



TOPIC - AGRICULTURE

MASTER NOTES PART X AS PER SYLLABUS

Fisheries: Fisheries resources, management and exploitation - freshwater, brackish water and marine; **Aquaculture-** Inland and marine; biotechnology; post-harvest technology. Importance of fisheries in India. Common terms pertaining to fish production.

You Tube Lectures on these topics can be accessed through following Links

Important Fishery MCQ: <https://youtu.be/12ZZGncRvtc>

NEXT – Part XI Forestry

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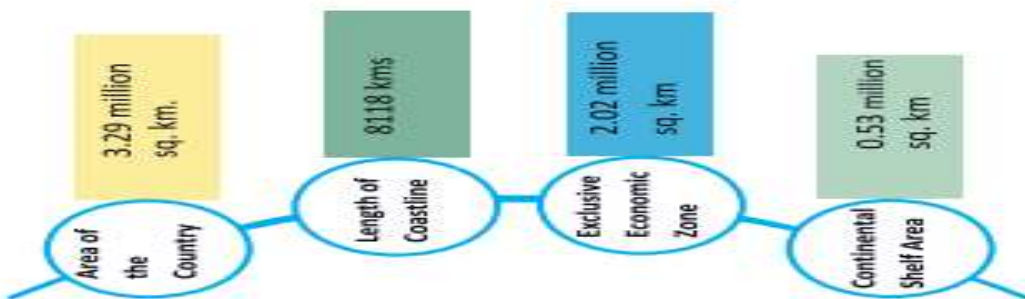
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PART A-Statistics

1 Fisheries Resources in India

SOFIA State of world fisheries and aquaculture 2022 by FAO	Top Marine capture fish producing country	<ul style="list-style-type: none"> – China-Peru-Indonesia • India – 6th
	Top Major Inland capture fish producing country	<ul style="list-style-type: none"> – India-China- Bangladesh
	Top Capture Fishery	<ul style="list-style-type: none"> • China • India 4th
	Top marine capture species	<ul style="list-style-type: none"> • Anchoveta (<i>Engraulis ringens</i>) – Alaska Pollock <p>fin fish contributes at larger scale to global aquaculture</p>
	Top Aquaculture Species	<ul style="list-style-type: none"> • Grass carp – Silver carp- Tilapia (at fish level) • White legged shrimp>Grass carp>Silver carp>Tilapia (At all Species level)
	Top Five Shellfish	<ul style="list-style-type: none"> • White legged shrimp (<i>P.Vannamei</i> – 53%)-Red swamp craw fish- Chinese mitten crab- Giant tiger prawn (<i>P. Mondon</i>)
	Top exporter	<ul style="list-style-type: none"> • China – Norway- Vietnam • India 5th <p>(Department of fisheries says 4th with 7.7% global fish production)</p>
	Top importer	<ul style="list-style-type: none"> • USA-Japan- China
National GVA	<ul style="list-style-type: none"> • 1.069% in the National GVA (2021-22 constant prices) 	
Agriculture GVA	<ul style="list-style-type: none"> • 6.86% in Agriculture GVA (2021-22 constant prices) • Growth rate of GVA of fisheries at current prices 6.02% 	
Share in Export out of all exports in India	<ul style="list-style-type: none"> • 17% (46663 cr 2019-20) • Quantity wise – China • Value wise – USA • Item – Frozen shrimp> Frozen Fish 	
Top Five consuming states	<ul style="list-style-type: none"> • Tripura – Kerala – Manipur (2019-20) 	
Fishing Areas		
State with Highest Marine production (2021-22)	<ul style="list-style-type: none"> • State: Gujarat>TNAP • Species : Red toothed trigger>Ribbon Fish 	

Top Inland Production (2019-20)	<ul style="list-style-type: none"> • Andhra – WB
Total (M+I)	<ul style="list-style-type: none"> • Andhra Pradesh
Major type	<ul style="list-style-type: none"> • IMC>Exotic Carp>Minor Carp>Catfishes>Murrels
Major P & P	<ul style="list-style-type: none"> • Frozen shrimp & Prawn>Marine fishes
Major fish seed producing	<ul style="list-style-type: none"> • Jharkhand
Usage	<ul style="list-style-type: none"> • Fresh market>Frozen>Curing>Canning
Population	<ul style="list-style-type: none"> • Bihar>WB
Coastal Length	<ul style="list-style-type: none"> • Andaman>Gujarat>TN
Brackish Area	<ul style="list-style-type: none"> • Odisha>WB>Gujarat. • Species Prawn> Indian Oil ardine

TABLE 10 WORLD PRODUCTION OF MAJOR AQUACULTURE SPECIES (INCLUDING SPECIES GROUPS)

	2000	2005	2010	2015	2020	Percentage of total, 2020
(thousand tonnes, live weight)						
Finfish in inland aquaculture						
Grass carp, <i>Ctenopharyngodon idellus</i>	2 976.5	3 396.6	4 213.1	5 315.0	5 791.5	11.8
Silver carp, <i>Hypophthalmichthys molitrix</i>	3 034.7	3 690.0	3 972.0	4 713.6	4 896.6	10
Nile tilapia, <i>Oreochromis niloticus</i>	1 001.5	1 721.3	2 637.4	4 000.9	4 407.2	9
Common carp, <i>Cyprinus carpio</i>	2 410.4	2 666.3	3 331.0	4 025.8	4 236.3	8.6
Catla, <i>Catla catla</i>	602.3	1 317.5	2 526.4	2 313.4	3 540.3	7.2
Bighead carp, <i>Hypophthalmichthys nobilis</i>	1 438.9	1 929.5	2 513.6	3 109.1	3 187.2	6.5
<i>Carassius</i> spp.	1 198.5	1 798.2	2 137.8	2 644.1	2 748.6	5.6

Others

India is the **3rd largest fish producing (8% global share) and 2nd largest aquaculture** producing nation in the world.

During the last 9 years, the annual fish production of India has increased from 95.79 lakh tons (at the end of 2013-14) to an all-time record of **162.48 lakh tons** (at the end of 2021-22) i.e. an increase of 66.69 lakh tons.

While the **seafood exports** stands at **Rs. 63,969.14** crore during FY 2022-23 an increase of 111.73%. Today, Indian seafood is exported to 129 countries with largest importer being **USA**

The **shrimp exports** have more than doubled with an increase of 123% **to Rs 43,135 crore** at the end of 2022-23.

- The fisheries sector in India has shown a sustained annual average growth rate of **8.61%** for the 8-year period from 2014-15 to 2021-22 (at constant prices).
- During eight-year period from 2014-15 to 2021-22, the **GVA of Fisheries Sector** has increased from Rs. 76,487 crore in 2013-14 to **1,47,518.87 crore (at constant prices)** and from 98,189.64 crore in 2013-14 to **2,88,526.19 crore in 2021-22 (at current prices)**.
- The sector contributes **1.069% in the National GVA** and **6.86% in Agriculture GVA**. (21-22 at constant prices)

Group Accident Insurance Scheme (GAIS) under Pradhan Mantri Matsya Sampada Yojana.

- ❖ **Rs 5 lakh** in provided against accidental death or permanent disability,
- ❖ **Rs 2.5 lakh** for accidental permanent partial disability and
- ❖ **Rs 25,000** against hospitalization.

Earlier under Blue Revolution Scheme, the accidental insurance provided was Rs. 2 lakh against death or permanent total disability, Rs.1 lakh against partial permanent disability and Rs. 10,000 towards hospitalization expenses.

Production from inland fisheries and aquaculture increased to **121.12 lakh tons** in 2021-22. The inland fisheries and aquaculture production has doubled

From 2015, the central government has approved or announced cumulative investments to the tune of Rs 38,572 crore. These include:

- Rs. 5,000 crore investment under Blue Revolution Scheme;
- Rs. 7,522 crore Fisheries and Aquaculture Infrastructure Development Fund (FIDF);
- Rs. 20,050 crore investment under Pradhan Mantri Matsya Sampada Yojana;
- **Rs 6,000 crore Sub-scheme under PMMSY**, announced in Union Budget 2023-24

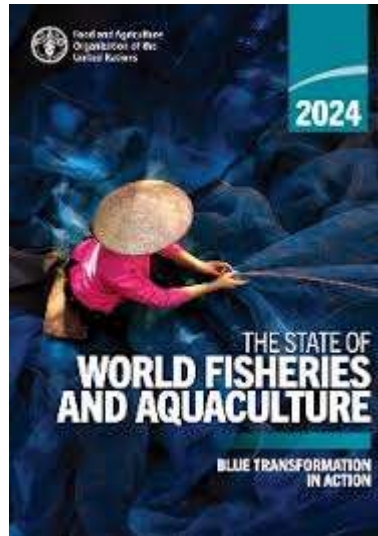
The Minister for Fisheries, Animal Husbandry and Dairying will launch a six-month-long outreach initiative of the Department of Fisheries "**Matsya Sampada Jagrukata Abhiyan**", aiming for an efficient implementation of the scheme and reaching out to the potential stakeholders so that the eligible beneficiaries can take benefits of the schemes, wherein 108 Matsya Kisan Sammelan under the Abhiyan will be organised across the country from September 2023 to February 2024. Started 15 Sept 2023 **Indore M.P**

SUMMARY AT A GLANCE 2021-22



2 Highlights of SOFIA report 2024

According to the Food and Agriculture Organisation (FAO)'s 'The State of World Fisheries and Aquaculture (SOFIA) 2024' report, India has joined the list of top fish producing countries in the world.



- **Status of Aquaculture and Fish Production in India**
- India is the third largest fish producer in the world and the second largest aquaculture producer after China.
- China ranks first and Indonesia ranks second in fish production.
- India has achieved a record fish production of 175.45 lakh tonnes in the financial year 2022-23 which is 8% of the global production.
- It contributes about 1.09% to the country's Gross Value Added (GVA) and over 6.724% to the agricultural GVA. The sector supports the livelihood of over 28 million people in the country.

About SOFIA Report

- It is a flagship report of the Food and Agriculture Organisation (FAO) that analyses the status and health of global fish stocks, as well as trends in fisheries and aquaculture at the global and regional levels.
- The 2024 edition highlights the solid progress made by the Blue Transformation initiative and demonstrates FAO's role in driving transformation towards sustainable aquaculture expansion and intensification, effectively managed fisheries, and life chains that prioritise efficiency, security and equity.

SOFIA 2024 statistics

global Production

- Fisheries and aquaculture production: 223.2 million tonnes
- Aquatic animals: 185.4 million tonnes
- Algae: 37.8 million tonnes
- Aquaculture production: 130.9 million tonnes
- Capture fisheries: 92.3 million tonnes
- Aquatic animal production by region: Asia (70%), Europe (9%), Latin America and the Caribbean (9%), Africa (7%), North America (3%) and Oceania (1%)
- Main producers of aquatic animals by country: China (36%), India (8%), Indonesia (7%), Vietnam (5%) and Peru (3%)

consumption

- Global apparent consumption of aquatic animal foods (2021): 162.5 million tonnes
- Global apparent consumption of aquatic foods per capita (2021): 20.6 kg
- Global apparent consumption of aquatic foods per capita increases from 9.1 kg in 1961 to 20.6 kg in 2021.

employment

- People employed in primary production: 61.8 million
- Workers by sector: Fisheries (54%), Aquaculture (36%), Sector not specified (10%)
- Percentage of jobs by region: Asia (85%), Africa (10%), Latin America and the Caribbean (4%), Europe, Oceania and North America combined (1%).

Business

- Top exporters of aquatic animal products: China, Norway, Vietnam, Ecuador, Chile
- Top importers of aquatic animal products: United States, China, Japan, Spain, France
- Value of international trade in aquatic products: US\$195 billion

Key points of SOFIA report

increase in total production

Global fisheries and aquaculture production is projected to grow by 4.4% by 2020.

