

EXOTIC INTRODUCTION AS A TREND IN AQUACULTURE & THEIR IMPACTS

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Abstract: Aquaculture is one of the fastest growing food production sector. For increasing production, various techniques are experimented in this field. Genetic modifications, selective breeding programmes, introduction of exotic species are few among them. Most of the introduced species shows better growth performance up to the expectations of the farmers and scientists. In addition to the positive results these introductions have much adverse effect. The escape of these fishes into the natural water bodies negatively impacts the biodiversity of the area. Important candidate species in aquaculture, history of their introduction, presence in natural water bodies and their adverse effects are discussed in this paper.

Keywords: Aquaculture, exotics, fish introduction, impact.

Introduction: Aquatic ecosystems are the largest ecosystem of the world. With the increase in human population the requirement of protein has also increased and the pressure to increase the production has also increased. But at the same time capture fishery landing is also decreasing. This has increased the demand for aquaculture products and aquaculture has become one of the fastest growing food production sector. According to Reference [1] aquaculture production overtakes the cattle ranching as the largest food source. In order to get better growth rate and disease resistance many new techniques like genetic modification, selective breeding are practised in the field. But the most successful methods among is the culture of introduced species. The major reason for this is the presence of already proven technology, resource and market demand. Another study [2] reported that introduced species contributed about 17% of total global fish production in 1996.

Exotics and its adverse effect: Any species which is distributed outside its natural range of distribution is known as exotic. One of the major threat associated with the culture of exotic species are the accidental escape of farmed species in to common water bodies. Some of these introduced species gets adapted to their new environment quickly, becomes established, and compete with indigenous species for food and space. They alter the habitat and food web balances, predate the natives, manipulate the gene pool, introduce exotic parasites and pathogens and reduce the ecological integration of that area, eliminate the key stone species and thus became a threat to biodiversity.

Candidate exotic species in Aquaculture and history of their introduction: Almost 10% of global aquaculture production are from introduced species [3]. In India there are about 300 alien fishes that are reported. Among them 31 species are introduced only for aquaculture [4]. The major exotic species for aquaculture are *Cyprinus carpio*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Osphronemus*

gouramy, *Oreochromis mossambicus*, *Oreochromis niloticus*, *Aristichthys nobilis*, *Piaractus brachypomus*, *Pangasianodon hypophthalmus*, *Onchorynchus mykiss*, *Clarias gariepinus*, *Tinca tinca*, *Carassius carassius*, *Barbus javanicus*, *Puntius japonicas*, *Barbonymus gonionotus*, *Salvelinus fontinalis*, Lake trout etc.

Common carp (*Cyprinus carpio*) was first introduced in India in 1939 from Ceylon [5]. *Ctenopharyngodon idella* introduced from Hongkong in 1957 to Cuttack [6]. *Hypophthalmichthys molitrix* introduced in 1959 from Hongkong Japan [7]. *Clarius gariepinus* have a secret entry to India from Bangladesh to West Bengal and later spread to other parts of the country [8]. The Tench (*Tinca tinca*) and Crucian carps (*Carassius carassius*) were introduced in the Nilgiri in 1874 from Europe [7]. *Aristichthys nobilis* came from Bangladesh in 1957 to Bangalore [6]. *O.Gourami* introduced in 1865 from Java & Mauritius to Calcutta (un successful) and to Tamil Nadu [6]. *Barbus javanicus* introduced in 1972 from Indonesia [9]. *Barbonymus gonionotus* (thaiputi) introduced in 1972 from Indonesia [6]. *Puntius japonicas* introduced in 1933 from Indonesia [5]. Rainbow trout and *Salmo salar* introduced in 1984 and 1960 to Kashmir from Canada [10]. *Tilapia mossambicus* introduced in 1952 from Bangkok to Mandapam [5]. *Salvelinus fontinalis* introduced in 1968 from USA to Kashmir [6]. Lake trout (Hybrid between Lake Trout and Brown Trout) introduced in 1968 from Canada to Kashmir [10]. In addition to this several varieties of salmon and trout are also introduced for culture. Most of these exotic species invade to natural system and establish their population.

