

# Planetary Health Case Studies

AN ANTHOLOGY OF SOLUTIONS



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This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](http://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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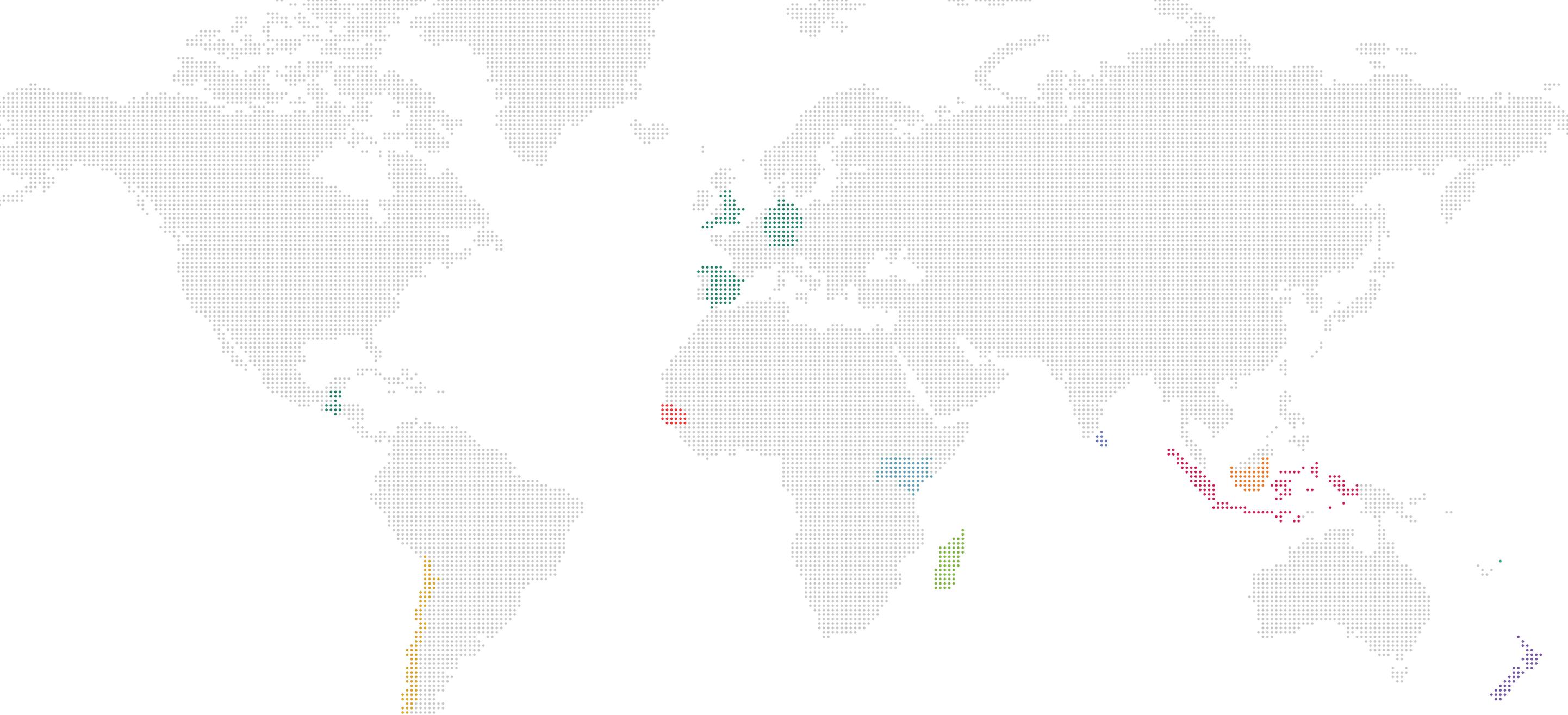
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Case Study	Indonesia	Senegal	Indonesia	Chile	Madagascar	Fiji	Germany, Guatemala, Europe	Uganda, Kenya	Sri Lanka	New Zealand
Ecosystem	Peatland	River basin	Rainforest	Urban center	Rainforest	River basin/coastal	Urban, highlands	Lake basin	Mangrove	Country-wide
Project Lead	Government agency; academic researchers	Academic researchers; NGO	NGO	Private sector	Academic researchers; NGO	Academic researchers; NGO	NGO; private sector	NGO; private sector	NGO	Indigenous <i>iwi</i> (tribes)
Topics	Land use and land cover change (peatland fires and deforestation); climate change; non-communicable disease; local solution; social determinants of health; policy link; scaling up solutions	Infectious disease; food security; biodiversity shifts; land use and land cover change; water security; local solution; social determinants of health; scaling up solutions	Land use and land cover change (peatland fires and deforestation); climate change; non-communicable disease; local solution; social determinants of health; policy link; scaling up solutions	Circular economy; climate change; infectious disease; urbanization; water security; local solution; scaling up solutions	Biodiversity shifts; food security; land use and land cover change (deforestation); zoonotic/infectious disease; demographic shifts; local solution; Indigenous knowledge	Water quality; infectious disease; land use and land cover change (deforestation and farming); food security; climate change; Indigenous knowledge; social determinants of health; policy link	Food security; food waste; circular economy; climate change; non-communicable disease; gender lens; local solution; social determinants of health; policy link	Biodiversity shifts; food security; gender lens; climate change; infectious disease; water quality; demographic shifts; local solution; social determinants of health; policy link; scaling up solutions	Land use and land cover change (mangrove loss); food security; local solution; policy link; climate change; gender lens; Indigenous knowledge; social determinants of health	Indigenous knowledge; mental health and well-being; nutrition; climate change; non-communicable disease; water quality; local solution; social determinants of health; policy link

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Hilary Duff is a multimedia journalist who has worked and reported from six continents. She is interested in solution-based storytelling—amplifying the positive changes being driven at every level, from young social innovators in sub-Saharan Africa to national governments in Asia. Prior to creating this case study anthology, Hilary reported extensively on social and environmental entrepreneurship in sub-Saharan Africa and the MENA region for both Canadian NGOs and international projects run by the European Union and the United Nations Environmental Programme. Her website is <http://www.hilaryduff.work/>

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## Introduction

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This anthology is a collection of stories about how we can create a healthier future by rewriting the relationship we have with our Earth. The cases in this anthology introduce a range of environmental challenges perpetuated by people worldwide: deforestation in the Indonesian Borneo, contaminated river systems in Fiji, bushmeat hunting as a driver for species-loss in Madagascar—just to name a few. Each of these environmental challenges, in turn, contribute to a variety of human health outcomes, including cardiorespiratory disease, food insecurity, water-borne diseases like schistosomiasis and typhoid, and concerns related to mental health and cultural identity. At their core, these stories illustrate how human health and well-being are inextricably linked to the status of our natural environment.

Importantly, these cases go beyond simply identifying urgent, interconnected problems. This anthology is inherently solutions-based, and each story highlights a concrete example of how groups of actors worldwide are using planetary health approaches to address problems in their communities: from millions of Europeans using a phone app to reduce food waste; to villages reducing pressure on wildlife populations; to private sector innovation in wastewater treatment; to women's groups working in partnership with the Sri Lankan navy to replant mangroves. What they share in common is action fueled by commitment to bring people and planet back into balance to ensure the health and well-being of future generations.



*Rainforests in Borneo have faced substantial deforestation in recent decades due to community-based logging and conversion for oil palm concessions.*



*A group of young girls in Senegal inspect the snails that host schistosomiasis, a parasitic, water-borne disease.*

We find ourselves at an extraordinary, even unique, moment in human history. By most metrics, there has never been a better time to be a human being. The last 70 years have been marked by almost unimaginable improvements in global wealth, health, and education. The percentage of the global population living in extreme poverty dropped from 63% to less than 10%, despite a near tripling of the human population.<sup>1</sup> Average global life expectancy climbed by nearly 30 years,<sup>2</sup> while child mortality dropped by a factor of four worldwide.<sup>3</sup> The percent of the adult population able to read and write has doubled.<sup>4</sup>

But the 70 year period that has delivered these enormous human development gains has not come without sacrifice. The economic growth and scientific and technological developments that fueled these improvements have driven an extraordinary ballooning of humanity's ecological footprint. It is hard to overstate the scale of human impacts across our planet's natural systems. We have converted 40% of Earth's land surface into croplands and pasture in order to feed ourselves.<sup>5</sup> We use about half the accessible fresh water on the planet, mostly to irrigate our crops,<sup>6</sup> and we exploit a third of monitored fisheries beyond maximum sustainable limits.<sup>7</sup>



*A mangrove replanting session in northern Sri Lanka.*

A fishing site on Lake Victoria, one of East Africa's most important fisheries.



We have cut down roughly half the world's temperate and tropical forests<sup>5</sup> and dammed over 60% of the world's rivers,<sup>8</sup> with proposed dams expected to increase this figure to 93%.<sup>9</sup> These and other activities are crowding out the rest of life on our planet. In May 2019, 145 authors from 50 countries released the Global Assessment of the Intergovernmental Panel on Biodiversity and Ecosystem Services. They concluded that roughly one million species face extinction, many within decades.<sup>10</sup> Already, we have halved the population of birds, mammals, reptiles, amphibians, and fishes since 1970.<sup>11</sup> Extraordinary improvements in human well-being have come on the groaning back of a crumbling biosphere.

A bamboo lemur near Andasibe-Mantadia National Park in eastern Madagascar. Bamboo lemurs are one of the world's most critically endangered species.



The scale of human activity now exceeds our planet's capacity to absorb the wastes we produce or regenerate the resources we use. As a result, we are transforming and disrupting most of Earth's natural systems at by far the fastest rates since humans arrived on Earth. These changes in the conditions of our lives ultimately impact every dimension of our health and well-being as illustrated in **Figure 1**. Planetary health focuses on understanding and quantifying the human health impacts of these global environmental disruptions, and focuses on developing solutions that will allow humanity and the natural systems we depend on to thrive now and in the future.

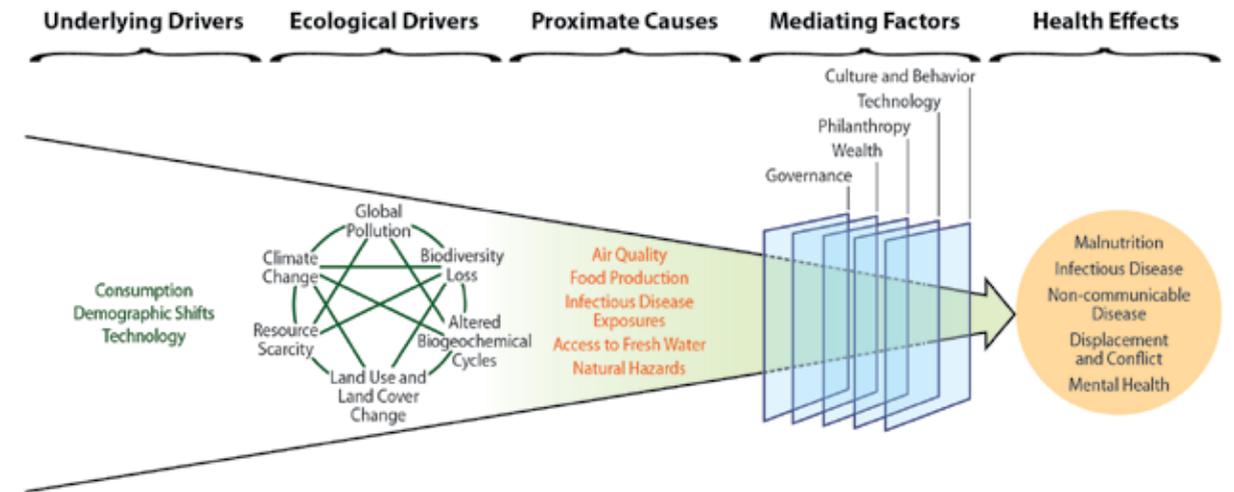


Figure 1: Schematic illustrating the impacts of anthropogenic change on human health. Underlying drivers include rapid population growth, additional increases in consumption, and the use of technologies with large environmental impacts. These drivers occur at such a scale that they are transforming our natural systems and changing fundamental conditions for human health and well-being. Ultimately, nearly every dimension of human health is affected.

Much has been written recently about the science of planetary health and its theoretical foundations,<sup>12 13</sup> including a new textbook that serves as a companion to this anthology: *Planetary Health: Protecting Nature to Protect Ourselves* <https://islandpress.org/books/planetary-health>. However, there are few resources to describe planetary health practice in action. How do we *do* planetary health? And what best practices and values do these actions share across scales (local, regional, national, etc.) and regions of the world?

This anthology of case studies is an attempt to begin filling that gap. Over a year and a half, journalist and photographer Hilary Duff travelled around the world interviewing practitioners, community members, government officials, business leaders, and other stakeholders on the front lines of environmental change. Combining their experiences and knowledge with existing scientific research, the resulting case studies tell the stories of planetary health in practice. Together with the new textbook, these case studies support the goal of growing the next generation of planetary health scholars and practitioners. These new resources promote classroom education and provide the foundation for further efforts to communicate complex, interdisciplinary planetary health science and solutions to policy makers, funders, government agencies, students, and NGOs.

Achieving planetary health will require a broad societal transformation. Some have described it as the “Great Transition”<sup>14</sup> where we learn to do nearly everything differently: how we produce and consume food, manufacture products and energy; how we construct and live in our cities; how we manage our natural landscapes and resources. The changes needed are not only in the physical world. The Great Transition demands a mindset shift—a rewriting of the stories we tell about our place in the world, our relationship with Nature, how we compensate for and address the significant inequalities that exist, and what it means to live a good life. The cases in this anthology are by no means representative of all the kinds of change that will be needed or all the types of practitioners whose contributions will be critical. But we do hope they illustrate the breadth of approaches that will be relevant and necessary to achieving planetary health.



*Hilary Duff, the case study author, during her case study reporting in the Senegal River Basin.*

## Overarching themes

As you read through these cases, we hope you will begin to recognize a group of overarching themes that run through many of them and are central to the field of planetary health.

### Listening

Several stories in this anthology take place at the level of communities living in or near threatened natural systems: the rainforests of Kalimantan, a protected area in northeastern Madagascar, the shores of Lake Victoria, the islands of Fiji, or the mangrove forests of Sri Lanka. More often than not, local people are well aware that their use of natural resources is not sustainable, but they have few other options. If local people are cutting trees as a way to pay for urgent medical costs (Kalimantan), or hunting wildlife because it is the only available source of nutritious diets for their families (Madagascar), then efforts aimed at curbing these activities must directly address those needs and limitations. Meaningful relationship-building and reciprocity are necessary for sustainable planetary health interventions. That requires practitioners carefully listen to understand local needs, ideas, and priorities—and then take action to craft community-proposed solutions alongside these new partners. This crucial element—what one project describes as “radical listening”—should be the foundation underlying the initial approach, and guide course corrections along the way.

These case studies also deconstruct a problematic international development paradigm: that “developed” countries are the ones best positioned to bring “solutions” to “developing” countries. While countries in the Global North often have greater financial resources available to fund planetary health interventions, “radical listening” recognizes the agency of communities to identify the needed solutions. In listening to communities, planetary health practitioners and scholars must respect that knowledge and focus on creating programs that are community-centric as opposed to prescriptive.

### Equity and Justice

People generally disrupt natural systems for a purpose. Dams in West Africa generate electricity, create much needed arable farmland, and provide reliable water to irrigate crops. Fire is an effective and inexpensive way to clear land for agriculture in many parts of the world. Shrimp farms constructed atop mangrove ecosystems are a lucrative business opportunity. However, the



*Farmland in Senegal relies on irrigation water redirected from a dam that was constructed in the mid-1980s.*

people who reap the rewards are often categorically different from the people who pay the greatest health tolls. This divide is commonly illustrated among key lines: Global North and Global South, rural and urban communities, Indigenous and settler groups, and socioeconomic status. Quantifying the health externalities of projects like dam building or biomass burning is an important step in ensuring that certain groups aren't forced to pay the costs of other people's economic gain. Planetary health practitioners and scholars can also use their power and privilege to advocate for those communities whose health is most affected, but whose voices often go unheard.

These case studies also force students to question the barriers that exist in concepts of universality and access. Though certain sexual and reproductive health services are freely available for women in Uganda, gender norms, culture, and geography can limit them from accessing these rights. While Indonesia has an ambitious universal healthcare program, people living in remote villages may need to travel over land and sea to access medical facilities. Though international aid organizations may provide nutritional supplements to a country like Guatemala, corruption and systemic racism can prevent those supplements from reaching the families who need them most. And though some Senegal River Basin villages can access tapped water and improved sanitation facilities, financial, educational, and cultural barriers commonly prevent people from utilizing this infrastructure that could reduce schistosomiasis transmission.

### Problems Rooted in Power

Research and technological innovations can, to an extent, solve important problems. But some problems are rooted in power inequalities and can't be solved without movement building, social action, and system change. Structural racism and intergenerational trauma prevent many Māori from accessing health care in New Zealand. In this case, improving health equity demands a paradigm shift to create a health system that reflects Māori cultural values, ways of knowing, and relationship with the natural world. In Indonesia, although better science was necessary to quantify the true health burdens associated with biomass burning, success came in part by organizing restoration efforts at a grassroots level. Mangrove protection in Sri Lanka would not have been possible without recognizing the agency of local fisherfolk communities and elevating the role of women in households. The stories shared in this anthology demonstrate the ability for planetary health interventions to correct for these historical power imbalances.

### Addressing Livelihoods

Many of the cases illustrate the need to consider livelihoods when crafting planetary health solutions. Providing access to microloans (Sri Lanka, Kalimantan) or other development support (Madagascar, Senegal, Lake Victoria) can help jumpstart income-generating activities. Poverty is an urgent determinant of environmental destruction. Income-generating activities can help families overcome cycles of poverty that perpetuate the feedback loops between environmentally-destructive behaviors and human health concerns.

Further, several of the cases emphasize the role women must play in livelihood activities. Much of our world is still a patriarchy, and planetary health interventions are an opportunity to elevate the role of women in society to the benefit of all. This is most clear in the stories shared from Kalimantan, Guatemala, Sri Lanka, and the Lake Victoria region.

### Unique Context, Unique Solution

The cases included in this anthology are at varying stages in their solution-finding process. While there are many best practices that can be adapted in other parts of the world, each context requires a unique solution. The stories in this anthology demonstrate that solutions must closely consider the cultural, governance, economic, and social realms—the mediating factors outlined in Figure 1. Each of these layers influences the way a solution is implemented and perceived in any one community.

Indeed, there's not even a single solution for any one context. Many of these cases caution against a "silver bullet" solution that can easily solve all the problems at hand. In Senegal, for instance, planetary health practitioners are looking at prawns as one option in an ever-evolving "portfolio of solutions." Similarly, the project highlighted in the Fiji case is looking at the many interventions that need to take place at various scales in order to restore river catchment health and reduce water-borne disease.

### Circular Economy

A key element of the Great Transition will be a significant reduction in waste flows and the reuse and recycling of materials. An impactful example can be found in Santiago, Chile, where the wastewater agency is turning sewage into a source of clean energy, fresh water, and fertilizer for surrounding fields. Similarly, the



*Women in northern Sri Lanka sign off to receive a microloan from the Sri Lanka Mangrove Conservation Project.*

use of a popular phone app in Europe allows tens of millions of consumers and tens of thousands of retailers to divert healthy food from landfill, redirecting it to a new customer base. This, in turn, saves money for consumers, provides new revenue for business owners, and reduces pressure on the planet. Across manufacturing, food systems, the built environment, and other domains, rethinking practices to dramatically reduce waste and encourage reuse and recycling of materials is a critical tenet of planetary health.

*Matthew Bannister, a Too Good To Go waste warrior uses the food waste app to buy lunch in central London.*



### Behavior Change

The Great Transition will also require behavior change as people around the globe learn new ways of living. Whether it is loggers transitioning to new livelihoods (Kalimantan) or school children learning to cook plant-based meals (Germany), the Great Transition will require investment in education and training. In some cases, behavior change requires engaging traditional habits in a new way (farming mealworms in Guatemala as a source of nutrients), creating technologies (Too Good To Go app in Europe), and elevating collective action to build power (Māori action around creating a healthcare system that incorporates their cultural values and needs). Further, the cases emphasize that planetary health practitioners must understand the motivators that are driving environmentally-harmful activities. It's only when these root causes are identified that solutions can change behaviors and be truly responsive to community need.



*MealFlour is an NGO in Guatemala that is improving local food security using edible mealworms.*

### Innovation, Technology, and Knowledge

Scientific and technological innovation is critical in achieving planetary health. Innovative use of biofactories in Chile's capital city has turned sewage treatment into a source of energy, clean water, and fertilizer for surrounding farms. Use of a mobile phone app in Europe is reducing food waste at a retail and consumer level. Research on river prawns in the Senegal River Basin led to an intervention to control schistosomiasis while simultaneously providing a new source of income and nutritious food for communities. All three innovations have the ability to be scaled and replicated in other parts of the world.

But these case studies also urge readers to expand their views of what constitutes innovation, technology, and knowledge. Innovation doesn't always mean building something from nothing, nor does it need to be high-tech. In Sri Lanka, traditional brushpark fishing techniques have been passed down through generations. This practice was refined around the sustainable use of mangrove ecosystems and the behavior of local fish species, confirming the immense environmental knowledge held by local communities. Local customs and protocols in Madagascar, Fiji, and New Zealand have also guided the interactions people have with their surroundings, and often it is the breakdown of traditional knowledge or practices that leads to unsustainable relationships. Innovations in support of planetary health include precision agriculture with the use of artificial intelligence and robotics, but they also include novel applications of agro-ecological techniques that have been used for centuries.

*Dodoely, a traditional healer in Antavato, Madagascar. She produces remedies based on her knowledge of local medicinal plants.*



A goal of these cases is to help the next generation of planetary health practitioners and scholars recognize the many linkages between human health and changes to Earth's natural systems. But another aim is to have readers begin to reflect on the humility, compassion, and care we must have for one another—skills that aren't always taught in the classroom. Some of these stories may be difficult to read. They demand people question their own assumptions about “good” and “bad” and acknowledge the privileges they may hold. The cases require readers enter the murky grey area to understand the true complexities of peoples' lives. By combining scientific research and storytelling, we hope this anthology sparks a journey driven by a sense of understanding and empathy as well as informed by data and academic rigor.

*Gertrude, a young mother on Bussi Island in the Ugandan portion of Lake Victoria.*



### **The Anthology as a Teaching and Learning Resource**

Beyond immersing readers in inspiring stories from around the world, this anthology aspires to create structured learning opportunities to ensure readers effectively connect theory with practice, knowledge with reality. In conjunction, the anthology seeks to impart the knowledge, skills, and attitudes relevant to planetary health practice that students will need in order to integrate these competencies into solution-driven actions in the near future.

As a method, case studies are transformative learning opportunities, and they are part of a well-established practice of teaching and learning about complex situations. The case study technique involves representing complexity in real-life situations in a way that can invoke a multiplicity of perspectives in the evaluation/analysis of the case and a creative generation/application of solutions from the learners. The case studies in this anthology also reflect real-life uncertainty and illustrate practical

and pragmatic approaches to diverse situations around the globe. As an additional layer, the cases encourage critical thinking and reflection as an essential component of the learning process, enabling the reader to acknowledge their position concerning the geographical, historical, cultural, epistemological perspectives of each case, and future actions based on these considerations. We further hope to foster curiosity and the development of lifelong learning, in addition to allowing the reader to feel empowered, responsible, and an active part of the learning process.

#### Using the cases as teaching tools

Each case is supplemented with a set of assets that allows them to become effective teaching resources. It is important to highlight that the cases do not seek to provide definitive solutions to planetary health challenges, but rather train learners to generate them as a group through collaborative work and team decision-making. To achieve this, cases are accompanied by –

#### *For Learners:*

*Connections to explore further theoretical concepts within the “Planetary Health: Protecting Nature to Protect Ourselves” textbook. Questions and side notes that are designed to promote reflection and further exploration of contextual and theoretical factors. Links to resources of interest designed to promote curiosity and provide insights for further group discussions. Objectives that allow the learner to clearly understand the expected outcomes of the learning process.*



*Monitoring the water level of peatlands in Central Kalimantan, Indonesia.*



*Cornelia Lemke, a teacher in Berlin, Germany, has adjusted her curriculum to include greater discussion of plant-based foods.*

#### *For educators:*

Structured teaching guides for each case study provide:

*An overview of the main themes covered in each case study. Learning objectives that can be modified according to learner levels and other contextual factors. Guidance on appropriately positioning each case within curriculum. Optional assignments or suggested background readings for learners. Ice-breakers or similar dynamic exercises to start each case group discussion. Questions to lead group discussions. Recommendations to guide board plan and group discussion. Suggested concluding remarks for group discussion.*

#### *A note for learners:*

Case study methodology requires the learner become a protagonist and take charge of their learning process. Learners are expected to read with retention each case study, solving the reader questions, and preparing any background readings or assignments suggested by the facilitator. Active participation and motivation are expected from all students during the group discussion. In addition, learners are expected to:

*Become familiar with using the case method approach, including its objectives and limitations. Connect previous knowledge and personal experiences with each case study. Synthesize perspectives in a way that is understandable to others. Listen comprehensively, critically analyze, and evaluate the conclusions and opinions of others. Motivate others to speak up and present their ideas, as well as be respectful if they choose not to do so. Respectfully rebut opposing views of their peers or instructor. Analyze situations from multiple perspectives and propose solutions based on complex analysis. Work collaboratively in groups when required.*

***A note for educators:***

The case study method requires the educator become a facilitator. In preparing for the case discussion, the facilitator must review each case and the subject matter in detail until they feel comfortable leading the discussion. Once leading the group discussion, they must actively influence the learning process by encouraging critical thinking, reflection, synthesizing students' perspectives, accommodating divergent understanding, and negotiating within multiple frameworks of knowledge. The instructor must be aware not to impose their views and should allow for learners to reach a consensus within the group discussion. Facilitators are also expected to:

*Establish guidelines for appropriate group discussion. Urge learners to strive for comprehensive, nuanced, and critical answers, and avoid simplistic positions. Connect theoretical underpinnings with emerging themes and perspectives from the group. Embrace and capitalize on the diversity of opinions and new ways of thinking about the challenge being addressed. Motivate participation and balance distinct voices from within the group. Keep a cordial environment for debate and divergent perspectives. Maintain a dynamic and engaging discussion with appropriate timekeeping. Maintain a cordial and egalitarian relationship with students. Prepare for uncertainty and acknowledge what is not known. Seek opportunities to bring out broader themes related to planetary health (like those described above) that run through several cases*

***A note for evaluating student performance:***

As with other aspects of the learning process, students should be evaluated based on clear criteria established beforehand by the instructors. It is important to highlight that beyond theoretical knowledge and participation, the case study method allows for



the evaluation of a variety of other essential learning outcomes relevant to liberal and civic education, and those particularly relevant to planetary health practice. We suggest the facilitator also evaluate students on the following domains: critical thinking, creative thinking, problem-solving, inquiry and analysis, intercultural knowledge and competence, ethical reasoning, oral communication, quantitative and information literacy, and teamwork. The Association of American Colleges & Universities has developed adaptable rubrics for each of these domains: *VALUE* (Valid Assessment of Learning in Undergraduate Education)<sup>15</sup>. The *VALUE* rubrics enable educators to evaluate students in a transparent and adaptable fashion and may be useful as an assessment tool.

*Andy Chamberlin and Dr. Susanne Sokolow with Stanford University use a drone to map water access points in the Senegal River Basin.*



Three residents of Naqarawai village in the highlands of Viti Levu, Fiji.

Finally, we acknowledge that this anthology and its teaching notes are neither exhaustive nor definitive; nor are they a perfect representation of every situation or perspective. These cases were written based on interviews conducted in 2018-2019, and certain situations and approaches will likely shift with the passage of time. Innovation is meant to be challenged and revised. We encourage anyone using this anthology to adapt it to their unique situations or objectives, as well as to provide the *Planetary Health Alliance* with timely feedback for future editions. The anthology should be a starting point for anyone looking to engage in any of the many fields that represent planetary health and as part of a continuum for the creation of the next generation of planetary health scholars and practitioners.

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# Health and Haze

A SCIENCE-DRIVEN POLICY APPROACH  
TO SOUTHEAST ASIA'S ANNUAL OCCURRENCE

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](http://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

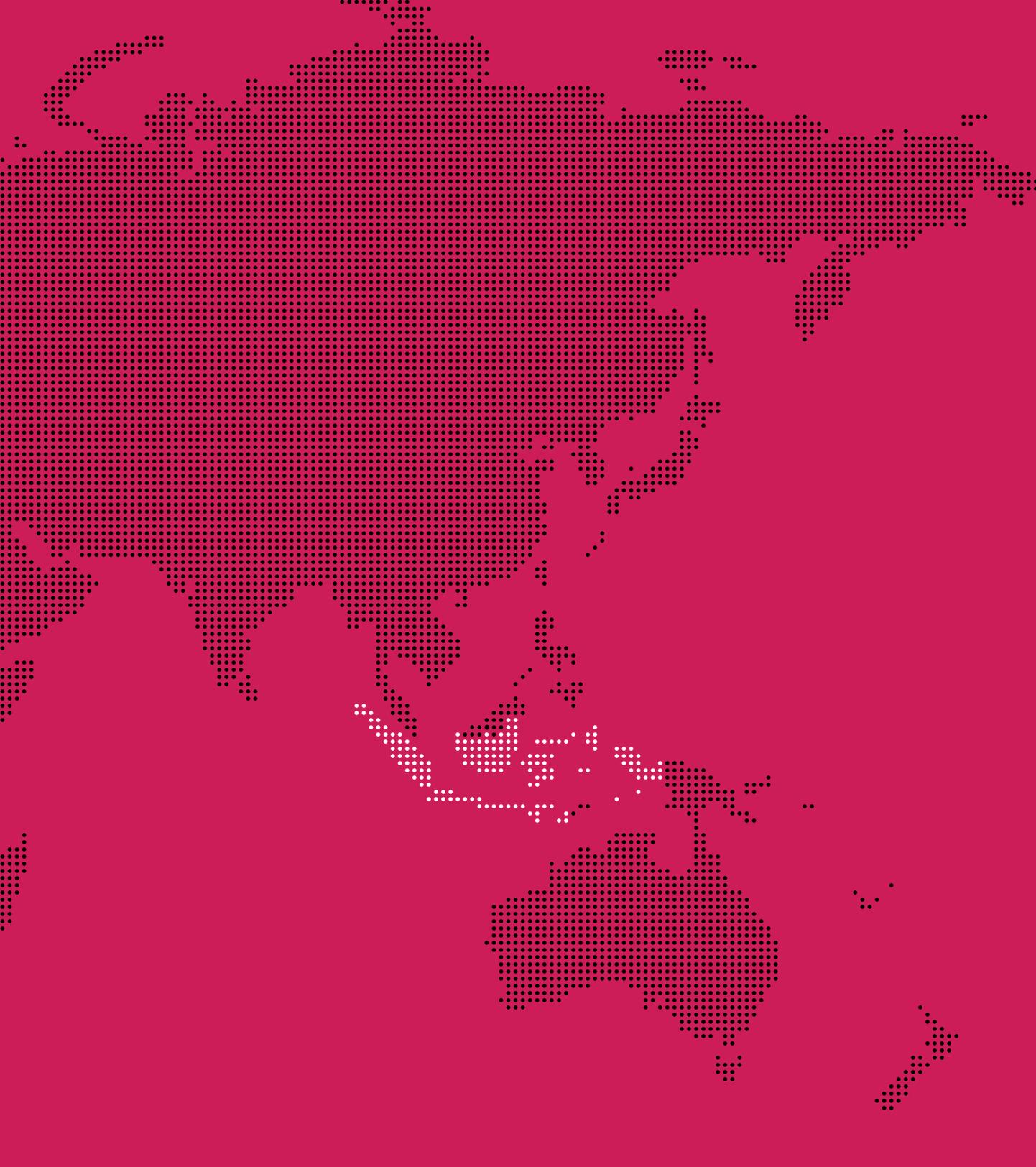
Case studies were written and photographed by Hilary Duff with editing and support from Amalia Almada, Christopher Golden, and Sam Myers. Teaching guides were written by Carlos A. Faerron Guzmán.

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## Executive Summary

Themes from this case study are explored in greater detail in the land use section of chapter 4 and the non-communicable disease chapter 7 as well as the discussion of air pollution in the energy chapter 12 of [\ Planetary Health: Protecting Nature to Protect Ourselves.](#)

### Learning Objectives

*After examining this case, students should be able to:*

- ① Analyze the underlying driving forces of haze events.
- ② Appraise the short- and long-term health effects of haze events.
- ③ Explain the importance of multidisciplinary and multi-sectoral actions when facing planetary health challenges, specifically haze events prevention and peatland restoration.
- ④ Evaluate how determinants of health frameworks can guide problem analysis and the solution design process.
- ⑤ Apply principles of good governance, equity, and evidence-informed policy in the face of planetary health challenges.

This case study explores how an anthropogenic haze episode in September and October 2015 contributed to 100,300 excess premature cardiopulmonary disease-related deaths in Southeast Asia, with a focus on Indonesia, Singapore, and Malaysia. It will look at how historical and present-day land use and land cover change (LULCC) practices on peatland areas altered ecosystems and influenced the vulnerability and severity of the 2015 event.

The case study will also outline how the Indonesian government has addressed this issue: with the creation of new policies and the establishment of a government agency to manage and restore peatlands. Collaborating with groups across the country, as well as with international researchers, that government agency is using a multi-tiered approach to address the complex drivers that contribute to peatland fires. Included in that approach is the use of a new tool that allows policymakers to link land use scenarios, associated fire emissions, and long-term health consequences into the foreseeable future.

*This case study is based on interviews conducted in Jakarta and communities across Central Kalimantan in August 2018.*

## Introduction

On this humid day in August 2018, the *Badan Restorasi Gambut* (BRG) office in Central Jakarta is buzzing with activity. If the BRG (the Peatland Restoration Agency in English), had a busy season, this would be it. August is the mid-way point in Indonesia's dry season, a period that stretches from June to October each year. With those months comes a history of haze—the dense air pollution that drifts over much of Indonesia and other Southeast Asian countries as a result of smoldering, human-caused peatland fires.

BRG's mission is to reduce haze by facilitating the restoration of more than 20,000 square kilometers of peatland. They also coordinate the sustainable management of those ecosystems with many levels of government, organizations, and communities across Indonesia.

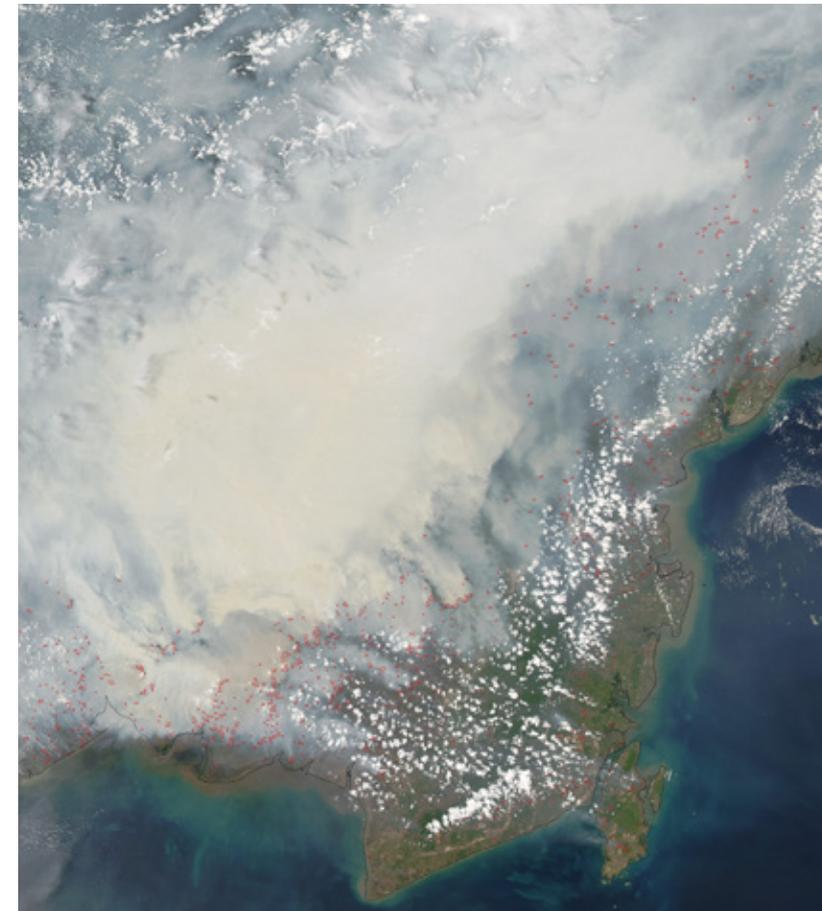
Today, that mission is still a work in progress. A newspaper headline announces the number of hot spot fire areas in Central Kalimantan, one of Indonesia's most fire-prone provinces. Along the capital city's notoriously traffic clogged streets, every other person riding an *ojek* motorbike taxi has their face covered by a mask. While caused by vehicle pollution rather than peatland fires, today's hazy scene is a small glimpse into what thousands in the country face year-after-year. In both cases, face masks offer inadequate protection.

*A family riding a motorcycle through the thick air and smoke from peat fires in October 2015. Outside Palangka Raya, Central Kalimantan. Photo by Aulia Erlangga, CIFOR; [cifor.org](http://cifor.org)*



Hanging in the BRG office is a photo of President Joko Widodo, Indonesia's leader since 2014. President Jokowi, as he's commonly referred, established the BRG as his first presidential decree of 2016, and the agency is overseen by his office. Its establishment was a bold statement marking the political seriousness with which the issue is now regarded—and the international pressure that urged its creation.

In 2015, that international pressure was intense. Photos of Indonesia's red-and-yellow tinged skies captured headlines worldwide. "Southeast Asia, Choking on Haze, Struggles for a Solution," proclaimed *The New York Times*. "Indonesia's fires labelled a 'crime against humanity' as 500,000 suffer," declared *The Guardian*. Images captured by NASA satellites show a dense cloud of smoke blanketing the region during September and October 2015,<sup>1</sup> the period in which 68% of all active fires were detected.<sup>2</sup>



*Dense clouds of smoke seen over the island of Borneo in September 2015. Photo via NASA Earth Observatory.*

What is striking about these satellite images is that the smoke hangs heaviest not over the burning areas, but those regions downwind in Indonesia and, to a lesser extent, in neighboring countries. In Malaysia, Members of Parliament called for the government to adopt regulations that could be used to take legal action against companies responsible for creating the haze<sup>3</sup>—similar regulations had already been passed in Singapore. Indonesia’s environmental crisis was the plight of the region and the talk of the world.

This was the media and political climate that surrounded President Jokowi in December 2015 as he attended the United Nations Climate Change Conference, COP21, in Paris. The fires of the previous three months were finally being extinguished by monsoon season downpours, but not before they had scorched through 26,000 square kilometers of Indonesian land. The cause had already been identified: human-triggered fires set as an inexpensive way to clear land for agriculture. A 2015 World Bank report laid out the short-term impacts of the event: the haze had forced weeks of school closures, grounded airplanes, and caused thousands to fall sick across the region.<sup>4</sup> Early estimates placed the initial economic cost of that year’s haze at US \$16 billion<sup>i</sup>—twice the amount that it took the country to clean-up the devastating 2004 tsunami.<sup>5</sup> This estimate does not account for the long-term health costs of sustained haze exposure nor the loss of biodiversity and ecosystem services.

“The creation of BRG was the response of the president to stop and prevent fire, haze, and further peatland degradation. It was also because of the international concerns to the republic,” says Pak Budi Wardhana, the agency’s Deputy Head of Planning and Coordination. “During the Paris COP21 [in December 2015], the President made a commitment to the international community that Indonesia will take every measure, and will set up an agency that focuses on peatland restoration. That was the seed of establishing the BRG.”

The need for peatland restoration became more apparent the following year. Research published by Harvard and Columbia University researchers linked the haze exposure in September and October 2015 to 100,300 excess deaths in Indonesia and neighboring countries of Malaysia and Singapore.<sup>6</sup><sup>ii</sup> That research was conducted by a multidisciplinary group of scientists, medical professionals, and policymakers who called themselves The SMOKE Team.



*Pak Budi is the Deputy Head of Planning and Coordination with Badan Restorasi Gambut (BRG), Indonesia’s Peatland Restoration Agency. That agency was created in response to 2015’s transboundary haze event.*

Using their diverse backgrounds, the team more recently combined fire emissions inventories, satellite monitoring, chemical transport models, and epidemiological data. The result was a framework to determine which peatland areas should be prioritized for management in order to prevent the greatest number of downwind health effects in the future. Another takeaway was that preventing haze-related deaths demanded more than a reactionary response. The team concluded that an effective long-term solution would require shifts in land use management in order to target the root cause of the haze.

This long-term view of prevention and mitigation resonates with the BRG. “The World Bank study only covered five months of the disaster. It wasn’t really looking into the long-term effect of the health problems,” says Pak Budi of the 2015 report. “Those health effects will add more cost to the government, so with [the SMOKE Team’s studies] we can provide the government with a compelling argument that the sustainable management of peatlands is much more important, rather than just restoring it.”

Addressing the causes of the 2015 haze event demanded Indonesia take a dive into its long history of fires. While the public health toll of the 2015 dry season was the first to be carefully quantified, similar episodes have been occurring for decades.

<sup>i</sup> A detailed breakdown of this estimate is included in the full World Bank report (see above). It includes losses of US \$399 million in the tourism sector, US \$372 million in the transportation sector (including shipping), and US \$151 million in immediate health costs. Overall, the costs represented 1.9% of Indonesia’s 2015 Gross Domestic Product.

<sup>ii</sup> How are excess deaths calculated? Why is this measure useful? [Learn more here](#)



*The waterlogged appearance of a healthy peatland forest in Central Kalimantan. Photo by Nanang Sujana, CIFOR; cifor.org*

## Southeast Asia and a History of Haze

With a land area of 1.9 million square kilometers, the Republic of Indonesia is the largest country in Southeast Asia. It's the fourth most populous country in the world, and its 264 million inhabitants live across a sprawling archipelago of more than 17,000 islands.

