PANGASIUS (*Pangasianodon hypophthalmus):* CAN IT BECOME NIGERIA'S THIRD CULTURED FISH?

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Abstract
Pangasius, *Pangasianodon hypophthalmus*is an emerging fast-growing and one of the most significant freshwater aquaculture species globally. This fish originates from the Mekong River Delta in Vietnam. It has gained its popularity from its fast growth rate, efficient food conversion, adaptability to different farming regimes, and market dynamics. This fish species has enjoyed farm trials in different parts of Nigeria, but yet not to be fully cultured as a commercial fish food specie. This paper provides a comprehensive overview of Pangasius fish species as a suitable aquaculture fish species, that can join Tilapia and Catfish production in Nigeria. The paper elucidates the possibilities and robust considerations for the culture of this fish as the third possible aquaculture specie next to tilapia and catfish. Amongst these are, (a) the suitability of Nigeria's various water conditions for its growth, (b) low feed cost, (c) available human experts in fish farming of different fish species in Nigeria. The paper shows some comparative analysis between catfish and Pangasius culture in Nigeria and highlights some of the culture difficulties. The paper suggested scientific and cultural solutions that will enhance profitable culture of Pangasius in Nigeria. Having Pangasius as Nigeria's third economic fish species (after Tilapia and Catfish) has many advantages, which include, diversification of our aquaculture industry; expansion of our fish demand market and fish species diversification.

Keywords: Pangasius, aquaculture, diversification, fish culture, Nigeria

Introduction

The family Pangasiidae comprises a diverse group of catfishes of significant ecological and economic importance, particularly in aquaculture. Pangasius is a genus of medium to very large shark catfishes native to freshwater environments in South and Southeast Asia. While there are many species within the Pangasius genus, only a few are commonly farmed, and many remain primarily wild. The commonly farmed Pangasius species are: (a) *Pangasianodon hypophthalmus* (Striped Catfish, Iridescent Shark, Sutchi Catfish, Swai, Tra): This is by far the most widely farmed Pangasius species globally, especially in the Mekong Delta of Vietnam. It is known for its fast growth rate and adaptability to aquaculture conditions. In many markets, it's commonly sold as "basa fish" or "swai."

(b) *Pangasius bocourti* (Basa Fish, Bocourti): This is also a significant farmed species. It is often marketed as "basa fish" and is known for its mild flavor and flaky white flesh.

(c) *Pangasius pangasius* (Yellowtail Catfish, Pangas Catfish). Though traditionally a wild-caught species, this species is also being increasingly farmed, particularly in countries like Bangladesh.

There are many other recognized species within the Pangasius genus, most of which are not widely farmed for commercial purposes. Some examples of notable ones include, (a) *Pangasius conchophilus* (Snail-eating Pangasius); (b) *Pangasius djambal;* (c) *Pangasius elongatus*; (d) *Pangasius humeralis*(e) *Pangasius krempfi*(f) *Pangasius kunyit* (g) *Pangasius larnaudii (Spot Pangasius),* and (h) *Pangasius lithostoma,* to name a few.

Pangasiids catfish can be found in major freshwater rivers of South Asia to Southeast Asia. For several decades, this type of catfish has been particularly significant for fisheries in several Asian countries (Gustiano *et al.*, 2021).In the aquaculture sectors of Asian countries, *Pangasius* has experienced significant growth and emerged as a major aquaculture commodity, contributing to the country's economic development and export income (Ali *et al.,* 2013; Ho *et al.,* 2016; Jeyakumari *et al.,* 2016; Nguyen *et al.,* 2018).Their adaptability, fast growth rates, and mild-flavored white flesh have propelled them to become one of the most globally traded aquaculture products.

The family Pangasiidae consists of approximately 30 valid species distributed across four genera: Helicophagus, Pangasianodon, Pangasius, and Pseudolais. Among these, the genus Pangasius is the most dominant. (FAO, 2024). This particular species is responsible for the vast majority of Pangasius aquaculture production and trade worldwide. These species are characterized by their laterally compressed bodies, two sets of barbels (maxillary and mandibular), a long anal fin, a short dorsal fin with strong spines, and smooth skin. They are facultative air-breathers, allowing them to tolerate low dissolved oxygen levels and relatively poor water quality, which contributes to their suitability for intensive aquaculture (FAO, 2024).

