

*Review*

# Unconventional cultivable freshwater fish species: a potential tool for increased aquaculture production in Nigeria.

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The persistent gap between fish supply and demand in a country endowed with vast natural water resources potential like Nigeria is really a source of concern. Current domestic fish production rate in combination with importation strategy have failed to achieve results, as a gap of about 1.05 million metric tons stand as deficit. Conventional fish species as; *Clarias*, *Tilapia*, *Heterobranchus* and the likes are producing significant results, however, there is that need of effective and efficient utilization of existing vast natural water resources to increase aquaculture production in Nigeria. Areas discussed include: factors to be considered in selection of fish for culture, conventional culture species in Nigeria, unconventional culture species, culture methods and suitable receptacle, fecundity and biology, ecology and promotional potentials of unconventional fish species. The later reveals the possibility of promoting all considered species as candidate for use in the utilization of existing vast water resources to increase local production thereby, bridging existing gap.

**Key words:** Freshwater fish species, potential tool, aquaculture production, supply and demand

## INTRODUCTION

Fish used to be one of the cheapest sources of digestible animal protein in Nigeria; however, the gap between the demand and supply of fish tend to widens as the day goes by thus making fish unaffordable to most Nigerian (Oluyinka, 2013). The existing gap cannot be met through captured fisheries (FAO, 1994). According to Rajbanshi (1996), situations have changed as there are fewer fish to catch from rivers and streams. This is due to changes in natural phenomena, ever increasing human population and human activities. The natural habitat (ecosystem) of fish is fast deteriorating via deforestation, building of

dams for hydropower generation and irrigation, building of road and bridges and the ever increasing urbanization. These factors have not only put maximum fishing pressure but they have also destroyed many fish breeding grounds, resulting in sharp depletion of the fish populations in all water bodies leading to a state where fish becomes scarce day after day.

In order to forestall the total depletion of fish, there is a need for an intervention. Culture fisheries as an intervention was born out of necessity to sustain one of richest source of animal protein and to increase production of fish to meet the ever increasing demand. The practice involves raising fish species in controlled environment. In Nigeria, the practice has span over five decades as the first documented fish farm date back the 1950s (USAID, 2013, Wokoma, 1987). Like in other parts of the world, fish culture is the most productive culture

practice in aquaculture. Today, the industry is contributing about 35% of the total animal protein consumed in Nigeria (USAID, 2013). The industry is a vibrant and dynamic commercial sector with ripe investment and employment opportunity.

Different reports have identified some major constraints to aquaculture development in Nigeria to include: inadequate input; mainly fish seeds and fish food, inadequate database on the biology and ecological requirement of endemic fish species with aquaculture potentials, lack of knowledge on the profitability of the aquaculture industry, selfishness (as can be seen in the promotion of only catfish by those representing farmers at the Agricultural Transformation Agenda( ATA), lack of rational aquaculture developmental plan etc. (Dada, 1976; Tobor, 1985 and Oluyinka, 2013). Fish seeds are very expensive and constitute a major operational cost of about 20% (Abiodun, 1986). However, major research programmes at Nigerian institute for oceanography and marine research(NIOMR) and National institute for Freshwater fisheries(NIFFR) has addressed hatchery production of fish seed of species generally preferred by consumers in Nigeria (FAO, 1994).

According to Food and Agricultural Organization (FAO), fish production in Nigeria increased from 580,000 metric tons in 2005 about 800,000 metric tons in 2012, an increase of about 30%. In 2012, the minister of agriculture, Adesina Akinwumi disclosed current demand for fish in Nigeria stands at 2.6 million metric tons/annum valued at N346 billion is been imported annually. Both import and domestic production account for only 1.55 million metric tons worth N206 billion. This reveals a deficit of about 1.05 million metric tons worth N140 billion explaining the rising cost of fish in the country (Oluyinka, 2013).

Nigeria is endowed with an extensive inland water system, lakes, reservoirs, estuaries, lagoons, creeks, floodplains and approximately 800km of marine coastline. According to Ayoade and Oyebande (1983), Nigeria has an extensive lake and reservoir systems covering about 300,000 hectare. This reveals a tremendous aquaculture potential. Fish species such as Carp, Tilapia, *Heterobranchus* and *Clarias* are the most commonly found in Nigerian fish market. However, Sivalingan (1972) and Ezenwa (1976) highlighted some cultivable species whose potentials can also be effectively harnessed in a bid to maximize the vast water resources. This paper reviews the promotional potential of *Heterotis niloticus*, *Lates niloticus*, *Gymnarchus niloticus*, *Citharinus citharus* and *Chrysichthys nigrodigitatu*.