Seasonal haze is an annual problem in Indonesia and across the region, although severity varies from year to year. So common is the issue that it's looked at as an inevitable event expected every year around the dry season. The past two decades alone have provided plenty of cause for concern, with severe fires in 1997-98, 2006, and 2013 making headlines long before the events that transpired in 2015. Fire activity has historically been most severe on the islands of Sumatra and Kalimantan, the Indonesian portion of Borneo island. Fires that burned through the Indonesian and Malaysian Borneo in 1982-83 remain the largest on record, with 50,000 square kilometers scorched.<sup>7</sup><sup>iii</sup> Primary, logged, and secondary forests contributed to more than half of the total area burned in these years.<sup>8</sup>

Experts say the government response to these fires has historically been underwhelming. "When the cases happen then the government is very busy and concerned about this situation, but after the haze passes then it's business as usual," says Dr. Budi Haryanto, an environmental epidemiologist at the University of Indonesia's Research Center for Climate Change. "The Indonesian government was in denial when the [2015 SMOKE Team] study came out, but for me, I believed it because I have been looking at the health findings associated with haze and air pollutants for many years."

While the miniscule particles that cause haze can be generated by coal burning factory emissions, traffic pollution, and road dust, the haze events that so frequently occur in Southeast Asia are produced by vast, human-triggered fires. What made the 2015 fires so harmful to public health was not only that a large area burned—but the length of time that the fires smoldered, and the material that was set ablaze: peat.

<sup>iii</sup> Roughly the size of Costa Rica, or Alabama. As reference, the Amazon fires of 2019 burned around 10,000 square kilometers

## Peatlands: The World's Carbon Bank

Peatlands are a wetland ecosystem created when trees and other organic matter have partially decomposed in a water-logged, oxygen-poor environment.<sup>iv</sup> The result is a thick layer of wet, organic material, ranging from half a meter to 20 meters in depth.<sup>9</sup> Having existed on our planet for around 360 million years, the oldest peatlands store carbon captured thousands of years ago.<sup>10</sup> ↘ [Watch: An introduction to peatland ecosystems video from the BRG](#)

Despite covering just 3% of the Earth's surface,<sup>11</sup> peatlands store more carbon than all other ecosystems combined.<sup>v</sup> The majority is stored in tropical peatlands, most of which are found in Indonesia and Southeast Asia.<sup>12</sup>

Peatlands store carbon through a process called carbon sequestration. Rather than allowing decaying vegetation to release carbon into the atmosphere, peatlands contain and hold this carbon over the long-term, reducing the amount of carbon dioxide (CO<sub>2</sub>) circulating in the atmosphere. The release of CO<sub>2</sub> into the atmosphere is the main contributor to climate change. This can happen from the combustion of fossil fuels, and also through the burning of carbon rich ecosystems such as peatlands.<sup>vi</sup>

<sup>iv</sup> Are there peatlands in your country of origin? Are they protected or sustainably managed? What policies surround these ecosystems in your country?

<sup>v</sup> What other ecosystems store large amount of carbon compared to their total surface? ↘ [Find out here](#)

<sup>vi</sup> Which countries emit more net total carbon dioxide and other greenhouse gases? How about per capita emissions? What is surprising about this data? ↘ [Find out more here](#)



### The Issues Beyond Burning

Burning peatlands emit large amounts of carbon dioxide (CO<sub>2</sub>). But even non-burning peatlands emit CO<sub>2</sub> through a process called oxidation. Peatland oxidation happens when dried peatland is exposed to the sun, releasing the carbon that's been previously sequestered in the form of CO<sub>2</sub>.

Oxidation will continue unless peatlands are rewetted to ground surface level, says Marcel Silvius, a peatlands expert with the Global Green Growth Institute in Indonesia. Current regulation classifies peatlands as rewetted when the water table sits no more than 40 centimeters below ground surface level.

Paired with the issue of oxidation is the risk that comes when peatlands subside—organic matter that had been previously propped up by natural water levels sinks once that water has been drained. Peatland subsidence is a significant issue in the Netherlands, Silvius' home country, where water has been pumped from the peatlands for several centuries to allow for continued agricultural development. "Half of the Netherlands lies below sea level as a result of the oxidation of peatlands over the centuries," says Silvius. In 2016, the country's Environmental Assessment Agency found that the continued subsidence of peatlands in the Netherlands will cost taxpayers between €1.7 billion and €5.2 billion from the date of publishing until 2050.<sup>13</sup>

“In the Netherlands, dykes have been built along the coast and the rivers, and we let farmers continue their unsustainable business even though it costs society huge amounts of money,” expands Silvius. “[One hundred thousand square kilometers] of peatland in Indonesia is going to face the same problem and subside. In the Netherlands, the rate of subsidence is 1-2 centimeters a year. It happens much faster in tropical locations, at a rate of 3-6 centimeters annually.” The long-term risk, Silvius says, is when the ground level subsides to sea-water level: “Indonesia would have to build thousands of kilometers of coastal and river dykes to prevent flooding and keep that land arable and livable. It’s an issue of huge financial, economic, and social proportions.”

An area of peatland near the Trans-Kalimantan Highway in Central Kalimantan—this area was scorched during the 2015 fires.



While providing valuable ecosystem services like carbon sequestration, water storage and regulation, habitat for biodiversity, and nutrient cycling,<sup>14</sup> tropical peatlands have experienced decades of land use and land cover change (LULCC). This is especially true in Sumatra, Kalimantan,<sup>vii</sup> and Papua, the three Indonesian islands with the greatest peatland area.<sup>15</sup> Human activity on Indonesia’s peatlands began in the 1980s, with extensive land conversion by large-scale concessions and small-holder farmers leading to deforestation<sup>viii</sup> and peatland degradation. Between 1990 and 2015, Sumatra, Borneo, and Peninsular Malaysia experienced a 47% decline in peat swamp forest area.<sup>ix</sup> There was a growing demand for arable land and the flat topography of peatlands made them an easy target for production.<sup>16</sup> As of 2015, industrial plantations and small-holder farms cover half of all former peatland areas in Sumatra, Borneo, and Peninsular Malaysia.<sup>17</sup>

<sup>vii</sup> Kalimantan is the name for the Indonesian portion of Borneo island. Borneo is shared by three countries, including Malaysia (an area known as the Malaysian Borneo) and Brunei.

<sup>viii</sup> Another case study in this anthology focuses on deforestation and illegal logging in Kalimantan, with a focus on the lowland rainforest around Gunung Palung National Park in West Kalimantan.

<sup>ix</sup> Peatlands that have not been drained and deforested.

Water-logged peatlands must be drained in order to be used for farming—an act that dramatically increases the land’s susceptibility to fire.<sup>18</sup> Draining is most easily done by digging a series of deep canals beneath the peatland. Once drained, remaining peatland vegetation is cleared by setting fires—the fastest and most cost effective way to prepare land for new growth. This method is referred to as slash and burn agriculture. The ash cover that settles after burning provides a nutrient-rich layer for new crops which offers short-term benefits for farmers.<sup>19</sup> Those nutrients, however, are short-lasting, and slash and burn agriculture leads to detrimental long-term effects, including soil degradation, loss of habitat, soil erosion, water contamination, and, in the case of peatlands, deadly haze. Slash and burn is the traditional method used by Indonesian farmers annually to prepare their land for the approaching rainy season. While these slash and burn fires are deliberate and their area planned, blazes can sometimes burn out of control, and “escape fires” create damage on neighboring land.<sup>x</sup>

In their natural state, peatlands are moist and non-flammable. Once drained, however, they become tinderboxes of organic material. Fires that spread from slash and burn sites to areas of surrounding dried peat become virtually impossible to extinguish. As they burn, centuries worth of CO<sub>2</sub> and other greenhouse gas emissions are released into the atmosphere—10 times more CO<sub>2</sub> than the amount released by forest fires.<sup>20</sup> The depth of peatlands means that while fire crews can tame surface-level fires, the thick carpet beneath can continue to smolder for weeks until monsoon rains finally dampen the blaze. The effect is eerie: tracts of land where you see no fire, only the huge clouds of smoke that billow from within.

<sup>x</sup> Is slash and burn used in your country? Are there sustainable ways of doing slash and burn? Why or why not? Are there policies in your country in this regard?



*The contrast between an area of burnt peatland (left) and regrown peatland (right). Though a valuable carbon bank, peatlands are often perceived as wasted space and are cleared and drained to make way for more “productive” activities.*

## The Burning of 2015

This was the scene in much of Indonesia during the 2015 haze event.

In Gohong Village, Central Kalimantan province, village secretary Pak Anang Sogito remembers not being able to see beyond two meters. If he had been able to see, he would have witnessed devastation—village records say the 2015 fires burned through more than 150 square kilometers of land. “We lost our sources of food and our economy was totally damaged. The income decreased for all of the villagers,” Pak Anang says.

At the time, the residents of Gohong Village took the only action they could: they attempted to extinguish the fires using traditional methods. Those methods involved isolating fire areas by digging four-meter-deep wells into the ground to limit their spread, just as firefighters may clear cut part of a forest to prevent the growth of a wildfire. This method worked to contain some blazes, but many more times the depth of peat meant fires would spread unseen beneath the surface. “We all fought until we reached our limit, using big cans of water to make the peatland wet,” Pak Anang describes. “But it didn’t solve the problem because it was just the top of the peatland that was wet.”

Gohong Village is located in Pulang Pisau, a priority area for the BRG. More than half of the region is peatland, and the regency was particularly affected by the 2015 fires. Draining of the peatlands in this area began in the 1980s when the government constructed the 3,900-kilometer Trans-Kalimantan Highway that runs across the island. The drainage canals that were built created transportation channels allowing villagers to reach once inaccessible parts of the island. As a result of this practicality, more canals were made, further drying peatlands. “At first it helped us reach new land, but after a lot of canals were built it affected us, especially during the long dry season,” Pak Anang explains.

At a global scale, atmospheric scientists knew 2015 would be a problem. “Everyone who was paying attention to fires knew it was going to be a bad year by late July, August,” says Dr. Shannon Koplitz, an atmospheric scientist on The SMOKE Team. For one thing, 2015’s dry season followed a similar pattern to previous fire years. “We were watching that El Niño index creep up, and a positive Indian Ocean dipole index creep up, too. You could see it a

mile away, and it became more of a question of what people on the ground were supposed to do with that information,” says Koplitz. Both meteorological phenomena are associated with reduced dry season precipitation and exacerbate the risk of drought in landscapes that have become highly flammable because of human alteration.



### When Meteorological Systems Meet

Two meteorological systems played a role in creating the ideal setting for 2015’s haze events: the coupling of the El Niño Southern Oscillation (ENSO) phenomena and a positive Indian Ocean dipole.

El Niño conditions\* occur in the Pacific Ocean basin, and mean less rain on the western side of the basin, including in Indonesia. The El Niño phenomenon in 2015 was the strongest on record since 1997.<sup>21</sup> These dry conditions increase the flammability of landscapes as plants lose their leaves and lower their moisture content.<sup>22</sup>

The Indian Ocean dipole operates in the ocean basin of the same name. Like the Pacific Ocean, the Indian Ocean has a variance in temperature, with warmer sea surface temperatures around Indonesia typically leading to more precipitation. A positive Indian Ocean dipole, like the one in 2015, brings less precipitation.

“When you have both of those systems operating in unison it is a double whammy for drought, and that’s what happened in 2015, 2006, and 1997,” says Koplitz. Scientists are still actively looking into how the ENSO and dipole systems interact with one another, as well as the effect climate change could have on these systems.

Unlike other places where fires are a natural part of the ecosystem, the ecology and climate of Indonesia rule out meteorological conditions alone as the cause of the 2015 fires. “In the humid tropics like Southeast Asia, fires don’t generally occur unless there are people setting them,” explains Dr. Ruth DeFries, an environmental geographer at Columbia University. A member of The SMOKE Team, DeFries has worked at the intersection of fire, deforestation, and air quality for the better part of three decades. In 2015, it was the combination of meteorological systems and individual and industrial land use that created the setting for a destructive fire season. By September and October 2015, the height of the year’s burning season, the Global Fire Emissions Database<sup>xi</sup> had detected more than 100,000 active fires across Indonesia.<sup>23</sup>

\*The Pacific Ocean is where the El Niño Southern Oscillation (ENSO) system occurs. The ENSO controls much of the year-to-year variability in the areas surrounding the Pacific Ocean, including precipitation patterns, winds, and storm systems. The Pacific Ocean basin has a variance in temperature, an in non-El Niño years, the eastern side of the basin is cooler than the western side. This is why the western United States experiences dryer weather, and countries in Southeast Asia experience more rain. During an El Niño system, that gradient in ocean temperature lessens, leading to less precipitation on the western side of the basin.

<sup>xi</sup> Check out real time data on global fire emissions ↘ [here](#). What can you conclude from this map?

<sup>xii</sup> 15.95 mega tons is the U.S. daily average. The United States is the world's largest producer of greenhouse gas emissions.

<sup>xiii</sup> What is a GHG equivalency? Why is it useful? \ [Explore more here](#)

<sup>xiv</sup> Do you think your actions might be affecting the severity of haze events in Indonesia? Why or why not?

## The Health Toll of Haze

The emissions produced by those fires was intense. For a three week stretch, Indonesia's peatland fires produced more daily CO<sub>2</sub> than the average daily emissions of the entire United States.<sup>xii</sup> By the end of the 2015 fire season, 4 teragrams (4 million tons) of emissions had been emitted between July and October.<sup>24</sup> After just a few months, Indonesia's CO<sub>2</sub> emissions were on par with the amount of fossil fuel-attributed emissions generated by countries like Japan and India over the course of an entire year.<sup>25</sup><sup>xiii</sup> More than three quarters of all emissions came from Kalimantan and South Sumatra, the islands most badly burned.<sup>26</sup>

While the impact on the global climate was concerning, more dire still were the serious health effects being faced by millions.<sup>xiv</sup>

It's a beautiful clear day in Palangka Raya, the capital city of Central Kalimantan province. The windows and front door are wide open on Pak Tuberyono's home, a very different sight from 2015. That year, he and his family were trying to make their house as airtight as possible to prevent haze from seeping in. "Where the wind could come in, the haze could also come in," Tuberyono remembers. The average Indonesian home is rarely airtight, and outside air and pollutants can waft in through gaps in floorboards and ventilation slots above windows.

The birth of Tuberyono's third grandchild, Ratu Agnesia, had aligned with the start of 2015's haze season. A healthy baby girl, Ratu Agnesia's life was cut devastatingly short when she developed an acute respiratory tract infection, an ailment the hospital confirms was caused by the haze. "It was very fast. It started with it being hard for her to breathe, then we asked for medicine from the midwife," Tuberyono recalls, staring out the window. "We brought her to the hospital but it wasn't long before she passed away." Ratu Agnesia was just 45-days-old.

Tuberyono and his family weren't the only ones who sought medical help during the 2015 haze. Indonesia-wide data found that the percent of children under five diagnosed with pneumonia during a hospital visit jumped from a baseline that had historically ranged from 23-29% to 63% that year.<sup>27</sup> Global data indicates that children under the age of five and adults over 60 are the groups most impacted by air pollution.<sup>28</sup><sup>xv</sup> Pollution-related mortality disproportionately occurs in low and middle income countries, of which Indonesia is one.<sup>29</sup>

<sup>xv</sup> Why are children most affected by haze?

According to the 2016 research published by The SMOKE Team, the 2015 haze accounted for 91,600 excess deaths in Indonesia. Neighboring countries of Malaysia and Singapore faced 6,500 and 2,200 excess deaths respectively. That's because haze is a transboundary environmental issue,<sup>30</sup> meaning the pollution is so thick and dense that its concentration downwind remains high enough to create health impacts. That includes in densely populated urban centers such as Singapore and Kuala Lumpur, Malaysia.

Ultimately, it was those living in close proximity to the peatland fires who experienced the worst health effects. That includes Pak Tuberyono and his 45-day-old granddaughter, and other people living in Central Kalimantan province. Dr. Mual Bobby had been working as a pulmonologist at RSUD Doris Sylvanus the largest state-run hospital in the province, for six years when the 2015 haze began. During a normal shift he would see around 100 patients, but in 2015 he was treating up to 500 a day. The hospital faced so much demand for treatment that it turned away patients for three weeks in September and October, admitting only those who would receive treatment while sitting on the floor.

"It was especially bad for people with asthma and elderly people with chronic obstructive pulmonary disease (COPD)," says Dr. Bobby. "Every day their lung function decreased, and this happened faster during the haze situation. They were in terrible condition. I was giving them the anti-inflammatory medication [for asthma and COPD] and oxygen but that didn't change their condition."

Like homes, hospital buildings in tropical climates are rarely airtight. Open architecture allows for natural ventilation, but in 2015 it meant the haze could drift in and hang above the wards where patients were being treated in the beds below.

It was a similar scene in the local *puskesmas* clinics, the community-health units that provide first-response primary care for outlying urban areas and rural villages in Indonesia. "We started from 8 a.m. and would usually end at 10:30 a.m., because our vision would be blurred if we worked earlier or later in the morning. I remember that breathing made us weak," says Dr. Yulitha Christiana, who worked in a *puskesmas* location at the edge of Palangka Raya. Dr. Christiana also saw patients in her home clinic. "Here I had oxygen available for patients. I blocked the door with a wet towel, but it



*Dr. Mual Bobby is a pulmonologist in Palangka Raya, Central Kalimantan. He would see as many as 500 patients a day during the haze events in September and October 2015 — sometimes treating people lying on the ward floor when all the beds were occupied.*

could still not free us from the haze,” she recalls, adding that it was virtually impossible to find oxygen canisters in September and October. They were sold out across the city.

So bad was the haze that Stefani Koseanto and her mother left their home in Palangaka Raya for Jakarta. Prior to leaving, Koseanto had been going through a morning ritual: waking up in a day dark as night and posting photos on her Facebook page. Those photos included screenshots of the city’s Pollutant Standards Index (PSI) and the color of the sky outside her window, shades that shifted from a sepia yellow to an alarming red. On many days the PSI was higher than 2,000. A healthy figure is 0-50, with anything beyond 301 considered hazardous.

Koseanto has asthma, and had been taking five times the normal dosage from her inhaler. Her father, a doctor in the city, eventually suggested she evacuate. “The air was so thick in my room. I used an air purifier but it didn’t help,” she said. Despite growing up in Palangka Raya, Koseanto had never seen haze so bad. “In the past it was white smoke, it wasn’t a yellow and red sky, and it would only stay for a few days,” Koseanto recalled.

For Pak Tuberyono and his ailing granddaughter, the scale of the haze made evacuation seem fruitless. “The smoke was all over the province and in the next province—where would we go? All the peatland was burning,” he says. Turns out the question was moot. Tuberyono and his family wouldn’t have been able to afford to leave even if they had wanted to.

The impact haze has on human health and well-being is a growing field of research. A 2016 review of epidemiological studies highlights the role automobile exhaust, haze from burning biomass, and wildfire smoke has in COPD risk and incidence. Both short-term and chronic exposure to haze cause respiratory symptoms, reduce lung function, and lead to the development of COPD.<sup>31</sup> Increased risk depends on a number of factors, including the chemical composition of the haze and the concentration to which people are exposed. In most cases, the fine particulate matter component of haze presents the gravest health concern.<sup>xvi</sup>

<sup>xvi</sup> What is the global burden of disease due to air pollution? Who is more affected? [Read more, and check the status of the air you breathe on the State of Global Air here](#)



*A student goes to school wearing a mask to protect him from the smoke that blankets the city of Palangka Raya, Central Kalimantan. October 2015. Photo by Aulia Erlangga, CIFOR; [cifor.org](http://cifor.org)*

Referred to as PM<sub>2.5</sub> because particles are less than 2.5 micrometers (µm) in diameter, you could fit 20 fine particulate matter particles across the width of a single human hair. “PM<sub>2.5</sub> in particular is a health concern because it’s so small it can go deep into our lungs,” explains Jonathan Buonocore, a Harvard University-based epidemiologist, environmental health expert, and member of the multidisciplinary SMOKE Team. From there it can cross the lung-blood barrier and get into the bloodstream. Samples taken from the September 2015 peatland fires in Indonesia found that 81.6% of all particulate matter was less than 2.5 µm in size. That size, combined with the chemicals that composed the particulate matter, made the episode particularly harmful to people’s health.<sup>32</sup> According to the WHO, fine particulate matter is the most harmful form of air pollutants, a broad category accounting for the anthropogenic chemicals generated by industry, transportation, and households.<sup>33</sup>

Peatland fires in Indonesia are particularly hazardous, emitting a cocktail of up to 90 chemicals, including toxic gases such as formaldehyde, carbon monoxide, and ammonia.<sup>34</sup> These chemicals are invisible to the naked eye until the fine particulate matter binds together to create haze. Research is currently underway to differentiate the chemicals that come from Indonesia’s peatland fires versus other types of urban air pollution.

Despite the global literature establishing the health impacts of air pollution and haze, local governments still seek ‘local data’—in this case, research gathered and published in Indonesia. To address the desire for local data, UNICEF commissioned a 10-year epidemiological time-series study to look at seasonal spikes in air pollution and health outcomes in the country. Based on data from health facilities and air quality monitoring devices in affected areas, the study demonstrated the impact of haze on respiratory health. It also highlighted the limitations that come with relying on public health data.

“We found that the cases recorded at health centers did not reflect the true caseload or the long-term burden of disease,” says Richard Wecker, a Risk Reduction Specialist in UNICEF Indonesia’s Disaster Management, Climate Change Adaptation & Mitigation portfolio. He says collecting data for the 10-year study was costly time-wise and financially, and that the satellite data and modelling methods used by The SMOKE Team may be more accurate and cost-effective. “However, this information is not always as compelling to stakeholders, so we need a balance,” Wecker says, referring again to the need for local data to show Indonesian policymakers.



*In 2015, activists in Palangka Raya, Central Kalimantan put masks on city statues as a symbol of protest against peatland fires. Photo by Aulia Erlangga, CIFOR; cifor.org*

### Attempted Health Interventions

Various health-focused interventions were implemented with little success during the 2015 haze. “During the peak of the fires, most agencies including the government were helpless to do anything beyond band-aid measures to protect the health of people,” says Richard Wecker. “You could not possibly evacuate the tens of millions of people affected by transboundary haze. At that stage harm reduction measures were necessary, but most were not appropriate and offered limited overall coverage.”

The first of those harm reduction measures was the distribution of masks. In Palangka Raya, the provincial Ministry of Health also set up airtight, air-conditioned tents where people could seek refuge from the haze. Even government offices became mini hospitals where people could stay in an air conditioned and well-ventilated space. “We also asked cooperation from parents to restrict the outside activities of their children,” says Erna Parida Susanti, a midwife at a local *puskesmas*. With school suspended for as much as three weeks, she admits this was a near impossible ask.

Back in Dr. Bobby’s office at RSUD Doris Sylvanus hospital in Central Kalimantan, the brightness of the day has been spoiled by conversation of the haze. “I don’t want to talk because what happened in 2015 is a kind of trauma for us pulmonologists. We opened our eyes and we could not see in front of us. For three months we had this situation. Maybe if you don’t have a healthy mind you could go crazy. Every day I went to the hospital and saw people die.”



Midwife Erna Parida Susanty, Dr. Yulitha Christiana, and nurse Nurul Hafizhah were on the frontline of care during the 2015 haze. Employed at a *puskesmas*, a community health clinic, the three women saw patients throughout the course of the fires.

### The Role of Land Use Management

<sup>xvii</sup> What other countries produce palm oil? At what scale? Why has there been a rise in palm oil production globally?  
↘ [Read more here](#)

The role individuals versus industry play in Indonesia’s peatland fires is a contentious topic. On one side is the large oil palm, timber, and logging companies that have shaped the landscape of Southeast Asia for decades. Fly over many Indonesian islands, but especially Kalimantan and Sumatra, and you’ll notice the unmistakable patchwork of oil palm plantations: palm trees in orderly grids the size of dozens of city blocks. Trucks carrying the valuable fruit rumble down the highway, precious cargo secured in place by canvas tarps. The commodity is the country’s largest agricultural export.<sup>xvii</sup>

In control of large areas and with a vested interest in preparing land for rows of palm trees, oil palm plantations are the most common scapegoat for the destruction of Indonesia’s peatlands. However, a study looking at a decade of manmade fire ignitions in Kalimantan between 2000 and 2010 found that only 17 to 19% of man-made fires originated on palm oil concessions.<sup>35</sup> Satellite data showed the majority of fires came from a mosaic of non-forested areas—land composed of small-scale, independent oil palm producers, farmers, and swatches of degraded and drained peatlands. This came as a surprise to Dr. Ruth DeFries of Columbia University, who co-authored the research with other members of The SMOKE Team. “We went into this thinking we would find that the big oil palm concessions are the root cause of the fires and the haze problem. The oil palm industry is what everyone loves to hate. [...] That’s lesson number one: challenge your assumptions.”

DeFries says this revelation both simplified and complicated the land use scenario. While it shed light on the true source of fires, it meant the haze issue could not be solved by targeting a single player. “To have a policy that targeted big oil palm producers would have been easier because there’s less of them, but at the same time more challenging since they’re a large industry and they have lobbies and lots of profit at stake,” she says. Meanwhile, most of the fires were occurring on a mosaic of degraded land that had thousands of users. It became increasingly apparent that preventing fires required a paradigm shift in how that land was used, protected, and restored. Only once all three were addressed could a group address the root cause of the haze.

It was within this context that The SMOKE Team set out to build a tool to help policymakers prioritize restoration areas that would yield the greatest benefits to human health.

*A common scene on roadsides in much of Indonesia. Palm oil is one of the country's largest industries, and individual households often get involved by threshing the fruit from the spiked bunches. Be it rainforest or peatlands, the creation of oil palm plantations is a main driver of land use change in the country.*



### The SMOKE Policy Tool

While The SMOKE Team's 2016 paper focused on quantifying the public health effects of the 2015 haze, their latest research is forward-looking. Published in July 2019 with BRG's Pak Budi as a co-author, the paper outlines a framework policymakers can use to maximize the health benefits from peatland restoration.

The paper documents the future health outcomes for five land use scenarios. It does this by synthesizing historical data: looking at land use and land cover change, where fires have originated and the resulting smoke traveled, and the public health outcomes. Over the next several decades, a business-as-usual (BAU) land use scenario would lead to an average of 36,000 premature adult deaths each year across Indonesia, Malaysia, and Singapore. Additionally, the model forecasts an average of 1,100 annual deaths of children under the age of five due to acute lower respiratory infections.<sup>36</sup> These figures are averages, and the team acknowledges mortality numbers could range from <100 to 80,000 annual deaths, depending on the year.

The scientific framework outlined in the paper is publicly available through the SMOKE Policy Tool, a free online decision support tool that allows stakeholders to forecast public health effects in a way that would have previously been prohibitive. "For policymakers to run 30 years of five different land use scenarios—that would be a lot of expensive computer hours and would require knowledge of complicated tools," explains Shannon Koplitz of The SMOKE Team.<sup>xviii</sup>

Policymakers can use the tool to toggle between land use scenarios. That includes a BAU scenario, and others demonstrating what would happen if fires were blocked on all industrial oil palm, wood pulp, and logging concessions; in existing conservation areas; and on BRG priority sites which involve peatlands in both concession and non-concession areas.

Pak Budi of the BRG notes that the areas identified by the SMOKE Policy Tool as having the greatest potential health impact generally align with the agency's priority areas. He says the tool adds two other useful elements: honing in further still on specific priority protection sites, and quantifying the downwind health concerns of possible haze events. The most ideal land use scenario for human health involves the blocking of all fire in peatland areas. In this scenario, mortality from haze exposure decreases by 65% annually

in Indonesia, with similar reductions in Malaysia and Singapore (73% and 70% respectively).<sup>37</sup>

The SMOKE Team's tool enables policymakers to better consider public health consequences when making land use decisions. These policy-level approaches are complemented by more community-oriented, grassroots interventions spearheaded by BRG and the Government of Indonesia. With varying levels of success, these bottom-up efforts are an attempt to consider not only the public health outcomes of haze, but also the complex social, economic, and cultural reasons behind why peatlands are burned.



*Palm Oil becomes the main source of income for many villagers in Indonesia.*

<sup>xviii</sup> ↘ Take a moment to visit the [policy tool here](#) and change the different settings to achieve different scenarios.

## National and Regional Responses to Peatland Management

Experts say it's only recently that the Government of Indonesia started to change its stance towards degraded peatlands—something that was long overdue. “In 2006 Wetlands International came out with a report on peat carbon dioxide which showed huge emissions from peatland degradation in Indonesia and Malaysia. That was not welcome from either government, and the first reaction was to deny the issue and ban discussions on it,” says Marcel Silvius, who has been working on the issue of peatland restoration worldwide, first with Wetlands International and now with the Indonesian branch of the Global Green Growth Institute (GGGI). “It took Indonesia several years to acknowledge the problem, and the major fires that have occurred repeatedly contributed to that level of awareness raising,” Silvius says in neighboring Malaysia, peatland degradation and its related consequences are still not being seriously discussed by the government.

Pak Budi, BRG's Deputy Head of Planning and Coordination, worked with the World Wildlife Fund before joining the agency. He says policy around peatland restoration didn't exist before 2015, despite the annual effects of peatland fires. Restoration involves restricting the development on a piece of land while also taking active measures to improve its integrity. “Before [2015] it was just a matter of protecting peatlands, monitoring the [fire] hotspots, and responding to those without really taking into account the larger policy,” he expands.

The first inkling of policy around peatland restoration came in May 2011 when the central government led by then-President Susilo Bambang Yudhoyono instated a two-year moratorium on issuing new concession licenses on areas of primary forest and peatland. That moratorium has since been extended on three occasions, the latest in May 2017 by President Jokowi.<sup>38</sup> That moratorium will be in place at least until the government has mapped which peatland areas could be appropriate for production, and those which must be conserved.<sup>xix</sup>

In direct response to the 2015 fires, Jokowi also issued a permanent, national zero burning decree for industry and individuals, banning the use of fire to clear peatland areas. Not using fire, and taking the means to prevent and monitor flames proactively, is also one of the criteria oil palm companies must meet to comply with Roundtable on Sustainable Palm Oil (RSPO)<sup>xx</sup> criteria, though standards are voluntary and still permit planting on peatlands.<sup>xxi</sup>

<sup>xix</sup> Can you think of some unintended consequences a moratorium like this might have?

<sup>xx</sup> Explore the RSPO website, and take a look at some of their criteria for sustainable palm oil production

<sup>xxi</sup> Which countries or regions purchase most of Indonesia's palm oil? Explore the chart here



### Mapping Indonesia's Peatlands

Mapping—or a lack thereof—has presented one of the greatest challenges to peatland protection and restoration in Indonesia, and has fueled historic conflicts around property rights. One of the first tasks of the newly-established BRG was to work with partners such as the World Resources Institute to put together a more comprehensive map of the country's landscapes. The government calls this the One Map Initiative. The map, which will feature peatland area and depth, will become the basis for future restoration planning.

In 2016, Indonesia's Geospatial Information Agency (Badan Informasi Geospasial, or BIG) launched the million dollar Indonesian Peat Prize in order to more comprehensively map the area and depth of the country's peatlands. Two years and 44 teams later, the winners of the Indonesian Peat Prize were announced on World Wetlands Day in February 2018.

Pak Budi says the “breakthrough” moment came in late 2016. That's when the Government of Indonesia updated a previous regulation,<sup>xxii</sup> proactively protecting peatlands by banning the use of peat areas with a depth of more than three meters, even on existing industrial concessions. The regulation also stipulates the water table of peatland areas be no lower than 40 centimeters as a way to prevent the deep smoldering that occurred during the 2015 fires.<sup>xxiii</sup> The World Resources Institute (WRI) notes that primary forest loss on Indonesia's protected peat areas declined by 88% between 2016 and 2017, and attributes part of the change to this updated regulation.<sup>39</sup>

The private sector bears the brunt of this updated regulation. More than half of the peatland area prioritized for restoration is industrial concession land. If a company is found to be burning their land or operating on deep peat areas, it can face warnings or civil and criminal sanctions.

Pak Budi admits the private sector reaction to the 2016 regulation was quite negative. “They saw this regulation as adding more complications to the bureaucracy. We made several consultations with forestry and oil palm groups to provide data around which areas were and were not peatland, and provided them with restoration activities,” he says of the BRG's attempts to cushion the initial negativity. Since then, two-way communication has been key, and companies can come forward if an area has been mistakenly identified as peat. Each company is responsible for producing a restoration plan, with the BRG planning to verify the

<sup>xxii</sup> The original regulation was Government Regulation No. 71/2014 Concerning Protection and Management of Peatland Ecosystems

<sup>xxiii</sup> The 40 centimeter figure was determined by Susilo et al (2013) to be the ideal depth as to prevent the risk of peat fires.

impact of those activities in the coming years. A land-swap plan has also been introduced as a means of compromise with forestry companies that have more than 40% of their land on protected peat areas (those with a depth greater than three meters), though it has received criticism from NGOs and private sector companies alike.<sup>40</sup>

While the private sector thought the 2016 regulation went too far, others felt it was only scratching the surface of what was needed. “The Minister [of Environment and Forestry] stuck her neck out in doing this, so it’s a daring step, but it is still not sufficient to address all the peatland degradation related issues,” says GGGI’s Marcel Silvius of the 40 centimeter regulation. Silvius advocates for full peatland rewetting, which would restore peatlands to near-natural hydrological conditions. That would stop emissions and soil subsidence, reduce fire risk, and offer an environment to grow commercially interesting local species.<sup>xxiv</sup>

Striking a balance of restoration buy-in from a wide spectrum of partners is necessary for the BRG to achieve its ambitious restoration goals. “One of the reasons a lot of people are interested in this issue is because we all realize restoring [25,000 square kilometers] is a humongous task, and BRG knows it’s impossible if they do it alone,” says Satrio Wicaksono, the World Resource Institute’s former Forest and Landscape Restoration Manager in Indonesia. For its part, WRI is helping BRG map peatland areas in three priority provinces and create restoration action plans. The institute also oversees the upkeep of *Pantau Gambut*, an interactive watchdog tool people can use to hold the BRG accountable to its commitments.<sup>41</sup> “It’s been working out quite well. BRG is seen as easier to work with than the Ministry of the Environment and Forestry,” Wicaksono says. “If you look at who the people are in BRG, they used to be in NGOs and academia. It’s not like they’re long-time government bureaucrats, [many of whom can stereotypically] be averse to working with partners.”

At a regional level, policies from other Southeast Asian countries have also taken aim at addressing Indonesia’s peatland fires. In 2002, the Government of Singapore tabled the ASEAN Agreement on Transboundary Haze. That environmental agreement came in response to large-scale forested peatland fires that occurred in 1997. The Center for International Forestry Research estimates the degradation and deforestation that resulted from those fires

<sup>xxiv</sup> What other policies would have to be in place to make this regulation overall successful?

<sup>xxv</sup> What are some challenges in the implementation of international legal mechanisms such as this one?

<sup>xxvi</sup> The first use of that act was in 2014 when six lawsuits against Indonesian companies were filed. The largest was filed against Indonesian plantation company Sampoerna Agro, at a fine of US \$81.62 million.

cost between \$1.62-2.7 billion.<sup>42</sup> “The costs of smoke haze pollution were in the range of \$674-799 million, and probably higher because estimates for the economic impacts on Indonesian business activities were not available,” says a CIFOR report.<sup>xxv</sup>

However, the agreement was virtually powerless until 2014 when Indonesia, the largest producer of haze, finally ratified the agreement. That set the stage for the next iteration of the policy, the Transboundary Haze Pollution Act of 2014. Since then, Singapore has levied fines on Indonesian companies in each subsequent year.<sup>xxvi</sup>

But as Ruth DeFries and others found in their research, policies and regulations that consider only the actions of large companies failed to address the millions of small-scale farmers using traditional fire methods to clear land—and the economic practicalities of why they were choosing that method. While the national and regional response was important, peatland protection and restoration demanded the involvement of people at every level.

*Pak Ardiansyah is a Fire Guard with the Ministry of Environment and Forestry. Along with other members of Gohong Village in Central Kalimantan, he has received firefighting training since 2015.*



## Community-based Solutions: The BRG's 3 R's

The sun is low in the sky by the time Pak Anang Sogito from Gohong Village reaches his destination: a rickety, four-story fire tower constructed a few meters from the highway. The view from the top is spectacular: green shrubs and small trees sprouting from peatland as far as the eye can see—except in one direction where it reaches the boundary of a rubber tree forest and oil palm plantation, an inescapable reminder of the delicate state of Kalimantan's peatlands.

This peatland is slowly experiencing regrowth after being scorched in 2015. Had this fire tower been standing that year, it too would have burned. An inconspicuous white pipe—picture a simplified fire hydrant—protrudes from the ground at the base of the tower. It's one of 300 pumps found across the hotspot area near Gohong Village, installed since 2015 by the BRG and USAID funded project, *Lestari*. As of mid-2018, the BRG had installed more than 23,000 of these deep water wells across its seven priority provinces.

In heavily peated fire-risk areas like this, pumps sit in a 400 meter by 200 meter grid. They wouldn't offer full coverage if a hotspot were to become a full-blown fire, but Pak Anang says they're a start. Plus its presence means villagers wouldn't need to rely on traditional extinguishing methods: the aforementioned buckets of water thrown fruitlessly over smoldering fires. Expanding local firefighting capacity and community response has been one of the main mitigation efforts introduced since 2015, and is the focus of both the Ministry of the Environment and Forestry's *Manggala Agni* fire brigade and the UN Environment Programme's Gambut project.

The installation of deep well water pipes is one of the BRG's interventions to proactively restore Indonesia's peatlands. The agency has a double mandate: facilitate the restoration of degraded peatlands, and coordinate the sustainable management of those ecosystems. That work is the responsibility of a National Coordination Team, a body consisting of 17 government agencies, 10 ministries, and governors in the seven priority provinces, each of whom play a role in supervising restoration efforts by individuals, communities, and private sector.

Notable are the interventions that make up BRG's community restoration efforts. These interventions take what the agency calls a "3-R" approach. While the national government has focused on several top-down policies regulating peatland use, the BRG is

focused more on grassroots activities and behavior change. The goal is to shift perceptions around the usefulness of peatlands, and provide affordable alternatives to traditional land clearing methods using fire.

"We needed to have interventions in activities that were really important to people, and found that economic activities were central," says Dr. Myrna Safitri, the BRG's Deputy of Education, Socialization and Participation. After these activities, people gradually change their perception that peatland restoration is something harmful to their lives. They see it can improve their household."

The first R intervention is rewetting, in order to accelerate the recovery and restoration of the hydrological functions of the peatland. Rewetting efforts include installing grids of deep water wells like the ones in Gohong Village, in addition to supporting community firefighting efforts. It also involves the construction of dams to block the canals historically used to drain peatlands. The goal is for rainwater to eventually re-saturate the dried areas to prevent further oxidation. Rewetting success depends on natural precipitation, but also the education and understanding of people living near those canals. Safitri says some communities resisted the dams at first, particularly because the canals had been used as illegal logging access points.

Sensitizing people about interventions like canal dams is two-fold. "We use language that people easily understand," explains Safitri. "When we talk about what peatland restoration means, we tell people it's like a hospital. We're in the emergency room now where we're facing very serious degradation of peatland ecosystems. If we do nothing it will get worse, and we tell people they will be the first victims. Many children get sick because of the haze, and peoples' agricultural land burns. If our ecosystem can be saved then lives can be saved."



*Pak Anang stands next to one of the deep water wells at the edge of Gohong Village.*

*Pak Charles overlooks a peatland canal constructed on his land. With support and funding from the Peatland Restoration Agency, he and others have built the canal blocking dam that he now stands on.*



Canal dams have been constructed in nearly 20,000 locations across Indonesia. Two of them are in Tumbang Nusa Village in Central Kalimantan province. That's where Pak Charles stands squinting in the midday sun, observing a wooden canal block on his property. It was constructed by his farming group, with money and support from the provincial government, who in turn received funding and guidance from the BRG. In addition to rewetting the peatland, when filled with water the blocked canal makes it easier for Pak Charles to reach his property far from the road. "After we make the canal blocking the land surrounding is good for farming," adds Pak Charles.

The canal water is also used by the Ministry of the Environment and Forestry's *Manggala Agni* fire brigade. Even with efforts to rewet peatlands, the project is a work in progress and the ground's dryness is evidently dire. Pak Imade, the Chief of *Manggala Agni* for this district, prods at a piece of wood that has been warped and dehydrated by heat and a lack of peatland saturation. It crumbles easily in his palm, the perfect fire tinder. Each day, Pak Imade's joint squad of army, police, and *Manggala Agni* officials monitor the peatlands around the village. They use two satellite monitoring applications to look for fire hotspots, before investigating in-person. "It wasn't until after 2015 that we started our joint patrol, and to do door-to-door socialization about the new government rule forbidding people to burn their land," explains Pak Imade.

Revegetation is BRG's next "R" intervention. This planting of new tree and shrub species is especially important in peatland areas that were previously burned or degraded. Not only can agroforestry projects provide livelihoods for community members, but the new vegetation can also provide biomass that helps peat form.

Community involvement is key for BRG, especially for the third "R": revitalization. This intervention involves the introduction of alternative livelihood activities conducted without burning. That includes farming peatland-appropriate crops, livestock rearing, creating ecotourism destinations, and social forestry projects. Anything that helps villagers benefit economically from healthy peatlands. Another of BRG's community involvement approaches is to help individuals understand that their actions are part of a bigger picture. Often, that involves inviting a farmer to talk about their activities at an international event. "This helps farmers know what they do in their village is not only impacting their communities, but has a global impact," says Dr. Myrna Safitri with BRG.



### An Indigenous Youth-led Movement Addressing the Haze

Emmanuela Shinta is a young Dayak leader from Central Kalimantan, Borneo. She recently spoke at the 2019 planetary health conference hosted by Stanford University. During a panel session on Mobilizing a Planetary Health Movement, Shinta introduced the Youth Act Campaign that she and other Indigenous youth started in 2016 in response to the fires and haze that had been occurring since 1997.