Presence of the exotic in natural water bodies and their adverse effect: Common carp is present in almost every state of India as a principle candidate species of aquaculture and their introduction in the Kashmir Lake adversely affected the indigenous population of schizothoacids. In Manipur their introduction adversely affected the *Osteobrahma belangari* of Loktak Lake [11], [12]. Established common carp and Tilapia compete with the

endangered species *L.typos* and *Crossocheilus periyarensis* in Periyar Lake of Kerala [13],[14]. This fish is the major reason for the disappearance of indigenous fish *Puntius dubius* in Krishnarajuna sagar reservoir of Karnataka and resulted in the decline in the population of indigenous fishes like *Labeo fimbriatus*, *Cirrhinus cirrhosa*, *Puntius karnaticus* [15]. The introduction of silver carp declined the population of *Tor putitora* in Govindasagar reservoir, Himachal Pradesh [16]. Tilapia is a prolific breeder and its presence adversely affects many indigenous fishes. In Rajasthan Jaisamund reservoir the carp fishery was collapsed after the introduction of Tilapia. Its presence is reported from almost all reservoirs of Kerala, and reduces the fish contributions [17]. Their presence in large scale is reported in Periyar and Chalakudy river of Kerala. Presence of *Tilapia* adversely affected the existence of indigenous fish *Tor khudree*, in Chalakudy because of the diet overlapping. It shares common food of about 78% [18]. Live specimens of piranha *Pygocentrus nattereri* and pacu *P. brachypomus* were reported from Periyar river of Kerala, several rivers and lakes of Andhra Pradesh and Per Dimbhe reservoir near Pune, Maharashtra [4]. Different species of exotic trout's were reported in the cold water and high altitude of the country. They compete with native fauna, inter breed with them [19] and also act as predator of egg and young ones of native fauna [20]. Presence of highly carnivorous *C. gariepinus* is confirmed in almost every state including Andaman & Nicobar by NBFGR. The unauthorised culture of exotic species like Black carp (*Mylopharyngodon piceus*, *A.nobilis*, *P. suchi*, *C. gariepinus*, Piranha (*Serrasalmus spilopleura*) and Hybrid koi are reported from Naihati district of W.bengal.

Presences of exotics are also reported from all the major river systems of India. The Yamuna and Ganges River system harboured several exotic fish species including common carp and Nile tilapia [20]. They

also report the presence of 10 alien species which include Tilapia, African cat fish, Common carp, silver carp, grass carp, Gambusia, *Carassius auratus*, *A. nobilis* etc. in Yamuna River out of the total 63 species reported. Presence of dangerous *C.gariepinus* reported from rivers of Ganga, Yamuna, Sutlej and Godavari [8]. African catfish contribute about 16 % of the total catch from river Yamuna in a single day with weight ranging from 1 to 2 kg.

In addition to the above mentioned fin fishes *Litopenaeus vannamei* is the single large group of exotic crustacean, introduced for aquaculture. The major reason for this species introduction is the attack of white spot syndrome virus to the *P.monodon* culture. *Vennamei* culture is common in states like Kerala and Karnataka. According to FAO report, there were 3 *L.vennamei* hatcheries producing about 2 million seed/month and 120 ha of farms involved in commercial production of this species in India [22]. They are highly susceptible to and carrier of many viruses like Taura syndrome Virus, WSSV etc. In case of shrimp introduction there is no report of establishment of introduced exotic species which has escaped or stocked in the wild except *P.merguensis* in Fiji [23]. But a chance for their escape to natural water body exists.

Conclusion: Increasing demand for aquaculture is one of the major reasons for the introduction of exotic species. These introductions will lead to the loss of biodiversity. India is country with rich biodiversity and is blessed with many indigenous fish species with great culture potentials. So it is advisable to depend on our native and indigenous fish species by developing our own technologies for breeding and larval rearing suitable for their production. For this we require a combined work of researchers, officials, authorities, policy makers and farmers. Prevention is always better than cure, especially in the case of exotic introductions, where the cure is hardly possible.

References:

1. Lester Brown., Worldwatch Organization .<http://www.naia.ca/faq.asp>. 2001.
2. D. Bartley, and C. Casal, "Impacts of introductions on the conservation and sustainable use of aquatic biodiversity." FAO Aquaculture Newsletter, vol. 20. 1998, pp.15-19
3. L. Garibaldi, and D. Bartley, "The database on introductions of aquatic species (DIAS): the web site." FAO Aquaculture Newsletter, vol.20. 1998, pp. 20 - 24.
4. A. K. Singh, "Emerging alien species in Indian aquaculture: prospects and threats." Journal of Aquatic biology and fisheries vol. 2(1).2014, pp. 232-41.
5. E. Ambekar, Eknath, Chindi Vasudevappa, and Basavaraju, "Impact of Fish Introductions: A Global Perspective." In, Fish introduction in India status Potential and challenges.W. S. Lakrs, A. K. Singh, S. Ayyappan.Eds.2008,pp.25-35.
6. Shresha Kulkarni, Nikisha Raut, Saraswati Patel, Purification and Kinetic Study of Xylanases From *Lysinibacillus Boronitolerans* Isolated From Soil; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 197-204
7. R. A. Khan, R.P. Barman , and S.S. Mishra, "Status of exotic fishes introduced in India and their impact." In, Fish introduction in India status

