secure, while the level of fish consumption in the last week reflects the importance of fish in their diets.

Table 1. General characteristics of surveyed households in Kwara

Variable	Mean	SD
Household size (number of people)	5.3	2.3
FCS* (units)	78.8	9.7
Fish consumption in the previous week (number of days)	4.6	1.8
Meals per day (number)	2.8	0.4

* FCS >=35 is considered acceptable ((World Food Programme, 2024))

General characteristics of farming systems in Kwara

The majority of farmers in Kwara exclusively use earthen ponds (86%), followed by a combination of earthen ponds and other systems such as concrete and plastic tanks (**Table 2**). This high reliance on earthen ponds for grow-out aquaculture aligns with findings from other states, as reported by Lozano Lazo et al. (2023) and Subasinghe et al. (2021). On average, farmers operated five earthen ponds, with a total farming area of 0.3 hectares (**Table 3**).

Table 2. Types of facilities in Kwara

Facility	Prevalence
Earthen Pond	86%
Earthen Pond + Other	9%
Other	5%

Table 3. Characteristics of facilities in Kwara

Variable	Mean	Median
Number of Facilities (all types)	6.1	4.0
Number of Earthen Ponds	5.1	4.0
Total Facilities Area (Ha)	0.3	0.1

The primary species farmed in Kwara are African catfish (Clarias gariepinus), which dominate production, followed by Heteroclarias (Clarias gariepinus × Heterobranchus bidorsalis). A smaller proportion of farmers cultivate a combination of African catfish with tilapia, or African catfish alongside Heteroclarias (**Table 4**).

Table 4. Types of species farmed in Kwara

Species	Prevalence
African Catfish (*Clarias gariepinus*)	85%
Heteroclarias (*Clarias gariepinus* × *Heterobranchus bidorsalis*)	10%
African Catfish + Tilapia	5%
African Catfish + Heteroclarias	1%

The study identified that stocking is conducted typically from January to June, with 70% of farmers doing the stocking activities during that period. The month when most farmers start stocking is June. On the other hand, harvesting activities run typically from June to December, with 83% of farmers conducting these activities during that period. The month when most farmers initiate harvest is December (**Table 5**).

Table 5. Seasonality of stocking and harvesting activities in Kwara

Month	Stocking		Harvesting	
	% of farmers	Cumm. %	% of farmers	Cumm. %
January	10%	10%	1%	1%
February	14%	24%	4%	5%
March	10%	34%	4%	9%
April	9%	43%	4%	13%
May	11%	54%	4%	17%
June	16%	70%	9%	26%
July	5%	75%	8%	33%
August	5%	80%	11%	44%
September	3%	83%	9%	53%
October	4%	87%	16%	69%
November	7%	94%	15%	83%
December	6%	100%	17%	100%

Adoption Potential of GIFT Tilapia in Kwara

Farmers were initially asked about their prior knowledge of this improved strain. The results revealed that only 18% of farmers had some awareness of GIFT, primarily through interactions with extension officers, peer farmers, or exposure to aquaculture training sessions (**Error! Reference source not found.**). This indicates a significant gap in knowledge dissemination about the strain among the broader farming community. The remaining 82% of farmers indicated they had no prior knowledge of GIFT, underscoring the need for targeted awareness campaigns and information-sharing efforts to bridge this gap.

To address this, a brief but comprehensive explanation of GIFT was provided during the survey to those unfamiliar with the strain. Farmers were informed about the key attributes of GIFT, such as its faster growth rates, improved feed conversion efficiency, higher yields, and enhanced resilience to environmental conditions. This explanation aimed to ensure that all respondents could make informed decisions when evaluating their interest in adopting GIFT.

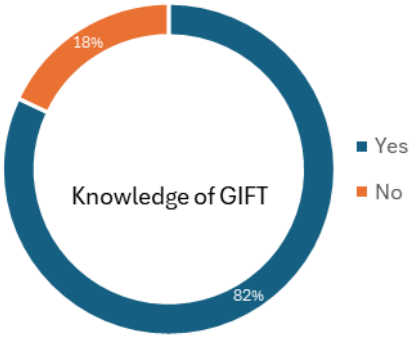

Figure 3. Knowledge about GIFT

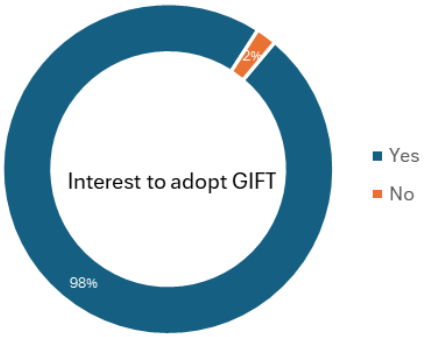

Figure 4. Willingness to adopt GIFT among farmers in Kwara

Following the explanation, all farmers were asked about their interest in adopting the improved strain. The response was overwhelmingly positive, with 98% of farmers expressing their willingness to adopt GIFT (**Figure 4**). This strong interest was consistent across diverse farmer demographics, reflecting a high level of enthusiasm for improved farming technologies.

Motivations to adopt GIFT among grow-out farmers

When farmers elaborated on their interest in adopting GIFT Tilapia, the most compelling feature was its fast-growing characteristic, consistently identified as the highest-valued trait (**Figure 5**). Farmers emphasized that faster growth translates into shorter production cycles, enabling more frequent harvests and boosting profitability. This trait particularly appeals to those seeking to optimize their operations, reduce time to market, and enhance productivity, aligning seamlessly with their aspirations for efficiency and sustainability.

Equally noteworthy was GIFT's potential to diversify farm production systems. Farmers recognized that incorporating GIFT could mitigate the risks of over-reliance on a single species, increase resilience against market fluctuations, and attract a broader customer base by offering variety. Diversification not only strengthens economic stability but also enhances ecological balance, making GIFT a strategic choice for sustainable aquaculture practices.