The Youth Act Campaign organized many activities to get young people politically engaged, including creating haze shelters and training them as firefighters to help extinguish peatland fires. "They put all of their energy and time to protect their own people, their family, and our beloved homeland: our beautiful forest which is part of our identity," Shinta said on the panel, recognizing her people as the guardians of the forest.

Shinta is an advocate for bottom-up approaches to land management—this starts, she says, by consulting Indigenous communities who best know the land. "If you want to know how to manage the land and preserve the forest ask the Indigenous communities because they have been doing that for thousands of years," Shinta explained.

Shinta also compels people internationally to take individual action to reduce the large-scale clearing of land: "I would like to urge everyone here to mind your palm oil consumption. There is a lot of suffering behind the products that you consume."

To further emphasize the value of peatlands, BRG has created more than 200 Peat Care Villages across their seven priority provinces. In these villages, the agency supports the creation of farming demonstration plots, farmer groups, and village development plans that integrate peatland restoration. Villagers also receive legal training so they can advocate for their land rights around peatlands and beyond. Land boundary issues remain one of the largest conflicts, both among neighboring villages and with large concession companies.

Safitri says it's never the agency's aim to introduce something completely new, since BRG's mandate and capacity are ultimately limited. "We analyze existing initiatives and see how we can support improvement," she explains.

One example of BRG supporting existing initiatives is in Anjir Kalampan, where village chief, Pak Yanir, has become somewhat of a celebrity for his success growing fire-free crops on peatland. While Pak Yanir had been experimenting with non-burning methods of opening land since 2011, his efforts ramped up following 2015, and with support from BRG. "I considered the haze accident as the

important moment. It became the urgent thing to do,” he explains, sitting on the floor of the village office.

Pak Yanir, 52, has lived in Anjir Kalampan his entire life. Over the last decade he has developed a specific technique to grow vegetables in the highly acidic peatland environment. His method involves creating raised rows of soil so plant roots don't reach the acidic groundwater, even during rainy season. Unlike rice paddy fields, a traditional crop in the region that requires the flooding of land, Pak Yanir plants crops with shallow roots such as watermelon, chili, and onions. His method is also entirely organic. Instead of buying expensive pesticides and creating nutrients on the land through burning, Pak Yanir mixes the feces of ducks that have been provided by BRG with decomposing grass. The result is a nutrient-rich manure.

*Pak Yanir, a resident of Anjir Kalampan village.*



He says it's a misconception that opening land with fire is less expensive, though admits his method does require some start-up resources such as the ducks and the manual labor to create raised garden beds. It took a handful of failures and years of experimentation for Pak Yanir to master this burning-free method but it's one that has today been adopted by the village's farmers. The combination of producing his own manure, carefully selecting his crops, and raising his garden beds has proven productive. Importantly, this method is also affordable for subsistence farmers.

Proposing affordable and culturally acceptable alternatives to clearing land without fire is key for BRG. “At the beginning villagers were reluctant of the no fire rule,” confesses Pak Yanir. “They blamed the government for making a rule without any solution, and refused to follow it because they could not afford anything other than burning.” Pak Yanir says people eventually came around as the result of training sessions—and the threat of prosecution.

Using demonstration plots and field schools as learning sites, BRG's proposed land clearing methods involve training farmers to manually prepare farmland using machetes and other tools. The slashed organic material is then combined with animal feces and other ingredients and left to decompose for several months. The resulting manure mixture minimizes the need for fires.

However, this method isn't perfect. For one, it's a substantially longer process than lighting a fire and watching it burn, and it's one that can attract pests and diseases. That's what a team from the Centre for International Forestry Research (CIFOR) found when they looked into the effect the government's zero-burning policy had on small farmers in Riau province. In Riau and other provinces across Indonesia, fire has been a part of traditional land clearing methods for generations. “There is a need for flexibility in implementing the policy on the ground,” wrote CIFOR Researcher Dede Rohadi in a 2017 opinion piece.<sup>43</sup> “Genuine farmers should be allowed to implement controlled land burning. Traditional community wisdom makes it possible to apply the technique with the guidance of government officials in the field.” Rohadi argues that without this needed flexibility smallholder farmers may be forced to abandon their land because the cost of fire-free clearing is higher than what they're able to earn through their harvest.



## Restoring Russia's Peatlands

Southeast Asia is not the only region that has experienced the health effects of haze. Like Indonesia, Russia is home to a considerable area of peat—it makes up 8% of the world's largest country. The similarities do not end there. The country's peatlands have also fallen victim to short-term economic gain, particularly in the 1970s and 1980s when peatlands were drained for agriculture, forestry, and use as fuel. These actions were supported by the Soviet state, and Russian engineers also bolstered the draining of peatlands in Indonesia by providing calculations, surveys, and designs. With the fall of the Soviet Union in 1990, hundreds of thousands of square kilometers of drained peatland were abandoned. Similar to in Indonesia, these drained layers of peat provided the ideal kindling for hazy fires, and are located upwind from many large population centers.

In 2010, peat fires smoldering around the Moscow Region contributed to 11,000 premature excess deaths.<sup>44</sup> Resulting from that crisis was a bilateral project between Russia and Germany. Working with the Russian branch of international NGO Wetlands International, as well as a team of lawyers, scientists, sociologists, and engineers, the ongoing project has rewet 950 square kilometers of drained peatland, and is one of the largest peatland ecosystem restoration projects worldwide. About a third of that restoration has occurred using an ecological restoration approach.

The goal of ecological restoration is to not only rewet areas, but also to restore natural ecosystems. In order to do this, natural dams are constructed along the man-made canals formerly used to drain the peat areas. Rainfall remains trapped within the dammed areas, and resaturates the dry peat, leading to the slow restoration of its original water-logged state and biodiversity. With dams created using vegetation native to the area and filled solely by natural rainfall, this form of ecological rewetting has been found to be 10 times cheaper than other rewetting methods.

According to Dr. Tatiana Minayeva, a peatland restoration expert with Wetlands International, a major challenge of the project has been convincing Russian stakeholders of the importance of peatlands. Similar to BRG's work in Indonesia, the approach in Russia recognizes that it's not possible to simply demand people act differently. "The attitude is that peat is an obstacle for your development. Draining it was positive for them. We have learned that you need to have different models and schemes," says Dr. Minayeva.

Those models are different based on each community—as are the barriers faced. Some communities, Dr. Minayeva says, demand proof of profit upfront. Some want direction from the highest level of government, and others want to see how rewetting has benefited nearby villages. The introduction of paludiculture—a form of agriculture that happens atop healthy peatlands—is one of the ways Wetlands International and its partners are hoping to convince Russian partners that there is value to be gained from maintaining peatlands.

While policy changes have not been put into place by the Russian government, this ecological restoration project is an example of what can happen when behavior change, economic benefit, and the health of the planet and humans is combined.

Back in Anjir Kalampan village, one of Pak Yanir's farm helpers, Wasis, proudly recalls a week earlier when he harvested five tons of juicy red, orange, and yellow watermelon—a bounty, he notes, was promptly sold. The watermelon was grown on peatland that had been prepared and fertilized by hand, using the raised bed method explained earlier by Pak Yanir.

Wasis says villagers now look at peatlands differently, including seeing the value of protecting peatlands beyond the purely economic: "They understand that when the peatland burns it affects their health. But education still needs to happen, because ultimately burning remains the easiest way [to clear the land]."



*Wasis moved from the populous island of Java to Central Kalimantan in search of agricultural land. What he found was plenty of open peatland—an ecosystem that is typically challenging for growing given its high soil acidity level. The Peatland Restoration Agency works alongside farmers like Wasis, conducting agricultural trainings to demonstrate that it is possible to have a viable livelihood on healthy peatlands.*

Indonesia has not conclusively shaken its pattern of dry season fires. “There was lower fire incidence in 2016-2017 overall, and we now know that those areas did not burn because of our activities, socialization, education, and stronger law enforcement,” confirms BRG’s Pak Budi of the progress that has been made, though says the interventions are still too nascent to fully assess their effectiveness. Pak Budi points out that climate-wise, 2016-2017 were drier compared to the previous three years, including 2015. In 2017, NASA satellites detected 1,927 hotspots during the July to October dry season months—a fraction of the 130,000 fire hotspots during the same period in 2015, and a new record low.<sup>45</sup>

However, 2019 saw the return of the transboundary haze crisis. The worst fire and haze season since 2015, nearly 16,000 square kilometers of land burned in Indonesia, particularly on the islands of Sumatra and Borneo.<sup>46</sup> Nazir Foad, head of the BRG, told *Mongabay* the agency’s monitoring had detected the overly-dry peatlands in as early as May 2019. He acknowledged the need to re-check the canal blocks and deep wells that had been installed in previous years, but added that “fires are flaring up in areas that seldom burned [in the past] and indeed they weren’t monitored.”<sup>47</sup> Other BRG officials have pointed to the lack of maintenance budgets for rewetting infrastructure, while certain Indonesian NGOs say the agency isn’t being transparent enough about progress being made in peatland restoration.<sup>48</sup>

A suite of solutions for this annual environmental crisis is still underway. The BRG’s Pak Budi says it’s important to ensure the issue maintains the political support and funding it needs. For that, he stresses the importance of having the agency’s work backed by science and public health data. That’s one of the reasons he joined The SMOKE Team to co-author their 2019 paper connecting peatland restoration areas with their long-term health benefits. “That paper gives us an argument that regional policy and coordinated work are important, not only to suppress the fires, but to prevent health concerns from happening,” Pak Budi says. “We always need more data and studies that the health effect isn’t only in the five months of the dry season, but can have a long-term effect, too.”<sup>xxvi</sup>

<sup>xxvi</sup> What are other examples in which scientific research has informed policy decision at a large scale?



*Peatland forest in Central Kalimantan.  
Photo by Nanang Sujana, CIFOR;  
cifor.org*

## Keeping Track of Who's Who

### Dr. Mual Bobby

*Pulmonologist at RSUD Doris Sylvanus hospital in Palangka Raya, Central Kalimantan*

### Jonathan Buonocore

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### Dr. Ruth DeFries

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### Dr. Budi Haryanto

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### Dr. Shannon Koplitz

*Atmospheric scientist and member of The SMOKE Team*

### Stefani Koseanto

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### Marcel Silvius

*Indonesia Country Representative with the Global Green Growth Institute in Jakarta*

### Pak Anang Sogito

*Village Secretary, Gohong village in Central Kalimantan*

### Erna Parida Susanti

*Midwife at a puskesmas in Palangka Raya, Central Kalimantan*

### Pak Tuberyono

*Resident of Palangka Raya in Central Kalimantan, grandfather of Ratu Agnesia*

### Pak Budi Wardhana

*Deputy Head of Planning and Coordination, Badan Restorasi Gambut (Peatland Restoration Agency)*

### Richard Wecker

*Risk Reduction Specialist with UNICEF Indonesia's Disaster Management, Climate Change Adaptation & Mitigation portfolio in Jakarta*

### Satrio Wicaksono

*Forest and Landscape Restoration Manager, World Resources Institute*

### Pak Yanir

*Chief of Anjir Kalampan village and peatland farmer*

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*Several preventative measures are being used to reduce the risk of new peatland fires. That includes regular monitoring by a group called Manggala Agni.*

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# Dams and Disease

AN ECOLOGICAL SOLUTION  
TO SCHISTOSOMIASIS IN SENEGAL

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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## Executive Summary

Many of the ideas and themes in this case study are explored in depth in chapter 6 on infectious disease in [Planetary Health: Protecting Nature to Protect Ourselves](#).

### Learning Objectives

*After the case discussion, in relation to the Senegal River Basin and the construction of the Diama Dam, students should be able to:*

- ① Understand the short- and long-term positive and negative outcomes of large dams.
- ② Appraise the unintended health consequences of large dams, particularly in relation to schistosomiasis.
- ③ Analyze social and environmental factors that influence schistosomiasis transmission.
- ④ Assess the challenges associated with scaling and sustaining solutions to planetary health challenges, especially in relation to schistosomiasis.
- ⑤ Apply systems thinking principles to the analysis and solution-seeking process of planetary health challenges.

This case study is about the effects dam building and land use change have had on schistosomiasis, a parasitic disease, in the Senegal River Basin in West Africa. Construction of the Diama Dam at the mouth of the Senegal River was intended to bring various human health and economic benefits. While there were some positive impacts, the dam also had unintended consequences. For one, it affected the life cycle of a native river prawn, hindering its essential migration to the mixed fresh and saltwater estuary near the Atlantic Ocean. An important predator in the river ecosystem, the local extinction of prawns led to an upstream explosion in the snail species that serve as a reservoir for schistosomiasis. Disease rates spiked and schistosomiasis has been endemic in Senegal since the dam was completed in 1986. As similar human infrastructure projects are proposed worldwide, it is key to understand the effect these developments could have not only on the environment but also on human health.

Past interventions addressing schistosomiasis have focused on the distribution of therapeutic drugs. These campaigns have been unsuccessful in countries like Senegal. One reason is because they fail to consider how social, ecological, economic, cultural, and health access factors affect the transmission of disease. A team of researchers and civilians called The Upstream Alliance are mindful of these complexities and the original ecosystem balance that kept snail populations in check. The group proposes re-introducing the native prawn species as an ecological intervention to complement drug therapy. This intervention has been found to reduce schistosomiasis rates and, if successful and sustainable, could provide food and livelihood security for people living in the Senegal River Basin.

*This case study is based on interviews conducted in the Senegal River Basin and Dakar, Senegal in April 2019.*

## Introduction

“Look how beautiful they are, I love them!” Dr. Susanne Sokolow is gushing as she peers into a large basin, roughly the size of a backyard swimming pool. She’s referring to the 300-some prawns skittering around the base of the tank. Sokolow’s enthusiasm for these crustaceans, and the prawn hatchery that houses them, is understandable. These prawns are in many ways the culmination of the decade-long efforts of Sokolow and others in the West African country of Senegal. Sokolow is a disease ecologist and veterinarian at Stanford University, and a co-founder of The Upstream Alliance, a partnership of scientists and citizens from four continents, all equally dedicated to the promise of these particular prawns.

Not far from this prawn hatchery lies the Senegal River, the 1,800-kilometer-long band of water that traces the border between the countries of Senegal and Mauritania. The Senegal River Basin’s landscape is arid desert that extends from the Sahara and stretches across much of the region. The river and its tributaries are the water source for the 3.5 million people in four countries who live, farm, and fish within the basin.<sup>1</sup>

The prawns in this hatchery are being raised to support the health of nearby villagers in surprising ways. The crustaceans could reduce rates of schistosomiasis, a parasitic disease that infects an estimated 240 million people worldwide and puts more than 700 million at risk.<sup>2</sup> The World Health Organization estimates 200,000 people die from schistosomiasis each year.<sup>3</sup> Over 90% of the people infected live in sub-Saharan Africa, and schistosomiasis is second only to malaria as the most burdensome parasitic disease globally.<sup>4i</sup>

Senegal is one of 52 countries where the disease is endemic<sup>5</sup>, meaning levels of infection are consistently maintained. This is especially true in the Senegal River Basin, where there has been a high and continued incidence of schistosomiasis since the late 1980s.<sup>6ii</sup>

Regional inequity is to blame. Schistosomiasis is a disease of poverty, disproportionately affecting people who live in low-income settings without access to safe drinking water and sanitation. It has been deemed a neglected tropical disease<sup>iii</sup> as a result of the people it affects and the comparative lack of attention it receives from funders\*, governments, media, and researchers alike. Worldwide, less than half of people infected receive drug treatment.

When interventions do occur, mass drug administration campaigns have been the public health community’s control method of choice. The Upstream Alliance’s complementary contribution is prawns, a predator of the snails that serve as the reservoir host for the parasite that causes schistosomiasis. Research has shown that restoration of native river prawns can reduce the number of snails—and as a result, the prevalence of disease—in the Senegal River Basin.<sup>7</sup> It’s one part of an ecological solution that, if scalable in the way The Upstream Alliance envisions, could be a triple-win for human health, restoring the ecosystem, and alleviating poverty.



*Aquaculture engineer Papa Demba Ndao gestures at the prawns at the hatchery outside of Saint-Louis.*

<sup>i</sup> Which countries are affected the most by schistosomiasis? [\ Learn more here](#)

<sup>ii</sup> Other than the new number of cases (i.e., incidence), how else would you measure the burden of this disease?

<sup>iii</sup> What other diseases fall under this category of neglected tropical diseases? [\ Learn about NTDs here](#)

\*For context, the World Health Organization estimates there were 228 million malaria cases worldwide in 2018, and 405,000 deaths. It reports that US \$2.7 billion was available for global malaria control and elimination programming that year. Meanwhile, the WHO says the total amount spent on all 18 Neglected Tropical Diseases (including schistosomiasis) amounted to between \$200 million and \$300 million a year between 2012 and 2014.

## Senegal: The Gateway to West Africa

Located at the westernmost point of the African continent, Senegal is known as the “Gateway to Africa.” The country’s economy is one of the strongest in sub-Saharan Africa, with economic growth exceeding 6% every year since 2015.<sup>8</sup> Macky Sall was re-elected as President in February 2019, and is implementing the second phase of “Emerging Senegal,” his economic and social development plan that started in 2014. That plan includes a focus on agriculture and aquaculture, the practice of farming fish, prawns, and other aquatic species.

Agriculture is Senegal’s most important industry. Farming, fishing, livestock rearing, and other livelihoods employ an estimated 60% of the labor force.<sup>9</sup> The fishing industry is evident from the large wooden boats that line the oceanside of coastal cities like Saint-Louis—what’s less outwardly visible is the farmland. Main highways in the north of the country cut through sandy desert landscapes, clustering most agricultural land around the Senegal River Basin, its tributaries, and the large Lac de Guiers. With a growing population<sup>iv</sup> and changing climatic patterns, development projects such as dams and irrigation schemes have been expanding to support farming and livestock husbandry by providing year-round access to freshwater. While these developments were designed to increase available land for agriculture and the generation of clean energy, they can also alter ecosystems and cause unintended human health consequences.

Those negative health effects disproportionately affect people living in rural regions where healthcare access can be limited. Over half of Senegal’s population of 15.4 million people live in urban centers, including the capital city of Dakar.<sup>10</sup> While wealthier Dakar residents have geographic and economic access to medical care, there are significant inconsistencies in accessing health services in peri-urban and rural areas, including the Senegal River Basin. This is partly due to decentralization of health services, and the fact that each of the country’s 14 regions independently decide how to spend their healthcare budget. However, it has been reported that local governments contribute less towards local healthcare services than they’re legislated to do.<sup>11v</sup>

This gap in funding means people often need to pay for health costs out of pocket, including medication to treat diseases like schistosomiasis. It’s estimated that more than a third of national health spending comes from the wallets of everyday Senegalese

rather than through insurance, with individual patients paying for care and medication at healthcare facilities<sup>12</sup>, similar to other parts of the world without universal healthcare. This figure is high in a country where, on last measure in 2011, 46.7% of the population lived below the national poverty line.<sup>13</sup> The Senegalese government has made strides in improving healthcare access for some demographics and diseases. For example, free healthcare is provided to newborns under the age of one and people over 60, and the country has a comprehensive tuberculosis treatment program.

Small health posts overseen by a nurse or midwife are the first point of care for most Senegalese, and represent 90% of the country’s public healthcare facilities.<sup>14</sup> There are also 14 regional hospitals across Senegal, though these are found in the regional capital cities which are still commonly inaccessible due to cost or travel time. More serious health cases are referred to one of the national hospitals in Dakar.

These barriers in reaching and affording healthcare treatment have become more urgent in the last 30 years as new infrastructure projects have increased the prevalence of schistosomiasis in the Senegal River Basin.



*A Senegal River Basin village seen in proximity to the river—and the desert landscape. (photo courtesy of Andy Chamberlin, The Upstream Alliance)*

<sup>iv</sup> How does population growth in Senegal compare to that of your country of origin?

<sup>v</sup> Do you know how your health care is funded?

## The Diama Dam and the Dynamics of Land Use Change

A herd of cows strolls lazily alongside the irrigation canal that connects the Senegal River with Maguette Diop's family land. With the dust and dry of the surrounding environment, arable farmland is an unexpected sight. Diop lives in Maka Diama, a village about seven kilometers from this property. His daily commute is via the horse-drawn cart that sits at the edge of the field. He and his family alternate what they grow on this land—half of the time it's flooded as a rice paddy field and the other half, like now, it's filled with small green onion sprouts. Both are essential sources of food and revenue for the family.

Maguette Diop in his family field.



Year-round agriculture hasn't always been possible in the Senegal River Basin. The region faced two pressing challenges by the turn of the 1970s: persisting drought and a growing population. Located in the Sahel region where the Sahara Desert transitions into the tropical ecosystems of sub-Saharan Africa, climatic variability is dramatic and precipitation scarce. This was especially true during the 1970s and 1980s—average rainfall in the Sahel had decreased by more than 30% when compared to 1950 levels.<sup>15</sup> This put the predominantly agricultural region in a precarious state.

Drought resistant crops such as sorghum and millet were not new, and their production was increasing at a rate of 1% a year. However, this agricultural yield was outpaced by a 2.5% annual population growth.<sup>16</sup> Further, governments in the region prioritized the cultivation of cash crops such as cotton and peanuts for export, neglecting the food needs of the growing population. It was the

making of a food crisis, and national governments feared the political and social instability that could come if prices were raised and basic food needs unmet.

All the while, low precipitation levels meant a drop in groundwater supply. This allowed saltwater from the Atlantic Ocean to seep into freshwater aquifers and flow up the Senegal River, reaching 250 kilometers inland. Salinity in groundwater stores increased and further limited the land suitable for agriculture and the water available for household use.<sup>vi</sup> This shortage of arable land led to actions that stressed the environment but were necessary to meet food production demands. This included the cutting of trees to create more inland farming areas and planting farm plots year after year, preventing nutrients from being restored.<sup>17</sup>

In response to these freshwater access challenges, the West African countries of Senegal, Mauritania, and Mali came together in 1972 to form the Organisation pour la mise en valeur du fleuve Sénégal (Organization for the Development of the Senegal River, OMVS).<sup>vii</sup> OMVS's first act was to propose a technological solution: two dams to be installed in the river basin.

Expectations for the dams were high. Objectives included ending the basin's food shortage crisis by expanding the area for irrigated farmland, producing hydroelectric power, and maintaining river water levels to allow for navigation and use by irrigation canals.<sup>18</sup> The primary purpose of the Diama Dam was to block saltwater from further intruding into upstream groundwater supplies and soil. Saltwater intrusion is expected to become a greater problem worldwide as sea levels rise, precipitation patterns shift, and a greater demand for freshwater stresses groundwater supplies to the point where seawater begins to seep into the source.<sup>19</sup>

Envisioned as a fix-all solution for the region's challenges, construction of the Manantali and Diama Dams were enough to temporarily band the member states together towards a shared purpose. Senegal, Mauritania, and Mali handed control of their land and river works over to OMVS in order for the pair of dams to be constructed.<sup>20</sup> The Diama Dam opened in 1986, approximately 30 kilometers inland from the coastal city of Saint-Louis, Senegal. The Manantali dam opened two years later, a further 1,150 kilometers upstream along the Bafing River in Mali.

<sup>vi</sup> How does this process of salinization happen? How will increasing temperatures affect this process? Who is most at risk?

<sup>vii</sup> The West African country of Guinea joined the alliance in 2006.



*Amadou Mbodji waters his green onions in the arid landscape of northern Senegal. The water used on his farm and others would not have been available without the construction of the Diama Dam.*

The project received ample criticism. “The worst possible solution,” said one critic.<sup>21</sup> There were concerns that OMVS’s intentions might be misleading. “Once more, peasant farmers are being used as an alibi. In theory, all this is being done for their benefit,” proclaimed a French agronomist in a 1982 publication.<sup>22</sup> He continued: “if one looks more closely, one notes that the dams have already benefited: the consultancy firms that have already earned several thousand million francs in fees, and hope to earn much more; [and] the bureaucracy of OMVS and its counterparts in each of the three member States.”

Criticism wasn’t unfounded. A British consulting firm hired to do a pre-construction evaluation of the project deemed the need for two dams unnecessary, stating that one would have likely been fine without the other.<sup>23</sup> OMVS ignored these recommendations, constructing the two dams as planned.

The Diama Dam achieved its mission in some ways. Protection against saltwater intrusion and a new series of irrigation canals led to a higher availability of freshwater. Land with access to irrigated agriculture grew over 24-fold.<sup>24</sup> That benefited farmers like Maguette Diop, whose original family land in Maka Diama was flooded and covered with aquatic vegetation following the construction of the dam. Like many other farming families, Diop had to shift where his land was located and adopt new methods of agriculture. The initial impact of this was challenging: not only is tending an irrigated field different than relying on annual patterns of flooding and precipitation, but the displacement and reassignment of new farmland led to land tenure conflicts across the basin.<sup>25</sup>

Still, Diop admits the Diama Dam brought his family more benefits than setbacks. “Before the dam was constructed we couldn’t do farming activities during the dry season but now farming is possible through the whole year,” he says, gesturing to the nearby irrigation canal.<sup>viii</sup> “If we weren’t able to water our fields it might get complicated for us because farming is the main activity in this region.” While the construction of the dam allowed for year-round freshwater access from irrigation canals, it also contributed to a 50% decline in the Senegal River Basin’s fishery.<sup>26</sup> Certain species in the river fishery required a mix of salt and freshwater to complete their life cycles, conditions that were not possible after the construction of the Diama Dam.<sup>27</sup>

<sup>viii</sup> The distribution of irrigation water in Senegal is overseen by a number of groups, including organizations operating at arms-length from the government and NGOs.

More detailed cost benefit analyses have revealed the true value of the dam infrastructure 30 years after construction. Despite the initial financial revenue that came from increased agricultural activity, it’s calculated that the dams cost the region approximately US \$572.1 million over 20 years due to lost productivity, environmental degradation, costs to human health, and other social impacts.<sup>28</sup> <sup>ix</sup>

<sup>ix</sup> How do you think this is estimated?

## Disrupting the Predator-Prey Relationship

The Diama Dam altered the upstream ecology of the Senegal River. Just as the dam blocked saltwater from reaching upstream, it also prevented the flow of aquatic species in the opposite direction from river to sea. That had devastating effects on the river’s population of *Macrobrachium vollehoveni*, a native species of giant river prawn that needed to travel up and downstream to complete its lifecycle. Survival of the species requires that female prawns migrate to the brackish water of the estuary in order to lay their eggs and raise larvae. Once the larvae reach adulthood, prawns would normally migrate back upstream to the freshwater environment. The dam trapped them on one side of an impassable concrete structure.<sup>x</sup>

<sup>x</sup> This has been described in other parts of the world, but with other species. Has it happened in your country or region? Why or why not?



### Trophic Cascades

Trophic cascades involve the addition or removal of an ecosystem’s top carnivorous predator. Present worldwide, trophic cascades send complex ripples through food webs.

One of the most well-known trophic cascades was the local extinction of wolves from Yellowstone National Park. Killed off in the early 20th century as part of predator control programs meant to protect domestic livestock<sup>29</sup>, the absence of wolves saw an increase in deer in the park. The deer population had previously been kept in check because of predation from wolves. Liberated from predatory pressure, the deer grazed leisurely through the park’s flora, decimating plant species to the detriment of other species in the park. Since the reintroduction of wolves to Yellowstone in 1995, the deer population has been re-regulated, erosion decreased, and species of all kinds, from beavers to songbirds to fish, have benefited from the natural restoration of order in the ecosystem.<sup>30</sup>

Trophic cascades don’t always have positive endings. Another case study in this anthology details the trophic cascade triggered when the non-native Nile perch was introduced to Lake Victoria for sport fishing purposes. That introduction had devastating implications on the ecology of Africa’s largest lake and continues to affect people living on its shores today—including possibly increasing the risk of schistosomiasis as the non-native perch out-compete native cichlid species that kept snail populations in check.



One of the water access points where Senegal River Basin village residents get much of their water for drinking, cooking, and other daily activities. (photo courtesy of Andy Chamberlin, The Upstream Alliance)

Not only an important food source for Senegal River villages, the prawns played a key role in the ecosystem's food web.<sup>xi</sup> They served as a natural predator for the many small snail species that existed within the river. With no predator and blooms of aquatic vegetation caused by newly stagnant water, the snail population thrived. That wasn't good news for human health: the more snails, the more parasitic reservoirs. Two years later, people living upstream from the dam started urinating blood<sup>xii</sup> and displaying other symptoms of schistosomiasis. It was a turning point for the health of people living in the Senegal River Basin.

<sup>xi</sup> Before moving forward, can you find out what the food web in Senegal might have looked like before the dams were built?

<sup>xii</sup> This is known as hematuria.

Recognizing the surprising consequences of dams on disease is an urgent problem worldwide. Only one-third of the world's long rivers remain free of man-made dams and other infrastructure.<sup>31</sup> The number of similar infrastructure projects is expected to continue to grow as countries transition from fossil fuel derived energy to cleaner sources, and as freshwater supply decreases with climatic variability.

Worldwide, nearly 400 million people are at a higher risk of contracting schistosomiasis, partly because dams have blocked the migration of snail-eating river prawns.<sup>32</sup> Though prawns are not the only predator for snails, they are a significant regulating force. Additionally, dams bring increased human migration due to the agricultural or industrial development they support — a social driver that can increase risk of schistosomiasis.<sup>xiii</sup>

<sup>xiii</sup> Start thinking of all the determinants of health that are at play in the context of schistosomiasis.

Take, for example, northern Egypt, where schistosomiasis prevalence<sup>xiv</sup> increased from less than 20% to 75% in some areas after a new dam was constructed in the 1930s.<sup>33</sup> This was attributed to an increase in the snails that serve as a host for the disease. Today, people in sub-Saharan Africa living within five kilometers of dam reservoirs are at increased schistosomiasis risk, as are people living closer to dam-supported irrigation systems.<sup>34</sup> New dams are still being constructed worldwide without the necessary consideration of not only their environmental effects but also their public health implications.

<sup>xiv</sup> It is unspecified whether this was an increase in intestinal or urinary schistosomiasis.

## Origins of an Outbreak

January 13, 1988. Dr. Idrissa Talla recalls the date without a moment's hesitation. He's sitting in his office at the Université Amadou Hampathe Ba in Dakar, where he serves as head of the Community Health Programme in the public health department. In 1988 Talla was in a very different position, geographically and seniority-wise.

Four years into his career, Talla was appointed as the medical doctor in charge of the health district of Richard Toll, a rapidly-growing town in the Senegal River Basin known for its sugarcane production.<sup>xv</sup> The factory was big business, and people were flocking from across the country and West Africa to seek employment. The population boom soon put a strain on freshwater resources, and the town's small reservoir was insufficient for the expanding community. The dam had provided increased freshwater for agriculture, but not for the growing population. People spent their days centered around the network of irrigation canals that channeled water from the river into the sugarcane fields. They'd work in them during the day and, as a result of the limited reservoir, use the same water for domestic purposes like cleaning, bathing, and drinking. "People were very closely in touch with the water," Talla describes.

That intimate relationship between people and their limited water resources had human health consequences. "A colleague, the only microscopist at the district laboratory, knocked on my door and said 'Dr. Talla, I saw something very bizarre and I don't know what it is,'" recalls Talla of the January day in 1988. Initially brushing off the concerns, his colleague persisted. Eventually, Talla and two other doctors went to the laboratory. Looking in the microscope, they were perplexed by what they thought they saw: the eggs of *Schistosoma mansoni*, the parasite that causes intestinal schistosomiasis.

Talla and his team requested another stool sample from the patient. And then another. "We put the slides under the microscope and it became more and more clear—this thing is schisto." Talla quickly ordered a meeting with the nurses and midwives, demanding stool samples be collected from all patients. "We were surprised. Almost every single person was infected," Talla says.

The outbreak happened virtually overnight. *Schistosoma haematobium*, which causes urinary schistosomiasis, had first

been described in the Senegal River Basin in 1908, and by the 1960s the disease was found across the country.<sup>35</sup> Cases of intestinal schistosomiasis, however, were rare in the region. In 1988, only 1.9% of stool samples collected from Richard Toll residents tested positive for intestinal schistosomiasis. By the end of 1989, 71.5% of stool samples showed evidence of these parasitic eggs.<sup>36</sup>

Acute symptoms of intestinal or urinary schistosomiasis can include fever, chills, cough, and muscle aches. Chronic schistosomiasis can cause abdominal pain, an increased risk of liver fibrosis and bladder cancer, and bloody diarrhea (for intestinal schistosomiasis) and painful urination and blood in the urine (for urinary schistosomiasis). According to the Centers for Disease Control and Prevention, repeated infection in children can lead to anemia, malnutrition, and learning difficulties, as cognitive growth is affected by parasitic eggs reaching the brain.<sup>37</sup>

Talla and his team were shocked by the discovery of intestinal schistosomiasis. The environmental impact assessment performed before the dam's construction had suggested there would be an increase in urinary schistosomiasis, but said intestinal schistosomiasis wouldn't be possible because of the environmental conditions.

Contrary to all that was suggested, the Richard Toll health center had an outbreak on its hands. Talla published the findings in an international journal without seeking permission from the national Ministry of Health, fearing they'd try to downplay the findings. The study attributed the outbreak to two factors: construction of the Diama Dam which introduced environmental alterations and the demographic shifts that came as people migrated to Richard Toll from countries where intestinal schistosomiasis was persistent.<sup>38</sup>

The paper was widely read, and an international contingent of schistosomiasis scientists soon converged on Richard Toll. "I was very tiny at the time, just around 30-years-old. I think they wondered 'who is this small bush doctor talking about schistosomiasis?'" Talla laughs. He took them to the irrigation canals to see the snails. "We took them from the water, went to the lab, and heated them with a lamp. When we exposed them to the heat the cercariae<sup>xvi</sup> came out. Everybody looked at that incredulously and said 'ah, now we are convinced!'"

<sup>xv</sup> Sugarcane in Senegal is produced by the Compagnie Sucrière Sénégalaise (CSS), which basically acts like a state-owned monopoly for sugar production.



Dr. Idrissa Talla outside of his office in Dakar, Senegal's capital city.

<sup>xvi</sup> Cercariae are the larval stage of the parasite.

## A disease with an environmental reservoir

The cercariae that Talla and the team of scientists saw under the microscope are central to understanding the life cycle of the parasite and the transmission from snail to human. As for the place of transmission itself—you just need to find the water.

There are two very different types of activity happening along the shores of Mbarigo village. The village of 600 sits on a tributary of the Senegal River. This shallow watering hole is one of three points where residents have direct access to fresh water.

The water is a cloudy mix of sediment and soap. It surrounds a group of young girls doing their afternoon chores, including 16-year-old Nafissatou Diagne. Knee-deep in the water, Nafissatou is scrubbing her family's colorful woven mat. She stops occasionally to adjust her pink skirt, gingerly lifting the bottom seam from the water's surface.

On either side of Nafissatou, Dr. Susanne Sokolow and Souleyman are wearing a slightly different uniform. Donning the high waterproof boots often worn when fishing, their movements are surprisingly agile as they scoop vegetation from the river bottom. Mossy vegetation undulates gently around their legs.

Raising her scoop from the water, Sokolow picks through the knotted vegetation searching for snails. “The *bulinus* snails are super attracted to this plant, probably because of all its surface area. They get to eat all the algae on here,” she says. She extends a gloved hand to reveal the miniscule snails she's extracted from the vegetation.

Schistosomiasis is a vector-borne parasitic disease. It relies on an environmental reservoir, meaning its transmission cycle includes a significant component in the environment outside a human host. This is the case for many of the world's most prevalent diseases: malaria, typhoid fever, and zoonotic diseases such as Ebola and Nipah virus, just to name a few. In the case of schistosomiasis, the environmental component is the time the parasite spends in snails, as well as in the water in search of a human host. “Because the pathogen of these diseases stays in the environment for a considerable amount of time, there is the obvious opportunity for a wide range of environmental drivers to affect their survival,” says Dr. Giulio De Leo, a Stanford University biologist and Science



A young girl in Mbarigo village washes her family's lunch dishes. This is just one of the many activities that happen at these water access points. These water outlets are as much a community gathering spot as they are a bathtub, kitchen sink, and toilet for local villages.

Director of The Upstream Alliance. Environmental changes like warming, deforestation, or introduction of new species can increase or decrease the persistence of parasites in the environment. That includes boosting the population of river snails by installing a dam at one end of an ecosystem.<sup>xvii</sup>

<sup>xvii</sup> Do you know of other examples where something similar has happened?



### Typha Taking Over

Prawns and snails were two species impacted by construction of the Diama Dam. Another ecological effect of the dam was an increased abundance of *typha*<sup>xviii</sup>, an invasive wetland reed that thrives along the riverbanks of freshwater ecosystems.

In no place is this altered river ecology more apparent than at the Diama Dam itself. Standing along the land barrier that separates the dam and the Mauritania side of the Senegal River, one can easily see the difference between the natural and altered ecology.

On one side, the bank of the river is still visible and bare of vegetation; on the other, a dense mat of healthy *typha* fringes the river's edge. Its increased abundance is both a nuisance and a public health risk. For one, its overgrowth restricts the ability of villagers to reach their water access points.<sup>39</sup> *Typha* can also clog pumping stations used to supply water to irrigated agriculture.

*Typha* has also been connected with the presence of schistosomiasis. In Zimbabwe, an increased number of snails has been found to correlate with the presence of *typha* reeds,<sup>40</sup> and the same is suspected in the Senegal River Basin. *Typha* is common in each of the water access points studied by The Upstream Alliance in the Senegal River Basin.<sup>41</sup>

<sup>xviii</sup> Pronounced TEA-fuh. Goes by the common name cattail.

Raphael Ndione from the Senegalese biomedical research centre *Espoir pour la Santé (EPLS)* works with Andy Chamberlin and Dr. Susanne Sokolow from Stanford University to collect snails from the shore of the Senegal River. These snails will later be dissected and examined for the microscopic parasite that causes schistosomiasis.



Schistosomiasis is caused by a parasitic organism that lives either on or in a reservoir host. In Senegal, there are three common species (and a few other less common species<sup>42</sup>) of snails that serve as the intermediate reservoir host for the schistosomes that infect humans<sup>43</sup>, though other mammals like livestock can also be hosts. Infection happens when people come in contact with parasite infested waters.

Driven by warm temperatures to leave the snail's shell, the parasite propels itself through the water in search of a human or mammalian host. This is why, at the water access point in Mbarigo village, Sokolow and Souleyman are wearing wader boots. It's also why the group of girls, including Nafissatou, are at risk of contracting schistosomiasis.

Once the parasites have found a human host, they burrow through the skin and live as adult worms in the veins surrounding the bladder (for urinary schistosomiasis)<sup>xix</sup> or intestines (for intestinal schistosomiasis). Female worms can lay as many as 300 eggs per day.<sup>44</sup> Bearing a sharp barb on their side, eggs become lodged in human tissue. This deposition of eggs and their exit from the body can cause severe tissue damage and is the cause of blood in a person's urine or stool. [Appendix 1: CDC schistosomiasis diagram](#)

A person infected with schistosomiasis is immediately at risk of spreading the disease to others by urinating or defecating the eggs into or nearby a water source. The eggs hatch into larvae which find a new snail host, completing the life cycle. More snails, more schistosomes, and an increased likelihood of people coming into contact with the disease.<sup>xx</sup>

<sup>xix</sup> Schistosomiasis has a specific tissue tropism to these organs. What other parasites have a particular affinity for certain organs? Why do you think this happens?  
[Learn more here](#)

<sup>xx</sup> How many people in your country do not have access to improved sanitation facilities? How about in Senegal? And in the world?  
[Learn more here](#)

The health and environmental consequences weren't of particular surprise to OMVS, the group behind the Senegal River dams. "We knew that we were going to face many problems after the construction of the [Diama] dam, but when we compared the drawbacks and the advantages we realized there were more advantages," says Adama Cheibany, technical manager of the Diama Dam. He again references the increase in irrigated agricultural land, the availability of freshwater, and the generation of clean energy provided by the Diama Dam's sister project, the Manantali dam. "Now we are trying to minimize the negative impacts," Cheibany says.<sup>xxi</sup>

<sup>xxi</sup> If you were to weigh the pros and the cons of the large infrastructure project, what things would be most important to you when making a final decision on whether to build it or not?



Tapped water is available in some Senegal River Basin villages, but it costs money to access. Despite understanding the connection between the water and schistosomiasis, poverty means that many people have no choice but to continue using the river.

## Past Interventions: Mass Drug Administration and Sanitation

<sup>xxi</sup> These approaches are known as reductionist approaches. Do you know what the opposite approach is called?

There have been several unsuccessful attempts to reduce or eliminate schistosomiasis rates in the Senegal River Basin. A reason for that failure is that interventions typically target only one arm of transmission, focusing on the reduction of disease in humans while ignoring that the problem is also mitigated by environmental conditions.<sup>xxi</sup>

A decade before the first cases of intestinal schistosomiasis were discovered in Richard Toll, another medical discovery was made. The innovation was praziquantel, a new therapeutic drug to treat parasitic worm diseases, including intestinal and urinary schistosomiasis. By the mid-1980s an estimated one million patients had been treated safely and successfully on three continents<sup>45</sup> and the global health community was optimistic that praziquantel could be a means to treat schistosomiasis.

By 2001, the distribution of praziquantel through mass drug administration (MDA) campaigns had become the key control strategy for schistosomiasis worldwide. MDA is the treatment of targeted populations without individual diagnoses.<sup>xxii</sup> In the case of schistosomiasis in Senegal, the campaigns targeted school-age children between the ages of 5 and 14-years-old. This demographic has the highest risk of schistosomiasis infection and faces the longest-term health implications due to their young age.

Praziquantel is highly effective under certain circumstances. A trial from the 1990s found that two treatments of 40 mg/kg given 40 days apart “cured” three out of four individuals—meaning they had “worm burdens below the detection level.”<sup>46</sup> Double doses of praziquantel given in this schedule also reduced the intensity of schistosomiasis by 88%, which is to say individuals had a lower burden of worms in their system.

However, most Senegal River Basin residents are not able to get two doses of praziquantel treatment. This is usually because of the cost of the medication and an inability to reach a health post to purchase the drug. Since 2009, annual large-scale MDA campaigns have aimed to address schistosomiasis in Senegal. During those campaigns, doses of praziquantel are distributed to school-age children and at-risk adults. Funding for Senegal’s National Control Program currently depends on the World Bank.

