



**Developing Sri Lanka as a Center of Excellence for Climate
Action**

Sustainable Fishing; Local

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Outline

1. Impact of ocean warming on large pelagic fish stocks

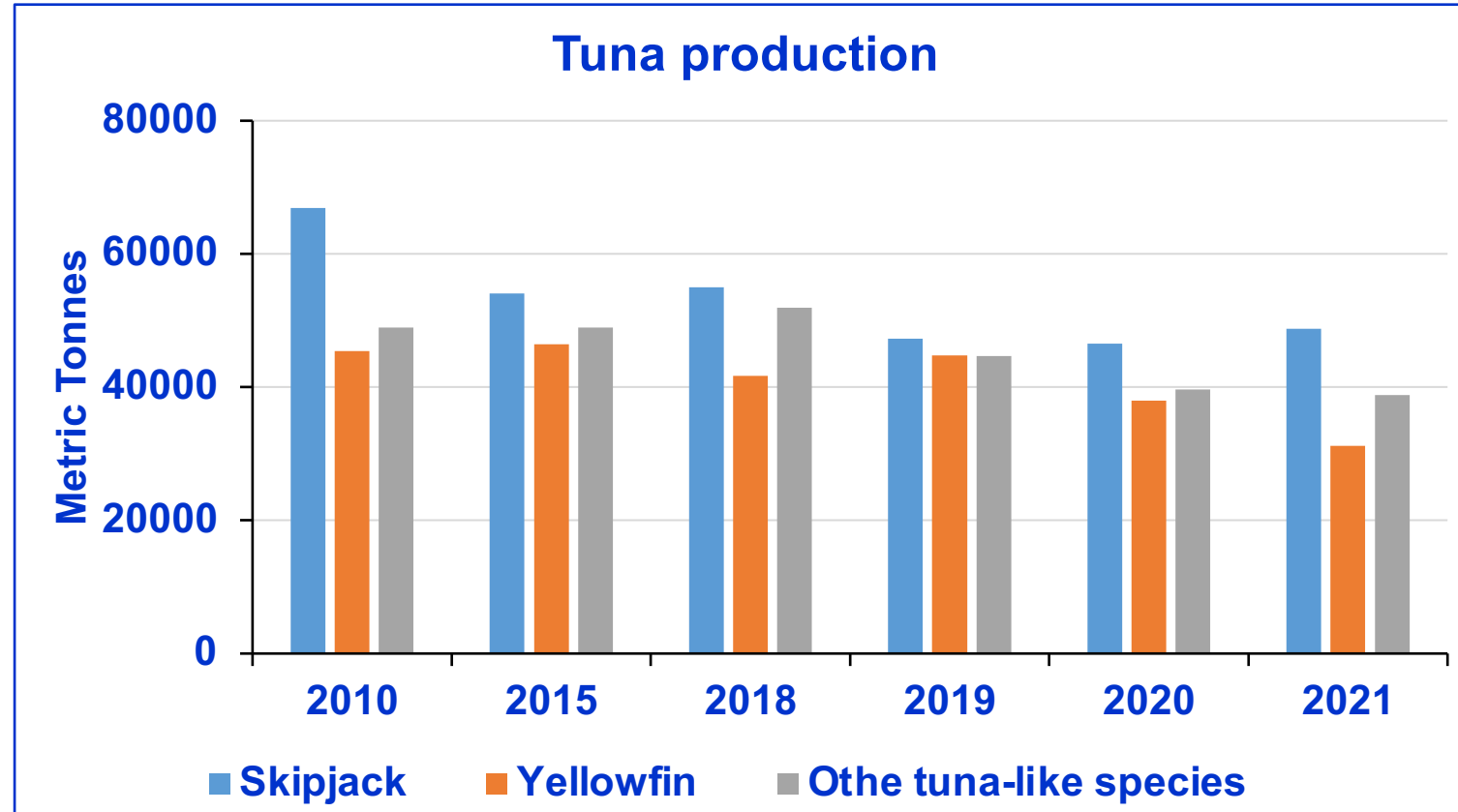
- Effect on export industry
- Possible mitigation measures