Increase in Aquaculture Production

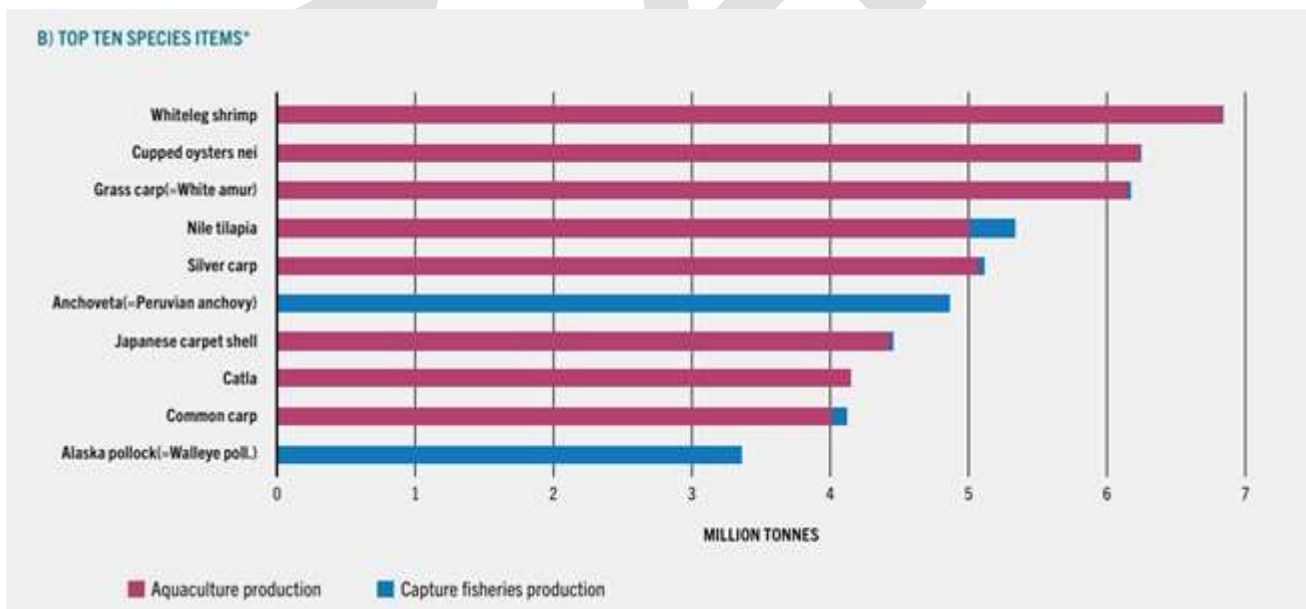
- According to FAO's SOFIA report, for the first time in the world, aquaculture production has exceeded fish produced from conventional fisheries.
- Aquaculture production in 2022 was unprecedented, reaching 130.9 million tonnes, of which 94.4 million tonnes were aquatic animals.

90% of fish production in 10 countries

According to the report, China, Indonesia, India, Vietnam, Bangladesh, Philippines, South Korea, Norway, Egypt and Chile are among the 10 countries where 90% of the world's fish production takes place.

Katla species included in top ten

- In terms of fish production in the year 2022, the Katla species ranked eighth in the list of top ten species.
- This species was initially found in North India, the Indus plains and the adjacent hilly rivers of Pakistan, Bangladesh, Nepal and Myanmar. Later, it was spread to all the rivers and reservoirs across India.



3 WTO agreement on fisheries

- The WTO Agreement on Fisheries Subsidies is a groundbreaking achievement that focuses on environmental sustainability. It establishes a set of binding prohibitions

and rules to ensure that government support for the fishing sector does not undermine the sustainability of marine resources.

Content of the Agreement

- The Agreement on Fisheries Subsidies (AFS) consists of twelve articles, each addressing specific aspects of fisheries subsidies.
- **It focuses on tackling subsidies contributing to illegal, unreported, and unregulated fishing (IUU fishing)**, subsidies linked to overfished stocks, and other harmful fisheries subsidies. However, it excludes subsidies related to aquaculture or inland freshwater fisheries.

Categories of Fisheries Subsidies

- **Beneficial subsidies:** These are investments that promote the conservation and management of fishery resources.
- **Capacity-enhancing subsidies:** These programs encourage fishing capacity to a level where it exceeds sustainable yield, leading to overexploitation.
- **Ambiguous subsidies:** These subsidies have the potential to either contribute to sustainable management or result in overexploitation of the fishery resource.

Challenges in Fisheries Sector

- **The fisheries sector faces challenges such as overfishing and overcapacity.** Inefficiencies in value chains contribute to significant losses in global fisheries and aquaculture production.
- Despite global overcapacity, the fisheries subsidies amounted to \$35.4 billion in 2018, with about 60% considered capacity-enhancing subsidies.

Addressing Overfishing and Overcapacity

- Need to address overfishing and overcapacity, suggesting that limiting or even prohibiting capacity-enhancing subsidies is essential for promoting sustainable practices.
- The proposed solutions include a cap-based approach, which involves dividing WTO Members into tiers based on their contribution to global marine capture production. Members in each tier negotiate subsidy caps or adhere to a default annual cap.

IUU Fishing and Overfished Stocks

- **Combating illegal, unreported and unregulated (IUU) fishing is crucial, accounting for over 30% of all fishing activities globally.** The agreement calls for reinforcing monitoring, control, and surveillance (MCS) mechanisms to address IUU fishing. Overfished stocks are determined based on the best available scientific evidence.

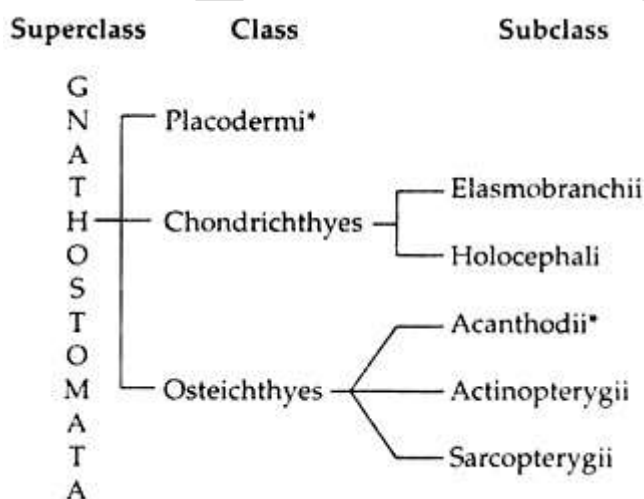
4 Highlights of fisheries – Budget 2024

- **India is currently, the 2nd largest fish producing country with around 8% share in global fish** production and a record high fish production of 174.45 lakh tonnes (2023-24). India also stands at 2nd in aquaculture production and is one of the top shrimp producing and seafood exporting nations in the world. The sector provides sustainable livelihoods to over 30 million people mostly within the marginalized and vulnerable communities.
- With the motto of '**Reform-Perform-Transform**', GoI continues to prioritise the development of the fisheries sector as a key driver towards a Viksit Bharat by 2047. In continuation to the launch of transformative schemes and initiatives in the past, the Budget Announcement 2024-25 increases the budget allocation for the fisheries sector and provisions to address major sectoral challenge of high operational and production cost.
- A total budgetary allocation of Rs. 2,616.44 crore has been made for the Department of Fisheries (GoI) for the year 2024-25 against Rs. 1,701.00 crore (Revised Estimate) during the year 2023-24. The overall budget of the Department of Fisheries (GoI) for the financial year 2024-25 has been increased by 54% as compared to the allocation during the year 2023-24. For the year 2024-25, Rs. 2,352 crore has been allocated for Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme; this allocation is 56% more than the allocation of Rs. 1,500 crore made during the year 2023-24.
- To ensure availability of quality brood for quality seed, Finance Minister Smt. Nirmala Sitharaman announced the financial support for setting up a network of Nucleus Breeding Centre (NBC) for shrimp brood stocks. Further, financing for shrimp farming, processing and export will be facilitated through NABARD. Establishment of state-of-art facilities in NBCs will improve the genetic quality of aquaculture species for higher productivity and quality, reduce the dependence on import of shrimp brood stock. This is a welcoming step to promote the shrimp industry, as shrimp is a major contributor to seafood export. Shrimp exports have significantly growth to Rs. 40,013 crore in 2023-24 from Rs. 8,175 Crore in 2011. In 2023-24, the export of frozen shrimp was to the tune of 7.16 lakh ton worth Rs. 40,013 crore.
- Under Fisheries Infrastructure Development Fund (FIDF), concessional finance support will be provided to private entrepreneurs and investors for setting up of shrimp aquaculture facilities, processing plants and export related infrastructure. The investments made in infrastructure, adoption in technology and improving fisheries' practices will translate into higher production and productivity, better quality, and

increased efficiency across the shrimp value chain. New avenues shall thus open up with enhanced production of quality shrimp value-added products for meeting the demand of the global as well as domestic markets.

- To strengthen India's shrimp farming industry globally, import duty reductions on key inputs are proposed for lowering production costs and increase revenues & profit margins. Basic Customs Duty (BCD) on shrimp broodstock (*Litopenaeus vannamei* and Black Tiger/ *Penaeus monodon*) will be reduced from 10% to 5%, on polychaete worms from 30% to 5% and on shrimp and fish feed from 15% to 5%. Further, various inputs like mineral and vitamin pre mixes, krill meal, fish lipid oil and crude fish oil, algal prime (flour) and algal oil, artemia and artemia cyst have been exempted from custom duties.
- Further, to strengthen India's position as a leader in value-added fish processing, import duties on value-added fish processing ingredients - pre-dust breeding powder duty has also been removed.
- Finance Minister also announced that the Government will bring out National Co-operation Policy for systematic, orderly and overall development of the co-operative sector. Development of Fisheries Co-operatives as per the holistic national policy will empower the fishers and fish farmers in carrying out various fisheries value chain activities in an organised manner. This is expected to enhance their bargaining power and facilitate market linkages for better value creation and value realization.

5 Fish Classification (Just have an idea no need to study in detail)



<u>Chondrichthyes</u>	<u>Osteichthyes</u>
They are mostly marine fishes.	Largest class of vertebrates.
They contain 5-7 pairs of gills.	Their endoskeleton is made up of bones.

They lack air bladders so they swim actively to avoid sinking.	Bony fishes contain four pairs of gills.
<ul style="list-style-type: none"> • Shark (Scolidon -Dogfish) • Ray • Skates • Sawfish 	<ul style="list-style-type: none"> • Marine Bony fishes - Hippocampus (Sea horse) Exocetus (Flying fish) • Freshwater bony fishes <ul style="list-style-type: none"> ❖ Labeo rohita (Rohu) ❖ Labeo catla (Katla) ❖ Clarias (Walking catfish or Magur) ❖ Mystus (Catfish) • Aquarium bony fishes <ul style="list-style-type: none"> ❖ Betta splendens (Fighting fish) ❖ Pterophyllum (Angelfish) • Lungfishes <ul style="list-style-type: none"> ❖ Lepidosiren - South American Lungfish ❖ Neoceratodus - Australian lungfish ❖ Protopterus - African Lungfish

Type of fish	Moisture %	Protein %	Fat %	Ash %	Carbohydrate %
Fatty fish	68.8	20.0	10.0	1.2	Negligible
Lean fish	81.8	16.4	0.5	1.3	< 0.5
Crustaceans	76.0	18.8	2.1	3.1	< 0.5
Mollusks	81.0	12.0	1.5	2.6	2.9

PYQ

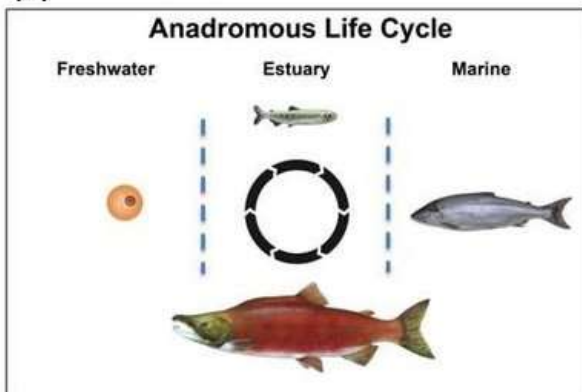
• Masula Boats are used in which of the following parts of India? NABARD 2020
• Smoking in Fish preservation NABARD 2019
• Breathing Fish NABARD 2018
• Anadromous and Catadromous fishes – Definition and example based Q NABARD
• Carps feeding in Bottom and column
• The nodal agency for the holistic development of seafood industry, including export of marine products in india is – MPEDA
• Optimum Ph Required for most of freshwater fish is? 6.5-10 (Nabard 2022)
• Indigenous fish which is suitable for bottom and column feeding in polyculture system is? – Catla (Nabard 2022)
• In inland fisheries which fish has been banned due to their predatory nature? – African catfish (Nabard 2021)
• The traditional methods of processing fish by salting, drying, smoking, pickling is known as – Curing (Nabard 2021)
• Potadromous fish lived their entire lifestyle in freshwater systems. Which of the following is - Potadromous fish (Nabard 2021)
• Which of the following is the name of indigenous major carp, which is also known to be fastest growing among fin fishes? Catla Catla
• Which of the following is organic in nature which is used in fish ponds is? – Cow dung (Nabard 2021)
• Most fishes feeding habit - Omnivore

PART B – TERMINOLOGY

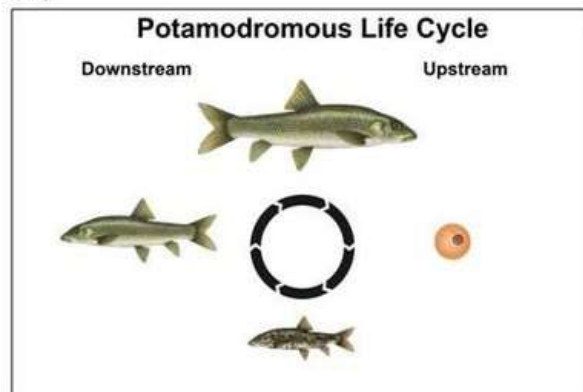
6 Pisciculture Terminology

- **Extensive aquaculture** – managed aquaculture dependent on the local natural setting, such as a pond or coastal sea area.
- **Intensive aquaculture** – managed aquaculture controlled through human engineered means, such as managing water quality and sources of food.
- **Game fish** – Fish, such as **trout**, raised to become replenishment stock for natural sport fisheries.
- **Fish husbandry** – the breeding and rearing of fish for a variety of reasons.
- **Anadromous fish** – migratory fish that live in salt water but breed in fresh water. Ex **salmon**, smelt, American shad, striped bass, **lamprey**, gulf sturgeon, **Hilsa**
- **Catadromous fish** – migratory fish that live in fresh water but breed in salt water. Ex American **eel**, European eel, inanga, shortfin eel, longfin eel
- **Amphidromous fish** – migratory fish that live in both fresh and salt water, independent of breeding.
- **Potamodromous fish** – migratory fish that move within fresh water only. Example carps, catfish and trout
- **Oceanodromous fish** – migratory fish that move within salt water only.