<sup>xxii</sup> Have you ever been exposed to an MDA campaign?

High costs and an inability to distribute praziquantel more frequently are two of the challenges and limitations to MDA campaigns, says Dr. Gilles Riveau, CEO of the Biomedical Research Center Espoir Pour La Santé (BRC EPLS), a Senegalese institution based in Saint-Louis. BRC EPLS has been addressing schistosomiasis and other parasitic diseases in the Senegal River Basin since 1991, and the institution’s research helped influence the methodology of the country’s MDA campaigns. “You have to find a way to use [praziquantel] that meets the economic and access issues in a country,” Riveau says. “How can you reach the people with the products? What methods will you use? Who will give the drugs? You develop an incredibly long list of questions and you have to find the way to be the most efficient.”



### Schistosomiasis Vaccine: A Work in Progress

Researchers around the world, including in Senegal, have spent the past several decades working towards a schistosomiasis vaccine. It was under the pretense of developing a vaccine that Biomedical Research Center Espoir Pour La Santé (BRC EPLS), a Senegalese research hub and NGO was founded in 1995 by Dr Gilles Riveau. BRC EPLS is The Upstream Alliance’s scientific and community partner in Senegal.

Bilhvax (Sh28GST), a vaccine for urinary schistosomiasis, showed promise when trialed on non-human primates and cattle. However, human clinical trials have yet to show efficacy.<sup>47</sup> The most recent phase III of clinical trials involved 250 school-aged children in the Senegal River Basin. The vaccine was administered alongside praziquantel to see if together they could delay reinfection of the disease. Follow-up assessments over the course of three years found there was no significant difference between the half of children who had gotten the Bilhvax vaccination versus those who were injected with a placebo.

Another vaccine currently in clinical trials is the Brazilian-developed SM14/GLA-SE. The next trial phase will involve 95 school children living in areas of the Senegal River Basin. BRC EPLS is overseeing this trial and supervised the one performed for Bilhvax. While vaccine development and testing is underway, BRC EPLS relies on other interventions to lessen the burden of disease in the basin. That includes working with The Upstream Alliance on the prawn project, and also supporting government MDA campaigns for praziquantel.

“We wanted a tool to fight the pressure of the disease, and praziquantel leaves people in relatively good shape even if they will be reinfected one day after,” says Gilles Riveau, Executive Director of BRC EPLS. “It wasn’t logical for us to think we could only focus on the vaccine if you remember that we are at the service of the population. In the short term we have to use praziquantel and in the far future we have to work on a vaccine.”

Like the prawn intervention, there is the possibility that a successful vaccine be incorporated into control programs for schistosomiasis alongside existing interventions like praziquantel rather than being seen as a standalone “silver bullet” solution.

Dr. Idrissa Talla later became head of the National Control Program of Schistosomiasis. He agrees that the logistics of praziquantel distribution were the greatest obstacle. “The medicine was there, people were trained, and the populations were aware of the necessity of the medication. But you still had logistics. The government needed to give us cars, but we had to ask for money outside of the country instead. That was a weakness, and I think that it hasn’t much changed,” he says.

MDA campaigns have another catch: even if there was a way to regularly treat those at risk of contracting schistosomiasis, it still wouldn’t be enough. The drug kills only the adult worms in humans, and doesn’t address the environmental reservoir—the snails. That means a child treated as part of an MDA program can go back into the water an hour later and not only get new worms, but release eggs into the water if they urinate or defecate nearby. The cycle continues.



#### From Corsica, With Love

Schistosomiasis has recently made the news in unexpected places. A popular tourist destination in the middle of the Mediterranean Sea, the French island of Corsica experienced an outbreak of over 120 cases of urinary schistosomiasis in the summer of 2013. Tourists and locals, some of whom had never left Europe, were exhibiting symptoms of schistosomiasis after swimming in the island’s Cavu River.

Interestingly, the cases in Corsica were caused by a hybrid of two schistosome parasites. Just as travel contributes to the spread of parasites worldwide, studies suggested the schistosome culprits in this outbreak could have been introduced by a person who was either infected in or visiting from Senegal.<sup>48</sup>

Ultimately, it’s not enough for an infected individual to urinate or defecate near a water source—there also needs to be the correct species of snail to serve as a reservoir for the disease. While the implications of precipitation, climate, and land use change on snail populations and schistosomiasis prevalence are still being determined, initial research suggests snail survival rate is affected by temperature.<sup>49</sup> Further data show that deforestation in some areas can favor transmission of schistosomiasis and other vector-borne diseases by allowing more sunlight and warmth to reach water bodies. Overall, changes to the Earth’s natural systems could eventually lead to high rates of schistosomiasis in some areas and a reduced risk in others.

According to Dr. Giulio De Leo, it’s important to remember that there will be people who win and lose with these environmental changes. “An increase in temperature might actually remove a disease in places that become unsuitable for the parasite to complete its life cycle because it’s too hot,” he says. “Given the level of climate change expected and the extent of land use change through agriculture and urbanization, we know we are going to be dealing with these new challenges in the future to come.”

## The Socioeconomics of Disease Transmission

“The pills work great, it’s just that in a zone of transmission that’s as high as this, kids end up being almost on a treadmill where they’re treated and they get re-infected at such a rate that it negates the treatment,” explains Dr. Susanne Sokolow. “If it were a low risk area where you wouldn’t acquire new worms so rapidly after going back in the water, then you could march towards elimination through drugs alone.” Today, prevalence rates of urinary and intestinal schistosomiasis among children in the Senegal River Basin are estimated at between 90 and 100%.<sup>50</sup>

Schistosomiasis transmission is also exacerbated by social and economic factors, variables that can’t be addressed by drugs. Transmission of disease requires exposure to infected water, and the water access points of villages and murky rice paddy fields provide an ideal environment. In theory, improved sanitation and drinking water infrastructure could reduce the risk of transmission, but that hypothesis is imperfect in real-world application.

A 2004 study investigated the hygiene practices of children and mothers with infants in Northern Senegal. It found that more than two-thirds of children rarely or never used latrines, and that a quarter of kids defecate in or near water,<sup>51</sup> releasing parasitic eggs as a result. Disease transmission is also common among adults who use rivers for bathing purposes following defecation. While some latrines are available, particularly in schools, many are not used or are deemed too dirty.

Hoping to reduce rates of schistosomiasis through infrastructure alone also neglects the importance of the river in people’s identities and livelihoods. “We could not imagine life without the existence of the river,” says Alassane dit Baye Ndiaye, a resident of Lampsar, a village upstream from Mbarigo. “Every family here has a fisherman, a farmer, or someone who is breeding animals. For all those activities you need water.” Standing near one of Lampsar village’s water access points, Ndiaye is surrounded by activity. A group of young boys splash joyfully; large silver platters bob just below the surface of the water waiting to be washed by a pair of girls; a mother prepares to bathe her infant son.

While Ndiaye says there are families who try to only use tap water, this ultimately isn’t realistic. “You can sensitize children and tell them to only use taps, but you can’t prevent them from coming

here,” Ndiaye says of the river. As if on cue, the gaggle of young boys shriek in a splashing frenzy. “Even if children do not come here they are obliged to go to the fields and help water the gardens, so they need to be in contact with water. Many people have no other choice.”

Maguette Diop, the farmer from Maka Diama, has been infected with schistosomiasis twice. Both times he has had to purchase praziquantel treatment in the nearby village. He suspects he contracted the disease while in his rice field. Despite these suspicions, Diop wasn’t able to change his behavior: “it couldn’t prevent me from coming to work every day,” he says.

Awa Diop, unrelated to Maguette, lives in Lampsar village with her nine children. She’s tried to change the behavior of her kids since two of her daughters contracted schistosomiasis after what she suspects was a post-lunch bath. While she was able to afford the cost of praziquantel for her children, she says this might not always be the case. As a result, she’s limited her kids access to the river, encouraging them instead to use the tap and well water on their property for chores. That means they could avoid all contact with the river—technically. “If they had the choice they would rather do laundry in the river since it’s easier and cooler,” Diop shrugs. And unlike tap water, the river is free. “With the river you don’t need to collect water or change the water in your bucket. It’s a bit complicated when they can’t go there.”

Tap and well water isn’t an option for other families living in the Senegal River Basin, despite its proximity to Lac de Guiers. That lake is the most important freshwater reservoir in Senegal, and is the primary water source for Dakar, located 160 kilometers southwest of the lake. While Senegal’s urban areas have water coverage and sanitation rates sitting at 93% and 89% respectively, this drops to 71% for water coverage and 43% for sanitation in rural areas.<sup>52</sup> These disparities put rural communities at a higher risk of waterborne diseases like schistosomiasis.

The socioeconomic barriers faced by families combined with the cost and logistical limitations of MDA campaigns mean actors battling schistosomiasis have had to turn their gaze in new directions. To The Upstream Alliance, that pluralization of ‘directions’ is key. Prawns could be the missing piece in a suite of solutions that address the complex layers of environmental, social, and economic factors.

*Awa Diop stands with three of her nine children outside their home in Lampsar village.*



## More Prawns, Fewer Snails, Less Disease

xxiii Molluscicides are pesticides used to kill mollusks, including snails. While they often accomplish this mission, they can also affect other species.



Malacologist and Lampsar village resident Alassane dit Baye Ndiaye holds one of the snails that serves as an intermediate reservoir for the parasite causing schistosomiasis. Ndiaye has led sensitization and education workshops with community members, but notes that it can be difficult to ask people to stay away from water access points.

Before the advent of praziquantel, the public health community had no choice but to consider how changing environmental conditions could reduce or eliminate schistosomiasis. This approach has had success in a number of countries worldwide. Japan drained its wetlands, used chemical molluscicides<sup>xxiii</sup>, and cemented its irrigation canals, reducing weeds and snail habitat as a result.<sup>53</sup> By 1994, schistosomiasis had been eliminated from the country. In the past century, countries and territories from Iran to Morocco to Puerto Rico have used snail control to completely eliminate the disease. Nearly a dozen others have used snail control methods to reduce prevalence of the disease by more than 90%.<sup>54</sup> The global evidence supports that environmental controls can also address schistosomiasis, rather than relying on drug administration alone.

For The Upstream Alliance focused on the Senegal River Basin, prawns are one potential environmental control method. With increased risk of schistosomiasis attributed to dammed river catchments, a decline in the native river prawn population, and an increase in snail hosts—as well as the limitations of MDA campaigns in high-risk regions like Senegal—the next step was for the team to prove that *reintroducing* wild river prawns into the could reduce the burden of disease.

To do that, the Stanford team joined with Espoir Pour La Santé (BRC EPLS), the Saint-Louis based biomedical research center, to run their first trial stocking of native prawns in villages. Scientific expertise came from both groups. The collaboration with EPLS was key in making it possible to test the prawn intervention in partnership with affected communities. EPLS had been working with Senegal River Basin villages for more than 20 years. “[EPLS] is not using the local population as a guinea pig, but they’re working with them to try and solve environmental and public health challenges that are taking a big toll on people locally. They really were our eyes and ears in the field,” says Dr. Giulio De Leo.

In 2012, the project reintroduced native *M. vollenhoveni* river prawns into Lampsar, one Senegal River Basin village. The prawns were put in a mesh net enclosure spread across the village water access point. The prawns were able to prey on snails that entered the enclosure. Another nearby village served as the control site for the study. The water point in this second village was not stocked with prawns, allowing researchers to compare and determine if the presence of prawns did, in fact, impact schistosomiasis transmission.

Over the course of the pilot study, thousands of snails were collected from the two village water access points, dissected, and analyzed for signs of infection from schistosomes. The study also looked at whether praziquantel, the drug used in MDA campaigns, could be more effective when combined with a prawn intervention. Midway through the study, participants were given two consecutive doses of praziquantel three weeks apart.

By the end of the pilot study, the abundance of infected snails had dropped by 80% in Lampsar, the prawn-stocked village.<sup>55</sup> Importantly, there were also fewer schistosome eggs found in the stool of villagers, meaning the intensity of infection in people had been reduced to a rate where praziquantel could cure in the long-run, rather than simply treat. There were more prawns, fewer snails, and less disease.

Expanded studies across 16 villages support that finding. An epidemiological model developed from those observations demonstrates that continued MDA campaigns *alongside* a prawn intervention offers the most rapid reduction in the burden of schistosomiasis.<sup>56</sup> This emphasizes The Upstream Alliance’s argument that it’s not about finding one right answer. “If you give the drug and control the environmental risks at the same time, whether that’s through improved WASH standards, molluscicides, or prawns, it’s going to be synergistic,” says Dr. Susanne Sokolow. “You’re balancing the equation so the worms you’re getting rid of are not being replaced rapidly. You end this perpetual cycle.”

↘ [Appendix 2: Figure 4A from 2019 Hoover et al paper](#)

In scientific principle, The Upstream Alliance has proven its reduced snails-reduced disease intervention in Senegal. But challenges still exist in getting enough prawns into the villages where they could affect the prevalence of disease. The adult prawns used in the pilot trials were either imported from Cameroon or fished out of nearby estuaries. What’s next for this planetary health intervention is determining how to get a steady, locally-sourced stock of prawns. To do that, The Upstream Alliance needs to focus on expanding a nascent industry.



Dr. Susanne Sokolow dissects snails in the Espoir Pour La Santé laboratory in Saint-Louis.

## Putting Prawns Back on the Table

<sup>xxiv</sup> Aquaculture is an increasingly “popular” technique to combat poverty and food security challenges. Can you find global trends on what types of species predominately are fished, what countries predominate in the industry, and the benefits and challenges of various types (coastal, offshore) or species type (algae, shellfish, finfish)?

<sup>xxv</sup> What are the negative consequences of the intensification of aquaculture?



### Aquaculture and the Blue Economy

Aquaculture constitutes nearly half of the world’s fish production and provides 53% of fish for human consumption.<sup>60</sup> Not limited to fish species, aquaculture production also involves the production mollusks, crustaceans, and aquatic plants and algae. In its 2018 State of the World Fisheries and Aquaculture Report, the FAO notes aquaculture is growing faster than any major food production sector worldwide. With the world’s population expected to grow to 10 billion by 2050, sustainable intensification of aquaculture could be key in ensuring everyone has access to nutritious diets.

The majority of aquaculture production (90%) occurs in Asia. China is the leading producer, with production rates nearly four times higher than the world’s second top producer, Indonesia. India, Vietnam, and Bangladesh round out the top five list in terms of aquaculture production.<sup>61</sup> While the earliest forms of aquaculture have been around since the Neolithic period (some estimate 4,000 B.C.), the industry is less than a century old on the African continent.<sup>62</sup>

There are a number of aquaculture methods, with operations taking place on land, in the ocean, and in freshwater. These techniques vary in productivity and environmental impact. For example, tilapia and shrimp are typically farmed using a pond method. If not treated and filtered, wastewater from these ponds can pollute the surrounding environment. This is what we saw in the Sri Lanka case study, where shrimps farmed using intensive pond aquaculture had a devastating effect on mangrove ecosystems. Contained systems typically have a lower environmental impact, as wastewater is managed and species are prevented from escaping into the surrounding ecosystem. SeaChoice outlines the many types of aquaculture methods on its [website](#).

Re-introducing prawns to Senegal River Basin villages could have a positive impact on public health—and that’s not all they could do. If sustainably managed, the prawns could restore the Senegal River’s fishery which had been disrupted by the construction of the Diama Dam. The domestic breeding of prawns could also support the growth of the aquaculture industry, a priority for the Senegalese government. Finally, prawns could provide an important source of food and protein for people living in the region.<sup>xxiv</sup>

Senegal’s aquaculture industry has grown steadily over the last decade, and production expanded by 46 fold between 2007 and 2016.<sup>57</sup> The growth in Senegalese aquaculture is consistent with global trends—especially important as marine fisheries decline worldwide.<sup>58</sup> Globally, the Food and Agriculture Organization of the United Nations (FAO) acknowledges that sustainable intensification of aquaculture could fill the gap of livelihood creation and food security. There’s a long way to go.<sup>xxv</sup> As of 2016, sub-Saharan Africa contributed less than 1% to the global production of aquaculture.<sup>59</sup> Aquaculture is still a nascent sector in the region, and this figure is perhaps not surprising given the region’s limitations in freshwater access, technology, governance, energy supply, and technical capacity.



The fledgling hub of Senegal’s prawn aquaculture industry is a large hatchery warehouse on the property of Gaston Berger University, a 30 minute drive from Saint-Louis. Papa Demba Ndao rolls back the large metal door to reveal the operation that, if and when it reaches capacity, could produce one million prawns a year for up to 1,000 villages in the Senegal River Basin. There’s not much happening during this time of the year — Wjust Ndao and a colleague amidst the droning whir of one of the prawn tank filters.

*A group of men prepare to catch pond-grown prawns that are being bred as part of SIA breeding trials.*



Papa Demba Ndao holds two *M. vollenhoveni* prawns at the Station d’Innovation Aquacole (SIA) prawn hatchery. This is one of the locations where The Upstream Alliance has raised the prawns needed for its intervention, and it will continue to be a central hub for future research and development.

Ndao is an aquaculture engineer with *Station d’Innovation Aquacole* (SIA), an arm of The Upstream Alliance that runs this operation. The hatchery is headed by Nicolas Jouanard, Executive Board Member of The Upstream Alliance. He also works for *Espoir Pour La Santé*.

In the Senegal River Basin, this hatchery is an essential piece of infrastructure needed to make a prawn intervention possible. With the Diama Dam still impeding the ability for prawns to migrate up and downstream, aquaculturists need to imitate the reproduction cycle that existed naturally in the basin’s environment. That requires the regular adjustment of water temperature and quality, salt water content, and food sources to ensure prawns and new larvae have the ideal conditions to survive and reproduce.

However, a key challenge has obstructed progress so far: *M. vollenhoveni*, the native African river prawn that The Upstream Alliance used for its pilot prawn interventions, has never been successfully domesticated.

Aquaculture ventures that currently exist in Senegal focus on tilapia and catfish, two fast-growing species that are low-maintenance when it comes to water quality and the food needed for survival. While tilapia and catfish can go from fingerling to fish in just six months, the process of prawn reproduction and raising larvae can take four months alone, with another minimum of seven months for the prawns to grow to their adult size.

“Prawns are very demanding and expensive because they need a lot of attention,” says Ndao, scooping one up off the bottom of the tank and holding it in his hand. Its exoskeleton is delicate and soft to the touch—it has just gone through a molting stage. “Compare this prawn with catfish which can almost grow in a tank without air. That’s not okay for prawns. You must have aeration and that needs electricity,” Ndao says. Unfortunately, consistency of power supply isn’t always a given in Senegal.

Unlike the adult *M. vollenhoveni* prawns that were used for The Upstream Alliance’s pilot studies, the long-term sustainability of this intervention depends on raising prawns from larval stage. So far, SIA’s breeding trials report a maximum of 5% survival during the larval stage. Successfully creating a new business venture would require at least 20% survival, and more developed aquaculture

ventures worldwide have 80% larval survival. “So we have a long way to go,” says Dr. Susanne Sokolow. “The biology is challenging. We have the world’s experts on it, both in Senegal and outside.” One of the options is to potentially import an all-male cohort of a non-native freshwater prawn, *Macrobrachium rosenbergii*, in place of the native prawn (see textbox 5 for more information about the implications of this introduction).<sup>xxvi</sup>

<sup>xxvi</sup> Introducing non-native species might have negative consequences. What are they? What are some examples from around the world?

“Any species is complicated to breed in a context where the aquaculture sector is embryonic,” adds Nicolas Jouanard, CEO of *Station d’Innovation Aquacole*. Successfully domesticating the prawns in the hatchery is one piece in the puzzle. The other is getting the adult prawns to survive the precarious conditions of village water access points. To-date, the ability for prawns to eat the snails and reduce disease has been challenged by the fact that the enclosure is not durable enough to survive the demanding environment of these water sites. The prawns either die or are collected before they can serve their public health purpose.



#### Next Steps for Prawn Progress

The Upstream Alliance has considered three options for raising the prawns needed to make any future venture a success. The first was the attempted domestication of *Macrobrachium vollenhovenii*, the native river prawn from West Africa. The team is looking at what comes next after pilot attempts to domesticate the prawn yielded a maximum of 5% survival rate during the larval rearing phase.

One option is to fish *M. vollenhovenii* prawns from estuaries in Senegal and other parts of West Africa, growing them to size in an outdoor pond before transporting them to villages or selling them to the market.

A third option may provide faster prawn growth and, as a result, more commercial and public health gain. That option involves introducing *Macrobrachium rosenbergii*, the variety of giant river prawn commonly used for aquaculture ventures worldwide. However, there’s a catch: as a non-native species to Senegal there is the concern of how an alien species could affect existing biodiversity. The Upstream Alliance is working with Ben Gurion University in Israel to trial the introduction of transgender female prawns —changing the sex of *M. rosenbergii* from female to male ensures that only male offspring are produced. Laboratory tests have found no evidence of cross fertilization between the local and single-sex species.<sup>63</sup> This means introduced all-male prawns could be bred for aquaculture purposes without a risk of the population exploding out of control.

The Upstream Alliance received a permit from Senegal’s Ministry of Environment in order to import *M. rosenbergii* from Israel. That importation of 15,000 *M. rosenbergii* post larvae will allow the team to begin to understand the challenges of growing the species using the resources and conditions available in Senegal.

“[The enclosure is] just a net, and everything can happen in the village. It’s a public space and people do their laundry, dishes, and wash themselves and their animals. It’s basically the worst place in terms of water quality,” says Jouanard. “If I were a prawn I would also do everything I could to escape.” Ultimately, he doesn’t see the enclosure nets, which were designed for research purposes, as a translatable solution for prawn aquaculture.

Alassane dit Baye Ndiaye, a resident of Lampsar village, saw this problem firsthand. Ndiaye was responsible for maintaining the prawn enclosure in his village during The Upstream Alliance’s pilot study. At first, he says there were some struggles with the enclosure because people didn’t know its purpose, and kids and fishermen alike tried to cross the net to reach the other side of the river. By the end of the trial period, though, he says people in the village understood the role the prawn could play in their health. “Even when people saw a dead prawn they would come to my house and tell me. So they knew the importance of the prawns,” Ndiaye says. “We would be pleased to again see them back in the village.”

The Upstream Alliance is investigating ways to introduce prawns in villages without the need for a net enclosure. There’s been discussion that adding prawns to rice paddy fields could provide a more hospitable environment while limiting the frequent public visits and household pollution of water access points. Another goal would be to encourage the company that manages the Diama Dam to construct a prawn ladder—a piece of infrastructure that would again allow prawns to naturally migrate up and down the river. The original species collapse may have been avoided had this cost-effective measure been taken in 1986.

The Upstream Alliance team has also calculated the prime stocking density of both the native *M. vollenhoveni* and the non-native *M. rosenbergii* prawns in order to effectively complement MDA campaigns. Those calculations include the optimal harvest time of prawns as well as the economic and food benefits each harvest would yield. For example, the non-native *M. rosenbergii* would be optimally harvested every 165 days, yielding about 1,560 prawns each time. That would bring in a 10-year average of US \$5,400 with every harvest.<sup>64</sup> These economic calculations may seem outside the realm of The Upstream Alliance’s original public health mission, but the team believes that if the prawn project is going to have sustainable long-term health effects there also need to be economic benefits.

## Beyond the Ivory Tower: A Business Case for Prawns

In the future, The Upstream Alliance aspires to grow Station d’Innovation Aquacole (SIA) into a for-profit social enterprise. Social entrepreneurship fuses the for-profit mentality of the business world with the social impact more commonly associated with non-profits—demonstrating that financial success and positive impact are not mutually exclusive ambitions. Some dots need to be connected between The Upstream Alliance’s current work and investors before that can happen.

SIA’s business model is to use aquaculture to eliminate schistosomiasis in the Senegal River Basin. A percentage of the prawns domesticated at the SIA hatchery would go directly free-of-charge to villages where they could be stocked in nets, rice fields, or another location as a way to lessen the number of snails and, as proven by pilot studies, reduce schistosomiasis alongside strategic administration of praziquantel. Once prawns reach maturity, they could be harvested and sold or eaten by villagers, improving food security and providing a new livelihood opportunity.

The remaining prawns from the hatchery would be sold to high-end restaurants and hotels, with the revenue from those sales funding the continued restocking of prawns in Senegal River Basin villages. The sale of prawns to these restaurants and hotels means market demand would fund schistosomiasis interventions, allowing SIA to generate its own revenue and be financially sustainable.

If successful, this for-profit model would allow The Upstream Alliance to escape the time and focus constraints of traditional research grants or donor funding. Typically funded for just a few years, the short-term cycles of these forms of financing aren’t necessarily well suited for the longer timeline needed to establish an aquaculture venture in an emerging market. Further, grants are often limited to one discipline—funding research related to human health *or* ecology *or* aquaculture. The Upstream Alliance is concerned this restricted scope may not be a good fit for the multidisciplinary nature of its work.

The feasibility study and business plan for SIA’s for-profit model was developed by a team from the Middlebury Institute of International Studies at Monterey, California. The Upstream Alliance had reached out to the institute, wanting to prove to potential investors that they weren’t only biologists, ecologists, international development practitioners, and epidemiologists



—but savvy business people, too. They enlisted the help of Middlebury MBA students Tyler Higginson and Matthew Salyer, alongside economics professor Constantin Gurdgiev. Higginson visited Senegal to do market research and complete the feasibility study while Gurdgiev designed the venture’s funding model.

While The Upstream Alliance has proof of concept for its health intervention, the business feasibility of the project is still only theoretical. This means the project remains in the research and development stage, and the business is looking for investment that could be used to start producing prawns and test the Minimum Viable Product (MVP) model. Gurdgiev estimates it would take US \$60,000 to launch the MVP for the prawn venture. This start-up capital would fund upgrades to the current hatchery and allow for a first round of prawn breeding to fully assess market demand. Launching a new venture in addition to the existing pilot hatchery would require an additional ~\$335,000 in capital expenditure. Based on Gurdgiev’s market analysis, it would take 10 to 12 months from securing funding to produce the first commercially-viable batch of prawns.

According to Higginson’s feasibility study, there is a market for prawns, both in Senegal River Basin villages and among high-end restaurants and hotels. “People are eager for it. They really enjoyed them in the past, almost to a nostalgic level, and they truly want the prawns,” he says.

As well as supplying the market with an in-demand product, SIA’s mission would also accomplish two desires of the Senegalese government: helping the country accomplish its priority of growing the aquaculture industry all while addressing a persisting public health concern. As a result, Higginson says SIA could possibly introduce something like a social impact bond—where the government pays the venture to expand the social impact side of its business (the stocking of prawns in villages to reduce schistosomiasis). “For example, the government could help subsidize the lost revenue of the prawns that go to impact rather than to market,” Higginson says. “I think we will find a certain level of cooperation because we are addressing that social and health need.”

In the end, SIA and The Upstream Alliance need more time. Time to import the all-male *M. rosenbergii* prawns. Time to see whether they can be domesticated in Senegal. Time to create a new solution for how the prawns should be stocked in villages. Time (and funding) to establish whether its for-profit model could be a success in the first place.

Those many waiting periods and paced progress illustrate what Dr. Giulio De Leo from Stanford says is one of the key learnings of planetary health interventions: the need for endurance and patience when dealing with projects and teams that are complex and multidisciplinary. He admits that this longer time scale can sometimes seem exasperating, particularly when dealing with challenges as urgent as the ones currently facing the world.

The story is far from finished in Senegal. Members of The Upstream Alliance team from the University of South Florida will be continuing their work looking into the effects of agricultural fertilizer on the spread of schistosomiasis. Generally, as well as through their work in Senegal, The Upstream Alliance team is hoping the planetary health community can develop a suite of tools so decision makers are better equipped to consider the environmental and public health implications of a development project—before it happens. Finally, they'd like to eventually take the prawn intervention on the road, applying it in countries like Brazil where there are increasing rates of schistosomiasis, native river prawns, and a more robust aquaculture industry.

It is tempting to simplify and point to prawns alone as the ideal intervention to eradicating schistosomiasis. But as The Upstream Alliance and those responding to the disease worldwide have learned, there is no one-size-fits-all answer. Instead, it takes a portfolio of tools developed from years of multidisciplinary expertise, consideration of the dynamic variables that affect a person's health, and sometimes, a business case to drive it all home. As Dr. Susanne Sokolow puts it: “complex problems, complex solutions.”

## Keeping Track of Who's Who

### Adama Cheibany

*Technical manager of the Diama Dam with Société de Gestion et d'Exploitation de Diama (SOGED)*

### Alassane dit Baye Ndiaye

*Malacologist and resident of Lampsar village*

### Dr. Gilles Riveau

*CEO of Espoir Pour La Santé; Science Director (Senegal) with The Upstream Alliance*

### Dr. Giulio De Leo

*Professor of Biology and Senior Fellow at the Woods Institute for the Environment, Stanford University; Science Director with The Upstream Alliance*

### Constantin Gurdgiev

*Economics professor at the Middlebury Institute for International Studies at Monterey; Member of the business development team for The Upstream Alliance*

### Matthew Salyer

*Former MBA student at the Middlebury Institute for International Studies at Monterey; Member of the business development team for The Upstream Alliance*

### Nafissatou Diagne

*Resident of Mbarigo village*

### Tyler Higginson

*Former MBA student at the Middlebury Institute for International Studies at Monterey; Member of the business development team for The Upstream Alliance*

### Dr. Susanne Sokolow

*Disease epidemiologist and veterinarian at Stanford University; Executive Director of The Upstream Alliance*

### Awa Diop

*Resident of Lampsar village*

### Nicolas Jouanard

*CEO of Station d'Innovation Aquacole; Executive Board Member with The Upstream Alliance*

### Dr. Idrissa Talla

*Epidemiologist and Head of the Community Health Programme in the public health department at the Université Amadou Hampathé Ba; former head of the National Control Program of Schistosomiasis*

### Maguette Diop

*Farmer and resident of Maka Diama*

### Papa Demba Ndao

*Aquaculture engineer with Station d'Innovation Aquacole*

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*A water access point in Lampsar, one of the Senegal River Basin villages where The Upstream Alliance is working.*

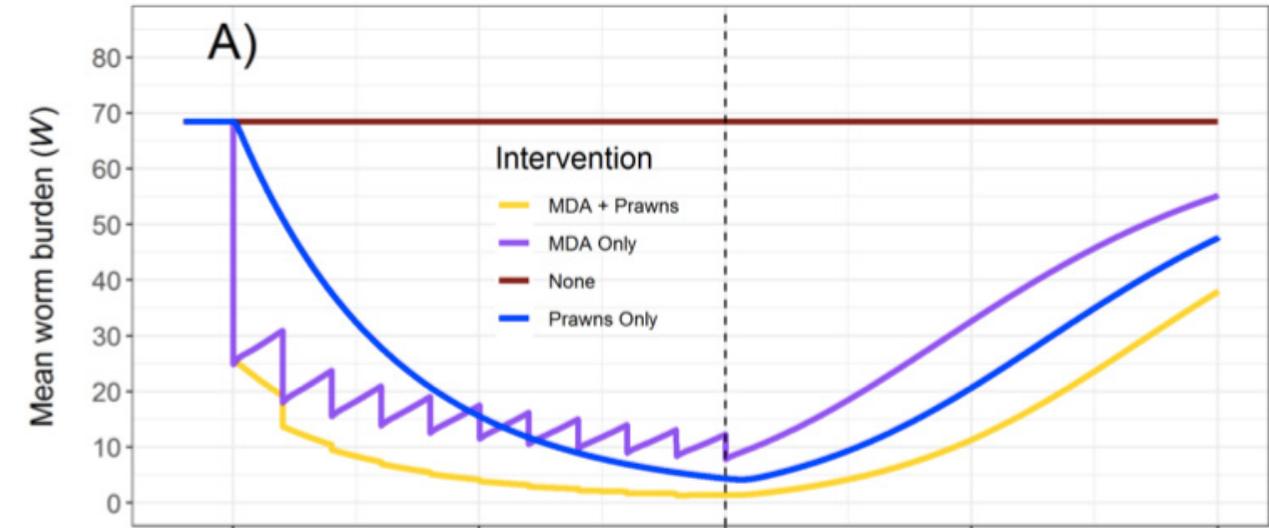
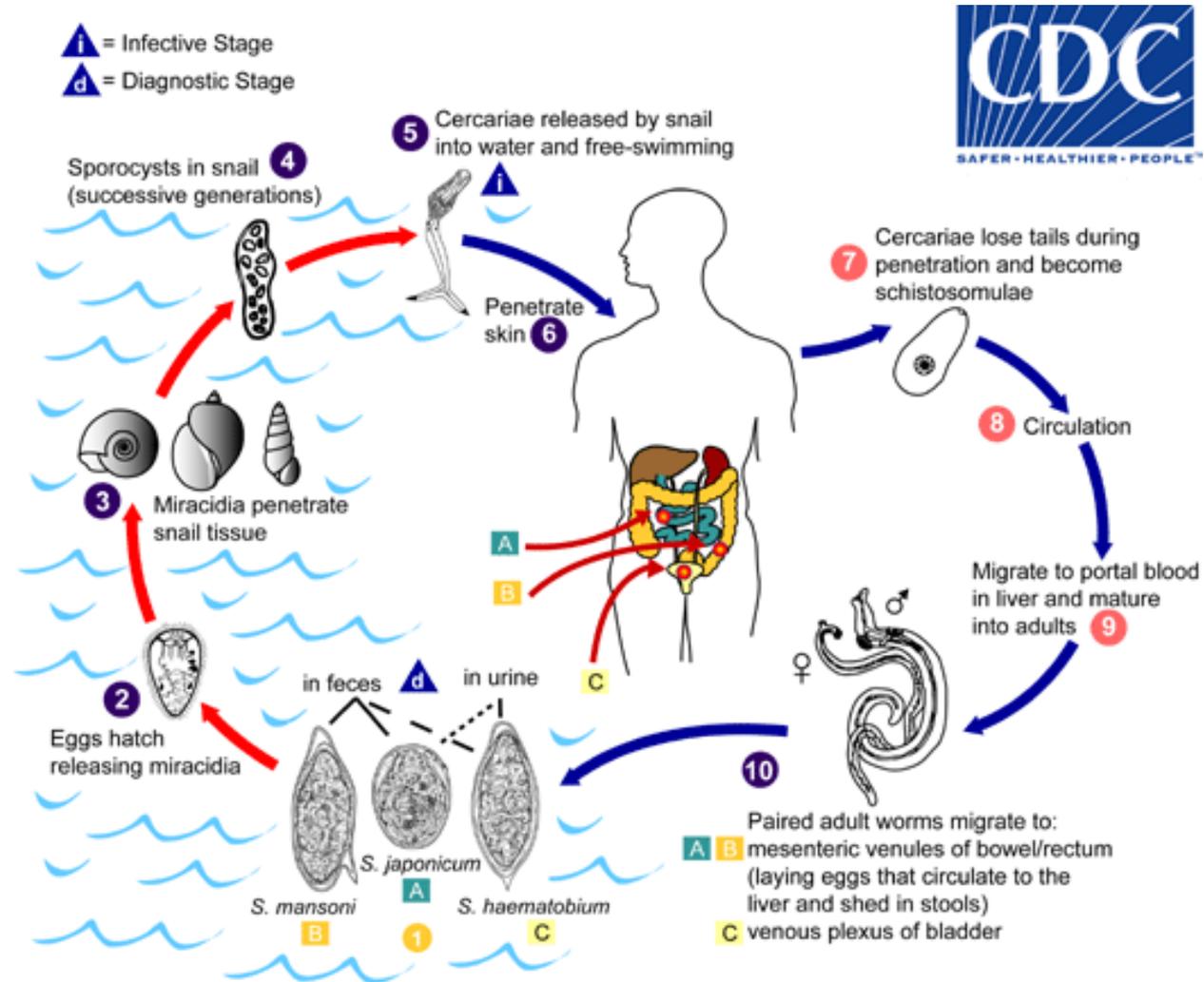
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# Medical Clinics for Planetary Health

THE SURPRISING LINK BETWEEN  
LOGGING AND HEALTHCARE IN INDONESIA

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

Case studies were written and photographed by Hilary Duff with editing and support from Amalia Almada, Christopher Golden, and Sam Myers. Teaching guides were written by Carlos A. Faerron Guzmán.

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## Executive Summary

Themes of land use change and deforestation are explored in the land use section of chapter 4 of [\ Planetary Health: Protecting Nature to Protect Ourselves](#). Environmental determinants of infectious disease exposure are explored in chapter 6. Developing business and economics models more consistent with planetary health are explored in chapters 15 and 16.

### Learning Objectives

*After examining this case, in relation to the communities surrounding GPNP, students should be able to:*

- ① Understand the interlinkages between deforestation and health.
- ② Analyze the push and pull factors of deforestation.
- ③ Describe common barriers to access healthcare services.
- ④ Appraise the utility of bottom-up approaches in the face of planetary health challenges.

This case study examines a connection between rainforest conservation and affordable healthcare access in communities surrounding Gunung Palung National Park (GPNP) in West Kalimantan, Indonesia. It emphasizes that human and environmental well-being cannot be seen as separate from one another. Specifically, it explores how deforestation impacts human health and well-being, and how implementing co-beneficial solutions can improve human health while protecting natural ecosystems. Finally, this case study highlights the importance of collaboration to achieve planetary health, both within communities and within organizational teams.

Featuring the work of U.S.-based NGO Health In Harmony and its Indonesian partner organization, Alam Sehat Lestari (ASRI), this case study details how a planetary health intervention that integrates medical care, conservation education, reforestation, and livelihoods training has had positive benefits on human health and the surrounding ecosystem. These benefits include a decrease in deforestation between 2008 and 2018 around the GPNP, and the opening of a medical clinic, which has served over 33,000 patients in that same time period.<sup>1</sup>

*This case study was developed based on interviews conducted in West Kalimantan, Indonesia, in July 2018.*

## Introduction

When Kinari Webb visited Borneo in 1993, the orangutans were her first love. “It was said at the time that an orangutan could go from coast to coast to coast on the third largest island in the world without touching the ground,” Webb recalls in a 2016 TEDx talk. “But even back then, you could hear that hated sound: the sound of a chainsaw. The trees they were cutting were so enormous that when they hit the ground you could literally feel the Earth shake in your feet.”

In the beginning, Webb hated not only that sound, but also the men wielding the weapon. But over the course of her year in the rainforest, she met some of the loggers—and she started to listen to what they had to say. What she heard were stories of impossibly large responsibility, men who had to pay for their family’s needs, including medication and emergency healthcare, while living in subsistence conditions. From her conversations and follow-up research, Webb learned families would spend approximately a year’s income on medical emergencies like surgeries, caesarean sections, wounds, and serious malaria cases. Those medical bills would leave most in debt, and as it happened, illegal logging was one of the best ways to get fast cash.

Near the end of her time in Borneo, Webb felt herself staring down diverging paths. “I remember writing a list of the pros and cons of doing conservation work versus health, and not being able to decide between the two,” she describes. “This intersection wasn’t on anyone’s radar, but I could see it from my own experience talking to people. I had this real desire to focus on human health and the protection of the rainforest.”

Instead of continuing orangutan research and working for a traditional single-sector NGO, Webb decided to tackle one of the root causes contributing to the loss of the species: the illegal logging that was occurring to pay for emergency healthcare. Finishing medical school in 2005, Webb—now with an MD after her name—founded Health In Harmony. The organization started with the understanding that human and environmental health are inextricably intertwined, and that the best way to save the forest is to ask communities what solutions they think would work.

After searching for an appropriate site to set up the program, Webb moved to Kalimantan with her husband Cam Webb who she had originally met in Gunung Palung National Park when he was doing his PhD in rainforest ecology. In 2007, alongside Dr. Hotlin Ompusunggu and ecologist Antonia Gorog, they created partner organization Alam Sehat Lestari (ASRI). ASRI is a dual community medical clinic and conservation organization in Sukadana, West Kalimantan, Indonesia. A planetary health organization before the term existed, ASRI provides people living in and around Gunung Palung with the access and means to a livelihood outside of logging.



*Gunung Palung National Park as seen above ASRI’s clinic. Photo courtesy of Jocelyn Stokes.*

## Borneo and Gunung Palung National Park: Biodiversity Hotspots

The close interaction between nature and people is evident even before reaching Sukadana. The road into town is mercilessly bumpy, an amusement park ride through rainforest vegetation. Just beyond, the distinctive branchless-trunks of giant dipterocarp trees extend a hundred meters into the sky, exploding into a dense canopy shading the road from the afternoon sun.

Gunung Palung National Park (GPNP) and Sukadana are found on Borneo in the Indonesian province of West Kalimantan. As an island, Borneo is shared between Indonesia, Malaysia, and the tiny nation of Brunei. The Indonesian portion of the island goes by the name Kalimantan.

↘ *Appendix 1: Three maps featuring the area where ASRI operates*

One of the thousands of islands that compose Indonesia's 5,000 kilometer archipelago, Kalimantan is home to eight national parks. Gunung Palung National Park has tripled in size since it was first protected as a forest nature reserve in 1937, and is considered one of the best maintained examples of the primary lowland forest that once characterized the island.<sup>2</sup> Recognized as a national park in 1990, GPNP now covers 1,080 square kilometers along Kalimantan's western coast.<sup>1</sup>

The area holds a special place in the hearts of many conservationists. "Borneo as an island has one of the richest biodiversity levels in the world," says Mahardika Putra Purba, ASRI's Conservation Manager. "Some of the flora and fauna can also be found in Sumatra (another of Indonesia's islands) or Malaysia, but they were originally from here. That's what makes Borneo unique."

Putra Purba further explains that 80% of that biodiversity can be found within GPNP's boundaries. That includes 2,500 critically-endangered Bornean orangutans (*Pongo pygmaeus*), and the park remains one of the last remaining places where orangutans thrive in the wild. Other unique species join this list: endangered proboscis monkeys with their peculiar long noses, vulnerable clouded leopard and sun bear populations, and hundreds of species of birds, mammals, and other primate groups, several endemic to Borneo.<sup>3</sup> Much of the region's flora is also on the endangered species list, including many trees within the dipterocarpus genus—valuable tropical hardwood trees that form the foundation of Kalimantan's lowland forests.