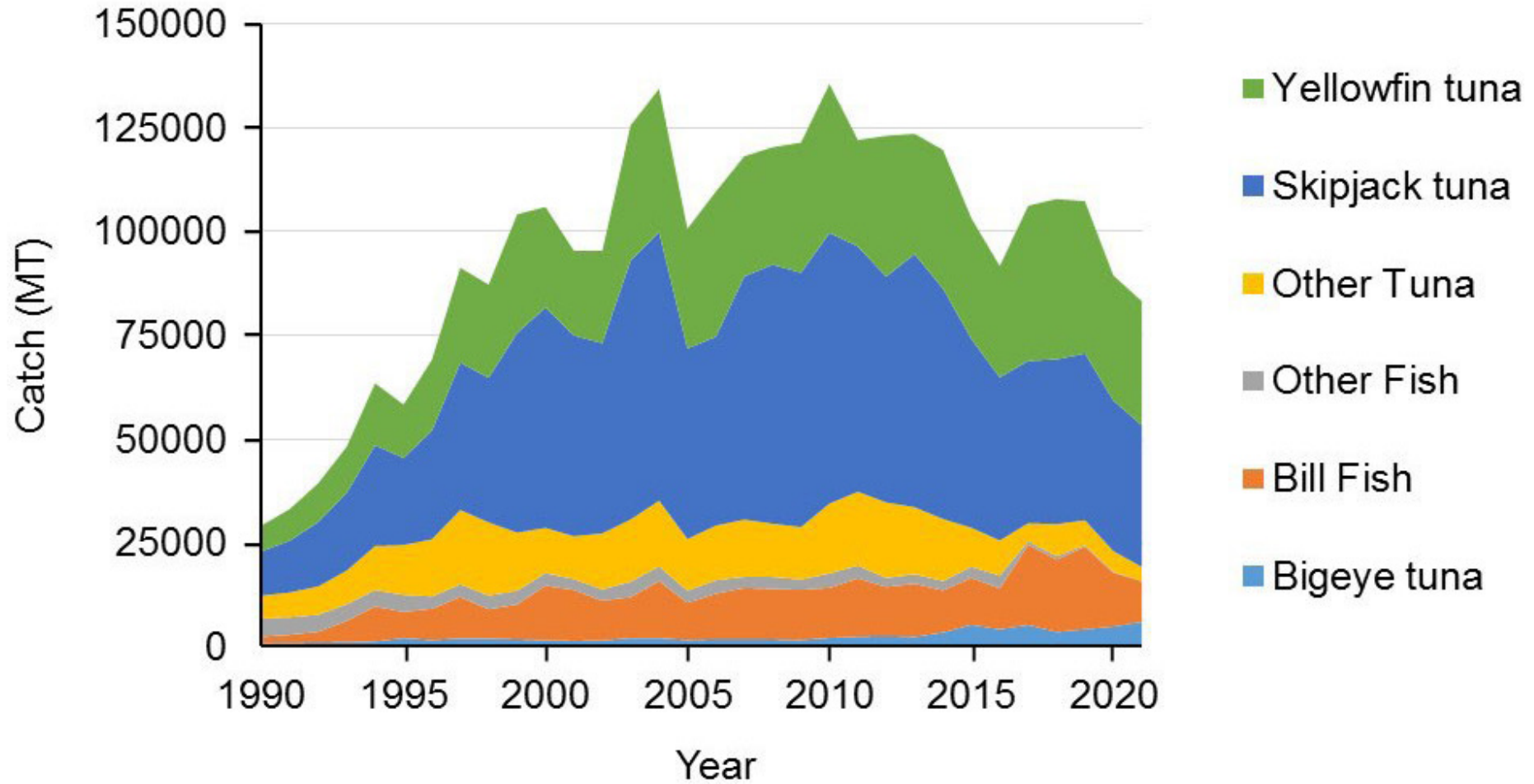
2. Impact of shifting of monsoonal rainfall on culture-based fisheries in inland reservoirs

- Possible resilience to climate change impacts
- Potential for value addition
- Role of business community

(1) Impact of ocean warming on large pelagic fish stocks

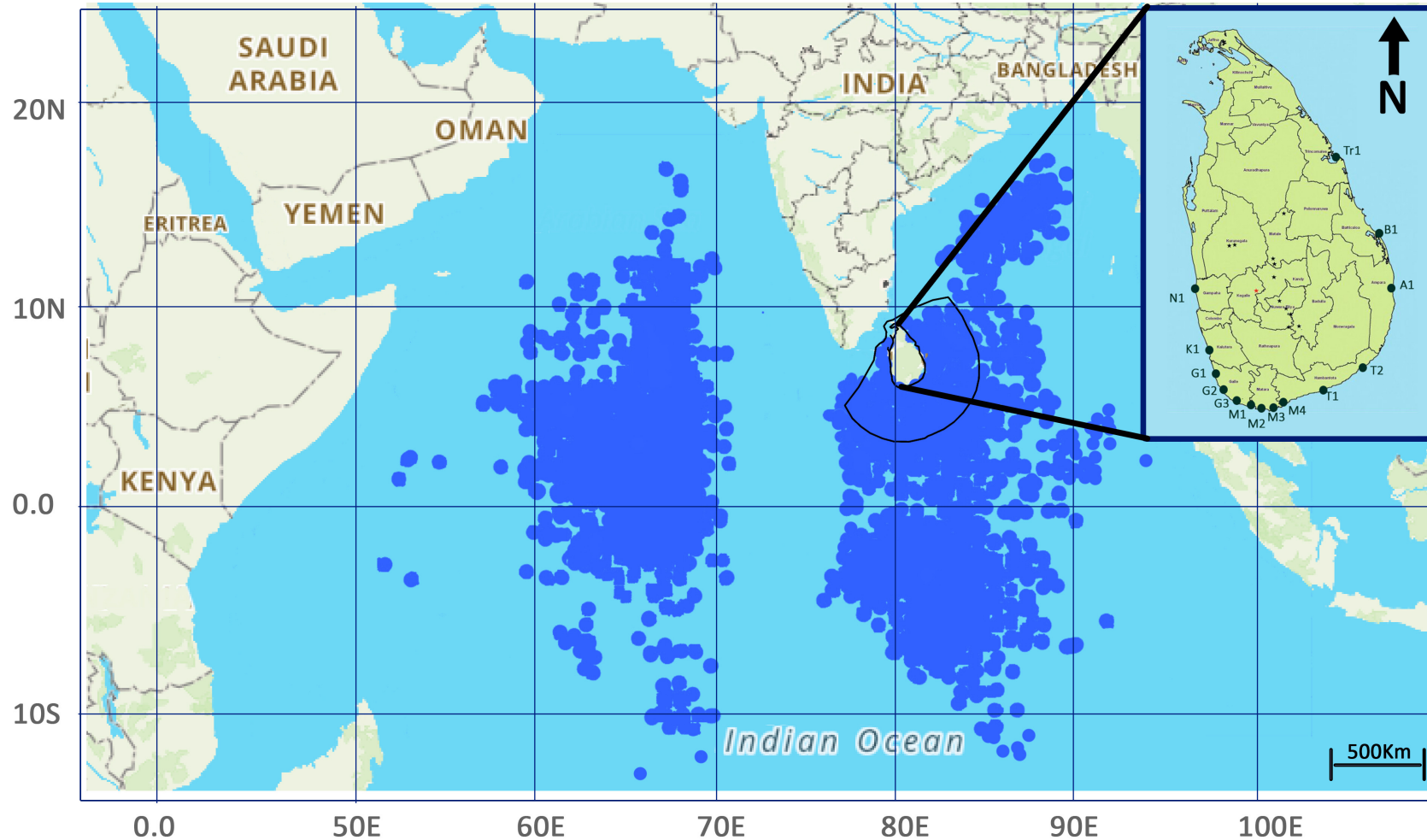
Effect on export industry





Especially, export-oriented tuna species are in decline.

