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Over two decades of clandestinely introduced African catfish *Clarias gariepinus* (Burchell 1822) culture in India: Issues and experiences

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.**Abstract**

The first unofficial introduction of African catfish *Clarias gariepinus* in India was possibly during 1995-1996 when farmers and aqua-culturists got attracted to culture it. Fast and impressive growth of the fish created especial interest amongst farmers and aqua-culturists who started growing it well even in derelict waters without any proper husbandry. There was mooted discussion amongst scientists on the pros and cons of rapid adoption of the fish in aquaculture without any standard operational practice (SOP). Farmers and aqua-culturists rapidly adopted its intensive culture using variety of cheap feed and slaughterhouse wastes while scientists started debating adverse environmental impacts and ecological concerns of its heedless spread in aquaculture in the entire country. The data generated on the introduced species indicated that it was a hybrid developed in Thailand by crossbreeding *Clarias gariepinus* (n=56) with *Clarias macrocephalus* (n=54) (Tonguthai et al., 1993), which was capable of growing over one kg in few months only. The introduced African catfish *Clarias gariepinus* was found to be widely cultured due to its tolerance to environmental extremities, high growth and good feed conversion rate. The fish has been a good scavenger and is cultivated using slaughterhouse wastes and even fish wastes (Singh & Lakra, 2011; Singh et al., 2015). In India, monoculture of *Clarias gariepinus* showed a wide variation in growth however, it was impressive when integrated with slaughterhouse and chicken wastes and improvised feed with 40% protein (Singh and Mishra, 2001; Singh et al., 2015). Production under monoculture was estimated to range from few hundred kg to over 20 t/ha/year at different farms (Singh and Lakra, 2011; Singh et al., 2015).

When *C. gariepinus* was cultured under polyculture with carps, the loss to the carps was observed to be in the range of 78.2–86.3% (Baruah et al., 1999; Singh et al., 2015). An average growth of 1.63 mm/day was observed in managed grow-out ponds (Singh et al., 2015). The hybrid African catfish unofficially available in India were found to attain maturity and breed readily. Observations collected showed that the assorted fish could attain maturity in few months only when it weighed over 70-100 g. This behavior of the fish along with variations in feed given to the fish at different farms created a scenario of significantly large differences in production levels (Singh et al., 2015). The breeding of African catfish in captivity is now widely practiced but mainly in the State of West Bengal. The *C. gariepinus* was found to breed throughout year except December to February (Singh et al., 2015). However, absence of standards for early feeding especially during first two months after hatching was found to result into high mortality upto 70% (Boon et al., 1987). The highly voracious nature and high cannibalism of the catfish were also attributable to high variability in production.

The nutrient value of African catfish was assessed and it was found that total muscle protein value of *Clarias garipinus* was 133.6 mg/g and it was 183.2 mg/g in *C. batrachus*

(*Clarias magur*) indicating that local magur is more nutritive than the introduced African catfish (Figure 1). At the same time, environmental monitoring for heavy metals bioaccumulation in African catfish culture especially lead (Pb) and mercury (Hg) revealed a possible Human Health Risk of consuming cultured African catfish (Singh et al., 2012).

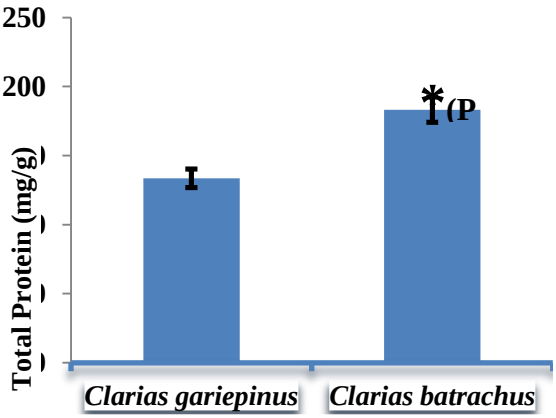

Figure 1: Total muscular protein content in African catfish and local magur

In general, diseases have not been found to be a serious problem in African catfish culture although some fungal, parasitic and bacterial diseases were observed. The major cause of appearance of diseases was the bad water quality and poor management. However, the fish could be seen as the carrier of diseases especially in co-cultures and polycultures (Gabriel and Benedict, 2011).

