
MANAGEMENT OF SUSTAINABLE ECOSYSTEM: A CORAL REEF STORY

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INTRODUCTION

Coral reef exhibits an excellent example of highly biodiverse community which develops under warm and clear water of tropical oceans. It supports large number of marine invertebrates-vertebrates and delivers services of ecological importance such as fishery, tourism and coastline protection. Nowadays, coral bleaching has become an alarming environmental issue. It is estimated by scientist that 70-90% of all coral reefs will disappear in next 20 years mainly due to warming oceanic water, change in pH and pollution(Trevor, 2020). Coral reef protection through various ways and restoration of reefs through coral aquaculture can provide solution up-to certain extent but the reef rejuvenation is highly dependent on coral species with heat-resistant capacity, high tolerance for pollution and ability to grow on diverse new substrates forming oceanic debris, such as plastic, rubber, concrete, etc.Undoubtedly, sustainable economic and ecological prosperity of tropical coastal areas can be achieved only through the successful restoration of coral reefs.

CONTEXT

Coral reefs of oceans can be equated to tropical rain forests of terrestrial ecosystem. Reefs are developed by coral polyps which are connected by hard skeleton of calcium carbonate. They are produced in coastal areas of tropical oceans which provide favourable conditions of clear, sunny, shallow, warm, saline and agitated water. Corals belongs to animal phylum Cnidaria but evolved with natural endosymbiont algae, i.e. dinoflagellates (Wikipedia contributors, 2022). Nearly 0.1% of world's ocean area is covered by coral reef which provide feeding-breeding ground and shelterfor diverse marine species (25%)including fish and other invertebrates like molluscs, crustaceans, echinoderms, sponges, tunicates and cnidarians(Hajime, 2016). The additional structural feature of reef is that it presents lot of hiding places for number of animals which enhance species richness and abundance of inhabitant animals (Gratwicke, &Speight, 2005;

Fontaneto, *et.al.*, 2013;Mulhall, Spring 2009). At the same time it creates water movements in the crevices for food circulation.The phytoplanktons, seaweeds and coralline algae are chief producers which provide food for fish, crustaceans and sponges while the coral polyps feed on small zooplanktons helping in recycling of nutrients and balancing food chain. Coral reefs act as barriers to reduce erosion caused by oceanic waves. The magnificent colours of coral reef are also an added attraction. The brown to golden brown colour is due to dinoflagellate algae (*Symbiodinium* i.e. zooxanthellae) while variety of pigmented marine animals produce red, blue and green proteins. Coral reefs present the most intricate ecosystem of ocean that supports biodiversity which in turn helps in fishery and tourism businesses.

In addition to this, coral species produce variety of chemicals which are used as medicines against infections and chronic diseases like cancer, arthritis, heart diseases, etc. (NOAA National Ocean Service Education: Corals).The limestone skeleton of coral is porous in nature and has been tested as an alternative for human bone graft. It shows lower rate of rejection than artificial bone graft materials (Demers, *et. al.*, 2002). Thus live coral reefs are essential for ecological, economical and medicinal benefits.

In recent decades, severe degradation has been observed in coral reefs due to range of threatening processes (14% decline from 2009 to 2018). Rapid Ocean warming due to climate change is the key risk for coral reefs (Hoegh-Guldberg, *et. al.* 2018; Visser, 2021). Other equally potent causes are bottom trawling, overfishing, marine pollution by chemicals, sewage and oil, marine acidification and algal blooms. It is observed that human settlements residing at coastal areas of tropical countries are constantly creating pressure on fragile system of coral reefs. These anthropogenic factors lead to severe stress on marine invertebrates which results in bleaching of corals. Coral reef loses the colourful zooxanthellate (the endosymbiont algae) which leads to death of reef, making it unsupportive to other organisms.As photosynthetic partner (zooxanthellate) disappears, other herbivores and subsequent carnivores vanish due to food scarcity. Thus economic gain through fishery and medicines is hampered and aesthetic value of the region is also ruined.

In this context, coral reef protection and restoration are utmost important but it is difficult to devise efficient plan for healthy coral reef due to its location in open sea and complex nature of development. However, certain private and government groups have made significant work for

the restoration of coral reefs e.g. METT, NOAA, SocMon. They are trying to understand human interactions with coastal resources. The focus is also on sustainable management of valuable resources through devising policies (Edwards, 2014; Pomeroy, *et. al.* 2005; Bunce, *et.al.* 2003; Stolton, *et.al.* 2003). Another way of protecting a reef is designating it as a biosphere reserve, marine park, national monument, and world heritage site. Australian ‘Great Barrier Reef’ is the world’s largest reef which spans over 2300 Km is famous tourist destination and world heritage site. Other examples are ‘Belize Barrier Reef’ of Caribbean sea, ‘Raja Ampat Reef’ of Indonesia, Red Sea Coral Reef, etc. (UNESCO World Heritage Coral Reefs, 2022). Similarly by controlling fishing, sewage inflow, assessment of invasive species of macroalgae and monitoring hydro-biological parameters may prove helpful in conservation of corals. In this regards, there is lot of scope to develop high technology for monitoring devises, underwater vehicles and remote sensing.

Coral farming or gardening is another promising method of restoring the coral reef at given places in short time. Coral has natural ability to grow if it’s fragments anchor themselves onto new substrates (Baruch, 1995). The coral seeds are developed either in ocean based nurseries i.e. at dead reef or in land based nurseries (in laboratories) and then transplanted in natural habitats. The land based nurseries are comparatively cost effective as it reduces expenses of SCUBA diving throughout gardening stage. Additionally, in land based nurseries corals can be grown in different conditions to induce more stress tolerance. Nowadays nurseries are also trying to grow corals on different substrate include discarded materials of vehicle tires, ships and concrete (Ortiz-Prosper, 2001). Coral farms show reduced rates of polyp and juvenile mortality. Additionally in predator free environment, corals are able to mature without much difficulty. In this case, awareness about coral reef and its importance need to be communicated to local people whose active participation will assure the success. However, it is impossible to stop global climate change where warming temperatures or hurricanes can disrupt delicate colony of nursery corals (Lirman and Schopmeyer, 2016). Hence it is utmost important to make coral reef more resilient towards climate stressors. The major stressor being increased temperature of oceans; selective breeding mechanism is suggested to induce heat tolerance in coral species (Van Oppen, *et.al.*, 2017; Van Oppen, *et.al.*, 2015). Therefore, an immediate effective action plan against pollution, climate change, overfishing, and restoration of coral reef may assure healthy growth of

tropical coral reefs (Duarte, *et.al.* 2020). Coral gardening can deliver innovative solutions to coral reef restoration and can serve as successful strategy of sustainable management.

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