Historically, Pangasius species were important components of wild fisheries in their native ranges. However, with the development of artificial propagation

techniques in the mid-1990s, aquaculture of Pangasius, particularly *P. hypophthalmus*, expanded rapidly. This shift from wild capture to commercial hatchery production significantly reduced reliance on wild juveniles and fueled the growth of floating net-pen and pond culture systems (Seafish, 2020). Reports show that Vietnam has emerged as the leading global producer and exporter of Pangasius, accounting for a substantial volume of the world's supply and exporting to over 100 countries (Vinh Hoan Corp.). The rapid growth and adaptability of Pangasius have led to its widespread farming, providing an affordable protein source and supporting livelihoods in many regions. It is our belief that asustained introduction of these fish-to-fish farmers in Nigeria will open the possibility of increase in our freshwater fish supply.

Factors that contributed to the widespread of Pangasius aquaculture in the world

In Bangladesh, *Pangasius* catfish is considered as one of the most successful aquaculture species due to its relative ease in culture, high-market demand, and suitability to local climate conditions (Rahman, 2005, Rahman *et al.* 2012).The traditional development of capture-based aquaculture for this species, particularly in Vietnam and to a lesser extent in Thailand and Cambodia, probably began because it is a prolific spawner, producing relatively large numbers of larvae that are easily harvested from the flowing river (Griffiths *et al*, 2011).The widespread adoption and success of Pangasius aquaculture can be attributed to several factors.

It is cultured due to its good market demand, fast grower, few countries dominate the culture production, and it is well recognized as oneof the most important freshwater fish groups within aquaculture sector. *Pangassius* is now cultured in several countries in the world like Thailand, Nepal, Pakistan, India, Bangladesh, Vietnam, Laos, Myanmar, Indonesia, and Cambodia (Haider *et al* 2023). These include (a) Fast growth and high yields: Pangasius can reach market size relatively quickly, offering efficient production cycles; (b) Adaptability: Their tolerance to varying water conditions and lower dissolved oxygen levels makes them suitable for diverse farming environments; (c) Cost-effectiveness: Pangasius can thrive on lower-cost feed compared to some other farmed species, contributing to lower production expenses (AquaPet Ventures); (d) Nutritional value: Pangasius is a lean white fish, low in fat and carbohydrates, rich in protein, and a source of various vitamins and minerals (Youreverydayfish.com). While generally lower in Omega-3 fatty acids compared to oily fish like salmon, it remains a healthy and affordable protein source, and, (e) Global market demand: Its mild flavor and versatility in cooking have made Pangasius a popular choice for consumers worldwide, contributing to its high demand in both local and international markets (AquaPet Ventures, 2021).

In summary, Pangasius species, particularly *Pangasianodon hypophthalmus*, have undergone a remarkable transformation from regional wild fish to a globally significant aquaculture commodity. Their biological characteristics, combined with advancements in farming techniques, have enabled their

rapid growth in production and trade. While challenges remain in ensuring environmental sustainability and addressing public perception, the ongoing efforts towards responsible aquaculture practices highlight the continued importance and evolution of Pangasius in global food systems (FAO, 2014).

Some basic comparisons between Catfish and Pangasius culture in Nigeria

In Nigeria's aquaculture sector, the African Catfish, primarily *Clarias gariepinus,* has long been the dominant species. However, Pangasius, often referred to as "Panga catfish" in the local context, is gaining increasing attention as a viable alternative or complementary species. However, a brief comparison of these two fish species under aquaculture in Nigeria will assist the farmers to decide which species to improve upon its cultivation.

A quick observation of the African catfish shows the following when compared to Pangasius.

(a). Dominance and History: *Clarias gariepinus* is the most widely cultured fish species in Nigeria, accounting for a significant majority (around 90%) of farmed fish. Its aquaculture has a long history and is deeply ingrained in the Nigerian farming landscape. (Ajah *et al*., 2022)

(b) Characteristics: The following characteristics of catfish are evident in its culture over the years. (i) Hardiness: Known for its resilience, ability to withstand handling stress, and tolerance to adverse pond conditions, especially low oxygen content and high turbidity, due to its accessory respiratory organs (air-breathing) (Bawa,2014)(ii) Growth Rate: Catfish has been considered to have a good growth rate, reaching market size in a reasonable timeframe (Bawa, 2014); (iii) Feed Requirements: catfish requires a relatively high-protein diet, which can contribute to higher feed costs(AquaPet Ventures); (iv) Cannibalism: Catfish is known for its cannibalistic tendencies, especially at younger stages, which requires careful management and sorting. (No direct reference for Nigeria but generally known for Clarias species); (v) Disease Susceptibility: While generally hardy, they are susceptible to certain diseases, with bacterial infections being a significant cause of mortality. (Bawa, 2014).

