



**WorldFish**



Confederation of Indian Industry

# **A business case for scaling the production of tilapia in India**

## **A report for the SCALE Committee of the Government of India**

WORLD FISH & THE CONFEDERATION OF INDIAN INDUSTRY • APRIL 2022

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# Glossary



**Annual growth rate:** is the change in the value of a measurement over the period of a year.

**Aquaculture:** farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants.

**Aquaculture Stewardship Council (ASC):** an independent non-profit and labeling organization that establishes protocol on farmed seafood while ensuring sustainable aquaculture.

**Best Aquaculture Practices:** a third-party aquaculture certification program that encompasses the entire production chain, including the processing plant, farm, hatchery and feed mill.

**Biofloc tanks/systems:** the use of aggregates of bacteria, algae or protozoa, held together in a matrix along with particulate organic matter, to improve water quality, waste treatment and disease prevention in intensive aquaculture systems.

**Broodstock/broodfish:** a group of mature individuals used in aquaculture for breeding purposes.

**Cage tanks/reservoir tanks:** Cages that sit inside freshwater, often in a large body of water.

**Capital expenditure (CAPEX):** the money an organization or corporate entity spends to buy, maintain, or improve its fixed assets, such as buildings, vehicles, equipment, or land.

**Earthen ponds/tanks:** tanks constructed in the natural environment using clay soil and underground water.

**Fingerling:** As soon as the fry grow up to 10–15 cm in size or roughly equal to the size of a finger it is known as a fingerling. A fingerling is the proper size for stocking fish production ponds.

**Fishpond:** an artificial structure used for farming fish. It is filled with freshwater, is fairly shallow, and is usually non-flowing.

**Fry:** When spawn assumes a fish shape and grows to about 1–2 cm.

**Genetically improved farmed tilapia (GIFT):** an improved strain of Nile tilapia (*Oreochromis niloticus*).

**Global Good Aquaculture Practices (GAP):** a trademark and a set of standards for good agricultural practice to benefit farmers, retailers, and consumers.

**Gross domestic product:** the total monetary or market value of all the finished goods and services produced within a country's borders in a specific period.

**Gross Value Added:** the measure of the value of goods and services produced in an area, industry, or sector of an economy.

**Grow-out/flow-through or raceway farming:** a fish production system where freshwater is passed through artificial channels to ensure good quality water for the aquatic organisms.

**Hatchery:** A place for artificial breeding, hatching, and rearing through the early life stages of animals, particularly for finfish and shellfish.

**Hatchling:** The larvae emerging from the fertilized eggs after hatching. It is characterized by the presence of a yolk sac hanging below from where it draws its nutrition for 2–3 days.

**Inland fisheries:** any activity conducted to extract fish and other aquatic organisms from inland waters.

**Inland waters:** lakes, rivers, brooks, streams, ponds, inland canals, dams and other land-locked (usually freshwater) waters.

**Marine fisheries:** Fisheries within all the oceans and seas of the world, including bays and estuaries.

**CGIAR:** a global research partnership for a food secure future dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources.

**Operating expenses (OPEX):** a company's day-to-day expenses.

**Recirculatory aquaculture system:** a production system where system water is continuously filtered.

**Spawn:** As soon as the yolk sac of the hatchling is absorbed, it is known as spawn.

**Whole round fish:** Fish sold completely intact.

# List of acronyms, currencies and measurements

<b>ASC</b>	Aquaculture Stewardship Council
<b>BAP</b>	Best Aquaculture Practices
<b>CAPEX</b>	capital expenditure
<b>CII</b>	Confederation of Indian Industry
<b>cr.</b>	crore
<b>FCR</b>	feed conversion ratio
<b>FY</b>	financial year
<b>g</b>	gram
<b>GAP</b>	Global Good Aquaculture Practices
<b>GST</b>	Goods and Services Tax
<b>kg</b>	kilogram
<b>km</b>	kilometer
<b>MPEDA</b>	Marine Products Export Development Authority
<b>OPEX</b>	operating expenses
<b>m<sup>3</sup></b>	cubic meters
<b>MSME</b>	Ministry of Micro, Small and Medium Enterprises (MSME) is a Ministry of the Government of India, MSME is the apex executive body for the formulation and administration of rules, regulations and laws relating to micro, small and medium enterprises in India
<b>Nos</b>	numbers
<b>RGCA</b>	Rajiv Gandhi Centre for Aquaculture
<b>RNA</b>	ribonucleic acid
<b>Rs.</b>	Indian rupees
<b>TILV</b>	Tilapia Lake Virus, also known as Tilapia tilapinevirus

## Currency conversion

1 crore (cr.) = 10 million rupees or 100 Lakh

1 lakh = 100,000 rupees

1 USD<sup>1</sup> = 73 Indian rupees

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<sup>1</sup> Based on exchange rates at time of publication

# Executive summary

The Government of India has committed to a national target to increase fish production to 22 million metric tons by 2024–2025.<sup>2</sup> This commitment will benefit 28 million fishers and fish farmers, fish workers, fish vendors and other stakeholders who depend on aquaculture and fisheries for their livelihoods, and almost twice that number of actors along fish-related value chains.<sup>2</sup> It will increase employment opportunities and incomes, empower women and help deliver food and nutrition security. These developmental outcomes are well aligned with the Sustainable Development Goals, the Government of India's priorities as articulated in policies such as Pradhan Mantri Matsya Sampada Yojana (PMMSY), and the strategic objectives of the authors of this report – WorldFish and the Confederation of Indian Industry (CII).

As part of the SCALE committee's work to advance the growth of the tilapia industry in India, WorldFish and CII have prepared this report to analyze the opportunities and what is needed to significantly expand tilapia production in India. WorldFish has played a major role in promoting nutritious and affordable tilapia globally since the 1980s, especially through its long-standing tilapia genetic improvement program which has widely distributed genetically improved farmed tilapia (GIFT) as

a global public good. At present, more than 50% of the global commercial tilapia production is based on GIFT or GIFT-derived strains.

Building on its proven success at increasing production at scale for shrimp, India has carried out a "best bet" species assessment and identified tilapia as a species to pursue based on its suitability for domestic production and rising demand in global markets. It is also a species that can boost production in Indian inland fisheries and help diversify current fish production. To this end, India has set a transformative and ambitious goal to produce 0.766 million metric tons of tilapia by 2026–2027 and 2.155 million metric tons, valued at about USD 4.398 billion (Rs. 32,105 crore), by 2032.

The anticipated year-on-year revenue potential from tilapia export is USD 1.135 billion, which is 8% of the total target for Indian seafood export revenue of USD 14 billion by 2027. By 2032 India's estimated revenue from tilapia export could touch USD 3.92 billion, contributing 15% of the targeted USD 28 billion of fish and marine produce exports from India.

India has the required inland fisheries resources to spur sustainable growth in tilapia aquaculture in the coming

decades. In 2018–2019, only 58% of India's inland fisheries<sup>3</sup> potential had been realized. However, to achieve the target of 2.155 million metric tons of tilapia by 2032, India needs to invest in tilapia production infrastructure, including hatcheries, grow-out ponds and reservoir cages. This investment represents a total capital expenditure of approximately Rs. 5,557 crore (USD 761 million) over 10 years. The proposed additional financial support needed by the sector to increase tilapia production – primarily in the form of subsidies and interest subvention<sup>4</sup> – is estimated at Rs. 2,587 crore (USD 354 million) by 2032.

Investing in boosting India's tilapia production is predicted to bring a healthy return on investment of 24%–30%, provide new business opportunities, especially for young people and women, and earn foreign currency for India through exports. It will also ensure a steady supply of affordable fish protein to significantly boost nutrition among domestic consumers.

<sup>2</sup> India's National Fish Policy 2020

<sup>3</sup> Handbook of Fisheries Statistics, 2020. Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India [https://dof.gov.in/sites/default/files/2021-02/Final\\_Book.pdf](https://dof.gov.in/sites/default/files/2021-02/Final_Book.pdf)