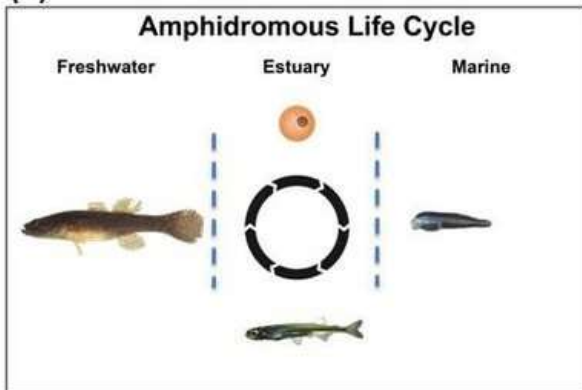
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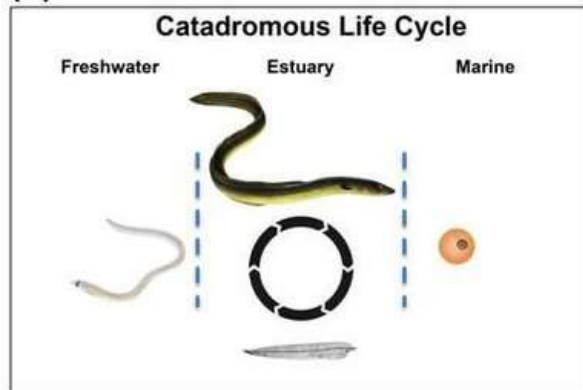
(b)



(c)



(d)



- **Mariculture** - is a specialized branch of aquaculture (which includes freshwater aquaculture) involving the cultivation of marine organisms for food and other products in the open ocean of offshore aquaculture, an enclosed section of the ocean, or in tanks, ponds or raceways which are filled with seawater.
- **Brood stock** – fish of any particular species which are raised for reproduction purposes.
- **Euryhaline**: Euryhaline organisms are able to adapt to a wide range of **salinities**. An example of a euryhaline fish is the **molly** which can live in fresh water, brackish water, or salt water. The green crab is an example of a euryhaline invertebrate
- **Stenohaline Fish**: Stenohaline describes an organism, usually fish, that cannot tolerate a wide fluctuation in the salinity of water. Example Goldfish, Haddock
- **Halocline**: The zone of the ocean in which salinity increases rapidly with depth
- **Masheer**: It is state fish of Madhya Pradesh
- **Bathypelagic**: the open ocean or pelagic zone that extends from a depth of 1000 to 4000 meters below the ocean surface
- **Bait or Forage Fish**: Used as prey for large fish
- **Principal fish**: used is 60% rest 40% other fish can be used in composite culture
- **Biotone**: a region where a distinctive transition from one set of biota to another occurs. An example is the region where tropical and temperate waters mix.
- **Lowest Ground water brackish water** : Karnataka
- **Bony Fish**: fish that have a bony skeleton and belong to the class osteichthyes. Basically, this is all fish except for sharks, rays, skates, hagfish and lampreys.
- **Biofloc Technique**: Biofloc system is a wastewater treatment which has gained vital importance as an approach in aquaculture. The principle of the technique is to maintain the higher C-N ratio by adding carbohydrate source and the water quality is improved through the production of high quality single cell microbial protein In such condition, heterotrophic microbial growth occurs which assimilates the nitrogenous waste that can be exploited by the cultured species as a feed and also works as bioreactor controlling of water quality. Immobilization of toxic nitrogen species occurs more rapidly in biofloc because of the growth rate and microbial production per unit substrate of heterotrophs are ten-times greater than that of the autotrophic nitrifying bacteria. This technology is based on the principle of flocculation within the system
- **Brackish water**: water that has more salinity than fresh water, but not as much as seawater. It may result from mixing seawater with fresh water, as in estuaries.
- **Carapace**: a calcified protective cover on the upper frontal surface of crustaceans. It is particularly well developed in lobsters and crabs.
- **CHUMMING**: A fishing technique by which bait or scent is released into the water to attract fish to take a lure or baited hook.
- **Labyrinth fish: Bettas and Gouramis** make up the lion's share of labyrinth fish species. Labyrinth fish are native to Africa and Southeast Asia, residing in areas where high temperature and low water depth result in low oxygen saturation in the water

(Labyrinth: An organ common to fish of the suborder Anabantoidae that enables them to breathe air.)

- **Aquatic Chicken: 'Tilapia'** has emerged to be one of the most productive and internationally traded food fish in the world. The culture of tilapia has become commercially popular in many parts of the world and the fishery experts have dubbed the tilapia as "aquatic chicken" due to its quick growth and low maintenance cultivation. Today, if any fish that could be named as global fish, no better name can be thought of than Tilapia. Tilapia are also known to be **mouth-brooding species**, which means they carry the fertilized eggs and young fish in their mouths for several days after the yolk sac is absorbed.
- **Recirculatory Aquaculture System (RAS)** is a technology where water is recycled and reused after mechanical and biological filtration and removal of suspended matter and metabolites. The reconditioned water circulates through the system and **not more than 10% of the total water volume** of the system is replaced daily
- **Red Pest Disease:** Red pest disease also known as pond pest, causes blood red spots or patches on the fish's body. is caused by a bacterial infection (bacterium *Cyprinicida*).
- **Surimi** was developed in Japan several centuries ago when it was discovered that washing minced fish flesh, followed by heating, resulted in a natural gelling of the flesh. When the surimi was combined with other ingredients, mixed or kneaded, and steamed, various fish gel products called kamaboko (fish cakes) were produced and sold as neriseihin (kneaded seafoods).
- **Aeromonas infection** is the most common bacterial infection of freshwater aquarium fish. Fish infected with *Aeromonas* or other closely related bacteria may show signs that include bloody spots or ulcers on the body, fluid accumulation in the abdomen ("dropsy" and "pinecone disease"), ragged fins, or enlarged eyes.
- **Cloudy eye, dropsy and white spot are disease of Fishes.**

Dropsy	By bacteria, bloating of body
Red Pest	Bloody streak in Fins
Vibriosis	Cause one month mortality syndrome
Columnaris	Bacteria

- **MPEDA:** The Marine Products Export Development Authority (MPEDA) was set up by an act of Parliament during 1972. The erstwhile Marine Products Export Promotion Council established by the Government of India in September 1961 was converged in to MPEDA on 24th August 1972. MPEDA is given the mandate to promote the marine products industry with special reference to exports from the country
- **Casting:** the act of throwing bait or a lure over the water, using a fishing rod.
- **Crustaceans:** A group of freshwater and saltwater animals having no backbone, with jointed legs and a hard shell made of chitin. Includes **crabs, lobsters, crayfish, shrimp and krill.**

- **Molluscs:** Gastropod, Bivalves etc.
- **Demersal Zone:** the zone at or near the bottom of a sea or lake. Inhabitants of the demersal zone feed off the bottom or off other demersal fish
- **High Sea:** for areas beyond the EEZ of **200 nautical miles**
- **IOTC** - The Indian Ocean Tuna Commission is an intergovernmental organization that co-ordinates the regulation and management of tuna in the Indian Ocean. Conceived in 1993, it entered into existence in 1996. IOTC headquarters are located in Victoria, Seychelles.
- **RFD** - app '**Report Fish Disease**', which helps farmers to report disease cases in finfish, shrimps and molluscs on their farms to the field level-officers and fish health experts and get scientific advice quickly.
- **Ichthyology:** is the branch of science dealing with the study of fishes, with the study of commercial aspects of fishes, including the study of hydrobiology (Chemistry of water), limnology, behaviour of environment, population dynamics, (Craft) use of nets and gears, methods of fish catching and detection, study of pollution, aquaculture and breeding etc
- **Excusive Economic Zone:** a seazone under the law of the sea over which a state has special rights to the exploration and use of marine resources. Generally a state's EEZ extends to a distance of 200 nautical miles (370 km) out from its coast.
- **Fecundity:** the number of eggs a fish produces each reproductive cycle; the potential reproductive capacity of an organism or population. Fecundity changes with the age and size of the fish.
- **Jigging:** method of fishing which uses lures on a vertical line that is moved up and down, or jigged
- **Littoral:** the shallow water region around lake or sea shores where significant light penetrates to the bottom.
- **Neretic Zone:** the shallow pelagic zone over the continental shelf.
- **Purse Seine:** a fishing technique capable of **harvesting large quantities of surface-schooling pelagic fish** by surrounding the school with a net. A line which passes through rings on the bottom of the net can be tightened to close the net so that the fish are unable to escape
- **Shellfish:** general term for aquatic invertebrates (molluscs, crustaceans and echinoderms).
- **Shoaling:** Fish that socialize or hang out in loose groups in the same place are said to be shoaling.
- **Spawning:** the production or depositing of large quantities of eggs in water.
- **Stock:** Group of fish of the same species (for example, snapper) that occupy a defined area of the ocean.
- **Riparian Zone:** Area along river edge
- **Ram Ventilation:** The fishes like Tuna swim with its mouth parts open in a high speed. There are no visible breathing movements and water flows continuously over the gills;

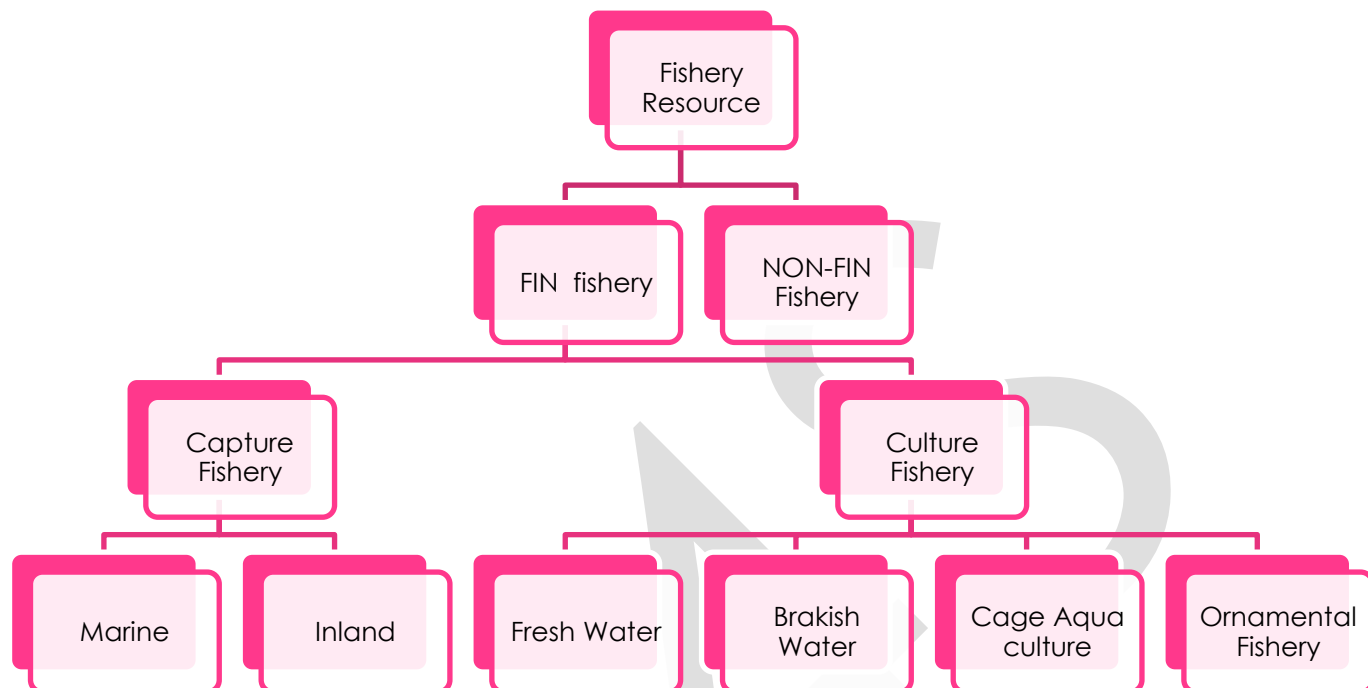
this is called ram ventilation. Many fish breathe by pumping at low speed and change to ram ventilation at higher speeds. The transition takes place around speeds of 0.5 to 1.0 ms⁻¹ and above this speed, active breathing movement cease. If opercular pumping is maintained at the higher swimming speeds, the cost of pumping would be far exceed what was measured when the fish used ram ventilation.