Because of large-scale culture and propagation of the fish, it was inadvertently spread into several river streams including mid-stream of the Ganga River. Our recent observations revealed regular catch of the fish in some of the sampling stations in the mid-stretch of River Ganga suggesting its establishment in the River (Singh et al., 2015). A total of 23 river streams were surveyed in the state of Uttar Pradesh for the availability of African catfish in different catches and it was confirmed that it was present in different river streams in different size range (Table 1). The biggest size (8.5 kg) of African catfish was captured from the Yamuna River and landed for sale in Agra fish market. The fishermen used multi-meshed gill nets of mesh size 8.5–50 mm. Fishermen used different type of nets namely gill net, cast nets, dragnets for capturing African catfish from river streams.

Table 1: Size distribution of *Clarias gariepinus* available in different river streams

Sl No	**Name of the River streams**	**Size (kg) of feral African catfish captured**
1	Ganga	0.1-3.5
2	Yamuna	0.05-2.8
3	Ghaghra	0.2-0.7
4	Hindon	0.1-18.5
5	RamGanga	0.2-0.6
6	Tamsa	0.1-0.8
7	Senger	0.1-2.5
8	Matiyari	0.2-1.5
9	Gerua	0.2-3
10	Gomti	0.1-1.8
11	Rapti	0.2-2.3
12	Ool	0.3-1
13	Saryu	0.2-0.9
14	Kali	0.05-2.7
15	Dhasan	0.1-1.8
16	Varuna	0.15-2.5
17	Karmnasa	0.2-1.3
18	Rohini	0.2-1
19	Gandak	0.1-2.9
20	Khannot	0.2-1
21	Devha	0.2-1.8
22	Baigul	0.2-1.5
23	Nakatia	0.1-2

The collected observations on the gut contents of the wild captured African catfish revealed the presence of majorly six items of which a big chunk was consisting of fish, mollusks and crustaceans (Table 2).

Table 2: Occurrences of major food items in the gut of wild caught *C. gariepinus* from different river streams in Uttar Pradesh state of India

Names of the river streams	**Food Items (%) observed from the gut of**					
	Detritus	**Aquatic weeds**	**Insects**	**Fishes**	**Crustacean**	**Molluscs**
Ganga	16	15	10	24	20	15
Yamuna	19	20	15	27	11	8
Ghaghra	17	17	15	24	16	11
Hindon	19	18	16	26	13	8
RamGanga	19	14	12	25	21	9
Tamsa	17	16	14	18	18	12
Senger	18	13	16	28	15	10
Matiyari	19	14	15	29	15	8
Gerua	17	18	16	28	13	8
Gomti	19	21	18	28	9	5
Rapti	16	18	13	26	18	9
Ool	19	14	20	27	12	8
Saryu	19	16	17	29	12	7
Kali	20	16	16	29	13	6
Dhasan	16	15	14	27	20	8
Varuna	17	16	17	28	13	9
Karmnasa	18	25	14	28	11	4
Rohini	17	19	21	28	9	6
Gandak	16	23	17	29	8	7
Khannot	17	26	16	27	9	5
Devha	16	22	20	26	11	5
Baigul	15	22	17	29	12	5
Nakatia	16	25	15	28	11	5

It is apparent that the presence of African catfish in wild has been mainly because of inadvertant releases and natural processes like floods. However, natural propagation of the fish has also been ascertained through reproductive examinations of feral population. Six reproductive phases of *C. gariepinus* have been examined which are available in the life cycle of African catfish cultured in ponds. It was found that wild caught *C. gariepinus* showed all existing six reproductive stages in river streams along the Ganga river wherever it was present indicating that natural breeding of the fish in river streams was in the process of establishing the natural population of the fish (Singh et al., 2015).

The spread of the fish in wild has been found to be associated with high risk to the fish biodiversity in general (Vitule et al., 2006; Singh & Lakra, 2011; Weyl et al., 2016) and Clarias batrachus in particular, which has declined, notably in recent years (Sahoo et al., 2003; Ranjan, 2018). The fish has been reported from the Godavari, Yamuna, Gomti and the Ganga Rivers, back waters of Kerala and several reservoirs (Pillai et al., 2016) having different pristine diversity is deemed detrimental (Sugunan, 2002; Singh and Lakra, 2011; Ranjan 2018). Since it is highly carnivorous (FishBase 2018), *Clarias gariepinus* culture has been found to replace local C. batrachus from all areas wherever it exists. Further, C. gariepinus has the potential to hybridize with local C. batrachus (Clarias magur) as experimental hybrids are produced in Bangladesh and also in India (Rahman et al., 1995; Sahoo et al., 2003), suggesting the possibility of genetic pollution as escapee fish may breed in the wild. In Western Ghats, a biodiversity rich hotspot, culture of *C. gariepinus* has endangered the endemic yellow catfish (Horabagrus brachysoma), which is now critically declined (Singh and Lakra, 2011). The threats of *C. gariepinus* due to dispersal into the river in south Brazil have been reported (Singh et al., 2015; Weyl et al., 2016). Further, there is apprehension that introduced *Clarias gariepinus* and Pangasianodon hypophthalmus in India may interact with each other not only in culture but also in wild since the native habitats of both

