# Artificial Reefs Management and Development in Malaysia

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***Abstract***

Development of artificial reefs in Malaysia started since 1975 in Kedah. The 1st artificial reefs were made of used tyres. Advancements in technology allowed the development of artificial reefs using other materials such as PVC, ceramic, culvert, and concrete. From 2006 until 2014, development of artificial reefs in Malaysia focused on specially built concrete-based materials since concrete provides better and stronger foundation to sustain the artificial reefs' functions. Various designs have been made to match the seabed conditions in order to obtain optimum effects in enhancing the fishery resources and habitat rehabilitation. Results of socio-economic studies among fishers in Terengganu indicated that 89% of fishers agree that artificial reefs development enhance their monthly income from fishing activities. In addition, artificial reefs installation also increased fishers' monthly income by RM12.45. Artificial reefs installation usually involves local communities especially fishers to make sure that planning to build and installation will be beneficial to fishers. Artificial reefs installation also helps to minimize conflicts between traditional fishers and commercial fishers by curbing encroachment of commercial fishers in traditional fishers' areas. Underwater observation conducted in several artificial reefs showed that more than 100 fish species are living or foraging in artificial reefs areas. The Malaysian Fisheries Act 1985 clearly stipulates that fishing activities within 0.5 nautical miles radius from artificial reefs areas are prohibited and considered as an offence.

**Keywords:** artificial reef, concrete reef, Malaysian Fisheries Act, fishery resources, fish stock enhancement

## Introduction/Background Information

In 1970s, the Australian Royal Air Force based in Butterworth, Kedah, Malaysia introduced artificial reefs (ARs) made from used tires for recreational purposes. Research and development on ARs were then initiated by the Research Division of the Department of Fisheries Malaysia (DOFM) with used tires as building materials. The first ARs made from used tires were installed in Pulau Telur, Kedah in 1975. Over the years, other materials have been used such as PVC pipes, decommissioned vessels, ceramics, and concrete. From 2006 until 2015, Malaysian ARs focused on concrete-based materials since these proved to be more durable as well as provide better and stronger foundation to sustain the functions of ARs. A number of AR designs had been produced since then to suit certain areas and target species. The main objective of ARs installation in Malaysian waters is to enhance and conserve marine biology and fishery resources productivity in coastal waters by establishing an ecosystem which could function as sanctuary, breeding and nursery areas for fishes; and conserve and protect damaged/destroyed habitats due to natural disasters or human activities. ARs also act as tidal breaker to minimize and control beach erosions, provide new substrate for coral propagation, enhance fish stocks and increase fish landings, and help curb encroachment of commercial fishers in traditional fishers' areas (<5 nautical miles). Development of ARs has been based on a guideline published by the United Nation Environmental Program (UNEP) *'Guideline for the Placement of Artificial Reefs'* which indicates that building materials for ARs should not be made from hazardous materials or items meant for disposal but of materials/items which help to enhance the fishery resources productivity. The Guideline also specifies that tidal breakers, buoys, cables, pipes and platforms should not be considered as artificial reefs even though they provide similar effects/functions as ARs.

### Activities Conducted

#### *Construction and Installation of ARs*

*Site Selection*

Site studies have been conducted to determine the location and suitability of ARs installation by monitoring the water parameters such as seabed conditions, water depth, turbidity, and current. Conducted by researchers, the site studies consider that public engagement is important to get feedback/suggestions from local communities and to obtain their consent to avoid any conflict.

*Design*

The AR designs are chosen or re-designed based on results of site studies and purpose of ARs installation. Engineers are commissioned to come up with the appropriate designs after several discussions with managers and researchers.

*Construction*

Construction site should be closed to deep water jetty, near to deployment site, and accessible to hired cranes, trucks and pontoon. The site should have access to unload ARs, sufficient supply of water and electricity, road for heavy vehicles.

All specifications and technical drawings provided by DOFM must be met. For constructing concrete-based ARs, the use of vibrator and ready-mix concrete equipment from batching plant is mandatory. Cube test is conducted to determine concrete strength and curing period of at least 28 days after construction.