<sup>4</sup> A grant of money or aid mostly paid by the government

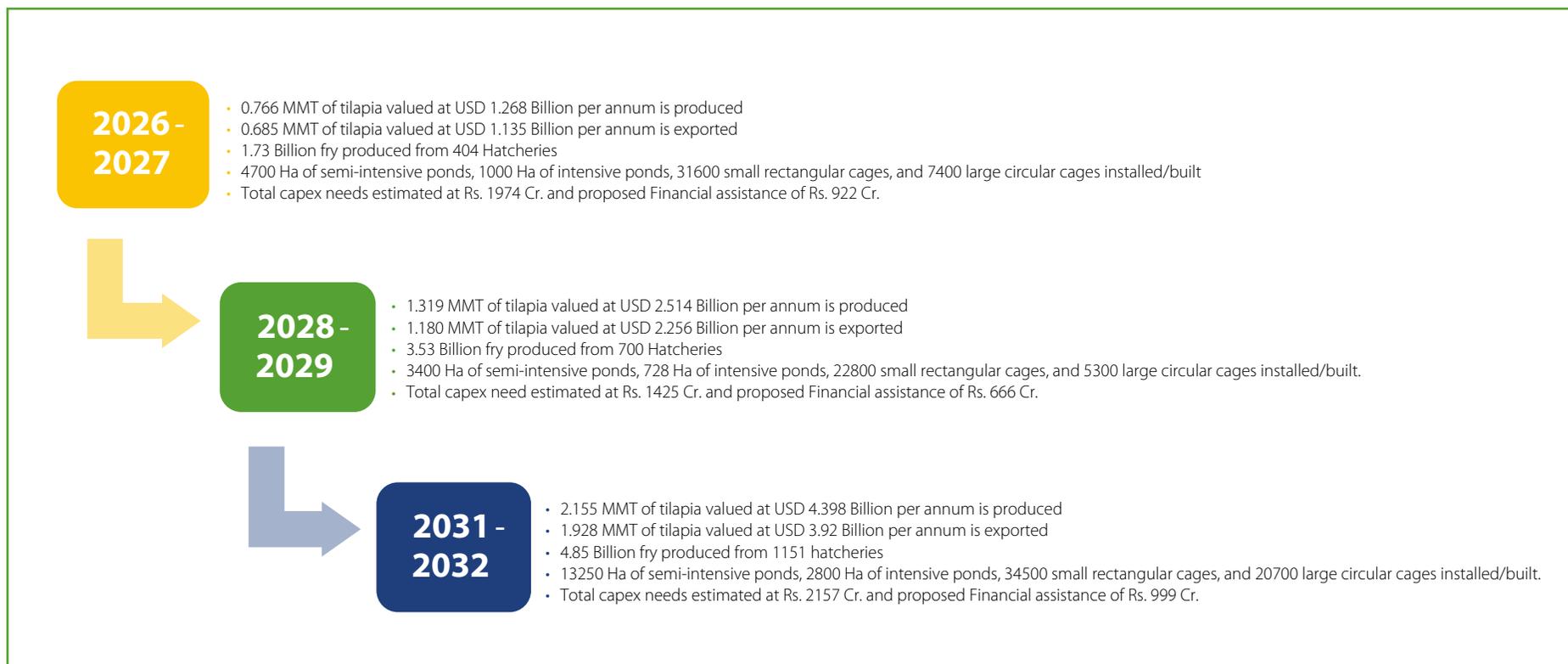
# Key messages

1. The Government of India has committed to a national target to increase fish production to 22 million metric tons by 2026–2027. This commitment will benefit 28 million people in India who depend on small-scale aquaculture and fisheries for their livelihoods. It will also increase employment opportunities and deliver food and nutrition security. This transformative and ambitious goal includes an annual production target of 0.766 million metric tons of tilapia by 2027 and 2.155 million metric tons of tilapia valued at USD 4.398 billion (Rs. 32,105 crore) by 2032. In this scenario, USD 3.92 billion worth of tilapia would be sold in the export market, mostly in processed frozen fillet form.
2. Between 2010 and 2018, global tilapia production almost doubled from 3.49 million metric tons to 9.03 million metric tons, and steady gains are forecast to continue. Major technological breakthroughs have catalyzed this exponential growth including the increased availability of genetically improved farmed tilapia (GIFT), an improved strain of Nile tilapia.
3. Out of India's targeted annual production of 2.155 million metric tons of whole round fresh tilapia by 2032, 1.93 million metric tons could be exported in the form of processed and value-added frozen fillets (0.59 million metric tons of fillets processed from 1.77 million metric tons of whole fish) to premium markets such as the USA, Europe and Japan. An additional 0.15 million metric tons of whole round frozen fish could be exported to African countries. It is envisaged that the remaining 0.227 million metric tons of tilapia would be sold in domestic markets as 0.144 million metric tons of fresh whole round fish and 0.038 million metric tons of fillets derived from 0.114 million metric tons of whole round fish for the hotel, restaurant & catering (HORECA) sector. Since the processing yield of fillets is 33% of the whole round fish weight, the total saleable quantity of tilapia, including both fillets and whole round fish, is calculated to be 0.838 million metric tons in 2032.
4. The anticipated revenue potential from tilapia export is USD 1.135 billion which is 8% of the total estimated seafood export revenue of USD 14 billion by 2027. By the 2032 financial year, the estimated revenue from tilapia export will grow to USD 3.92 billion, contributing 15% of the target of USD 24 billion in Indian seafood exports.
5. In India, tilapia farming is at a nascent stage, so providing investment and financial support to farmers is critical to building production capacity. To achieve the target of 2.155 million metric tons of tilapia by 2032, India needs to produce 4.85 billion tilapia monosex all-male seed (fry) from 1151 hatcheries of three different sizes (based on fry production capacity). Installation costs will mean a capital expenditure of Rs. 534 crore. In total, 977 small hatcheries (each producing 2 million fry per year), 145 medium hatcheries (each producing 10 million fry per year), and 29 large hatcheries (each producing 50 million fry per year) are needed. The proposed financial support to install 1151 hatcheries is Rs. 236 crore over 10 years.
6. Grow-out assets such as 13,200 hectares of semi-intensive ponds, 2800 hectares of intensive ponds, and, for reservoir production, 89,000 small rectangular cages of 100 m<sup>3</sup> and 21,000 large circular cages of 1000 m<sup>3</sup> will deliver 2.155 million metric tons of 750 g plate size fish by 2032. The capital expenditure required to create these growout assets over 10 years is Rs. 5,022 crore and the proposed financial support in the form of subsidy and interest subvention is Rs. 2,350 crore by 2032.
7. In total, the capital expenditure and financial support required to build the required hatchery and grow-out assets during the 2022–2032 financial period to meet the 2.155 million metric tons production target is Rs. 5,557 crore and Rs. 2,587 crore, respectively. In the 2024–27 block financial year, the total capital expenditure and financial support required for hatchery and grow-out assets is Rs. 1,975 crore and Rs. 922 crore, respectively. In the 2028–29 block financial year, it is Rs. 1,425 crore and Rs. 666 crore, and in 2031–32 block financial year, it is Rs. 2,157 crore and Rs. 999 crore.

8. Investing in India's tilapia production is predicted to bring a healthy return on investment of 24%–30%. This estimate is based on current prices related to building capacity in tilapia hatchery and farming systems at various scales. It is also anticipated that by 2025 the volume of farmed tilapia will ensure a sustainable and steady supply, which in turn will bring investment into processing and manufacturing value-added products for domestic and international customers. Fillet production in processing plants will create substantial job opportunities, especially for women.
9. Once production is established and scaled, tilapia has the potential to become part of India's export basket and could contribute to India's export target of USD 14 billion of fish and aquaculture products by 2027, and USD 28 billion by 2032 over the long term. To achieve sustainable growth in volume and market share in key global markets such as the USA and Europe, India needs to ensure that its tilapia production is carried out sustainably and that it maintains biodiversity. Additionally, it needs to put in place digital traceability to meet national food safety standards and to target global markets, and achieve consistent quality, in particular, in its tilapia flavor profile.

10. The primary focus of the first stage of increasing tilapia production is on increased rural livelihoods and job opportunities, particularly for women and young people. Tilapia is inexpensive, climate resilient, and can be farmed in any kind of small-scale or commercial culture system, meaning production and start-up costs are low. It is affordable, contains no inter-muscular bones so is easy to eat, has a mild taste, and is a good source of protein, essential fatty acids, and other micronutrients, so is ideally placed to help mitigate hunger and malnutrition. Scaling tilapia production in India will help deliver simultaneous progress both domestically and internationally across several Sustainable Development Goals, including but not limited to Zero Poverty (1), Zero Hunger (2), Gender Equality (5), Decent Work, and Economic Growth (8), and Responsible Production and Consumption (12).





**Figure 1.** Projected milestones of tilapia production in India and exports 2023–2032.

A Note on the Tables in this Report: Many of the milestones in the report are given for the financial years 2026-27, 2028-29 and 2031-32. In India, the official financial year is from 1st April to 31st March of the following year. In this case, FY 2026-2027 means from 1st April 2026 to 31st March 2027; FY 2028-2029 means from 1st April 2028 to 31st March 2029; and FY 2031-2032 means from 1st April 2031 to 31st March 2032. The data has been structured this way to provide reasonable timelines for delivering the targets within this report. Therefore, it is not an anomaly if the year 2030 is missing from any charts or tables, please note that it has been included in the analysis, and a lot of the data is provided using India's financial years and not calendar years.

# 1 A guide to tilapia



## 1.1 What is tilapia?

Tilapia is a freshwater fish that lives in shallow streams, ponds, rivers and lakes. It is the second most farm-raised fish in the world after carp, sometimes referred to as “aquatic chicken” because of its low maintenance cultivation needs. It is affordable, contains no inter-muscular bones so it is easy to eat, has a mild taste and is a good source of protein, essential fatty acids and other micronutrients.

## 1.2 About genetically improved farmed tilapia (GIFT)

Genetically improved farmed tilapia (GIFT) is a selective breeding initiative, pioneered by CGIAR researchers at WorldFish. Started in 1988, it has played a critical role in boosting fish productivity in both commercial and small-scale systems, benefiting millions around the world. For small-scale farmers, GIFT has helped provide a sustainable source of income, food and nutrition and helped adaptation to climate change.

GIFT is an improved strain of Nile tilapia (*Oreochromis niloticus*) which is hardy, resilient and faster growing than existing tilapia, so completes a production cycle more quickly and efficiently than non-improved tilapia. The improved strain, Nile tilapia, and its derivatives now make up or constitute more than half of the tilapia production in the world. GIFT is one of the main drivers behind Tilapia's exponential growth, alongside the ability to produce monosex tilapia.<sup>5</sup>



Freshly caught GIFT tilapia from a backyard pond, Kishorenagar, Cuttack, Odisha, India.

<sup>5</sup> Ahmed and Ahmed 2009; WorldFish 2015

### 1.3 The tilapia production cycle: characteristics of the six stages

#### 1 Nucleus breeding center



Tilapia breeding facility in Jitra, Malaysia.

- Cutting-edge scientific program.
- Genetic improvement for various traits such as fast growth, disease resistance, etc.
- Fool-proof biosecurity for pathogen-free parental stock production.
- Normally, this is a global program with gestation period (minimum 7 - 10 years) needed to deliver on investments.

#### 2 Broodstock multiplication center (Satellite breeding center)



Larval rearing tank.

- Focused on production of a large quantity of broodstock to be sold to hatcheries.
- Normally established at the national level with a medium-term (1-2 years) gestation period needed to deliver on investments.

#### 3 Hatchery



Glass jar hatchery for egg hatching.

- Mass production of tilapia fry (0.50 g or about 2 cm length).
- These fry are mono-sex (all-male) fry to be sold to farmers.
- 25-day cycle from egg to fry.
- Highly-skilled activity which requires training.
- Hatcheries are often established by progressive farmers and entrepreneurs near the farming cluster.

#### 4 Fingerling production (Seed rearing)



Photo credit: Arun Padiyar P./WorldFish

Tilapia fingerling (25 gram size).

- Growing the fry to fingerlings (25–50 g size or 10–12 cm in length).
- It is a 45–60 day cycle.
- Usually farmers rear the seed through captive fingerling production inside the pond, using nursery cages or in small tanks (0.25–0.50 acre).
- In some places commercial seed growers are also present.

#### 5 Grow-out



Photo credit: Arun Padiyar P./WorldFish

Semi-intensive Grow-out in Earthen Tank with 10 ton/Ha/crop.

- In grow-outs, tilapia is grown from fingerling to plate-sized fish (0.40 kg –1 kg) over a period of 4–8 months depending on its size at harvest.
- Grow-out farming can be done in earthen tanks, reservoir cages, backyard biofloc tanks, Recirculatory Aquaculture Systems (RAS), race-way systems, etc.
- Normally the earthen tanks are 0.05–2.50 acre tanks.

#### 6 Processing and Marketing



Photo credit: Samuel Stacey/WorldFish

Farmed tilapia in a fish market, Cairo, Egypt.

- Bigger-sized fish (>0.75 kg) are normally used for fillets and value addition in processing plants, and can be exported.
- Smaller-sized fish (<0.75 Kg) are sold as whole fish in live or fresh chilled condition in domestic markets.

## 2 Tilapia in India: Current status and future opportunities



## 2.1 A growing global tilapia market

Between 2010 and 2018, global tilapia production almost doubled from 3.49 million metric tons to 9.03 million metric tons. Steady gains are forecast to continue in 2021 and beyond, despite the COVID-19 pandemic. Today it is the second-most farmed fish in the world and is produced in 127 countries. China is the world's top tilapia producer, and the USA is the world's largest tilapia importer. The global market is predicted to be valued at \$9.2 billion by 2027.

## 2.2 Tilapia as a “best bet” species

Investing in India's tilapia production is predicted to bring a healthy return on investment of 24%–30%. This estimate is based on current prices related to building capacity in tilapia hatchery and farming systems at various scales, carrying a low to medium risk. It is anticipated that by 2025, the volume of farmed tilapia will ensure a sustainable and steady supply of products, which in turn will bring investment into processing and manufacturing value-added products for domestic and international customers. Once production is established and scaled, tilapia has the potential to become part of India's export basket and could contribute to India's export target of USD 14 billion of fish and aquaculture products by 2027, and USD 28 billion by 2032.

In the domestic market, tilapia is ideally placed to boost India's inland fishery production potential and diversify production, two of the strategic objectives of the Indian Government. It has an extremely high breeding rate and can be farmed in many kinds of small-scale or commercial culture systems. It does not require high start-up costs, so it is an ideal species to stimulate small-

scale fish production businesses. It is also an affordable source of protein and other nutrients, so will contribute toward national and state-wide food security strategies that target malnutrition. The vast majority of tilapia produced in small-scale systems is consumed and sold within local fishing communities, serving the dual role of providing income and delivering a rich source of animal protein and Omega 3 fatty acids.