(c) Market Acceptance: Highly popular in the Nigerian market, consumed widely in various forms (fresh, smoked, dried). However, Pangasius is currently an emerging alternative culturable fish species especially in Nigeria. Currently its being promoted as a "game-changer" in Nigerian aquaculture, offering diversification and a potential solution to some of the challenges faced by catfish farmers. (AquaPet Ventures)

In comparison to Catfish, these are the prevailing characteristics of pangasius:

General Characteristics of Pangasius*:*

(a) Faster Growth: reports from some isolated farmers show that Pangasius can reach market size within four to six months under optimal conditions, significantly faster than catfish. (AquaPet Ventures); (b) Efficient Feed Conversion: it is known for its efficient feed conversion ratio (FCR) and ability to thrive on lower-cost, lower-protein feed, which significantly reduces production

expenses. (AquaPet Ventures); (c) High Survival Rate: Generally, Pangasius has a high survival rate, making it a more reliable option. (AquaPet Ventures); (d) Tolerance to Water Conditions: Highly adaptable and can thrive in diverse water conditions, making it suitable for various farming systems. (AquaPet Ventures); (e) Non-Cannibalistic: Unlike *Clarias gariepinus*, Pangasius is not cannibalistic, simplifying stocking and management. (Anon, 2021) (f) Pangasius has a high Market Versatility. It can be sold fresh, frozen, smoked, or as fillets, offering multiple market opportunities and potential for export
(AquaPet Ventures) (g) Nutritional Value:
It's a valuable source of animal protein, and while wild Pangasius has higher omega-3s, farmed varieties still offer good nutritional benefits. (Haider *et al.,* 2023).
(h) Market Acceptance. When compared to Catfish, it could be predicted that while gaining traction, it may still face the challenge of shifting consumer preference from the deeply entrenched catfish market. In addition, the processing and filleting for marketing and the market for fillets might require more advanced processing infrastructure.
In conclusion, while *Clarias gariepinus* remains a staple farmed fish in Nigerian aquaculture, the possible introduction of *Pangasianodon hypophthalmus*as a promising species can help diversify the industry, and potentially address Nigeria's fish demand-supply gap.
The shift towards Pangasius can reflect a strategic move to enhance the sustainability and profitability of fish farming in the country.

Early observations about the culture of Pangasius in Nigeria

Based on literature and available information, *Pangasius hypophthalmus* fries were imported into Nigeria some years ago, (around 2010/early 2011) under license from the Federal Ministry of Agriculture, as a consequence of the felt needs to diversify Nigeria's aquaculture breeds, and to ensure that such breeds like Pangasius which can utilize plant-based ingredients more efficiently. The whole idea is to ensure that Nigerian consumers have access to other fish species apart from Clarias species (Anon,2023). A company named AquaPet Ventures undertook some aspects of the culturing of Pangasius, and has come up with different reports on some achieved successes. The need to expand the culture of Pangasius to a sustainable, profitable and economic level can be encouraged nationwide, through the newly established Ministry of Marine and Blue Economy. Pangasius is one of the white-fleshed catfish in the world and in addition to other factors, have made it an acceptable fish in the world market. AquaPet Ventures has observed that it can be cultured under various polyculture systems such as, (a)*Pangasius hypophthalmus* and Tilapia, (b) *Pangasius hypophthalmus* and *Clarias gariepinus* and (c) *Pangasius hypophthalmus*, Tilapia and Clarias. In addition to other favorable management skills, the above can be practiced with good stocking density to have a desirable harvest (Anon, 2023).
The successful breeding of Pangasius by organizations like AquaPet Ventures has spurred interest and adoption among farmers. Recognizing the global significance of pangasius as a versatile and nutritious fish,

AquaPet Ventures have embarked on a comprehensive research and development initiative specifically tailored to the Nigerian content (AquaPet Ventures)

Envisaged advantages of Pangasius farming in Nigeria

Generally, every effort to culture Pangasius on a large scale will provide the following advantages. These include, (a) Diversification of Aquaculture: Nigeria's aquaculture industry is heavily dominated by African Catfish (*Clarias gariepinus*). Introducing Pangasius offers a crucial opportunity for species diversification, reducing reliance on a single species and potentially mitigating risks associated with market saturation or species-specific disease outbreaks.

