

## **Data logging, seasonal calendar, fishing schedules and conflict resolution**

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The AR sites in our experience get active in 12 weeks of incubation time and the fishers can test their sites using baited hooks. Based on the natural fishery grounds and the reefs areas in the vicinity it is ideal to draw a seasonal timeline series of the resource availability and grounds specific to the gears employed in each village. Many studies have been conducted to determine when communities on newly placed reefs have reached a point of equilibrium. This ecological stability seems to be reached after two to three years. Seasonality has been observed to be the second major factor to affect the quantitative species composition of assemblages. The effect of seasonality, however, seems to be mitigated in the course of a year. Inputs are to be generated from the fisher log books, analysed and compared with the benchmark data of ICAR-CMFRI from these sites and zones with respect to the specific gears and crafts.

### **Case study: Kovalam village in Chingleput district, Tamil Nadu**

January: Trammel nets for cuttlefishes, bottom set gillnets for the reef fishes, hook lines fishing for the perches and groupers.

February: The capture of shore shoaling pelagics, anchovies, sardines and mackerel.

March: Hooks & lines over reefs and other areas, gill nets for mackerel, ground-set nets and lines for groupers and snappers, deep sea lines for seerfish, sail fishes, dolphin fishes etc.

April: Lean period. Gill nets for mackerel, carangids, bottom-set nets for reef fishes like belones and lobsters.

May: Lean period. Gill net fishing for pelagics, belones, tunas, seer fish lines, gill nets for mackerel

June: Reef fishing for snappers and groupers, bottom-set gill nets for goat fishes, rays, crabs, lines for seer fishes.

July: Better fishing season. Bottom-set gill nets for rabbit fishes, mackerel, carangids and barracuda, halibut, drift gill nets for pelagics, lines for seer fish.

August: Better fishing season. Reef fishery with drift gill nets and hooks and lines, bottom-set gill nets for goat fishes, rabbit fishes, gerrids, halibut.

September: Lines for seer fish, groupers, gill nets for mackerel, carangids, barracudas, bottom set gill nets for rabbit fishes, drepanids, breams, crabs.

October: Good fishing season. Bottom set nets for shrimps, shore gill nets for pelagics like sardines, carangids, silver bellies, mackerel, and lines for seer fish, groupers, and snappers.

November: Bottom-set gill nets and surface drift nets for pelagics like carangids, lobsters, crabs, shrimps, smaller pelagics.

December: Surface and nearshore fishery of mullets, bottom-set gill nets for shrimps, reef fishes, rays, sciaenid, rabbit fishes, surface gill nets for sardines and ribbonfishes.

Fishing practices prevalent over the reefs:

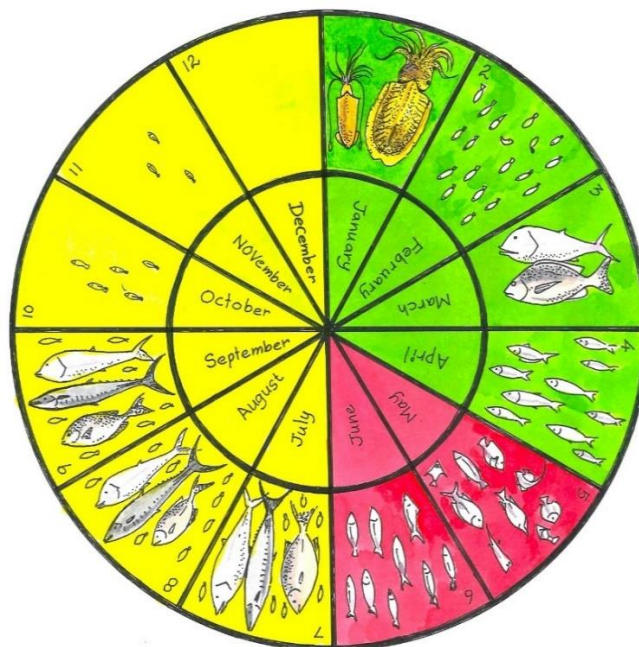
**1. Direct**

- Fishing by hooks and lines
- Drift gill nets
- Trap nets and surface seines

**2. Indirect**

- Small hooks –live bait collection
- Shadow fishing –temporary fads

A typical model fishing calendar and schedule can be introduced once the fishing patterns and resource trends are available. They may vary from village to village and therefore need to be perfected to each village and zone based on the reef performance and assemblage characteristic. These calendars could minimize energy and effort costs and look into resource health in a better manner and as well could add value to the caught fishes since they are from sustainable practices. These tools would serve as the first step toward AR assisting in coastal fisheries management.



**Fig.63. Model Seasonal calendar developed for AR site at Kovalam, Tamil Nadu**

The calendars developed could be on different parameters

- a. Fish availability and abundance
- b. Migrants and visitors stay periods
- c. Recruitments and nursing periods of important varieties
- d. Aggregation and spawning intervals of important groups
- e. Efficient fishing periods over reefs for select species and best periods for recommended sizes for capture
- f. Periods of no fishing for select groups
- g. Periods of good dives and visibility
- h. Periods of annual visitors and large fishes, whale sharks
- i. Periods of anoxia and upwelling
- j. Periods for monitoring and ghost net clean-ups
- k. Rotation of fishing amongst the AR patches and natural grounds and reefs.

### **Recreational fisheries**

**SCUBA Diving:** When the water is clear and less violent and the sailing conditions are good, sport fishing and SCUBA could be a very interesting alternative for the youth to engage into eco-tourism.

**Pole and lines:** Live baits and jigs can attract fishes and thus be another option.

**Troll lines:** Having false baits and trolling over the reef sites in clear conditions can be a very good alternative for the capture of larger pelagics - seer fish, cobia, sharks, tunas, barracudas and coryphaenids for sport fishing.

**Ornamental collections:** A future scope for this is emerging and consistent brood stock and ranching to the ARs could possibly supplement the ornamental industry in a big way.

**Breeder banks and juvenile repository:** The breeding populations sheltering in the ARs could possibly give scope for the revival of a population: and this also gives us an opportunity to transplant/ relocate or ranch and wild release of select breeders onto the ARs sites and these programs could well be organized and supported through CSR fundings.

**Transplantation and relocation space:** The AR surfaces offer excellent spatial accommodation for the basic sedentary /immobile/ invertebrate colonial groups. Similarly, the shadow areas developed are ideally suited for the transplant of seagrasses, corals, pearl oysters and sponge colonies. They are also ideally suited for establishing marine ornamental brood banks in natural ecosystems. Typical examples are the success stories of transplant of kelp and ranching of sandfish and seabass in other countries. Cryptic species like the octopus and lobsters can revive their population abundance and thus the recruitment survival.

**Live fish hold and trade:** When the live fish trade becomes a trend and there is a good demand in the market, the AR offers immense scope for fresh capture and sustained availability for

supply. If the sizes and the numbers are regulated by the ARSC members, this could see a premium jump in fish pricing and economic returns to the traditional fishers.

### **Data logging**

After the formation of the ARSC in consultation with the leaders the expert team discusses the important functions and lead activities which they should perform during their administration. The roles and conditions are clearly mentioned, and include -

- a. Record of the fish catches and boat details
- b. Record on their average sizes and abundance
- c. Record of off- season declarations and fishing moratoriums for a stipulated time.
- d. Record of reef performance in terms of any damages, collapses, sunken, drifted or buried.
- e. Record of diver's inputs on the fish stocks and habitat orientations and status of the diversity
- f. Record of unwanted fishing practices, numbers, craft particulars, registration numbers and person and village names
- g. Record any pictures or videos of such violations
- h. Record of unusual observations such as whale sharks, dolphins, sawfish, hammer heads, dugongs, porpoises, and turtles
- i. Record of ghost net presence and efforts on clean-ups
- j. Minutes of successive meetings and concurrences with Panchayat leaders
- k. Reports to the next-level leaders and other village leaders
- l. Reports and complaints lodged with the AD Fisheries and ATR.
- m. Review the benefits and note the decline of performance.
- n. Agreements on the expansion and addition of the reef modules and the source of funding and budgeting
- o. Reporting on the utility and management efforts to the ADF regularly.