These standout features – efficiency and diversification – underscore GIFT's promise as an innovative solution for modern aquaculture. By addressing both economic imperatives and ecological needs, GIFT presents a transformative opportunity for farmers striving to achieve growth, resilience, and long-term sustainability in their operations

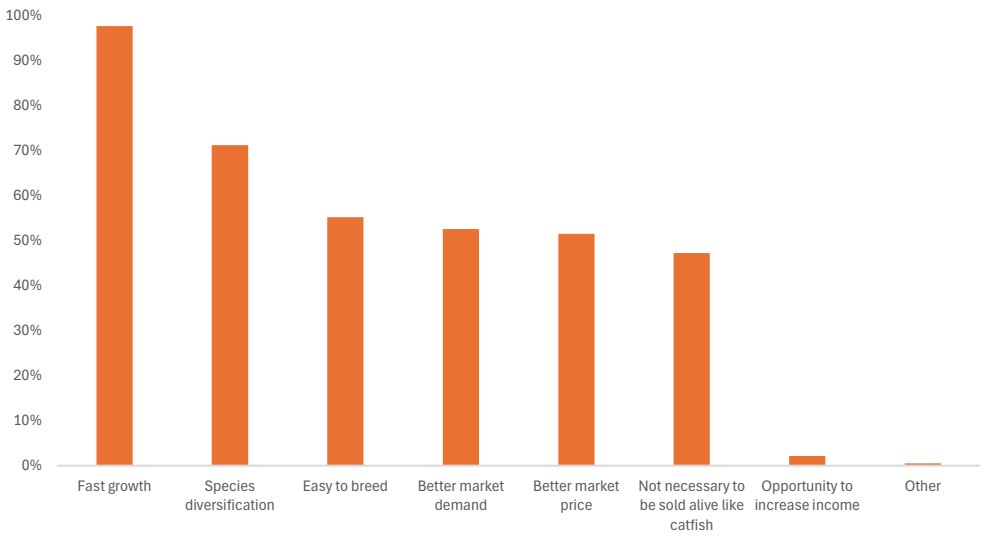

Figure 5. Reasons for interest in adopting GIFT in Kwara

Reasons for lack of interest in GIFT

Among the small percentage of farmers who expressed a lack of interest in adopting GIFT, the most frequently cited reason was its reduced market demand compared to catfish. These farmers noted that catfish remains a more popular choice among buyers in their local markets, offering them a more reliable revenue stream. Additionally, they pointed to the lower market price of tilapia as a disadvantage, emphasizing that the economic returns might not match those of catfish farming. Another significant concern was the limited availability of GIFT fry, which they perceived as a logistical barrier to adoption, particularly when compared to the more readily accessible fry of catfish species. These concerns highlight the importance of addressing market dynamics and supply chain challenges to enhance the adoption potential of GIFT among this group of farmers (Figure 6).

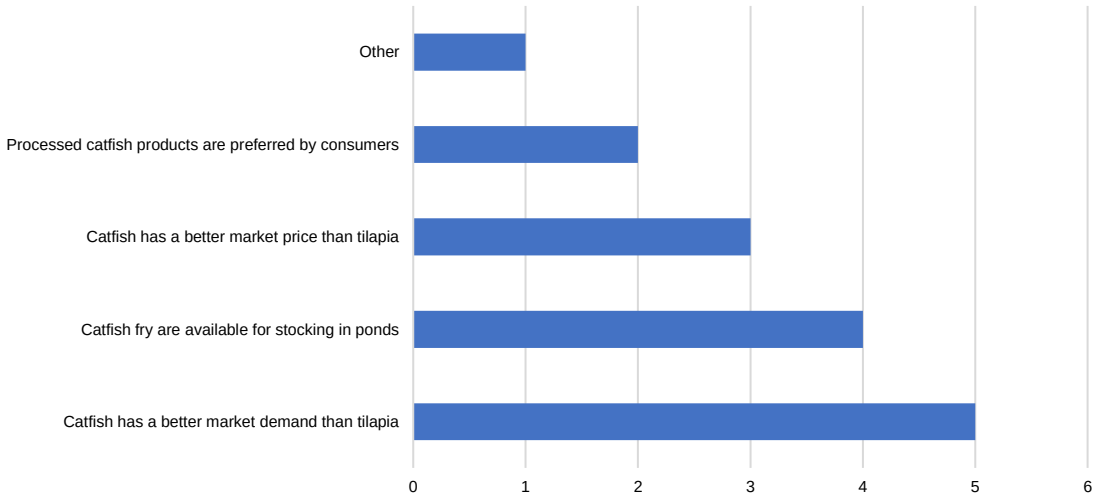

Figure 6. Reasons for lack of interest among farmers in adopting GIFT in Kwara

Hatcheries in Kwara

General characterictics of hatcheries

The study examined 16 hatcheries across various local government areas (LGAs) in Kwara State, with the highest concentration in Offa, followed by Ilorin West, Edu, Asa, Ilorin South, and Irepodun LGAs. All hatcheries were male-owned, reflecting persistent gender imbalances in the hatchery sector. The owners had an average age of 45 years, with a broad range of experience averaging 15 years in the fish seed business. Catfish seed production was universal among the hatcheries, with a quarter also producing tilapia seed. All hatcheries operated in clusters, and most were members of farmer associations. The Catfish Farmers Association of Nigeria (CAFAN) was the most common affiliation, followed by memberships in the Kwara Farmers Association (KWAFA), the All-Farmers Association of Nigeria (AFFAN), and the IFA Association.

