

How local communities in Indonesia's Gili islands are restoring coral ecosystems amid rising sea temperatures

November 22 2023, by Robby Irfany Maqoma



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This article is the second part of an in-depth science-based reporting series, supported by the Environmental Reporting from Asia-Pacific Island Countries [grant](#) by Internews' [Earth Journalism Network](#).

Sukding, a 42-year-old local fisherman from a [remote island](#) in West Nusa Tenggara, Indonesia, remembers a bitter childhood memory of him damaging coral reefs in the shallow waters off Gili Air island.

"Thinking about it again, I really feel regretful," Sukding told *The Conversation* in August.

As a child, Sukding didn't understand the benefits of coral reefs. He and his father damaged the reefs to make space for their seaweed business. Unfortunately, the business went bust, and for a long time, Sukding never figured out why.

The damaged coral reefs in the area never recovered, leaving it devoid of fish and seaweeds.

Sukding is now the village head of Gili Air, one of the three islands in Gili Matra National Marine Conservation Area, West Nusa Tenggara Province. Over time, Sukding has realized the Gili Matra community's well-being is heavily dependent on a healthy coral ecosystem, especially since the area is [internationally renowned](#) for its beautiful coral reefs.

In addition to being home to many aquatic species such as fish, lobsters, sharks, and turtles, corals also store carbon from the atmosphere, [help to tackle climate change](#).

Tourists from around the world flock to Gili Matra, located near Bali. During peak time, the island can welcome a thousand visitors per day. Most came from Bali by fast boat, hoping to enjoy the beauty of Gili Matra's coral reefs through snorkeling or diving.

About half of the local population, which amounts to 4,871 people, rely on the tourism sector, including hotels, restaurants, shops, and tour services.

Given the importance of sustaining the [local environment](#) to attract tourists, Sukding now actively participates in various coral reef restoration activities in Gili Matra.

Sukding has created artificial reefs with other residents and installed them by diving underwater. "I also make sure that my activities and those of my friends here do not harm the coral," he said.

The Gili Matra area has been buzzing with community-based coral reef ecosystem restoration efforts in recent years. One was done by the Gili Matra Bersama Foundation, a local marine conservation organization in Gili Matra.

In September 2023, *The Conversation Indonesia* visited one of the restoration sites on the eastern side of Gili Matra, managed by the Gili Matra Bersama Foundation. At a depth of five meters below the sea surface, we saw a coral nursery consisting of four iron poles with weights on the seabed.

Each pole had two to three tree-like "branches", decorated with neatly arranged small pieces of coral.

Near the iron trees, we could see hexagonal and rectangular steel frames filled with larger corals. While diving underwater, we saw long corals that looked like fingers. Others looked like outstretched palms.

Restoration began in 2021, according to to the Gili Matra Bersama Foundation's Director, Cakra Adiwijaya.

Gili Matra Bersama Foundation use healthy coral *Acropora* genus, known for their rapid growth, to restore the coral ecosystems. They support and monitor coral growth and clean up corals regularly while collecting data on other species nearby, like grouper fish, hawksbill

turtles, and white-tip sharks.

"Once a week, we go diving to maintain our projects and conduct surveys. We need to ensure the growth of our coral so that they can enrich the coral ecosystem in Gili Matra," Adiwijaya told The Conversation Indonesia.

Coral ecosystems in Gili Matra have suffered because of three major coral bleaching events in 1998, 2010 and 2016. All are linked to warmer sea temperatures. The coral area has shrunk by a big 90%, now covering only [247 hectares](#), down from what it used to be before [the 1990s](#). The situation worsened following mass tourism in Gili Matra in the 1990s.

Now, Gili Matra is a hotspot for coral ecosystem restoration projects, according to a 2022 [study](#) by coral researcher at Padjadjaran University, Tries Blandine Razak. Between 1990 and 2020, there have been around 18 coral restoration activities in Gili Matra.

But coral restoration efforts are in a race against time. [Recent research](#) led by University of Glasgow marine ecologist, Laurence De Clippele, forecast that by 2075, coral ecosystems in 161 of 196 Indonesia's marine conservation areas will experience severe bleaching every year, due to climate change.

Gili Matra is predicted to be among the earliest affected by severe annual bleaching, starting from 2026.

Coral recovery amid rising temperatures

Climate-induced ocean warming significantly impacts coral organisms, especially those still in their early stages, such as in restoration sites.

Gili Matra Bersama Foundation's Cakra Adiwijaya said that last June he found coral reefs at one of the restoration points dying from "skeletal eroding band" disease. This disease's symptoms are coral whitening followed by black spots, likely due to heat stress.

During that time, according to Adiwijaya, the monthly average water temperature in the Gili Matra waters reached 30°C, exceeding the average of around 28°C.

"So, you see, the coral gets stressed out, first because of the ongoing high temperatures, and then it catches the disease," Adiwijaya said.