- **Gills:** In bony fish , the gas exchange organs of fish are called gills . The gills lie in a branchial chamber covered by a bony operculum.
- **Metamorphosis:** Metamorphosis means transformation; it involves the loss of the features which mark an individual as a larva, and the attainment of those which characterize it as an adult. Complete metamorphosis consists of four stages: 1) egg, 2) larva, 3) pupa, and 4) adult
- **Finfish:** Vertebrate and cartilaginous fishery species, not including crustaceans, cephalopds, or other mollusks.
- **Growing Stage:**

Hatchling	Spawn	Fry	Fingerling	Yearling
The larvae emerging from the fertilized eggs after hatching is called a hatchling. It is characterized by the presence of a yolk sac hanging below from where it draws its nutrition for 2-3days.	Spawn is the eggs and sperm released or deposited into water by aquatic animals. As soon as the yolk sac of the hatchling is absorbed, it is known as spawn	As soon as the spawn assumes the shape of the fish and grows to about 1-2cm it is known as a fry. At this stage, they are primarily smaller size zooplankton feeder. It takes about 7-10 days for the spawn to grow up to the fry stage.	As soon as the fry grow up to 10-15cm size or roughly equal the size of a finger, it is known as a fingerling. 3-4 month Fingerling is the proper size for stocking in table fish production ponds. It takes about 30-60 days for the fry to grow up to fingerling size.	Development stage of fish following the fingerling stage and lasting until approximately one year of age.

Spawn→Egg→Larvae (Hatchling)→Fry→Juvenile→Adult

7 Fisheries: Fisheries resources, management and exploitation - freshwater, brackish water and marine



Fin Fishery						Non Fin
Capture		Culture				Prawn, crab, lobster, mussel, oyster, sea cucumbers, frog, sea weeds, etc.
Marine	Inland	Fresh	Brackish	Cage	Ornamental	
Marine Pelagic Demersal	Riverine River Estuarine Wetland					

Type for inland fishery	Highest Area under fishery
Tank & Pond	Andhra Pradesh
River & Canal	Uttar Pradesh
Reservoirs	Tamil Nadu
Brackish water	Odisha

7.1 Fin Fishery

Cultivation of **true fishes** is **Fin fishery** which include two major groups Capture Fishery and Culture Fishery (True fishes belong to the super-class Pisces. To be a true fish, a fish must have fins, gills, and a vertebra. Example Dog Fish)

7.2 Non Fishery

Non-fin fisheries is the fisheries of organisms other than true fish like **prawn, crab, lobster, mussel, oyster, sea cucumbers, frog, sea weeds, etc.**

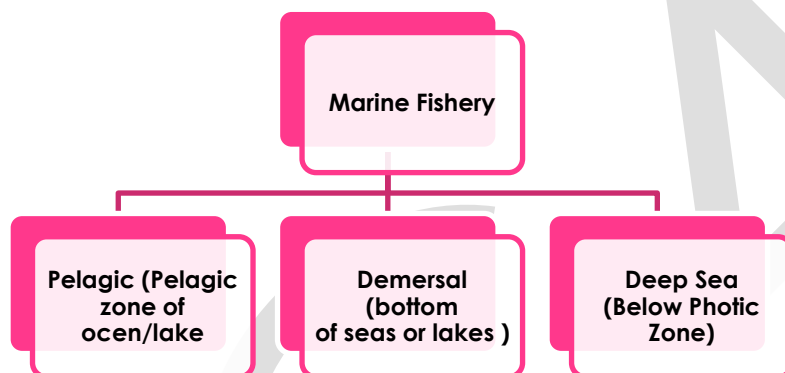
7.3 Capture Fishery

Capture fisheries is exploitation of aquatic organisms without stocking the seed, Recruitment of the species occur naturally. This is carried out in the sea, rivers, reservoirs, etc. Fish yield decreases gradually in capture fisheries due to indiscriminate catching of fish including brooders and juveniles.

7.4 Culture Fishery

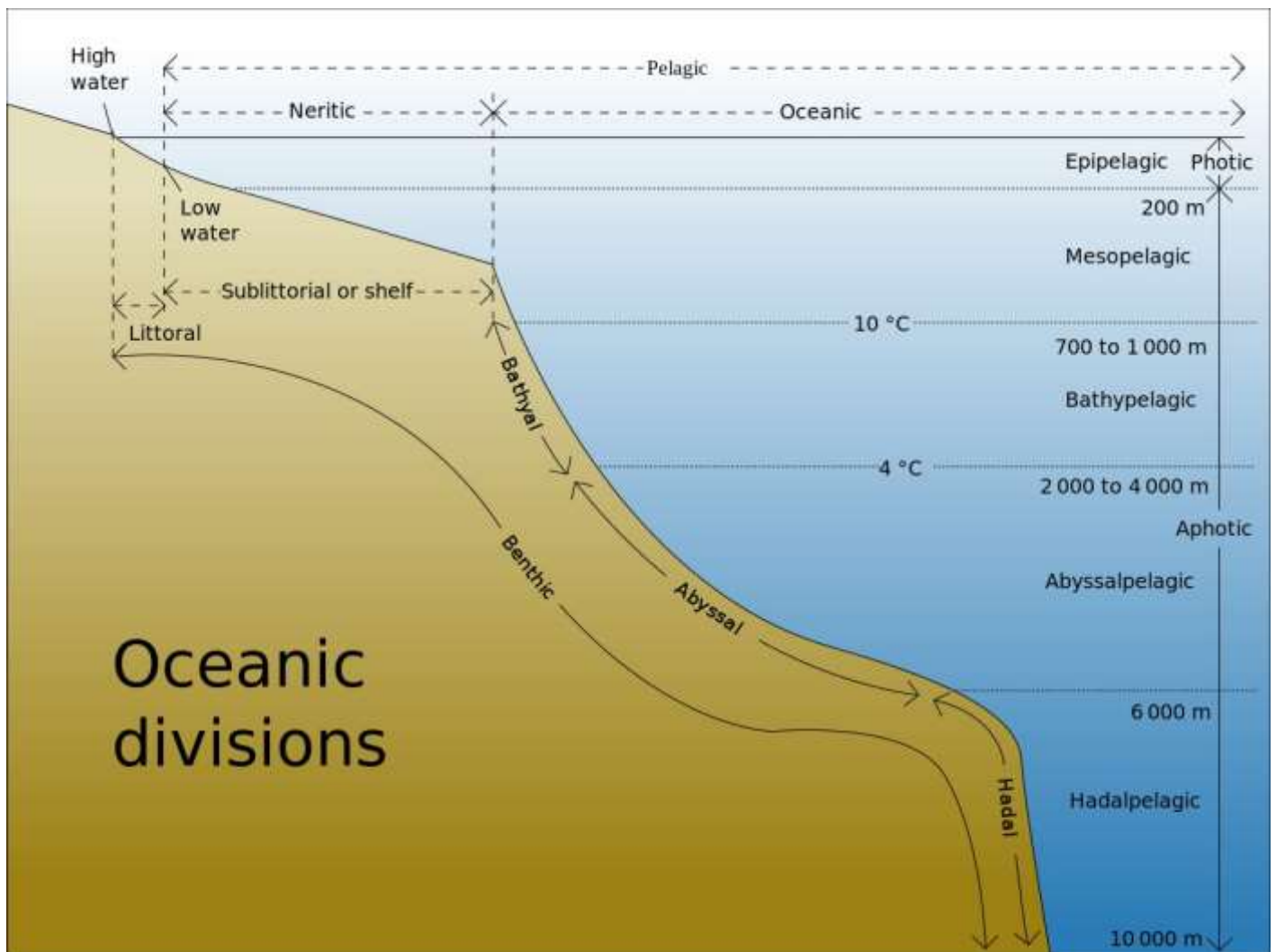
Culture fisheries is the cultivation of selected fishes in **confined areas** with utmost care to get maximum yield. The seed is stocked, nursed and reared in confined waters, then the crop is harvested. Marine Fishery

Can be majorly Classified into two three groups



7.5 Pelagic Fish

Pelagic fish live in the **pelagic zone of ocean or lake waters** - being neither close to the bottom nor near the shore - in contrast with demersal fish, which do live on or near the bottom, and reef fish, which are associated with coral reefs. Fishes in pelagic region – Anchovines, Sardines, Mackerels, Tuna, ribbon, Bombay duck



Marine pelagic fish can be divided into - **Pelagic coastal fish & oceanic pelagic fish.**

- **Coastal fish** inhabit the relatively **shallow and sunlit waters** above the continental shelf, while **oceanic fish** (which may well also swim inshore) inhabit the **vast and deep waters** beyond the continental shelf
- **Oceanic fish** inhabit the oceanic zone, which is the **deep open water** which lies beyond the continental shelves. Oceanic fish (also called Open Ocean or offshore fish) live in the waters that are not above the continental shelf.
- **True Oceanic fish live their entire life in the open ocean.** Only a few species are true residents, such as tuna, billfish, flying fish, sauries, commercial pilot fish and remoras, dolphin, ocean sharks and ocean sunfish.

7.6 Dermal Fish

- Demersal fish live and feed on or near the bottom of seas or lakes (the demersal zone). They occupy the sea floors and lake beds, which usually consist of mud, sand, gravel or rocks.

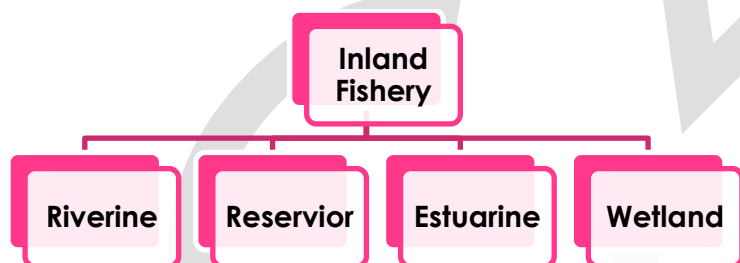
- Demersal fish can be divided into two main types: strictly **benthic** fish which can rest on the sea floor, and **benthopelagic** fish which can float in the water column just above the sea floor.
- Example: Silver bellies, perches

7.7 Deep sea fish

- Deep-sea fish are fish that live in the darkness below the sunlit surface waters, that is below the epipelagic or photic zone of the ocean. The lantern fish is, by far, the most common deep-sea fish. Other deep sea fish include the **flashlight fish, cookie cutter shark, bristle mouths, anglerfish, and viperfish.**
- Deep-sea organisms generally inhabit **bathypelagic** (1000m-4000m deep) and **abyssopelagic** (4000m-6000m deep) zones.
- However, characteristics of deep-sea organisms, such as bioluminescence can be seen in the **mesopelagic** (200m-1000m deep) zone as well. The mesopelagic zone is the disphotic zone, meaning light there is minimal but still measurable. **The bathypelagic and abyssopelagic zones are aphotic**, meaning that no light penetrates this area of the ocean.

8 Inland Fishery

It can be classified into four groups



8.1 Riverine

India is blessed with vast inland water resources in the form of rivers, estuaries, natural and manmade lakes. The Inland water bodies have been divided into five riverine systems and their tributaries extending to a length of about 29,000 km in the country – Indus, Ganges, Brahmaputra, East flowing riverine system and West riverine system.

8.1.1 Ganga River System

Fisheries of Ganga river systems: The Ganga river system supports a large number of commercially important fish species-

- **Major carps** (Labeo. rohita: L.Calabasu, Catla catla and **Cirrhinus mrigala**). **Catla is fastest growing Carp**
- **Minor carps** (Labeo fimbriatus; L.bata; Cirrhinus. reba),

- **Catfishes** (Wallago. attu ; Mystus. aor; M.tengara, Clarias. batrachus; Heteropneustes fossilis. **They can breathe in AIR due with gill like structure**)
- Clupeoids, **murrels (Channa species)**, feather backs (Notopterus. notopterus; N.chitala), **mullets (Mugil corsula)**,
- Fresh water eel (Anguilla) and prawns (Macrobrachium malcolmsonii; Palaemon. Lamarii).
- **Fishing gears used:** The principal gears used in Ganga river system are dragnets, cast nets and bag nets.

