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Current status of fisheries resource of India: Present status and future prospective

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Abstract. Indian fisheries sector provides jobs to millions of people and also contribute significantly to the country's food supply and overall GDP. From the pristine Himalayan streams to the huge Indian Ocean, the country fisheries sector is surrounded by a unique and diverse combination of resources. The country's fisheries encompass a wide variety of physical and biological aspects that support the livelihoods of sizeable population of the country. Recent years have witnessed a considerable development in aquaculture, which might lead to a large increase in fish production of the country. In the present review, our focus is to generate data on fisheries resource of India, by studying the present situation and forecasted changes. To become self-sufficient in fish production as well as to provide surplus to the world, it is necessary to utilize the country's resources extensively. An increase in production might be achieved via the use of more advanced technology, greater planning and strategies. In order to boost output and productivity, it is necessary to understand the different issues faced by farmers and fishermen. Analysis of present conditions and future possibilities would lead to projections on fishing prospects as well as development and improvement of future strategies.
Keywords: Fish production, Freshwater, Marine water, India

Introduction

Recently, it has been reported that around 36,248fish species are being identified worldwide including about 18,336 freshwater species with 149 species added in 2022 (Fricke *et al.* 2022). The fishes characteristically variable in morphology, biology, number and size as ecological conditions affected the distribution of fishes in a particular region or habitat. Fishes occupy everything from Antarctica water (Dornburg *et al.* 2017) to hot soda water having temperature as high as 44^{o}C, world the highest to deepest lake (Mugue *et al.* 2021). Freshwater fishes in eastern Europe is sparsely distributed (Collen *et al*. 2014). Africa have diverse freshwater fishes (Stewart 2001), while South American have poor among the tropical (Gupta and Gupta 2006), North America have greatest diversity of freshwater amongtemperate (Griffiths *et al*. 2014). Whereas Red Sea, Indian Ocean to North Australia and Polynesia are the richest in marine fishes (Nelson *et al*. 2016). Arctic and Antarctica are poor in fish fauna. Interestingly among all, Southeast Asian region represented largest number of species (Sodhi *et al.* 2010). Due to highly valuable and easily available primary source of protein (Pradeepkiran 2019), fish have great significance, as it plays a vital role in the development of a nation (Barclay and Epstein 2013). Besides being a rich source of highly nutritive protein, it also provides essential nutrients required by the human body (Balami *et al.* 2019, Ross *et al.* 2003).

More than 9 billion people throughout the globe rely on fish for their protein needs and over 200 million of those people, 90 percent of whom reside developing countries, depend on it for their livelihoods (FAO 2018). The worldwide marine catch has increased by more than four-fold in the past 40 years, from 18.5 million tonnes in 1950 to 178.5 million tonnes in 2018 with China at the top (FAO 2020). Globally, every tonne of fish is consumed by half a tonne of fuel. Marine fishing is part of the $400 billion global seafood industry (Ding *et al.* 2021). The marine fisheries sector loses USD 50 billion annually as a result of poor management, inefficiency and

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overfishing(Cochrane 2021). If marine fisheries are properly managed, millions of fishermen and coastal communities might reap long-term economic benefits.

Food, nutrition and employment could be generated through fishing and aquaculture in India. Indian fisheries contribute INR 1.75 lakh billion (1.03%) in gross value added to the country's economy every year (Rajeev and Bhandarkar 2022), thus fish could be considered as one of the most significant agricultural commodities exported from Indian ports. More than 20 million fishermen and fish farmers depend on the fisheries sector for their livelihood. As a consequence of COVID-19 and the subsequent shutdown, India's fisheries have also been left in the lurch. Other countries aren't as isolated as India is. Export-driven fisheries with complex supply networks have suffered the most, as have the severe economic losses they've suffered across the globe (Sreeram *et al.* 2021). However, India's barrel has already filled with decades of well-intentioned due to one or other reason.

Global and Indian fish production scenario

Global Scenario: Aquaculture was responsible for 82 million tonnes of the world's 179 million tonne fish production in 2018 (Mehanna 2022). For human consumption, 156 million tonnes of fish were eaten or 20.5 kg per person per year. There were still 22 million tonnes of fishmeal and fish oil that was used for various purposes including preparation of fish feed itself. Aquaculture accounted for 46 percent of total production, but produced 52 percent of fish for human consumption (Delgado *et al.* 2021). As an example, from 1986 to 1995, aquaculture made up just 14.6% of world productivity. It's clear that this is a sign of great things to come. The international figures show that aquaculture has expanded at an annual pace of 5.3 percent from 2001 to 2018 (Table I), an achievement few businesses can boast of. In light of the bleak state of the world's fisheries, aquaculture, or fish farming as it is usually known, is showing signs of rapid expansion in an effort to provide a bright spot. Aquaculture is the only option to meet the growing global demand for fish as a food source and this is universally accepted. In order to ensure rural livelihoods and food and nutritional security, we must acknowledge, recognise and affirm the important significance of fish farming.