*Gunung Palung National Park in West Kalimantan, Indonesia, is home to 10% of the remaining wild Bornean orangutan population. The name orangutan comes from two Bahasa Indonesian words: orang and hutan. The translation, "person of the forest," is an indication of the connection people feel to that species.*

<sup>1</sup> Based on a map drafted by the park in 2014.

## The Intertwined Nature of Human Health and Forest Health

<sup>ii</sup> Before moving ahead, what do you think these benefits are?

<sup>iii</sup> “Pak” is the respectful honorific used to refer to an adult man, the equivalent of saying “Mr.” in English. Many Indonesians only use one name, in this case, Sahmadi.

<sup>iv</sup> What microbes are primarily responsible for this high burden of disease and mortality? You will probably be surprised.  
↳ [Read more here](#)

<sup>v</sup> What do you think are the biological mechanisms at play here? Does soil play a role?

Rainforests provide invaluable health benefits for those living around them.<sup>ii</sup> There’s often a misconception that the people who exploit nature fail to understand the connection between environmental well-being and the health of their families. In many cases, this couldn’t be further from the truth.

Early on a Sunday morning, Pak Sahmadi<sup>iii</sup> stands on the beach in Sukadana. He’s preparing his boat for a fishing expedition, but for now he’s marooned on the shore, a pool of muddy water reflecting his blue and red craft, and the towering rainforest beyond. The morning is quiet, but Sahmadi says it wasn’t always that way.

“Before, I heard the sound of many chainsaws here,” Sahmadi remembers. “Usually in the morning I would see trees falling from where I stood.” The effects of logging became even more apparent when he would go to the rainforest to gather water. In the past, he says the number of drinking sources were declining, and many children were getting sick because of poor water quality. The water flowing into the villages around GPNP draws its source from three upstream watersheds.<sup>4</sup> The watershed supplying Sukadana and other coastal communities is facing an acute human-caused loss of its lowland dipterocarp forest, despite being classified as an area of High Conservation Value.<sup>5</sup>

Sahmadi’s observations linking the health of children in his village with water quality are not purely anecdotal. Research conducted in 35 countries, including on the Indonesian island of Flores, has verified that link, finding a higher level of upstream tree cover associated with a lower probability of downstream diarrheal disease for children under five.<sup>6</sup> The World Health Organization (WHO) lists diarrheal disease as the second leading cause of death for children in this age group, killing around 525,000 children annually. In total, there are an estimated 1.7 billion childhood cases globally each year.<sup>7iv</sup>

Preventing diarrheal disease is one of the ways in which forest ecosystems safeguard human health. They do this in two ways: “by displacing human activities that can pollute the watershed, or by filtering or diluting pollutants from areas of human activity.”<sup>8</sup> In other words, people are less likely to disrupt a watershed if they can’t access it, and if they do gain access, tree cover provides a layer of protection so pollutants have a lesser effect on people living downstream.<sup>v</sup>

The ability of Gunung Palung’s forests to regulate pollutants was tested by unseasonably high rainfall in 2017, which caused flooding in and around Sukadana. Many people blamed this event on the logged forests. The effect that land use and land cover change has on flooding in Indonesian Borneo was the focus of a 2016 study. It acknowledged that a major rainfall event can lead to flooding even in ecosystems that have not undergone land use and land cover change—the clearing of land through logging, for example.<sup>9</sup> However, the authors noted that natural land conversion can result in increased flooding risk. These risks originate from a loss of groundwater storage in deforested areas, erosion and sedimentation, and the role that man-made roads and footpaths play in channeling the direction and speed of water.<sup>10</sup>

When forests are intact, trees regulate heavy rainfall using their canopy and root systems. The canopy above prevents heavy rain from falling directly to the ground. When rain filters through the leaves, it reaches the soil at a rate in which it can be absorbed and stored by root systems. This helps prevent flooding. The 2016 study reported that flood frequency was less likely in watersheds with a greater level of intact forest, while villages within five kilometers of a logged forest recorded higher-than-average recent flood activity.

Past publications have directly and indirectly linked flooding to multiple health problems, including diarrhea, acute respiratory infections, skin infections, and non-communicable diseases.<sup>11vi</sup> Dr. Nurmilia Afriliani, a General Practitioner and former Clinic Director at ASRI says this was reflected in the clinic’s patient diagnoses after the 2017 flooding event: “there were cases of diarrhea and many bacterial skin infections because the water contained everything,” she remembers.

The services provided by forest ecosystems have added importance in rural, lower income communities where people are more vulnerable to the impacts of upstream tree cover loss.<sup>vii</sup> The aforementioned 2016 study of 35 countries found that 93% of people relying on surface water live in rural communities, making the effects of watershed degradation disproportionately impactful to these populations.

<sup>vi</sup> What are the mechanisms at play here?

<sup>vii</sup> Ecosystem services are widely discussed in the Chile-Aguas Andinas Case Study. Make sure you review this concept before moving forward.  
↳ [Learn more here](#)



*Pak Sahmadi on the beach in Sukadana, West Kalimantan.*

## Community Healthcare Access: A Multi-Layered Challenge

<sup>viii</sup> The area around Gunung Palung National Park is Kayong Utara Regency. Indonesia is divided into provinces, and sub-divided further into regencies. For example, Kalimantan has five provinces, including West Kalimantan where the ASRI clinic is located. West Kalimantan is divided into 14 regencies, including Kayong Utara Regency, of which Sukadana is the capital city. Kayong Utara is West Kalimantan's newest regency, and was created by the government in 2007.

<sup>ix</sup> What is the recommended ratio by the WHO? What is it in your country? Refer to the [WHO data here](#)

<sup>x</sup> How many people in your country are covered by health insurance? How many services are covered? What does this depend on?

<sup>xi</sup> Beyond having social insurance, what other factors determine your access to healthcare?

In the communities around GPNP, the outcome of past deforestation is already being witnessed: loggers and their families are the ones most acutely affected by the domino health effects of forest loss. As Mahardika Putra Purba, ASRI's Conservation Manager, points out, communities and forests can continue functioning after the effects of deforestation, but the impact won't go unnoticed: "Imagine you cut off one of your arms," Putra Purba says. "You can still live, but your activity will be limited. The balance of the ecosystem is completely disturbed."

The forests surrounding Gunung Palung National Park (GPNP) are home to many families. More than 107,200 people in 23 districts live around the park,<sup>viii</sup> and the population has grown steadily in recent decades.

Economic growth brought by industries such as oil palm and forestry have made a difference on the household incomes of rural Indonesian families. Today, 5.8% of the country's rural population (nearly 120 million people) live below the international poverty line of \$1.90 a day. That's a steep decline from 1984 when 80% of rural households fell into that category.<sup>12</sup> When it comes to healthcare, lower rural incomes are compounded by the country's doctor shortage. Kalimantan has one doctor for every 2,700 people. The doctor-to-patient ratio is much lower in the regency around Gunung Palung—approximately one general practitioner for every 10,700 people.<sup>13ix</sup>

In 2014, seven years after the establishment of Alam Sehat Lestari in Sukadana, the central government introduced a mandatory National Health Insurance in the aim of making medical care more accessible. The insurance program is overseen by an agency called *Badan Penyelenggara Jaminan Sosial*<sup>14</sup> (BPJS, the Social Security Administration for Health in English) and is slowly being phased in for all Indonesians. More than 222 million people<sup>15</sup> (about 85% of the total population) currently hold membership, making the insurance program one of the largest worldwide.<sup>x</sup> The government aspires to have all Indonesians covered, but challenges include government deficits,<sup>16</sup> large population numbers, and significant regional disparities in accessing resources and care.<sup>xi</sup>

BPJS health insurance coverage<sup>xii</sup> does acknowledge some of the socio-economic inequities that exist in the country. Less economically-fortunate Indonesians have their health insurance paid by the central government, which waives the cost of doctor's fees, minor procedures, and limited medications. In smaller villages and towns where appointments are available only with a nurse or general practitioner, patients can be referred to a free-of-charge hospital in what Indonesia classifies as a more advanced Type C, B, or A facility.<sup>xiii</sup>

Although implementing universal health insurance relieves many of the burdens of healthcare costs, it does not remove them all. For example, the insurance does not account for the expenses of accessing healthcare away from home: costs like transportation, accommodation, and food for a patient and at least one family member. "Getting referred to another medical facility is okay in big cities because everything is in the same area," says Dr. Afriliani. In Sukadana, however, she points out that patients need to travel 80 kilometers to access more advanced medical care. If they still can't be treated, the next level of care requires either a five-hour speedboat or hour-long flight to a larger city. Sometimes patients are even asked to travel to Jakarta for an appointment with a specialist. "Patients in critical condition sometimes refuse to get referred because they cannot pay," Dr. Afriliani explains.



<sup>xii</sup> Attracting more patients who are subscribed to a BPJS scheme is one of ASRI's future pathways to financial sustainability. As a healthcare provider, ASRI receives a monthly payment based on the number of BPJS patients who have listed the clinic as their primary care provider, regardless of whether a patient received care that month. As of time of writing, 1,000 BPJS patients had ASRI listed as their primary care provider, and ASRI aspires to grow that number to 10,000 patients in the next five years.

<sup>xiii</sup> Type D category medical facilities include small community clinics like ASRI, including ones that aspire to reach hospital status.

*Dr. Nurmilia Afriliani is the former Clinic Director at Alam Sehat Lestari (ASRI). She says a number of anthropogenic environmental changes have affected the health of the clinic's patients, including flooding and haze events.*

In other cases, physical access to even the first-tier of primary care is nearly impossible. Many villages outside of Sukadana are accessible only via four-wheel-drive, motorbike, boat, or a combination of the three. Prior to ASRI's establishment in 2007, residents of Sukadana had access only to a government health-clinic (*puskesmas*) which offered sub-par primary care and lacked a general practitioner. This remains the case in many smaller villages around GPNP.

Pak Sukri Sabar was the head of Pangkalan Jihing sub-village for 12 years. He remembers the story of a woman who experienced complications during childbirth. She was carried from her home and, after a full day of travel aboard two boats, was finally able to see a medical professional. "If we had not brought her to that place, she probably would have died," he says. Sabar recalls another time before the community had cell phone reception. They would bring a patient to the nearest large village only to discover the midwife wasn't working that day. Sukri Sabar's story is one example of how universal healthcare is true only in theory. In reality, the burdens of physical access and additional travel costs mean many Indonesians face significant barriers preventing them from utilizing universal healthcare coverage. Similar limitations affect rural communities worldwide.<sup>xiv</sup>

For people living in remote, low-income communities like Pangkalan Jihing, essential medical care could be attained through either a higher household income or infusions of quick cash. These monetary gains would help people afford travel to their healthcare provider, and pay for subsequent medications or procedures. Illegal logging was the most reliable way for community members to earn that quick cash.

Logging is deeply entrenched in Indonesian culture. Its roots stem back to the 17th century when the Dutch East India Company (DEIC) first took control of what is now modern-day Indonesia. Forestry policies from the Dutch colonial and post-Independence Indonesian governments favored the exploitation of forestry resources over conservation.<sup>xv</sup>

Indonesia gained independence from the Netherlands in 1945. Over the next 50 years, the country's forest cover decreased from 1.62 million square kilometers to 980,000 square kilometers.<sup>17xvi</sup> By the 1980s, Indonesia was the world's largest exporter of tropical hardwood, and forests were being unsustainably cleared.<sup>18xvii</sup>

Recent government policies indicate a greater shift towards conservation. A 2002 government regulation divided forests into three categories: conservation forests, protection forests, and production forests, with national parks and nature preserves falling into the first category.<sup>19</sup> In 2011 the government also issued a moratorium on new logging concessions.<sup>20</sup> That moratorium couldn't prevent illegal logging, however, and an estimated half of all Indonesia's timber comes from illegal, small-scale sources.<sup>21</sup>

Still, the World Resources Institute notes the incredible complexity and contradictory nature of Indonesia's forestry laws, with more than 1,000 bodies and individuals holding the ability to create new laws across many levels of government.<sup>xviii</sup> This complicates the monitoring and enforcement of illegal logging, including in the area around Gunung Palung.<sup>xix</sup> The effectiveness of negative incentives in curbing logging rates has not been measured.

National park regulations state that people living around parks can use the protected forest to obtain non-timber forest products. This includes collection of fruits and vegetables, water, and rattan—pliable palm stems used to create furniture and handicrafts. While non-timber forest products offer some value, logging has always been a lucrative activity, and local communities saw an opportunity to pay for their basic needs. Many secondary industries around the park, including wood processing and the sale of chainsaws, spare parts, and gas, were also dependent on the continuation of illegal logging.<sup>22</sup> Vested interests were everywhere.

Community surveys conducted around Gunung Palung National Park found other factors motivating community-based illegal logging.<sup>23</sup> For example, the transition from a bartering system to a cash-based economy meant people who had historically obtained goods through trading suddenly needed access to cash. There was also a movement away from traditional medicine collected in the forest, in favor of modern medical systems—all of which cost money. Additionally, the timber concessions that operated around the park closed by the late 1990s. This meant that villagers—now with greater access to chainsaws—had free-range to use their logging training and knowledge of waterway and road access to pick-up where the concessions left off. Some of the sawmills that had once processed wood from legal concessions switched to purchasing illegally logged wood.

<sup>xvii</sup> Where is Indonesian wood mainly exported? \ [Explore the chart here](#)

Visit \ [Global Forest Watch](#) to see satellite imagery of deforestation in Indonesia over the last 15 years.

<sup>xviii</sup> To learn more about the various regulations that govern production, protection, trade, and taxation of Indonesia's forests, visit the World Resources Institute's \ [Risk Tool](#). It includes summary descriptions of key forestry policy and links to the original regulations.

<sup>xix</sup> \ [Read more about the complexities of this issue here](#)

<sup>xiv</sup> The issues rural communities face in accessing primary health care is also discussed in chapter 5 of this anthology in the context of northeastern Madagascar.

## The History and Effects of Community-Based Logging

<sup>xv</sup> Why do you think post-colonial governments favored exploitation over conservation?

See: 1865 Forest Law and the Basic Forestry Law No. 5 1967, for instance.

<sup>xvi</sup> Who benefited more from this exploitation of hardwood?

Illegal as it may be, community-based logging had the potential to transform the average income of households around GPNP. Though logging provided families with quick cash, the supply chain was fraught with inequality. The amount individual loggers received—around USD \$20 per tree—was a fraction of the timber’s high market value. Logged trees purchased by a middleman were often sold to sawmills for twice the price paid to community loggers. From there, the timber reached the market where it was priced higher still and sold to meet local and national demand.

A study around Gunung Palung from the late 1990s found that 47% of households relied on logging as their primary source of income—a 71% increase in the seven years leading up to the time of survey.<sup>24</sup> When ASRI started its work in 2007, Kinari Webb’s calculations estimated that 1,450 households around GPNP were logging as their primary source of income.<sup>xx</sup> This figure came through self-reported community surveys, and the ASRI and Health In Harmony teams suspect the number was higher.

A bird’s eye view of GPNP offers a sense of the changing landscape. Nurul Ihsan Fawzi sits cross-legged on the floor and opens his laptop. ASRI’s Reforestation Program Manager and GIS Remote Sensing Analyst, Fawzi knows the park inside and out. He zooms into the area of Gunung Palung on the satellite layer of Google Maps. Zoom in enough and you see the orderly blocks that make up the unmistakable landscape of oil palm plantations. Move your eyes west of the park and you come across rice paddy terraces and other gardens, areas cleared for rubber, durian fruit, and chili growth. There are bare spots in the dark green patches that represent the park’s primary forest—land once covered in towering trees is now bald with anthropogenic grasslands. Fawzi used remote sensing data from Landsat<sup>xxi</sup> to calculate that the lowland forest in GPNP declined by nearly 40% between 1989 and 2017. The land dedicated to mixed plantations nearly doubled in the same time period, and mixed agriculture land use increased 33 fold, though still makes up a small portion of the park.<sup>xxii</sup>

*↘ Appendix 2, 3: Land cover change in Gunung Palung National Park from 1989 to 2017. Table / Maps*

While GIS mapping offers a bird’s eye perspective, hiking through the park also reveals the extent of land use change. Only three sections of GPNP are currently accessible by visitors. The nearest

is Lubuk Baji, a section of park a half hour’s motorbike from Sukadana. Along the way, the road passes through rice paddies, agricultural fields, and small sub-villages, all of which were historically forested areas.

Pak Muslianto is the park guide for the day. He leads the way through a quiltwork of fields, a handful of which are currently being scorched as a cheap and efficient way to prepare land for agricultural purposes.<sup>xxiii</sup> Pillars of smoke billow into the air, and the ashy land sits gently smoldering, waiting to be replanted. From here, it’s a transition through recovering grassland to reach the depths of the rainforest. Soon, it’s like someone has dimmed the lights and boosted the humidity. The vegetation underfoot becomes tangled and challenging to navigate—a web of roots, decomposing leaves, and scurrying ant trails. Walking is a slow and graceless task, and yet for many years this landscape was expertly navigated by men wielding chainsaws.

When it comes to trees, Lubuk Baji is both a graveyard and the site of new vegetation growth. Muslianto points out each tree that was illegally downed, using his hands to imitate the act of a chainsaw taking its final blow. The operations that downed these trees were a far cry from industrial production, and often involved villagers using traditional tools or chainsaws, transporting their timber via motorbike, bicycle, or river floats. Though small-scale in nature, the cumulative effect was a substantial environmental threat, contributing to the 40% decrease in forest cover that Fawzi mapped through satellite data.

As Kinari Webb learned during her first visit to Borneo, logging isn’t viewed through a simple lens of good or bad. A 2013 study from Borneo supports what Health In Harmony learned in 2007. It found that nearly half of people on the island approved of small-scale forest clearing if it was for their own direct use.<sup>26</sup> Interestingly, it also noted that 93% of people recognized the forest as either “very important” or “quite important” for their health. The seemingly contradictory data illustrates the complex relationship people have with the forest: despite the majority wanting it maintained, it was also seen as a source of economic value.<sup>xxiv</sup>

To combat illegal logging, Health In Harmony recognized the need for an intervention that considered the realities of people who wanted to live in peace with the forest but also use its timber to benefit their families.

<sup>xxiii</sup> Traditional shifting cultivation methods (also known as slash and burn) are a common practice in Indonesia, including in Kalimantan. This agricultural preparation method was a contributor to substantial peatland fires in 2015. The haze created by this event, and the subsequent health effects, are the topic of chapter 1 of this anthology.

<sup>xxiv</sup> For the case discussion, remember to look up general socio-economic data for Indonesia.

## Forest Cover Change Around Gunung Palung National Park

<sup>xx</sup> A logging household is classified as any household where one person has logged in a month.

<sup>xxi</sup> Landsat is a free collection of satellite imagery that has been compiled by the U.S. Geological Survey and NASA over the course of four-decades. The images are often used by agriculture, forestry, geology, and other sectors to identify land change over time. More information and data sets can be found on the [Landsat website](#).

<sup>xxii</sup> Mixed plantations include land that is converted for use as industrial timber, pulp and paper, or oil palm concession. Mixed agricultural land is composed of areas where food crops are grown, including rice and vegetables.



*Pak Muslianto appears miniscule amongst the giant trees in Lubuk Baji, the only publicly accessible section of Gunung Palung National Park.*

## Identifying an Intervention through “Radical Listening”

*xxv* These techniques fall broadly in the category of action/research methods called Community-based Participatory Research – or CBPR for short. Why are these methods important? Why are they useful? When should they be used?

That paradox presented an opportunity for Health In Harmony and ASRI. Ask anyone at either organization why their work has been successful and they’ll say it’s because the community proposed the solution that led to their approach.

To learn how goes back to ASRI’s founding in 2007, and Kinari Webb’s prior work in Kalimantan. Webb and the other ASRI founders knew their end goal was to conserve the rainforest around the park. What they didn’t fully understand were the drivers causing logging in the first place. In order to gain greater insight, the newly created ASRI team made the choice to “radically listen.”<sup>xxv</sup>

“Radical listening” doesn’t look any different than normal listening. In practice, 15 to 50 people take part in a radical listening session, and everyone sits in a circle at the same level. There are always two listeners, who, for trust and gender consideration purposes, are ideally both women. One of those two listeners should come from a religious or cultural background similar to participants, and one with an outsider’s perspective. They ask an open-ended question, like the one asked by ASRI listeners in 2006: “what would you need as a thank you from the world community so that you could protect this precious rainforest that you all are the guardians of?”

The answers, Webb says, rarely touched on a single sector. “As long as you give people a big enough container, they’ll bring all the issues: health, conservation, economics.” “Radical listening” is similar to the Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) approaches that became popular in the 1980s and 1990s. Both RRA and PRA were approaches used by outside groups to learn more about the lives and conditions of people living in rural settings.<sup>27</sup> PRA saw outsiders as facilitators, asking questions and learning from the people who lived in a place.

What Health In Harmony says is fundamentally different about its “radical listening” approach is its readiness to implement the solutions proposed by community members. “This is a different paradigm,” says Jonathan Jennings, Health In Harmony’s Executive Director. “We aren’t just listening to learn and extract, we are listening to drive solutions which we can then invest in realizing.” Webb says “radical listening” is inherently solutions-oriented: “It’s not asking people what the problems are—it’s asking them for the solutions and getting a consensus, which is a whole other step.”

“Radical listening” and a commitment to implement community solutions have been core values of Health In Harmony and ASRI since the very beginning. At the time of the radical listening sessions in 2007, ASRI was a lean start-up. The main office was Webb’s small home, where the team of five gathered each day to discuss which villages to visit. Pak Wilfirmus and his wife, Clara, were two of the original nurses who served as listeners for the first community meetings.

The approach was different from what Wilfirmus had encountered in previous NGO work. “We were just doing, never hearing the community, or even talking to them,” Wilfirmus describes of past experiences. “It’s different with ASRI—we are listening to the community and then we do something. That’s how the community approved and trusted ASRI, and we became the best healthcare option in this area.”

The nascent ASRI team spent 10 months systematically listening to all 23 communities around Gunung Palung National Park. “It’s possible that in those formal listening sessions there might have been bias in the solutions that the communities proposed so that they could protect the national park,” Webb admits, since they introduced themselves as medical professionals opening a clinic. But from her 10 years working with the communities around GPNP, she knew there was truth to the healthcare request. In later years when they did radical listening in other regions of Indonesia, the Philippines, and Madagascar they concealed the fact that they were medical professionals, but still often found radical listening sessions yielded requests for healthcare.

After more than 400 hours of radical listening sessions around Gunung Palung, community solutions became clear. The consensus was that people could stop logging if they had access to high quality, affordable healthcare and training in organic farming techniques—a request that surprised the team. With the community-driven solutions identified and permits secured, the ASRI clinic opened its doors for service.



*Pak Wilfirmus and his wife, Clara, were two of ASRI’s original team members.*

## A Win-Win for Human Health and the Rainforest

Today, ASRI's operations in Sukadana have grown significantly. The program employs a team of 100 staff members, a cohort that's entirely Indonesian, the majority of whom are women. The clinic sits along one of the village's main roads, and the large, bright building stands in contrast to the smaller houses and open shopfronts nearby. This newly-built clinic opened in October 2016, replacing the makeshift single-family home that housed ASRI for its first nine years.

Household surveys conducted between 2007 and 2017 exhibit measurable improvements in the health of people living around Gunung Palung National Park.<sup>xxvi</sup> These surveys were conducted in villages where ASRI had signed a Memorandum of Understanding agreement. MoU agreements mean ASRI works with those villages to offer conservation activities, tiered healthcare costs based on logging activities, education sessions, and livelihood trainings.

Individuals were asked to self-assess their health and well-being during the surveys. Analysis found there was a decrease in infant and childhood mortality rates during the 10-year period, and a drop in disease symptoms such as fever, persistent cough, diarrhea, and weight loss symptoms.<sup>xxvii</sup> Further analysis of this health data is currently underway in order to determine whether MoU-signing villages experience a greater improvement in health outcomes.

Offering affordable and high-quality primary<sup>xxviii</sup> care will remain ASRI's focus in the short-to-midterm period, which includes partnering with the new district hospital so it can utilize their expertise to offer more specialized services. A surgeon has recently completed his ASRI-funded residency and returned to Sukadana where he has been positioned at the district hospital. "The hospital has not had a surgeon since July 2019 and it is very hard to get a specialist who wants to stay in a small town like Sukadana," explains Nur Febriani, ASRI's Executive Director. "It is ASRI's contribution to the community." She adds that the surgeon will likely spend the afternoons at ASRI serving patients and training young doctors.

Meanwhile, ASRI continues to incorporate the values of nature and conservation into its clinic space. The spine of the building is a long, sunlight-flooded corridor with views onto garden courtyards. Beyond, the back half of the building houses ASRI's conservation office and space for training and volunteer accommodation.

Continue down the hallway and you can literally walk into nature—there is no door. Two hundred meters later you reach the rainforest and an unassuming log marks the spot where ASRI property ends and the national park begins.



*Today, ASRI is in its second home, a custom-built medical facility where patients can sit among nature. The hallways are open-air and gardens dot the property.*

<sup>xxvi</sup> Fankhauser, Katie. "Health in Harmony Impact Data." June 17, 2018; unpublished

<sup>xxvii</sup> Fankhauser, Katie. "Health in Harmony Impact Data." June 17, 2018; unpublished.

<sup>xxviii</sup> What is meant by "primary care" and "primary health care"? How are these different? Why is this difference important?

<sup>xxix</sup> Anthropogenic environmental shifts include human-produced air and water pollution, shifts in biodiversity, land use change, and more. In 2015, The Rockefeller Foundation and The Lancet released their Commission on Planetary Health. The Commission is the forefront academic resource shedding light on the many ways in which human-caused disruptions to the Earth's natural systems affect human health. ↘ [The Commission's documents can be found here.](#)

### Health Levers for Conservation

Planetary health examines the ways in which human health is impacted by human-caused disruptions to the Earth's natural systems. Within that definition is a feedback loop. Anthropogenic environmental changes affect the health of people.<sup>xxix</sup> But the health of people—the ability to be physically, socially, and mentally well, in addition to economically secure—also influences the way people interact with the natural environment.

This loop reiterates the interconnectedness of human health and environmental systems. It introduces the possibility of designing win-win planetary health solutions that recognize that a change in one system can trigger positive shifts within another. Ecological levers for public health are interventions in the ecosystem or conservation space that have positive outcomes for human health.

There are also health levers for conservation, such as Health In Harmony and ASRI's intervention. The theory of change was straightforward enough: by creating a dual conservation-health program, the organizations were able to improve human health and reduce deforestation of Gunung Palung's rainforests. While the lever-based framework offers a helpful way to envision the interplay between different systems, these links are not easy to prove or quantify. Monitoring impact across its diverse programmatic areas is one of the greatest challenges flagged by ASRI and Health In Harmony leadership.

In the case of Health In Harmony and ASRI's intervention, community surveys spoke of a 90% decrease in illegal logging households since 2007, down to a total of an estimated 150 households. However notable, the organizations want to confirm whether there was an actual decline in deforestation during that time period. Engaging a team from Stanford University, researchers are using satellite imagery and statistical inference to compare forest change rates in GPNP to that in all other national parks across Indonesia, during the period of 2007 to 2017. The Stanford team is also in the midst of assessing whether a decrease in deforestation could be attributed to community engagement with ASRI activities.

The next question the Stanford team asked was whether a decrease in deforestation could be attributed to engagement with ASRI activities. Engagement was defined as a person interacting with the clinic, or participating in conservation, education, and livelihood

activities. Data found that forest loss decreased in a dose-response ratio to the level of engagement. According to the team's paper, a "casual association between the intervention (including health, livelihood, and conservation programs) and ultimate deforestation outcomes is plausible."

### Planetary Health in the Clinic

For ASRI and Health In Harmony, the interplay between human health and conservation exists in daily practice. Collaboration among ASRI's multidisciplinary teams is a central value. Each workday starts with a morning meeting in the clinic's library. Medical staff sit next to conservation team members who chat up the ASRI economist who calls across to the garden landscaper. A pen is spun, and whomever it points to is in charge of taking notes and leading the meeting. Everyone is given an opportunity to speak and the day's activities are coordinated between the health and conservation teams.

"It really helps bring people together from a teamwork point of view," says Dr. Monica Nirmala, ASRI's Executive Director between 2014 and 2018. Coming from Jakarta with little exposure to environmental issues, Dr. Nirmala says she was surprised by what she learned, in part thanks to these meetings. "If we didn't have a morning meeting then maybe someone on the conservation team wouldn't know the nurses. It helps everyone to have the same planetary health perspective," she says. The morning meeting also works in a practical sense—staff can disseminate educational information, coordinate travel to pick up planting supplies or medicines, and ask questions, knowing that everyone who can answer them is in the same room and on the same page.

The fusion of conservation and healthcare extends beyond morning meeting. ASRI patients receive their medical check-up with a side of planetary health education. That includes planetary health presentations delivered by ASRI staff in the waiting room, as well as information directly from doctors. "I talk about nature with my patients, and tell them to open the windows on their home so that the air from outside can enter. And I try to make them understand how it can be harmful when they burn garbage," says Dr. Fitriyani Simangunsong, ASRI's new Clinic Manager and a general practitioner.

Clinic art further supports this dual education: photos of reforestation progress, maps of GPNP’s ecosystems, an illustration of a human body outlining what happens when the environment is healthy, versus when it’s not. There’s even a large banner of an orangutan with puckered lips, a favorite selfie spot for staff and visitors alike.



The scene from ASRI’s morning meeting.

## Designing an Intervention for Success: Affordability and Positive Incentives

Creating a planetary health intervention is one thing—maintaining its success is another. That’s where affordability and positive incentive measures come into play. Health In Harmony and ASRI have initiated a non-cash payment system to ensure people can always afford the clinic’s medical services. Meanwhile, the organization also offers a number of positive incentives to discourage people from logging while accessing care.

### Non-Cash Payments

It’s not far from ASRI’s seedling nursery that Pak Sebani sits waiting for his doctor’s appointment. He’s borrowed his neighbor’s motorbike to visit the clinic—he makes a modest income as a farmer, and can’t afford his own mode of transportation. Without ASRI’s non-cash payments, he wouldn’t be able to afford care, either.

Sebani is recovering from tuberculosis. Today, he’s suffering shortness of breath and pains in his stomach. In the past, he would drive two-hours to buy his medication. “We had a lot of costs when I did this. My daughter had to take a break from school because I got sick and we couldn’t afford the books and other school costs,” Sebani says. “The most important thing is the cost. But expensive medications are not a problem now because at ASRI you can buy them with other things.”

Tree seedlings have been Sebani’s payment of choice on two separate occasions. The seedlings are commonly grown by patients themselves using seeds foraged in the rainforest. These young plants are the non-cash payment most encouraged by ASRI, and carry the highest value. In-demand ironwood and meranti seedlings earn patients between \$0.70 and \$1.40, and are brought to one of ASRI’s reforestation sites. The goal is to have 10,000 seedlings “paid” by patients every year. Figures from 2019 exceeded that, with 23,146 seedlings received from patient payments.

Today, about one patient a week pays using a non-cash payment, though these are often the patients with higher bills.<sup>xxx</sup> The options are displayed on a large green poster outside the cashier till: requests for fertilizer, manure, rice husks, and egg shells, all of which are used in the ASRI-established organic farming cooperatives. Patients can even make handicrafts and barter with Nani Utari, ASRI’s cashier, in exchange for their visit fees. The average visit ranges from \$0.55 and \$2, and patients can bank extra non-cash value for later visits or emergencies. As was demonstrated

<sup>xxx</sup> A small percent of patients pay using non-cash methods, but they constitute a higher percentage of ASRI’s income.

in a shortfall with the national healthcare scheme, high quality healthcare can only get patients so far if it's prohibitively expensive and difficult to access. ASRI's non-cash payments help reduce some of these barriers.

### Village-wide Incentives

ASRI has also created an initiative to circumvent the rational behavior that would tempt families to access high-quality healthcare while continuing to illegally log. Since 2018, ASRI has been offering community-wide discounts to incentivize the curbing of illegal logging.

To begin, villages are color categorized based on the progress they've made towards ending the indicators of illegal logging. Assessed as either red, yellow, or green, villagers receive between a 30% discount (for red villages) and 70% discount (for green villages) applied to their healthcare bill. Administration of these discounts takes regular monitoring, and is overseen by Agus Supianto, ASRI's Monitoring Coordinator. Supianto visits villages three times a year, looking for any of seven negative indicators of illegal logging, including small sawmills and logging access routes. No indicators, and the village is green, more than three, and it's deemed red.

Supianto says the act of implicating an entire village in the actions of one or two loggers is key. "If we give punishment only to the logger then maybe the other villagers will not care about the forest because they have their discount," he says. "This category system makes caring for the forest the responsibility of all villagers, and they are the ones who give social punishment and pressure to the logger." This village-wide discount system has been identified by ASRI patients as the most important incentive to reduce illegal logging.

Despite being deemed effective, Agus Supiano, ASRI's Monitoring Coordinator, says villages regularly go back and forth between red, yellow, and green. He explains: "in the dry season the indicators of forest gardens could increase because people's crops aren't growing. In the rainy season the indicators can increase because the rain makes it easier for loggers to access forest areas, which makes transporting wood easier." Harvesting bird nests is another popular industry around West Kalimantan—bird nest soup is a delicacy in China. The harvesting is done in the multi-story, windowless buildings that line the roads. "Whenever there is a

spike in prices for bird nests more people try to build the houses to benefit," says Supianto. Illegal logging is a main source of building material. Finally, while one village may not exhibit any logging activity, Supianto admits that could simply be because individuals are logging outside of the park, their activity undetected by ASRI.



*Thousands of seedlings are stored behind ASRI's clinic in Sukadana. In addition to accepting them as non-cash payments from customers, ASRI also receives seedlings from children and teenagers who participate in their education program. Health In Harmony's recent [carbon offset program](#) also allows people living worldwide to purchase seedlings and support the organization's replanting efforts.*

## Livelihoods to End Logging

Seasonal spikes in logging activity meant that providing high quality healthcare alone wasn't going to be enough to protect the rainforest. When asked in 2007 what they needed to put down their chainsaws, community members said they wanted affordable and high-quality healthcare, and training in organic farming practices. The message was clear and reasonable: if loggers were going to permanently give up their main source of income, they needed to replace it with another.

This idea references a new framework that was developed by labor unions and the environmental justice movement. "Just Transition" is the term used to describe the shift between an environmentally-detrimental, extractive industry (such as logging) to more planet-friendly, regenerative economic activities. The framework was created in part to protect worker's rights, ensuring they had other meaningful work to turn to when their extractive job was eliminated. In West Kalimantan, Just Transition demands that an alternative work solution be introduced so loggers can maintain their household income and benefit from the transition away from logging.

Dr. Courtney Howard, a Canadian ER doctor and member of the Health In Harmony board of directors, spent a month in Sukadana in early 2018. Two months earlier, she had been in a very different setting, serving as a Canadian delegate to climate change negotiations at COP23. There, the importance of Just Transition was brought up in every meeting.

"I was thinking that the health community hadn't done a good job in addressing this transition, and I felt quite guilty," Howard recalls. "Then, I go from the center of the world conversation to rural Sukadana, where I'm watching a fisherman sign over his chainsaw in exchange for a small business loan. I'm sitting there thinking 'holy cow, ASRI has a giant Just Transition component in their community-based project.' I was blown away." Howard says Kalimantan was the first place she saw a Just Transition approach in practice, rather than in theory.



### The Time for Just Transition

As the world transitions towards more environmentally sustainable economies and industries, an important mission is to ensure the people whose industries and jobs are being transitioned don't get left behind. This has been a demand since the 1970s when the Just Transition concept was born during the US labor movement. The acknowledged father of the movement, Tony Mazzocchi, was a member of the Oil, Chemical and Atomic Workers' Union, and he established the movement to ensure the rights of workers were respected through the environmental and social movements that were taking place in the country.<sup>33</sup>

Whether it's men dependent on illegal logging in Indonesia, coal workers in America, or people employed by fossil-fuel dependent industries worldwide, the Just Transition movement was created to ensure those people had a voice and a job to turn to when their current position was deemed environmentally-defunct. In a way, the Just Transition movement draws from the lessons of Participatory Rural Appraisal and "radical listening," by putting the people who are affected by this transition in a place of power and self-determination. Just Transition is becoming a greater part of climate action policy worldwide. COP24 in Poland saw the creation of the Solidarity and Just Transition Silesia Declaration, signed by 50 countries, including Indonesia. That declaration recognizes that developing countries and their citizens are especially vulnerable to the adverse effects of climate change, and that conditions of poverty would make it more difficult for these communities to experience a Just Transition.<sup>34</sup>



*Pak Iskander and his family outside of their home.*

### From Logger to Alternative Livelihood

Former loggers aren't using terms like Just Transition, but they do agree that the opportunity to access an alternative source of income has helped them put down their chainsaw.

The afternoon light filters into Pak Iskandar's home in Penjajaan Village, illuminating a faint tinge of smoke and dust. School is out for the day, and there is a small huddle of children crouched in the front room. Four of them are Iskandar's children, and along with his wife, Ibu Suryati, and mother, Ibu Amah, there are three generations and seven people living in this modest wood home.

Supporting a family of any size costs money, and this household is no exception. That's why in 2000, Iskandar started logging the protected rainforest around his home. He had heard from friends that it was good money. "The money I earned was for the daily needs of my family: healthcare, school costs, clothes, food," Iskandar explains.

While many of his friends were caught and punished for logging, Iskandar never received a warning. The park rangers would often tell the village office they were planning a visit, and word got out to the loggers that a "guest" was coming to the forest. On these days, Iskandar would watch from the safety of his home as the rangers rode by on their motorbikes.

"I cannot blame the police rangers, and it's good that they asked us to take a break," Iskandar admits. "But if they ask us to have a break from cutting the trees then it meant my family would have a break from food. I didn't have another job and we still needed to cook." It wasn't that he didn't feel guilty. "Even though I did not steal someone's money from their house, I bought oil, I bought a chainsaw, and I knew it was stealing in the forest."

On one occasion, Iskandar remembers being surrounded by park rangers. Like a scene in an action movie, the officials were closing in from all sides. Spotting an escape route, Iskandar threw his chainsaw into the trees and bolted. When the park rangers left the village the following day, he trekked back, recovered his chainsaw, and resumed logging.

His attitude only recently shifted. For one thing, Iskandar's 12-year-old daughter, Ayu, started attending ASRI Kids, the organization's after school program. There, she learned how cutting down trees could cause floods, fires, and sickness, and about how important it was to protect wildlife. She brought that message home to her father, once, twice, many times. Eventually what she was saying struck a chord.

Ayu's pressure was paired with a visit from Agus Novianto, ASRI's Economist and head of the Chainsaw Buyback Program.<sup>35</sup> The Chainsaw Buyback Program is ASRI's approach to convert "last mile" loggers. Despite an 90% decline in logging households since 2007, the forest guardians counted a remaining 141 loggers in 2017. This correlated with the estimated 150 logging households from ASRI's 10 year survey in 2017. At this point, ASRI staff recognized they needed another solution, one that acknowledged the education level and economic well-being of families. Mindful of these social determinants of health,<sup>xxxii</sup> ASRI created an alternative livelihood program to help loggers experience a Just Transition away from logging.

Introduced in January 2017, the Chainsaw Buyback Program is a business development program for families. After five days of entrepreneurship training with Novianto, loggers and their wives have a business plan they can use to start or scale their enterprise, which is co-owned by ASRI. Including wives in the process is deliberate and important. "Usually at home it's the wife who manages the finances, and often even the business," Novianto explains. He says that while men might use the income to buy cigarettes, women are more likely to spend that cash on family needs. This fits in with another main principle of Just Transition framework, which is to use new livelihoods as a way to redistribute power and transform traditional gender inequities.<sup>36</sup>

The funds for the new family business come from two sources. Families are given approximately \$275 for selling their chainsaw, and can access another \$400 in zero-interest loans to support their new business. The entire amount is held by Novianto, who accompanies families to buy the supplies outlined in their business plan. Once the loan is paid off, the business is wholly owned by the family.

<sup>xxxii</sup> The World Health Organization defines social determinants of health as "the conditions in which people are born, grow, live, work, and age." It notes that social determinants of health are responsible for many health inequities, as they are shaped by the distribution of money, power, and resources.

For Pak Iskandar, the Chainsaw Buyback program has meant reconnecting with his former work as a fisherman. ASRI program data found that the most common livelihoods couples have transitioned to are those in retail, agriculture, and food and drink. Unlike the forest rangers or police who threaten loggers with arrest or punishment, Iskandar says he was drawn to ASRI's proposal of a solution. Hanging on the wall in his home are two hand woven nets awaiting their first use. Beneath is an insulated container for fish storage, and a box of hooks and lines. Parked outside is the motorbike he was able to repair with some of the money so that he could transport his catch. Down the road, the used boat he purchased has a new coat of paint. Ayu, Iskandar's daughter, looks pleased. "She wants to be a policewoman," Iskandar laughs, proudly pointing at the trophies she has won for academics and chess. "Luckily I already stopped being a logger!"

A consistency in income and a desire to transition away from a risky livelihood are factors former loggers say make ASRI's alternative livelihood programs attractive, even if they're bringing in less money overall. It's not just ASRI promoting the program to loggers—Novianto says forest rangers and police often present the Chainsaw Buyback Program in order to avoid conflict with the community.

Nowhere is the initial success of that program more evident than in a room at the ASRI clinic, where dozens of purchased chainsaws lie haphazardly on the floor, rusty blades in the air, surrounded by a dried puddle of oil. The plan is to turn these collected chainsaws into a number of monuments, as a memorial of sorts to the thousands of trees that were cut using the tools and as a testament to the new planetary health future of these communities.

*Agus Novianto stands carefully among the chainsaws that have been purchased as part of ASRI's Chainsaw Buyback Program. The program creates financial incentives for both men and women in a household, supporting them in the creation of a new livelihood.*



## Improvement and a Regrowth Approach

Despite successes like the Chainsaw Buyback program, ASRI and Health In Harmony face similar challenges to those of other organizations. One is the aforementioned difficulty in quantitatively linking improvements in health outcomes to a reduction in deforestation, as well as capturing other success metrics.

