CLIMATE CHANGE AND ENERGY

The quest to build islands with ocean currents in the Maldives

An alternative to dredging aims to capture moving sand to protect the archipelago from erosion and rising seas.

By
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In satellite images, the 20-odd coral atolls of the Maldives look something like skeletal remains or chalk lines at a crime scene. But these landforms, which circle the peaks of a mountain range that has vanished under the Indian Ocean, are far from inert. They're the products of living processes—places where coral has grown toward the surface over hundreds of thousands of years. Shifting ocean currents have gradually pushed sand—made from broken-up bits of this same coral—into more than 1,000 other islands that poke above the surface.

But these currents can also be remarkably transient, constructing new sandbanks or washing them away in a matter of weeks. In the coming decades, the daily lives of the half-million people who live on this archipelago—the world's lowest-lying nation—will depend on finding ways to keep a solid foothold amid these shifting sands. More than 90% of the islands have experienced severe erosion, and climate change could make much of the country uninhabitable by the middle of the century.

Off one atoll, just south of the Maldives' capital, Malé, researchers are testing one way to capture sand in strategic locations—to grow islands, rebuild beaches, and protect coastal communities from sea-level rise. Swim 10 minutes out into the En'boodhoofinolhu Lagoon and you'll find the Ramp Ring, an unusual structure made up of six tough-skinned geotextile bladders. These submerged bags, part of a recent effort called the Growing Islands project, form a pair of parentheses separated by 90 meters (around 300 feet).

The bags, each about two meters tall, were deployed in December 2024, and by February, underwater images showed that sand had climbed about a meter and a half up the surface of each one, demonstrating how passive structures can quickly replenish beaches and, in time, build a solid foundation for new land. “There’s just a ton of sand in there. It’s really looking good,” says Skylar Tibbits, an architect and founder of the MIT Self-Assembly Lab, which is developing the project in partnership with the Malé-based climate tech company Invena.

The Self-Assembly Lab designs material technologies that can be programmed to transform or “self-assemble” in the air or underwater, exploiting natural forces like gravity, wind, waves, and sunlight. Its creations include sheets of wood fiber that form into three-dimensional structures when splashed with water, which the researchers hope could be used for tool-free flat-pack furniture.

Growing Islands is their largest-scale undertaking yet. Since 2017, the project has deployed 10 experiments in the Maldives, testing different materials, locations, and strategies, including inflatable structures and mesh nets. The Ramp Ring is many times larger than previous deployments and aims to overcome their biggest limitation.

In the Maldives, the direction of the currents changes with the seasons. Past experiments have been able to capture only one seasonal flow, meaning they lie dormant for months of the year. By contrast, the Ramp Ring is “omnidirectional,” capturing sand year-round. “It’s basically a big ring, a big loop, and no matter which monsoon season and which wave direction, it accumulates sand in the same area,” Tibbits says.

The approach points to a more sustainable way to protect the archipelago, whose growing population is supported by an economy that caters to 2 million annual tourists drawn by its white beaches and teeming coral reefs. Most of the country's 187 inhabited islands have already had some form of human intervention to reclaim land or defend against erosion, such as concrete blocks, jetties, and breakwaters. Since the 1990s, dredging has become by far the most significant strategy. Boats equipped with high-power pumping systems vacuum up sand from one part of the seabed and spray it into a pile somewhere else. This temporary process allows resort developers and densely populated islands like Malé to quickly replenish beaches and build limitlessly customizable islands. But it also leaves behind dead zones where sand has been extracted—and plumes of sediment that cloud the water with a sort of choking marine smog. Last year, the government placed a temporary ban on dredging to prevent damage to reef ecosystems, which were already struggling amid spiking ocean temperatures.

Holly East, a geographer at the University of Northumbria, says Growing Islands' structures offer an exciting alternative to dredging. But East, who is not involved in the project, warns that they must be sited carefully to avoid interrupting sand flows that already build up islands' coastlines.

To do this, Tibbits and Invena cofounder Sarah Dole are conducting long-term satellite analysis of the En'boodhoofinolhu Lagoon to understand how sediment flows move around atolls. On the basis of this work, the team is currently spinning out a predictive coastal intelligence platform called Littoral. The aim is for it to be "a global health monitoring system for sediment transport," Dole says. It's meant not only to show where beaches are losing sand but to "tell us where erosion is going to happen," allowing government agencies and developers to know where new structures like Ramp Rings can best be placed.

Growing Islands has been supported by the National Geographic Society, MIT, the Sri Lankan engineering group Sanken, and tourist resort developers. In 2023, it got a big bump from the US Agency for International Development: a $250,000 grant that funded the construction of the Ramp Ring deployment and would have provided opportunities to scale up the approach. But the termination of nearly all USAID contracts following the inauguration of President Trump means the project is looking for new partners.

ref. https://selfassemblylab.mit.edu/growingislands