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EARTH SCIENCES
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HOW REMOVING OVERGROWN WATER PLANTS CAN HELP KIDS STAY HEALTHY AND IMPROVE THE PLANET

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YOUNG REVIEWERS:

ANTONIO

AGE: 12

TOMAS

AGE: 11

In Africa, many kids get sick from tiny worms called Schistosoma. These worms can slow children's growth and development; damage the liver, intestines, and bladder; and sometimes lead to cancer or even death. Schistosoma can keep communities poor by reducing people's ability to work. Over 800 million people are at risk of infection. People get infected when they play or wash in water filled with certain plants and snails. These plants grow fast because fertilizer from farmers' fields washes into the water when it rains. We found that removing these plants can reduce Schistosoma. Plants that are removed can be turned into food for animals, compost for farms, or gas for cooking and electricity. This solution helps protect kids from getting sick and can even help to slow climate change. By working together, communities can clean their waterbodies and create a healthier, happier future, which is a win-win for people and nature.

WATER CAN BE RISKY!

Have you ever played near water, such as a stream, river, pond, or lake? It is fun to splash in the water, cool off on a hot day, or even fish. But in some parts of Africa, stepping into the water to play or wash is risky business. Tiny worms called Schistosoma live in waterbodies in Africa, and these worms can make children and adults very sick [1]. Schistosoma infections can prevent the liver, intestines, and bladder from functioning properly, sometimes leading to cancer and even death. Many children who face the risk of Schistosoma are poor and do not have electricity for their homes or enough food to eat. This story is about a win-win for people and nature: we will describe how people can work together to make waterbodies safe, keep kids healthy, and even help families have electricity and food to eat.

THE PROBLEM: SNEAKY WORMS AND OVERGROWN WATERBODIES

Schistosoma worms start their lives inside certain types of freshwater snails. Once they are ready, the worms leave the snails and swim through the water searching for people (and farm animals, like cows) to infect. The snails thrive where there are lots of underwater plants to live on. So, more plants in the water means more snails, and more snails means more worms to infect people.

Why are there so many plants in the water? It is partly because farmers use **fertilizers** to help crops like corn, rice, and lettuce grow better. Unfortunately, rain washes some of the fertilizer from farms into waterbodies, where it helps underwater plants grow really fast

FERTILIZER

A substance added to soil to boost plant growth by adding elements that plants need, like nitrogen, phosphorus, and potassium. Compost is a natural fertilizer.

(Figure 1) [2, 3]. These plants grow so much that they block water access from the shore, making it harder for people to wash, play, fish, or collect water for their homes. Worse, the extra plants mean more snails and worms, and thus more kids get sick with the disease called **schistosomiasis** [2–4]. This disease makes people tired, can make kids feel so sick that they cannot go to school, and can slow kids' growth and development [1]. We found that the more crops were being grown around a village, the more fertilizer was used and the more schoolchildren had schistosomiasis. Also, the more fertilizer that was used, the more underwater plants and snails were present, increasing the spread of schistosomiasis to people.