Fishing grounds of multi-day boats



As vessels are monitored by VMS and Logbook records, fishing movements are restricted.

Why pelagic fish production (especially in longline fishing) declined?

Fish growth rate = anabolism – catabolism

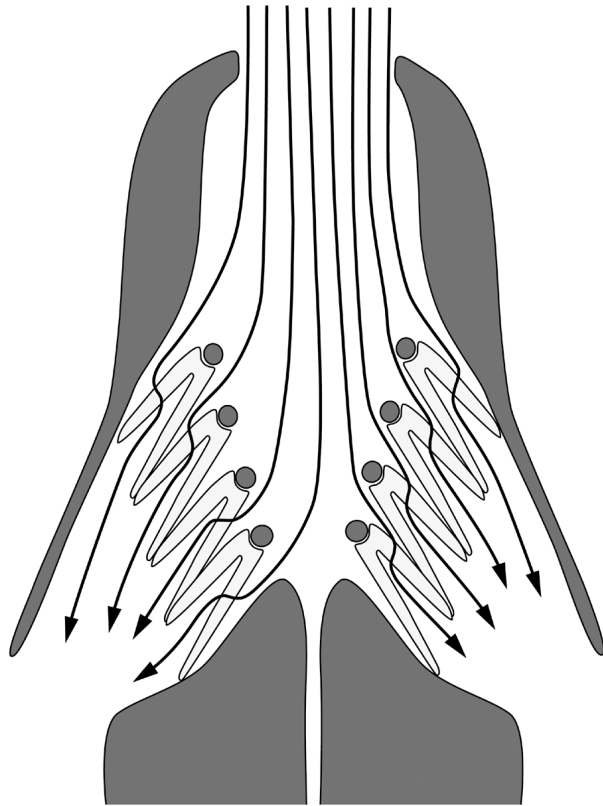
Anabolism is protein synthesis (which needs oxygen); Catabolism is protein denature (which does not need oxygen).

When Anabolism = Catabolism, growth of fish stops.

Fishes are water-breathing ectotherms. Therefore, metabolic rate (anabolism, which requires oxygen) is dependent on temperature.

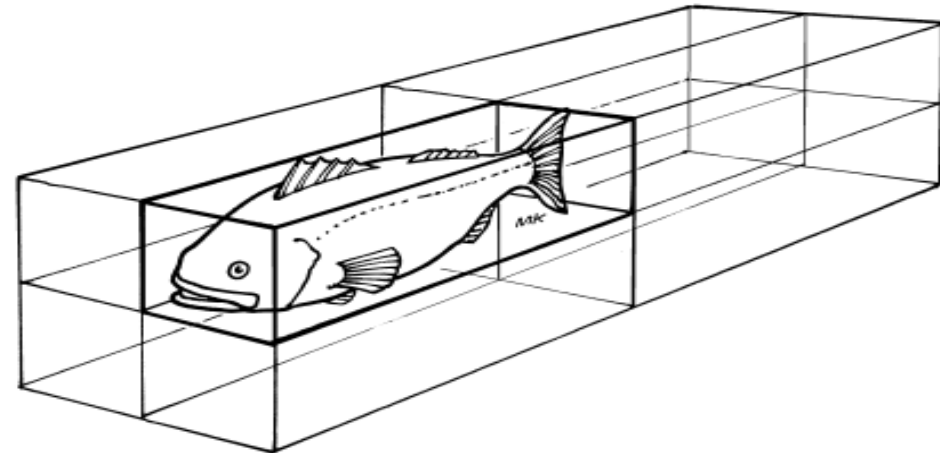
Also, oxygen availability is about 23 times less than in atmosphere.

Oxygen limitation in fish



Fish obtain oxygen via gills. Gill surface area grows two-dimensionally.