## 2.3 India's tilapia production overview

Tilapia farming is slowly gaining momentum across the East, West and Southern States of India, following the increased costs of carp and sea catch. Tilapia production is currently estimated to be around 70,000 metric tons with 30,000 metric tons coming from aquaculture and

40,000 metric tons from natural wild catches from rivers, reservoirs, lakes, and other inland water bodies. Future projections for India's domestic and export tilapia market, considering variations under base, conservative, and optimistic scenarios respectively, see the tilapia market size grow to more than 0.766 million metric tons by 2027 and more than 2.155 million metric tons by 2032.

It is important to note regional differences. For example, in West Bengal, Maharashtra, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand and Kerala, where populations regularly consume local fish, tilapia production is increasing steadily, in particular through the use of backyard biofloc tanks and reservoir cage culture systems. In Andhra Pradesh, a major hub of aquaculture in India, consumption of tilapia remains low which means that grow-out farmers are looking for markets to further sell their harvests. This is a normal phenomenon during

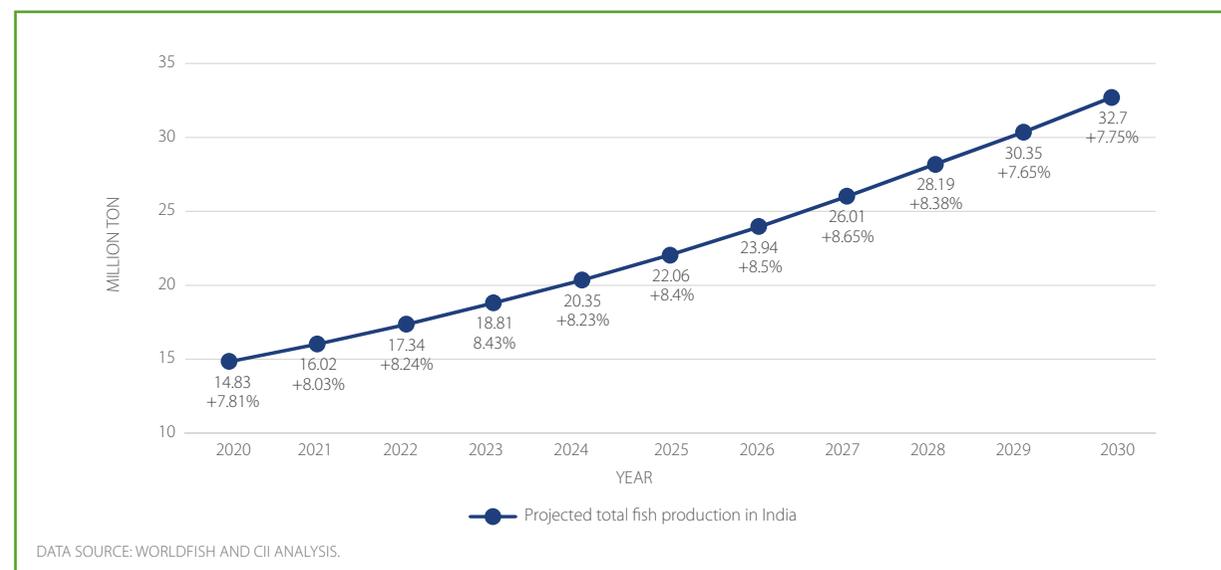
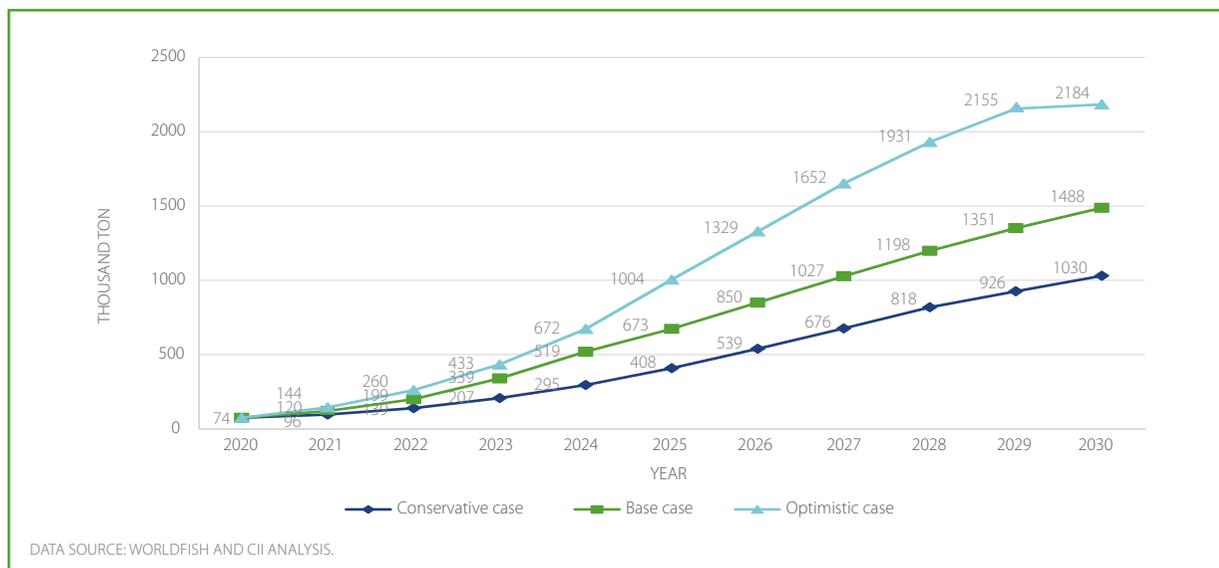


Figure 2. Projected total fish production in India.



**Figure 3.** Projected tilapia production in 3 different scenarios.

an introductory phase of a food product and hence, immediate market interventions are required to promote tilapia consumption and encourage tilapia farming in Andhra Pradesh to further incentivize production and to boost nutrition outcomes in the state.

## 2.4 Fish consumption in India

Fish provides an affordable and rich source of animal protein and is one of the healthiest options to mitigate hunger and malnutrition. Currently, 68.8% of the Indian population consumes fish. India's Ministry of Fisheries, Animal Husbandry, and Dairying estimates that demand for fish is expected to reach 22 million metric tons by 2026–2027. Inland aquaculture is expected to play a major role in meeting this demand by enhancing the availability and affordability of fresh fish, increasing consumption and boosting nutrition outcomes, including for the most vulnerable communities

## 2.5 Export market potential

The primary aim of scaling tilapia production is to strengthen rural livelihoods and job opportunities and increase domestic consumption of fish. In the longer term, tilapia has the potential to become part of India's export basket and substantially contribute to India's export target of USD 14 billion of fish and aquaculture products by 2025, and USD 28 billion by 2032. To this end, a target of 0.766 million metric tons of whole round tilapia production by 2027, as well as 2.155 million metric tons of whole round tilapia production by 2032, has been set, geared mainly towards established export markets including the lucrative markets of the USA, Europe and Japan.

To successfully export into these markets, it is critical to institute 100% digital traceability at every step in the production cycle, from broodstock to ingredients

in fish feed. Moreover, India must prepare to comply with various international certification standards that encompass the entire production chain including Best Aquaculture Practices (BAP), the Global Good Aquaculture Practices (GAP) and the Aquaculture Stewardship Council (ASC).

Meeting the standards of the ASC could be a major differentiator for India. The ASC is an independent non-profit organization that establishes protocols for farmed seafood while ensuring aquaculture production is sustainable. This would mean that farmed tilapia performance in India would be measured against both environmental and social requirements. This means that it is of utmost importance to institutionalize tilapia farming processes in line with ASC standards from the initial stages of tilapia value chain promotion, giving India a comparative advantage, particularly as many tilapia exporting countries are not yet able to fulfill these requirements.

In addition to certification, India also needs to pay attention to product quality, for example, by ensuring that fillets have a uniform flavor profile for the USA, Europe and Japan markets. Flavor profiles are influenced by factors including pond water quality, pond maintenance and feed quality, so to ensure consistency, export market-oriented production should be done through cage culture in large reservoirs, following the Indian national guidelines for cage culture in inland open water bodies. Production from small backyard and commercial ponds should be exported to the African market as whole round frozen fish or processed into frozen fillet for the domestic market, in particular the HORECA sector. Whole round fresh fish produced from ponds should be sold in local domestic markets.

## 2.6 Benefits and beneficiaries of tilapia production in India

Fisheries are a strategic asset of India's national economy, providing a critical source of food, nutrition, employment and income to around 28 million fishers and fish farmers, fish workers, and almost twice that number along fish-related value chains.

The primary focus of increasing tilapia production initially is on increased rural livelihoods and job opportunities, particularly for women and young people, across the whole value chain, including hatchery operators, nursery operators, feed millers, feed dealers and companies, transporters, processors, wholesalers, retailers, and consumers. Tilapia supports the promotion of small-scale aquaculture integrating well with homestead production systems and offers a low-investment start-up business opportunity for small-scale producers.

As 44% of the workers in the fisheries sector are women, ensuring their active participation in scaling tilapia production will help to increase income, boost nutrition at the household level and empower them to become leaders in tilapia production and markets in their communities and networks, offering a great opportunity to boost gender quality in rural India.



Rectangular Cages (100m<sup>3</sup> volume and production capacity of 3 tons per harvest).

# 3 Capital expenditure needs and estimated revenues of tilapia production in India



To reach the target of 0.766 million metric tons of tilapia production by 2026–2027 and contribute to the Fishery and Marine produce export goals of USD 14 billion of fish and aquaculture products by 2027 and USD 28 billion by 2032, India needs to build its production capacity. This includes capacity in hatcheries, grow-out ponds, reservoir cages, tilapia feed, processing plants, cold storage, ice plants and more. As tilapia farming is at a nascent stage in India, building capacity to scale up production requires financial support to farmers, entrepreneurs and industries.

In 2019–20, 11 licensed hatcheries in India produced 94 million tilapia fry. The fry were mainly genetically

improved farmed tilapia (GIFT), Chitralada and Golden tilapia, and included 10 million GIFT monosex fry. Out of around 30,000 metric tons of total farmed tilapia production in the country, GIFT contributed 2000 metric tons of plate-size tilapia.

### 3.1 Capital expenditure needs and estimated revenues for hatcheries, fry, and fish production 2023–2032

To build hatchery capacity, there must be a consistent supply of quality tilapia seed all year round. As per the

estimates below, India needs 1151 hatcheries, including in small, medium, and large sizes, for which Rs 534 crore capital expenditure will be incurred by the 2032 financial year. The total land required to establish 1151 hatcheries is 4129 acres (1670 hectares) of land near the farming clusters which will produce 4.85 billion monosex tilapia fry by the year 2032.

#### 3.1.1 Small hatchery

To set up a small hatchery, a farmer needs at least two acres of land, barricaded and fitted with bird netting to prevent the escape of the biological material from the farm to the water source. The farmer also needs to establish separate units for different parts of the seed production cycle, for example, broodstock rearing, sex reversal tanks and nursery tanks. The broodstock take around six months to reach sexual maturity, after which they can produce fry regularly for two years, after which they should be discarded and replaced with a fresh batch of young broodstock.

A small hatchery can produce 100,000 eggs per week (400,000 per month) and about 50,000 fry per week (200,000 fry per month). This means about 2 million



Pellet feed for tilapia which has soya meal as major content.