Table 6. General characteristics of hatcheries and respondents

Variable		Mean/%
n = 16		
Sex of hatchery owner	Male	100.00
Age of hatchery owner		44.94
Experience in fish seed business		15.38
Type of fish seed	Catfish	100.00
	Tilapia	25.00
Role	Owner	100.00
Cluster membership		100.00
Membership to association		81.25
	CAFFAN	69.23
	KWAFA	15.38
	AFAN	7.69
	IFA	7.69

Facilities at hatchery

Different pond facilities at a hatchery are crucial for supporting various stages of fish development and ensuring efficient breeding and production management. An assessment of the facilities in these hatcheries revealed the presence of broodfish ponds, nursing ponds, and hatching tanks (**Table 7**). On average, hatcheries had approximately 3.5 broodfish ponds, 9 nursing ponds, and 2 hatching tanks, with significant variation among them. Broodfish ponds occupied the largest share of the total pond area, followed by nursing ponds, and finally hatching and spawning tanks. Notably, broodfish ponds were slightly deeper than nursing ponds, exceeding 1.5 meters in depth, while hatching and spawning tanks were typically 1 meter deep.

Table 7. Breakdown of hatchery facilities

Facility	No.	Total pond area m^2	Average pond depth (m)
Brood fishpond	3.5(2)	1,227.71(1,760.81)	1.69(0.62)
Hatching and spawning tanks	2.37(1.76)	125.24 (186.20)	1.02(0.69)
Nursing pond	8.69(5.400)	309.74 (440.58)	1.53(1.01)

Broodstock Management

Effective broodstock management is essential for ensuring the quality and sustainability of fish seed production in hatcheries. By selecting and maintaining healthy broodstock, hatcheries can significantly enhance the genetic quality, health, and performance of offspring. This leads to robust, disease-resistant stock with improved growth rates and adaptability to diverse environmental conditions. Additionally, superior broodstock management practices boost fecundity and spawning efficiency, contributing to the profitability and long-term viability of hatcheries.

As summarized in **Table 11**, the hatcheries typically utilize broodfish weighing around 3 kilograms on average. In 2022, they used approximately 173 broodfish for fish seed production. While the broodstock were initially acquired about 13 years ago, the hatcheries reported regularly replacing them every 1 to 2 years. Most hatcheries produce their own broodstock; however, less than half engage in broodstock exchange with other hatcheries. The reasons for such exchanges include minimizing inbreeding (5 hatcheries), ensuring genetic diversity (2 hatcheries), and meeting customer demand (3 hatcheries).

Operational diversity was evident in the number of hatching and spawn cycles, averaging 19 and 15 cycles per year, respectively. The nursing period for fingerlings before sale typically lasted 42 days, reflecting standard practices for optimizing fingerling development.

Table 8. Broodstock characteristics

Variable	Mean/%
Weight	2,937.50
Brood fish (no)	172.81
Broodstock duration	13.25
Own broodstock production (% yes)	81.25
Broodstock replacement	100
Frequency of broodstock replacement	1.875
Brood stock exchange (% yes)	43.75
Number of hatching cycles	18.69

Number of spawn cycles	15.25
Nursing period	41.75

Hatchery operator' interest in producing GIFT seeds in Kwara

All the farmers surveyed hatchery operators expressed a unanimous interest in producing fish seed of genetically improved farmed tilapia (GIFT), highlighting a strong preference for advanced aquaculture practices. **Figure 7** illustrates the numerous and compelling reasons behind hatchery operators' keen interest in GIFT. Foremost, all hatcheries emphasized the strain's faster growth rates, which enable quicker production cycles and potentially higher profits. This was complemented by widespread appreciation for GIFT's reduced feed requirements, a critical factor in lowering operational costs. Several hatcheries also highlighted GIFT's ability to survive in low-oxygen conditions (14 hatcheries) and its disease tolerance (11 hatcheries), both of which contribute to improved survival rates and minimized losses. Furthermore, high yields were identified by eight hatcheries, while seven noted the strain's good taste, making it an appealing option for consumers. Additional benefits, such as its attractive skin (four hatcheries) and high market demand (three hatcheries), further enhance its marketability. These diverse advantages underscore why GIFT is seen as a transformative opportunity for hatcheries looking to maximize production efficiency and expand their market reach.

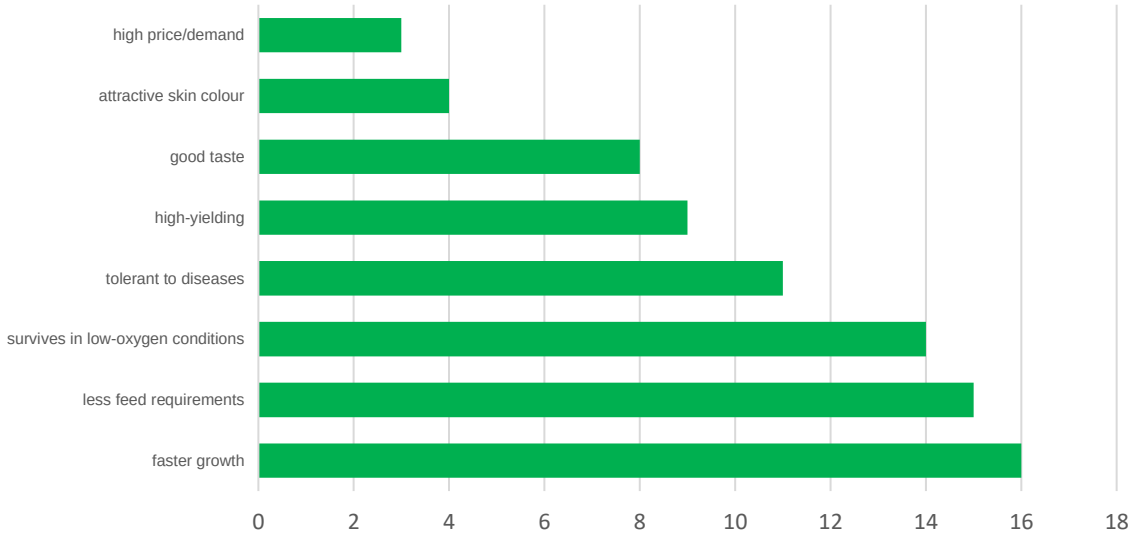

Figure 7. Hatchery motivations to produce GIFT seeds

NASARAWA STATE

Grow Out Farmers in Nasarawa

Socio-demographic and general household characteristics in Nasarawa

The sociodemographic characteristics of grow-out farmers in Nasarawa revealed distinct trends, particularly in age and education. Over 80% of households were male-headed, consistent with findings from Kwara. However, Nasarawa's household heads were older, with approximately 67% aged over 40 years, while nearly half of the sample fell within the 31– 40 age range. Education levels were notably high, as more than 70% of household heads had attained tertiary education. Despite all households participating in grow-out farming, about 44% reported other primary occupations, reflecting diverse livelihood strategies. These insights align closely with patterns observed in Kwara, emphasizing shared socioeconomic dynamics across the regions.

