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Opportunities and prospects of inland freshwater aquaculture in Telangana: A step towards blue revolution

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Abstract
Fisheries sector plays a significant role in Indian economic development. In India the estimated annual fish production rise from 0.752 million tonnes (mt) in 1950-51 to 10.76 mt in 2016 comprising 3.60 mt of marine fish and 7.16 mt of fresh water fishes. Besides, more than 14 million people are employed in fisheries related auxiliary activities. The fisheries sector contributes 5.15% to the total GDP from agriculture. And contributing annual export earnings of 33, 441.61 crore rupees for the year 2016-17. Telangana is moving very fast towards Blue Revolution with available inland water resources of the state. Telangana crossed 2.36 lakh tonnes fish production mark with a water spread area of 5.7 lakh hectares in 2015-16. There is a vast scope of developing this sector in the state of Telangana, which possesses immense potential towards diversification, demand and marketing flexibility. The demand on aquaculture will not only be on the quantity but also on the quality, safety and species diversity of the fish produced. This can be achieved through expansion, intensification and by improving the efficiency while utilization of resources, by adopting the scientific technologies and innovative techniques, with a greater emphasis on minimizing the environmental impacts. Only little land of the potential area of tanks and ponds available is developed so far, showing immense possibilities for horizontal expansion of fish culture in the state. The main objective of the article was to review the status of fisheries sector in Telangana, species diversity, action plans to increase the annual fish production of the state.

Keywords: Fisheries, production, Telangana, blue revolution

1. Introduction

India is endowed with vast and varied aquatic resources for capture fisheries and culture fisheries. This sector plays an important role in the socioeconomic development by providing employment for a larger population [14]. The marine water bodies are used mainly for capture fisheries, where as Inland water bodies are used for both culture and capture fisheries. Most of the inland water bodies are captive ecosystems where intensive processes can be possible and thereby hold enormous potential for many fold increase in fish production [3]. The demand for fish is increasing day by day, greater priority was given to develop fresh water aquaculture sector in the five year plans, during a decade. Fisheries sector aims both exploitation of natural resources and culture for increasing production through sustainable development. There are about 19,370 reservoirs present in India with water spread area of 3.15 million ha [18]. These are mainly created for irrigation and power generation, but invariably utilized for fisheries. In India about 2,500 verities of fish species is there, out of which 930 freshwater and 1570 marine water fishes [8]. Telangana is the 29th state of India bifurcated from Andhra Pradesh is endowed with vast and varied Inland water bodies and diverse aquatic resources viz., reservoirs, rivers, tanks, canals, lakes and ponds. During the year 2015 highest production was recorded with 2.36 lakh tonnes of fish and shell fishes. The Krishna and Godavari rivers are major perennial rivers and their several tributaries forms chief perennial river systems of the Telangana. In addition to this, large number of medium and small rivers to several man-made reservoirs and tanks present in Telangana. Telangana has a total of 74 numbers of small, medium and large reservoirs. Among 35031 tanks, more than 600 are found in Warangal, Medak, Karimnagar and Mahabubnagar districts (Dept. of fisheries, Telangana). Hundred and sixty five species of fishes were recorded from inland waters of Telangana state comprising of 11 orders, 29 families and 74 genera [10]. On the basis of percentage composition and species richness in Telangana, order Cypriniformes was dominant followed by Siluriformes,

Perciformes, Cyprinodontiformes, Synbranchiformes, Belonif ormes, Osteoglossiformes, Anguiliformes, Characiformes, Cl upeiformes and Mugiliformes [10]. Along with these, the species diversity in Telangana increasingly day by day due to awareness in fisheries, action plans and constant encouragement from department of fisheries. Species composition consist of Indian major carps, exotic major carps, cat fishes, Pangasius, GIFT Tilapia (Genetically Improved Farmed Tilapia), crustaceans such as *Penaeus vannamei* and *Macrobranchium rosenbergeii*. A total of 19.04 lakh fishermen are actively participating in fisheries activities, of which 65% of fishermen are represented from Warangal, Mahbubnagar, Nalgonda, Medak and Karimnagar districts.