8.1.2 Godavari River System

The head waters harbour a variety of game fishes but don't support the commercial fisheries. The commercial fisheries consist of carps (major caps, Labeo fimbriatus), large cat fish (Mystus spp., Wallago attu; Bagarius bagarius) and **fresh water prawn (Macrobrachium rosenbergii)**

8.1.3 Other River systems include

Krishna, Cauveri, Narmada etc

8.2 Reservoirs

The man made water bodies created by obstructing the surface flow or erecting a dam of any description, on a river, stream or any water course called reservoirs. **The small reservoirs have an area of <1000 ha.**

8.3 Estuarine

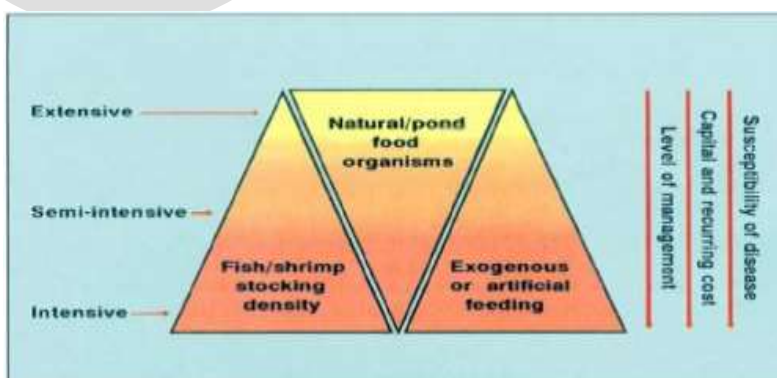
An estuary is defined as a semi-enclosed coastal body of water, which has a free connection with the open sea and within which the seawater is measurably diluted with the freshwater of land drainage. Fish here survive in **different concentration of SALINITY.**

Brakish water resource of India:

- State with Maximum Brakish Water : West Bengal
- State with Maximum % Brakish Water used for fish culturing : Odisha

9 Fishery on basis of On the basis of intensity of input and stocking density aquaculture is categorized as follows

	Extensive/Traditional	Modified Extensive	Semi-intensive	Intensive	Super-intensive
Pond size	5 hectares	1 – 2 hectares	1 hectare	0.2 – 0.4 hectare	0.05 – 0.1 ha
Shape	Any	Any	Rectangular	Square	Circular
Stocking density	Mixed culture uncontrolled	3/m ² Mixed culture	8-15/m ² Monoculture	50-100/m ² Monoculture	100/m ² Monoculture
Water exchange	Sometimes with the help of pump	5%/day	5–10% per day	20-50% per day	100% flow through
Water depth	1.2–5.0 m	1.0 – 3.0 m	0.8 – 1.5 m	0.6 – 1.5 m	
Aeration	Not needed	Very less, if needed	2 HP	8–12 HP	Continuous
Production	500 kg/hectares	1000-3000 kg/ha	3000-6000 kg/ha	15000 kg/ha	25000 kg/ha
Feed used	Natural feed	Natural and formulated feed	Natural and formulated feed	Pellet feed	Pellet feed
Rate of feeding	—	1-4 times daily	3-6 times daily	—	—
Crops/year	1	2	2	Batch-wise	Batch-wise
Engineering	Not needed	Very less needed	Essential	Essential of high quality	Essential of high quality
Investment	Very less	Less	High	Very high	Very high
Care	Not much needed	Needed	Essential	Essential	Essential
Generator and current	Not needed	If needed	Necessary	Compulsory	Compulsory
Prawn/shrimp larva source	Wild	Wild	Hatchery	Hatchery	Hatchery



9.1 Hilsa

- Hilsa's peculiar habitat makes it impossible to breed it artificially through aquaculture, unlike other fish. The adult **Hilsa** swims several kilometres upstream to freshwater from the sea for spawning and returns to saline water after that. The eggs hatch in freshwater and the sub-adult hilsa, called jatka, flows back downstream into the sea, a process that takes a few months.
- Hilsa, a common renewable aquatic resource, having **anadromous migratory habits** and trans- boundary distribution, is a significant component of open- water capture fishery in our state contributing to about 19% of total fish landing in the **Hoogly -Matla estuarine system**.
- The most famous hilsha fish comes from Chandpur District, Bangladesh. It is **the national fish of Bangladesh and the state fish of West Bengal**

10 Reproduction in Fish

- The most common reproductive strategy in marine ecosystems is **oviparity**. Approximately **90% of bony and 43% of cartilaginous fish are oviparous** . In oviparous fish, females spawn eggs into the water column, which are then fertilized by males. For most oviparous fish, the eggs take less energy to produce so the females release large quantities of eggs
- Ovoviviparity** is another reproductive strategy that occurs in most Sharks and Rays, as well as species of Rockfish. In ovoviviparous fish, the eggs are fertilized inside of the female. The eggs remain within the mother while they develop allowing for a greater degree of protection from predators and difficult environmental conditions than in oviparous fish.
- Viviparity** occurs in some Sharks and Surfperches. Similar to ovoviviparous fish, internal fertilization and development occurs. However, the embryos receive direct nourishment from the mother, similar to the development of an embryo in mammals

11 NABARD MODEL PROJECTS IN FISHERY

Composite culture	
Shrimp Culture	
Wetland Culture	
Integrated Fish cum Poultry	
Integrated Fish cum dairy	
Intensive Fish culture	

11.1 COMPOSITE FISH CULTURE

- Composite Means multiple species
- Rearing of fish in pond/tank etc with more than one fish species using the concept of Vertical space utilization.

11.1.1 SPECIES:

Species are listed in block as follows which are used in composite culture to utilize vertical space-

Species	Feeding habit	Feeding zone
Indian Major Carp		
Catla	Zoo plankton feeder	Surface feeder
Rohu	Omnivorous	Column feeder
Mrigal	Detritivorous	Bottom feeder
Exotic carps		
Silver carp	Phytoplankton feeder	Surface feeder
Grass carp	Herbivorous	Surface, column and marginal areas
Common carp (European carp/ Vulnerable) Cyprus Carpo	Detritivorous/Omnivorous	Bottom feeder

11.1.2 Ratio of species

For example in case of 3 species combination **4:3:3**

Species	3-species	4-species	6-species
Catla	4.0	3.0	1.5
Rohu	3.0	3.0	2.0
Mrigal	3.0	2.0	1.5
Silver Carp	-	-	1.5
Grass Carp	-	-	1.5
Common Carp	-	2.0	2.0

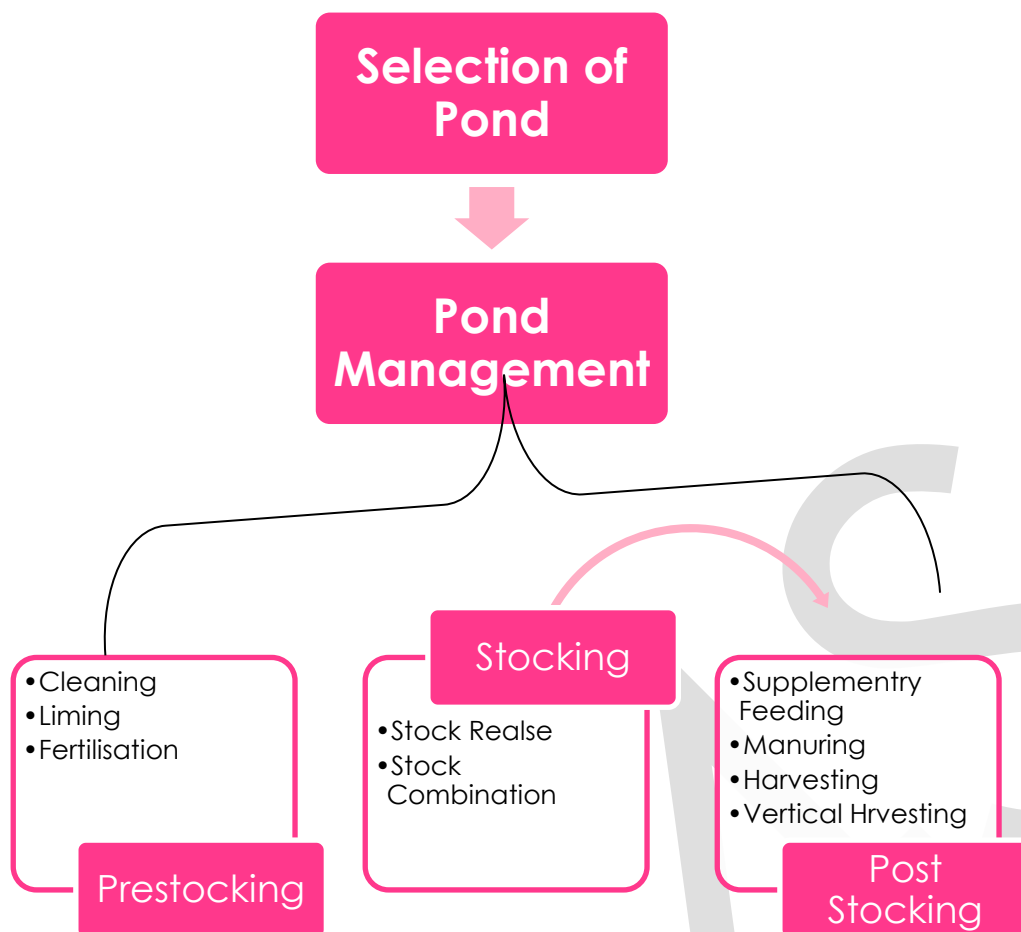
11.1.3 STEPS-

Sequence of steps to be followed in Composite Fish rearing

- Selection of Pond → Pond Management → Pre-stocking → Stocking → Post Stocking

11.1.4 STEP I

Selection of Pond



11.1.5 STEP II POND MANAGEMENT

A. Pre-stocking

- i) **Liming:** The normal doses of the lime desired ranges from **200 to 250 Kg/ha. However,** the actual dose has to be calculated based on pH of the soil and water as follows:

Soil pH	Lime (kg/ha)
4.5-5.0	2,000
5.1-6.5	1,000
6.6-7.5	500
7.6-8.5	200
8.6-9.5	Nil

- ii) **Fertilization/ Manuring:** Fertilization of the pond is an important means for intensifying

fish culture by increasing the natural productivity of the pond.

a) Organic	Organic manure to be applied after a gap of 3 days from the date of liming. Cow dung @ 5000 kg/ha or any other organic manure in equivalent manurial value.
b) Inorganic	Inorganic fertilization to be undertaken after 15 days of organic manuring.

iii) Inorganic Fertilizer Application (kg/ha/month)

Soil fertility status	Ammonium sulphate	Urea
1. Nitrogen (mg/100 g soil)	70	30
i) High (51-75)	90	40
ii) Medium (26-50)	140	60
iii) Low (upto 25)		
2. Phosphorus	Single super phosphate	Triple super Phosphate
(mg/100 gm soil)		
i) High (7-12)	40	15
ii) Medium (4-6)	50	20
iii) Low (upto 3)	70	30

B. STOCKING

- The pond will be ready for stocking after **15 days of application of fertilisers.**
- **Fish fingerlings of 50- 100 gm size (approx) should be used for stocking @ 5000 nos. per hectare.**
- The present model envisages stocking of advanced fingerlings and rearing for **10-12 months. Depending on availability of seed and market condition, stocking can be of 3, 4 or 6 species combination ratio.**

C. POST STOCKING

- Supplementary Feeding
- Manuring
- Harvesting
- Vertical Harvesting

Supplementary feeding

- Fishes can be fed with a mixture of rice bran and oilcakes in the ratio 4:1
- The recommended feeding rate is **5 - 6 % of the body weight upto 500gm size of fish and then reduce to 3.5% of body weight from 500- 1000gm size .**

Manuring

- Organic manuring may be done in monthly instalments @ **1000 kg/ha.**

Harvesting

- **Harvesting is generally done at the end of 1st year, when the fishes attain average weight of 800 gm to 1.25 kg.**
- With Proper management a production of **4 to 5 tons/ha** can be obtained in a year

Vertical expansion of fish culture

- It is possible to increase the per hectare production of fish to 7 to 10 tonnes per ha per year by employing different methods as indicated above.