Resources are another challenge. A dual medical-conservation approach means resources have to be spread across a large and diverse team—positive for programming, but challenging for staff capacity. “I am the long boat [that travels down the river to monitor logging sites], I am the drone,” laughs Agus Supianto, referencing how he is the only ASRI staff member responsible for monitoring the forest activities in dozens of villages.



### ASRI's Forest Guardians

At the request of community members, ASRI launched its Forest Guardians (Sahabat Hutan) program in 2011 to help monitoring efforts. Based in more than 30 villages surrounding Gunung Palung National Park, Forest Guardians are the link between clinic and community. They're responsible for reporting illegal logging activity in their villages, and help ASRI staff members approach those loggers to discuss an alternative livelihood.

Many Forest Guardians are former loggers, and believe this makes them better at their job since they understand the motivations and realities of being a logger. That includes Pak Handayani, who had been logging the forests around GPNP for 26 years before being nominated to become a Forest Guardian. “At the time we were poor, and we didn't have other jobs or choices,” he says of his quarter century as an illegal logger. “Now we have a lot of jobs through ASRI so we can move from logging to something else.” In addition to working as a Forest Guardian, Pak Handayani is also a member of his village's ASRI-coordinated organic farming group. These farming groups are meant to produce food for family consumption and selling at market.

Pak Muslianto, the guide on the hike through Lubuk Baji, is another Forest Guardian. Before becoming a guardian, Muslianto was a long-time national park guide. Despite encountering loggers in the forest, Muslianto says he didn't have the courage or ability to stop them until he was trained as a Forest Guardian. “I learned how to approach the community. When I find loggers cutting down trees I've learned to not make them upset and offended. It's very helpful to persuade them with ASRI's programs,” he says. Since starting as a Forest Guardian, Muslianto has persuaded six loggers to put down their chainsaws and adopt an alternative livelihood.



*The view from Batu Bulan. The reforested corridor is visible on the right side, connecting Lubuk Baji with the main portion of Gunung Palung National Park. In the next ground-level photo, a concealed camera reveals that orangutans have again started to use the forest corridor.*

Lack of staff capacity is also felt by other members of the conservation team. Despite multiple people working on reforestation efforts, ASRI needs more data to inform its future strategy. That includes the development of more comprehensive indicators to identify illegal logging, and a forest inventory and map so the team can site-match seedlings with the conditions that support their growth. The latter, Conservation Manager Mahardika Putra Purba says, can come from improved collaboration with national park staff. ASRI has a long-running Memorandum of Understanding with GPNP, but Putra Purba says the organization would benefit from information sharing, as well as potential assistance in accessing government funds. When it comes to the indicators and drivers of illegal logging, ASRI is also proposing potential research areas with different organizations and universities.

### A Long-Term Outlook: Beyond Restoration to Reforestation

A main focus of ASRI's current five-year strategy—just one of the ways in which the sister organizations are closing the feedback loops that connect rainforest and human health.

Back on the hike with Pak Muslianto in the Lubuk Baji portion of Gunung Palung National Park, the climax of the multi-hour loop is the Batu Bulan viewpoint. Standing at the cliffside forest clearing offers a dramatic vista across to the primary forest that makes up the majority of the park. Until recently, the rainforest between Lubuk Baji and the rest of the park was disconnected by a band of rice fields. Today, one of ASRI's reforestation sites is dedicated to reconnecting these two portions of park, creating an orangutan corridor in what was previously sparse forest and grasslands. In addition to focusing on key areas like the orangutan corridor, the reforestation projects also target areas that have been heavily logged and burned to grassland, places where natural recovery is less likely. Alongside two other reforestation sites, the organization has replanted 1.6 square kilometers of degraded or deforested areas since 2007. It's aiming for 4.8 square kilometers over the next five years. This area is small when compared to the huge areas that are deforested each year, but it's a start.

Community members are in favor of reforestation. In fact, it was what people asked for as part of a 10-year radical listening check-in. One of the reasons for that request, ASRI suspects, is that people now better understand that replanting efforts also bring jobs, and that healthy forests supply fruits for harvest and protect water supply.



### Funding the Future

ASRI's reforestation work is also a strategic move to access grants. Reforestation is currently a popular funding area—by using conservation grants to buy seedlings from patients for reforestation efforts, ASRI is indirectly using environmentally-oriented grants to fund medical care. The team says it's a workaround since many grants and other traditional funders still dole out money using a single sector approach.<sup>xxxii</sup>



<sup>xxxii</sup> How can planetary health organizations like ASRI and Health In Harmony overcome the challenges of single-sector funding? What are ways foundations and grantors could adapt their system to acknowledge the need for holistic approaches?

*Etty Rahmawati speaks to a group of preteens as part of the ASRI Kids program. The sessions cover a range of topics, from the effects of climate change to plant identification to the importance of not littering.*

Education is at least partly responsible for this attitude shift, and it's an element that unites Health In Harmony and ASRI's medical, conservation, and livelihoods approach. Community outreach is central in that learning campaign. That's why every second Wednesday, a handful of team members pile into a car to give a presentation to a community that may not have had the chance to hear about ASRI's programs.

Crucial, too, are ASRI Kids and ASRI Teens, after school programs like the one attended by Ayu, the daughter of former logger, Pak Iskandar. While education has been part of Health In Harmony and ASRI from the beginning, the term "planetary health" has only been actively incorporated in the past few years. "I think the community is aware of the benefits of the forest, but they don't get that it really affects your health a lot," says Etty Rahmawati, ASRI's Planetary Health Education Manager. "Our outreach is about making them draw that connection to the next level."

ASRI surpassed its 10-year mark in 2017. Now, Health In Harmony is replicating that model worldwide—taking the successes and lessons learned from Sukadana and applying them in other similar contexts. “This means high conservation value areas where human health and well-being barriers are driving ecosystem degradation,” says Jonathan Jennings, Health In Harmony’s Executive Director. In 2018, Bukit Baka Bukit Raya (BBBR) National Park on the border of Central and West Kalimantan provinces became the organization’s first replication site. The Health In Harmony also began work in 2019 in rainforests as far away as Madagascar and will likely begin in the Brazilian Amazon in 2020. In all of these sites, the radical listening methodology is being used to create a community-driven planetary health solution that takes local challenges into account.

Kinari Webb, Health In Harmony’s Founder, acknowledges its interventions will always be multi-sectoral, though they may need to shift depending on what the team hears. They haven’t yet visited a site where health was not one of the needs. “We have done a first round of “radical listening” in Madagascar and found that food security was a much bigger issue than it is in Indonesia,” she says. “Health and hunger are clearly both major drivers of logging.”

While the intervention in Borneo is an example of a health lever for conservation, future replication sites could hone in further and adopt a ‘livelihoods lever for conservation’ or ‘food security lever for conservation’ approach. This possible adaptation demonstrates the need to localize even proven planetary health solutions. Regardless of the lever at play, the value of interconnectedness remains: an improvement in one system can have co-benefits in many others.

In Webb’s 2016 TEDx talk<sup>xxxiii</sup>, she shares the story of Pak Nasir, a logger since the age of 12 who once cut down dozens of trees to pay for a family member’s caesarean section. Some elements of Nasir’s story remain the same: he still lives in Sukadana, a few minutes from the ASRI clinic. But outside his home today is a small storefront. Stocked with packets of instant coffee and shelled peanuts, Nasir and his wife opened the shop in 2017 in partnership with ASRI’s Chainsaw Buyback Program. He no longer needs to log the forest to make quick cash, and in turn gets to spend more time with his family. Nasir’s story has come full circle.

<sup>xxxiii</sup> ↘ [Click here to watch Kinari Webb’s TEDx talk](#)

Ultimately, Health In Harmony and ASRI’s interventions are unique to this context. In West Kalimantan, the organizations’ “radical listening” sessions identified the need for affordable, high quality healthcare, alternative livelihoods, conservation education, and a switch from deforestation to reforestation. The combination of planetary health interventions will most certainly look differently for those working elsewhere. However, the methodology for effectively working with communities is universal: ask, listen, and act.

This co-creation of solutions between outside groups and communities is gaining momentum worldwide. While experts have found that many of these interventions have yet to eliminate systemic issues, they note that, they note that co-creation has the potential to break the status quo of how companies, non-profits, and other groups serve and collaborate with communities. Interdisciplinary research in this space has identified five best practices shared by groups who are changing how they work with people. They include finding ways to share power, prioritizing relationships, and legitimizing different ways of knowing.<sup>37</sup> Utilizing these learnings, planetary health practitioners can partner with community members to identify their needs and design human-centered innovations that make a real impact. In doing so, these solutions can further validate Health In Harmony’s theory of change: that it’s possible to conserve and regenerate the world’s most biodiverse ecosystems by respecting the realities of people living within them.



*Pak Nasir and his daughter outside of their home and storefront.*

## Keeping Track of Who's Who

### Dr. Nurmilia Afriliani

General Practitioner and former Clinic Director, Alam Sehat Lestari (ASRI);

### Dr. Monica Nirmala

Executive Director of ASRI from 2014-2018

### Pak Sahmadi

A resident of Sukadana and a Forest Guardian with ASRI

### Dr. Fitriyani Simangunsong

General Practitioner and Clinic Manager at ASRI

### Nurul Ihsan Fawzi

Reforestation Program Manager and GIS Remote Sensing Analyst, ASRI

### Agus Novianto

Economist, ASRI

### Pak Sebani

Former MBA student at the Middlebury Institute for International Studies at Monterey; Member of the business development team for The Upstream Alliance

### Agus Supianto

Monitoring Coordinator, ASRI

### Nur Febriani

Executive Director, ASRI

### Mahardika Putra Purba

Conservation Manager, ASRI

### Pak Sukri Sabar

Former head of Pangkalan Jihing sub-village, one of the communities where ASRI operates

### Dr. Kinari Webb

Founder of Health In Harmony and Co-Founder of ASRI

### Dr. Courtney Howard

Canadian ER doctor and member of the Health In Harmony board of directors

### Pak Muslianto

CEO of Station d'Innovation Aquacole; Executive Board Member with The Upstream Alliance

### Pak Wilfirmus

A nurse at ASRI and one of the organization's original team members

### Pak Iskandar

Farmer and resident of Maka Diama

### Pak Nasir

Former logger and resident of Sukadana, participant in ASRI's Chainsaw Buyback program

### Etty Rahmawati

Planetary Health Education Manager, ASRI

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Pak Muslianto appears miniscule amongst the giant trees in Lubuk Baji, the only publicly accessible section of Gunung Palung National Park.

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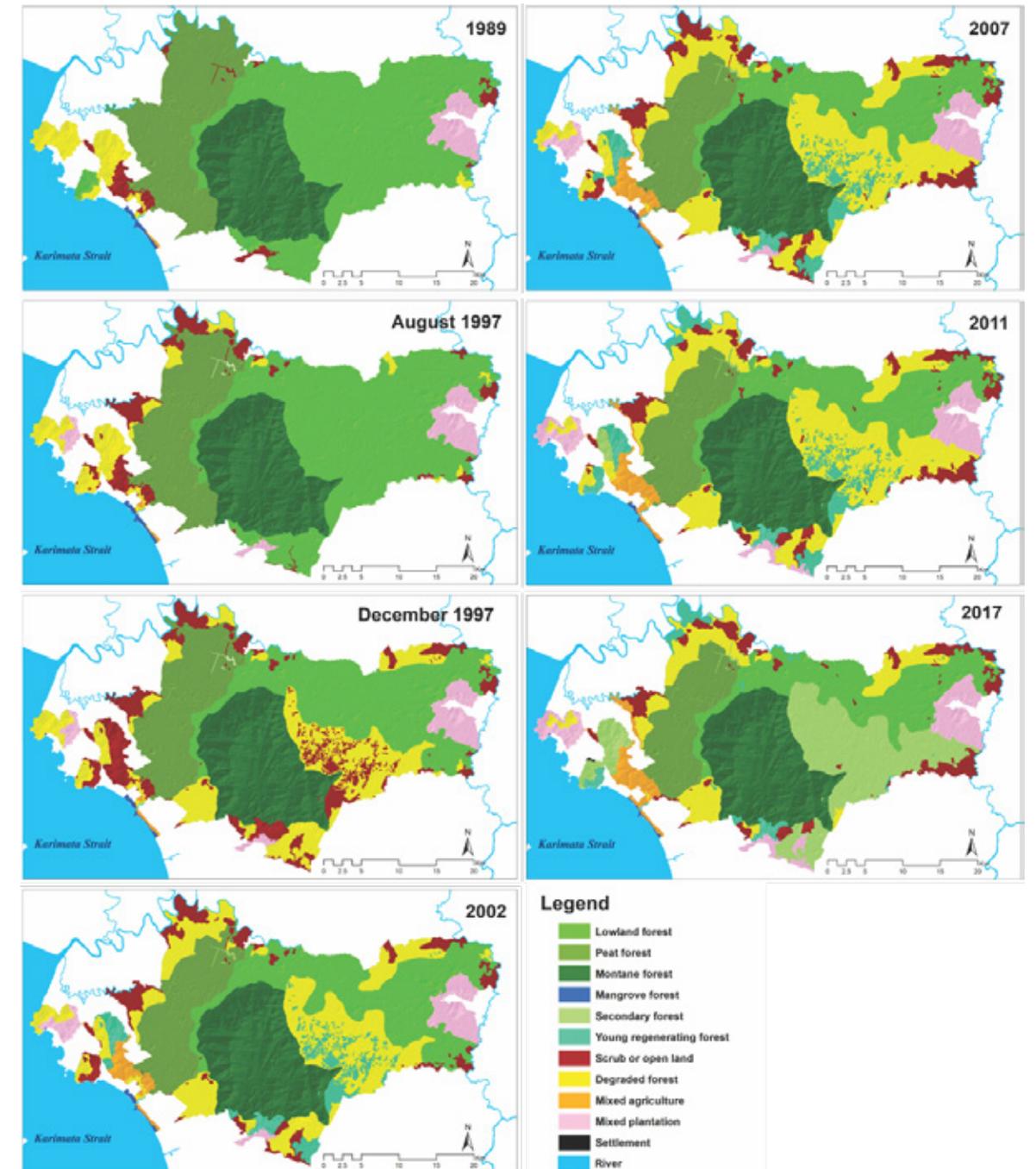
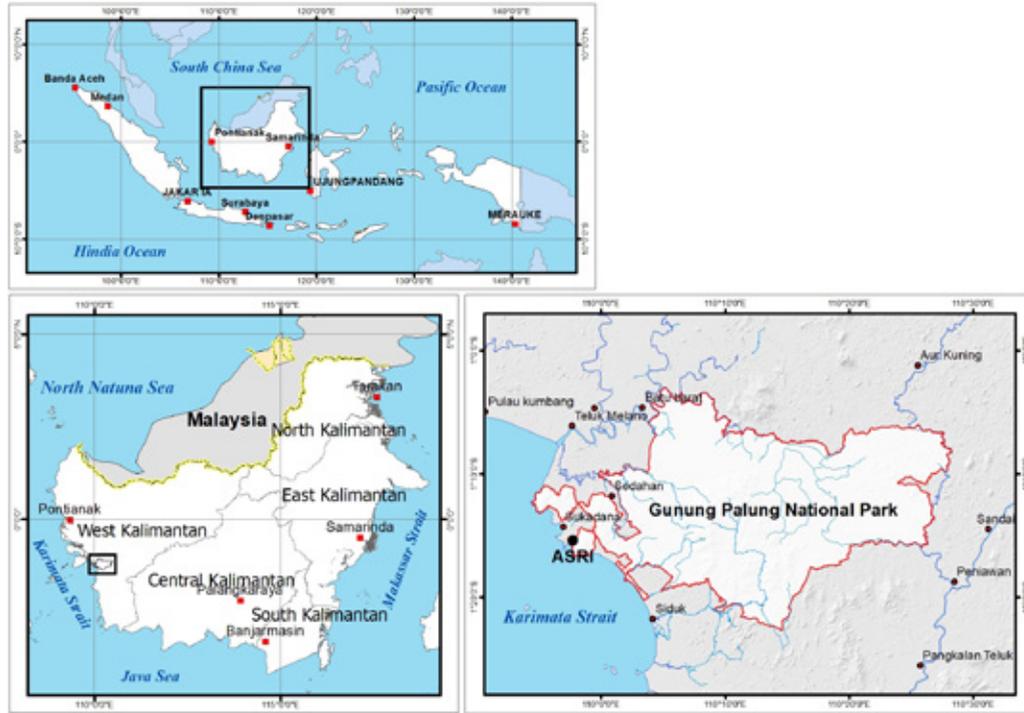
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Land cover change in Gunung Palung National Park from 1989 to 2017 (in hectares)

No	Land use	1989	Aug-97	Dec-97	2002	2007	2011	2017
1	Lowland forest	48,741.55	46,921.43	28,360.32	24,060.45	19,579.92	19,436.93	19,125.77
2	Peat forest	24,561.19	19,892.65	17,244.91	14,085.23	13,366.52	13,265.14	12,951.78
3	Montane forest	22,790.20	22,790.04	22,200.86	22,149.86	22,126.82	22,126.82	22,126.82
4	Mangrove forest	311.91	311.91	213.78	213.78	196.96	169.62	118.04
5	Mixed agriculture	83.30	136.96	235.08	1,800.03	2,330.43	2,479.78	2,764.48
6	Mixed plantation	3,653.29	4,714.56	4,714.56	5,192.37	5,332.56	6,346.62	6,842.24
7	Scrub or open land	2,807.31	6,243.31	14,017.88	7,607.28	8,800.11	7,068.74	7,097.09
8	Degraded forest	5,063.86	6,889.85	20,913.32	26,523.77	29,821.87	28,756.91	11,107.40
9	Young regenerating forest	0.00	111.90	111.90	6,267.93	6,345.52	7,621.28	2,517.68
10	Secondary forest	0.00	0.00	0.00	111.90	111.90	740.76	23,330.37
11	Settlement	0.00	0.00	0.00	0.00	0.00	0.00	30.96
<b>Total</b>		<b>108,012.61</b>						

# Going Circular

HOW RESTORING A RIVER ECOSYSTEM  
IN CHILE'S CAPITAL CITY HAS BENEFITED  
HUMAN HEALTH AND ECONOMICS

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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## Executive Summary

For further detail on themes covered in this case study, see the water section of chapter 4, chapter 6 on infectious disease, chapter 9 on mental health, chapter 13 on healthy cities, and chapter 16 on the business of planetary health of [Planetary Health: Protecting Nature to Protect Ourselves](#).

### Learning Objectives

*After examining this case, in the context of Santiago, Chile, students should be able to:*

- ① Recognize the challenges of urbanization in the context of a changing climate with regards to water use and wastewater.
- ② Evaluate the linkages between water, water security, water governance, and health.
- ③ Assess how circular economy principles can be beneficial in the face of planetary health challenges.
- ④ Apply co-benefit strategies to advocate for planetary health solutions.

The Mapocho River running through Santiago, Chile's capital city, was a literal sewage dump for decades. The pressures of urbanization were taking a toll on the city's water resources. Outbreaks of typhoid fever, cholera, and hepatitis A were common as Santiago residents consumed crops irrigated by river water teeming with household waste. In 1999, less than 3% of Santiago's wastewater was treated. That year, Chile privatized its water resources in order to increase the capacity and efficiency of wastewater management. The bid for Santiago's water services went to Aguas Andinas, now Chile's largest water utility company.

Twenty years later, the Mapocho is unrecognizable. Between 2000 and 2015, Aguas Andinas increased wastewater treatment to 100%, a change that has contributed to improved health outcomes for the city's residents, a revival of the river's aquatic plant and animal species, and the creation of new green spaces. In 2017, the company also adopted a circular economy approach in its operations. This approach is characterized by its cyclical reuse of resources and byproducts that may otherwise have gone to waste.

By turning its two largest wastewater treatment plants into "biofactories," Aguas Andinas has increased its energy self-sufficiency and created a valuable suite of products from treated sewage that would have previously been sent to landfill—all while demonstrating that a circular economy model is better for the company's bottom line and for climate change resilience.

*This case study is based on interviews conducted in Santiago, Chile, in May and June 2019.*

## Introduction

It feels more like a place for a leisurely picnic than the site of a sewage treatment plant. Paulina Vicentela walks towards the edge of the lagoon and gestures at the black-necked swans gliding along its still surface. One of the 170 species of birds found in this lagoon, she notes. It's autumn in the southern hemisphere, and the air smells faintly of decomposing leaves.

If this serene lagoon seems like an unusual site so close to Santiago, Chile's capital city, more unexpected still is its genesis on this spot and the owner of the land. Continue up the road around the lagoon and you reach the property's main tenant: La Farfana, one of the largest wastewater treatment plants in Latin America. Wastewater is anything that goes down the drain, from flushed toilets to kitchen dishwasher to laundry liquid.<sup>i</sup> While wastewater treatment plants don't typically attract visitors, two big buses have just pulled up at La Farfana's main entrance. The university students starting their visit today join the more than 9,000 visitors who have come to tour the plant since 2018. Through the glass windows of the front reception they can be seen reading colorful information panels and getting a dizzying aerial view of the plant using a set of virtual reality goggles.

La Farfana is one of three *biofactorias* (biofactories) in Santiago. This site and La Farfana's partner biofactories, Mapocho-Trebal and El Rutil, are owned by Aguas Andinas, Chile's largest wastewater company. Aguas Andinas oversees the household water supply for 85% of Santiago's residents.

Utilizing its three biofactories and a series of 10 other small plants, Aguas Andinas treats 100% of Santiago's wastewater. This is a relatively new accomplishment for the city and the continent. At the cusp of the new millennium, wastewater treatment levels in the capital city sat at less than 3%. Raw sewage from household and industrial waste poured directly into the Mapocho River, the waterbody that runs through the center of Santiago. That polluted water came at the detriment of environmental and human health, disrupting the river ecosystem and contributing to outbreaks of enteric disease among Santiaguinos.<sup>ii</sup>

<sup>i</sup> Wastewater can also go by the term gray water.

<sup>ii</sup> Enteric diseases are those caused by intestinal infections.

Paulina Vicentela is the Chief of Resource Management of Biofactories at La Farfana. She explains that the biofactories don't only treat wastewater—they also give it new life. Biofactories use a series of biological processes to transform sewage sludge into useful resources, including biogas to power the plants themselves and surrounding homes; fertilizer for local farmer's fields; and sanitary water that can be safely used for irrigation. This *modus operandi* where resources are recycled and reused in order to extract maximum value and minimize waste is a business model called the circular economy. In addition to reducing Aguas Andinas' carbon footprint, the biofactories have demonstrated that the bold changes needed to protect planetary health can also be the best strategic move for a company's bottom line.

Making its operations circular is one of Aguas Andinas' key sustainability strategies for the future. With the scientific community predicting increased water insecurity internationally, Aguas Andinas' circular economy strategy and emphasis on planetary health present a progressive model for private sector industries worldwide.



*Paulina Vicentela, Chief of Resource Management of Biofactories at La Farfana, stands next to the lagoon nearby the plant.*



*An aerial view of the lagoon that was constructed adjacent to La Farfana biofactory. Aguas Andinas was required by legislation to compensate for the land and ecosystems that would be displaced by the construction of the wastewater treatment plant. Instead of purchasing land elsewhere or opting to buy green bonds, the company decided it was important to keep animal species near their original habitat.*

## Santiago: Growing City, Contaminated River

Santiago sits in the bowl of a valley, and on a day free of smog you can see foothills and the Andes Mountains rising from its outlying neighborhoods. The city is the capital of both Chile and the Metropolitan Region, one of the country's 16 administrative regions. Santiago is the most populous city in the country, and has grown from 380,000 people in 1907 to 6.5 million in 2019.<sup>1</sup> That constitutes over a third of the country's total population. Throughout Chile, 90% of the country's population now lives in urban centers compared to 58% in 1950.<sup>2</sup> Politics have contributed to this shift from rural to urban, namely the centralization of services in Santiago as part of a multi-decade military regime that ended in 1990. Chile has experienced rapid economic growth since then, and today its economy is one of the fastest growing in Latin America.<sup>3</sup>



### Chile's Political Past

Chile's political past greatly shaped the country, especially the period between 1973 and 1990. In 1973, Augusto Pinochet became the leader of a military government. One of his priorities was centralizing the country's resources. He was assisted by the natural geography of the country—Chile extends 4,270 kilometers from north to south, marginally less than the width of continental U.S. Communities in the north and south are geographically isolated, with distinctive climatic and industrial conditions. During Pinochet's military government, Santiago was the priority for government spending on infrastructure, health, and social programming. A supporter of neo-liberal policies such as lessened government control and free market economics, this period in Chile's political history saw the privatization of many essential services, including water. This privatization remains controversial today.

Environmental challenges are imminent threats to this prosperity. In 2017, the Global Climate Risk Index ranked Chile as number 16 on its list of countries most likely to be impacted by climate change. Risk has increased substantially—in the two previous decades, Chile's average ranking on the index was 94.<sup>4</sup> At a more local scale, Santiaguinos have identified the urgency of environmental stressors. A survey conducted as part of the city's March 2017 resilience strategy elaborates on citizen concerns such as air pollution, lack of green space, and the management of solid waste.<sup>5</sup> At the time of its release, the governor of the Metropolitan Region went so far as to tell *Reuters* that “Santiago is a city of disasters – we have had in the last year the worst fires ever, we had two floods in the city (and) two important water supply cuts.”<sup>6</sup> Exacerbated by inequality and corruption, the city's resilience strategy was clear: environmental challenges pose a dire threat to Santiago and its residents.



Recent events and weather trends support that statement. An 8.8 magnitude earthquake in 2010 shook Santiago. The quake and the tsunami it triggered caused more than 500 fatalities.<sup>7</sup> In January 2017, the worst wildfires in Chile's history scorched through the country. It drove home the findings of a study from the previous year documenting that Chile's wildfire frequency had been on the rise since 1985. The authors found that “climate conditions and problems of human pressure,” including poor land use management by forestry companies, were two of the main factors contributing to that increase.<sup>8</sup>

Then, there's the issue of water—be it too much at once or the threat of future scarcity. Trends have already demonstrated a rise in temperature in the Andes Mountains, where most of the country's water resources are stored, including for Santiago.<sup>9</sup> Higher temperatures in the mountainous regions translates to less snow and glaciers to serve as water reserves in dry summer months. Precipitation levels are also projected to decrease, and the World Resources Institute (WRI) ranked Chile as one of the most

*The skyline of Santiago, Chile, featuring the central placement of the Mapocho River*

iii How is water security defined?  
↳ [Review the UN Water infographic here](#)

iii ↳ [Learn about the WRI and their work on water here](#)

iv What do you think drives increased water demand globally?

water stressed countries worldwide.<sup>iii</sup> Water security is already an issue in present-day Chile, and WRI suggests that stress will increase further still, reaching extremely high levels by 2040.<sup>10</sup> These challenges pose a threat to Chile's rapid economic growth, as an estimated quarter of the country's GDP is dependent on water intensive industries such as mining, agriculture, forestry, and manufacturing.<sup>11</sup> Water challenges are not faced by Chile alone. Global demand for water is expected to outpace supply by 40% over the next decade, which will create severe water stress for nearly half of the world's population.<sup>12</sup><sup>iv</sup>

Closer to Santiago, conditions are already changing. Droughts in the Maipo Valley followed by periods of heavy, sudden rainfall have triggered landslides that have flushed mud into the Maipo River, the intake source of Santiago's drinking water supply.<sup>13</sup> Ironically, the increasing occurrence of flash floods is paired with the forecast of long term water shortages. Studies predict a 12% drop in average monthly flow in the Maipo River between 2035 and 2065,<sup>14</sup> putting a serious strain on water supply for Santiago's growing population. While water supply will be a defining challenge for Santiago in the coming decades, the city has long had water concerns of another nature.

A close-up of the Mapocho River in 2019. Much of its original flow has been diverted upstream.



### A Contaminated River

Patricia Arroyo Meneses has many childhood memories of the Mapocho River. She remembers the natural flow of the river, and boats sailing through the city. Then, there were the floods: torrents of water that would surge the banks of the river and sweep through the streets of Bellavista, the neighborhood where Meneses was born and raised. "The flood even reached our home two blocks from the river. I remember seeing the water. It was black and very dirty with a lot of waste from the mountainside," she says.



Now 59-years-old, Meneses has spent the better part of her life working at La Vega, Santiago's largest fruit and vegetable market on the northern bank of the Mapocho River. The Mapocho is a tributary of the Maipo River, which rises on the western slopes of the Andes. An essential source of water, the Maipo supplies up to 90% of the drinking water for Santiago<sup>15</sup> as well as irrigation water for surrounding agricultural fields. That has proven problematic in the city's past.

*Patricia Arroyo Meneses has been working at La Vega vegetable market since she was a child in the 1970s. She has witnessed many changes in Santiago, from shifts in government to ones pertaining to the cleanliness of the river. Like many vendors here, Meneses remembers a time when they needed to rinse vegetables with chloride before they could be sold or eaten.*

By the 1980s, rapid urbanization was impacting the cleanliness of the Mapocho and the health of Santiaguinos. Rivers in this part of Chile are naturally clean, originating high in the mountains and flowing for relatively short distances before emptying into the Pacific Ocean. This was historically the case with the Mapocho, says Manuel Contreras, Executive Director of El Centro de Ecología Aplicada, a Santiago-based environmental consulting group. That water purity, Contreras says, was negatively affected by the pressures of rural-urban migration. “When the population grows, particularly in a city like Santiago, the load of contaminants in the river increases. That was the situation of the Mapocho River,” Contreras says. “There was a bigger demand on water, and a larger load of materials being disposed in the river. At the beginning it was wastewater and organic material, and then it was industrial contaminant. The water supply was stressed.”

Increased contamination of the river was also connected with Santiago’s efforts to increase household sewage collection. By 1991, 87% of Santiago homes were connected to a sewage collection system<sup>16</sup> operated by Empresa Metropolitana de Obras Sanitarias (EMOS), a public utility. Increased sanitation access is an indicator of improved health worldwide, but in the case of Santiago, sewage collection did not equate to sewage treatment. One chemist articulated the problem particularly well: “[sewage collection] merely removes the bulk of our excreta from our houses to choke our rivers with foul deposits and rot at our neighbors’ door.”<sup>17</sup>

That chemist was onto something. Soon, the Mapocho River that market vendor Patricia Arroyo Meneses remembers was no longer, and she was presented with another sight and smell: the city’s household waste. Santiago’s wastewater discharged directly into the river, and the Mapocho became an open sewage dump. Waste poured in at a rate of 13.3 cubic meters a second,<sup>18</sup> an Olympic swimming pool worth of sewage every three minutes. EMOS was responsible for producing and distributing clean water and collecting wastewater in Santiago, but treatment was nonexistent.

The open disposal of sewage was a problem for local irrigation as well. After flowing through Santiago, the mixture of river water and sewage was used to irrigate 1,300 square kilometers of agricultural land in the Metropolitan Region. This included 70 square kilometers of vegetable crops that would be consumed raw from La Vega and Santiago’s other markets.<sup>19</sup> This isn’t unusual—fields worldwide

are still irrigated with wastewater.<sup>20</sup> The difference, however, is that higher income countries often treat that wastewater first.<sup>v</sup> Compare that with Chile in the 1980s and 90s when wastewater was being used, untreated and sometimes unplanned, to water the crops that would feed a growing population. The public health implications were substantial.

Tests of irrigation water in 1983-84 found evidence of *Salmonella enterica serovar typhi* in 10% of samples.<sup>21</sup> *Salmonella typhi* is the bacterium causing typhoid fever, an infectious disease contracted through contact with contaminated water and food. Between 1977 and 1985 Chile faced the largest typhoid epidemic in Latin America, despite the country having the best health indicators in the region. This included a higher life expectancy and reduced rates of maternal and infant mortality.<sup>22</sup>

The highest incidence rates of typhoid were found in the region that includes Santiago, even though the city had a better sanitation system than the rest of the country. At its peak in 1983, typhoid incidence in Santiago was 219 cases per 100,000 people. High prevalence rates were representative of a broader trend in Latin America which, during this decade, experienced some of the highest rates of typhoid worldwide.<sup>23</sup>

Urbanization had led to greater water demand and more waste entering the river—it also increased the number of people in close proximity who could contract disease.<sup>24</sup> Dr. Sandra Cortes, a public health epidemiologist at the Pontifical Catholic University of Chile, says there were other contributors to the high prevalence of disease, including the country’s political climate. “Everything related to environmental control was not a priority from 1973 to 1990,” says Cortes of the past government. Unemployment conditions and a lack of health services intensified the spread of disease from contaminated irrigation waters. Not limited to one disease, the typhoid epidemic was compounded by a cholera outbreak in 1991 and cases of other enteric infections such as hepatitis A.<sup>vi</sup>

As Patricia Arroyo Meneses recalls, the connection between the spread of disease and agriculture wasn’t good for market business. “Customers started asking for sanitary approvals before they would buy our vegetables,” she says. “We would have to wash our vegetables with chloride diluted by water.”

<sup>v</sup> A study found that as per capita income increases, a country progresses from using untreated water to treated.

<sup>vi</sup> Beyond infectious diseases, how can contaminated rivers affect the health of populations?

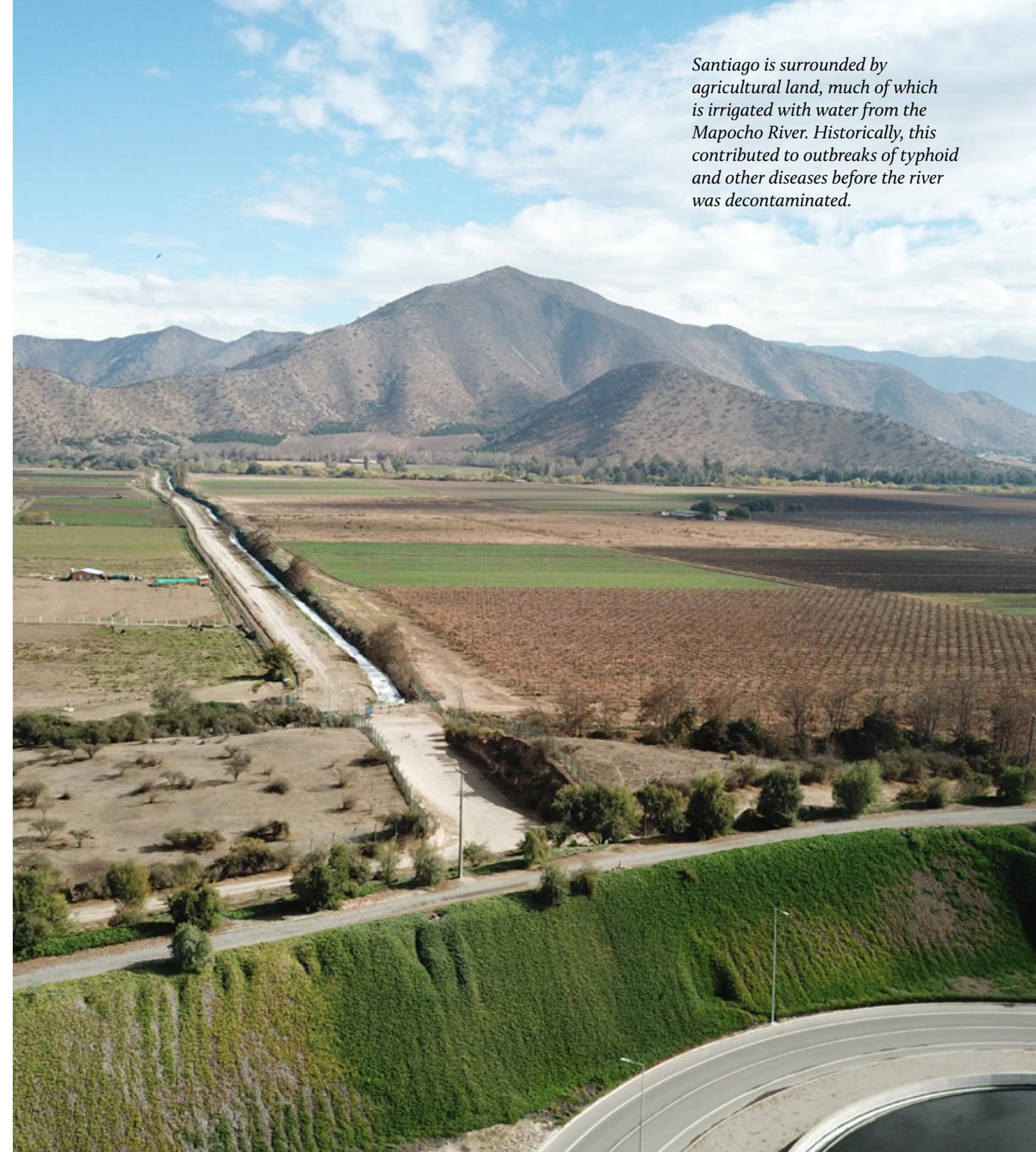
The outbreaks prompted emergency action from the Chilean government. An intervention in 1983-84 involved communication and education campaigns about hygienic crop preparation and the administration of an oral vaccine for typhoid. In 1991, emergency interventions included “increasing the number of prohibited crops; banning restaurants from serving raw vegetables, [...] and construction of new irrigation channels separated from sewage discharges”—interventions that one study notes were more effective at addressing the environmental transmission of disease rather than person-to-person transmission.<sup>25</sup> While these interventions had a level of success in reducing disease prevalence, the long-term improvement of public health required addressing the root cause of the problem: the contaminated Mapocho River.

#### Wastewater Treatment—A Public Sector Attempt

“There was an awareness of the problem [of wastewater] but it still led to the huge question of how to solve it.” This is how Yves Lesty, Circular Economy Manager at Aguas Andinas, describes the situation in Santiago in the mid-1990s. Despite having identified irrigation with untreated wastewater as a cause of disease, no stakeholder had succeeded in removing the sewage from the river.

Santiago’s need for wastewater treatment had first been flagged as part of a 1984 sewage master plan developed by EMOS, the city’s public sanitary works company. That plan proposed constructing more than 200 kilometers of sewers as a way to prevent contamination in irrigation channels and reduce the incidence of typhoid fever.<sup>26</sup> The sewers would feed into a new plant that would pilot sewage treatment in the city.

Construction of the sewers was to start two years later with funding assistance from the World Bank. The goal was sidelined, however, by budgetary and bureaucratic hold-ups, in addition to flooding in 1986 that damaged existing water infrastructure. Soon, the focus of the project shifted from improving sewage coverage to improving water supply. A project completion report filed by the World Bank found that the project had not accomplished its sewerage component but had been successful in increasing water coverage.<sup>27</sup> The construction of infrastructure to intercept and treat household sewage would have to be managed by another project at another time. EMOS set a new goal: 100% wastewater treatment by 2024.<sup>28</sup>



*Santiago is surrounded by agricultural land, much of which is irrigated with water from the Mapocho River. Historically, this contributed to outbreaks of typhoid and other diseases before the river was decontaminated.*

## Clean River, New Life: The Privatization of Chile's Water Utility

In the end, Santiaguinos didn't need to wait until 2024. By the turn of the new millennium, Santiago's water supply and sewage infrastructure was primed for another set of upgrades. After considering the idea for decades, the Chilean government decided the task of water supply and sanitation was best managed by the private sector. In 1999, the majority stake in EMOS was sold to Sociedad Inversiones Aguas Metropolitanas Ltda., owned by Agbar and Suez Group, two multinational companies. Two years later the company was renamed, and Aguas Andinas officially came into being as a privately-owned, publicly-listed operation. Angel Simon, who today serves as Executive Vice President of Suez Group in charge of Spain and Latin America, was the first General Manager of Aguas Andinas between 1999 and 2002.

Despite being privatized, water services must still comply with Chile's regulatory framework set out by a body called the *Superintendencia de Servicio Sanitario* (Superintendent of Sanitary Services). As the regulating body, the Superintendent sets the tariffs that customers pay and has final approval over any tariff increase, including ones proposed to build a new piece of infrastructure or upgrade existing systems.

The complete treatment of wastewater was one of the requirements of the new private utility. This promised to be a substantial undertaking: just 3% of Santiago's wastewater was being treated in 1999, one of the lowest rates in Chile.<sup>29</sup> With that requirement, Aguas Andinas launched a new program that year: Mapocho Urbano Limpio (MUL, Clean Urban Mapocho) in order to decontaminate the river. MUL involved several large infrastructure upgrades, including the construction of three new wastewater treatment plants: La Farfana, El Trebal, and Mapocho.

Prior to its decontamination efforts, Aguas Andinas commissioned an environmental baseline study of the Mapocho. "In general terms, the river was in very poor shape," says Manuel Contreras with El Centro de Ecología Aplicada, the agency that authored the report. The pressures of urbanization on the river had caused biodiversity shifts. "There should have been many fish, birds, and aquatic plants. But having the Mapocho River sick meant that the environment was sick as well," says Contreras, explaining there was not enough oxygen in the contaminated ecosystem to support life. "Our main conclusion was that the conditions were very poor and the recovery was going to be a slow process."



*Manuel Contreras stands behind the office of El Centro de Ecología Aplicada. One of the only offices in Santiago with what he calls "waterfront property," Contreras says being located near this small stream would not have been possible when the Mapocho was contaminated.*

In its natural state, the Mapocho River had once provided Santiaguinos with many services. "People could take a bath, they fished, they visited and walked around the area, and navigated by boat," says Contreras of the river's past. "In 2003 [before decontamination] none of that was happening." In order to improve the health of the river, Manuel Contreras and his team offered Aguas Andinas a few recommendations. One echoed the requirement of privatization: the removal of organic matter from the river through the creation of wastewater treatment plants.

Aguas Andinas got to work. Construction of the first treatment plant, El Trebal, started in 2000 and La Farfana began operations in 2003. Over the next 12 years the company eliminated 46 discharges—places where millions of cubic meters of sewage previously emptied into the river. Instead, the sewage collection pipes spilled into a new 102-kilometer-long interceptor system that channeled wastewater directly to one of three new sewage treatment plants. With the opening of the Mapocho Sewage Treatment Plant in 2013, Aguas Andinas had achieved its 100% wastewater treatment obligation in less than 15 years.