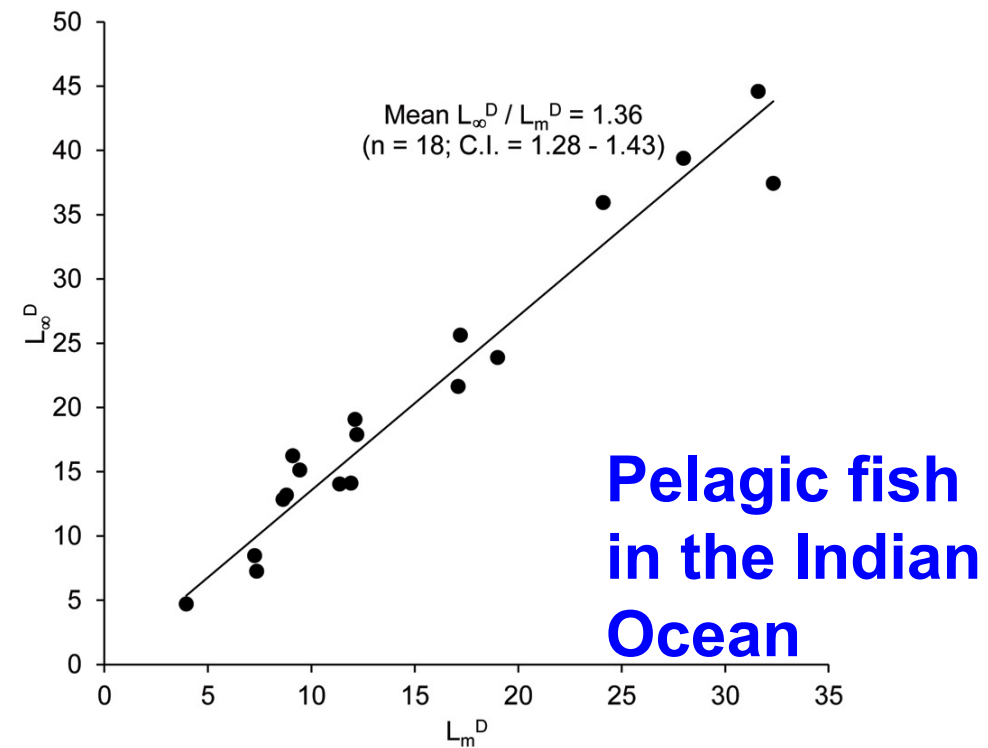
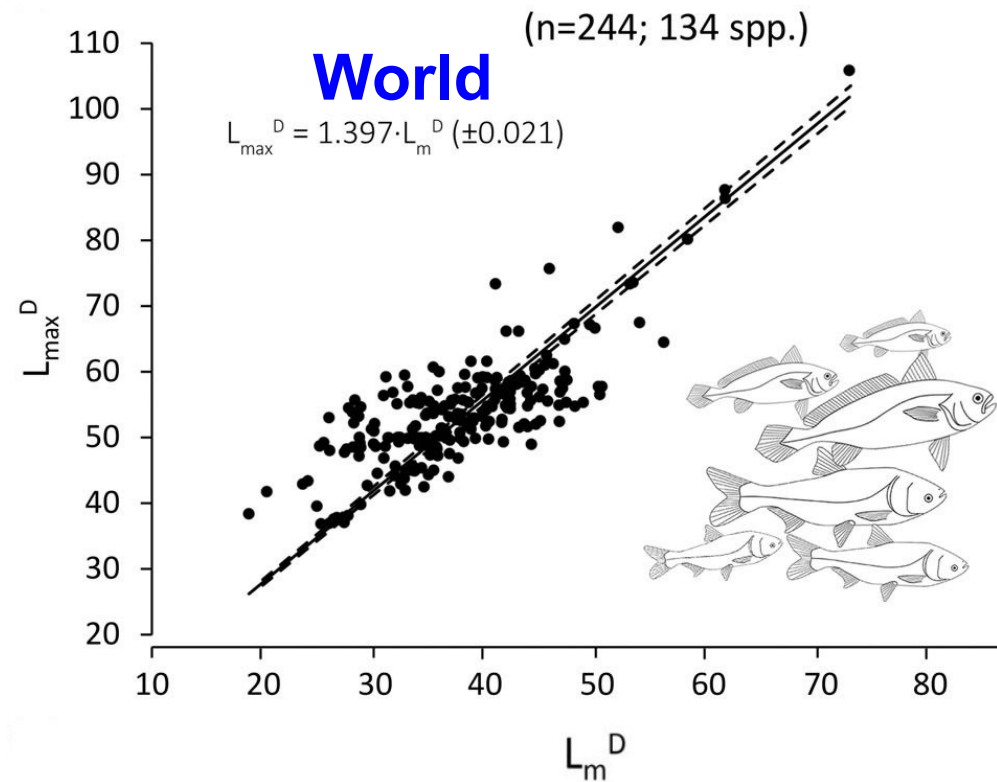
On the other hand, body size grows three-dimensionally.



As fish grow, at one stage, their two-dimensional gills have difficulties providing oxygen to their growing three-dimensional bodies. Less oxygen means that there is a point at which the oxygen required for growth is limited.

At this stage, the hormonal cascade is triggered to commence spawning.

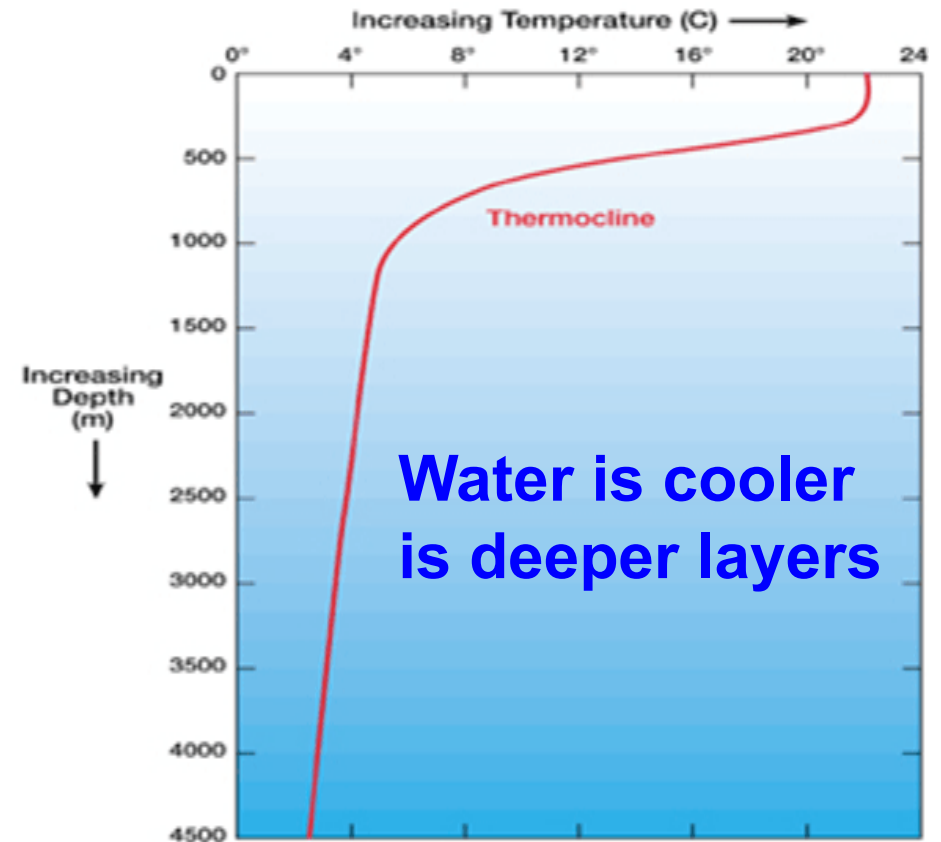
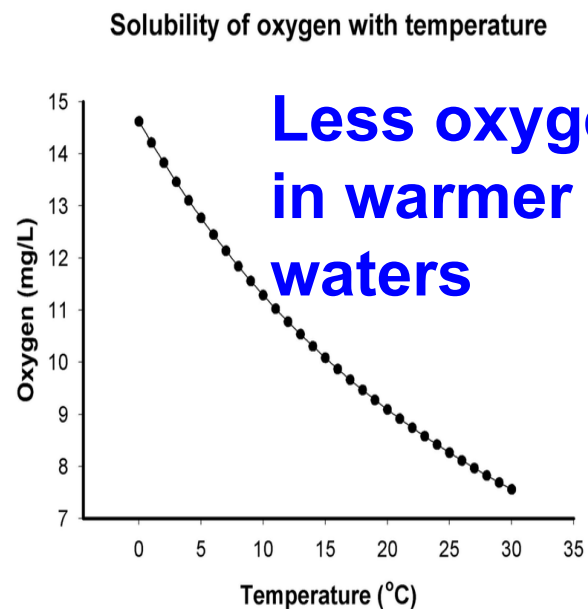
In all fish species, therefore, the ratio of size of maturity to the maximum body size is fairly consistent having a value of 1.3 to 1.4.