Authentic records and documentary evidence will help in identifying violators of the system and penalizing them with reduced fishing days or subsidy cards, thus narrowing down the possibilities of errors on such field-level issues internally. An understanding of the efforts taken up by a community towards the preservation and revival of habitats and resources will attract attention and self-respect, and in turn, will be a motivating factor for others.

The ARSC log books will serve as an essential tool in understanding coastal fishery dynamics, resource characteristics, fluctuations and shifts during seasons, and long-term changes and impacts. This would serve as a perfect guide or reference point for future scaling up, sea ranching and transplanting trials for the enhancement of habitats and resources.

The installation of ARs and the involvement of the primary stakeholders in the frameworks of sustainable coastal fisheries management is the long-term goal of the program. With increasing coastal vulnerability and climate change impacts on coastal living and livelihoods, a **Sustainable Resilient Ecosystem** will be the best way forward.

In an open access system when competition with no limits is the rule, the resource takes a back seat and just participatory management alone is not a suitable solution to it. The extent of investments varies and the shares accordingly, but the sea cannot provide continuously. The AR in a stakeholder’s purview and management involves his participation and operations, and resource utilization can see a revolutionary “U-turn” in the fishermen’s attitude towards conservation and efficient management of valuable resources. ARs provide scope for an ownership/proprietorship framework and assist the progress in achieving the goals of sustainable harvesting and organizing management measures locally.