2. Production

Telangana is blessed with huge and diverse water bodies for aquatic resources which are utilized by the rural people for their livelihood and acquiring employment. Telangana stands 3rd place in area-wise and 8th place in production wise in India from Inland water bodies. The production value increased since last decade with good growth rate in terms of quantity in both fish and prawn production (Fig. 1). During the year 1995-96, the production of freshwater fish is 74,633 tonnes, which grows up to 2, 60,010 tonnes in 2014-15. On the other hand, in 2015-2017 there is production fall varies water bodies of the Telangana state mainly due to drought conditions during 2015-16 has affected the production level in some areas. While in freshwater prawn production has increased from 471 tonnes to 8,352 tonnes during the year 1995-96 to 2014-15 (Fig. 2).

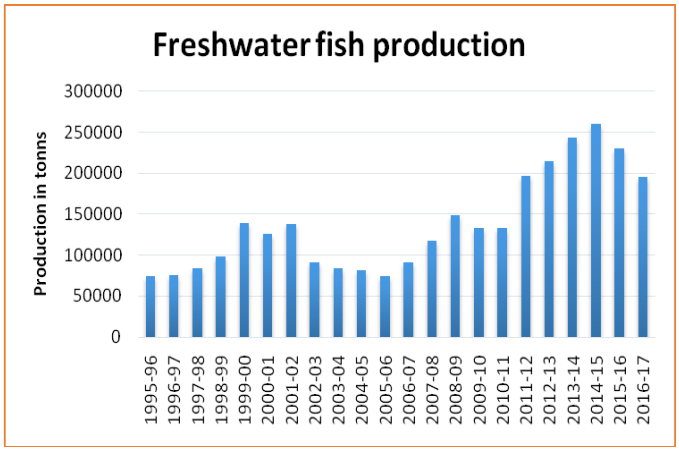

Fig 1: Production of freshwater fish in Telangana (Source: Dept. of Fisheries, Telangana).

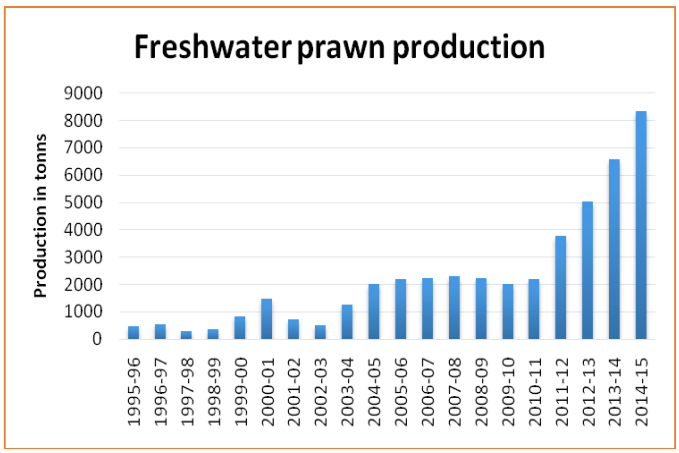

Fig 2: Production of freshwater prawn in Telangana (Source: Dept. of Fisheries, TS)

3. Inland water resources

Telangana water resources are suitable for both capture and culture aquatic organisms. The water resources include rivers, ponds, tanks, reservoirs etc. Godavari and Krishna are major rivers flowing through Telangana, act as most lucrative areas for fish production in the state.

3.1 Godavari riverine system

River Godavari is second longest river that runs with in the country and longest river in South India having a total length of 1440 Km [9, 17]. It originates near Nasik district of Maharashtra state and it flows towards East-coast of India across the Deccan Plateau into Bay of Bengal near Narasapuram in Andhra Pradesh. The number of dams present in Godavari basin is the highest among all the river basins in India. Nearly 350 major and minor dams and barrages had been constructed in the river basin by the year 2012 [6]. Species diversity in Godavari river is dominated by Cypriniformes with 08 fish species (44%) followed by Perciformes 05 (28%), Osteoglossiformes 02 (11%), Siluriformes 02 (11%) and Synbranchiformes with one fish species (6%) [7, 17].