Table I. **World Fisheries and Aquaculture Production (In Million Tonnes)**

	1986-1995	**1996-2005**	**2006-2015**	**2016**	**2017**	**2018**
Production			**Average per year**			
CAPTURE						
Inland	6.4	8.3	10.6	11.4	11.9	12
Marine	80.5	83	79.3	78.3	81.2	84.4
Total capture	86.9	91.4	89.8	89.6	93.1	96.4
AQUACULTURE						
Inland	8.6	19.8	36.8	48	49.6	51.3
marine	6.3	14.4	22.8	28.5	30	30.8
Total Aquaculture	14.9	34.2	59.7	76.5	79.5	82.1
Total world fisheries and aquaculture	101.8	125.6	149.5	166.1	172.7	178.5

Source: SOFIA 2020. – State of Fisheries and Aquaculture in the world

The fact that more than 800 million people throughout the globe are undernourished, with 98% of them residing in developing countries (Gustafson and Raven 2021), is shocking in this context. But these countries growing middle class is expected to reach over 66% of the population by 2030, according to the projections for countries throughout the Asia-Pacific region. People in the world's poorest countries might tremendously benefit from aquaculture, if the correct interventions and management will be used. Aquaculture could be the possible solution that Asia has understood for millennia, but that the rest of the world has only just begun to appreciate. Today, aquaculture produces more than 52% of the world's fish food for human consumption (Naylor *et al.* 2021), means that aquaculture will soon provide almost all fish food in the future. It has traditionally been pioneered throughout Asia. India should continue to remain at the forefront of this growth as a worldwide leader in fisheries and aquaculture. It's important to keep an eye on sustainable aquaculture growth in Asia and India, where aquaculture is growing at a far quicker pace than any other food-producing industry.

Indian Scenario: In India majority of the peoples are still rely on fishing as a source of income and it was initially a capture-based economy. More over 7.5 lakh tonnes of fish were produced in the country in 1950-51, with marine fisheries accounting for 71% of that total. There were 56 lakh tonnes of fish produced in 2000, with both marine and interior fisheries contributing equally to that total (Rajeev and Bhandarkar 2022). After then, fish production increased rapidly, mostly as a result of increased inland fishing. As of 2018-19, India produced 134 lakh tonnes of fish, of which 28 percent came from marine fisheries and the remaining 72 percent from inland fishery sector (Fig. 1). The fish production of the country has been grown faster than any other country in the globe.

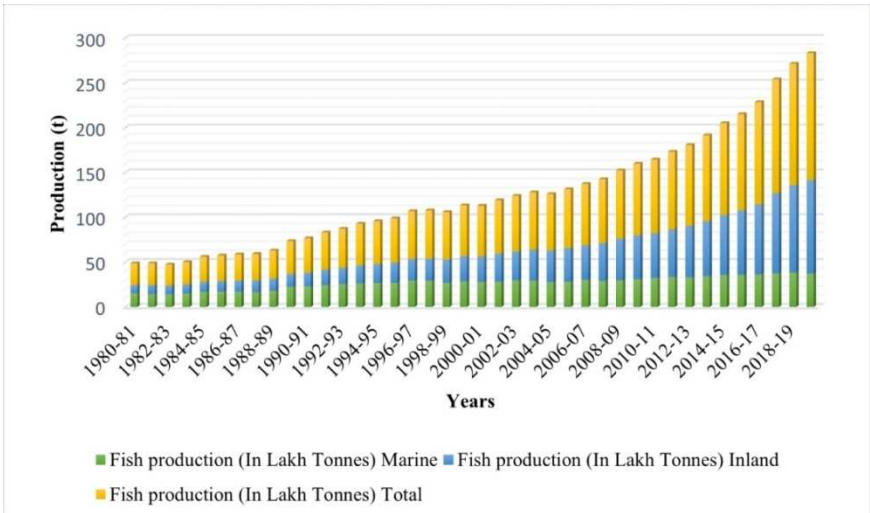

Fig. 1. Fish Production in India for the period 1980-81 to 2019-20 [Department of Fisheries, 2020]

The rate of rise in inland fish production in India was faster than the global average, despite the fact that the rate of increase in global fish output remained the same. There has been more rapid expansion in inland fisheries as a consequence of promotional and developmental initiatives such as the establishment of infrastructure and support programmes for fish farming supported through subsidy marketing services as well as extension. There is still a lot of scope for the improvement in India's fish farming industry.