### Factors to be Considered in Selection of Fish Species for Culture

A number of biological factors have been authenticated as important in the selection of fish species for culture. Rajbanshi (1996) highlighted some of the under listed

criterion as basis for the selection of cultivable fish for culture;

- High survivability in culture facility
- Ability to reproduce in captivity and availability of fingerlings in the wild
- Good feed conversion ratio
- Ability to efficiently utilize grasses or by-product of grains or all other food made available in the pond via manuring
- Rapid growth performance
- Good stocking ratio and adaptability
- Easy sex selection
- Ability to exhibit complementarily in food habit when grown together with two or more fish species
- Ability to co-exist without predation
- Good taste, market value and demand

Generally, in considering the suitability of the fish species, the ecological niche of the species and the biology and special requirements of the various stages of the fish should be carefully studied. The culture condition should be suitably adjusted-or the species chosen should fit into the culture conditions and if not polyculture should be compatible with the other species in the culture. Care must be taken to design the culture system to approximate natural conditions of the species recruited for culture, especially with reference to water quality, natural feeds, predators etc. The freshwater, brackish water and marine habitats have to be considered separately and suitable species recommended.

### Conventional Culture Species in Nigeria

In aquaculture, the word conventional has often being associated with fish feed. However, in the context of this review conventional culture species are proven cultivable fish species of higher consumer preference due to their high premium and food productivity. These species have been cultured wildly in the tropics for food and ornamental purposes. According to FAO, (1994), the conventional culture fish species in Nigeria are;

- *Tilapia species*
- *Heterobranchus species*
- *Clarias species*
- *Carp species*

Aside the aforementioned, there are other cultivable fish species (unconventional cultured fish) whose potentials have so far remain untapped to the Nigeria aquaculture industry.

### Unconventional Cultured Fish Species

These are proven cultivable fish species with low preference probably due to lack of promotion or identification. The status of a species varies with community as an unconventional species in community A might be conventional in community B. In Nigeria, the aquaculture industry is yet to tap the fallowed potentials some cultivable fish species. Below is a tabular

**Table 1:** Unconventional Cultured Fish Species and Traits

Species	Outstanding Traits
<i>Heterotis niloticus</i>	Rapid growth, breeding in captivity, availability of wild fingerling
<i>Gymnarchus niloticus</i>	Rapid growth, high premium, tasteful, seasonal availability of wild growers
<i>Lates niloticus</i>	High commercial value, rapid growth, induced captivity breeder
<i>Chrysichthys nigrodigitatus</i>	Rapid growth, induced breeders, availability of fingerling and growers

Sources: Okaeme, (2006) practical fish farming 23Pp

**Table 2:** Culture Method and Suitable Receptacle

Species	Culture method	Culture receptacle
<i>Heterotis niloticus</i>	Polyculture	Reservoirs and large earthen ponds 100m2
<i>Lates niloticus</i>	Polyculture	100m2
<i>G. niloticus</i>	Polyculture	100m2
<i>G. nigrodigitatus</i>	Polyculture	100m2
<i>C. citharus</i>	Polyculture	100m2

Sources: Okaeme, (2006) practical fish farming 23Pp

**Table 3:** Fecundity of Unconventional Species

Species	Fecundity range (eggs)
<i>Heterotis niloticus</i>	4,000 – 6000
<i>Lates niloticus</i>	1.24 – 37.44M
<i>G. niloticus</i>	6,000 – 9,000
<i>C. nigrodigitatus</i>	4,522 – 5,543
<i>C. citharus</i>	65,500 – 1.5M

Source: Okaeme, (2006) Practical fish farming 24pp

representation of some unconventional cultured fish Species (UCFS) and their traits as shown in [table 1](#)

### Culture Method and Suitable Receptacles for Unconventional Species

For the Nigerian environment and based on experience, a number of species have been found to perform better in particular culture system as represented in [table 2](#)

### Fecundity

Fecundity is the potential reproductive capacity of an individual or a population. It simply means the ability to reproduce. Certain regulatory factors as well as prevailing conditions are factors that determine increase or decrease of fecundity. The [table 3](#) shows the fecundity ranges of the reviewed unconventional species.

### Biology, Ecology and Promotional Potential of Unconventional Species

#### *Heterotis niloticus* (African arowana)

This is a long-bodied fish with broad scales, long dorsal and anal fin set far back on the body and a round caudal fin. Studies have shown that it could measure up to 100cm (SL) and weight up to 10.2kg. it is a pelagic species of the family *Osteoglossidae*. It lives in shallow water (mostly swamp and creeks) where it feeds on invertebrates, copepods and chironomids (Reed *et al.*, 1967).

The male has only anal and urogenital openings just anterior to the anal fin whereas the female has a genital

orifice separate from the urinary opening. They became sexually mature at age three.