11.2 WET LAND FISHERY

Introduction

- The inland fisheries and aquaculture contributes about 65 per cent of the total fish production of the country and growing fast over the years.
- The average productivity from culture ponds is presently only **2800 kg per ha** as against the potential yield of 4000 to 5000 kg per ha with scientific fish culture practices.

11.2.1 Scope for Fish farming in Wet lands

- The Indian Major Carps (IMC) i.e. Catla, Rohu and Mrigal are having more demand by the consumers. Majorly these species are reared for brighter scope as per demand and supply.

11.2.2 Technical Parameters

- For composite fish culture in ponds of wet lands, the culture of IMC (Rohu, Catla & Mrigal) and other exotic carps (Common Carp, Silver carp and Grass carp) are suitable.
- The culture of a combination of **3 to 6 species** in the pond ecosystem helps to utilize the natural fish feed available in the pond ecosystem optimally and thus increases production and productivity Site Selection.

11.2.3 Soil

- The ideal soil quality for culture of carps should be clay, clay loam, silty clay and sandy clay with good water retention capacity. The pH of the soil should be in the range of **6.5 to 7.5**.

11.2.4 Water

- The water depth of 1.2 m should be maintained throughout the culture period. The optimum water quality parameters for culture of IMC and exotic carps are as under:-

Temperature	: 25 -32 °C
Dissolved oxygen	: 5-7 ppm (5-7 mg oxygen per liter of water) Visibility : 40 cm
Color	: Light Green/Brown
PH	: 7 to 7.5
Salinity	: 0-5 ppt
Total alkalinity	: 50-100 ppm
Ammonia	: not more than 0.1 ppm

The water quality needs to be monitored regularly, for which ready to use kits are available.

11.2.5 Pond Construction

- Normally a size of 0.4 to 1.5 ha is found suitable. The average depth of the pond should be minimum 1 m and maximum of 1.5 m.

11.2.6 Farm Management

- The culture period in wet lands would be maximum of **7-8 months**. The advanced fingerlings **upto 50 g size** should be stocked and average growth of 600 to 700 gram would be possible in the culture period.
- The stocking of fingerlings should be done at the rate of 5000 numbers per ha after acclimatization in the pond. The fingerlings obtained should be of healthy and good quality.
- The fish Farmers Club or Producer Groups may be formed in a cluster of 100 to 200 ha of fish farms in a village to get the required extension services, procurement of feed, fertilizers, fishing equipment and also to help in marketing of fish. Margin

11.2.7 Financial Viability

- The financial viability of the model has been assessed with the assumptions mentioned below.

Sl. No.	Parameters	Assumptions
I	Unit size	1 ha
II	Grow out period	7-8 months
III	Stocking density	5000
IV	Stocking Size	50 g
V	Survival	90 %
VI	Expected Production per ha	2500 kg first year and 3000 kg second year

11.3 Integrated Fish farming with Dairy-IFFD

11.3.1 Scope for Integrated Fish farming with Dairy

- Integration of dairy with fish culture is suitable and economically viable practice in which the dung containing undigested feeding material is used as feed and organic manure in fish ponds. Both cattle dung and urine is utilized in the integrated farming system.
- The cattle dung contains 14 per cent organic matter, **0.3 per cent nitrogen, 0.2 per cent phosphorous and 0.1 per cent potash.**

11.3.2 Technical Parameters

- For integrated fish farming with dairy, fast growing and compatible species of IMC (Rohu, Catla & Mrigal) and other exotic carps like Common Carp, Silver Carp and Grass Carp are preferred. The seeds of these variety of fishes are available from the hatcheries existing in the State.
- The culture of a combination of 3 to 6 species of carps in the pond ecosystem helps to utilize the natural fish feed available and thus increases production as well as productivity.
- The biological oxygen demand of cow dung is lower than other livestock manures as it is already decomposed by the microorganisms in rumina. The application of cow dung results in growth of natural food organisms of fish in the pond.** The cow dung and urine are extremely beneficial for fishes like Catla and Silver Carp.

11.3.3 Site Selection

- The selection of site plays a pivotal role in integrated fish farming unit as the management measures to be adopted depends on the site conditions.

11.3.4 SOIL

- The pH of the soil should be in the range of **6.5 to 7.5**. The soil pH affects the productivity of ponds. **The acidic soils are less productive than alkaline soils.**

11.3.5 Water

- Adequate and good quality of water free from pollution is required for integrated fish farming. The water depth of 1.2 m should be maintained throughout the culture period. The optimum water quality parameters for culture of IMC and exotic carps are as under:- **(No need to mugup each data just have an idea)**

Temperature	: 25 -32 °C
Dissolved oxygen	: 5-7 ppm (5-7 mg oxygen per liter of water)
Visibility	: 40 cm
Color	: Light Green/Brown
pH	: 7 to 7.5
Salinity	: 0-5 ppt
Total alkalinity	: 50-100 ppm
Ammonia	: not more than 0.1 ppm

11.3.6 Pond Construction

- A convenient width of 30 to 50 m is recommended, whereas length of the pond depends on site, topography and farm layout.
- The length should be from east to west direction. **Normally pond size of 0.4 to 1.5 ha** is found suitable. The average depth of the pond should be minimum 1 m and maximum of 1.5 m

11.3.7 Farm Management

- The **stocking density** of fish is maintained at **5000 numbers per ha**.
- The seed obtained should be of healthy and good quality. **The culture period would**

be around 11 months. The **stunted yearlings** should be stocked and average growth of **700 to 800 gram** would be possible.

- **Out of 5 cows** required in the integrated system of **1 Ha farm**, in the first phase 2 or 3 CB Cows are to be purchased and after 5-6 months another 3/2 CB Cows are to be purchased. Care needs to be taken to select animals with milk yield of 8-10 litres per day. Extension Services.

11.3.8 Subsidy

- Under *Blue Revolution* scheme of GoI, the subsidy assistance is available for development of new ponds@ 40 per cent of the unit cost for general category and 60 per cent of the unit cost for the category of SC/ST/women and their cooperatives.
- Under Dairy Entrepreneurship Development Scheme (DEDS) of GoI implemented through NABARD, the subsidy assistance @25 per cent for general category and 33.33 per cent for SC/ST category is available for milch cattle rearing of 2 to 10 animals.

11.3.9 Financial Viability

- The financial viability of integrated fish farming with dairy has been assessed with the assumptions mentioned below

Sl. No.	Parameters	Assumptions
I	Pond size	1 ha
II	Grow out period of Fish	11 months
iii	Stocking density of fish	5000 nos.
iv	Grow out period – Dairy	Throughout the year
V	Total no. of CB cows	5
vi	Purchase of cows	On first calving in two phases
vii	Average milk yield per cow	8 litres
viii	Stocking size of fish	50 g-60g

11.4 Integrated Fish Farming with Poultry

11.4.1 Scope

- The integrated fish farming with poultry (broiler) is suitable in the State as there is immense demand for both chicken and fish. The integrated fish farming can be taken up in the existing ponds/tanks and also by constructing new ponds.

11.4.2 Technical Parameters

- In the integrated fish cum poultry farming system, fish farming is the nucleus activity. The culture of IMC (Rohu, Catla & Mrigal) and exotic carps like Common Carp and Silver Carp are taken up for culture.
- The grow-out period is maximum of **8 weeks for broiler and maximum 4 batches are taken in a year.**

11.4.3 Site Selection

11.4.4 Soil

- The ideal soil quality for culture of carps should be clay, clay loam, silty clay and sandy clay with good water retention capacity. The pH of the soil should be in the range of **6.5 to 7.5.**

11.4.5 Water

- Adequate and good quality of water, free from pollution is required for fish culture. The water depth of 1.2 m should be maintained throughout the culture period. The optimum water quality parameters for culture of IMC and exotic carps are as under:-

Temperature	: 25 -32 °C
Dissolved oxygen	: 5-7 ppm (5-7 mg oxygen per liter of water)
Visibility	: 40 cm
Color	: Light Green/Brown
pH	: 7 to 7.5
Salinity	: 0-5 ppt
Total alkalinity	: 50-100 ppm
Ammonia	: not more than 0.1 ppm

11.4.6 Pond Construction

- Normally pond size of 0.4 to 1.5 ha is found suitable. The average depth of the pond should be minimum 1 m and maximum of 1.5 m.

11.4.7 Farm Management

- In the integrated fish cum poultry farming system, approximately **500 to 600 birds** are required to fertilize **one ha of pond area**.
- The type of pond preparation to be adopted before stocking of fish is based on the type of culture, its intensity and the culture period. The **stocking density of 5000 fingerlings** is recommended. The culture period of fish would be maximum **of 11 months**.
- **The stunted yearlings (50 to 60 g)** should be stocked and average growth of **600 to 700 gram** would be possible at harvest.
- The broiler birds are reared for **6-8 weeks in four batches per year with 250** birds per batch. The broilers are fed with formulated feed (prestarter, starter and finisher). The litters can be applied daily @ 30 to 35 kg per ha or in weekly basis.

11.4.8 MARKETING

- Marketing of broilers should start from **4-5 weeks** of rearing during which birds weigh **1.2 to 1.5 kg**.

11.4.9 Financial Viability

The financial viability of integrated fish farming with poultry has been assessed with the assumptions mentioned below.

Sl. No.	Parameters	Assumptions
I	Unit size	1 ha
ii	Grow out period – Fish	11 months
iii	Stocking density of Fish	5000
iv	Grow out period - Broiler per batch	4-6 weeks
V	No. of poultry batches per year (all in all out system)	4
Vi	No. of birds per batch	250
vii	Survival of birds and fish	95%
viii	Average weight of birds at harvest	1.3 kg
ix	Stocking Size of Fish	50g -60g

X	Production Fish	2500 kg in first year and 3000 kg from second year onwards
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Income Parameters

Culture period – Fish	11 months	
Broiler - 250 birds per batch	4 batches per year	
Production – Fish	2500	kg first year
	3000	kg second year onwards

12 Comparison

Type	Wet land fishery	Integrated Fish farming with Dairy-IFFD	Integrated Fish Farming with Poultry
GoP	7-8 Months	11 Months	11 Months

Try to remember all three models on comparative basis

13 Culture of white legged shrimp , *Litopenaeus vannamei* (Both NABARD & TNAU MODEL Discussed)



Shrimp vs Prawn

Prawns are in the suborder Dendrobranchiata, while shrimp are in suborder Pleocyemata. The main difference between these two suborders is gill structure. Shrimp have branching gills, while prawns have lamellar gills

13.1 Introduction:

- In the seventies fishermen started concentrating on catching prawns more commonly known as '**shrimps**' due to high profitable return on the same on account of their export value. Brackish water prawn farming started in a big way during 91-94 especially in the coastal districts of Andhra Pradesh and Tamil Nadu.

- Shrimp farming in India, till 2009, was synonymous with the mono culture of **tiger shrimp, *Penaeus monodon***.
- Since 1995 culture of *P. monodon* is affected by White Spot Syndrome Virus (WSSV) and the development of shrimp farming has been stagnant. Most of the South East Asian countries like Thailand, Vietnam, Indonesia were also culturing *P. monodon*.
- Since 2001-02 onwards most of them have shifted to culture of exotic **White leg shrimp, *Litopenaeus vannamei*** because of the availability of Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) brood stock. In India, Pilot-scale introduction of *L. vannamei* was initiated in 2003 and large scale introduction in 2009.
- *L. vannamei* is native of **pacific coast of Mexico and Central and South America as far south as Peru**.
- The maximum weight of the females in the wild is about **120 g**. The males are smaller at **60-80g**. It lives in the column and prefers clayey loam soil.
- Due to its large size and high price, *Penaeus monodon* and *P. indicus* are generally considered for farming.
- For *L. vannamei* the growth at **30°C** is much higher than at 25°C. The optimal range of temperature for the species is between **30 and 34°C**. At 20°C growth virtually stops. It can tolerate salinity levels of 0 to 50 ppt.
- Growth is uniform within **10-40 ppt**. They can grow in freshwater also but the growth is slower below 10 ppt. **pH range of 7 to 9** is tolerated with **optimal growth at pH 8.0**. Dissolved oxygen levels **above 4.5 ppm** are required for optimal growth.
- The shrimps attained the size of 20g within a period of 100-120 days depending on the stocking density.
- *L. vannamei* normally grows at the rate of 0.2gm /day after the first 30 days. Weekly growth rate will range between 1.5 to 2.0 gm depending on the stocking density. At 60 nos./m² the shrimps attain 20g size within 100 -120 days.
- *L. vannamei* is very suitable species for semi-intensive culture

Comparison as per TNAU

P. monodon (Tiger Prawn)	P. Indicus	P. Vannamei (Whiteleg shrimp)
<ul style="list-style-type: none"> • It attains a large size. Shrimp with a size of 10 to 12 pieces/kg are common, and sizes of 5 to 7 pieces/kg have been grown in ponds. • It is the fastest growing of all shrimp tested for culture. In ponds, juveniles of 3 cm in length 	<ul style="list-style-type: none"> • This shrimp grows to a fairly large size and brings a good price. • It is fairly fast growing, especially when young. Cultured in tanks at a density of 15/m², it reached a size of 14 g in 16 weeks. In polyculture with milkfish in earthen ponds, females grow 	<ul style="list-style-type: none"> • <i>Penaeus vannamei</i> has the potential to grow as fast as <i>P. monodon</i> (at up to 3 g/wk) up to 20 g under intensive culture conditions. • They are amenable to culture at very high stocking densities of up to 150/m² in pond culture, and even as

have been grown to a size of 75 to 100 g in only five to six months.