Size	Estimated CAPEX per hatchery (Rs. crore)	Estimated number of fry per hatchery per annum (million)	Cumulative number of hatcheries			Cumulative estimated capex (Rs. crore)		
			FY 2026-27	FY 2028-29	FY 2030-32	FY 2026-27	FY 2028-29	FY 2030-32
Small	0.25	2	341	592	977	85.30	148.10	244.30
Medium	1.00	10	52	89	145	51.80	89.30	145.00
Large	5.00	50	11	18	29	52.50	89.30	145.00
<b>Total</b>	<b>6.25</b>	<b>62</b>	<b>404</b>	<b>699</b>	<b>1151</b>	<b>189.6</b>	<b>326.7</b>	<b>534.3</b>

**Table 1.** Cumulative number of hatcheries and capital expenditures required from 2023–2032.

tilapia monosex fry per annum. The selling price per fry is 1–2 Rs. while the cost of production per fry is estimated at Rs. 0.80. The capital requirement cost is Rs 25 lakh for each small hatchery and the total capital expenditure required to construct 977 small hatcheries by the 2032 financial year is Rs. 244 crore.

### 3.1.2 Medium hatchery

To set up a medium hatchery, the process is the same as for a small one, except that the farmer needs at least ten acres of land and eight to ten workers. This size hatchery can produce 10 million tilapia fry per annum. Expanding production brings economies of scale, lowering the cost of production from Rs. 0.80 per fry for a small hatchery to Rs. 0.70 per fry for a medium hatchery. The capital expenditure for building a medium hatchery is Rs. 1.00 crore and the total capital expenditure required to construct 145 medium hatcheries by the 2032 financial year is Rs.145 crore.

### 3.1.3 Large hatchery

To set up a large hatchery, the minimum land requirement is 25 acres and 18–20 workers are needed. This size hatchery can produce 50 million tilapia fry per annum. Economies of scale significantly bring down the cost of production to Rs. 0.60 per fry, but the distribution area will be larger and hence transport costs must be factored in, which may be Rs 0.05 to 0.20 per fry depending on the distance. Another factor to consider is that a large-scale hatchery produces better quality fry due to the stringent application of best practices. The capital expenditure for building a large hatchery is Rs. 5.00 crore and the total capital expenditure required to construct 29 large hatcheries by the 2032 financial year is Rs.145 crore.



Tilapia brood management operation at Khulna Tilapia Hatchery, Bangladesh.

### 3.1.4 Summary of capital expenditure needs and estimated revenues of tilapia production in India

To meet its target, India needs to build its tilapia hatchery infrastructure over the next 10 years. In addition to the target of 0.766 million metric tons of production by 2026-27 which is geared towards the domestic market, an additional 1.389 million metric tons production of whole round fish is required to cover export and domestic market demand by 2032. Small hatcheries will generate Rs. 102 crore by the 2025 and Rs. 195 crore by the 2032 financial year, assuming a constant current price. The combination of medium and large hatcheries will generate a combined turnover of Rs. 156 crore in the 2027 and Rs. 290 crore in the 2032. As more hatcheries start production and become more competitive, it is estimated that the sale price of fry will drop from Rs. 1.50 in the 2027 to Rs. 1.00 per fry in the 2032. It is also anticipated that the cost of fry production will drop from Rs. 0.80 to Rs. 0.65 over this period due to streamlining of operations and better efficiency.

To ensure that a greater number of fish farmers including women can participate in and benefit from increased tilapia production, it is proposed that 35% of the total fry production comes from small hatcheries. The remainder will come from 52 medium and 11 large hatcheries by the end of the 2025 financial year. By 2029–2032, it is projected that India will have 977 small, 145 medium and 29 large tilapia hatcheries with a total capital investment of Rs. 534 crore.

For this to happen, the government recognizes that it needs to incentivize and support farmers, small-scale entrepreneurs and the private sector to establish hatcheries. Proposals include introducing a 50% subsidy for small hatchery farmers and a 40%

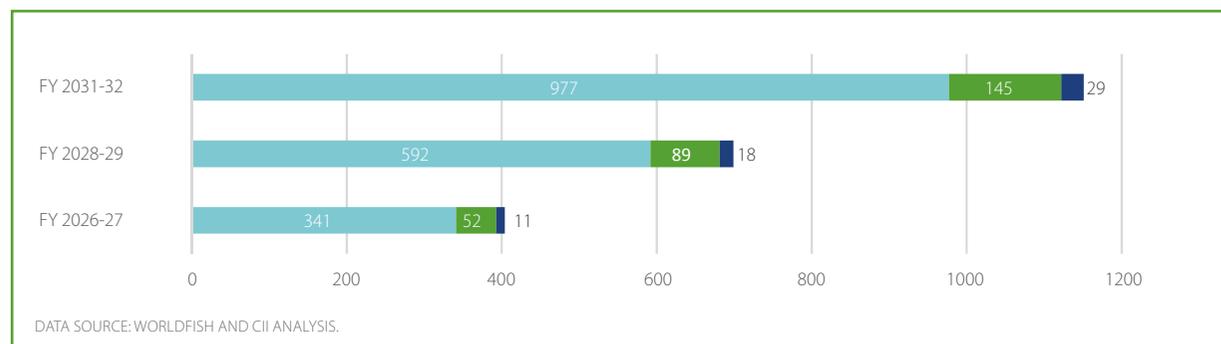


Figure 4. Cumulative number of hatcheries.

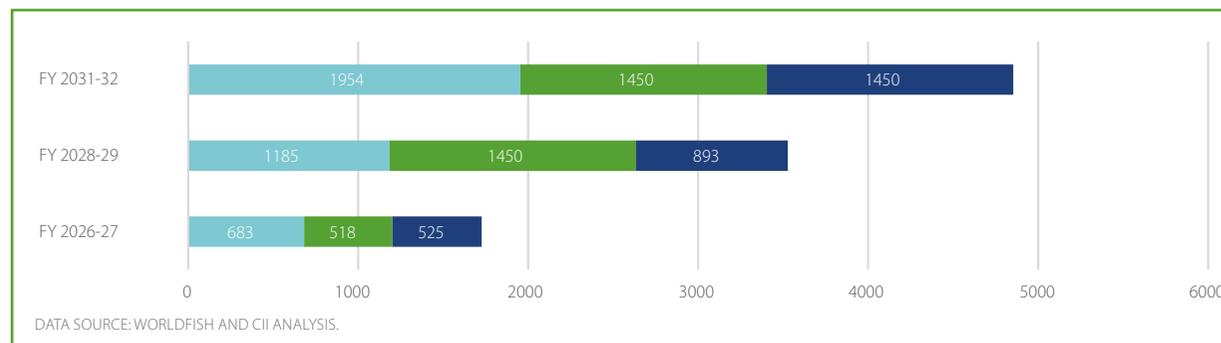


Figure 5. Tilapia fry production numbers (million).

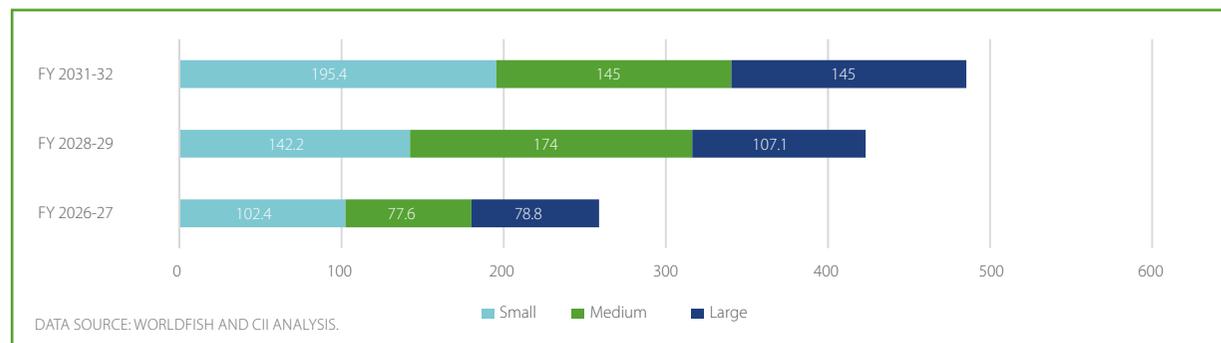


Figure 6. Tilapia fry production revenue (Rs. crore).



Circular Cages (1000 m<sup>3</sup> volume and production capacity of 30 tons per harvest).

subsidy for medium-size hatchery entrepreneurs. There is also a proposed 40% subsidy to set up large hatcheries from now until the 2027 financial year and 25% from 2031 to 2032. These large hatcheries will cater to the needs of farmers in a large geographical area. Financial support to entrepreneurs and industry may be reduced after an initial seven years. Proposals also include a 3% interest subsidy under the interest subvention scheme<sup>6</sup> to make tilapia production an attractive sector and encourage the flow of investment. Financial support for the working capital is expected to be in line with the Micro, Small, and Medium Enterprises Sector (MSME)<sup>7</sup> and has been kept out of the proposal.

Therefore, it is estimated that the total financial support needed to establish 1151 tilapia hatcheries will be

approximately Rs. 230 crore over the 2023–2032 financial period. However, the total capital expenditure required is Rs. 534 crore.

To achieve the target of 1 million metric tons of production by 2026–2027, capacity-building efforts need to start in the 2024 financial year. Ease of land leasing, including change in its use, registration and renewal processes, should be captured under the Ministry of Commerce's DPIIT Ease of Doing Business ranking among Indian states. Projected hatchery numbers and capacity will provide India with an estimated 0.78 million metric tons of whole round tilapia at the farm-gate in 2027 for both domestic consumption and exports of value-added frozen fillet products and frozen whole fish.

Hatchery size	Per unit CAPEX* (Rs. crore)	FY 2026-27		FY 2028-29		FY 2031-32		Total hatchery Nos.	Total Capex in (Rs. crore)
		Nos.	Capex	Additional Nos.	Capex	Additional Nos.	Capex		
Small	0.25	341	85.30	251	62.80	385	96.10	977	244.30
Medium	1.00	52	51.80	38	37.50	56	55.80	145	145.00
Large	5.00	11	52.50	7	36.80	11	55.80	29	145.00
<b>Total</b>		<b>404</b>	<b>189.60</b>	<b>296</b>	<b>137.10</b>	<b>451</b>	<b>207.60</b>	<b>1151</b>	<b>534.30</b>

\* For ease of working, the per-unit capital expenditure value has been kept constant at today's price

**Table 2.** Total capital investment required for hatcheries.

6 A scheme introduced by the Reserve Bank of India wherein relief is provided up to 2% of interest to all the legal micro, small and medium enterprises on their outstanding fresh/incremental term loan/working capital during the period of its validity.

7 A branch of the Government of India, MSME is the apex executive body for the formulation and administration of rules, regulations and laws relating to micro, small and medium enterprises in India.

Size of hatchery	Small Hatcheries (10% Equity)			Medium Hatcheries (20% Equity)			Large Hatcheries (20% Equity)			Total Rs Mn
	FY 2026-27	FY 2028-29	FY 2031-32	FY 2026-27	FY 2028-29	FY 2031-32	FY 2026-27	FY 2026-27	FY 2028-29	
Proposed Subsidy (%)	50%	50%	50%	40%	40%	40%	40%	40%	25%	
Capex Value (in Rs. Crores)	85.31	62.80	96.14	51.75	37.50	55.75	52.50	36.75	55.75	534.25
Financial Subsidy (in Rs. Crores)	42.66	31.40	48.07	20.70	15.00	22.30	21.00	14.70	13.94	229.76
Interest Subvention (@3% impact Rs. Crores)	10.24	0.75	1.15	0.62	0.45	0.67	0.63	0.44	0.92	6.66
<b>Total Financial Support (in Rs Crores)</b>	<b>43.68</b>	<b>32.15</b>	<b>49.22</b>	<b>21.32</b>	<b>15.45</b>	<b>22.97</b>	<b>21.63</b>	<b>15.14</b>	<b>14.86</b>	<b>236.42</b>

**Table 3.** Proposed financial support to hatchery capacity building<sup>8</sup>.

Hatchery size	FY 2026-27	FY 2028-29	FY 2031-32	Total financial support (Rs. crore)
Small hatchery	44	32	49	125
Medium hatchery	21	15	23	60
Large hatchery	22	15	15	52
<b>Total financial support</b>	<b>87</b>	<b>63</b>	<b>87</b>	<b>236</b>

**Table 4.** Estimated financial support needed to run various hatchery sizes.

<sup>8</sup> It is important to note that almost 50% subsidy out flow is towards small farmers and 24% towards medium-size entrepreneurs. Over a 10-year period, 53% of the total financial support has been earmarked for the small hatcheries owned by farmers and 25% will be given out to medium-size hatchery owners who are primarily entrepreneurs or current generation farmers.