Marta Colet, Deputy CEO of Aguas Andinas, notes how this timeline compares to other parts of the world: “France and Spain started with water treatment plants in the 1950s and it was a slow progressive increase because the investment was made through public funds. It took 50 to 60 years, and in some parts of Spain, we still have areas which do not comply with European regulations,” she says. “So to have 100% [wastewater] treated and returned to the environment in good condition in this time period is a record.”



### The Chilean Water Code

While it had the benefit of accelerating the treatment of Santiago’s wastewater, the neo-liberal system of privatization has long been a controversial topic in the city and country. It started in 1981 when the military government created the Chilean Water Code, the piece of legislation that to this day governs use and management of the resource. The code made water a private commodity that could be bought, sold, or leased like any other resource.

The idea for free-market privatization came from a group of University of Chicago-educated Chilean economists nicknamed the Chicago Boys. Their new policies were supported by World Bank recommendations. Both groups suggested privatization would be a more effective way to manage water coverage and access, and said privatization would allow for a reduction in state intervention and the encouragement of foreign trade.<sup>30</sup>

Critics of the existing Water Code challenge its contradictory nature. It establishes water as a national public good, but also grants ownership in perpetuity to private companies, including Aguas Andinas. In some parts of Chile, this has interfered with people’s access to water, one of the essential human rights set out by the United Nations General Assembly.<sup>31</sup> And while water privatization has improved services like wastewater treatment, advocates in favor of public ownership have demonstrated that this has come at the cost of customer tariff hikes, while private companies and utilities continue to expand their profits.<sup>32</sup>

The conversation of who to best manage water and other natural resources is playing out in other parts of the world, where research has found that the privatization of services could leave lower income communities more vulnerable to climate change.<sup>33vii</sup>

Globally, wastewater treatment isn’t the norm. An estimated 80% of wastewater worldwide is discharged into the environment without ever receiving treatment.<sup>34</sup> Latin America does a bit better, treating nearly 40% of its wastewater, approximately double the global average.<sup>35</sup> A report from the International Resource Panel suggests recycling, reusing, and returning this water to the environment are three measures that could help countries more holistically manage their water resources<sup>36</sup> and minimize negative impacts on local ecosystems.

vii Where do you stand on this discussion that’s happening in Chile and worldwide?

Privatization of Santiago’s water resources impacted the price customers were paying for their household water supply. Tariffs rose by 90% in the four years following privatization<sup>37</sup> in order to upgrade the city’s wastewater treatment services. To reduce water access inequities that would come with tariff increases, the central government has a water subsidy program that covers the first 15 cubic meters used by lower income households monthly. Depending on household size and use, this covers between 15 and 85% of water bills, and experts say this safety net has made water privatization and tariff hikes in Chile less controversial than in other Latin American countries.<sup>38viii</sup>

viii How is wastewater managed in the places you live and work?

### Impacts on Human and Environmental Health

According to Dr. Sandra Cortes from the Pontifical Catholic University of Chile, it’s difficult to quantify the exact impact privatization and the decontamination of the river had on the health of Santiago residents. As noted, incidence of typhoid fever had already dropped after 1991 with emergency government interventions that ordered an end to crop irrigation with sewage-contaminated water.<sup>39</sup> The only Latin American study looking at the impacts of privatization on public health found that childhood mortality rates were lower in communities with privatized utilities.<sup>40</sup> Overall, a literature review found the verdict is still inconclusive as to whether privatization in the region has been necessary in achieving better health outcomes.<sup>41</sup>

Cortes says the lowering of enteric disease also correlated with a change in government in 1990. Environmental control and public health programs had been stalled for the better part of three decades, and the new government resumed social programming. “That’s why it hasn’t been easy to prove that only Aguas Andinas did something about [improving the health of Santiago residents] because that improvement is also a consequence of development,” says Cortes.

A decade and a half after its first study, El Centro de Ecología Aplicada performed a follow-up study on the condition of the Mapocho River. Its findings were more directly linked to the actions taken by Aguas Andinas during its Mapocho Urbano Limpio program.

“We found a high diversity of aquatic insects, and these are indicators of the quality of the water,” says Manuel Contreras of the

2016 report. Compare this to 2003 when the river was home only to worms that could survive in oxygen-poor settings. “This was proof in ecological terms that the Mapocho River was improving little by little.” Those aquatic insects were joined by the recurrence of native fish species, including small catfish, Chilean silverside, and the mosquito fish. The study also found that aquatic plants had increased and that mammals and birds were beginning to reappear along the riverbank.

Cleaning of the Mapocho also led to an increase in the number of parks along the river. Numerous studies have quantified the impact of daily greenspace exposure on physical, mental, and social health. Iván Poduje, an architect and urban planner in Santiago, points out the parks on Google Earth—new strips of greenspace lining the river. Some of these spaces, he notes, were built in the 90s when the Mapocho River was still contaminated. As a result, they were rarely used. “Then we built the Parque de la Familia after the water was cleaned,” he says. A key feature of the park is a calm lagoon with water from the Mapocho River. Walk through the manicured landscape and visitors can reach a strip of path that sits next to the river. While there’s still some trash and pollution in the water, it’s a far cry from the open sewage dump of the 1980s and 90s.

Poduje adds that the Parque de la Familia is in a lower income part of Santiago. “When you clean the river and create green area you break the social segregation of the people with the river,” he says. “You create a park, land and property values go up. You eliminate security issues, and people have a beautiful park nearby. When this happens you forever change the quality of life of the people.”

With improved public health, a cleaner river, and increased green space all either directly or indirectly linked to its full treatment of wastewater, Aguas Andinas had reached an operational crossroads and had the opportunity to ask “what’s next?”



*Parque de La Familia, constructed near the edge of the Mapocho River, is one of Santiago’s newest greenspaces. The park features a testament to the decontaminated river: this lagoon filled with water from the Mapocho. On the weekends families stroll through the park and take paddle boats onto the lagoon.*



*La Farfana is one of the largest wastewater treatment plants in Latin America. First opened in 2003, the plant was retrofit as a biofactory after Aguas Andinas' strategic change in 2016. Today, parts of the facility are open for public tours.*

## From Sewage to Circular

<sup>ix</sup> A monofill is a type of temporary landfill. In the case of Aguas Andinas, the monofill at El Rutil is a place where dried sludge is stored until it can be turned into something useful, like the biocement in Carlos Castro's office.

There's a cement block in the corner of Carlos Castro's office. Castro is the Manager of Biofactories and Sustainable Operations with Aguas Andinas, and was one of the original supporters of the company's biofactory project. This cement block is a tangible example of the valuable byproducts that can be created from what is extracted during the process of treating wastewater. This block was created from the dried ash of what was once household waste. "Our dream is that this biocement be produced from the monofill<sup>ix</sup> at El Rutil and then sent to plazas or buildings," says Castro, placing the block on his desk.

Having achieved 100% wastewater treatment by 2015, Aguas Andinas could take one of two paths. The company had met the requirements established by privatization, and the most straightforward next step would have been to maintain its status quo as a traditional water and wastewater utility. The other option was to forge a new business strategy that updated the company's mission in alignment with the shifting values of society and the changing needs of its clients.

"What we have now are empowered citizens who require a very different relationship with a utility," says Narciso Berberana, Aguas Andinas' Chief Executive Officer, and the person who led its change in strategy in Chile. He says clients today demand greater transparency around supply breaks and increased consideration of environmental responsibility, including ensuring wastewater is treated. "Nowadays it would be unthinkable to have sewage in the middle of the city," he says.

The strategy change required new infrastructure, turning Aguas Andinas' La Farfana, Mapocho-Trebal, and El Rutil facilities into one of the largest wastewater treatment systems in the world: the Gran Santiago Biofactory. The biofactories are one element of the circular economy model that was suggested by Angel Simon, and has been used by Agbar Group in Barcelona, one of the companies that owns Aguas Andinas.

At the same time, the biofactories demanded the adoption of new mindsets and business models. That wasn't easy. A long-time environmentalist, Narciso Berberana says it's key that a company change over time. "I believe in the sayings of a very famous Chilean biologist and philosopher, Humberto Maturana. He said that species arise and surge in environments that make it possible for



*Carlos Castro holds a biocement brick — made exclusively from dried ash extracted from household wastewater. This could be a future market for the byproducts that come from Aguas Andinas' circular economy model.*

them to do so. For me, the company is a biological being. It is alive and it depends on its surrounding environment. It needs to adapt to that environment in order to obtain a license to live," Berberana says.

He combined this personal philosophy with the new attitudes of clients, pointing to these societal demands to support his argument for a revised strategy: "how could we use the previous paradigm that was not up-to-date? We said that society is changing so we must too." At the same time, Berberana was careful not to criticize the company's past approach, mindful that his proposed changes could put the board of directors on the defensive.

The evolution of the company strategy took time. "Convincing the board was one of the most difficult things to do," says Berberana, now a board member himself. "It was a traditional board and they were used to a business environment where profit was only economically gained. The point of inflection was when I was able to open them to the vision of how the company could be five years into the future. [...] What I proposed was to change Aguas Andinas into a services company that had not only an economic focus but an environmental and social mission, too."

The updated corporate strategy was unanimously approved—almost. Water and quality of life, the final of the seven pillars proposed under the new strategy, received pushback. It included goals like increased participation in health and water studies and biodiversity preservation and recovery projects. "The board said this was outside the strategy of the company," Berberana explains.



## Biodiversity and Watershed Management

Preserving the biodiversity of ecosystems is one of the objectives of Santiago Merece un 7, Aguas Andinas' long-term strategy. This includes protection of the Mapocho River and the Maipo watershed from which the river draws its source. Less than 5% of that watershed is currently protected.<sup>42</sup>

The company's choice to include biodiversity in its strategy elicited some confusion. "Non-health focused companies [see the inclusion of biodiversity] as exotic," says Carmen Lacoma, Manager of Sustainable Development at Aguas Andinas. "However, we find it important to link the two because the preservation of biodiversity has a direct impact on the water we capture in the basin."

The company is in the midst of preparing its first biodiversity strategy. That strategy involves more effective measuring of the company's carbon footprint, supporting the release of endangered Trichahue parrots when the Pirque Mega Tanks open, and protecting the birds of prey that have flocked to its El Rutil biosolids monofill. Lacoma notes that these projects will likely be supported by the creation of a new corporate volunteering program.

In an effort to improve watershed management, Aguas Andinas is a signatory on The Nature Conservancy's Santiago Water Fund. The fund is a public-private partnership to protect nature in the Maipo watershed. This includes investigating how nature-based solutions such as river buffer zones and healthy vegetation can improve water quality and reduce treatment costs.

Manuel Contreras with Santiago's El Centro de Ecología Aplicada says collaboration is key in making future watershed management efforts a success. Environmental activities by industry and non-governmental organizations, he says, have previously been limited to the conservation of wetlands, with each stakeholder considering only its own vested interests. "Education and agreements with these groups would be one strategy that could change how we view the water, and this is one area where Aguas Andinas could contribute more," Contreras says. He adds that he'd also like to see the company use its influence to urge the Ministry of the Environment to take greater responsibility of the country's watersheds.

To convince them of this seventh pillar, Berberana played another strategy card: he assigned responsibility of the new strategic plan to the director who most opposed it. Suddenly, this director was personally invested and responsible for persuading the rest of the board to approve and adopt the new strategic direction, quality of life and all. Broadly, similar strategies could be key in helping private companies adopt or champion more holistic planetary health business practices.

"Reaching a consensus on the new corporate strategy took about nine months. The result of this new project was Santiago Merece un 7 (Santiago Deserves a 7), the long-term strategy of Aguas Andinas," says Esteve Clos, Organization and Talent Manager. Launched in 2017, its seven pillars include resilience, circular economy, social legitimacy and water and quality of life—each a new direction for the established company.

↘ [Appendix 1: The seven pillars of Santiago Merece un 7](#)

### When Waste Becomes Resource

Turning La Farfana and Mapocho-Trebal wastewater treatment plants into biofactories was an integral part of Aguas Andinas achieving its new vision. "Our difficulty has always been identifying how to connect with general people who don't have a technical vision," says Dulcinea Meijide, the Director of Sustainable Development with Suez Group Spain, the company that has ownership in Aguas Andinas. "When talking about the circular economy and shared value you need to identify examples. We can point to the biofactories and people say 'ah yes, I see.'"

With the opening of its biofactories, Aguas Andinas now defines itself as a "services company." It provides the traditional service of drinking water and wastewater treatment, but also produces and sells the raw materials and resources generated by its biofactories.

The creation of new products from what would otherwise be waste is part of the company's new circular economy model. It's an approach that envisions the cyclical reuse of products, resources, and waste to extract its maximum value. Compare this with standard linear economy models, defined by mentalities like "take, make, and dispose" and "use it or lose it."

↘ [Appendix 2: Linear and Circular Economy Diagram from the Ellen MacArthur Foundation](#)



*Narciso Berberana is the CEO of Aguas Andinas. He was one of the key people who led the company's strategic change in 2016 following the company achieving a 100% treatment of wastewater.*



### Circular Economy Initiatives Around the World<sup>x</sup>

The European Union has been a global leader on transitioning to a circular economy. In 2015, the European Commission, the executive branch of the EU, started its Circular Economy Action Plan. That plan included 54 specific actions that sectors and countries could follow to extend the life of its products and materials.<sup>43</sup> The action plan was considered fully implemented by 2019.

On a common thread, *The Switchers*, a joint project of the European Union and the United Nations Environment Programme, profiles circular economy initiatives in the Mediterranean region. This includes stories of an innovator finding a way to extend the life of electronic waste in Palestine, an Italian sailor who creates fashionable accessories from old sails and sail cloth, and a Moroccan innovator who uses a process called pyrolysis to transform agricultural waste into a charcoal fertilizer.

<sup>x</sup> What are some circular economy initiatives in the places you live and work?



The biosolids monofill is located north of Santiago—the piles are household waste that has been dehydrated and sanitized. These biosolids are then given a second life, reducing the amount of waste that ends up on landfill.

Yves Lesty, a long-time engineer with Aguas Andinas, became the company's first Circular Economy Manager in September 2017. “[The circular economy concept] was little developed in Chile. There are some companies that are more specialized and recycle plastic and glass products, but these few initiatives are relatively small in size,” Lesty says.

The Aguas Andinas biofactories in Chile aren't the first of their kind, but they are the largest-scale example worldwide. Suez Group, the company that owns Aguas Andinas, has also adopted biofactory models at its wastewater treatment plants in Spain. “[What we are doing in Santiago] is taking the cutting edge technology from other parts of the world and applying it in Chile,” says Jordi Fontana, the General Manager of Biofactories.

There are a number of secondary products that can be created from the extracts of wastewater. Back in the reception area at La Farfana biofactory, Fontana gestures at a placard highlighting the company's aspirations in adopting a circular economy approach: zero environmental impact through producing zero waste and zero emissions, and needing no energy consumption from outside sources. “La Farfana is the biggest plant of its kind and puts all these pieces together to achieve the goals,” he says.

The specifics of those goals are more technical. When wastewater enters a traditional treatment plant or biofactory, waste<sup>xi</sup> is extracted during the cleaning process. Traditionally, biosolids are sent to a landfill where utility companies pay for their disposal. Not only can this be expensive, but landfills are also an environmental liability, creating smells and unsafe areas. The biofactories, on the other hand, sanitize and dehydrate the biosolids, giving them to local farmers free of charge. Already high in nitrogen and phosphorous, farmers can add potassium in order to use the biosolids as fertilizer.<sup>xii</sup> “This allows us to reincorporate the biosolids into the food cycle and continue their lifespan,” says Yves Lesty. Today, 70% of the biosolids produced by Aguas Andinas are distributed as fertilizer and what remains is sent to the monofill at El Rutal, awaiting a second life. A future goal is to further dry the biosolids in order to create a more valuable product that could be sold rather than given away.



Jordi Fontana and Paulina Vicentela are on the management team at La Farfana biofactory. The displays behind them are in the entrance of the plant, and explain to visitors the process of the biofactories and the history of water sanitation in the capital city.

<sup>xi</sup> The waste extracted from wastewater is called biosolids or sewer sludge. Aguas Andinas uses the term biosolids.

<sup>xii</sup> What is the difference between organic and inorganic fertilizers? Are there downsides to fertilizer use?

<sup>xiii</sup> How is a carbon footprint calculated? Why is it important to calculate it? What is your carbon footprint?

↳ [Learn more here](#)

The creation of biosolids also helps reduce the company's emissions.<sup>xiii</sup> Before being disposed, biosolids are dried for about 20 days. This lowers the water content of the sludge by 75%, making it more compact and lightweight for transportation. Aguas Andinas estimates it currently produces 850 tons of emissions a day in biosolid transportation. This could be reduced to 300 tons daily with proposed further drying techniques.

Finally, the biofactories are key in Aguas Andinas' aspiration of reaching carbon neutrality, and the company aspires to be 100% energy self-sufficient by 2020.<sup>44</sup> Water and wastewater plants demand large amounts of energy to run continuously. The distribution and treatment of water and wastewater uses about 4% of the world's total electricity supply, and this energy demand is expected to double by 2040.<sup>45</sup> This creates an opportunity for companies to be more efficient through the production of their own energy sources.

<sup>xiv</sup> Where else can biogas be obtained? How is biogas turned into energy? Is burning biogas detrimental to the environment?

Biogas is one option.<sup>xiv</sup> Biogas is a mixture of gases created using a process called anaerobic digestion. Visualize a giant stomach: bacteria is used to break down the sludge cleaned from wastewater, and 'digest' it in an oxygen-devoid setting. The resulting biogas is then combusted to create heat or electricity. To date, 85% of the Mapocho-Trebal biofactory is run on this biogas. An agreement between the city and La Farfana plant means it's more cost effective for Aguas Andinas to use electricity supplied by the city than to capture its own. Instead, biogas from La Farfana is sold to Santiago's natural gas distributor and provides electricity to 30,000 households. This could change in the future when Aguas Andinas is able to modernize La Farfana to operate on the biogas that's produced. The company says this project must be evaluated on its own merit, and that this process is on track to happen by 2022.

"The idea is to recover the greatest portion of energy from the sludge," says Jordi Fontana of the biogas production. "This could be electricity, hot water, steam. All of these residual energies could be used later in a boiler or to dry more waste." Aguas Andinas sees these diverse energy sources as one of its key climate change mitigation efforts. It decreases reliance on fossil fuels and also creates a new source of revenue for the company.



*La Farfana's wastewater cleaning mechanics from above.*

### **Biofactories: A Benefit to Business**

The ability to create new revenue streams is another benefit of the circular economy. Take, for example, the fact that Aguas Andinas has started accepting industrial waste generated during the production of soda. This highly concentrated waste would have previously been brought by truck to the wastewater treatment plants at a high cost. The soda company would then pay to have the waste treated. Now for a lower cost, companies can opt to send effluent through a discharge pipe to the Mapocho-Trebal biofactory where it is added to the anaerobic digester and transformed into energy. Money is saved by both the soda company and Aguas Andinas, and a valuable product is produced. Aguas Andinas benefits financially at both ends of the process: with payment from the soda company and in the cost-savings it receives from producing biogas.

Whether it's biogas, biocement, fertilizer, or other future byproducts, each can be sold by Aguas Andinas through its subsidiary businesses. The requirement is that the income from these sales be used to reduce and/or mitigate the possible increases in the rates paid by customers. In other words, the more income obtained from the sale of biofactory resources, the greater the likelihood that residents of Santiago could see a stabilization in their water bills. "Aguas Andinas has the vision to advance steadily in the search for shared efficiencies," declares a company's statement.

While the biofactories have allowed Aguas Andinas to expand its environmental and social vision, it's not all about altruism, but economics, too. The company must run a careful cost-benefit analysis of every infrastructure upgrade and biofactory product it considers producing. This is because of the regulatory environment in which Aguas Andinas operates. Converting wastewater treatment plants into biofactories is not an inexpensive task. With a price tag of US \$61.2 million between 2018 and 2020,<sup>46</sup> these infrastructure upgrades are funded by the customer tariffs that can be updated by the *Superintendencia de Servicio Sanitario* every five years.

For better or worse, the Superintendent is notoriously conservative. "If they were asked about whether or not we could carry out a change they'd simply say no because they associate all that's traditional with control, even though that's an incorrect concept," says Narciso Berberana, Aguas Andinas' CEO.

As a result of this conservative regulator, no tariff change can be made without demonstrating it will bring cost-savings over the long-run. Aguas Andinas needs to prove that its circular economy approach makes more economic sense than the traditional way of doing business. For example, say it costs the company \$1 to dispose of its biosolids in a landfill. If distribution of those same biosolids to farmers cost \$1.50, Aguas Andinas would have no choice but to select the first option. If the circular method is shown to be more cost effective, however, the Superintendent is more likely to approve a tariff increase to raise money for that switch. In the case of biosolids disposal, Aguas Andinas says it costs 40% less to produce biosolids for fertilizer versus sending them to landfill.<sup>xv</sup>

<sup>xv</sup> What are co-benefits of climate action? Why are they important? Read more here



Tariff increases aren't the only approach Aguas Andinas is using to fund its upgrades. "The great jump in strategy was when we issued green and social bonds and the stock market received them successfully," says Berberana.

*The view over La Farfana's facility. Educational placards mark the place where visitors and students come each year to learn about Santiago's wastewater management system.*

He's referring to the two rounds of bonds the company issued in 2018 and 2019, raising US \$68 million and US \$83 million respectively.<sup>xv</sup> While this represented the first time green and social bonds were issued and sold in Latin America, the approach is becoming increasingly popular worldwide as a way to fund environmental and climate-related projects. The world's first green bonds were issued by the World Bank in 2008, though the water and wastewater sector represents just 10% of green and social bonds commitments in 2018.<sup>47</sup> New environmental funding streams are key in directing money to urgently-needed climate change resilience, adaptation, and mitigation measures. As Mami Mizutori, the UN secretary-general's special representative on disaster risk reduction told *The Guardian* "resilience needs to become a commodity that people will pay for."<sup>48</sup> Green and social bonds can offer that investment model.

<sup>xv</sup>The payback period on the 2018 bonds is seven years at an interest rate of 1.8%. The second round of green and social bonds will be paid back over the course of 25 years at an interest rate of 2%.

<sup>xvi</sup> What are other examples in which green and social bonds are being used? What international agreements have incorporated these finance mechanisms in the past? Were they successful?

## A Planetary Health Approach for Future Development

Bonds are long-term, typically lower risk investments that help finance certain projects—in the case of Aguas Andinas, the funds will be directed towards projects that make an environmental and social impact.<sup>49</sup> Berberana says it's notable that investors are starting to consider these categories of projects as being more secure over time. "You can associate sustainability visions with more stability. It would have been impossible to speak in these terms three years ago," he says. Demand exceeded the bond amount offered in both rounds of issuance, demonstrating that there was an interest in investing in the company's long-term vision. "The investors validated our strategy and were willing to invest in a company that makes radical changes," says Berberana. Unlike the shareholders of Aguas Andinas who are almost exclusively international, the green and social bonds were available only to Chileans.<sup>xvi</sup>

Climate change resilience and adaptation measures are two priorities for the funds raised by Aguas Andinas' green and social bonds. That includes accounting for an increase in climate-intensified flooding and future water shortages. "We have to defend our plants," says Eugenio Rodríguez, Director of Service Management with Aguas Andinas. At least five events in the last seven years have forced the company to suspend water services. Typically, this happens when sudden, heavy rains trigger landslides which muddy the river and force Aguas Andinas to close its intake valve along the Maipo River.

"This has meant one million customers without service for between one and three days. It's very bad for us because our core business is providing water continuity," says Rodríguez. "It's a reputation problem because customers don't understand that the climate is producing the event. They see a company stopping service." These water cuts occurred in the summer months, with 30 degree Celsius temperatures intensifying the impacts of water shortages.

Increasing emergency water autonomy is one of Aguas Andinas' main climate adaptation measures to address these cuts. Autonomy is the number of hours in which the company can support the city with emergency drinking water while normal water intake is disrupted. This is usually done in the form of large storage tanks and additional groundwater wells. Santiago had four hours of

autonomy when the first flooding event happened in 2008. "After this event we suggested to the Superintendent that we should construct a big emergency tank, but they said 'no' because it was very expensive and nobody thought there would be a bigger event," says Rodríguez.

Just as Aguas Andinas needs to demonstrate the economic argument for transitioning to a circular economy model, the same rule applies for the approval of climate change resilience and adaptation measures. Basically, the company needs to show that it would be more costly to do nothing in the face of climate change. Two major floods affected Santiago in the first months of 2013. Shortly after, the Superintendent approved the construction of the Pirque Mega Tanks, which will store 1.5 million cubic meters of emergency water. It's Aguas Andinas' largest climate change-related resilience project to date, and has increased Santiago's water autonomy from 11 to 34 hours. If the Pirque tanks had been operational in 2013 the company would have avoided that water cut event, notes Alberto Blanco, Director of Engineering and Sustainable Development. Aguas Andinas recently presented a new proposal to raise the autonomy levels further still to 48 hours.

While new emergency storage tanks help in the case of flooding or landslides, they don't address the drop in water supply that Santiago is forecast to face.<sup>50</sup> "We are working on this," says Eugenio Rodríguez, the Director of Service Management. "We talk about resilience and in parallel we have a drought plan that considers different alternatives like protecting glaciers, decreasing losses in our network, and convincing the community to use less water."<sup>xvii</sup>

Community water consumption, conservation, and efficiency are addressed in Aguas Andinas' sustainability roadmap. A goal is to educate at least 30,000 people each year on sustainable water use. A few years ago, Aguas Andinas launched a summertime campaign called *Plazas del Agua* (Water Squares), small community water parks where children can go to cool off. This is meant to decrease one of the company's most significant water consumption concerns: kids opening fire hydrants during warm weather months. The sustainability roadmap also addresses water and quality of life, emphasizing that the creation of healthy environments can improve the quality of life for Santiago's citizens.

<sup>xvii</sup> Take a moment to think if you are doing your share to save water. What else could you be doing? ↘ [Click here to learn more on where your water footprint is coming from](#)

Eventually, another way to address water supply issues could be treating wastewater to the extent that it could be reused as potable drinking water. This method is already being used in water-stressed cities around the world, from Perth, Australia, to Big Spring, Texas, to Singapore, to Windhoek, Namibia. “This is an eventual goal because of our strong limitation of water in the region,” explains Yves Lesty, Circular Economy Manager.

However, the greatest opportunity for curbing water use in Santiago and Chile lies not within the purview of Aguas Andinas and household water consumption, but instead in the adoption of more efficient technologies within industries such as agriculture, mining, manufacturing, and forestry. Industrial water demand accounts for more than 90% of all water use in Chile, and demand is forecast to rise in coming years.<sup>51</sup> While community education and individual household water conservation is important, it’s a drop in the bucket when it comes to the larger issue of water scarcity in Chile.

Be it the opportunity to improve the health of Santiago’s citizens by improving the health of the Mapocho River system, or through the ability to reduce waste and pollution by embracing circular economy principles, Aguas Andinas presents an example of a large private sector company that has adopted a planetary health framing in its business approach. Further, the company has proved that a planetary health model doesn’t come in conflict with economic development, but can in fact aid in its behalf.

## Epilogue

<sup>xviii</sup> Two other winners in the planetary health category, the Sri Lanka Mangrove Conservation Project and the Plant-Powered Pupils/Climate Efficient Schools Kitchens projects, are featured in case studies within this anthology.

In 2018, Aguas Andinas was named one of four winners of a planetary health Momentum for Change award from the United Nations Framework for the Convention on Climate Change (UNFCCC).<sup>xviii</sup> Former CEO Narciso Berberana says the award represented another milestone for the company’s new direction, and validated its circular economy model with politicians and other corporations in Chile. It also highlighted to the international community how the private sector can engage in planetary health efforts.

“Planetary health is not about the technical performance of our water networks,” says Berberana. “We would talk to the environment, treasury board, or financial ministers, and they’d say ‘wow, your award is not about water issues, it’s about planetary health and a low carbon economy.’ The change is huge for the company. It’s not about only water, it’s about people’s health.”

More effectively communicating its environmental and social mission is one of the most important next steps for Aguas Andinas. While its corporate strategy has changed greatly in the last five years, company management says this hasn’t yet been recognized by the general public. That’s why visits will continue at La Farfana biofactory—so people, especially students, can better understand the complexities of the water system and how what goes down the drain is connected with their health and the health of their city. “Students visit and they see this huge area and it’s beautiful surroundings. They’re impressed that all the wastewater from Greater Santiago comes here,” says Paulina Vicentela, looking out at La Farfana’s lagoon. “We tell them that what happens in Santiago isn’t what happens everywhere in the world, so they leave this place with a positive point of view and a sense of pride that commits them to reducing waste and taking care of water as a resource.”

At a larger scale, Narciso Berberana hopes Aguas Andinas can be a model for other private sector companies or utilities that understand the need to step up their environmental efforts but are concerned about their bottom line or optics among their investors. “I believe a private company that thinks its only purpose is to generate profit is wrong,” he says. We have to generate an environment that’s better, and companies receive money to achieve that planetary improvement.”

## Keeping Track of Who's Who

### Narciso Berberana

*Former Chief Executive Officer of Aguas Andinas, now a member of the board of directors*

### Manuel Contreras

*Executive Director of El Centro de Ecología Aplicada, a Santiago-based environmental consulting group*

### Dulcinea Meijide

*Director of Sustainable Development, Suez Group Spain*

### Alberto Blanco

*Director of Engineering and Sustainable Development, Aguas Andinas*

### Dr. Sandra Cortes

*A public health epidemiologist at the Pontifical Catholic University of Chile*

### Patricia Arroyo Meneses

*A long-time vegetable vendor at Santiago's La Vega market Alliance*

### Carlos Castro

*Manager of Biofactories and Sustainable Operations, Aguas Andinas*

### Jordi Fontana

*General Manager of Biofactories, Aguas Andinas*

### Iván Poduje

*An architect and urban planner in Santiago*

### Esteve Clos

*Organization and Talent Manager, Aguas Andinas*

### Carmen Lacoma

*Manager of Sustainable Development, Aguas Andinas*

### Eugenio Rodríguez

*Director of Service Management, Aguas Andinas*

### Marta Colet

*Deputy CEO of Aguas Andinas*

### Yves Lesty

*Circular Economy Manager, Aguas Andinas*

### Paulina Vicentela

*Chief of Resource Management of Biofactories at La Farfana, Aguas Andinas*

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*Aguas Andinas' La Farfana wastewater treatment plant as seen from above. The corridor in the top left is where the treated water from the plant gets rechanneled back into the Mapocho River.*

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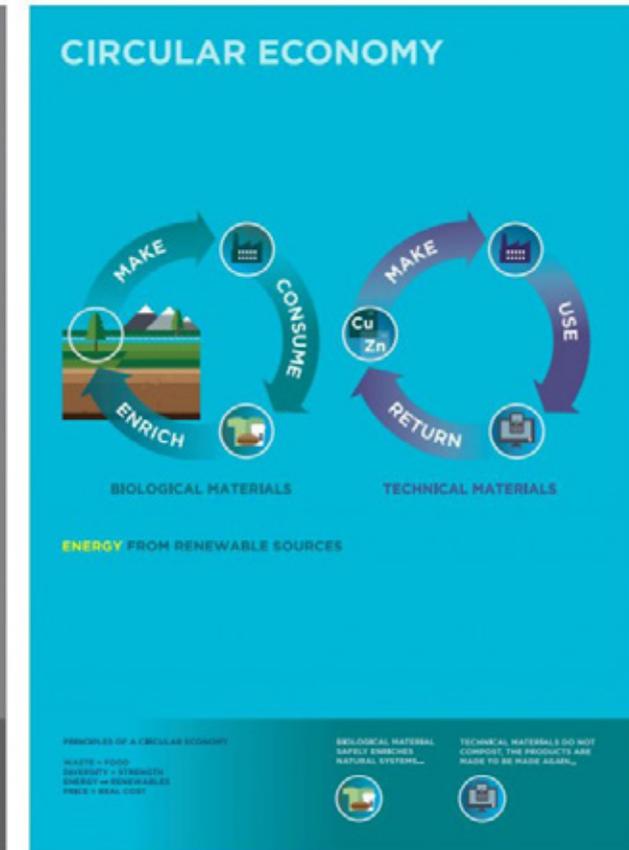
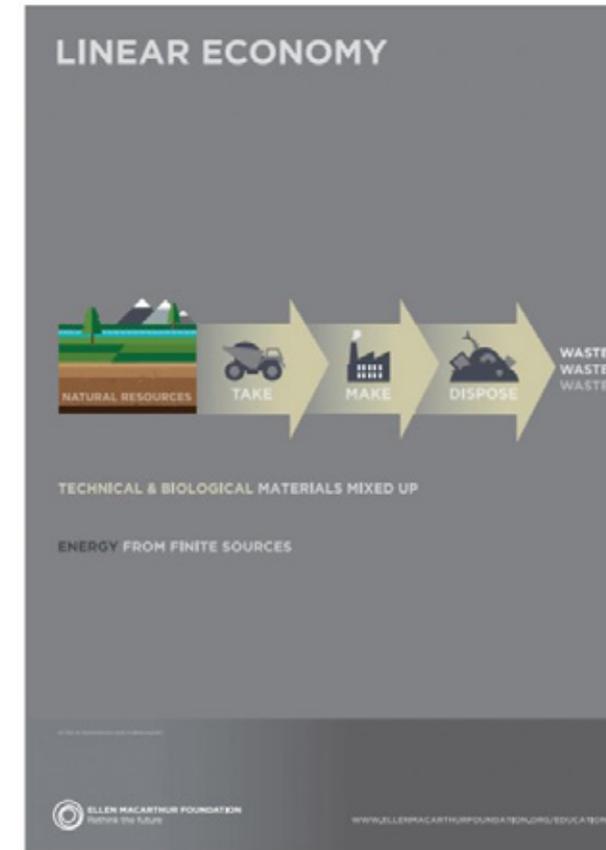
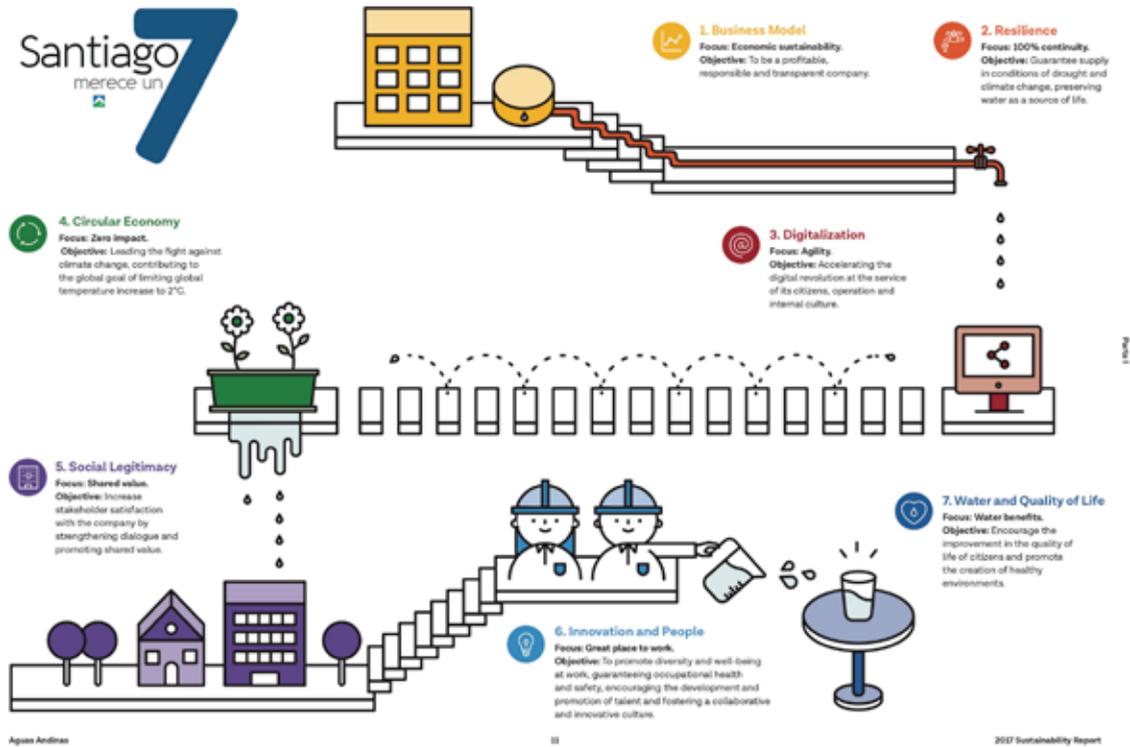
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# Putting Food Needs First

HOW ALTERNATIVE PROTEINS COULD SAVE  
MADAGASCAR'S ENDANGERED BIODIVERSITY

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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## Executive Summary

For further detail on themes covered in this case study, see the land use section of chapter 4 and chapter 5 on nutrition in [Planetary Health: Protecting Nature to Protect Ourselves](#).

### Learning Objectives

*After examining this case, students should be able to:*

- ① Understand the roles of policy, governance, culture, health access, malnutrition, and poverty in relation to Malagasy biodiversity and forests.
- ② Analyze the risks associated with bushmeat consumption.
- ③ Describe the role of health systems in response to zoonotic diseases.
- ④ Assess the opportunities and challenges associated with the community-based poultry intervention applied in this region of Madagascar.

Madagascar is one of the most biodiverse countries on Earth, and is home to a variety of endemic animal and plant species, including more than 100 species of lemur. Traditional conservation policies and laws have attempted to safeguard this wildlife for more than a century, but haven't always thoughtfully addressed the needs and motivations of people living in these environments.

Today, humans are impacting wildlife in Madagascar including its charismatic lemurs in two key ways: through land use change driven by agriculture and energy needs, and through the hunting of wildlife for subsistence needs. Both land use change and hunting can have positive and negative public health implications. For example, while the latter provides a critical source of nutrition, particularly for poor rural communities, hunted wildlife also increases the risk of exposure to zoonotic disease

Set in the Maroantsetra region of northeastern Madagascar, this case looks at interventions that could dually support wildlife conservation and promote human health. These interventions include the possibility of sustainable wildlife harvest as well as domestic animal rearing. Chickens are one of the desired domestic animals, and this case explores efforts to make the switch to domestic animal rearing possible and sustainable.

*This case study was drafted based on interviews conducted in northeastern Madagascar and Antananarivo, Madagascar, in March 2019.*

## Introduction

Most people are still asleep as Zandrilahy leaves Antaravato to check his lemur snare. Walking along the narrow dirt track that constitutes the main road of the village, the path continues through knee-deep mud in rice paddy fields and up a 45 degree incline where only a machete can slash some semblance of a trail through the brush. After a half hour of bushwhacking, Zandrilahy reaches his destination: a clearing called a *fira* where he's constructed the snare.

If this do-it-yourself assemblage of twigs, grass, and cord works as planned, it will be used to snare one of the 12 species of lemurs<sup>1</sup> hunted for food around Makira Natural Park, the largest protected rainforest area in Madagascar. Now, in the middle of the rainforest, Zandrilahy demonstrates the snare's effectiveness. Reaching for a fallen leaf the length of his arm, he skirts it down the branch that juts into the *fira* like a diving board over a swimming pool. A bunch of bananas sit at the end of the branch; in between is a mechanism constructed of grass and a delicate braid of orange cord. That cord is attached to another thinner branch that arches over the *fira*, creating what's called laly totoko—a baited bridge. As Zandrilahy brings the leaf towards the snare, its movements are eerily similar to the swaying of a lemur's tail. Into the trap the leaf goes and snap! It triggers the snare and the leaf is yanked out of Zandrilahy's hand and left to dangle above the *fira*—an imaginary lemur caught in a tight noose. Zandrilahy smiles.

Scenes like this are a nightmare for conservationists. Hunting lemurs has been illegal in Madagascar since 1960, and current consumption rates of the animal in the Makira forest point towards local extinction.<sup>2</sup> Seen through this lens, a complete ban on hunting would be a logical decision. But a shortcoming of such an all-or-nothing policy is that it fails to consider the growing body of research into the complex reasons why men like Zandrilahy hunt terrestrial wildlife in the first place.

Food security is a basic human right,<sup>1</sup> and Zandrilahy and his family depend on the forest's wildlife to survive. They're not alone—hundreds of millions of people worldwide rely on terrestrial wildlife for food.<sup>3</sup> As a result, an estimated 301 mammal species globally are threatened by human hunting pressure. Meat consumption is the primary purpose of that hunt.<sup>4,ii</sup>

<sup>i</sup> The right to food was first recognized in the 1948 Universal Declaration of Human Rights, and later ratified in the 1966 International Covenant on Economic, Social and Cultural Rights. What else is considered a basic human right?

<sup>ii</sup> Beyond mammals, what other species are hunted for meat consumption?

Although satisfying a family's food needs is essential, hunting wildlife can have negative public health implications. Around the world, terrestrial wildlife hunting has led to transmission of pathogens from their original animal hosts to humans—Ebola and HIV in the Congo-Cameroon Basin in continental Africa; Nipah virus, SARS, and Swine influenza in Malaysia.<sup>5</sup> In all cases, scientists and public health officials have connected each outbreak to the hunting, butchering, and eating of terrestrial wildlife. In Madagascar, where bubonic plague has recently made a resurgence, the World Health Organization has said hunting or other contact with rodents could lead to increased risk of contracting the disease.<sup>6,iii</sup>

<sup>iii</sup> Deforestation and an expanding agricultural frontier can also be a risk factor for zoonotic diseases. Has this happened in your country?



In northeastern Madagascar, or in any place where people rely on terrestrial wildlife as a food source, wildlife conservation and public health efforts must account for the needs of the people living in those environments. If governments and organizations are going to demand an end to hunting and, in turn, curb the possible spread of zoonotic disease, they also need to ask what other food sources can be offered as nutritional, sustainable, and accessible alternatives. Plus, those options need to be culturally appropriate and desirable—because as Zandrilahy says, lemur meat makes for a delicious dinner.