State-wise status of production in the country

Most of India's rivers and canals widely found in Uttar Pradesh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. While substantial part of the reservoir is occupied by the states of Tamil Nadu, Karnataka, Maharashtra, Orissa, Gujarat, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and Rajasthan. With the exception of the states of Orissa, West Bengal and Arunachal Pradesh, the majority of Indian states contain tanks and ponds as well. Many of the flood plain lakes and abandoned water bodies are also located in Kerala, Orissa, Uttar Pradesh and Assam. The state like Andaman & Nicobar Islands, Andhra Pradesh, Tamil Nadu, Orissa and Kerala contain substantial areas of brackish water fishery resources. Wetlands in Ladakh and the Sundarbans, for example, are shared with neighboring countries. The country's major river basins are the Ganges, Brahmaputra, Narmada, Tapti, Godavari, Krishna and Cauvery, beside Indus River system.Fish production in India is concentrated in Andhra Pradesh (27.4%) and West Bengal (13.8%), the two states that produce the most fish (Fig 2).

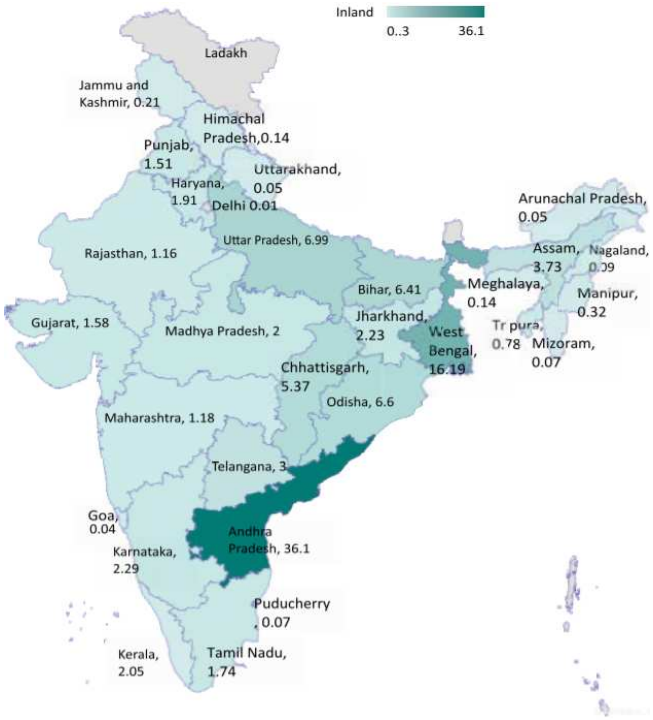

Fig 2. Inland Fish Production [2019-20]: (In Lakh Tonnes) [Department of Fisheries, 2020]

Only nine states and four UTs with coastlines have been able to produce marine fish till now (Fig. 3). The east coast produces 41% of marine fish, whereas the west coast produces 59%. Andhra Pradesh and Tamil Nadu are the second and third-largest producers of marine fish, respectively, accounting for 16% and 14% of total production, respectively. Andhra Pradesh has a market share of 27.4 percent, followed by West Bengal, which has a market share of 13.8 percent. Nearly a third of India's total inland fish production is generated in the top six states, which

include all but one of the country's 28 states. Andhra Pradesh, West Bengal and Uttar Pradesh together generate half of the country's freshwater.