Year	Fish fry production numbers (million)			Number of whole round fish produced at 60% survival rate (million)			Total whole round fish produced by weight (million metric tons)		
	FY 2026-27	FY 2028-29	FY 2031-32	FY 2026-27	FY 2028-29	FY 2031-32	FY 2026-27	FY 2028-29	FY 2031-32
<b>Total</b>	<b>1,725</b>	<b>3,527</b>	<b>4,854</b>	<b>1,035</b>	<b>2,116</b>	<b>2,912</b>	<b>0.766</b>	<b>1,566</b>	<b>2,155</b>

**Table 5.** Estimated fry and fish production by year.

### 3.2 Costs and benefits of different tilapia production systems

India has 8118 km of coastline, 252,431 km of rivers and canals and 14,159 reservoirs covering 4 million hectares. It also has 9.2 million hectares of tanks and ponds and 1 million hectares of brackish water. These vast and unique resources offer an opportunity to increase fish production including carp, pangasius and tilapia, and by restoring and sustainably using many of these resources, the potential to build up tilapia production could be greatly increased. Primarily, all the reservoirs in the targeted states – Odisha, Gujarat, Telangana, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh and Uttar Pradesh – must be surveyed for the suitability for fish farming, especially cage culture of tilapia. It is proposed to put in place an inclusive 360-degree strategy covering seed hatchery, feed mills, grow-out tanks/ cages/ cold chain infrastructure, processing and supply chain to leverage these resource assets not only impacting the livelihood of people living around these assets directly but manifold people who will get linked in the complete value chain.

To support small and medium farmers, the strategy has considered ponds of 1 hectare and small rectangle

cages of 100 m<sup>3</sup>, and large commercial circular cages of 1000 m<sup>3</sup>. This provides an opportunity for both small entrepreneurs and industries to enter into tilapia production, targeting both domestic and export markets to help achieve the 0.766 million metric tons target of whole round fresh tilapia fish production at the farm gate by the 2027 financial year.

Tilapia is farmed largely in monoculture systems around the world and characterized by a range of production systems including extensive, improved-extensive, semi-intensive, and intensive. In some countries, polyculture is practiced. For example, in Bangladesh where tilapia is farmed with carp and other species. In India, with appropriate regulatory changes and biosecurity considerations, it could significantly boost the area for tilapia production.

Andhra Pradesh has leveraged its water bodies very well and encourages farmers and industries to set up production and processing facilities. It has developed its end-to-end fish value chain within the state borders resulting in its cost of aquaculture production being far lower than any other state. With 4.6% of India's rivers and canals, 5.8% of its medium and large reservoirs and 3.6% of its tanks and ponds in terms of area, Andhra Pradesh produces 3.73 million metric tons, equivalent to 35% of Indian aquaculture production. In comparison to Andhra Pradesh, six eastern states have equally huge potential for tilapia and carp production.

Each approach brings different opportunities and costs and is suitable for different kinds of farmers and environments. Some different scenarios are outlined in this section.



Tilapia farming in backyard biofloc tanks.

<b>Eastern States</b>	<b>Rivers &amp; Canals (Km)</b>	<b>Small reservoirs area in hectares</b>	<b>Medium &amp; large reservoirs area in hectares</b>	<b>Tanks and ponds area in hectares</b>	<b>Fisherfolk population</b>	<b>Fish production in Lakh MT</b>	<b>Total hectare area without rivers &amp; canals</b>	<b>Fish productivity metric ton per hectare (considering nil production from rivers &amp; canals)</b>
Bihar	3200	0	26,304	93,218	6,027,375	6.41	119,522	5.36
Chhatisgarh	3570	43,682	39,036	109,004	220,355	5.72	191,722	2.98
Jharkhand	1800	28,790	104,363	79,010	140,897	2.23	212,163	1.05
Odisha	24,879	34,608	165,771	133,786	921,419	6.6	334,165	1.98
West Bengal	2526	28,050	0	263,372	2,833,574	16.19	291,422	5.56
<b>Total Eastern States</b>	<b>35,975</b>	<b>135,130</b>	<b>335,474</b>	<b>678,390</b>	<b>10,143,620</b>	<b>37.15</b>	<b>1,148,994</b>	<b>3.2</b>
Percentage out of all of India	14.3%	7.6%	14.9%	7.4%	43.9%	35.6%	8.7%	
Madhya Pradesh	17,088	124,486	228,321	76,982	2,232,822	2	429,789	0.5
<b>Eastern states + Madhya Pradesh</b>	<b>53,063</b>	<b>259,616</b>	<b>563,795</b>	<b>755,372</b>	<b>12,376,442</b>	<b>39.15</b>	<b>1,578,783</b>	<b>2.5</b>
Percentage out of all of India	21%	15%	25%	8%	54%	38%		
<b>Andhra Pradesh</b>	<b>11,514</b>	<b>34,693</b>	<b>130,898</b>	<b>333,634</b>	<b>621,851</b>	<b>36.1</b>	<b>499,225</b>	<b>7.2</b>
Percentage out of all of India	4.6%	2.0%	5.8%	3.6%	2.7%	34.6%	3.8%	
<b>All India</b>	<b>252,432</b>	<b>1,776,991</b>	<b>2,254,810</b>	<b>9,200,327</b>	<b>23,117,820</b>	<b>104.37</b>	<b>13,232,128</b>	<b>1.7</b>

**Table 6.** Inland resources available for aquaculture production in Eastern states and Andhra Pradesh, as at 2019–2020.

This table compares the aquaculture production potential of Andhra Pradesh to Eastern states of India. Despite having significantly fewer natural resources (e.g. rivers, canals, reservoirs, etc) and infrastructure (e.g. tanks and ponds), Andhra Pradesh currently has much higher levels of aquaculture production. This demonstrates the opportunities available for Eastern states to ramp up their activities within the sector.



Hatchery interior view.

### 3.2.1 Semi-intensive pond farm (10 metric tons per hectare per harvest)

Producing tilapia through a semi-intensive pond farm system can produce two harvests per year of 750 g fish each, equalling 10,000 kg per hectare (20,000 kg per hectare in total), assuming a survival rate of around 60%. It is a suitable approach for small- and medium-scale farmers. From a capital investment of Rs. 850,000 per hectare, a farmer can establish the infrastructure needed to start production, including bi-annual maintenance, as well as Rs. 650,000 per hectare working capital for feed, medicine, fry, etc. The infrastructure is expected to last for seven years during which the farmer's net profit can increase from Rs. 2.73 lakhs per hectare per year in Year 1 to Rs. 3.59 lakhs per hectare per year in Year 7.

This approach requires a minimum pond area of 2 hectares. Additionally, the farmer should be able to access 90% of the project cost through a capital expenditure loan (Rs. 85,000 per hectare in equity and Rs. 765,000 per hectare of debt). An interest subvention scheme of 3% should be provided to improve profitability, and a working capital loan should be given with an interest subvention of 3%. A credit guarantee must be available to overcome failure or force majeure incidents, and the Goods and Services Tax (GST) removed, as produce will not attract any GST so offsetting would be difficult. A power tariff should be matched with the agriculture tariff. All states should follow the Andhra Pradesh power tariff rates to encourage fish farming in these states.

	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7	
Sl. Items No.	Harvest I	Harvest II												
<b>Operational cost</b>														
1 Tilapia mono-sex fry	33,000	33,000	33,000	33,000	33,000	33,000	26,400	26,400	26,400	26,400	22,000	22,000	22,000	22,000
2 Feed in kg @ feed conversion ratio 1:1.30	4,94,000	4,94,000	5,08,820	5,08,820	5,24,085	5,24,085	5,39,807	5,39,807	5,56,001	5,56,001	5,72,681	5,72,681	5,89,862	5,89,862
3 Other costs Rs.	1,14,000	1,14,000	1,17,420	1,17,420	1,20,943	1,20,943	1,24,571	1,24,571	1,28,308	1,28,308	1,32,157	1,32,157	1,36,122	1,36,122
4 Total operating expenses	6,41,000	6,41,000	6,59,240	6,59,240	6,78,027	6,78,027	6,90,778	6,90,778	7,10,709	7,10,709	7,26,839	7,26,839	7,47,984	7,47,984
5 Annual depreciation and interest Rs.	2,61,819	-	2,49,797	-	2,37,776	-	2,25,754	-	2,13,733	-	2,01,712	-	1,89,690	-
6 Total cost	9,02,819	6,41,000	9,09,037	6,59,240	9,15,803	6,78,027	9,16,532	6,90,778	9,24,442	7,10,709	9,28,550	7,26,839	9,37,674	7,47,984
7 Production cost per kg fish	90	64	91	66	92	68	92	69	92	71	93	73	94	75
8 Total farm-gate revenue	9,02,500	9,02,500	9,20,550	9,20,550	9,38,961	9,38,961	9,57,740	9,57,740	9,76,895	9,76,895	9,96,433	9,96,433	10,16,362	10,16,362
9 Net profit per crop	11,824	2,61,500	23,656	2,61,310	35,301	2,60,934	53,351	2,66,962	64,595	2,66,186	80,026	2,69,594	90,830	2,68,378
10 Net profit per annum with 2 crops		2,73,324		2,84,966		2,96,235		3,20,313		3,30,781		3,49,620		3,59,208

Assumptions: (1) Tilapia fry stocking density is 22,000 nos per hectare; (2) the survival rate of fish from fry to market size in the grow-out system is 60%; (3) tilapia fry costs decrease from 1.50 Rs. per fry during Y1–Y3; 1.20 Rs. per fry during Y4–Y5; and 1.00 Rs. per fry during Y6–Y7.

**Table 7.** Economics of semi-intensive pond farming (10 metric tons per hectare per harvest in Rs.).

### 3.2.2 Intensive-pond farm (20 metric tons per hectare per harvest)

Producing tilapia through an intensive pond farm system can produce two crops per year of 750 g fish equalling 20,000 kg per hectare (40,000 kg per hectare in total), assuming a survival rate of around 60%. It is

a suitable approach for large-scale farmers, farmer-producer companies, and entrepreneurs. From a capital investment of Rs. 100,000 per hectare (Rs. 100,000 per hectare equity and Rs. 700,000 per hectare debt), a farmer can establish the infrastructure needed to start production, including bi-annual maintenance, as well as Rs. 1,341,000 per hectare working capital for feed,

medicine, fry, etc. The infrastructure is expected to last for seven years during which the net profit for the farmer can increase from Rs. 8.05 lakhs per hectare per year in Year 1 to Rs. 9.38 lakhs per hectare per year in Year 7. Interventions required are similar to those outlined for a 10 metric ton per crop semi-intensive pond.



Fry packed in polythene bag with oxygen.