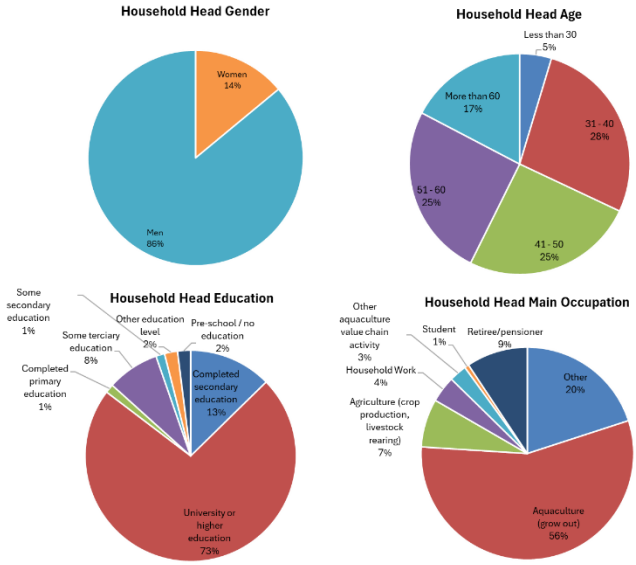

Figure 8. General socio-demographic characteristics of grow-out farmers in Nasarawa

The food security aspects of surveyed households paint a positive picture, as highlighted in Table 6. Key indicators such as household size, food consumption score (FCS), and meal frequency suggest a stable food security status. The FCS and the consistent number of daily meals underscore the households' ability to meet their nutritional needs. Additionally, the notable level of fish consumption in the past week highlights the vital role fish plays in their diets, further emphasizing its cultural and nutritional significance within these communities.

Table 9. General characteristics of surveyed households in Nasarawa

Variable	Mean	SD
Household size (number of people)	4.9	2.5
FCS* (units)	70.4	17.1
Fish consumption in the previous week (number of days)	4.6	2.1
Meals per day (number)	2.8	0.8

* FCS >=35 is considered acceptable ((World Food Programme, 2024)

General characteristics of farming systems in Nasarawa

The study revealed that concrete tanks were the predominant facility type used by farmers in Nasarawa, accounting for 60% of the total, followed by earthen ponds and a mix of both (**Figure 9**). On average, farmers managed six facilities, with four actively used for grow-out activities and two remaining idle (**Table 10**). The total grow-out area across farms averaged 429 square meters, reflecting a moderate scale of production within the surveyed households.

Table 10. Characteristics of facilities in Nasarawa

Variable	Mean	Median
Total number of facilities	6.5	4.0
Number of grow out facilities	4.0	3.0
Number of idle facilities	2.1	0
Number of hatching facilities	0.3	0
Number of Earthen Ponds	0.9	0
Number of Concrete Tanks	4.7	3.0
Total grow out area (sqm)	429	320

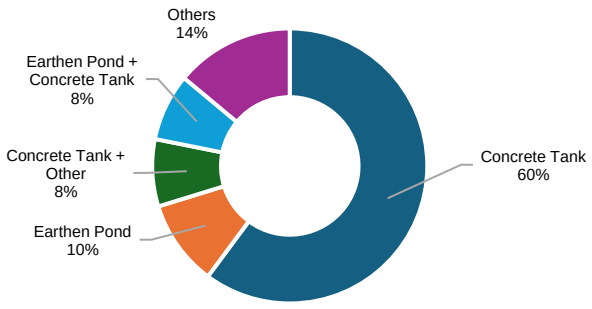

Figure 9. Types of facilities in Nasarawa

The study highlighted Catfish as the dominant species farmed, with 67% of farmers exclusively cultivating it, followed by 29% farming Clarias (**Figure 10**). A small portion (2%) of respondents reported farming a combination of Tilapia and other species. Monoculture practices were prevalent among farmers, while 14% engaged in polyculture activities (**Table 11**).

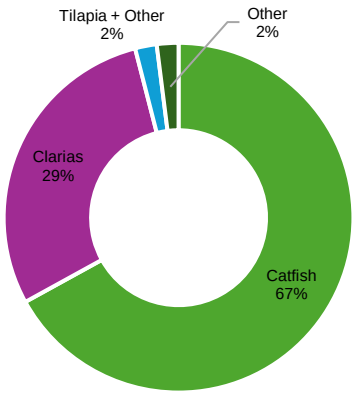

Figure 10. Fish species farmed in Nasarawa

Table 11. Monoculture vs Polyculture in Nasarawa

Practices	Prevalence
Monoculture	86%
Polyculture	14%

The study found that the stocking season predominantly occurs from January to May, with 78% of farmers initiating their activities within this period, particularly in January and April (Table 9). Harvesting typically takes place between April and October, with 83% of farmers actively engaged during these months. August emerged as the peak month for initiating harvests, highlighting the seasonal patterns of fish farming activities in the region.