- Due to its large size, it brings a high price to the farmer.
- It can tolerate a wide range of salinity.
- It can tolerate temperatures up to at least 37.5°C.

to about 28 g and males to about 12 g in 160 days.

- Survival is high during the first three months of growth or up to a size of about 10 cm.
- The exoskeleton is relatively thin, giving greater portion of edible meat to total weight.

high as 400/m² in controlled recirculated tank culture.

- *P. vannamei* is very tolerant to low temperatures (down to 15°C) enabling them to be cultured in the cold season.
- *P. vannamei* require lower protein feed (20-35%) than *P. monodon* resulting in a reduction in operational costs and amenability for closed, heterotrophic systems and has a better Food Conversion Ratios (FCRs) of 1.2.
- Specific Pathogen Free (SPF) brood stocks are available for this species to produce disease free larvae.

- The amount of oxygen dissolved in the pond water is vital to the shrimp's health. However, in the rearing pond, dissolved oxygen is mainly consumed by pond sediment (50-70%) and plankton (20-45%). Only a small portion of dissolved oxygen is consumed by the **shrimp (5%)**.
- Soil Conditions: Usually, clay or loam-based soil containing more than 90% clay and pH between 6.5-8.5 is preferable.
- If the average body weight of the shrimp is 30 gm, then the harvest should be planned for 7-8 days.

14 Fishing Crafts

14.1 Non Mechanized

(i) Catamaran: It has two hulls (Pair) (Hull mean body of boat)- is made of three logs, the centre one fitted at a lower level than the other two giving it a boat shape. The logs are held by means of two blocks of wood on either end and secured by coir ropes passing through the grooves on the side of the logs. Four types of catamarans are prevalent in Indian waters, namely the **Orissa type, Andhra type, Coromandal type and Kanyakumari type**.

(ii) Dug-out canoes any boat made from a hollowed log: The traditional fishing craft of **Goa** is dugout canoes and planked boats with large outriggers. Canoe with floating attachment are called as "**RAMPHANI**"

(iii) Plank-built canoes: This is an enlarged variety of dug-out canoe made of planks on the sides, largely used in **Kerala**.

(iv) Masula boats: It is made of non-rigid planks sewn together with coir ropes and are common along **Andhra coast, Madras coast.**

(v) Dhinghi: This is a carvel type of boat designed and constructed for a variety of purposes including fishing.

(vi) Outrigger canoes: Some times plank-built canoes may be provided with a single outrigger as in the “rampani” boats used for capturing mackerel in **Karnataka.**

(vii) Built-up boats: In most of the boats made at present, the carvel type of boats is built up of planks. The best type of built-up boats is seen in **centres along the northeast coast of India.**

(viii) Kolamaram (7 log catamaran): Made up of seven logs, Two masts are used.

(ix) Chinnanaram: Made of three logs

(x) Thundilmaram: Made of five logs without beaked prow

Active Fishing gears (Not important)

Surrounding nets	<ul style="list-style-type: none">• Roughly rectangular walls of netting rigged with floats and sinkers.• Generally operated in the surface layers.
Purse seines	<ul style="list-style-type: none">• Purse seines are the predominant type of surrounding nets, in which the bottom of the net is closed after encircling the fish school, by a purse line that prevent fish from escaping downwards by diving.
Seine nets	<ul style="list-style-type: none">• Seine net is along wall of netting with or without a bag, supported by float and sinkers, which are operated by surrounding areas of water with potential catch.• Seines operated from the shore are called shore seine or beach seine. An example is Rampani net operated in south-west India.
Trawls	<ul style="list-style-type: none">• Trawl nets are conical bag nets with two wings and a codend where catch is concentrated, operated by towing from one or two boats.
Dredges	<ul style="list-style-type: none">• Dredges are dragged gear, with a oblong iron frame with an attached bag net, operated on the bottom usually for collecting shellfish
Lift Nets	<ul style="list-style-type: none">• Lift net consists of horizontal netting panel or a cone-shaped bag with the mouth facing upwards, which are submerged and lifted either manually or mechanically to filter the fish in the overlying water column.

Passive Gears

Gill nets and entangling nets	<ul style="list-style-type: none"> Gill nets are rectangular walls of netting kept erect by means of floats and sinkers and positioned in the swimming layer of the target fish, which catch the fish by holding them in the mesh by gilling. Drift nets are operated in the surface layers and drift with the current Set gill nets or anchored gill nets are fixed to bottom or at a distance above bottom by means of anchors or ballast. Entangling nets are loosely hung single or multi-walled netting held vertically in water by floats and sinkers.
Traps	<ul style="list-style-type: none"> Traps are passive fishing gears with enclosures to which the fish are lured or guided and from which escape is made difficult by means of labyrinths or retarding devices like funnels or constrictions.
Hooks & Lines	<ul style="list-style-type: none"> In this gear, fish is enticed by edible bait or lure and are finally held by the hook concealed in the bait or lure.

15 Marine Fishery

Cage farming in India

- As an R & D activity, the first open sea cage was launched in Bay of Bengal off **Visakhapatnam** coast during May 2007. Due to the rough sea conditions, the first version of the cage had lasted only for 45 days in the sea. With further modifications, the second version of marine cage was fabricated involving marine engineering and naval diving experts and was launched in December 2007. With a low stocking density, the trial was successfully completed in April 2008.



Size

- CMFRI has developed open sea cages of 6 m dia and 15 m dia for grow out fish culture and 2 m dia HDPE cages for seed rearing. Ideal size for grow out cage is 6 m due to its easy manoeuvring and reduced labour. For fingerling 2 m cages can be used

Stocking

- Optimal stocking density varies with species and size of fish. For producing 5 tonnes of 500-600 g seabass from a 6 m dia. HDPE cage, 30-50 individuals (100 g) per cubic meter can be stocked.

Feeds and feed management

- Fresh or frozen trash fish, moist pellet (MP) and floating dry pellets are the common feed for growing fish in cages
- To avoid/ reduce fouling, net should be changed as and when required, which may vary from 2 to 4 weeks depending on the intensity of fouling.

Capture based aquaculture

- Capture based aquaculture (CBA) is a good concept for species for which hatchery technology has not been developed. Southern blue fin tuna (*Thunnus* spp) is cultured in Australia using wild- caught juveniles, which has great demand in global market. In India also many species can be cultured in a similar way.

16 Lobster Farming

What are Lobster?

Lobster is a shellfish; not a fish but a **crustacean**.

In wild It takes 5 to 7 years for a lobster to grow to the legal size to harvest

Commercially: Lobster is harvested approximately 6 to 7 months after when they reach a weight of about 800– 1000 grams.

Some Points to remember

Terms are not common though read it once so that if by chance they are asked atleast it can be marked with options available

- The greatest hurdle in commercial culture of spiny lobster is lack of a proven hatchery technology for commercial seed production.
- Prolonged larval phase (> 300 days for cold water and semi-tropical species)
- Egg bearing females from the wild or from captive broodstock are the two sources from which healthy larvae can be obtained for larval rearing.
- Peak breeding of *P. homarus homarus* in India is from December-March along the southwest and east coast of India and for *P. polyphagus* the period is from September-October.
- Newly deposited eggs are **orange in colour**.
- Newly settled puerulus is a non-feeding stage and they start feeding after the first moult.
- About 50 percent of lobster are caught through **trammel gill net**

- 'U' shaped polycarbonate or glass tanks were used by the Japanese investigators. The tank designed by Massachusetts Institute of Technology and used for rearing American lobster larvae was modified and used.
- Water temperature is maintained at 20-25°C for different species;
- Japanese prefer live lobsters of 200-300 g with deep red external colour.
- Minimum exportable weight of **200 g was achieved in 130 days**.
- 'Gaffkemia' - like disease was reported during fattening in indoor system.



- *Panulirus homarus* is a species of spiny lobster that lives along the coasts of the Indian and Pacific Oceans

17 Mussel Farming

What are mussels?

Mussel is the common name used for members of several families of **bivalve molluscs**, from saltwater and freshwater habitats.

On-Bottom Culture	<ul style="list-style-type: none"> • This method is widely used in Netherlands, Denmark and Germany. The culture is based on the principle of transferring seeds from areas of great abundance where growth is poor to culture plots in lower density to obtain better growth and fattening of the mussel • The production is about 22 tonnes per acre.
Long Line Culture	<ul style="list-style-type: none"> • This method is becoming very successful in open sea mussel farming. A rope is stretched horizontally near the water surface and maintained 1-2 m from the surface with buoys. Mussels are grown on vertical ropes known as 'droppers' which hang from the horizontal rope for a length of 4m. • The density at which mussels can be cultured on long lines could be about 300 per meter
Raft Culture	<ul style="list-style-type: none"> • The basic principle of raft culture is similar to long line culture in that the mussels are suspended on droppers but these are suspended from the raft instead of the long lines.

	<ul style="list-style-type: none"> This method of culture is used in the Galician Bays in Spain, Saldahna Bay in South Africa but has been abandoned by the New Zealand industry in favour of long lines.
Fixed Line culture	<ul style="list-style-type: none"> This is the simplest of the rope method used for green mussel cultivation in India and Philippines. The main purpose of the pole is to support the structure. In between these poles, ropes are suspended either vertically or kept horizontally where the depth is a limitation.

18 Fish Preservation (Post Harvest)

Packaging

Fish may be frozen using any of the following methods. If several fish are placed in the same package, place freezer paper or wrap between them for easier separation.

- **Lemon-Gelatin Glaze** Using lemon juice
- **Ice Glaze** — Place unwrapped fish in the freezer to freeze.
- **Water** — Place fish in a shallow metal, foil or plastic pan; cover with water and freeze.
- **FISH ROE** — Thoroughly wash and package in freezer containers or bags and boxes, leaving ¼-inch headspace. Seal and freeze.

Packing Practice

- They relate to the quality of foods labelled as "quick frozen" and require that foods labelled in this way should be brought through their zone of maximum ice crystallization as quickly as possible. Thereafter, they must be maintained at -18°C or below.
- **Freezing rates**

2 mm/h	Slow bulk freezing in a blast room.
5 to 30mm/h	Quick freezing in a tunnel air blast or plate freezer.
50 to 100 mm/h	Rapid freezing of small products.
100 to 1000 mm/h	Ultrarapid freezing in liquefied gases such as nitrogen and carbon dioxide

- **Frozen tuna**, which will eventually be eaten in its raw state as the Japanese product "Shasimi" seemingly requires to be reduced to a lower temperature than other fish products.
- **Double freezing means** freezing a product, thawing (change from a solid, frozen state to a liquid or soft one) or partly thawing it, and refreezing.
- **Freezing and frozen storage of fish can give a storage life of more than one year**, if properly carried out

- The mechanism by which frozen fish deteriorates is somewhat different from that causing spoilage of chilled fish. Provided the temperature is low enough - below -10°C bacterial action will be stopped by the freezing process.
- In extreme dehydration the frozen fish acquires a dry wrinkled look, tends to become pale or white in colour and the flesh become spongy. This characteristic appearance is called, inappropriately, '**freezerburn**'.
- Practical storage life for fish. From IIR Guide to Refrigerated Storage

	Storage life, months		
	-18°C	-25°C	-30°C
Fatty fish, sardines, salmon, ocean perch	4	8	12
Lean fish, cod, haddock	8	18	24
Flat fish, flounder, plaice, sole	9	18	24
Lobster, crabs	6	12	15
Shrimp	6	12	12

18.1 Fish Drying

Constant rate drying	During this period the rate of drying depends on the speed at which moisture can be carried away from the surface of the fish
FRP	The falling rate period is reached when the drying rate starts to decrease, and the surface water activity falls to less than one
Natural Drying	The energy of the sun and/or the wind is used in many countries to dry fish. Salted fish will take up moisture from the surrounding air if the relative humidity rises above 75 per cent.
Freeze Drying	Evaporation of moisture from fish placed in a vacuum quickly cools the fish due to the transfer of heat energy.
Hurdle Technology	Hurdle technology (also called combined methods, combined processes, combination preservation, combination techniques or barrier technology) advocates the deliberate combination of existing and novel preservation techniques in order to establish a series of preservative factors (hurdles) that any microorganisms should not be able to overcome.
Fish Marination	Fish marinades are fish or shellfish preserved in a mixture of acetic acid and salt so as to get a product with extended shelf life and flavour.
Fish fermentation	Fermented fish sauces and pastes generally contain amino acids and polypeptides equivalent to about 10% protein.
Smoking	Carrying out the smoking process at a temperature upto 30°C is called cold smoking Carrying out the smoking process in which the fish is exposed to increasing temperatures up to at least 70°C is called hot smoking In a mechanical kiln, hot smoking is carried out in three stages. <ul style="list-style-type: none"> • A preliminary drying period at about 30°C. During this time the skin is toughened to prevent breakage occurring in the remainder of the process.