At this stage, fish growth stops, and oxygen is utilized only for body maintenance.

However, migratory fish species like tuna can move to oxygen-rich areas.

Temperature vs. Dissolved Oxygen



Water is cooler in polarward area. Hence oxygen levels are higher.

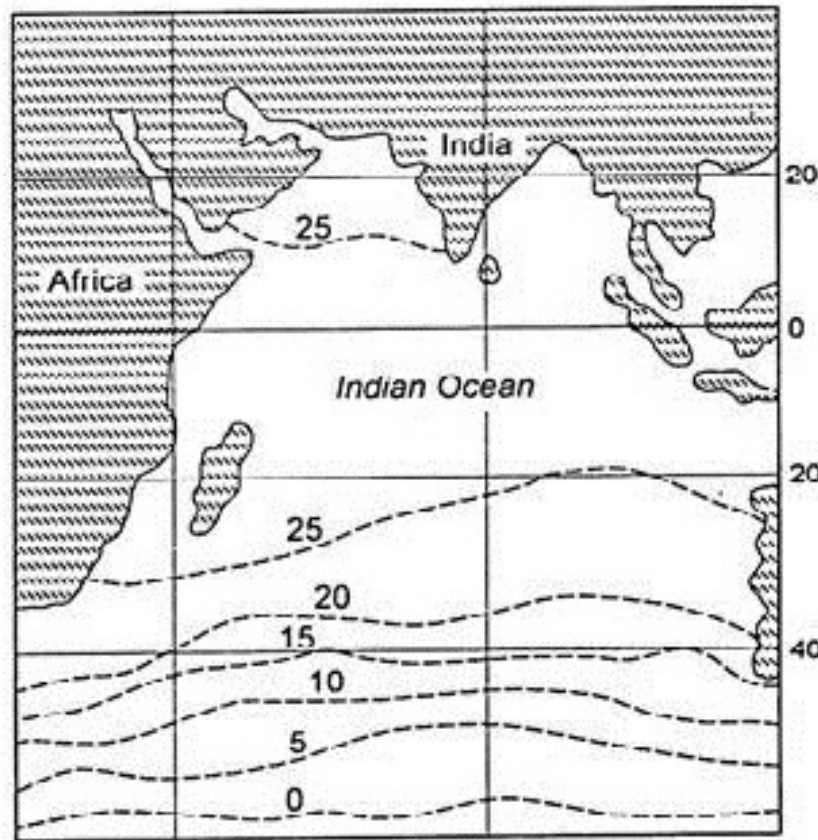


Fig. : Horizontal distribution of temperature in the Indian Ocean (February).

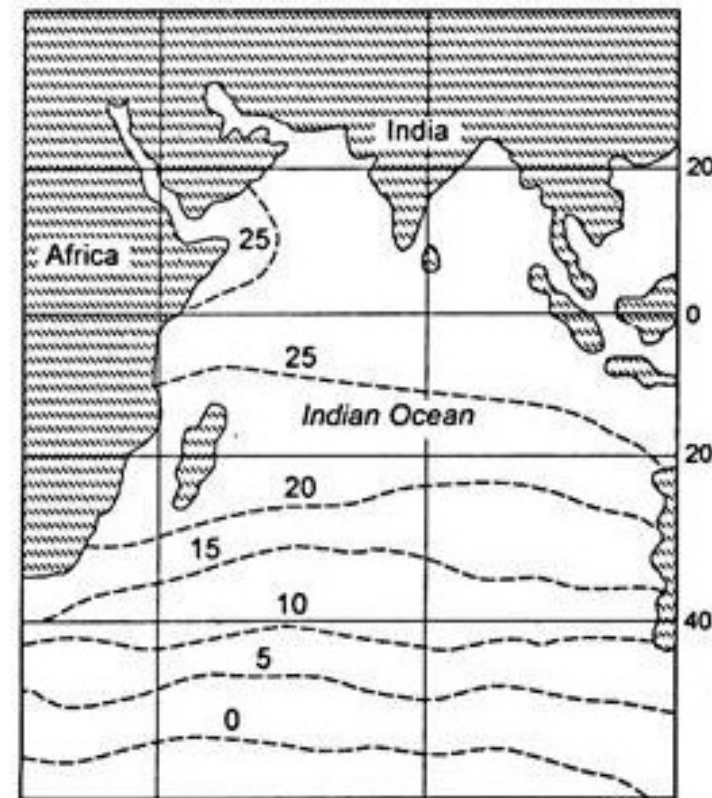


Fig. : Horizontal distribution of temperature in the Indian Ocean (August).