Table 12. Seasonality of stocking and harvesting activities in Nasarawa

Month	Stocking		Harvesting	
	%of farmers	Cumm. %	% of farmers	Cumm. %
January	10%	10%	1%	1%
February	14%	23%	4%	5%
March	10%	34%	4%	9%
April	9%	43%	4%	13%
May	11%	54%	4%	17%
June	16%	70%	9%	26%
July	5%	75%	8%	33%
August	5%	79%	11%	44%
September	3%	83%	9%	53%
October	4%	87%	16%	69%
November	7%	94%	15%	83%
December	6%	100%	17%	100%

Adoption Potential of GIFT in Nasarawa

The study explored the adoption potential of GIFT (Genetically Improved Farmed Tilapia) among farmers, starting with their prior awareness of the strain (**Figure 11**). Approximately 23% of farmers reported some knowledge of GIFT. After providing an explanation to those unfamiliar, 70% expressed interest in adopting the improved strain. Additionally, 92% of farmers indicated a broader interest in adopting other improved strains, with African catfish and carp being the most preferred choices (**Figure 11**).

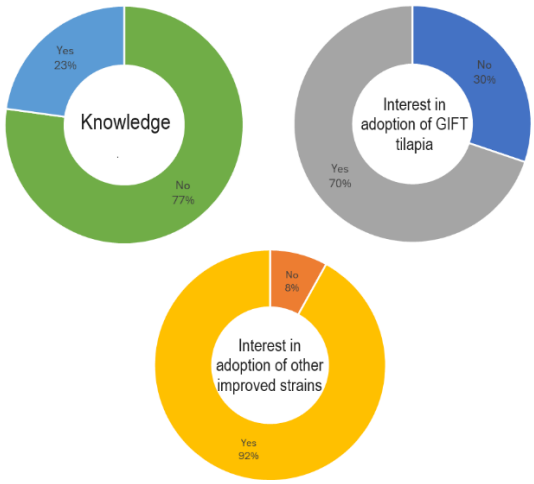

Figure 11. Knowledge and interest in adoption of GIFT and other improved fish strains in Nasarawa

Apart from GIFT Tilapia, farmers also identified other preferred improved strains, with the majority favoring the improved strain of African catfish, followed by carp species. Only a small number of respondents indicated a preference for rohu and other strains. These findings reflect the farmers' existing familiarity and comfort with certain species, while also signaling opportunities to expand options through targeted awareness and support initiatives.

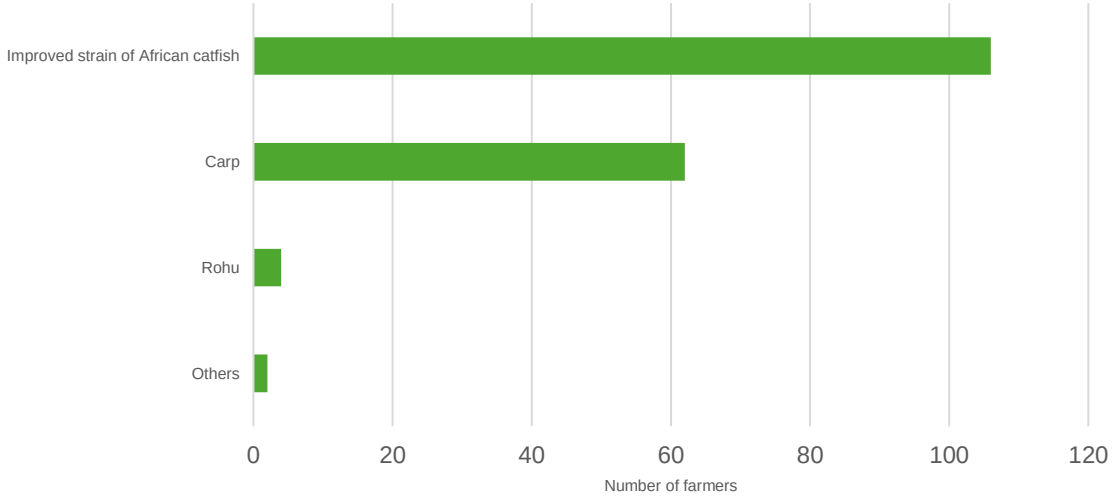

Figure 12. Preferred improved strains other than GIFT tilapia in Nasarawa

Farmers prioritized fast growth as the most desirable characteristic for improved fish strains, followed by strong market demand and higher market prices (Figure 13). Conversely, when comparing improved strains to catfish, the least desirable traits were related to customer demand, preferences, and market price, highlighting the critical role of market dynamics in shaping farmers' perceptions (**Error! Reference source not found.**).