	<ul style="list-style-type: none"> • A smoking and partial cooking period at 50°C • A final cooking period at 80°C • The total time could be up to 3 hours.
Salting	<ul style="list-style-type: none"> • Dry salting: This is the most widely used method of fish curing. All types of fishes except fatty fishes, big or small are cured by this method. Yield of the product by this method is about 35-40%. This product has a shelf life of 6-10 weeks. • Wet Salting: These products have moisture content of 50-55% and the salt content around 25%. • Mono Salting: Mono curing is mainly done on medium to small size fishes. The yield is about 70% and product has a shelf life of 50 days. • Pit Curing: The fish is mixed with salt in the ratio 4:1 and put in pits dug on the beaches. The quality is poor and the fish is highly contaminated with sand and has a shelf life of about 20 days. This is commonly called as 'Kuzhi Karuvadu'. • Colombo Curing: colombo curing is actually a pickling process for wet salt curing of pelagic fish. Colombo curing, although it became extinct in India, is still practiced in Sri Lanka where the process is known as "jadi".
Traditional methods	Salting, Drying, Marinating, Fermentation

19 Fish By Product

1. GELATIN: Fish Gelatin is a protein product extracted from collagen rich fish skin (or) scale material by hot water. The Gelatin molecule is made up of Amino Acids joined together by Amide Linkages in a long molecular chain.

- Gelatin is a protein **that lacks** in an essential amino acid **tryptophan**,
- **High source of lysine and methionine.**
- Gelatin can be extracted from the skin and bones of fish.
- Gelatin is used in the food industry as a gelling, stabilising, emulsifying, dispersing or thickening agent.

2. FISH INSULIN

- Stable form of fish Insulin is obtained.

3. FISH ALBUMIN

- Fish albumin is a product similar to egg albumin in physical and chemical properties.
- Two grades of fish albumin are produced, the technical grade and the food and pharmaceutical grade.

4. FISH PROTEIN CONCENTRATE

- Fish protein concentrate (FPC) is a stable protein concentrate prepared from whole fish or other aquatic animals or parts thereof.

5. SHARK FIN RAYS

- The shark fins are dried, soaked overnight in 10% acetic acid solution.
- Shark fin rays are an essential ingredient in some exotic soups.

6. Chitin and Chitosan

- In India, the single largest source of chitin is **the shrimp shell** and head waste.
- Chitin is produced from the shell waste by **de-proteinisation** and demineralization.
- Chitosan is produced by the **deacetylation** of chitin.
- Chitosan has several industrial and medicinal uses.

7. Squalene

- Squalene is a highly **unsaturated hydrocarbon** present in the liver oil of certain species of deep sea sharks mainly Centrophorus and Squalidae spp.
- The **liver oil of these species contain high percentage of squalene (90%)** which can be isolated and purified and can be used as a dietary supplement.

8. Isinglass

- Isinglass is prepared from **fish maws** (dried air bladder).
- Fish maws is soaked in water for 24 hours, washed and extruded, dried at 450 c and then powdered.
- It is mainly used for the **clarification of wines**.

9. Collagen-Chitosan Membrane for Plastic Surgery and Dentistry

- Obtained from collagen of fish air bladder and chitosan from prawn shell
- Has medical uses

Points to remember Fish By- Products

- Fish oil is obtained from Tissue of oily fish or fat of cold water fish
- Fish oil has **25% saturated and 75% unsaturated fatty acid**
- Fish liver oil has high concentration of Omega 3 fatty acid, EPA & DHA
- Fish meal contain 60-72% crude protein
- Fish Silage is liquid byproduct
- Tatamiiwashi Japanese dish from sardines

20 Importance

- Top Fish Producing State of India Andhra Pradesh

- World Fishery Day 21 November
- National Fish Farmers Day 10 July - NFFD is celebrated to honour and commemorate the contribution of Professor Dr. Hiralal Chaudhury and his colleague Dr. K. H. Alikunhi, in Indian fisheries sector who had guided the induced breeding and reproduction in **Indian Major Carps by Hypophysation technique**, on this day 1957, which eventually lead to a revolution in Inland Aquaculture. **Hypophysation** is a process in which ripe fish brooders are induced to breed in captivity using pituitary hormones and thus helps in SPAWNING.
- GnRH hormone is released by Hypothalamus (TRIGGERED BY Pituitary)
- World Tuna Day 2 May
- Seasonal Fishing Ban/ Closed Season (60 days)
- East Coast of India 15 April to 14 June
- West Coast of India 01 June to 31 July
- Matasya Bharat Newsletter Published by NFDB, Hyderabad
- The National Fisheries Development Board (NFDB) was established in 2006
- Salt concentration in sea water is 35% and salt concentration in fish tissue is 18%, so fish increases its salt concentration in body by drinking salt water, excreting salt through gills, minimal water loss in urine.
- Jellyfish, star fish, Silver Fish and cuttle fish do not fulfil all the criteria and that is why they are not true fishes.
- The ideal pH range of a freshwater aquarium is between 6.8 and 7.8. In open area range is from 6.8 to 9
- The **Bombay duck** is a popular fish in areas of India particularly In Maharashtra
- **Scoliodon** is the genus of the mud shark or the dogfish. They **are viviparous**, i.e. they give birth to live young ones, and develop embryos form a highly complex placental connection to the mother at a very small size.
- **Sardines are small epipelagic fish that sometimes migrate along the coast in large schools.**
- **Anabas** is a genus of climbing gouramies., They are **oviparous** as they lay eggs.
- **Heteropneustes** is a genus of catfishes. They are **oviparous** as they lay eggs.
- Catla catla is commonly known as carp. Carps too lay eggs and are oviparous.
- The **Central Marine Fisheries Research Institute** has taken part in a pioneering project of the Fisheries Department to deploy **artificial reefs (AR)** in a total of 3,477 fishing villages in the country with the objective of promoting sustainable fisheries and livelihood.
- **Milkfish (Chanos chanos):** The milkfish (Chanos chanos) is one of the most ideal finfishes for farming in coastal areas. They are fast growing, tolerates a wide range of temperature, oxygen and salinity.
- **Banned Fish in India:** African catfish or Thai Magur banned by NGT in 2000, Common Pleco (Sucker Catfish)

- Titled '**Marine Fish Stock Status of India 2022**', the report also highlighted the substantial reduction in unsustainable practices, with just 4.4 per cent of the stocks facing overfishing. Carried out by the ICAR-Central Marine Fisheries Research Institute (CMFRI), the study points out that a resounding 91.1 per cent of the 135 fish stocks assessed in 2022 were deemed healthy, marking a significant milestone in India's efforts to maintain the sustainability of its marine fisheries.
- In a significant boost to innovation and entrepreneurship in the field of fisheries, the **Kerala University of Fisheries and Ocean Studies (Kufos)** has secured a grant of ₹10 crore from **NITI Aayog**.
- The grant aims to establish India's first Atal Incubation Centre (AIC) in the field of fisheries at the University, fostering a culture of innovation and technological advancement. AIC initiative is part of the Atal Innovation Mission (AIM), which seeks to encourage a culture of innovation and entrepreneurship across various sectors in India.
- The 60 % of the expenses of total operational cost of fish farming goes for feed alone.
- The journey of "**Sagar Parikrama**" has started with the theme of "**KRANTI se SHANTI**" on 5th March 2022 from Mandvi, Gujarat covering 3 locations Mandavi, Okha-Dwarka and Porbandar.
- Finance Minister in her budget speech FY 2021-22 has allocated an amount of **Rs. 1220.84 crores for the Department of Fisheries**, which is the highest ever annual budgetary support for the Department.
- Fisheries has been recognized as a 'Sunrise Sector' and has demonstrated an outstanding double-digit average annual growth of 10.87% since 2014-15, this includes an allocation of **Rs. 1000 crores for the flagship scheme of the Department, Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme for FY 2020-21.**
- **5 major fishing harbours** – Kochi, Chennai, Visakhapatnam, Paradip, and Petuaghat – will be developed as hubs of economic activity.
- To promote seaweed cultivation, Multipurpose Seaweed Park will be established in Tamil Nadu, the announcement made by Honourable Finance Minister will further accelerate the growth of seaweed cultivation and enhance the incomes of the coastal communities. The Seaweed park in Tamil Nadu, with an investment of Rs. 100 crores, will be developed as a hub to serve as a One Stop Park for the entire seaweed value chain
- Government has decided for introducing a comprehensive and integrated 'National Fisheries Policy, 2020' by integrating the National Policy on Marine Fisheries, 2017 (NPMF), the Draft National Inland Fisheries and Aquaculture Policy (NIFAP) and the Draft National Mariculture Policy (NMP) along with the elements of Post Harvest.
- **Brood banks** (including seaweed banks) : 6 Nos approved
- **Matsya Seva Kendra**: 20 units approved. State/UT-wise targets prepared. Concept on establishment and operation of the MSK is being finalized.

- The Union Government in its Budget 2018 has set aside Rs. 7,550 crore for setting up of a dedicated Fisheries and Aquaculture Infrastructure Development Fund (FIDF).
- The Pradhan Mantri Matsya Sampada Yojana (PMMSY) aims to enhance fish production to 220 lakh metric tons by 2024-25 from 137.58 lakh metric tons in 2018-19 at an average annual growth rate of about 9%.



- **Andhra Pradesh**, with 71 per cent share, is the largest producer of shrimp in the country. West Bengal (10 per cent), Odisha (9 per cent), Gujarat (5.5 per cent) and Tamil Nadu (2.7 per cent) are the other producers.
- As per Central Marine Fisheries Research Institute (CMFRI) 2019 data, Tamil Nadu grabbed the first position with 7.75 lakh tonnes of landings overtaking Gujarat.
- As per “**Handbook on Fisheries Statistics - 2018**” Andhra Pradesh has recorded the highest production of inland fish (34.50 lakh tonnes) where as Gujarat is the leading state in Marine fish (7.01 Lakh tonnes) in the country.
- **Lean fish** are those that are low in fat. Examples: flounder, sole, cod, red snapper, bass, perch, halibut, pike. Fat fish are those that are high in fat. Examples: salmon, **tuna, trout, butterfish, mackerel**.
- **Mackerel** are carnivore fishes
- **The majority of marine fish are omnivorous, which means they need to eat both meat- and plant-based foods**
- **Parrotfish and surgeon fish are Herbivore fish**

21 List of Fisheries Institutes

1. Central Inland Fisheries Research Institute, Barrackpore, West Bengal
2. Central Institute of Brackishwater Aquaculture, Chennai, Tamilnadu
3. Central Institute of Fisheries Education, Mumbai, Maharashtra
4. Central Institute of Fisheries Technology, Kochi, Kerala
5. Central Institute of Freshwater Aquaculture, Bhubaneswar, Orissa
6. Central Marine Fisheries Research Institute, Kochi, Kerala

7. National Bureau of Fish Genetic Resources, Lucknow, Uttar Pradesh
8. National Research Centre on Coldwater Fisheries, Bhimtal, Uttarakhand
9. Central Institute of Fisheries nautical & Engineering Training (CIFNET)- Kerala
10. National Institute of Fisheries PHT & Training (NIFPHATT) – Kerala
11. Central Institute of Coastal Engineering for fishery (CICEF) – Bangalore, Karnataka

22 Biotechnology

• Aquaculture Marine Biotechnology Programme – 1988-89	
• ICAR NBFGR & DBT Germplasm resource centre – CMLRE	
• Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences – Kerala	
• Whole Genome Sequencing – Rohu & Magur	
• Triploidy – Trout and Cat fish	

NEXT – PART XI

FORESTRY

Forestry: Basic concepts of Forest and Forestry. Principles of silviculture, forest mensuration, forest management and forest economics. Concepts of social forestry, agroforestry, joint forest management. Forest policy and legislation in India, India State of Forest Report 2015. Recent developments under Ministry of Environment, Forest and Climate Change.

Feedback can be submitted to E-Mail: Clarity4sure@gmail.com

Notes will be updated as and when required and reposted in telegram channel