	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7	
Sl. Items No.	Harvest I	Harvest II												
<b>Operating expenses</b>														
1 Tilapia mono-sex fry	66,000	66,000	66,000	66,000	66,000	66,000	52,800	52,800	52,800	52,800	44,000	44,000	44,000	44,000
2 Feed in kg @ feed conversion ratio 1:1.30	9,88,000	9,88,000	10,17,640	10,17,640	10,48,169	10,48,169	10,79,614	10,79,614	11,12,003	11,12,003	11,45,363	11,45,363	11,79,724	11,79,724
3 Other costs	1,74,000	1,74,000	1,79,220	1,79,220	1,84,597	1,84,597	1,90,134	1,90,134	1,95,839	1,95,839	2,01,714	2,01,714	2,07,765	2,07,765
4 Total operating expenses	12,28,000	12,28,000	12,62,860	12,62,860	12,98,766	12,98,766	13,22,549	13,22,549	13,60,641	13,60,641	13,91,076	13,91,076	14,31,489	14,31,489
5 Annual depreciation and interest	3,62,770	-	3,48,627	-	3,34,484	-	3,20,341	-	3,06,199	-	2,92,056	-	2,77,913	-
6 Total cost	15,90,770	12,28,000	16,11,487	12,62,860	16,33,250	12,98,766	16,42,890	13,22,549	16,66,840	13,60,641	16,83,132	13,91,076	17,09,402	14,31,489
7 Production cost per kg fish	80	61	81	63	82	65	82	66	83	68	84	70	85	72
8 Total farm-gate revenue	18,05,000	18,05,000	18,41,100	18,41,100	18,77,922	18,77,922	19,15,480	19,15,480	19,53,790	19,53,790	19,92,866	19,92,866	20,32,723	20,32,723
9 Net profit per crop	2,28,516	5,77,000	2,43,899	5,78,240	2,58,958	5,79,156	2,86,876	5,92,932	3,01,236	5,93,149	3,24,019	6,01,789	3,37,607	6,01,234
10 Net profit per annum with 2 crops	8,05,516		8,22,139		8,38,114		8,79,808		8,94,385		9,25,809		9,38,842	

Assumptions: (1) Tilapia fry stocking density is 44,000 nos. per hectare; (2) the survival rate of fish from fry to market size in the grow-out system is 60%; (3) tilapia fry costs decrease from 1.50 Rs. per fry during Y1–Y3; 1.20 Rs. per fry during Y4–Y5; 1.00 Rs. per fry during Y6–Y7; (4) feed cost is 38 Rs. per kg; (5) operating expenses increases at 3% annual inflation from 2nd year onwards; (6) the annual interest rate on the capital and the working loan is 9.50%; (7) the farm-gate price of tilapia is 95 Rs. per kg with a 2% annual increase; (8) the saleable quantity of fish is 95% of the total harvested fish.

**Table 8.** Economics of intensive pond farming (20 metric tons per hectare per harvest in Rs.).

### 3.2.3 Reservoir rectangular cage culture (3 metric tons per cage per harvest)

Producing tilapia through a rectangular cage production system in reservoirs can produce two crops per year of 750 g fish, each equalling 3000 kg per cage (6000 kg per cage in total), assuming a survival rate of around 60%. It is a suitable approach for medium-scale farmers and entrepreneurs. From a capital investment of Rs. 150,000, a farmer can establish the infrastructure needed to start production, including bi-annual maintenance, as well as Rs. 210,000 working capital for feed, medicine, fry, etc. The infrastructure is expected to last for 10 years. The net profit for the farmer can increase from Rs. 0.97 lakhs per cage per year in Year 1 to Rs. 0.99 lakhs per cage per year in Year 7.

This approach requires that a risk assessment be taken into consideration<sup>9</sup> and that the farmer should be able to access 90% of the project cost through a capital expenditure loan (Rs. 85,000 debt and Rs. 15,000 equity). An interest subvention scheme of 3% should be provided to improve profitability, and a working capital loan should be given with an interest subvention of 3%. A credit guarantee must be available to overcome failure or force majeure incidents. Goods and Services Tax (GST) should be removed as their produce will not attract any GST so offsetting would be difficult. The lease of reservoir cage culture zones should have a minimum 10 year period.

### 3.2.4 Reservoir circular cage culture (30 metric tons per cage per harvest)

Producing tilapia through a reservoir circular cage culture system can produce two crops per year of 750 g fish. The estimated production volume per crop is 30,000 kg per cage per crop equalling 60,000 kg per cage in total in a year, considering a survival rate of around 60%. This is a suitable grow-out asset for large-scale farmers, farmer-producer organizations, entrepreneurs and industry. A capital investment of Rs. 11 lakhs per cage can establish the infrastructure needed to start production, including bi-annual maintenance with Rs. 20.50 lakhs per cage working capital for feed, medicine, fry, etc. The life of such infrastructure is around 10 years. The farmer's net profit can increase from Rs. 11.40 lakhs per cage per

year in Year 1 to Rs. 20.33 lakhs per cage per year in Year 7.

This approach requires that a risk assessment be taken into consideration and that the farmer should be able to access 90% of the project cost through a capital expenditure loan of Rs. 8.25 lakh per cage debt in addition to his own equity of Rs. 2.75 lakh per cage). An interest subvention scheme of 3% should be provided to improve profitability. Also, it is proposed that a working capital loan be given with an interest subvention of 3%. A credit guarantee must be available to overcome failure or force majeure incidents. Goods and Services Tax (GST) should be removed as produce will not attract any GST so offsetting would be difficult. The lease of the reservoir cage culture zones should have a minimum 10 year period.



Rectangular Cages (100m<sup>3</sup> volume and production capacity of 3 tons per harvest).

<sup>9</sup> The first tilapia was introduced to India in 1952 but did not lead to significant production or commercial success at that time due to a lack of improved strains. This led to undocumented tilapia arriving in the country without quarantine, biosecurity, organization or planning, and which subsequently escaped into natural water bodies disrupting the balance of ecosystems. GIFT Nile Tilapia, developed by WorldFish, was introduced in 1970s and recommended to the Government of India for commercial introduction following trials by ICAR-CIFA along with a monitoring and training program to mitigate future disruptions to natural systems.

Sl. Items No.	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		
	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	
<b>Operational cost</b>															
1	Tilapia mono-sex fry	9,750	9,750	9,750	9,750	9,750	9,750	7,800	7,800	7,800	7,800	6,500	6,500	6,500	6,500
2	Feed in kg @ feed conversion ratio 1:1.30	1,71,000	1,71,000	1,76,130	1,76,130	1,81,414	1,81,414	1,86,856	1,86,856	1,92,462	1,92,462	1,98,236	1,98,236	2,04,183	2,04,183
3	Other costs	20,063	20,456	20,727	21,134	21,413	21,835	22,560	22,560	23,308	23,308	24,082	24,082	24,881	24,881
4	Total operating expenses	2,00,813	2,01,206	2,06,607	2,07,014	2,12,577	2,12,999	2,17,216	2,17,216	2,23,570	2,23,570	2,28,818	2,28,818	2,35,564	2,35,564
5	Annual depreciation and interest	49,119	-	47,634	-	46,149	-	44,664	-	43,179	-	41,694	-	40,209	-
6	Total cost	2,49,932	2,01,206	2,54,241	2,07,014	2,58,727	2,12,999	2,61,880	2,17,216	2,66,750	2,23,570	2,70,512	2,28,818	2,75,774	2,35,564
7	Production cost per kg fish	83	67	85	69	86	71	87	72	89	75	90	76	92	79
8	Total farm-gate revenue	2,70,750	2,70,750	2,76,165	2,76,165	2,81,688	2,81,688	2,87,322	2,87,322	2,93,069	2,93,069	2,98,930	2,98,930	3,04,908	3,04,908
9	Net profit per crop	26,942	70,106	27,819	69,498	29,918	70,112	30,635	69,344	31,266	68,490	31,808	67,547	32,256	66,511
10	Net profit per annum with 2 crops		97,048		97,317		1,00,030		99,979		99,757		99,355		98,767

Assumptions: (1) Tilapia fry stocking density is 6,500 nos. per cage; (2) the survival rate of fish from fry to market size in the grow-out system is 60%; (3) tilapia fry costs decrease from 1.50 Rs. per fry during Y1–Y3; 1.20 Rs. per fry during Y4–Y5; 1.00 Rs. per fry during Y6–Y7, (4) feed cost is 38 Rs. per kg; (5) operating expenses increase at 3% annual inflation from 2nd year onwards; (6) the annual interest rate on the capital and the working loan is 9.50%; (7) the farm-gate price of tilapia is 95 Rs. per kg with a 2% annual increase; (8) the saleable quantity of fish is 95% of the total harvested fish.

**Table 9.** Economics of reservoir rectangular cage culture (3 metric tons per cage per harvest in Rs.).

Sl. Items No.	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		
	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	Harvest I	Harvest II	
<b>Operating expenses</b>															
1	Tilapia mono-sex fry	97,500	97,500	97,500	97,500	97,500	97,500	78,000	78,000	78,000	78,000	65,000	65,000	65,000	65,000
2	Feed in kg @ feed conversion ratio 1:1.30	17,10,000	17,10,000	17,61,300	17,61,300	18,14,139	18,14,139	18,68,563	18,68,563	19,24,620	19,24,620	19,82,359	19,82,359	20,41,829	20,41,829
3	Other costs	1,40,000	1,40,000	1,43,550	1,43,550	1,47,212	1,47,212	1,50,988	1,50,988	1,54,884	1,54,884	1,58,902	1,58,902	1,63,046	1,63,046
4	<b>Total operating expenses</b>	<b>19,47,500</b>	<b>19,47,500</b>	<b>20,02,350</b>	<b>20,02,350</b>	<b>20,58,851</b>	<b>20,58,851</b>	<b>20,97,551</b>	<b>20,97,551</b>	<b>21,57,504</b>	<b>21,57,504</b>	<b>22,06,260</b>	<b>22,06,260</b>	<b>22,69,876</b>	<b>22,69,876</b>
5	Annual depreciation and interest	3,90,866	-	3,81,791	-	3,72,716	-	3,63,641	-	3,54,566	-	3,45,491	-	3,36,416	-
6	<b>Total cost</b>	<b>23,38,366</b>	<b>19,47,500</b>	<b>23,84,141</b>	<b>20,02,350</b>	<b>24,31,566</b>	<b>20,58,851</b>	<b>24,61,192</b>	<b>20,97,551</b>	<b>25,12,069</b>	<b>21,57,504</b>	<b>25,51,751</b>	<b>22,06,260</b>	<b>26,06,291</b>	<b>22,69,876</b>
7	Production cost per kg fish	78	65	79	67	81	69	82	70	84	72	85	74	87	76
8	Total farm-gate revenue	27,07,500	27,07,500	28,15,800	28,15,800	29,28,432	29,28,432	30,45,569	30,45,569	31,67,392	31,67,392	32,94,088	32,94,088	34,25,851	34,25,851
9	<b>Net profit per crop</b>	<b>3,80,134</b>	<b>7,60,000</b>	<b>4,89,802</b>	<b>8,13,450</b>	<b>5,55,009</b>	<b>8,69,582</b>	<b>6,42,520</b>	<b>9,48,018</b>	<b>7,13,466</b>	<b>10,09,888</b>	<b>8,16,980</b>	<b>10,87,828</b>	<b>8,77,703</b>	<b>11,55,976</b>
10	Net profit per annum with 2 crops	11,40,134		13,03,252		14,24,590		15,90,538		17,23,354		19,04,807		20,33,678	

Assumptions: (1) Tilapia fry stocking density is 65,000 nos. per cage; (2) survival rate of fish from fry to market size in the grow-out system is 60%; (3) tilapia fry costs decrease from 1.50 Rs. per fry during Y1–Y3; 1.20 Rs. per fry during Y4–Y5; 1.00 Rs. per fry during Y6–Y7; (4) feed cost is 38 Rs. per kg, (5) operating expenses increase at 3% annual inflation from 2nd year onwards; (6) the annual Interest rate on capital and the working loan is 9.50%; (7) farm-gate price of tilapia is 95 Rs. per kg with a 2% annual increase; (8) the saleable quantity of fish is 95% of the total harvested fish.