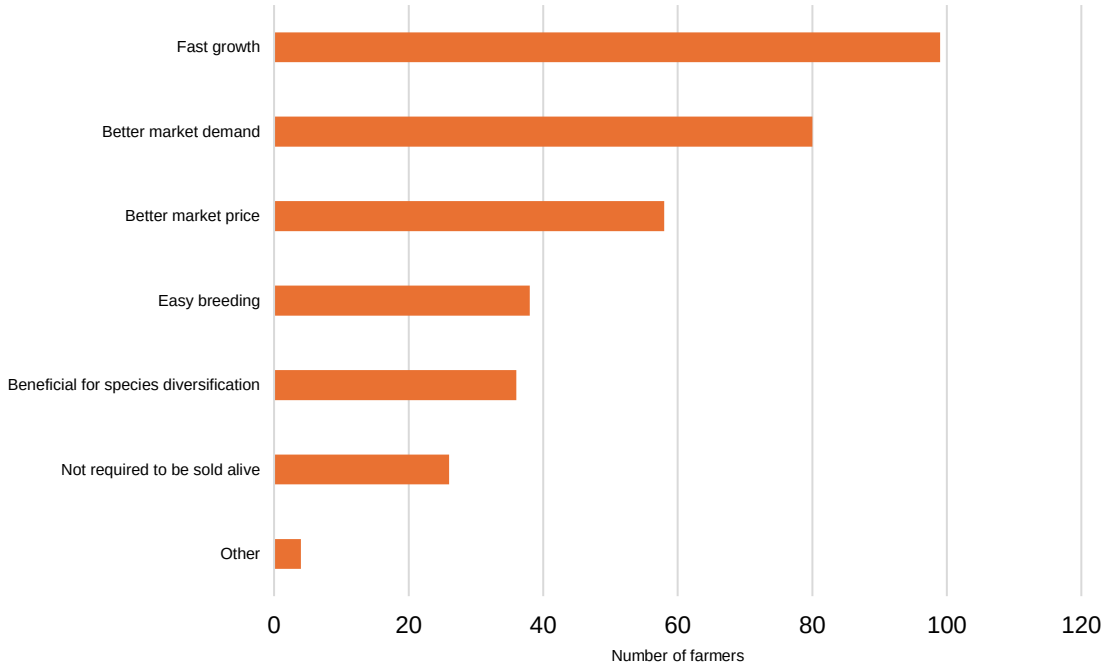

Figure 13. Preferred characteristics of improved fish strains in Nasarawa

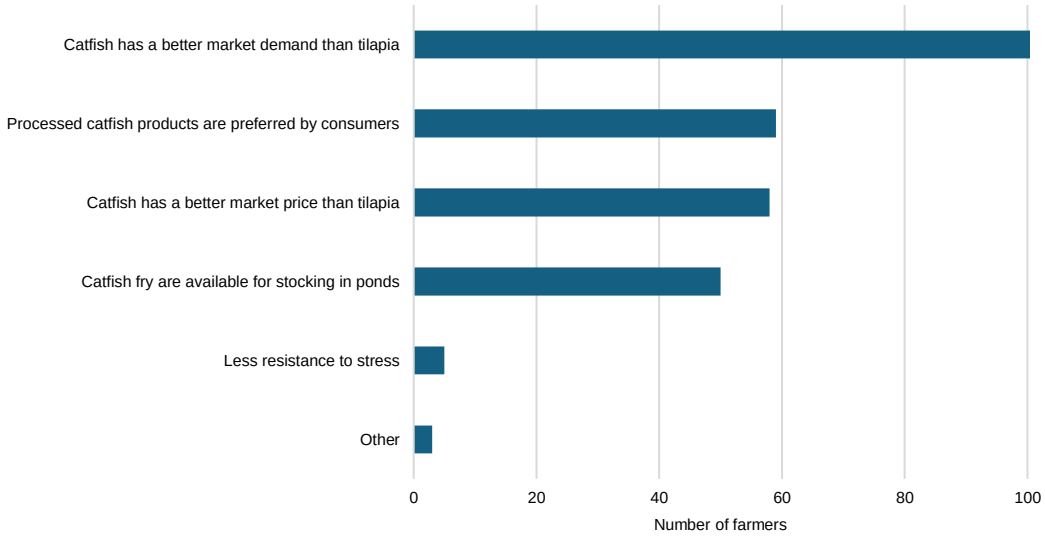

Figure 14. Least desirable characteristics of improved fish strains In Nasarawa

Hatcheries in Nasarawa

General characteristics of hatcheries in Nasarawa

A survey of 51 hatcheries across three Agricultural Development Programme (ADP) zones in Nasarawa State revealed key insights into the fish seed industry. On average, the hatcheries had been operating for nine years, with those in the Western zone showing slightly longer tenure. The average age of respondents was 44 years, with the Central zone averaging 48 years and the Southern zone 40 years. Among respondents, 27% were hatchery managers, while 73% were hatchery owners, of whom only 2 were female. Educational attainment was high, with 31 hatchery owners having completed university or higher education (**Figure 15**). Catfish seed production dominated, with 98% of hatcheries specializing in it, and only 2% producing both catfish and tilapia seed. Membership in farmer associations was notably low, reported by just 14% of hatcheries.