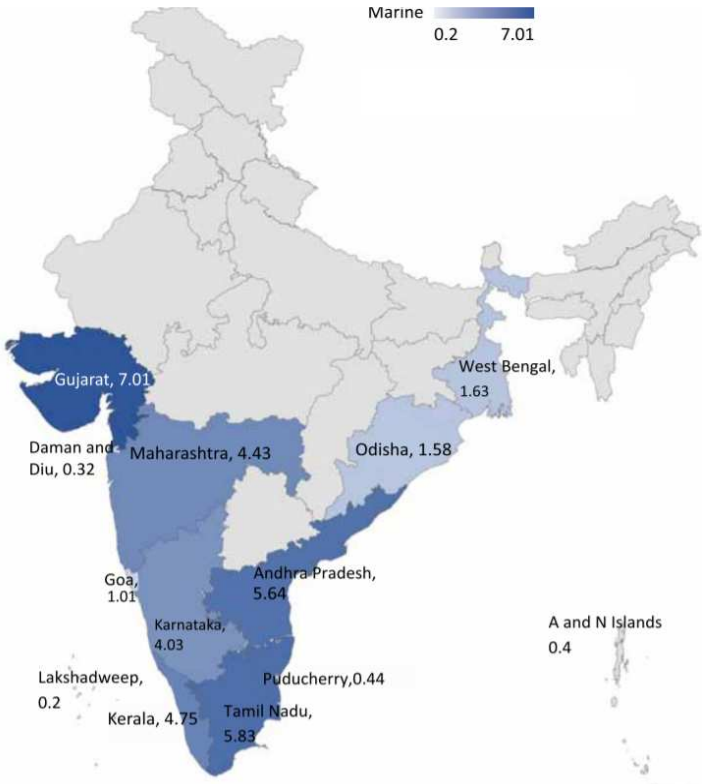

Fig. 3. Marine Fish Production [2019-20]: (In Lakh Tonnes) [Department of Fisheries, 2020]

Present status of fisheries sector of India

Unlike the agricultural and livestock sectors in India, the fisheries business which is a new comer has risen much quicker in the country. The industry employs a sizable section of the country's economically challenged population. Production and export are important sources of income and employment, while the production of low-cost, high-nutrient food is also important for the country's economy. In addition, it provides a source of affordable and healthy food that stimulates the development of a range of subsidiary enterprises. Fishing in India is becoming more important due to changing demographics, expanding market considerations and technological improvements in the fishing sector. Government aid, production methods, public infrastructure investment and fisheries research and extension have all significantly contributed in the increase in fish yield.

It has been estimated that in order to maintain current per person fishing supplies, the global supply of fish as a food (marine, freshwater and aquaculture) would have to grow from 142 to 180 million tonnes by 2030 (FAO 2018). Fisheries that use nets and lines to catch fish at sea are the most important sources of fish for the worldwide market. Currently, more than six out of ten of the world's fish is harvested from the oceans (84.4 million tonnes) (FAO 2018). For the last two decades, marine and inland water aquaculture has fastly increased and the percentage of marine capture fisheries to total global fish production has declined. Fishing contributes significantly to

the economy of India. Despite this, a large section of the country's poorest citizens is able to earn a living from it. More than 7 million people in the nation are supported by the country's fisheries and aquaculture industries. India rank4th in the world in terms of fish production and the second largest in the inland waters (Rajeev and Bhandarkar 2022).

Major source of Indian Fisheries

Fishery resources abound in India, both inland and at sea. Additionally, the country has a coastline of 8,118 kilometers and many estuaries, lagoons and other waterways that are perfect for catch and cultivation of fish. In 1977, the Exclusive Economic Zone (EEZ) was established, encompassing an area of 2.02 million square kilometers (0.8 million square kilometers on the west coast, 0.56 million square kilometers on the east coast and 0.60 square kilometers around the Andaman and Nicobar Islands (Nandakumar and Nayak 2010). Inland fishing resources include 1.96 lakh kilometers of rivers and canals, 3.15 million hectares of reservoirs, 2.44 million hectares of lakes and ponds, 0.798 million hectares of derelict water bodies, 1.24 million hectares of brackish water regions and 0.29 million hectares of estuaries. While the wetlands in the country's floodplains comprises about 500,000 hectares, providing a significant amount of territory for the development of culture-based fisheries (Sarkar *et al.* 2021). With 7.58 percent of global fish output, India ranks second in the globe. Fish and aquaculture continue to be crucial food and income source for millions of people. They account for 1.24 percent of our nation's Gross value added (GVA) and 7.28 percent of the agricultural Gross value of output (GVO) in 2018-19 **(**Sumithra *et al.* 2021). Astonishing annual growth rates of 8 to 12 percent have been witnessed in this mostly ignored business over the last decade.