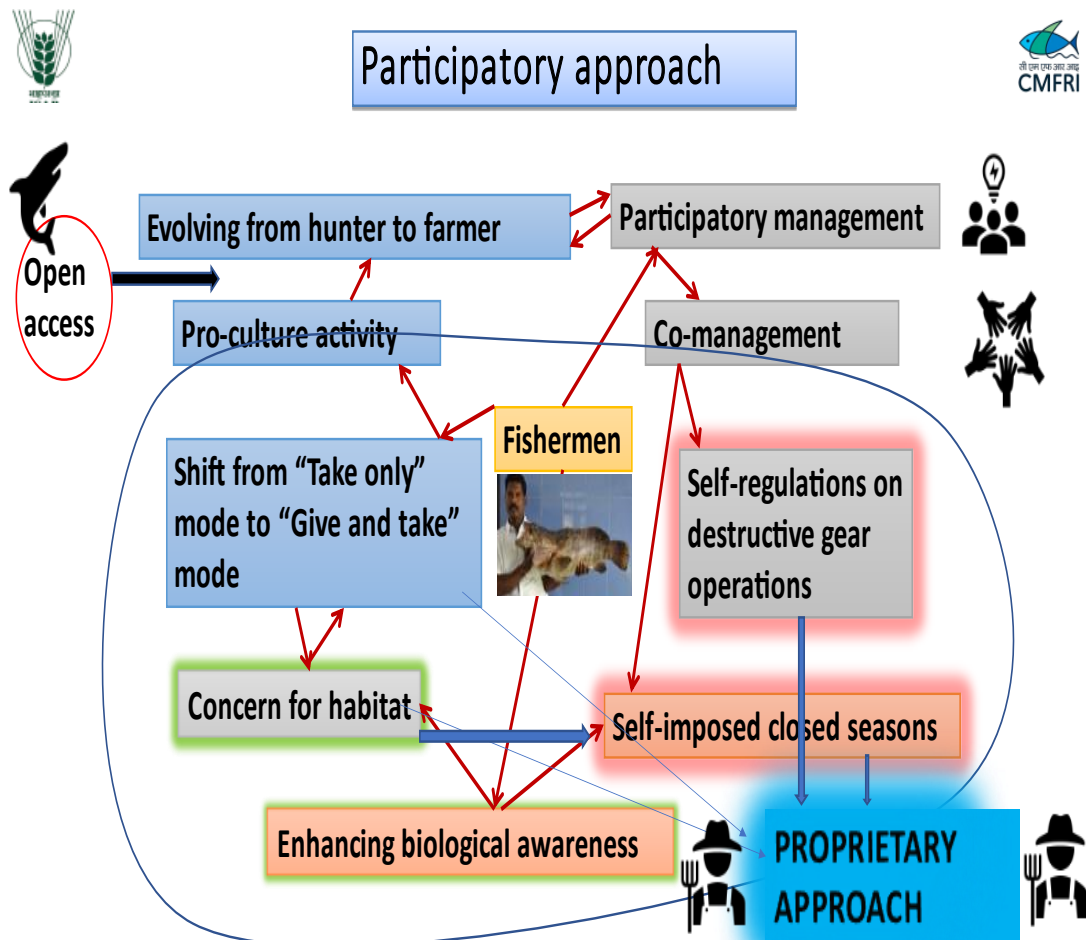
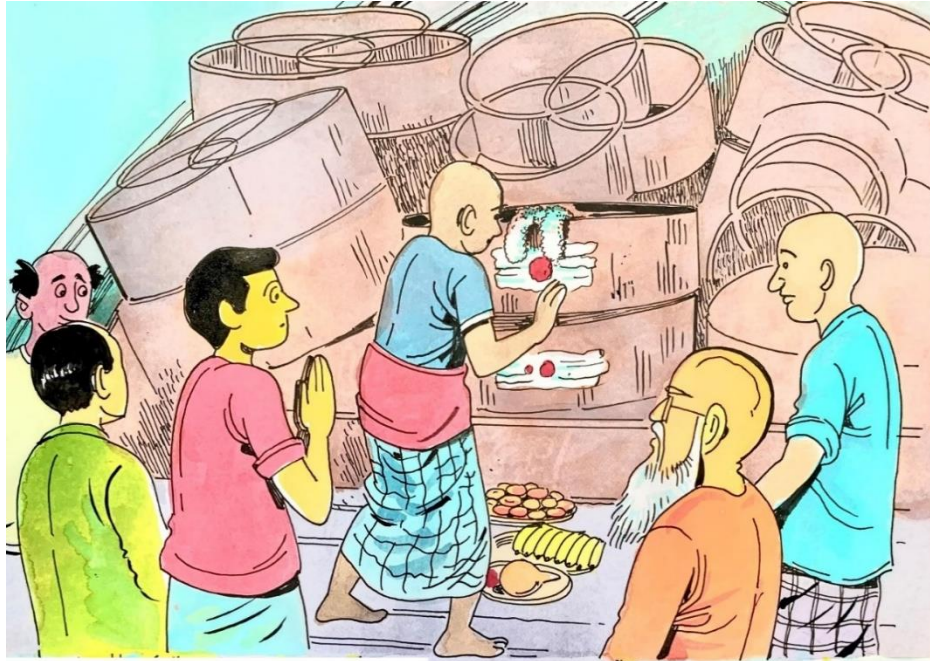


Fig.64. Evolution of participatory management concept towards the ownership/proprietorship approach by the intervention of Artificial reefs in the coastal systems.



**Fig.65. The fishermen at Nettukuppam offering prayers and worshipping the AR modules prior to the deployments indicating the intent, emotional and spiritual attachment to the resource wealth and its sustainability and the gifts from nature.**



**Fig.66. Interactions with villagers in different villages where artificial reefs have been deployed**