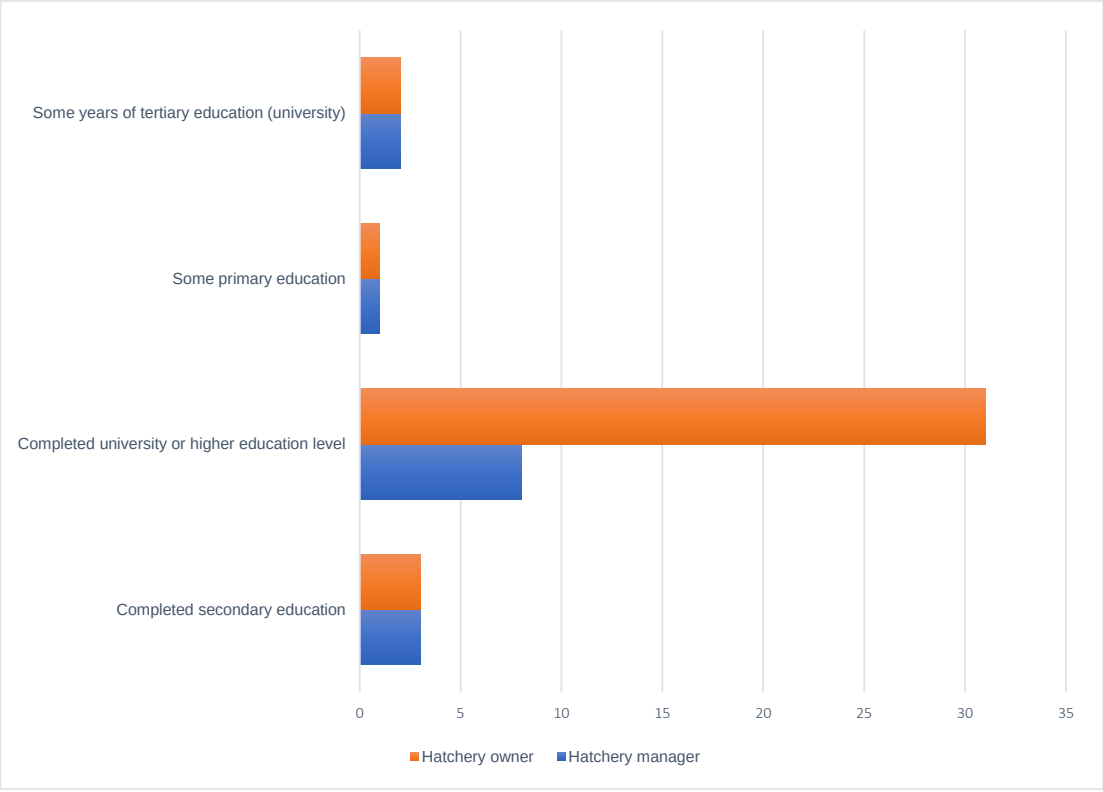

Figure 15. Education level of survey respondents

Broodstock Management

The performance of hatcheries is significantly influenced by the health and quality of their broodfish, among other factors. For Nigeria's aquaculture sector, effective broodstock management is crucial for producing high-quality fish seeds. Poor broodstock management has been identified as a primary obstacle to achieving optimal fry and fingerling outputs nationwide. Thus, implementing robust broodstock management practices is essential. This subsection examines the broodstock

characteristics and management strategies employed by 51 hatcheries across the three ADP zones of Nasarawa State.

Survey data reveals diverse broodstock characteristics among hatcheries (**Table 13**). On average, each hatchery maintained approximately 74 broodfish, though numbers varied by zone, with the Central zone hosting larger populations than the Southern and Western zones. The average broodfish weight across all hatcheries was around 1920 grams, with heavier broodfish observed in the Western zone compared to the Southern zone. Notably, about 61% of hatcheries had updated their original broodstock.

The data also show an average of six spawning cycles annually, with the Southern and Western zones slightly surpassing the Central zone. Similarly, hatcheries in the Southern and Western zones reported an average of six hatching cycles per year. Nursing periods differed by zone, with the Central and Western zones reporting longer durations of 52 and 51 days, respectively, compared to 47 days in the Southern zone. These findings highlight regional variations in broodstock management practices and their potential impact on hatchery performance.

Table 13. Broodstock characteristics

Variable	Central	Southern	Western	Whole sample
	Mean	Mean	Mean	Mean
Number of Catfish brood fish	188.43	35.56	69.50	73.84
Weight of broodfish (gr./piece)	2000	1760	2010	1920
Hatching cycles (number)	3	6.3	6.3	5.86
Spawning cycles (number)	4.5	6.9	6.1	6.4
Nursing period (days)	52	47	51	49.7

The study found that 67% of the surveyed hatcheries use separate ponds or facilities for different broodstocks, while a significant proportion does not practice broodstock segregation. Among those that do, over 80% distinguish broodstocks by sex, around 40% by age, and only 1% by strain (Figure 48). This variation in broodstock management strategies reflects differing levels of awareness regarding the importance of segregation. Additionally, 76% (39 hatcheries) reported separating seed batches until sale, a practice that likely aids in monitoring seed quality and maintaining breed strains.

Hatcheries willingness to produce fingerlings of genetically improved farmed tilapia

The levels of awareness and interest in genetically improved farmed Tilapia (GIFT) among respondents highlight both curiosity and a potential shift towards innovative aquaculture practices. Initially, only 14 respondents were aware of GIFT, revealing a significant knowledge gap regarding advanced genetic improvements in Tilapia farming. However, after a brief introduction to GIFT, the number of respondents interested in producing GIFT fingerlings increased to 39, demonstrating a strong interest triggered by the information shared. In contrast, 12 respondents remained

uninterested, possibly due to satisfaction with current practices or concerns about adopting new methods. The primary reasons for the increased interest in GIFT included its faster growth rates, disease tolerance, high yield, and favorable taste profile – factors that could significantly improve profitability and product quality in aquaculture operations (Figure 16). Although less frequently cited, other appealing characteristics of GIFT, such as reduced feed requirements, resilience in low-oxygen conditions, attractive skin color, and the potential for higher market prices, also contributed to the growing interest.