Fish diversity in India

A totally of 1027 different species of freshwater fish have been found in Indian rivers and lakes **(**Sandilyan 2022).While aquaculture in India's freshwaters relies heavily on carps, particularly the catla, rohu and mrigal. Exotic silver, grass and common carps have emerged as the second most important category since the introduction of the polyculture system in the country, with the silver carp being the most important among the three. Although the nation possesses a number of additional minor carp species with strong regional demand such as *Labeo calbasu, L. fimbriatus, L. gonius, L. bata, L. ariza, Puntius sarana, Hypselobarbus pulchellus, H. kolus* and *Amblypharyngodon mola* however, commercial farming has yet to take off for these species. The two most significant catfish magur, *Clarias batrachus* and the singhi, *Heteropneustes fossilis* are widely cultured in the country other species like *Ompok pabd*a have made tremendous progress in recent years (Fig 4), as have species like *Pangasius pangasius*, *Anabas testudineus*, *murrels*, *Channa striata* and *C. marulius*. All the species play an essential role in the aquatic ecosystem.

Crisis in the fisheries sector

More than 15,000 migrant fish workers had been stranded as a result of the global pandemic, which has wiped out the livelihoods of millions of people in India's fish industry (Dev and Sengupta 2020). When the fisheries activities reopened, they were met with broken supply lines, low consumer demand and the increased threat of infection with the COVID-19 virus due to this, many of India's automated fisheries sector depend heavily on migrant fishermen was badly affected. Meanwhile, the surviving licensed fisheries were battling to reestablish themselves when the annual mechanized fishing limitation entered into place on the east coast on April 15th, 2020

However, although certain states, like Kerala Maharashtra have made great strides in returning seafood to people's diets, the bulk of fishing operations are still in the dark. Despite the fact that this extension of the annual fishing ban is only in force until 2020, it does little to alleviate the current problems. India's small-scale (non-mechanized) fishermen and migrant laborers, who are among the country's diverse fishing community's most vulnerable, now face even more challenges as the government relaxes its restrictions on mechanized and motorized fishing. Fishermen's lives are placed at risk in hazardous seas to service markets that don't exist and the likelihood of indebted fisher migrants being forced into bonded labor has grown as a result.

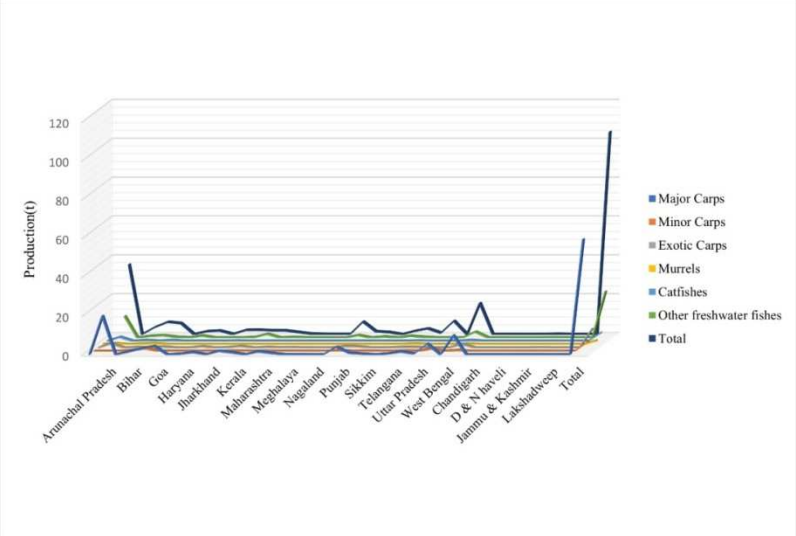

Fig 4. Species-wise Inland Fish landings by States and Union Territories: 2019-20 (In Lakh Tonnes) [Department of Fisheries, 2020]

Current country fisheries development programs

The Indian government has implemented both national and state sponsored programmes for the development of fisheries sector in the country as the 'Neel Kranti Mission' **(**Ngasotter *et al.* 2020). The 'Blue Revolution' was aimed at creating economic prosperity for fishermen and fish farmers, while also ensuring food security by maximizing water resources for sustainable fisheries development while keeping bio-security and environmental concerns in mind.To maximize fisheries output and productivity the focuses on aquaculture and fisheries resources in both inland and marine environments are imperative. Fishermen and fish producers can earn twice as much as they already do, while environmental and bio-security sustainability and the participation of the socioeconomically disadvantaged will also be ensured by the project. Under the Blue Revolution banner, the Department of Animal Husbandry, Dairy & Fisheries of the Ministry of Agriculture and Farmers Welfare overhauled the strategy. Inland, aquaculture and marine fisheries are all included in the new plan's emphasis on fisheries development and management, which encompasses all of the National Fisheries Development Board's tasks (NFDB). As part of an overall government budget of Rs 3000 crores for five years (2015-16 to 2019-20), the revised 'Blue Revolution: Integrated Development and Management of Fisheries' programme has been implemented to promote and improve fishing activities.