**Table 10.** Economics of reservoir circular cage culture (30 metric tons per cage per harvest in Rs.).

### 3.2.5 Summary of grow-out assets to be created, capital expenditure and financial support required yearly from 2023–2032

To produce 2.155 million metric tons of tilapia by 2032, it is proposed that 13,251 hectares of semi-intensive ponds and 2,840 hectares of intensive ponds are created and that 88,828 small rectangular cages and 20,727 large circular cages are installed in reservoirs in India's focus states by 2032. The total capital expenditure and the proposed financial assistance to create these grow-out assets by 2032 is Rs. 5,023 crore and Rs. 2,350 crore, respectively. To create new semi-intensive and intensive ponds, and small rectangular cages, financial assistance of 50% on fixed infrastructure costs is proposed during 2023–2032. Similarly for the installation of large circular cages, financial assistance of 40% on fixed infrastructure costs is proposed during 2023–2032.



Tilapia mating Hapa in outdoor earthen tank.

Grow-out asset	Capacity (metric tons per year)	% type of grow-out assets	2026-27 financial year	2028-29 financial year	2031-32 financial year
<b>Volume for domestic &amp; Africa market produced in ponds (Whole round fish equivalent metric tons)</b>			<b>134,550</b>	<b>275,137</b>	<b>378,612</b>
Semi-intensive ponds (hectares)	20	70%	4709	9630	13,251
Additional semi-intensive ponds (hectares)			4709	4921	3622
Intensive Ponds (hectares)	40	30%	1009	2064	2840
Additional Intensive Ponds (hectares)			1009	1054	776
<b>Volume for fillet export produced in reservoir cages (Whole round fish equivalent metric tons)</b>			<b>631,350</b>	<b>1,291,028</b>	<b>1,776,564</b>
Small rectangular cage nos. (100 m <sup>3</sup> )	6	30%	31,568	64,551	88,828
Additional rectangular cage nos.			31,568	32,984	24,277
Large circular cage nos. (1000 m <sup>3</sup> )	60	70%	7366	15,062	20,727
Additional circular cage nos.			7366	7696	5665

**Table 11.** Grow-out assets to be created for tilapia production from 2023–2032.

Year	Estimated grow-out additional assets in nos.				Estimated capex for grow-out assets (Rs. crore)				
	Semi-intensive pond (hectares)	Intensive pond (hectares)	Reservoir rectangular cage nos.	Reservoir circular cage nos.	Semi-intensive pond @ Rs. 0.085 crore per hectare	Intensive pond @ Rs. 0.10 crore per hectare	Reservoir rectangular cage @ Rs. 0.015 crore per cage	Reservoir circular cage @ Rs. 0.11 crore/Cage	Total grow-out capex (Rs in crore)
FY 2026-27	4709	1009	31,568	7366	400.30	100.90	473.50	810.20	1784.90
FY 2028-29	4921	1054	32,984	7696	418.20	105.40	494.80	846.60	1865.00
FY 2031-32	3622	776	24,277	5665	307.80	77.60	364.20	623.10	1372.70
<b>TOTAL</b>					<b>1126.40</b>	<b>284.00</b>	<b>1332.40</b>	<b>2279.90</b>	<b>5022.70</b>

Assumptions: Costs of setting up (1) semi-intensive pond is Rs. 0.085 crore per hectare; (2) intensive pond is Rs. 0.10 crore/ per hectare; (3) rectangular cage is Rs. 0.015 crore per cage; (4) circular cage is Rs. 0.11 crore per cage.

**Table 12.** Total capital expenditure required for grow-out assets to be created from 2023–2032.

Years	Semi-intensive pond (hectares)			Intensive pond (hectare)			Small rectangular cage (100 m <sup>3</sup> )			Large circular cage (1000 m <sup>3</sup> )			Total Rs Crore
	FY 27	FY 29	FY 32	FY 27	FY 29	FY 32	FY 27	FY 29	FY 32	FY 27	FY 29	FY 32	FY 23-32
Proposed subsidy %	50%	50%	50%	50%	50%	50%	50%	50%	50%	40%	40%	40%	
Financial subsidy	200.10	209.10	153.90	50.50	52.70	38.80	236.80	247.40	182.10	324.10	338.60	249.20	2283.30
Interest subvention @3% impact	4.80	5.00	3.70	1.20	1.30	0.90	5.70	5.90	4.40	12.20	12.70	9.30	67.10
<b>Total financial support</b>	<b>204.90</b>	<b>214.10</b>	<b>157.60</b>	<b>51.70</b>	<b>54.00</b>	<b>39.70</b>	<b>242.40</b>	<b>253.30</b>	<b>186.40</b>	<b>336.20</b>	<b>351.30</b>	<b>258.60</b>	<b>2350.50</b>

**Table 13.** Proposed financial support for grow-out assets to be created from 2023–2032 (Rs. in crore).

### 3.2.6 Summary of capital expenditure, investment and financial support needed across different tilapia production systems

The total capital expenditure and financial support required to build the hatchery and grow-out assets from the year 2023 till 2032 is Rs. 5,557 crore and Rs. 2,587 crore respectively. By the end of 2026-27 financial year, the total capital expenditure and financial support required is Rs. 1,975 crore and Rs. 922 crore respectively. During the block financial year 2027-2029 the total capital expenditure and financial support required is Rs. 1,425 crore and Rs. 666 crore respectively. Between 2029 and 2032 financial year, the total capital expenditure and financial support required is Rs. 2,157 crore and Rs. 999 crore respectively.

Years	Capital expenditure (Rs in crore)				Financial support (Rs in crore)			
	Hatchery	Grow-out asset	Total	Cumulative Total	Hatchery	Grow-out asset	Total	Cumulative Total
FY 2026-27	190	1785	1975	1975	87	835	922	922
FY 2028-29	137	1288	1425	3400	63	603	666	1587
FY 2031-32	208	1950	2157	<b>5557</b>	87	912	999	<b>2587</b>

**Table 14.** Capital expenditure and financial support required for capacity building (Rs in crore).

Year	Production of whole round fish numbers (millions of fish)				Fish for export numbers (million)			Fish for the domestic market (million)			
	Production of 750 g fish (1)	Production of 850 g fish (2)	Production of 650 g fish (3)	Total fish production	For fillet export (750 g fish)	Large fillet for export (850 g fish)	Export of whole round frozen fish for African market (4)	Total fish for export	Domestic market fillet (5)	Domestic market whole round fresh fish (6)	Total fish for the domestic market
FY 2026-27	725	104	207	<b>1035</b>	725	104	62	<b>890</b>	83	62	<b>145</b>
FY 2028-29	1482	212	423	<b>2116</b>	1482	212	85	<b>1778</b>	169	169	<b>339</b>
FY 2031-32	2039	291	582	<b>2912</b>	2039	291	58	<b>2388</b>	291	233	<b>524</b>

**Table 15.** Year-on-year estimated fish production and its market.

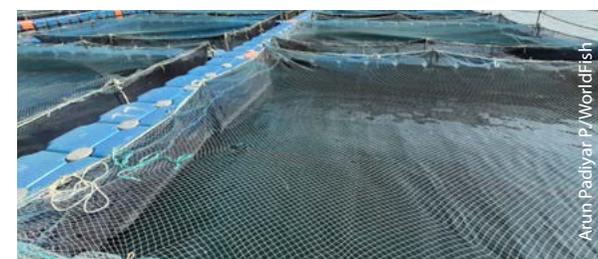
# 4 Capital expenditure costs and estimated revenues from India's tilapia export and domestic markets



In the first stage of building and stabilizing its export markets, India has set a target of 208,000 metric tons of fillet for export, which is destined for high-value markets in the USA and Europe, and 40,000 metric tons of frozen whole fish to Africa by 2026-27. Once market penetration is stabilized, India will then focus on accelerating production to achieve an export target of 587,000 metric tons of fillet and 38,000 metric tons of frozen fish to African countries by 2031-32. Internationally, India must differentiate its product and position its offerings at the

same level as tilapia products from Brazil and Honduras, or higher, and align with demand from the global market and product quality preferences, target fish size should be around 750 g fish while accepting that some will achieve 650–750 g while others will reach 750–850 g.

Domestically, India must build up markets including the hotel, restaurant, and catering (HORECA) sector. Currently, most HORECA customers in India use Pangasius Fillet (Basa) from Vietnam.



Rectangular Cages (100 m<sup>3</sup> volume and production capacity of 3 tons per harvest).

Arun Padiyar P/WorldFish

Year	Production of whole round fish numbers (million)				Fish for export numbers (million)			Fish for the domestic market (million)			
	Production of 750 g fish (1)	Production of 850 g fish (2)	Production of 650 g fish (3)	Total fish production	For fillet export (750 g fish)	Large fillet for export (850 g fish)	Export of whole round frozen fish for African market (4)	Total fish for export	Domestic market fillet (5)	Domestic market whole round fresh fish (6)	Total fish for the domestic market
FY 2026-27	725	104	207	<b>1035</b>	725	104	62	<b>890</b>	83	62	<b>145</b>
FY 2028-29	1482	212	423	<b>2116</b>	1482	212	85	<b>1778</b>	169	169	<b>339</b>
FY 2031-32	2039	291	582	<b>2912</b>	2039	291	58	<b>2388</b>	291	233	<b>524</b>

Assumptions: (1) 70% of total fish production volume is estimated as 750 g in size; (2) 10% of production volume will be 850 g; (3) 20% volume will be 650 g; (4) 40% of 650 g size volume will be exported as frozen whole round fish; (5) 30% of 650 g size volume will be processed for fillet for the domestic market; (6) 30% volume of 650 g size will be processed for fillet.

**Table 16.** Year-on-year estimated fish production and its market in numbers.

Tilapia consumption in African countries such as South Africa, Tanzania, Uganda, Kenya and Mozambique is increasing rapidly. Even though a few African countries like Uganda and Tanzania have started domestic production,

the cost remains high. Currently, imports of frozen whole round fish from China have reduced substantially due to an increase in China's domestic consumption. This reduction provides an opportunity for India to focus on building

export markets in these countries. Therefore, it is suggested that 40% of all 650 g fish should be exported, 30% made into fillets for the domestic catering (HORECA) segment and the remaining 30% sold in the domestic market.

Years	Production of whole round fish (million metric tons)				Fish for export (million metric tons)			Fish for the domestic market (million metric tons)			
	Production of 750 g fish (1)	Production of 850 g fish (2)	Production of 650 g fish (3)	Total fish production	For fillet export (750 g fish)	Large fillet for export (850 g fish)	Export of whole round frozen for African market (4)	Total fish for export	Domestic market fillet (5)	Domestic market whole round fresh fish (6)	Total fish for the domestic market
FY 2026-27	0.543	0.088	0.135	<b>0.766</b>	0.543	0.088	0.054	<b>0.685</b>	0.040	0.040	<b>0.081</b>
FY 2028-29	0.936	0.151	0.232	<b>1.319</b>	0.936	0.151	0.093	<b>1.180</b>	0.069	0.069	<b>0.139</b>
FY 2031-32	1.529	0.248	0.379	<b>2.155</b>	1.529	0.248	0.151	<b>1.928</b>	0.114	0.114	<b>0.227</b>

Assumptions: (1) 70% of total fish production volume is estimated to be of 750 g size; (2) 10% production volume will be 850 g size; (3) 20% volume will be 650 g size; (4) 40% of 650 g size volume will be exported as frozen whole round fish; (5) 30% of 650 g size volume will be processed for fillet for the domestic market; (6) 30% volume of 650 g size will be processed for fillet.