Costs of restoration vary depending on the location and methods used. The government has provided permits to enable these efforts, but no financial support.

To prevent the risk of disease caused by future warming, the foundation has started to move artificial reefs to deeper waters.

Adiwijaya's team observed that ailing corals were found in [shallow waters](#), approximately five meters below the sea surface. Meanwhile, corals in deeper areas—around 10 meters deep—tend to be healthier. Adiwijaya suspects this is because the deeper spots receive less direct sunlight and heat.

Imam Bachtiar, a coral reef expert from the University of Mataram in West Nusa Tenggara, admires the community's work in Gili Matra to rejuvenate coral reefs. But he points out that most restoration efforts have relied on *Acropora*, a fast-growing coral genus sensitive to temperature change.

Gili Matra also includes heat-tolerant coral genera like *Montipora* and *Stylophora*. But both are slow-growing species, making them less

suitable for a restoration project.

"If we have coral bleaching happening every year, the restored coral won't have enough time to grow, and sadly, they'll all perish. So we can't transplant them. Our best bet is to look for coral varieties that can withstand higher temperatures," Imam said.

Finding new ways to make a living

On top of restoring coral, some people in Gili Matra are also exploring alternative sources of livelihood to reduce their reliance on tourism, a move sparked by the COVID-19 pandemic—and spearheaded by local women.

Rohanisa, a 30-year-old resident of Gili Air, said tourism on her island at the height of the pandemic was paused due to social restrictions.

In 2020, tourist visits to Gili Matra dropped by [nearly 80%](#), according to local government data. This decline significantly impacted the villagers in Gili Matra, given half of them depended on the island's tourism sector.

To overcome the crisis, the villagers went fishing to make ends meet. Social restrictions due to the pandemic led to abundant fish supply, but the price plummeted.

Gili Air has received assistance from the Coral Reef Rehabilitation and Management Program—Coral Triangle Initiative (COREMAP-CTI). That initiative is a national conservation and coastal community empowerment program in Indonesia, managed by the Indonesian Environment Fund and the National Development Planning Agency.

It has also planned a sustainable economic program in Gili Matra.

Officials suggested the community develop alternative economic activities to support their livelihoods.

That's when the women of Gili Matra came up with the idea of turning the abundant supply of fish into floss.

Fish floss is commonly enjoyed as a topping for rice bowls, porridge or sandwich fillings. Villagers often made floss from local species like layang fish (*Decapterus* spp), cakalang fish (*Katsuwonus pelamis*) or tuna.

COREMAP-CTI then equipped the women of Gili Air with a series of training sessions on producing fish floss. The government of North Lombok Regency in West Nusa Tenggara Province also provided the equipment.

Eventually, around a dozen women from Gili Air started producing fish floss in 2021.

To this day, these women in Gili Matra can process 35 kilograms of fish into fish floss twice a week. Their products are shipped to various areas, from Lombok to Indonesia's capital, Jakarta.

"Most of the demand comes from the pre-orders," said Rohanisa, who is also the head of the fish floss production group called Putri Bahari (the daughter of the sea).

Tourism is growing again in Gili Matra, but fish floss production continues. Their production is no longer solely dependent on the catch of Gili Matra's fishermen. Even if the local fishermen's supply is limited, the women will find fish from other sources, including the markets in Lombok Island.

Director of the coral monitoring organization Reef Check Indonesia, Derta Prabuning, supports the efforts made by women in Gili Matra.

He sees these initiatives as crucial for community adaptation in case [coral reefs](#) cannot be restored, as thriving marine tourism relies on [healthy coral ecosystems](#).

Similar measures are being taken in various island regions, such as Bali, Wakatobi and Rote Island in eastern Indonesia. While not all island communities experience the same tourism booms, they still rely on coral ecosystems as fish habitat and food sources, keeping the water clean, and preventing erosion.

"If restoration is not enough, if the coral experiences bleaching and dies, the next step is socio-economic adaptation," Derta explained.

The coordinator of the Kupang National Marine Conservation Area, Gili Matra Working Area, Martanina, said sustainable economic empowerment is a key government focus. This aims to enable communities to benefit from conservation areas beyond tourism.

In addition to fish processing, she said that through the Ministry of Maritime Affairs and Fisheries, the government assists with boats and fishing equipment to help small-scale fishermen in Gili Matra. These fishermen receive training in sustainable fishing and coral rehabilitation.

She hopes increased benefits can encourage local communities to become more active in conserving protected areas. This is also one of the objectives of [Indonesia's Blue Economy agenda](#).

Despite all the efforts made by the locals in restoring the coral and seeking alternative income, Sukding said he hoped the Indonesian

government could find a way to provide long-term solutions, not just short-term assistance, to prevent coral ecosystem degradation in Gili Matra.

"I don't really have much knowledge on how to deal with this situation in the long run. But what's clear is that we want our grandchildren to continue experiencing healthy coral and benefiting from it," he said.

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Provided by The Conversation

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