*Installation*

Before ARs are installed, detailed briefing of concerned workers is mandatory. Officers from DOFM should be directly involved during ARs installation to ensure that all procedures and specifications are complied. Certified and experienced divers are tasked to monitor the ARs installation. Two installation methods are used: (i) cables released by divers (not practical for water depth more than 5 meters); and (ii) mechanical release from the surface (recommended).

*Monitoring*

Monitoring is done by researchers few months after ARs have been deployed.

***Results***

Monitoring of AR sites in Malaysian waters have been conducted from 2006 until 2010, results of which indicated that through the years, AR sites have developed into breeding and nursery grounds, substrate for coral growth, fish aggregating device and natural habitats for marine life. Nevertheless, AR developments after installation differ from one site to another due to several factors such as distribution of corals and conditions of seabed sedimentation. A socioeconomic study on traditional fishers in Terengganu, Malaysia was completed in 2012 by DOFM in collaboration with Universiti Putra Malaysia (UPM).

Results of the study indicated that the ARs development gave an average monthly income of more than RM 2,100. For every one unit of ARs, it is estimated that monthly landings value for each fishing vessel could increase to RM 12.45, and the annual benefits value is estimated at RM 342,375. This study however did not include other benefits of ARs to fishers such as recreational fishing, encroachment control, conservation of habitats, and other factors which could definitely give added value to fishers' livelihoods.

**Lessons Learnt**

***Management of ARs Site in Sabah***

Since 2008, a smart-partnership between DOFM and local fishers' community has been established for the development and protection of ARs sites aligned with the Ecosystem Approach to Fisheries management (EAFM). Locally, the system known as *Tagal System* provides the local community some kind of ownership to the ARs site. Local fishers are allowed to fish in ARs Site in a sustainable manner, and are responsible for monitoring and protecting the area from encroachment and fishing activities (*e.g.* use of dynamites and poison, and fishing with electric current) in close cooperation with DOFM, Marine Police, and the Agensi Penguatkuasaan Maritim Malaysia (APMM) or Malaysian Maritime Enforcement Agency, in the enforcement of regulations. Importantly, Sabah has a slightly different legislation which allows this type of management and collaboration to take place.

*Tagal System (ARs Zoning)*

Tagal System divides the ARs site into two zones, namely: Green Zone and Red Zone. While fishing activities is allowed in the Green Zone, it is prohibited in the Red Zone. The Red Zone acts and functions as fish sanctuary for conservation purposes. Rules are in place to control and monitor the fishing activities in the ARs site. These include:

i. Only local fishers are allowed to fish in the ARs site
ii. Fishers from other villages are allowed to fish in the ARs only after getting approval from the ARs Task Force
iii. Only hand lines are permitted to be used, while other gears are not allowed
iv. Fish less than 300 g must be released back to the waters
v. Anyone found encroaching in the ARs site must be advised to leave the site by the ARs Task Force, otherwise, they will be reported to DOFM, Marine Police and APMM for further actions.

### *Malaysian Fisheries Act 1985*

In the Malaysian Fisheries Act 1985, under the licensing policies and procedures, it is clearly stated that fishing activities within 0.5 nautical miles radius from gazetted ARs site are prohibited and considered an offence. However, there is no gazetted ARs site for the time being because discussions and public engagement are still in progress in order to obtain public consent.

### Recommendations and Way Forward

ARs installation is a famous method used to enhance and conserve fishery resources. However, what is important is the management of ARs sites after installation. Without proper management, ARs would not meet their objectives as conservation tools. The most preferable management tool is the EAFM concept which involves the collaboration among related agencies, the community and other stakeholders. Each party involved should discuss and play their respective roles in managing the fishery resources in ARs site.

Community's role is also essential and important especially in monitoring the ARs sites and reporting of any wrong doing or offence that occurs in the area. Scientific data and analysis is important to determine the most appropriate AR designs, sites for the installation, as well as the effectiveness of ARs, biomass calculation and other related data. A standard procedure or methodology must be in place in order to come up with good and conclusive results. This would also help researchers to develop a guide for ARs related studies and research.

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