The decline in tuna catches in longline fishing of multiday boats is therefore due to movement of target species to cooler areas.

Possible mitigation measures

Current fishing gear (i.e., lengths of branch lines of long lines) and fishing vessels are needed to be modified to increase catch.

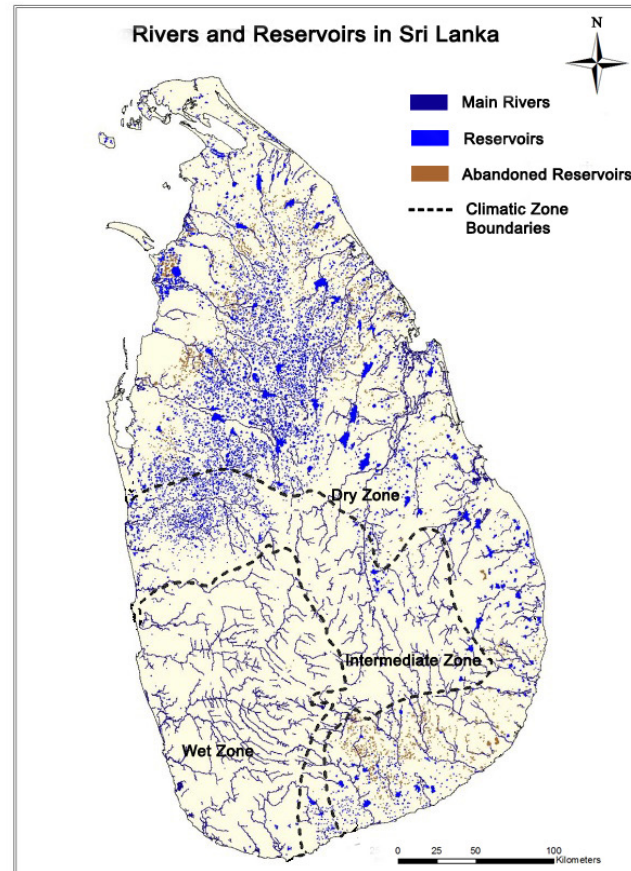
Accurate fishing ground forecasting system is needed to be introduced.

- Although fisheries authorities provide fishing ground forecasting information, fishers do not rely on them.
 - They use various traditional means such as presence of rocks, wave heights, bird behaviour, etc. to decide the areas to operate their fishing gear.
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- An operational information system, based on information technology and space technology as well as artificial intelligence and big data technology is needed to be in place for accurate forecasting of fishing grounds.
 - This remain extremely challenging, mainly due to unaffordability and lack of technology and capacity. Such systems also require significant investment and ongoing maintenance. **This needs external support/investment.**

Benefits to the stakeholders:

- Reduction of postharvest quality losses of fish landings of multi-day vessels;
- Reduction of operating cost of multi-day vessels;
- Increased foreign revenue by exporting high-quality tuna;
- Adoption of the novel method of forecasting productive fishing grounds by fishermen of multi-day vessels.

(2) Impact of shifting of monsoonal rainfall on culture-based fisheries in inland reservoirs



Sri Lanka's multitude of reservoirs, scattered all over the country can be used for culture-based fisheries (CBF) development.

CBF is a strategy to stock fish fingerlings in reservoirs for subsequent harvesting.

CBF development of village reservoirs is dependent on the inter-monsoonal rains (beyond our control).

All strategies should be adjusted to suit the timing of reservoir filling.

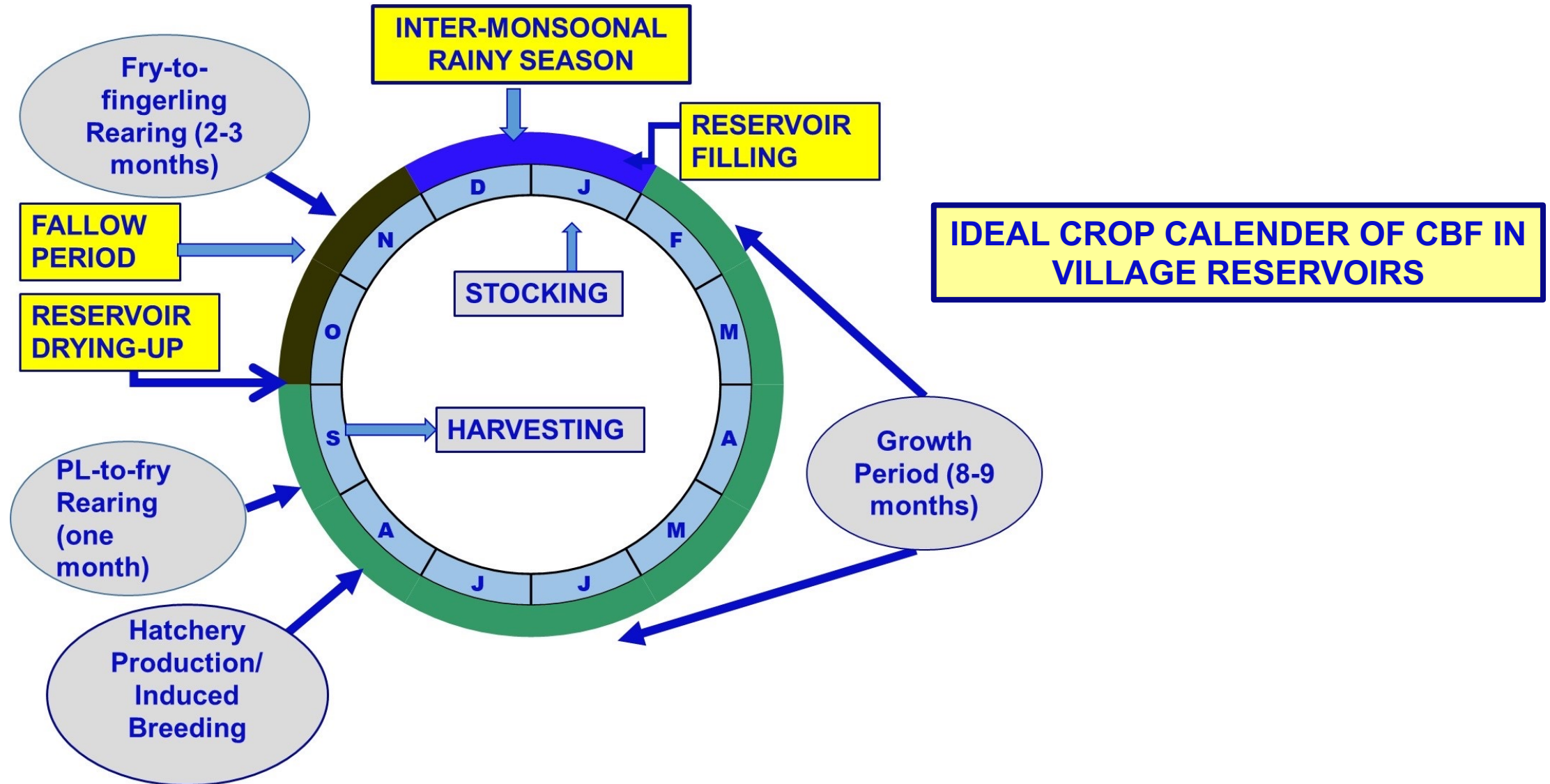
Fingerlings should be made available by January.