3.2 Krishna Riverine system

The Krishna River is the fourth-biggest river in terms of water inflows and river basin area after Ganga, Godavari and Brahmaputra in India [11]. This river is almost 1,300 km long and it originates near Mahabhaleswar of Maharashtra state, flows towards East-coast of India across the Deccan Plateau into Bay of Bengal near Hamsaladevi in Andhra Pradesh [11]. It is a major source of irrigation for Maharashtra, Karnataka, Telangana and Andhra Pradesh. The species diversity in Krishan River, almost 109 fish species belonging to 7orders 19 families and 46 genera it includes Cyprinidae, Balitoridae, Anguillidae, Ambassidae, Channidae, Schilbeidae, Cyprinidae, Gobiidae, Sisoridae, Heteropneustidae, Mastacembelidae, Siluridae, Cichlidae and Bagridae. The fish species are *Catla*, *Labeo rohita*, *L. bata*, *L. calbasu*, *Mugil cephalus*, *Rita*, *Puntius species*, *Ompok pabda*, *Notopterus*, *Heteropneustes fossilis*, *Channa maruliusetc* [6, 11].

3.3. Reservoirs in Telangana

Telangana state having 74 numbers of small, medium and large reservoirs with water spread area is 1.85 lakh ha. Among which 53 reservoirs having below 1000 ha of water spread area and 17 reservoirs having in between 1000 to 5000 ha and 8 percent of reservoirs have water spread area more than 5000 ha. Along with this, 35,031 number of tanks present in Telangana which includes perennial, long seasonal and seasonal tanks having 4.01 lakh ha of water spread area, aquaculture ponds is 781 ha and rivers and canal having 5,573 km (Source Dept. of fisheries, Telangana).

4. Species Diversity in Inland water bodies of Telangana

In Telangana, fish culture is remain poorly understood to people. But in most of the areas fishes are being captured and cultured in traditional way. One hundred of sixty five species of fishes recorded from inland waters of Telangana state comprising of 11 orders, 29 families and 74 genera. Among which, Cypriniformes families were dominant, which is being captured and cultured from varies resources of Telangana state. Remaining species belongs to families includes Siluriformes, Perciformes, Cyprinodontiformes, Synbranchiformes, Beloniformes, Osteoglossiformes, Anguiliformes, Caraciformes, Clupeformes and Mugiliformes

were naturally growing in tanks, reservoirs, canals and rivers [10]. Additional to this traditional species, some of non-native species came into aquaculture areas of Telangana such as Carps, Freshwater prawn (*Macrobranchium rosenbergeii*), American whiteleg shrimp (*P.vannamei)*, Pangasius, and Genetically Improved Farmed Tilapia (GIFT). The main reasons for introduction of non-native species is due to availability of seed, use of compound feed, fast growth rate, disease resistant and capable of adapting to new environment [5, 15].

5. Important commercial species in Telangana

5.1 Composite carp fish farming

Composite carp fish farming is conducting in three levels in different parts of Telangana state. The first is a low input or fertilizer based system, practices mostly in small community ponds, with multiple uses and open access. It requires only low levels of investment. The level of adaption and impact are also low since aquaculture is practiced mostly in community village ponds with multiple uses. These are utilized as common pool resources and it is difficult to adopt all culture practices recommended in the technology. Further, privatization of aquaculture activity in general and the returns from it in particular is constrained by management and property regimes for these water bodies. At the second level the aquaculture system is a medium input or fertilizer and feed based system. This system is prevalent in medium sized to large sized private ponds with moderate to high investments. The levels of adoption and impact are high, despite problems of scarcity of quality input, limited access to infrastructures and low remuneration. The last system prevalent in composite carp farming is a high input or intensive feed and aeration based system. This practice is generally followed in medium sized private ponds with high investments by agencies with risk bearing ability. These agencies generally use inputs higher than recommended levels, and therefore, the adoption level is very high. It leads to high risk, low ecological sustainability and low benefit cost ratios. The impact in this case is moderate.