**Table 17.** Year-on-year estimated fish production and its market for the equivalent of whole round fish at farm-gate prices in million metric tons.

Years	Export saleable quantity (million metric tons)				Domestic market saleable quantity (million metric tons)			
	Fillet export of 750 g fish	Fillet export of 850 g fish	Whole round frozen fish for the African market	Total export volume	Fillet volume domestic market	Whole round fresh fish volume	Total domestic saleable volume	Total saleable volume (million metric tons)
FY 2026-27	0.179	0.029	0.054	<b>0.262</b>	0.013	0.040	0.053	<b>0.315</b>
FY 2028-29	0.309	0.050	0.093	<b>0.452</b>	0.023	0.069	0.092	<b>0.544</b>
FY 2031-32	0.505	0.082	0.151	<b>0.738</b>	0.038	0.114	0.152	<b>0.890</b>

**Table 18.** Yearly estimated saleable quantity of fish in export and domestic markets in the form of fresh or value-added and packaged products.

The anticipated year-on-year revenue potential from exporting tilapia is USD 1.135 billion, equivalent to 8% of the total estimated seafood export revenue of USD 14 billion by 2027. By the 2032 financial year, the estimated revenue from exporting tilapia will grow to USD 3.92 billion contributing to 15% of the targeted seafood export of USD 28 billion. With increasing competition in the global market and the cost of delivered products, it is prudent to focus on tilapia as a second species to shrimp export, targeting lower-income to higher-income consumers, and the HORECA sector.



Circular Cages (1000 m<sup>3</sup> volume and production capacity of 30 tons per harvest).

Years	Export revenue estimates (USD billion)				Domestic market revenues (USD billion)			Total revenue from tilapia sales USD billion
	Frozen fillet produced from 750g-sized fish, at USD 5500 - 6500 per MT	Frozen fillet produced from 850g-sized fish, at USD 6000 - 7500 per MT	Frozen whole fish for African market @ USD 1,600-1,800 per metric ton	Total export revenue	Frozen fillet produced from 650g-sized fish, at USD 4500 per MT	Fresh fish produced from 650g-sized fish, at USD 1300 per MT	Domestic revenue	
FY 2026-27	0.897	0.174	0.065	<b>1.135</b>	0.080	0.052	0.132	<b>1.268</b>
FY 2028-29	1.852	0.325	0.079	<b>2.256</b>	0.138	0.120	0.258	<b>2.514</b>
FY 2031-32	3.280	0.572	0.068	<b>3.920</b>	0.281	0.197	0.478	<b>4.398</b>

**Table 19.** Estimated revenue from sales of tilapia in billions of USD.

# 5 Closing recommendations



As India's National Fisheries Policy 2020 notes: "In spite of its rapid growth, aquaculture is beset with several issues impacting productivity and production including disease, absence of species diversification and genetic improvement, poor brood and seed, high input cost, lack of access to institutional credit, credit guarantee and insurance, environmental sustainability, etc. The rapid growth of culture fisheries has enhanced the sector's vulnerability to aquatic diseases<sup>10</sup> – the mitigation and control of which requires a coordinated and concerted effort between the center and the state government."

India has already taken several steps to create an enabling environment to reach tilapia production growth targets and reduce risk including:

- Updating its *Guidelines for the Responsible Farming of Tilapia in India* (the National Committee on the Introduction of Exotic Aquatic Species into Indian Waters).
- Decreasing the minimum size of the tank/pond area required for tilapia farming from 1 acre to 0.05 acres will boost grow-out tilapia production – smaller tanks are not suitable for carp farming.
- Constituting a National Steering Committee to oversee and monitor tilapia seed and grow-out production.
- Creating a licensing program through the Marine Product Export Development Authority (MPEDA) for

the importation of broodstock to public and private hatcheries, including in conjunction with WorldFish for GIFT fish.

- Decentralizing the licensing process for tilapia hatcheries at the state level.

## Central and state level introductions

Four critical enablers – infrastructure, financial, capacity building, and branding and marketing – are needed in order to sustainably grow Tilapia production in India.

### Infrastructure Enablers

**Enable Long-Term Land Leasing:** With more than 1,000 new hatcheries needed to deliver India's Tilapia production targets, it is recommended that state governments allow long-term land leasing (10-20 years) to encourage the necessary infrastructure investments.

**Provide Subsidies:** The Central Government should incentivise and support farmers, small entrepreneurs, and the industry to establish hatcheries, including by providing subsidies. It is recommended that the government should provide a 50% subsidy for small hatchery farmers and a 40% subsidy for medium hatchery entrepreneurs. For large hatcheries, it is

recommended that the initial subsidy be at 40% for the scale-up period (2021-2027) and thereafter at 25% from 2031-2032. A 3% interest subsidy under the interest subvention scheme of the Reserve Bank of India is also recommended, to make the sector more attractive to investors. Given the potential impact of increased production on farmer incomes, the government should also consider making the power tariff to be on par with the tariff on agricultural activities.

### Financial Enablers

**Increase Access to Working Capital:** The growth of the Tilapia value chain needs to be supported through access to working capital. Availability of adequate credit at a reasonable cost is critical to ensuring the growth and development of this sector. It is thus recommended that the Central Government should extend working capital requirement under MSME Lending Norms, without insisting collateral security. Working capital loans to the sector could also be given with an interest subvention of 3%.

**Provide Credit Guarantees:** With limited fixed assets on the farm, it is difficult for farmers to provide adequate collateral security to banks. It is thus recommended that the Central Government should extend to the Tilapia sector the Credit Guarantee Support (under Credit Guarantee Fund Trust for Micro and Small Enterprises - CGTMSE) for loans, in order to offset the risks associated with agricultural loans advanced without adequate collateral security.

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<sup>10</sup> Key diseases of concern include Tilapia Lake Virus (TiLV). Tilapia fish can be vulnerable to TiLV, an RNA virus that infects both wild and farmed populations. At the moment there is no effective and affordable vaccine for this virus, but there are various precautionary and preventive measures and treatments to mitigate its spread. Breeding programs are also continually seeking to develop genetically improved strains that are resistant to known and novel viruses are also critical to increase and sustain resilience.

**Increase Insurance Support:** Like other agricultural sectors, Tilapia production is vulnerable to natural disasters, disease outbreaks, and other risks, therefore agricultural insurance should be extended to Tilapia farmers to cover their risks.

## Capacity Building Enablers

### **Adopting Better Farming and Management Practices:**

Technological advancements such as recirculating aquaculture system (RAS) are proving to be crucial footholds towards the development of sustainable tilapia farming systems. Thus, to ensure a robust and sustainable tilapia value chain in India, focus needs to be on building capacities towards farming, breeding, feeding harvesting, post-harvest and transportation areas. Increased training, awareness, and knowledge dissemination on the different farming systems and excellent management practices will need to be delivered to many fish farmers. Skilled manpower is especially needed to deliver proper breeding and feeding practices, and farmers should be trained on how to properly feed, harvest, and handle Tilapia. The recently-published New Guidelines for the Responsible Farming of Tilapia in India is an immediate source of knowledge that can be made more widely available.

**Sharing Best Practices:** Considering that the Tilapia value chain in India is still nascent, the Departments of Fisheries should create a shared platform comprising all states involved in Tilapia production, to ensure adoption of common practices and enable sharing of best practices and lessons learned.

## Branding and Marketing Enablers

**Creation of 'Brand India':** The creation of 'Brand India' is encouraged, and this can be delivered through a Tilapia Branding and Marketing Development Board. This enables the government to create specific export strategies for targeted markets such as USA, Europe, South East Asian Countries, and other countries that purchase value added products of tilapia.

**Increase Knowledge of Tilapia's Benefits:** To strengthen the domestic consumer market for Tilapia, the government will need to increase knowledge of the many benefits of Tilapia consumption, especially its nutritional benefits. Promotion and brand building of fresh and value-added tilapia products will be needed locally, especially for the HORECA sector.



Fish farm employee with freshly caught GIFT tilapia, Kishorenagar, Cuttack, Odisha, India.

# Odisha: A case study on GIFT production

The Government of Odisha started GIFT farm demonstrations and local market promotions under a state plan. In total, 800,000 GIFT monosex fry were procured from the Marine Products Export Development - Authority Rajiv Gandhi Centre for Aquaculture (MPEDA-RGCA) GIFT breeding center in Vijayawada and distributed to 136 farmers in 17 districts in Odisha. District fisheries officers issued tilapia farm licenses to the demonstration farmers as per the guidelines for responsible tilapia farming.<sup>11</sup>

During 2017–2018, 200,000 fry were stocked in tanks belonging to 36 farmers in nine districts, covering 33 acres. This was increased to 600,000 fry stocked in tanks belonging to 100 farmers in seven districts in 2018–2019, covering 100 acres. The program rollout followed a semi-intensive GIFT farming demonstration by the MPEDA-RGCA on a private farm in the Jagasinghpur District of Odisha during 2016–2017. The farm demonstration was successful, producing almost 50 metric tons in 2017–2018 and over 150 metric tons during 2018–2019, with an average farm yield of about 5000 kg/ha per crop. The farm-gate price ranged between INR 85/kg and INR 140/kg, with an average of INR 100/kg. The average cost of production including farm inputs, labor, and harvest costs was INR 60/kg during 2018–2019. The net profit margin was about INR 72,000/acre per crop.

Under the Odisha State plan, there are ongoing efforts to establish GIFT farms. At the same time, there are increased investments to encourage private sector entrepreneurs to establish tilapia hatcheries so that farmers have availability and easy access to GIFT.

<sup>11</sup> Government of India Guidelines for Responsible Tilapia Farming

# Bangladesh: A case study in scaling tilapia for sustainable livelihoods, food security and increased GDP

Fish provides around 60% of the animal-sourced protein in Bangladesh and the per capita daily fish consumption has increased from 38.45 g in 2000 to 62.58 g in 2016, representing 62.8% growth. Aquaculture has become an increasing source of fish production growing at an average rate of 8.6% between 2000 and 2019, and by 2019 aquaculture accounted for 56.8% of total fish production in the country. Aquaculture represents a substantial contribution to meeting the country's national production target of 4.55 million metric tons of fish in 2021 and owes part of its growth to an increase in tilapia production which is mainly consumed in domestic markets. Research shows a high preference for tilapia among consumers in both rural and urban areas, and that consumers were willing to increase consumption of tilapia in the future.

The remarkable increase in tilapia production in Bangladesh from only 15,000 metric tons in 2006–2007 to 390,559 metric tons in 2018–2019 has been attributed in large part to technological advancements including the development and dissemination of genetically improved farmed tilapia (GIFT). Research has shown better on-farm performance of GIFT compared with non-GIFT strains in both monoculture and polyculture systems in Bangladesh. Bangladesh has also adopted a polyculture tilapia farming approach which has vastly increased the area available for tilapia farming.

In 2017, Bangladesh was ranked the fourth-largest tilapia producer by volume in the world.

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# About WorldFish



WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

WorldFish is part of One CGIAR, the world's largest agricultural innovation network.

For more information, please visit [www.worldfishcenter.org](http://www.worldfishcenter.org)