the fish is similar in conditions. It has been established under experimental conditions that pangasius hybridizes with *C. gariepinus* and a successful breeding and larval production of hybrids from reciprocal crosses of Asian catfish Pangasianodon hypophthalmus (Sauvage, 1878) and African catfish Clarias gariepinus (Burchell, 1822) have been produced and documented by many workers (Okomoda et al., 2017; Tosin et al., 2018).

Several countries have reported adverse ecological impacts after the introduction of *C. gariepinus* (Alexander et al., 2014). Impacts of *C. gariepinus* on amphibian populations has also been recorded previously in temperate regions and the amphibian were found preyed upon. The high potential adverse impact that this catfish may impose will have catastrophe on ecological communities in aquatic environments (Ranjan, 2018). The continuous breeding *C. gariepinus* has emerged as a serious threat to native fish species in rivers and reservoirs in India with a real danger to local fish variety being wiped out. The authorities of the world famous Keoladeo National Park near Bharatpur in Rajasthan have reported that the species entered the park as recently as 2004 but now it is posing threat to other fish species and an endangered bird, Bustard which is found in the gut of the fish.

The African catfish *C. gariepinus* has although some economic value, but it has wreaked disorder in the ecosystems, resulting in the loss of endemic species and altered ecosystems with knock-on effects for livelihoods. *Clarias gariepinus* occurs in a variety of habitats that include rivers, swamps, natural lakes and man-made dams. In its natural range, it is an omnivore that feeds on fish, invertebrates, plant material, plankton, reptiles, and amphibians. Besides its continuous breeding behaviour, this predator fish has an ability to multiply even in adverse ecological situations compared to other native fish, which have a tough time due to environmental degradation. It is difficult for other types of fish to survive amidst these highly carnivorous killers. Our long experience with the introduced African catfish has accumulated several documents supporting adverse effects the fish on biodiversity suggesting urgent effective action plan to control the spread of this obnoxious fish.

The government has imposed a ban on farming of African catfish, an invasive species that is proliferating in natural water bodies across the country, posing threat to native aquatic species. The very confounding observation on natural pond breeding and breeding of the individuals in paddy field worried scientists and based on the observed adverse ecological effects Ministry of Agriculture, Department of Animal Husbandry, Fisheries and Dairying issued an order to ban its culture and to destroy the existing stocks during 2000 only. To the contrary, farmers are still continuing culturing it irrationally in the entire country including the coastal areas and mid hills of Himalayas. According to the Environment Protection Act of 1986, the culture of the African catfish or sale of the fish is liable to be punishable. However, there are no legislation and law to control this fish. Further, national response to prevent Invasive Alien Species (IAS) need to be intensified as the problem has so far been insufficiently addressed to counter the increasing toll on natural resources and society.

There are State Fishery Acts and Fishery Policy in in India but most of the fishery acts are very old where nuisance of African catfish is not covered in the Act. Recently, the Uttar Pradesh government, after the Tribunal's warning, had notified provisions to book those breeding and farming the banned species like African catfish under the Prevention of Food Adulteration Act and Section 270 (malignant act likely to spread infection of disease dangerous to life) of the IPC. It is equally important to know how citizen science can help preventing spread of obnoxious African catfish. It is suggested that necessary changes in the Fishery Act of different States and National Fishery Policy should be made stringently to contain the unauthorized culture and menace of the African catfish in India.

In general, the *C. gariepinus* farming may help to recycle the wastes generated in and around

metropolitan cities and adjacent municipalities, but it suffers from management issues. Since the fish is highly carnivorous and has invaded into several natural aquatic systems, there is possibility of huge economic losses besides disrupting the biodiversity wealth. This calls for immediate attention of researchers, administrators and extension personals to develop a sound protocol for an effective management of the fish.