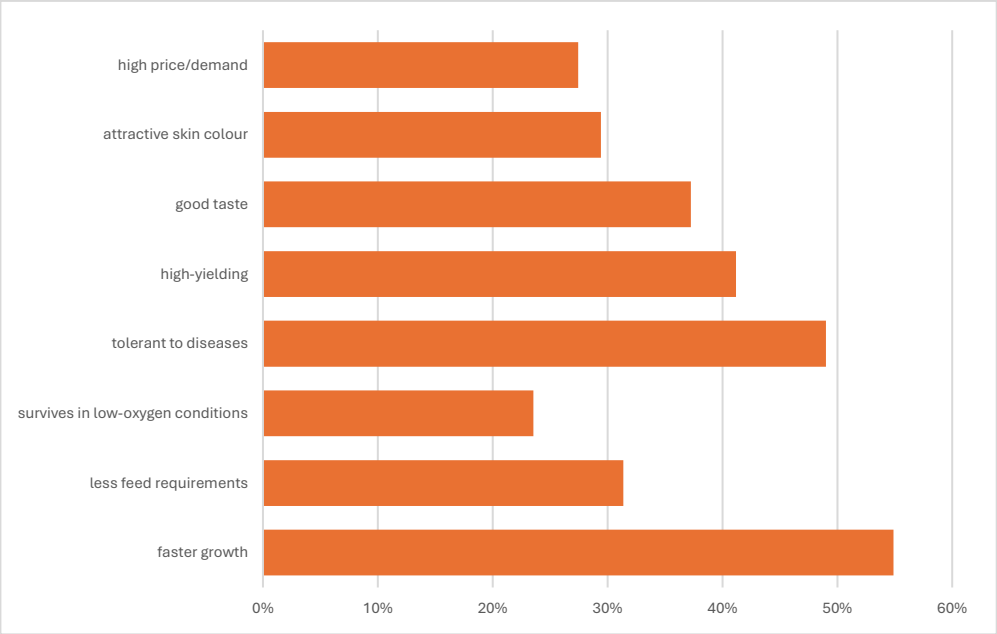

Figure 16. Reasons for the interest to produce fish seed of GIFT

Among the 12 hatcheries that expressed disinterest in producing GIFT fish seed, several concerns were highlighted that influenced their decision (Figure 17). A predominant viewpoint was that GIFT did not perform optimally in extensive and semi-intensive farming setups, which are common among these hatcheries, coupled with a perception of limited market availability for GIFT compared to well-established species like Catfish. This limited market appeal was a significant deterrent, with about 40% of these respondents citing lower market prices and challenges in feeding GIFT in comparison to the more resilient and less demanding Catfish. Additional reservations mentioned by a few farmers included a lack of government support for GIFT production and concerns over its adaptability to local environmental conditions. These factors collectively underscore the complexities and considerations hatcheries face in deciding which fish species to cultivate, balancing market demands, operational feasibility, and support infrastructure in their decision-making processes.

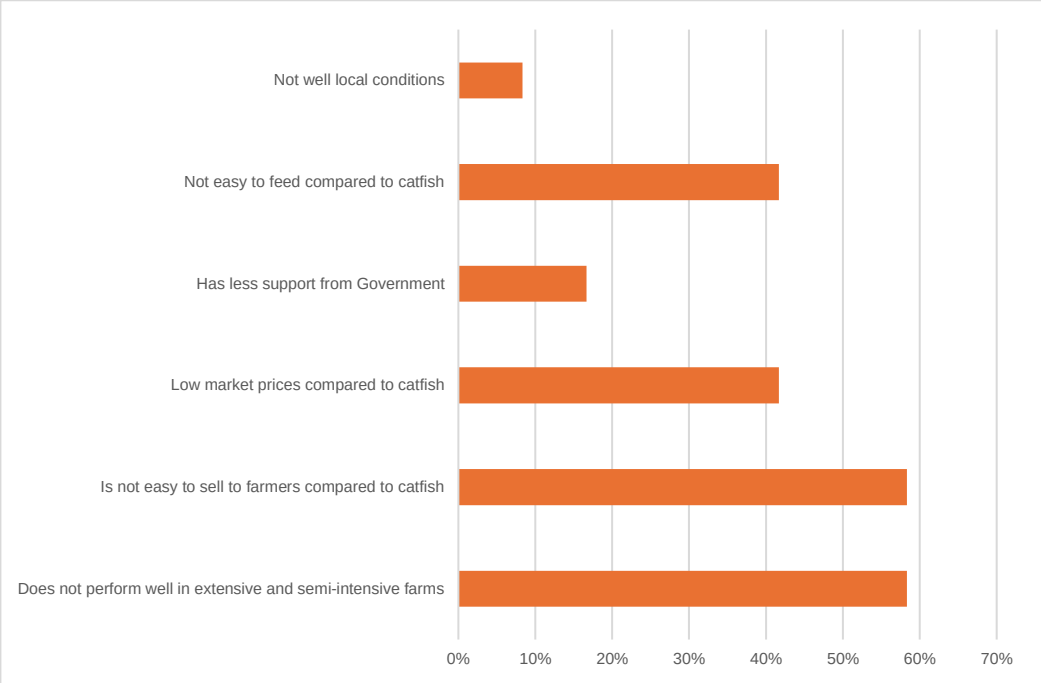

Figure 17. Reasons for lack of interest in producing GIFT fingerlings

Recommendations for the supporting adoption of improved fish strains

Based on the findings from the GIFT adoption study in these states, the following recommendations are proposed to encourage the successful adoption and scaling of GIFT (Genetically Improved Farmed Tilapia) in the aquaculture sector.

(i) Increase awareness and education

A significant knowledge gap about GIFT was identified, with only a small portion of respondents initially aware of it. To address this, targeted awareness campaigns should be implemented to educate farmers about the benefits of GIFT, including its faster growth rates, disease resistance, and high yield. These campaigns can be carried out through workshops, extension services, and information dissemination via radio, social media, and other accessible platforms.

(ii) Provide hands-on training

A substantial number of respondents expressed interest in adopting GIFT but had limited knowledge on its practical implementation. It is crucial to organize hands-on training sessions focusing on the production of GIFT fingerlings, including best practices for broodstock management, breeding, and maintaining optimal farming conditions. This will help bridge the knowledge gap and build the confidence of farmers in adopting GIFT.

(iii) Facilitate access to gift fingerlings and broodstock

To support farmers interested in adopting GIFT, initiatives should be put in place to ensure the availability of GIFT fingerlings and quality broodstock. Collaboration with hatcheries, both public and private, can help ensure a steady supply of high-quality GIFT stock. Subsidies or financial support for acquiring these resources could help mitigate the initial investment barriers for small-scale farmers.

(iv) Highlight economic benefits

Emphasizing the economic advantages of GIFT, such as higher yields, improved profitability, and the potential for fetching higher market prices, should be a key component of the adoption strategy. Case studies or success stories of other farmers who have adopted GIFT successfully can be shared to demonstrate the tangible benefits and motivate others.

(v) Offer technical support and extension services

Providing continuous technical support and access to extension services is vital to help farmers

optimize their GIFT farming practices. This includes guidance on disease management, feed optimization, and maintaining water quality—factors that are essential for the successful cultivation of GIFT. Extension agents should be trained on GIFT and its benefits to better support farmers in the field.

(vi) Strengthen farmer associations and networks

Fostering the formation of farmer associations or cooperatives focused on GIFT production can help create a supportive network for knowledge exchange, joint marketing, and collective bargaining for inputs and resources. Membership in these associations can also facilitate access to training, technical support, and other resources critical to GIFT adoption.

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WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

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