(b) Faster Growth and Higher Yields: Under a relatively good management (feed and skills), Pangasius exhibits a significantly faster growth rate compared to catfish, reaching market size (1-2 kg) in 4-6 months under optimal conditions. This translates to quicker production cycles and potentially higher yields per unit area, making it more profitable for farmers. Annual yields of up to 90-120 tons per hectare have been reported in Asia (AquaPet Ventures, 2023). (c) Lower Feed Costs and Efficient Feed Conversion: Pangasius is an omnivorous fish that can thrive on lower-protein diets compared to carnivorous catfish. This can significantly reduce feed costs, which often account for the largest portion (over 70%) of aquaculture production expenses. Its efficient feed conversion ratio (FCR) further contributes to cost-effectiveness (Aquapet Ventures,2023).

(d) Market Demand: There is a growing demand for fish in Nigeria, with domestic production currently falling short of demand. Pangasius, with its mild flavor and white, flaky flesh, is acceptable in the Nigerian market, especially in its frozen fillet form, which is already imported and consumed. (e) Job Creation and Food Security: Expanding Pangasius farming can create numerous employment opportunities across the value chain, from hatchery operations and farming to processing, distribution, and marketing. This contributes directly to food security and poverty alleviation. (f) Export Potential: As Nigeria aims to diversify its economy and reduce reliance on oil, developing a strong aquaculture sector with export potential, by adding to the number of our farmed fish species (like Pangasius) that can be exported, which could generate additional foreign exchange for the country.

Possible Challenges of Pangasius culture in Nigeria:

Based on the available reports (AquaPet Ventures), one of the major setbacks in the culture of *Pangasius* has remained breeding in captivity, which is related to low availability of technology and expertise. These setbacks can be addressed by improving the broodstock condition in terms of growth, maturation, egg quality, sperm quality, and mass production of fingerling through the manipulation of nutrients in their diets (Izquierdo *et al*., 2015).For example, the government of India started promoting the culture of pangasius in cages in reservoirs and other water bodies a fewyears ago, and in 2016 the National Fisheries Development Board produced its NFDB Manual on Guidelines for Pangasius (Izquierdo *et al*., 2015). This can be done gradually in Nigeria. Their government – through its "Blue Revolution" mission – has funded and supported several cage farming projects (Mugaonkar *et al*, 2017), Nigeria can do the

same though our current Blue Economy program.

Here are some probable difficulties that Nigeria's aquaculture industry may encounter in the culture of Pangasius:

1. Broodstock and Fingerling Production: Establishing and maintaining high-quality Pangasius broodstock in Nigeria is crucial. Relying on imported fingerlings or inadequate local breeding programs can lead to issues with genetics, growth rates, and disease resistance over time.

2. Hatchery Management Expertise: Successful large-scale fingerling production requires specialized knowledge in hatchery management, including hormone induction, larval rearing, and nursery management, which might not be widely available or standardized across the country.

3. Inbreeding: Without proper genetic management and exchange of broodstock, there's a risk of inbreeding, which can negatively impact growth, survival rates, and overall productivity in future generations.

4. Feed Quality and Availability: Dependence on Imported Ingredients has been known to be very uneconomical in aquaculture. While Pangasius can utilize lower-protein feeds than catfish, the availability and cost of key feed ingredients (even those of lower protein content) can still be a challenge. Nigeria's reliance on imported feed ingredients, or locally produced ingredients subject to market fluctuations, can drive up production costs. Formulating and producing high-quality, cost-effective Pangasius-specific feeds tailored to different life stages requires expertise in feed formulation and efficient feed milling facilities. Inadequate feed quality can hinder growth and health.

