Press Release: Coral Reef Restoration Project "InCORE"

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Kajima Corporation (President: Hiromasa Amano), Institute of Science Tokyo (formerly Tokyo Institute of Technology, hereinafter referred to as Science Tokyo), and the University of the Philippines (hereinafter, UP) were awarded a grant under the Asian Development Bank's Technology Innovation Challenge. Financed by the High-Level Technology Fund with support from the Government of Japan, this grant facilitated their collaboration on the coral conservation and restoration project 'InCORE'[*1] in Tangalan Bay, Aklan Province, Panay Island, Philippines. Successfully implemented from February 2023 to July 2024, the project focused on conserving and restoring vital coral reef ecosystems in the area. Through environmental assessments with advanced numerical simulation and remote sensing technologies, and subsequent installation of Kajima's "Coral Net" as artificial substrate structure for promoting coral growth, the project confirmed substantial growth of coral fragments and settlement of coral larvae at multiple locations in the area.

At the final meeting held in Tangalan with ADB representatives and local stakeholders, the project team reported the effectiveness of the applied technologies and confirmed to continue coral conservation and restoration activities based on the project's outcomes. The three parties will continue to collaborate with local governments, fisheries stakeholders, Aklan State University (hereafter, ASU), and others to support coral reef conservation and restoration efforts.

*1: **In**tegrated Approach for Coral Reef **Co**nservation and **Re**habilitation (InCORE)

Location of the target site, Tangalan Bay

Coral fragments successfully growing on the artificial substrate structure, Coral Net.

Overview of InCORE:

This project features an integrated approach that utilizes Kajima's coral restoration technology, "Coral Net," as the core technology in the project, Science Tokyo's numerical simulation technology, UP's satellite image analysis technology and ecological field surveys to assess suitable environments for coral restoration. Additionally, the project aimed to establish close collaborative partnership with various

stakeholders such as local municipalities, fisher organizations, divers, and ASU, for implementing the joint activities.
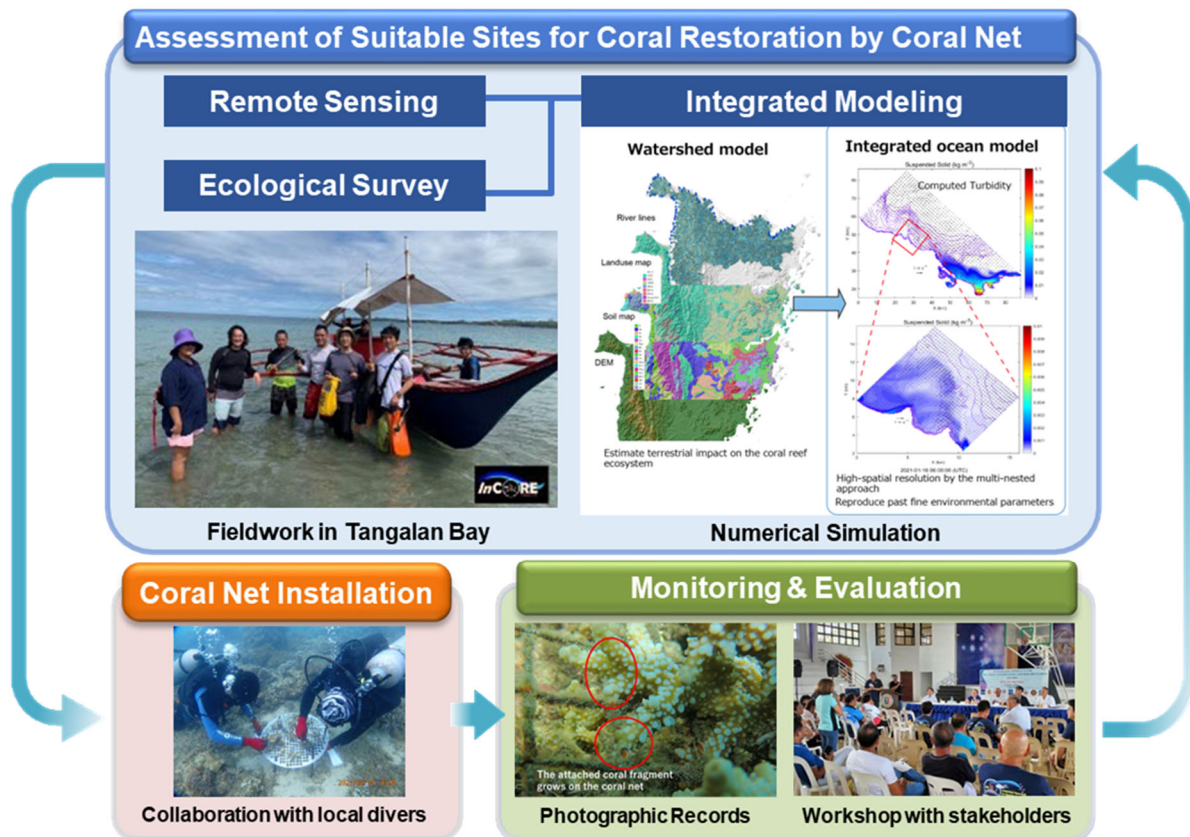
Schematic model of the integrated approaches for coral restoration and rehabilitation

Background of Coral Conservation and Restoration Projects:

In recent years, the decline of coral reefs has reported increasingly throughout the word, attributed to rising sea temperature and increased typhoon activities due to climate change, in addition to various local anthropogenic impacts like destructive fishing and water quality degradation. Coral reefs are rich fishing grounds that support diverse marine life and serve as natural breakwaters that mitigate wave impacts, as well as being valuable tourism resources. Therefore, achieving coral reef restoration is a global challenge for sustaining various reef ecosystem functions and services as well as coastal communities.