### ***Lates niloticus* ( Nile perch)**

*Lates niloticus* commonly called *Nile perch* is widely spread throughout the Ethiopian Region of Africa, occurring commonly in all major river basins including Nile, Chad, Niger, Senegal and Volta. The most common place to find the Nile perch is in Lake Victoria where the species was introduced in 1962(Hopson, 1972). It is a voracious carnivore, member of the family *Latidae*.

The species exercise territorial dominance and adopt schooling mechanism to shield against predators. It is often called ferocious predator, owing to its cannibal and voracious nature. The type of prey preyed on is dependent on the predator size, available prey and abundance within a given habitat (Ogari, 1984). Mature *Lates niloticus* prey primarily on fishes (especially clupeid and alestes) including its own species while the juveniles feed on zooplankton. It has been credited as one of the largest fresh fish measuring up to 2 meters and weighing about 200kg. the species is demersal and potamodromous, and is known to inhabit channels, lakes and irrigation canals, and are present in Nigeria waters (Ezenwa, 1976). Generally, they prefer sandy bottom but can also be found in rocky to muddy bottom. While adults inhabit deep waters the juveniles are found in shallow water (Froese and Pauly, 2003).The species have reported to grow rapidly in its first year and then show persistent decline in subsequent years(Acere, 1984). The introduction of this species to Lake Victoria is one of the most commonly cited examples of the negative effects, invasive alien species can have on ecosystems. The Nile perch was introduced to Lake Victoria in East Africa in the 1950s (Pringle, 2005) and has since been fished commercially. It is attributed with causing the extinction or near extinction of several hundred native species, but as Nile perch stocks decrease due to commercial fishing at least some of them are making a comeback. The fear of invasion might just be one of those many reasons why it has not been promoted in Nigeria.

Despite their predatory nature and invasive attribute, studies carried out at the Kajjansa Aquaculture Research and Development Centre KARDC Kampala, Uganda, in pond, tanks and net system suggest that the Nile perch has considerable potentials for aquaculture, as promising results were obtained following their culture in trash fed net cages sited ponds. Gregory (2006) obtained the following results from his study at KARDC under cage culture system, exponential increase in growth from 10g to 550g in seven months, improve food conversion ratio from 4:1 to 8:1, zero mortality, zero case of cannibalism, moderate sensitivity to dissolved oxygen levels. This finding might provide diversification option not only for Uganda but also Nigeria. However, there is need to try

the cage system in Nigeria as this will provide a better insight into the species worth.

### ***Gymnachus niloticus* ( Abba or Frankfish)**

Abba, Frank fish or fresh water rat tail as it is often called is the only species of the genus *Gymnachus*. It belongs to the family *Gymnachidae* and has along slender body void of caudal pelvic and anal fins. The average length of the species is about 80-100cm but it can grow up to 193cm(SL), also it weight reaches about 200kg. The elongated dorsal fin which runs through the back towards the blunt, finless tail is used for locomotion (Wikipedia, 2013). In some part of the world, the species breed at wet season, during this period, they migrate to flooded areas and breed amongst aquatic vegetations in areas that are rich in microbes. However, in Nigeria, November to April has been reported as their breeding season (Ezenwa *et al* 1990). Usually, prior to breeding, males build large bubble nest using water weeds in swamp along major coastal rivers and their tributaries where salinity is below 1.5‰, in which the eggs are deposited. The nest is about 1-1.5 metres in diameter, with its perimeter extending several centimeters above the waters, leaving a small opening for the entry and exits of parent stock. Also, there are reports that classify *G. niloticus* as mouth breeders, i.e the males carry the eggs in the mouth until they are hatched (Destiny 2009) and usually, hatching takes place after about five days. So far, there has been no reported case of any sort of captivity spawning. Ezenwa *et al* (1990) reported that farmers in Nigeria often collect fertilized eggs for hatching in burrowed pits around their homes and monitor larvae and fry maturity. At some point because of their popularity, the seeds were sold at six to ten naira higher than the cost price of Fecundity between 5000-100 depending on the size as smaller fish could have fecundity as low as 100 (Ezenwa *et al* 1990). However, good parenting helps to reduce the mortality of fry.

It is completely intolerant to con-specifics. When kept alone as a single specimen, once it reaches foot length there are possible tendencies of it affecting its breeder. Despite the fact that the specie is awesome to behold in aquarium, its aggressive nature, very low fecundity and predatory nature and its inability to breed in captivity might be the same likely reason why it has not been common in the Nigerian aquaculture industry.