5. Disease Management and Biosecurity: As an introduced species, there's a risk of introducing new diseases with imported Pangasius stock. Implementing robust biosecurity measures at all levels of the value chain is critical to prevent outbreaks. If diseases emerge, Nigeria lacks sufficient diagnostic laboratories and veterinary expertise specifically for Pangasius, making rapid identification and effective treatment challenging. Water quality management and waste disposal also can lead to water pollution, negatively impacting the environment and potentially causing self-inflicted fish health problems.

6. Market Dynamics and Consumer Acceptance: The issue of consumer preference will be addressed since Pangasius will compete with the already familiar African Catfish. Educating consumers about Pangasius's qualities (taste, texture, nutritional value) will be important for market acceptance.

7. Value addition and Processing. To maximize market potential, developing facilities for processing Pangasius into fillets, smoked products, or other value-added forms is necessary. This requires investment in processing infrastructure and adherence to food safety standards.

Addressing these potential difficulties through targeted research, infrastructure development, capacity building, and supportive policies will be crucial for Nigeria to fully realize the potential of Pangasius farming and strengthen its aquaculture sector.

Possible solutions to commercial and profitable culture of Pangasius in Nigeria

1. **Technical Solutions**

(a) Broodstock and Hatchery Development:
Establish reliable hatchery protocols and invest in technical training to improve broodstock management, artificial propagation, and consistent production of high-quality fingerlings adapted to local conditions.

(b) Feed Formulation and Nutrition:
Develop affordable and nutritionally balanced feeds using locally available ingredients (like rice bran and soybean meal), but ensure scientific support for dietary requirements.

(c) Polyculture and Production Systems:
Adopt best practices for stocking densities and water quality management in both monoculture and carefully managed polyculture systems with tilapia or catfish.

(d) Disease Management:
Implement effective disease surveillance, biosecurity measures, and farmer training on best management practices to prevent and control disease outbreaks.

(e) Research and Development:
Support ongoing research tailored to Nigerian conditions, including selective breeding, feed optimization, and culture system adaptation.

2. **Institutional Solutions**

(a) **Capacity Building:**
Provide regular training and extension services for farmers, hatchery operators, and technicians on Pangasius aquaculture and modern farming techniques.

(b) **Supportive Policy and Regulation:**
Develop clear governmental policies and regulations specific to Pangasius farming, covering hatchery certification, environmental protection, and biosecurity.

(c) **Access to Credit and Inputs:**
Facilitate access to affordable finance for farmers, as well as timely provision of high-quality fingerlings and feed.

(d) **Public-Private Partnerships:**
Encourage collaboration between government, research institutes, private investors, and farmer cooperatives to enhance the sector's growth and sustainability.

3. **Market-Related Solutions**

(a) **Consumer Education and Promotion:**
Implement marketing campaigns and educational programs to build public awareness and acceptance of locally farmed Pangasius products.

(b) **Value Chain and Processing Development:**
Invest in local processing infrastructure (filleting, packaging, cold storage), and promote value-added products to access both domestic and potential export markets.

(c) **Market Access and Distribution:**
Develop efficient distribution networks to link producers with urban, rural, and (if feasible) international markets.

(d)

(e) **Quality Assurance:**
Establish product quality standards and certification systems to ensure safety, traceability, and consumer confidence in Nigerian Pangasius.

Conclusion

Pangasius (*Pangasianodon hypophthalmus*) aquaculture has become an important part of the global seafood market, thanks to the species' rapid growth, adaptability, and efficient resource use. In Nigeria, the introduction of Pangasius presents new opportunities for diversifying aquaculture, improving fish supply, and enhancing farmer incomes. This review highlights the species' biological and market advantages, but also points out challenges such as breeding constraints, feed formulation, disease management, limited processing infrastructure, and the need for greater consumer awareness.

To fully realize the potential of Pangasius farming in Nigeria, it is crucial to invest in locally-adapted breeding and hatchery technology, develop cost-effective and nutritionally balanced feeds, and build technical and managerial capacity among farmers. Market acceptance should be fostered through consumer education and promotion of value-added products. Success will depend on coordinated efforts among policymakers, research institutions, and the private sector to support sustainable practices, ensure product quality, and strengthen the value chain. With these strategic actions, Pangasius can become a valuable and sustainable addition to Nigeria's aquaculture industry.

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