Project Achievements:

Field surveys, environmental assessments using numerical simulations, and interviews with local stakeholders revealed that the main factors contributing to the decline of corals in the area include extensive dynamite fishing in the past and water pollution closely related to sediment runoff from land. Coral Net is expected to address these issues by providing stable artificial substrates and mitigating the effects of siltation with their elevated structure above the seabed, respectively.

To prove and demonstrate the Coral Net performance in these respects, more than 84 Coral Net units were installed at six locations in the Tangalan Bay with various environmental conditions.

Two approaches were introduced for promoting coral growth on the Coral Net surfaces in collaboration with local fishers, divers, and researchers from ASU:

1. Fixing coral fragments collected from the nearby seabed onto the upper surface of the Coral Net unit, followed by the periodic monitoring of their subsequent growth.

2. Monitoring natural settlement of coral larvae onto the Coral Net unit's lower surface.

In both approaches, growth of coral fragments and settlement of the larvae were observed at several sites where corals had not regenerated for many years, confirming the effectiveness of the Coral Net for coral restoration. Especially at the location where coral recovery had not been seen for decades despite relatively better water quality simulated by numerical models, the growth of the coral fragments attached to the upper surface of Coral Net units achieved over 60% coral cover within one year, attracting abundant fish around the restored corals.
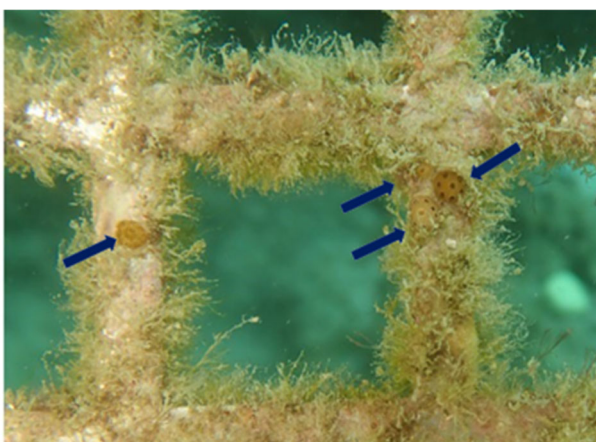

Initial status of coral fragments attached to Coral Net (August 2023)
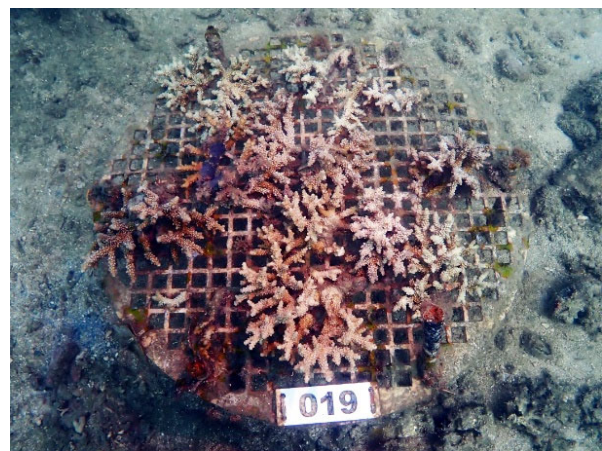
Coral fragments grown for 10 months after the installation (June 2024)

Furthermore, there were locations where more than 500 coral larvae per square meter settled naturally on the Coral Net unit surface, with the settled corals reaching sizes visible to the naked eye after almost one year.

Coral larvae naturally settled at the lower surface of the Coral Net

Coral larvae grown on the upper surface of the Coral Net within a year after installation

In contrast, at the locations where the preliminary numerical simulation results showed substantial siltation impacts, the introduction of Coral Net achieved short-term recovery of corals; however, after the increase of river flow during the monsoon season, anticipated declines were observed due to increased silt deposition and attached algae.

The differences in coral restoration status among the Coral Net installation sites were generally aligned with overall features of the environmental conditions assessed by the numerical simulations in advance, confirming the assessments based on the applied modeling technologies were effective to select suitable sites for Coral Net installation.

As an integrated environmental evaluation model this simulation technology incorporates terrestrial conditions. Therefore, it can be used to examine effective means to reduce sediment runoff from land, contributing to the development of holistic coral reef conservation and restoration planning together with the Coral Net technology.

One of the notable features of Coral Net is its simplicity, allowing ordinary divers and fisherfolk to install them without special training.

At the final meeting held in Tangalan, in July 2024, the project team presented the results of quantitative evaluations before and after the Coral Net installation based on scientific methods, confirming high performance of the InCORE approach with appreciable coral restoration even within a short period of time. The team also reported about the on-site training activities for local divers to periodically take photographic records of coral growth on the deployed units as one of essential activities for sustainable restoration initiatives. In the meeting, ADB and Tangalan Municipality highly appreciated the progress of the project and expressed high expectations for future coral restoration based on the project results.

Future Developments:

After completing this project, Kajima, Science Tokyo, and UP will continue to provide technical support in collaboration with local governments, fishery stakeholders, and ASU for facilitating ongoing restoration and monitoring activities. Furthermore, we aim to improve the technologies developed in this pilot project and apply them to other areas in Southeast Asia, especially the Coral Triangle and its surroundings.

(References)

Coral reef restoration project 'InCORE™' launched in the Philippines (Press Release, May 31, 2023)

https://www.kajima.co.jp/news/press/202305/31e1-j.htm

Environmentally Friendly! 'Coral Net' to Revive Coral Reefs

https://www.kajima.co.jp/tech/c_eco/ecosystem/index.html#!body_07

InCORE Official Website

https://sites.google.com/view/incorecoral/home