### ***Citharinus citarus* (Moon fish)**

This is a silvery fish whose pectorals and superior lobe of the caudal is grayish. the specie has been distributed throughout the major rivers and lakes of Africa. It is a member of the family *Citharinidae*, with two sub-species; *Citharinus citarus* and *Citharinus citarus intermidus*. So far, the maximum reported length and weight for the species is 58.0cm SL and 70kg respectively.(Grose 1990). They inhabit freshwater and are demersal and



anadromous. The specie is an important freshwater fish in Nigeria. It is in abundance from June to December in the Anambra river basin (Ezenwaji and Ezenwaji 2009). It also formed the mainstay of the fishery of the Onah Lake in Asaba, Delta state. In Otuocha, Anambra the species constitute a significant part of the fish diet of the local inhabitants thus providing the cheapest source of animal protein. Smoking has been shown to improve its palatability. The survey of their sales reveals monthly earning of between ₦6,360.00 and ₦20,720.00 (Ezenwaji and Ezenwaji 2009). The species have high fecundity. Olele and Obi (2004) reported a fecundity range of between 14,320 and 16,009 this high fecundity guarantee their survival. Spawning is often from May to July, i.e during the rains and the species are known as total spawners. After spawning, the recruit becomes ready for spawning or sexually mature after three years. Because the specie is not hardy, extreme care is needed if effective culture most be achieved.

### ***Chrysichthys nigrodigitatus* (Silver catfish)**

The silver catfish *Chrysichthys nigrodigitatus* (Lacepede 1803) is a highly valued food fish included among the dominant commercial catches exploited in major rivers of Nigeria and Africa at large (Offem et al 2008). Therefore, investigation has been conducted into the possibilities of its culture by Ezenwa (1982) and others and the investigation are still ongoing. Mo (1991) split *Chrysichthys* from the family *bagridae* to *Claroteidae* thus, it is currently a member of the family of *Claroteidae*. The specie has an oval head, large eye and deeply forked caudal fin. It is a fresh water fish with a maximum growth length of 65cm SL. They are hardy and can tolerate salinity level of up to 26%. *C. nigrodigitatus* are omnivorous in nature and will feed on a wide range of food including frozen food, tablets, pellets and prawns, when bred in captivity, supplementary feeding is absolutely necessary.

Breeding is carried out in excavated caves on the river banks. The specie lays her eggs in the caves and guard until they are hatched after which it protect the fry until they can effectively swim. In Nigeria, spawning has been reported between the months of October and November and thereafter. Fingerling becomes very abundant in creek, rivers and lagoon between April and September (Ezenwa et al, 1990). Ezenwa et al (1990) reported a fecundity range of between 20,000.00 to 30,000.00 eggs. Extensive studies have been carried out on the fecundity of *C. nigrodigitatus* in Nigeria (Ekanem 2000). The fecundity study of Ezenwa et al (1986) recommended *C. nigrodigitatus* in Warri river for culture purpose owing to their large eggs and high fecundity. It has been shown to grow mutually with Cichlid, Tinfoil and mullets. The specie is one amongst the few cultivable fish classified as conventional Perhaps, due to their aforementioned attributes or consumer preference.

## **CONCLUSION**

Nigeria is endowed with vast natural water bodies that could be harnessed to increased fish production. In 1986, the need to increase fish production and harness the abundant water resources led to the promotion of homestead fish production; a project that promoted alongside species like *Clarias*, *Tilapia*, *Heterobranchus* and the likes. The promoted species have so stood the taste of time but there is the need to increase the choice of cultivable species alternative. There are other species, though cultivable, but whose potentials have remained untapped (*H. niloticus*, *L. niloticus*, *G. niloticus*, *C. nigrodigitatus* and *C. citharus*) by the Nigeria fish industry. These species could be promoted to provide cultivable fish alternatives not only to increase production but to efficiently harness the abundant water resources and create employment opportunities.

### **In retrospect to cultivable criterion:**

- *H. niloticus* is hardy, it breeds in captivity and grow fast. It produces good flavor with high taste which is marketable worldwide. Thus fulfilling nearly all criterions
- *L. niloticus* may be invasive and predatory even to it juveniles but it has been shown to fulfill quite a number of criterion to include; rapid growth, high fecundity ranging between 1.24 – 37.44 million eggs; which guarantees their survival. Also, results of the cage system tried in Uganda might prove some or even better thus, raising the species prospects for utilization in the industry.
- So far there is no report on any successful case of any sort on spawning in captivity for *G. niloticus*. The fecundity of *G. niloticus* is relatively low and could get as low as 100. However, compatibility studies have proven to be a success as it has been used as a good predator for tilapia to reduce high number of juveniles at harvest. It also has a good growth performance
- *C. citharus* has high fecundity ranging between 14, 300 – 16,000 eggs and currently has been reported to be the mainstay of the fisheries resources of some south-south communities in the country.
- *C. nigrodigitatus* has the ability to utilize available feed in the growth receptacle. The species is abundant in Nigerian waters and has high fecundity.

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