The Pradhan Mantri Matsya Sampada Yojana (PMMSY) states as its purpose 'harnessing of fisheries potential in a sustainable, responsible, inclusive and equitable manner' with a projected investment of Rs. 20,050 crores (Lakra and Gopalakrishnan 2021). Fisheries and aquaculture should be a major source of economic success since fish are recognized as a 'Sampada' or 'wealth'. Furthermore, shrimp farming has shown that aquaculture can effectively move from subsistence farming to an economically viable enterprise.

Drivers of future growth

Increased investment in research and development, as well as technological advancements, is critical to the sector's long-term viability. In the late 1970s, the development of carp polyculture and composite fish culture was a crucial factor in aquaculture's rapid growth (Kumar *et al*. 2010). Investing heavily in infrastructure, such as building micro-ports, jetties, landing centers, introducing trawlers and automated boats and supplying nets, has led in increased catches in the capture fishing business(Rajeev andBhandarkar2022). Market forces have had little impact on the expansion of this industry thus far. Especially in the rapidly growing aquaculture sector, the market must drive the acceleration of growth in order to fully realize the industry's potential. Here are some instances of illustrative items under each of the key driving forces.

Technology

- Quality seed production
- Selective breeding of carps
- Formulation of low-cost feed materials using locally available ingredients
- Fabrication of nets for targeted fishing

Infrastructure

- Constructing landing centers in second tier potential coastal towns
- Creation of cold storage near landing centers
- Upgrading manually operated boats into outboard motorized ones
- Supply of ice boxes

Market

- Creation of domestic markets
- Creation of institutional structures like marketing societies with fishermen / fish farmers as members
- Creation of cold storage facilities
- Transportation of fish and fishery products by refrigerated containers from point of landing / production to consumption centers
- Documentation of innovative market models already existing in the sector and replicating in similar areas with support from both Govt. and non-governmental agencies
- Gradation, Standardization and Branding of fish and fishery products
- Creation of Market Information System with the application of ICT tools.

Areas of fishery sector where research and development is required

Given the immense potential of fisheries resources and the requirement to attain targeted output and productivity, the following research and development thrust areas have been highlighted as high priorities:

- Commercially important marine fish stocks are assessed and monitored. Clarification on the development of fuel-efficient deep-sea fishing vessels and gear.
- Preventing post-harvest losses, as well as improving fish transport, storage and processing.
- Export-ready value-added fishing products are being developed.
- Biomolecules from marine creatures and plants are extracted, produced and evaluated for industrial and therapeutic purposes.
- Fish/shellfish aquaculture and ornamental fish aquaculture
- HACCP is being used in the seafood processing industry.
- Conservation and management of marine biodiversity
- Increasing the supply of fish seed and feed through rural aquaculture and integrated fish farming. Molecular biology is being used in aquaculture.
- DNA fingerprinting is being used to map the genetics of significant fish species.
- Databases and informatics in the fishing industry.
- Nutrition and feed development for fish
- Aquaculture with a wide range of products.
- New fish and shellfish species are being bred and cultured in both fresh and brackish water habitats.
- Aquatic ecosystems are being monitored in the environment.
- Environmentally friendly and long-term fish/shellfish farming is being developed.
- Hill fisheries resource development and management
- Emerging fields of human resource development.
- Bioactive compounds found in aquatic biota.
- Environmental impact assessment and coastal zone management.
- Stoppage of illegal transshipment of fish at sea ‘saiko’, by various trawlers.

Conclusions

The country’s fisheries and aquaculture business are well-positioned to play an important role in people's lives in the next decades, given the growing population pressure on land and the increasing expectation of alternative food production systems from aquatic resources. Priority must be given to research and development in the frontier areas of fishing in order to meet the industry's new challenges and make the whole system ecologically friendly and sustainable. As a result of this research and development financing, fish production and productivity will rise, as well as nutritional and food security, employment possibilities and socioeconomic status of the population.However, in order to achieve its full potential, more attention is required. There are a number of neglected water sources that might be utilized to increase fish production. Farmers socioeconomic concerns, developing and implementing robust and current aquaculture system, upgrading infrastructural facilities as well as enhancing management rules are all important for the aquaculture system of the country.

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