Catla *Labeo rohit* *Cirrhinus mrigala*

Cyprinus carpio *Ctenopharyngodon idella* *Hypophthalmicthys molitirx*

Fig 3. Major Cultivable Carps in Inland water bodies of Telangana**.**

5.2 Gaint freshwater prawn or Scampi (*Macrobrachum rosenbergii)*

Fresh water prawn *Macrobrachum rosenbergii* (Scampi) was introduced in 1999 as an alternative to *P. monodon* and which culture was flourished up to 2005. Later the problems in scampi production like prolonged culture period, lack of availability of quality seed and growth problems in the culture led to its decline in culture. Due to continuous outbreak of WSSV in culture leads to shattering of shrimp culture in India [2]. By 2005, the farmers are in search of alternative species for tiger and scampi and the *P. vannamei* was found to be a right candidate species. In Telangana, freshwater prawn is traditionally being cultured in reservoirs and community tanks of various districts. Now it has been stocked in most of reservoirs of Telangana through the prestigious seed stocking program organized by department of fisheries, Telangana.

Fig 4: *Macrobranchium rosenbergeii* (Gaint freshwater prawn)

Shrimp culture in India has surpassed some major hurdles like disease outbreak and pollution during its development. Continuous outbreak of White Spot Syndrome Virus (WSSV) in *P. monodon* culture has shattered shrimp culture in India and farmers seriously looked for alternative shrimp species for culture [16]. Responding to the situation, in 2009-10 the Coastal Aquaculture Authority of India (CAA) introduced a new species *(Penaeus vannamei)* in India. At the same time CAA is very keen in the bio security and approval for culture of *P. vannamei* [14].

5.3 *Penaeus vannamei* (American Whiteleg Shrimp)

The Government of India permitted the Specific Pathogenic Free (SPF) brood stock of *P. vannamei* in 2009, due to production losses of *P. monodon* with White Spot Disease caused by White Spot Syndrome Virus (WSSV) [14, 15]. Non indigenous species (*P. vannamei*) provides with greater adaptation to Indian environmental conditions the shrimp cultivators replaced it instead of indigenous species (*P. monodon*), with the aim to improve the farms production efficiency. Due to its fast growth rate, availability of SPF seed (Specific Pathogen Free), adaptability to modernization techniques in shrimp culture will make the *P. vannamei* as candidate species and ruling or dominating shrimp culture all over the world [4, 5]. Basically *P. vannamei* is euryhaline species, but due to its demand in international markets its culture being switched to freshwater areas in Andhra Pradesh and Telangana. First time in Nagar Kurnool district of Telangana *P. vannamei* culture is practicing by farmers and got fruit full results in their first harvested crop. Along Nagar Kurnool district, intensively being cultured in potential areas of the inland water bodies in Telangana such as Karimnagar, Adilabad, Manchiryal and Warangal disticts.

Fig 5: *Penaeus vannamei* (American Whiteleg Shrimp)

5.4 *Pangasius pangasius*

Pangasius pangasius is a catfish species widely cultured in India, Bangladesh, Pakistan, Myanmar, Malaysia-peninsula, Indonesia, Vietnam, Java and Thailand [12, 13]. It is a popular food fish having good taste with high protein, mineral and fat content in its flesh. *Pangasius pangasius* mainly inhabits in rivers and estuaries; but can also be seen in irrigation canals, beels, natural depressions and even ponds especially during the monsoon period. Adult of *Pangasius pangasius* is a bottom feeder, carnivorous in habit; mainly prefer molluscs. Apart from molluscs, fishes, insects, crustaceans etc., are also documented from the gut content of adult pangasius [3]. On the other hand adult pangasiusis reported as an omnivorous fish. *Pangasius pangasius* is very hardy in nature; has high tolerance for temperature, salinity and turbidity [3]. This hardy species is introduced into varies inland water bodies and being cultured in highly productive, protected and feed managed cage culture system. But, due to market value fluctuations and high productions rates farmers are showing very less interest to take up this species in Telangana.