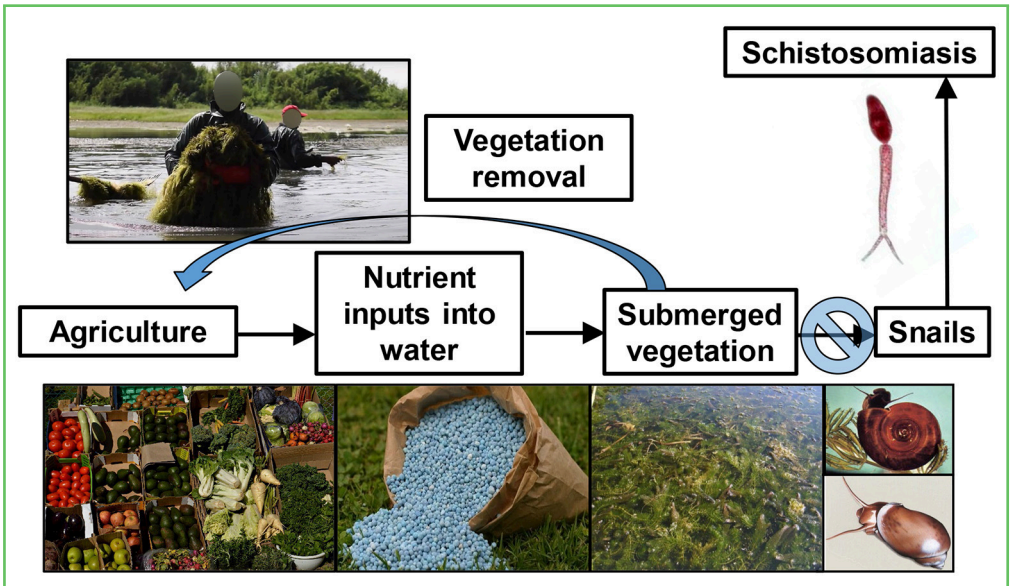

Figure 1

THE PLAN: CLEARING THE WATER

We had an idea: what if we took the overgrown plants out of the water? We tested this idea in villages in Senegal, a country in West Africa [4]. In half the villages, we used our hands (protected by rubber gloves to avoid infection) and pitchforks to remove the overgrown plants from villages' water access points, whereas no vegetation was removed in the other half of the villages. We found that the number of snails in the villages where vegetation was removed went way down relative to the villages where no vegetation was removed. Less vegetation and fewer snails meant fewer worms and less schistosomiasis in kids. The waterbodies also became easier to use. People did not have to fight through a jungle of aquatic plants to get to the water. The plant we removed is an **invasive species** that did not grow much in these areas in the past, so removing it also helps restore the original natural conditions of the region.

SCHISTOSOMIASIS

A parasitic disease caused by small worms called Schistosoma that live in freshwater snails and infect people who contact with contaminated water.

Figure 1

Hypothesized pathway by which agriculture affects schistosomiasis and the proposal to disrupt human schistosomiasis by returning nutrients captured in freshwater plants back to agriculture. We predicted that communities with more agriculture would use more fertilizer and thus have greater nutrients washing into waterbodies that promote growth of water plants. Given that water plants are habitat for snails that release Schistosoma parasites, we hypothesized that this would increase schistosomiasis. We found support for this hypothesis. So, we removed the water plants reducing schistosomiasis and returned the nutrients to captured in them back to agriculture increase food production at lower costs (Figure credits: FitNish Media on Unsplash and Anthony Trivet on Pexel).

INVASIVE SPECIES

a species that causes harm to the environment, economy, or human health.

COMPOST

Decayed plant and animal material used as a plant fertilizer.

WHAT TO DO WITH THE PLANTS?

But what should we do with all the removed plants? Instead of throwing them away, we encouraged the villagers to turn them into something useful. They used the plants as **compost** to help grow crops like onions and peppers (Figure 2), as food for sheep (Figure 3), and to generate energy for households.

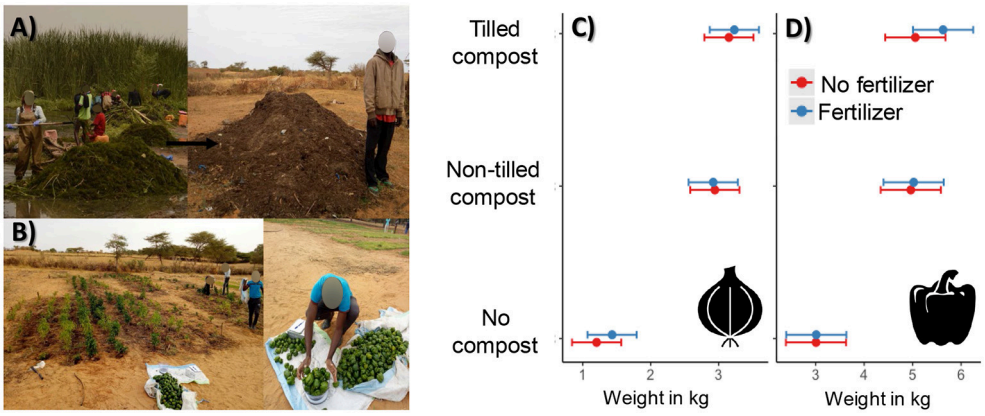

Figure 2

Plants pulled from waterbodies can be used as compost to increase food production. **(A)** Removed vegetation and compost piles. **(B)** Pepper plots receiving compost and fertilizer treatments, and the farmer collecting data for the project. The compost increased **(C)** onion and **(D)** pepper production, regardless of whether the fertilizer was tilled (mixed) into the soil. The dots show the means and the lines show the variation among the replicates [Figure adapted from Rohr et al. [4] with permission].

Figure 3

(A) Cattle and donkeys readily ate the removed plants. However, goats refused to eat them. **(B)** Sheep and feeds used in our sheep experiments. When their normal diet was replaced with up to 60% of the removed plants, the final weights of adult and juvenile sheep were similar to sheep that ate normal diets (data not shown). This tells us that the plants were not harmful. **(C)** Local communities willingly helped us to remove the plants from the water [Figure adapted from Rohr et al. [4], with permission].