Rainy season (November-January)



Dry season (August-October)

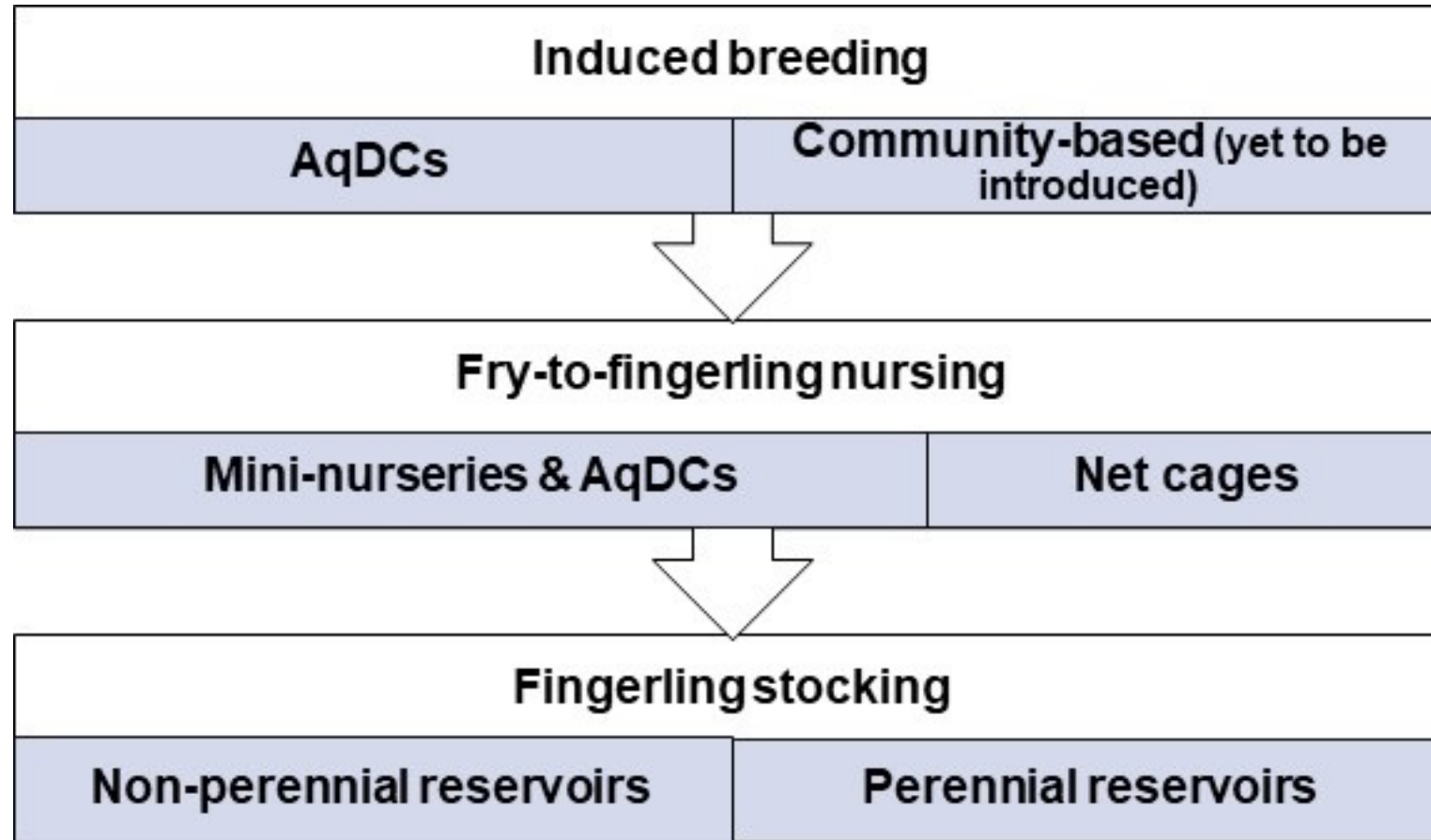




Possible resilience to climate change impacts

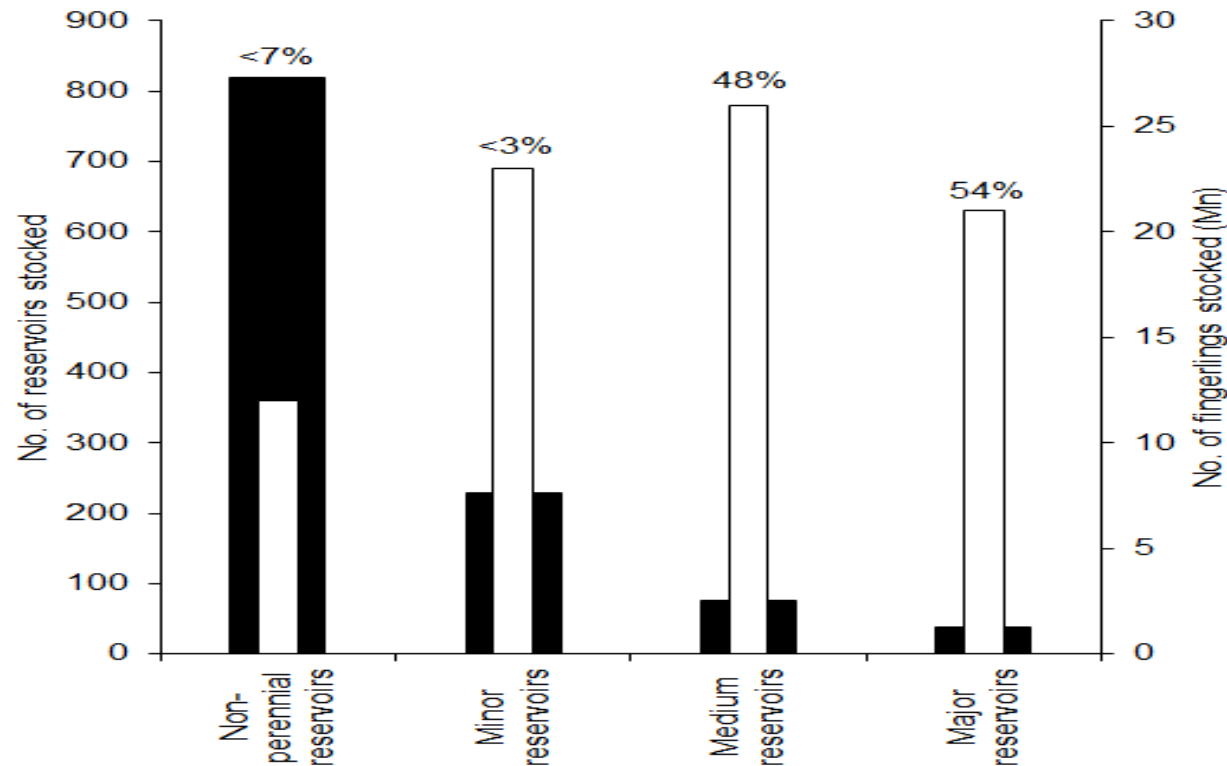
- **Due to monsoonal rainfall anomalies, inter-monsoonal rainfall and consequent reservoir filling is unpredictable.**
- **Hence, planning CBF in village reservoirs is problematic.**
- **Alternative strategies for stocking (i.e., stocking of minor and medium reservoirs) are necessary.**

Insufficiency of fingerlings to stock in reservoirs



As induced breeding of major carps is entirely carried out by AqDCs, fingerling production process has a bottleneck.

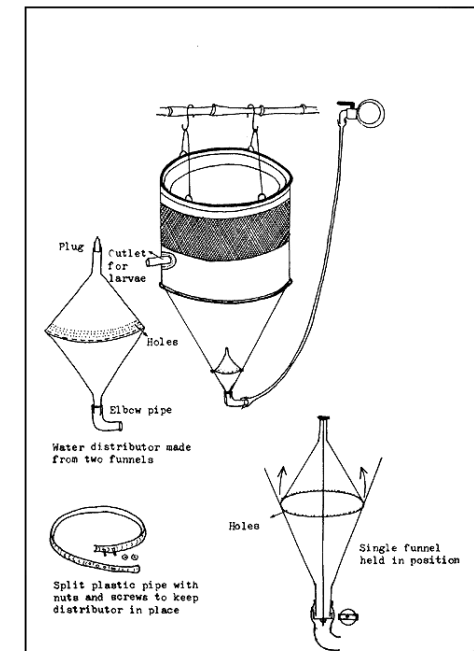
The proportions of the existing reservoirs of different categories (% values shown), that are annually stocked are very low, showing insufficiency of fingerlings produced. Only less than 7% of existing >12,000 village reservoirs are stocked annually.



Black columns: Number of reservoirs stocked

White columns: Number of fingerlings stocked

Simple backyard hatchery systems can be introduced to rural community groups with a proper training on induced breeding of major carps.



Possible to construct improvised hatchery jars using plastic mega soda bottles.

This intervention does not require 'full-scale' research. Simple technology transfer research is possible.

In the South Asian region, backyard hatcheries of Indian major carps are numerous (especially in India and Bangladesh).



Fibreglass reinforced plastic carp hatchery in Odisha, India, involving self-help women's group.

Postharvest products

Potential for value addition and Role of business community



Catla canned fish



Surimi



Fish balls

Summary of main points:

(1) Shifting of pelagic fish stocks

- Due to sea water temperature rise, resulting oxygen depletion, pelagic fish species move either to deeper, cooler areas or cooler polar ward area.
- Multiday fishers are unable to target these shifted fish species unless they modify their fishing gear and vessels.
- This might affect export earnings of fish (mainly tuna).
- New technologies should be introduced to find productive fishing grounds.

Summary of main points (continued):

(2) Effect of rainfall anomalies on culture-based fisheries

- Due to unpredictability of monsoonal rainfall, planning CBF is problematic.
- Alternative stocking strategies in minor and medium reservoirs should be introduced.
- Fingerling scarcity should be addressed through introduction of backyard hatcheries with community participation.
- Value-added products should be developed for the future surplus production of CBF.