Fig 6: *Pangasius pangasius*

5.5 GIFT Tilapia

Tilapia has been considered as Food Fish of 21st century and popularly known as Aquatic Chicken. Tilapias are native to Africa but now farmed in more than 85 countries due to many desirable qualities like Availability of seed, high stocking density, resistance to diseases, omnivorous feeding habit [1]. Genetically Improved Farmed Tilapia (GIFT) was developed by the World Fish Centre. GIFT has enhanced the culture as well as market potential as it is proved to be superior to fresh water carps and would be an ideal candidate species for fish culture in India due to availability of seed, fast growth, increased demand in domestic and international market and these are the utmost important factors for successful aquaculture. Recent years GIFT was introduced into the inland waters of Telangana with high expectations. But the culture of GIFT and other commercial species remain dormant condition in Telangana because lack of knowledge with culture systems, lack of fisheries professional at the field level and inadequate transfer of new technologies to field.

Fig 7: GIFT Tilapia

6. Future prospects

Telangana state water resources are suitable for aquaculture. The production from capture and culture fisheries remain relatively stable over the past decade in Telangana. There is need to implement varies schemes and action plans towards development of fisheries sector in Telangana and for welfare of fishermen. The government of Telangana has undertaken various action plans for fisheries sector development with respect to sustainability. In 2017, the Telangana government had allocated with 1000 crore rupees for integrated fisheries development project with the development of varies components in fisheries sector in Telangana. The components include enhancing seed production (establishment of hatcheries, fish seed rearing units, construction of new fish seed rearing tanks, strengthening of fish seed farms, pen culture and cage culture units in reservoir), Enhancing fish production (Establishment of new fish farms, re-circulatory aquaculture system and integrated development of reservoir fisheries), Harvesting support (arrangement of crafts and gears for fishermen), marketing support, infrastructure development projects, innovative projects and capacity building to encourage the fisheries activities and fisheries sector development. The subsidy pattern for beneficiaries are depends on component and through the fishermen co-operative society. The state fisheries department initiated the cage culture system in various reservoirs of Telangana (Source Dept. of fisheries, Telangana). The State government supplies fish seedlings at free of cost. In 2017, state has released 510 million fish fingerlings, as compared to 270 million fish fingerlings released in 2016. It has also released 15 million shrimp larvae into six reservoirs to promote prawn production in Telangana.

One of the major constraints is the lack of skilled person and lack of knowledge of the farmers on the scientific management of fish farm. Motivation of the farmers, knowledge development and skillness are the important aspects to think of at the present situation. It is necessary to arrange need based training programme such as demonstration, exposure visit etc. on fish production. The concerned department should organize interventions programme/ awareness camps for farmers so that they may be empowered with skill and latest technology of fish production. All the aquafarms existed in the state needs to be modernized with recent development of technology. So far freshwater aquaculture production is concerned, over eighty percent production is mainly carp oriented. It is high time to incorporating small and minor carps, small and large catfishes, murrels and freshwater prawn (scampi) and other indigenous fishes with an eye to the export market. Scope of the aquaculture development would largely depend on Govt. policies and support to the farmers in terms of availability of inputs, credit and marketing channels. Shortage of manpower in fisheries is the biggest constraints which ultimately influence the growth of the sector. It is necessary to have the full strength of well qualified and trained staff in this sector that would pay greater contribution to the Aquaculture development of the state.

Fig 8: Cage culture in Telangana reservoirs

7. Conclusion

Aquaculture is highly resilient in Telangana state. It was suggested that a mechanism for seed certification by the state fisheries department has to be developed to ensure supply of healthy and quality seed from import of brood stock to export the species. There is need to bring a comprehensive legislation on the practice of BMPs in general and quality of seed, particularly in aquaculture. There is a need to bring Insurance and the government should contribute certain percentage of the premium to reduce economic losses and risks involved in farming.

No doubt advancement in systems of aquaculture, standardization of breeding techniques and development of package of culture practices has substantially increased the fish production. However, In Telangana, there is a gap between the fish production and resource availability, even though the state has an excellent sub-tropical climate and varied types of water bodies for development of freshwater aquaculture. Therefore, this is the need of hour to think of the basic constraints in the culture system. One of the major constraints is the lack of skilled person and lack of knowledge of the farmers on the scientific management of fish farm. Fish farming is a viable enterprise which will ensure sustainable use of water bodies and provide a constant flow of income to the families.

8. Conflict of interest statement

Authors declare that there is no conflict of interest in the manuscript.

9. Acknowledgement

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