Soils are very sandy in this area, so farmers add nutrients to make the soil healthy enough to grow food and to hold water for crop roots to soak up. In addition to washing into nearby waterbodies when it rains, chemical fertilizers are expensive, and their production

and use contribute to climate change. Compost, created by letting the plants naturally break down for a few months (Figure 2A), is a natural fertilizer that can improve soil health. Would the nutrients in the composted plants help crops grow as well as crops receiving chemical fertilizers? We recruited local farmers to help answer this question (Figure 2B) and we discovered that the compost worked wonders. Compost almost tripled onion production and nearly doubled pepper production (Figures 2C, D), regardless of whether the compost was applied on top of the soil or tilled (mixed) into the soil, or whether it was applied alone or with chemical fertilizer [4]. Compost helped the soil hold water and gave the crops important nutrients, even more than chemical fertilizer. Additionally, the compost reduced fertilizer pollution in the environment and cost much less than chemical fertilizers, helping farmers save money.

Just as the plants pulled from the water can feed the farmers' soil, we also found that these plants could feed their farm animals. Many livestock, such as cattle, donkeys, and sheep, were attracted to the plants and started eating them (Figure 3A). So, we tested whether the plants (dried for a couple of weeks to kill any parasites) could be used as a substitute for purchased livestock feed (Figure 3B). We discovered that both adult and juvenile sheep maintained their weight when we substituted up to 60% of their diets with the plants we removed from nearby waterbodies (Figures 3C, D) [4]. Thus, the plants were not harmful to the sheep, and they cost much less than purchased animal feed.

BIODIGESTER

A tank in which microorganisms break down waste and produce fertilizer and gas that can be used to generate electricity.

We also mixed the plants with cow poop in **biodigesters**. Biodigesters use microorganisms to turn plant and animal waste into gas that can be used for cooking or electricity production. This is useful because many homes in Senegal do not have gas or electricity and more than 80% of households use firewood and charcoal as cooking fuel. With cleaner biodigester gases, families did not need to cut down trees and burn wood to cook their food, which can make the air cleaner. Additionally, when cow poop breaks down, it can release methane, one of the most powerful gases changing our climate. We found that combining the plants with cow poop in biodigesters produced high-quality gas, minimizing the amount of methane released while also providing homes with the energy they needed to cook their food. Biodigesters powered by these plants keep trees standing and air clean, while feeding people and helping slow climate change.

WHY IT MATTERS

This simple idea of clearing overgrown plants in this region of Africa has multiple benefits [4, 5]. First, it helps protect kids from getting sick with schistosomiasis. Second, it makes waterbodies easier to access and safer to use. Third, it helps farmers save money while growing more food. Fourth, it can help to provide households with cleaner

energy. Fifth, it can reduce pollution, deforestation, and climate change, all of which can be harmful to animals and people. Finally, it can improve lives by helping communities escape from extreme poverty. Actions that have multiple benefits are sometimes called win-win solutions; in this case, there are so many wins!

WORKING TOGETHER FOR A BETTER FUTURE

When we started removing the plants, many people in the communities joined in to help (Figure 3E), not just because it made the water safer but also because it provided many other benefits. We are now training communities to keep their waterbodies clear and how to turn the plants into a resource. In a partnership with these same communities, we are searching for ways to improve this process and are co-developing new knowledge to enhance their lives. By working as a team, the communities can keep their waterbodies clean and their families healthy. We are now using satellites to find which waterbodies have too many plants, so we know where to target our efforts next.

WHAT CAN WE LEARN?

Too often, people develop solutions to big problems without considering potential negative side effects or multiple benefits. This story teaches us that, if we are creative and open-minded, there might be relatively simple solutions to some serious problems. This story also shows how people can work together to create a healthier world for humans, plants, animals, and soils—a concept called **planetary health**. We hope this work inspires new ideas for win-win solutions that are positive for both nature and people. Next time you see a waterbody, think about how important it is to keep it clean and healthy and that a little teamwork can go a long way in making our planet a better place for children everywhere! (To learn even more, please check out our project website).

PLANETARY HEALTH

a concept that recognizes that human activities, such as climate change, deforestation, and pollution, have a significant impact on the environment and, in turn, on human health.

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ORIGINAL SOURCE ARTICLE

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Antonio is a bird and plant enthusiast with a talent for locating four leaf clovers. He enjoys playing soccer and watching Japanese anime.

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I am Tomas, I like playing with my brother in my free time and being on Discord. My favorite subjects at school are Art, Sports, and Physics. I also like animals, airplanes, and Formula 1.

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David López-Carr is a professor of geography at the University of California, Santa Barbara. He examines potential win-win outcomes for people and the environment. He has authored over 220 publications thanks to over 50 fellowships and grants from NASA, NOAA, NSF, NIH, and numerous other sources. López-Carr is an AAAS Fellow and was awarded the *Research Excellence Award* from both the Population Specialty Group and the Human Dimensions of Global Change Specialty Group of the Association of American Geographers, as well as the AAG *Excellence in Mentoring Award* and the Conference of Latin American Geography *Teaching Award*.

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