- Potential and challenges. W. S. Lakrs., A. K. Singh., S. Ayyappan.Eds.2008,pp.64 -77
8. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=146793>
 9. V. V. Sugunan, "Clarius gariepinus gravitates in to Yamuna, Sutlej, Godanari angst come true".Fishing chime,vol.19(10&11).2000, pp.50-52.
 10. C. S. Agarwal, and M. S. Kharb, 'Status of Exotic fishes in Haryana." In, Fish
 11. *Weldegerima Kide, Balkrishna Desai, Janardan Dhekale*, Feeding Effects of Maize and Barley Hydroponic Fodder on Dry Matter intake, Nutrient Digestibility and Body Weight Gain of Konkan Kanyal Goats; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Issue 2 (2015): Pg 96-101
 12. introduction in India status Potential and challenges. W.S.Lakrs, A.K. Singh, S. Ayyappan.Eds.2008,pp.289-295
 13. P.C. Mahanta, and Shyam Sunder, "Status of Exotic fish species in Upland waters of India." In, Fish introduction in India status Potential and challenges. W.S.Lakrs, A.K. Singh,S. Ayyappan.Eds.2008,pp.183-190.
 - A. K. Singh, and P. Das, "Status of common carp in aquaculture and its environmental impact." Aquaculture Muzaffaranagar India.vol.7(2).2006,pp.245-257.
 14. W. S. Lakra, Rehana Abidi, A.K. Singh, N. Sood, G. Rathore , and T.R. Swaminathan, "Fish introduction and quarantine: Indian scenario" A Publication of NBFGR (ICAR) Luknow.2006,pp. 198.
 15. L. K. Arun," Fish community assemblages of Periyar Tiger Reserve, Kerala, India." Report to the Kerala Forest Research Institute (KFRI).1999, pp.142.
 16. B. M. Kurup, T.G. Manojkumar, and K.V. Radhakrishnan, " Fish and Fisheries of Periyar Lake." Indian Journal of Fisheries.vol. 53(2).2006,pp.153-166.
 17. N. R. Ramakrishnan, " Exotic fishes in Karnataka: History, Status and Prospects." In, Fish introduction in India status Potential and challenges. W.S.Lakrs, A.K. Singh, S. Ayyappan.Eds.2008,pp.249 -254.
 18. P. V. Dehadri, "Problems and Prospects of exotic fishes in India" In, Fish introduction in India status Potential and challenges. W.S.Lakrs, A.K. Singh,S. Ayyappan.Eds.2008,pp.17 -23.
 - A. Bijukumar, "Exotic fishes and fresh water biodiversity" j.Zoosprint vol.xv, 2000, pp. 363-367.
 19. L.K. Arun, C.P.haji, and P.S.Easa, 1996., "Record of new fishes from PeriyarTiger Reserve." *J.Bombay Nat.His.Soc.*, vol.93(1),1996,pp. 103.
 20. J.N.Rinne,1995."The effect of introduced fishes on native fishes:Arizona,south Western United States" In,Protection of Aquatic biodiversity. Proceedings of the world fisheries Congress,Theme 3,149-159.oxford and IBH Publ.Co.,New Delhi,1995,pp.282.
 21. D.W.Blinn, C. Runk, D. A. Clark and J. N. Rinne." Effect of rainbow trout predation on Little Colarado spinedace." Trans. Amer. Fish Soc., vol.122,1991,pp.139-143.
 22. A.K.Singh,A. Ansari, S.C.Srivasthava, P. Verma, and A.K. Pathak, "Impacts of Invasive fishes on Fishery dynamics of the Yamuna river , India." *Agricultural science*, vol.5, 2014,pp.813-821.
 23. FAO,"The state of world fisheries and aquaculture". 2004.
 24. *Dr. Lalit Choudhary, Dr. Seema Bharadwaj*, Desire and Decision for Avifaunal Diversity of Pdamnath ; Life Sciences international Research Journal , ISSN 2347-8691, Volume 2 Issue 1 (2015), Pg 135-140
 25. Eldridge.<http://www.spc.int> SPREP Reports and Studies series No. 78.1995.

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