*Zandrilahy constructs a snare across a forest clearing in Makira Natural Park in northeastern Madagascar.*

## Madagascar: Old World Biodiversity Meets New World Challenges

<sup>iv</sup> Behind Greenland, New Guinea, and Borneo, Madagascar is almost as big as Texas!

It was approximately 88 million years ago that the island nation of Madagascar shifted away from all other landmasses. Now part of the African continent, Madagascar spent more of its geographic past attached to India, before tectonic plate activity isolated the country in the middle of the West Indian Ocean, hundreds of kilometers off the coast of mainland Africa. More than twice the size of the United Kingdom, Madagascar is the world's fourth largest island.<sup>iv</sup>

The country's geographic marooning had a remarkable impact on its biodiversity. More than 90% of Madagascar's mammal and reptile species can only be found in that country.<sup>7</sup> That includes 59 species of chameleons, more than two dozen species of small, hedgehog-like tenrecs, and what is perhaps Madagascar's most famous resident: the lemur.

Scientists believe lemurs crossed the Mozambique Channel from mainland Africa on floating mats of vegetation. Encountering Madagascar some 62 to 65 million years ago, the species evolved free of aggressive primates such as monkeys and chimpanzees, as well as the large predators that roam the savannas of mainland Africa. Lacking the predator-prey dynamic faced by other primates, lemurs evolved into a small-bodied, docile species that eat primarily fruits, insects, and leaves. Today, Madagascar is home to more than 100 endemic species and sub-species of lemurs, from the pocket-sized Madame Berthe's mouse lemur to the 9.5 kilogram indri.<sup>v</sup>

<sup>v</sup> Around the size of an adult beagle.

Though they historically lacked predation, lemur populations today face many threats. In fact, 94% of species "are under some level of threat, making lemurs the single most imperiled group of mammals on Earth."<sup>8</sup> Though different for each species, lemurs generally reproduce later in life and have longer intervals between births, two biological factors that affect the ability for healthy population growth. Then there are the pressures posed by another predatory primate: humans.

Humans are one of the more recent mammals to reach Madagascar.<sup>9vi</sup> Just as the country's endemic species rely on the natural resources of the island nation, so too do the 25.5 million people who now share that home.

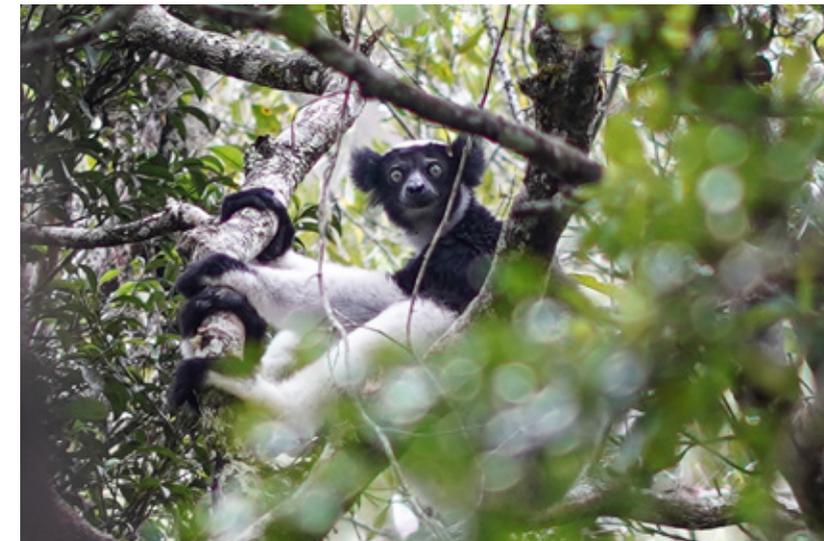
<sup>vi</sup> Islands were some of the last places to be populated by humans. Which do you think was the last region of the world to be populated by humans?

## The History of Malagasy Conservation

Colonial notions of conservation have often prevailed since the first settlers "discovered" new land and established authority over areas traditionally managed by Indigenous groups. This is true worldwide, but especially in Africa where all of the continent's wildlife reserves were established during European colonialism.

Colonial conservation, also known as fortress colonialism, was characterized by the expulsion of local populations from the land in order to protect wildlife and other biodiversity. The expectation was that local people would destroy environments and that the only way to protect valuable ecosystems was to exclude all human presence other than for tourism and scientific research.<sup>10</sup>

In Madagascar, colonial conservation policies started after 1894 when the country became a French colony. That style of governance continued following Madagascar's independence in 1960. Between 1927 and 1997, 46 protected areas were created across the country. Protection of species and enhancing opportunities for research were the primary motivations, similar interests to those held by colonial conservationists. The establishment of these protected areas did little to consider the communities living on the land—people who were reliant on the food, livelihoods, and spiritual sanctuary it provided.



*The indri, known in Malagasy as the babakoto, is one of Madagascar's most iconic lemur species. Critically endangered, the Indri is one of more than 20 species of lemurs hunted in northeastern Madagascar.*



## Traditional Malagasy Governance

Long before these written laws and European colonialism, however, there was the presence of *fady*—the Malagasy taboo system that influences social, moral, and cultural behavior. While *fady* vary by individual, household, community or ethno-linguistic group, there are many instances of taboos related to the avoidance<sup>vii</sup> of certain animal species. These are generally motivated by self-preservation and not by conservation.. Similar to Western conservation laws that have legal implications enforcing morality and action, so too does *dina*, the Malagasy system of community law. Neither *fady* nor *dina* were reflected in the French administration’s conservation system.

<sup>vii</sup> Avoidance includes staying away, not hunting, and not eating these species.

“Ignoring that was a major flaw in getting people to believe in the value of conservation,” says Dr. Christopher Golden, whose multi-decade research in northeastern Madagascar sits at the intersection of conservation, nutrition, and human health. “If you are excluding people from land that they have had de facto control over for generations and then not providing an incentive to conserve that land, it’s going to create a mixed message where conservation is seen as exclusionary and not benefiting them.”

<sup>viii</sup> These targets are expected to be 25% of all land and water protected by 2025 and 30% by 2030.

Which countries do you think are protecting more of their terrestrial and marine territories? Which are protecting less? \ Use this map to narrow down your assumptions.

The expansion of protected areas has continued in recent years. In 2003, Madagascar’s President Marc Ravalomanana pledged to triple the country’s protected area over the following six years. The bold plan put Madagascar on the path to achieving a UN Convention on Biological Diversity target: that each nation protect 17% of its land and freshwater and 10% of its marine and coastal ecosystems by the end of 2020.<sup>11viii</sup>

<sup>ix</sup> It should be noted that while Madagascar’s protected areas did grow substantially post-2003, the World Bank estimates that only 5.9% of terrestrial land in the country is protected today.

Madagascar’s protected areas quadrupled between 2003 and 2016.<sup>12ix</sup> Managed under the newly-created Madagascar Protected Area System (SAPM), governance of these areas shifted in an effort to better account for the needs of rural communities. “[SAPM management] parallels global trends in protected area policy, and reflects the realization that most priority sites were home to significant populations of rural people that depended to varying extents on natural resources for their subsistence and income,” write the authors of one report.<sup>13</sup>

<sup>x</sup> How is the concept of governance different to the concept of government?

Certain areas protected under SAPM have a shared governance model<sup>x</sup> where the central government mandates management to another body. This is often a Malagasy or international non-governmental organization that works closely with local communities to create protected area management plans.

SAPM also saw the creation of Communautés de Base (COBAs), federations of community members that jointly manage the expanded protected areas. COBAs formalize the process of land management and formerly transfer control of the area into the hands of the communities that have held traditional claims to the land. COBAs are then responsible for making their own land management plans that balance their livelihood and natural resource needs with conservation objectives. These groups also create and enforce *dina* (local customs and social norms) in these areas.

Conservation practitioners in Madagascar say the shift towards community management is the start in making biodiversity protection more inclusive and attractive to local communities. However, they admit that enhancing participation from rural communities, ensuring financial sustainability of the management programs, securing law enforcement, and alleviating poverty are among the principle challenges for Madagascar’s protected areas going forward.<sup>14</sup>

## Human Needs of the Forest

While an expanding network of protected areas is seen as aiding conservation efforts, it doesn’t bring immediate economic benefit to most Malagasy. Madagascar is one of the poorest countries in the world, and three quarters of the population live in extreme poverty, surviving on less than \$1.90 a day.<sup>15</sup> Over 60% of the country’s population lives in remote, rural regions, further limiting access to food markets, healthcare, education, and other basic services.

Four out of five Malagasy rely on agriculture as their main livelihood,<sup>16</sup> the majority of whom are small-scale rice farmers who grow the country’s staple food. Population pressure contributing to agricultural expansion is the leading cause of land use change in the country, as forest is cleared or burned to create space for agriculture, including rice fields.<sup>17</sup> The burning of land and forest for agriculture is called tavy, and it is significant as both an ancestral practice<sup>xi</sup> and as the most efficient and inexpensive way to prepare land for new growth.<sup>xii</sup>

Energy demands also contribute to deforestation rates. Only 13% of Madagascar’s population has access to electricity,<sup>18</sup> one of the lowest rates worldwide. This furthers the reliance on forests, and up to 99% of the population uses either firewood or charcoal as their cooking

<sup>xi</sup> Slash and burn is a practice used in many parts of the world. What are some pros and cons of this practice?

<sup>xii</sup> Chapter 1 in this anthology looks at the prevalence, cultural relevance, and economic necessity of slash-and-burn agriculture in Indonesia. There, the practice has increased the risk of fires on peatland ecosystems. This has led to annual haze events that have significant public health implications.

<sup>xiii</sup> What are some health consequences from using charcoal or wood as cooking fuel source?

In 2012 alone, 63% of the 8000 child deaths due to acute lower respiratory tract infections were attributable to household air pollution. ↘ [WHO 2012](#)

<sup>xiii</sup> Make sure to visit Global Forest Watch to understand the extent of the deforestation process in Madagascar over the last 20 years.

fuel source.<sup>xiii</sup> More than 90% of Madagascar's original forests have been lost since humans first came to the island thousands of years ago.<sup>19</sup> Almost half of that deforestation has occurred in the last 70 years.<sup>20</sup>

Deforestation and forest fragmentation have long been considered the main drivers of habitat and subsequent species loss for Madagascar's wildlife.<sup>21</sup> But a recent body of evidence points to subsistence hunting as an equally pressing anthropogenic threat, both in Madagascar and other parts of sub-Saharan Africa. In Madagascar, regions in the northeast have been a focal point of research into hunting, health, and conservation.\*



*A rice paddy field outside of Antaravato, northeastern Madagascar.*

## A Visit to MaMaBay

Communities in northeastern Madagascar are illustrative of the intersectional nature of Madagascar's environmental, social, and economic challenges. Reaching these communities is also revealing of the isolation faced by many of the country's rural regions.

Twice a week, a plane flies between Antananarivo, Madagascar's capital city, and Maroantsetra, a small market town in the country's northeast. Despite its position on Antongil Bay which connects to the ocean, Maroantsetra is described as landlocked because of the difficulty residents have in accessing goods and services from other parts of the country. The single road heading south from the town is little more than a mud track, and the 500-kilometer stretch is impassable at worst and can take days to navigate even during the dry season.

And so, most visitors arrive by plane, a landing that offers clear views of Nosy Mangabe, the island reserve that is part of nearby Masoala National Park. Mainland hillsides are fringed with dark rainforest canopy stretching as far as the eye can see, the landscapes of Masoala National Park to the east and Makira Natural Park in the west. Encapsulating the bay and the two protected areas, the region is often referred to as MaMaBay. While Masoala National Park was first created in 1997 and remains governed by Madagascar National Parks, Makira forest was protected as part of the post-2003 expansion under the Madagascar Protected Area System. Management of the park has been mandated to the Wildlife Conservation Society (WCS), an international NGO with a regional field office in Maroantsetra.

“Makira Natural Park is the largest protected block of terrestrial humid rainforest in Madagascar,” explains Andrew Kirkby, MaMaBay Landscape Coordinator with WCS. “Access to get from one side to the other can be three to four days. There are approximately 90,000 people living around the park, many of whom have very limited access to basic needs. This makes it quite a complicated landscape to address many of the problems.”



### The Limitations in Accessing Healthcare

Traditional ethnomedicine<sup>xiv</sup> is the first level of healthcare accessed by people living in the Maroantsetra region in northeastern Madagascar. Here, 241 species of plants have been identified as providing ethnomedical treatment to 82 categories of illness, demonstrating that traditional medicine is a well-established practice. Not limited to this region or Madagascar alone, the World Health Organization estimates traditional medicine is used by 80% of Africa's population as a way to address a gap in healthcare needs.

A survey looking at medical access and barriers in the Maroantsetra region found that the majority of adolescent men and women rely first on traditional medicine as a way to address illness.<sup>xv</sup> This is because of three key barriers in accessing healthcare in the region:

- **Geography:** People in Maroantsetra region need to travel between one and eight hours by foot to reach the nearest Centres de Santé de Base (CSB) I or II clinic, both of which provide different levels of service. River or sea travel would reduce that time, though safety and the logistics of finding and renting a boat can be complicated and cost-restrictive.
- **Financial:** Despite certain healthcare costs covered or subsidized by the government, CSB or hospital visits involve additional expenses, including transportation to facilities, loss of wages for the patient and the family member who likely needs to accompany that person, and the cost of any prescribed medication or treatment.
- **Expertise:** Madagascar has 1 physician per 7,000 people, with most professionals concentrated in urban centers. While<sup>xvi</sup> CSB I facilities have a healthcare professional, they provide only basic primary care and vaccinations. Physicians are limited to CSB II facilities. Allopathic (conventional pharmaceutical) medication is available at the village level in epiceries, pharmacies, and is commonly sold by traveling salespeople with no specific health-related training.

↳ *Watch: MAHERY video on the barriers to healthcare access in Madagascar*

Gathered from the forest and distributed by a traditional healer or self-administered, ethnomedicines are lower cost and more geographically accessible. The value of these plant-based medicines has been compared to that of local allopathic medications, and are estimated to bring household value equivalent of 43% to 63% of median household income.<sup>22</sup> Dependent on the health of the surrounding environment, ethnomedicine is just one further illustration of the important ecosystem services provided by the forest.

<sup>xiv</sup> Often referring to indigenous practices, ethnomedicine describes the use of plants and animal species for medical purposes.

<sup>xv</sup> Reliance on traditional medicine was lower for more vulnerable populations, including children and elderly.

<sup>xvi</sup> How about in your country or region of origin? What is the recommended rate of doctors per population?

Sources: Bustamante, N.D., et al. 2018. A qualitative evaluation of health care in the Maroantsetra region of Madagascar. *International Health*. <https://doi.org/10.1093/inthealth/ihy070>; Golden C.D., et al. 2012. Rainforest Pharmacopeia in Madagascar Provides High Value for Current Local and Prospective Global Uses. *PLoS ONE* 7 (7): e41221.



*An area of forest on Nosy Mangabe, a small island reserve in northeastern Madagascar that is part of Masoala National Park.*



*Park Director Hervé Andrianjara Amavatra outside the office of Masoala National Park. He says that while the park does not condone hunting, they can understand why it's a necessity for some families.*

Reaching the villages where those people live requires a trip via a combination of either motor vehicle, boat, or foot, a journey that can take from a few hours to days. Scarcity of food, finances, and healthcare pose an acute threat to these communities, and this reality has led to an increased dependence on the forest and its wildlife species.

Across Madagascar, including in the northeast, terrestrial mammals are commonly hunted as a subsistence food source.<sup>23</sup> Also known as bushmeat hunting, terrestrial wildlife hunting has not always been well studied in Madagascar. Part of the reason, experts say, was that it was never considered a significant threat when compared to other causes of species decline such as deforestation and forest fragmentation.

Another reason bushmeat hunting was not recognized as a threat was because of its low public visibility. Unlike in West and Central Africa where wildlife ranging from antelopes to chimpanzees to forest elephants can appear at local markets, the comparatively small size of Madagascar's mammals mean hunts are often surreptitiously transported from forest to home and consumed wholly by a single family. While other threats, including the short and long-term ownership of lemurs as pets<sup>24</sup> and the sale of certain types of bushmeat as a luxury food item,<sup>25</sup> are present in Madagascar, they're much less common than in other regions of Africa. For example, in the Congo Basin, a hotspot for illegal wildlife hunting, an estimated 4.5 million tons of bushmeat enters the market annually, often for luxury consumption.<sup>xvii</sup>

Lack of bushmeat visibility in Madagascar is also driven by the illegality of the action and by stigma. "[Bushmeat] is considered poor people's food, and so you're not broadcasting to people that you're eating it," says Dr. Christopher Golden, who in 2009 published one of the first papers looking at subsistence wildlife hunting in the Makira forest. The use of bushmeat as a subsistence food source is also reflected in some central African countries, including Cameroon where bushmeat can be purchased from the market. Similar to Madagascar, bushmeat consumption is generally limited to the poorest of households as opposed to being a luxury product.<sup>26</sup>

In Masoala National Park, Park Director Hervé Andrianjara Amavatra says there were 13 lawsuits against lemur hunters in

<sup>xvii</sup> Read more on the global bushmeat from [this document](#) of the Convention on Biological Diversity and Center for International Forestry Research (CIFOR)

2018, and nine the previous year—though he notes the greater number was due to an increase in patrols, and not necessarily in hunting activity. “I know the sanctions of the penalty are a little bit tough, but there are some awareness raising activities that we have done so people should not commit infractions,” says Amavatra. He says the park staff doesn’t explicitly see hunters as “bad” people, though.

Former bushmeat hunters are often aware of the consequences of their actions. “Almost all the animals have disappeared,” says Laurent, who lives in the northeastern village of Antaravato. “We can’t hear the voice of the babakoto<sup>xviii</sup> from our home anymore. I realized that if all the lemurs would disappear there would be no stories for the future generations.”

Moratombo, another former hunter, learned to catch wildlife when he was a child, a skill he attributes to his ancestors. “The meat of lemur was so tasty, and that’s the reason I ate it. It made me strong,” he explains. “I would bring the meat back to my family, normally three times a week. Now the lemurs and the forest are very far away because people are cutting the trees and others are hunting with guns.”

<sup>xviii</sup> Babakoto is the Malagasy name for the indri, the largest lemur species.



### The Effects of Social Discounting

A concept called social discounting can further the understanding of why people in northeast Madagascar hunt, despite seeing the decline of their surrounding natural environment. Social discount rates are the element of cost-benefit analysis used to “put a present value on costs and benefits that will occur at a later date.”<sup>27</sup> For example, someone with a 5% annual social discount rate may perceive a service offered by an ecosystem as worth \$1 today, but just \$0.95 a year from now—a 5% loss in value. The higher the social discount rate, the more a group of people is likely to use a resource today in fear that it will diminish in value in the future.

Social discount rates differ greatly based on context, but range in developing countries between 8-15% annually, with developed nations averaging 3-7% each year.<sup>28</sup> Early results from studies conducted in the Makira forest show that discount rates are incredibly high, perhaps approaching 50%. When it comes to wildlife hunting, this translates to an urgency of ‘hunt this animal today because there’s a high likelihood that it will not be there later.’

## Zoonoses in the Anthropocene

Bushmeat hunting still commonly occurs in northeastern Madagascar. A 2009 survey conducted by Dr. Christopher Golden and his team found that 95% of households had consumed some type of terrestrial mammal in the past year, including 23 species of lemur, bats, tenrecs, and bush pigs. Additionally, over half of households had eaten a lemur species even under a hunting ban. Bushmeat hunting can be a crucial food source, but also have negative implications for human health. Examining the risks requires a trip across the Mozambique Channel to mainland Africa.

Zoonotic disease may not be a mainstream term, but its epidemics are. The global shutdown caused by the COVID-19 pandemic in 2020. Ebola in Sierra Leone, Guinea, Liberia, and the Democratic Republic of Congo. The original emergence of HIV. All are examples of zoonotic disease—infectious diseases spread from animals to humans. Worldwide, 75% of emerging infectious diseases originate from this breaching of the animal-human barrier.<sup>29</sup> Patient zero—the first human infected by a disease—often comes from a location where there are unique or intensified interactions between humans and animals.

Though transmission varies depending on the infectious disease, the spread of pathogens generally happens through a few key steps. First, the zoonotic virus or bacterium is transmitted from a wild animal to humans or domestic animals. In his TED talk about the global emergence of zoonotic disease, virologist Dr. Nathan Wolfe illustrates this first step with photos of hunters in central Africa. The images show men with wild game hoisted over their shoulders—a source of either food or income for their families. In many cases these animals are bloody.

Wolfe says the intimate interaction between hunter and catch is an ideal scenario for people to come in contact with the fluids and tissues of infected wildlife, exposing them to disease as a result. Cuts and bites from infected animals also present an opportunity for disease exposure. Hunters and butchers of wildlife are at greatest risk, though risks affect any person overseeing the transportation, sale, or cooking of an infected animal. In many cases it’s not possible to know whether an animal is infected in the first place.

↘ [Appendix: Nathan Wolfe’s TED talk – The jungle search for viruses](#)

Larger-scale anthropogenic activities can exacerbate the spread of zoonotic disease. That includes the consumption demands of a growing human population and the globalization of trade. The first has led to rapid land use change to make way for human settlements and food production. Deforestation is a major cause of land use change in both Madagascar and across sub-Saharan Africa. With a population that is expected to double in the next three decades, the region's forests are a valuable source of fuel for firewood and land for agricultural expansion.

Madagascar is just one testament to this trend. A lower income country that is rich in natural resources, strong evidence has drawn the connection between greater economic prosperity and a reduction in forest cover.<sup>30</sup> The scale of this threat is substantial—in pursuit of traditional economic development and a desire to improve qualities of life, the motivations behind deforestation in low and middle income countries are difficult to contest.

Increased risk of disease transmission, zoonotic and otherwise,<sup>xix</sup> is an unintended consequence of deforestation. Interestingly, if looking solely through the lens of preventing zoonoses, a complete clear-cutting of forest would be better for human health, particularly when compared to the selective logging that happens in many parts of central Africa and Madagascar. Selective logging is the practice of cutting certain high-value hardwood species while choosing to leave the rest—this means wild animal habitat remains, though in a more concentrated area. There is as a result greater opportunity for humans to come in contact with wild animals and the diseases they may carry.<sup>31</sup>

Even anthropogenic activities meant to improve human health—the construction of a road into a rural village in order to provide improved health services, for example—can increase disease transmission. Those roads link previously isolated communities with urban centers, exposing people to diseases from other parts of the world and vice versa. Making previously inaccessible tracts of forest reachable by road can also increase the ease and appeal of bushmeat hunting in those locations. Finally, roads contribute to the globalization of trade, meaning that diseases once isolated to small pockets of the world now have greater potential to spread through traveling products and people.

In Madagascar specifically, there isn't yet evidence of the spread of zoonotic disease due to bushmeat hunting. General awareness campaigns do, however, aim to educate people about the real possibility of the emergence of zoonoses like has been witnessed in many regions around the world. "There are lots of national communications on the radio to say that people who eat wild animals, especially bats, need to be careful because they could bring viruses," says Johnnah Ranariniaina, Manager of Livelihoods with the Wildlife Conservation Society in Madagascar. Though discussed, Ranariniaina says people only have a basic awareness at best. "It's still minor because people have not seen a tangible case in their village that shows someone died because of a [zoonotic disease] outbreak."

However, research from northeastern Madagascar indicates many people have a deeper traditional knowledge of how animal and plant species affect their health. A study found that more than three-quarters of social taboos (*fady*) held by Malagasy households were linked to spiritual immunity, physical health, and personal security—all elements of human health and well-being.<sup>32</sup> These taboos have been orally passed down through empirical observation, and govern behavior through the prohibition of certain actions. Says the study: "The local Malagasy stories often illustrate a sophisticated understanding of germ theory, whereby microorganisms, too small to be seen by the eye, are believed to be the root of contagion and disease."



*A critically endangered bamboo lemur in Madagascar's Andasibe-Mantadia National Park.*

<sup>xix</sup> The case studies in chapter 3 and 6 of this anthology examine the effect deforestation has on water quality and the spread of diarrheal and water-borne diseases in Indonesia and Fiji.



*People living in Antaravato village talk outside their homes after a morning health survey. While some families live in houses with corrugated metal roofing and multiple rooms, most people live in these raised, one-room homes constructed of reeds and raffia.*



## The Role of Food Taboos on Health and Well-being

Be it for reasons of health, economics, religion, or simply what tastes best, everyone has motivations for why they eat what they eat. Food taboos are another factor—cultural practices that dictate what people should and should not hunt and, as a result, eat. “You can’t truly understand why people are hunting or not hunting certain species without understanding the social system in which hunting behaviors are embedded,” says Dr. Christopher Golden, who co-authored a study on the potential implication of Malagasy food taboos on human health and species conservation.

The study documented 1,119 taboo stories in 819 households, with 65% of households having an origin story for at least one food taboo. While taboos have sometimes been reduced to superstition, the study found certain taboos were consistent with findings of modern science and medicine. Based more on observation versus empirical “hard science,” taboos were found to be an invaluable form of Indigenous knowledge that could be used to advise against the consumption of certain animals that pose a potential threat to a person’s health. A notable 21% of food taboos related to physical health in the form of zoonotic disease, toxins, or allergic reactions.

The hedgehog tenrec is an interesting example of how a food taboo could potentially safeguard human health. The small ground mammal is an effective reservoir of the bubonic plague,<sup>xx</sup> a medieval zoonotic disease that has caused epidemics in Madagascar since 2012. The most common food taboo in the Makira forest region relates to hedgehog tenrecs and “according to local stories, ancestors would bleed, vomit, and have foamy mouths following hedgehog tenrec consumption, similar to symptoms of bubonic plague.” While 45% of households had a food taboo for the hedgehog tenrec, just 3% had a similar taboo for the common tenrec, a species similar in physical appearance, and yet not an effective host for the plague. In this case, the research concludes that traditional knowledge of plague and its link to hedgehog tenrecs could have informed the creation of this food taboo.

Conservation-wise, a quarter of the population has a food taboo related to lemurs. The study hypothesized as to whether this taboo could have conservation-related impact in a region where nearly half (49%) of the population hunts lemurs. It found that nearly all households with a lemur taboo abide by that taboo, whereas 42% of the population complies with local conservation policies. The conclusion was that, while not 100% effective in accomplishing conservation purposes, food taboos should be understood by conservation-focused organizations in order to thoughtfully couple these beliefs with more conventional forms of environmental policy-making.<sup>xxi</sup>

*Source: Golden, C. D., and J. Comaroff. 2015. The human health and conservation relevance of food taboos in northeastern Madagascar. Ecology and Society 20(2): 42. <http://dx.doi.org/10.5751/ES-07590-200242>*

<sup>xx</sup> Curious about the bubonic plague?  
↳ [Read here.](#)

<sup>xxi</sup> What are some food taboos from your place of origin or current place of living?

While taboos are present in Malagasy households, subsistence food needs can contradict these beliefs and lead to bushmeat hunting—a more affordable action families take to improve nutrition and provide other essential health benefits.



*A tenrec and a sifaka lemur (photos courtesy of Dr. Benjamin Rice)*

## Bushmeat Hunting: The Need for Nutritious Diets

It's smoky in the kitchen and the light streaming through the wood slat walls is suspended in the haze. Maman'i Aimé is preparing lunch. Crouching over the cooking hearth, she adjusts the burning branches and the fire radiates warmly into the small room.

Picking up an old condensed milk can, Maman'i Aimé measures portions of rice—enough for the nine people who will be joining her table today. Next to the fire hearth is a metal bowl of cassava leaves that have been pounded into a coarse grind. With the rice cooking, Maman'i Aimé calls out to her son who quickly clambers up a palm tree to retrieve a coconut. Her husband, Laurent, chops it in half with a machete and Maman'i Aimé extracts the milk by squeezing the meaty coconut flesh through the coarse weave of a cloth satchel. Combine these ingredients and you have a dish called ravimbazaha sy voanio—cassava leaves and coconut served over rice. Maman'i Aimé tosses the remaining coconut fibers to her chickens who squawk excitedly around the sandy yard.

The family's average meal is usually a bit more basic: moringa leaves stewed in salty water, perhaps with dried fish. Other staples include plantain, breadfruit, and ovy dia, a wild yam foraged from the surrounding Makira forest. Whatever the accompaniment, it's always served alongside a heaping plate of white rice, the likes of which is grown in the family's nearby paddy or hillside field. Rice is the foundation of Malagasy meals, and paddy field production is particularly high in this part of the country where consistent rain provides plenty of access to surface water. Eaten for breakfast, lunch, and dinner, Madagascar has one of the highest rates of rice consumption worldwide.

Maman'i Aimé's family is not unique in their meal selection. A nutritional analysis of diets in rainforest communities in northeastern Madagascar—including Antiaravato, the village where Maman'i Aimé and her family live—tracked the 250 types of foods eaten over a nine-month period. Research was gathered and analyzed by Madagascar Health and Environmental Research (MAHERY), an organization founded by Dr. Christopher Golden.

The study found that cereals like rice, root vegetables, and starchy tubers,<sup>xxii</sup> constitute nearly 80% of the Malagasy diet by weight. That translates to a diet that is very high in carbohydrates, has sufficient protein (primarily from rice), and not very much fat. Many of these foods are low in micronutrients,<sup>xxiii</sup> and diets were

<sup>xxii</sup> Including cassava, yams, taro, and sweet potato.

<sup>xxiii</sup> Why are micro-nutrients important? How about others like iodine, iron, or magnesium?

found to be severely lacking in calcium and vitamins A, B12, and D. Overall, households were found to be consuming an acceptable amount of food<sup>xxiv</sup> for just over half of the year, though distribution of food among family members is inconsistent.

Micronutrient deficiencies are difficult to visually diagnose, which has led to the public health community penning the term 'hidden hunger.' The term describes the chronic micronutrient deficiency faced by more than two billion people worldwide—more than twice the number who are malnourished due to a lack of calories.<sup>33</sup> Hidden hunger<sup>xxv</sup> can lead to a compromised immune system and predisposition to certain diseases, affecting the health of individuals, families, and countries for years to come. Economic growth is a major determinant in reducing this burden.<sup>34</sup>

While conventional and higher yield crops like carrots, onions, and tomatoes can be grown in other parts of Madagascar, year-round rain and a likelihood of cyclones means farmers in the northeast region are limited to growing rice and a variety of valuable cash crops like vanilla, coffee, and cloves.<sup>35</sup> Even though vegetables and other packaged products are shipped to Maroantsetra, the nearest market town, those products are expensive and geographically far. Maman'i Aimé makes the multi-hour trip to Maroantsetra just four times a year. For most people in Antiaravato, they're reliant on what they can grow, gather, and hunt in their surrounding environment.



<sup>xxiv</sup> The study used the World Food Programme's Food Consumption Score (FCS) index to determine whether a household was eating an acceptable, borderline, or poor consumption of food. The index outlines the frequency in which eight food groups should be eaten over the course of a week. Food groups include main staples, vegetables, fruit, meat/fish, and milk. More information about the FCS index [can be found here.](#)

<sup>xxv</sup> Is there hidden hunger in your part of the world? How is it being addressed? Check out [this map](#) to understand where the problem is worst.

Chickens in Antiaravato



*Pounded cassava leaves are a common green in Malagasy cooking*



*Maman'i Aimé uses a famiaham-banio to extract the milk from coconut shavings. She's preparing ravimbazaha sy voanio, a delicious dish of cassava leaves and coconut served over white rice.*





## Why the World Can't be Vegetarian

What would happen if the world were vegetarian or vegan? It's a question that's been posed by various popular media articles and pondered on global platforms like the World Economic Forum. Research supports the shift. Respected nutritionist and epidemiologist Dr. Walter Willett from the Harvard Chan School of Public Health recently advocated for the benefits of a plant-based diet, including its role in reducing the risk of non-communicable diseases like diabetes and heart disease.<sup>36</sup> Worldwide, red meat consumption is 288% higher than the planetary boundary (or 638% higher in North America).<sup>37xxvi</sup>

Decreasing consumption of animal-based protein is thought to be one of the most effective individual ways of lessening the effects of climate change. The agricultural industry is the largest producer of methane and nitrous oxide, which, in addition to carbon dioxide, are two of the most damaging greenhouse gases.<sup>38</sup> In fact, recent studies estimate the livestock sector (both the rearing of animals and the land use conversion to make space for domestication) could consume between 37% and 49% of the greenhouse gas budget created in order to limit global warming between 2°Celsius and 1.5°Celsius by 2030.<sup>39</sup>

With evidence mounting, it seems like a moral imperative to become vegetarian. But as the recent EAT-Lancet Commission on Food, Planet, Health found, pressing vegetarianism on the world is not feasible for many communities and cultures worldwide, especially in sub-Saharan Africa. The region has the highest burden of stunting, a condition that prevents the proper growth and cognitive development of children within the first 1,000 days of their life.<sup>40</sup> Chronic under- or malnutrition is commonly blamed for stunting, and can be linked to a lack of the protein and key micronutrients that are particularly rich in animal-source foods. Despite too-high red meat consumption trends worldwide, access to animal-based protein in sub-Saharan Africa is projected to be lower than the healthy reference diet developed by the EAT-Lancet team.<sup>xxvii</sup> Additionally, there is the need to consider the taste and cultural preferences of local communities who may be accustomed to eating fish and livestock as part of indigenous diets.

The conclusion drawn by the EAT-Lancet Commission is contrary to ideas of total vegetarianism: people living in sub-Saharan Africa could benefit from an increase rather than a decrease in animal-source protein, while still eating within planetary health boundaries. The commission advocates that, as with other categories of food, consumption needs to be considerate of the regional and socioeconomic realities of the people doing the dining.

More context on this topic is offered in a case study looking the need to restructure the present-day food system.

xxvi ↘ [Here are the countries that consume the most meat in the world.](#)

xxvii The healthy reference diet recommends the consumption of 84 grams of animal-source protein per day, while the availability of animal-source protein in sub-Saharan Africa is projected to be just 13 grams per day by 2050, given current population estimates.

Animal-source foods, rich in micronutrients, make up around 5% of the diet by weight in northeast villages with wildlife contributing 40% of the total. Up to three quarters of hunted terrestrial wildlife species are classified as endangered<sup>41</sup> or critically endangered. Another option for animal-source food is domestic livestock such as chickens and zebu, though ownership of these animals is often limited to wealthier households. Studies from eastern Madagascar have shown that domestic animals and fish are the preferred food among people, demonstrating that bushmeat hunting often occurs out of necessity as opposed to preference.<sup>42</sup>

A family's bushmeat consumption habits change throughout the year. People generally have a higher macro and micronutrient intake during the hot season of September to January, months that correspond with peak fishing and rice harvest season. On the contrary, surveys show a drop in protein, vitamins A and B12, zinc, and fat between February and September when fishing and rice aren't as readily available.<sup>43</sup> During these periods, families who cannot afford domestic meat supplement their nutritional intake by hunting lemurs, tenrecs, and other terrestrial mammals. This bushmeat is an essential part of diets, especially for children whose growth and development are seriously impacted by a lack of iron and other micronutrients.

### ↘ [Appendix: Seasons in Madagascar recognized by the local Malagasy in the Maroantsetra region \(from Golden et al 2019\)](#)

Iron-deficient anemia (IDA) is the most common cause of anemia worldwide,<sup>xxviii</sup> and is a hidden hunger that occurs primarily when a person isn't eating enough iron-rich foods. It's further exacerbated by infectious disease burden, intestinal parasites, or excessive blood loss.<sup>xxix</sup> West and Central parts of sub-Saharan Africa, as well as Madagascar, made little progress when it came to reducing anemia rates between 1990 and 2010.<sup>44</sup> IDA can lead to longer term health effects, including cognitive, motor, and emotional development issues.

xxviii Anemia is described as a low hematocrit. That is your body lacks enough properly functioning red blood cells, and that usually limits the capacity to carry adequate oxygen to your body's tissues. What then could be some signs and symptoms of anemias?

xxix What other conditions can cause iron-deficiency anemia?

Removing access to wildlife is estimated to lead to a 29% increase in the number of children suffering from anemia in northeastern Madagascar. In the poorest households where reliance on hunted wildlife is highest, anemia cases in children would triple.<sup>45</sup>



## Monitoring Malagasy Health

The health of families in Antaravato is well monitored by an organization called Madagascar Health and Environmental Research (MAHERY). Staff with the organization measure the growth and weight patterns of kids aged 12 and under quarterly and conduct dietary intake surveys three times a year.

Data is logged using a small offline tablet powered by the Dharma Platform, a health surveillance tool. The measurements help the MAHERY team track the long-term development and diets of families in northeastern Madagascar.

MAHERY is working in collaboration with the national Ministry of Public Health, Catholic Relief Services, and the Dharma Platform to pilot a community-based health surveillance platform. Currently, the main source of epidemiological data in the country is gathered by the ministry's Centres Santé de Bases when patients visit the clinic, says Hervet Randriamady, MAHERY's National Research Director. However, Randriamady says access to these clinics is often restrictive—and as a result, the data they can collect is limited and doesn't always record the full reality of people living in rural regions. For example, the ministry may never hear about community illnesses or outbreaks, and as such are unable to appropriately allocate resources or send in medical staff to address epidemics.

The health surveillance system being trialed by Randriamady and the MAHERY team could bridge the gap between community and ministry. The paperless platform reduces human error and allows for the faster transfer of data. If the pilot proves successful, community health workers across Madagascar could be equipped with a tablet and the health surveillance platform. Not only that, but the health data that's collected could be paired with climate and habitat mapping data to get a big picture look at how the health of communities is affected by changes to the natural environment.

*A young boy in Antaravato village stops snacking on rice in order for Rivo, an employee with Madagascar Health and Environmental Research (MAHERY), to measure his head circumference. These anthropometric measurements happen every three months.*





*Maman'i Aimé and Laurent outside their home in Antaravato.*

Back in her kitchen in Antaravato, Maman'i Aimé says her family was one of those households. “We were struggling to find food because of the difficulty getting money, especially for our first child,” she says. At the time, the family didn't have a plantation of their own to grow crops, and performed small jobs for other people to make enough income to purchase food.

“When I was working in the faraway field plantations I started to build some [wildlife] traps so I could eat,” explains Laurent, Maman'i Aimé's husband. Flipping over a piece of paper, he sketches his passive snaring method, identical to the trap set in the forest by Zandrilahy and similar to the majority of traps set up in the region.<sup>46</sup>

The family's meals were soon supplemented by bushmeat. “In 1992 our second son was born. Since then when I caught lemurs I would bring them home for all of my family. That was to feed them, and it related to the fact that I had two young children,” Laurent explains. “If I did not bring home that lemur we wouldn't eat meat and we would just eat greens.”

Laurent stopped hunting in 2005, persuaded by awareness programs conducted by the Wildlife Conservation Society and the prompting of a catchy tune from Malagasy artist Clément Mily. The musical ode to encourage people to protect their natural environment was widely popular in the nineties, and is called *Mandrora mantsilany*. This translates loosely to “if you spit lying down then your spit will come back to you.” Laurent smiles and hums a few bars outside of his home.

↘ [\*Appendix: Mandrora Mantsilany on YouTube\*](#)

Laurent and Maman'i Aimé say it's easier to put food on the table today. They started their own agricultural plantation in 2000 and can now grow more crops. Maman'i Aimé says they eat meat about once a week—sometimes zebu, but more commonly the scrawny chickens scurrying around their yard. Still, limitations exist. “We can eat every day but sometimes we cannot afford expensive meat,” Maman'i Aimé says. “My favorite meal is freshwater fish from this area with some greens. I do love lemurs, but they're very rare today.”

## Sustainable Wildlife Hunting: A Possibility in Madagascar?

Hunted wildlife remains an important part of diets for many in northeastern Madagascar. As research has shown, reducing a reliance on wildlife and conserving biodiversity demands more than hunting bans or creating protected areas. Instead, it requires a conservation and development intervention that will transition people away from bushmeat without taking a toll on their nutritional needs or limited financial resources.

That intervention could take different forms. One option is the continued hunting of certain wildlife, though done in a way that is sustainable and allows for the reproduction and growth of those populations. But is that possible in Madagascar and other parts of the world?

A 2013 review of 750 harvest sustainability evaluations worldwide found 65% of harvests had been deemed sustainable,<sup>47</sup> suggesting that sustainable hunting could be a possible strategy. However, the authors of the review noted that these evaluations may be challenged because they relied on indicators gathered once as opposed to over time. As a result, the data may not capture the wildlife population trends that could increase or decrease due to factors such as habitat and climate change.

In Madagascar, a new global program is taking on this question of whether hunting can be done sustainably. The European Commission-funded Sustainable Wildlife Management Programme was launched in July 2018 and is led in Madagascar by the Wildlife Conservation Society (WCS) in collaboration with various national and international partners. One of the programme's approaches in Madagascar is to see if there are "resilient wildlife and domestic species" that could be used to transition people away from a reliance on bushmeat<sup>48</sup> to achieve interlinked objectives of promoting wildlife, conserving the ecosystem, and improving livelihoods and food security.

Lemurs and many other terrestrial mammals are protected by law. However, "there are other [wildlife] species that are not protected, which, if hunted sustainably, could provide a sustainable and healthy source of wild meat for people," says Charlotte Spira, the Ecological and Social Research and Monitoring Manager with WCS. Possible legal, sustainable wildlife, she says, could be wild pigs, which are not a conservation priority as they are an introduced species, and certain species of rodents and tenrecs. "One of the

activities planned in the SWM Programme is conducting wildlife surveys to estimate the population sizes of these species to inform decision-making at the community level, for them to adopt more environmentally friendly hunting practices," says Andrew Kirkby, WCS' MaMaBay Landscape Coordinator.<sup>xxx</sup>

Ecologist and founder of MAHERY, Dr. Christopher Golden, agrees that wild pigs could be a sustainable hunting option, but says they're an exception. Overall, he's less certain the terms 'sustainable' and 'wildlife hunting' can go together in Madagascar. This is because of the types of species in the country, their reproductive behavior, and the size of the human population that relies on them.

For example, lemur species that reproduce at a later age and have longer intervals between births are more susceptible to overharvesting.<sup>49</sup> Research indicates that the season in which people hunt has the ability to both positively and negatively influence the sustainability of lemur populations.<sup>50</sup> Bushmeat hunting in northeastern Madagascar is especially common between March 15 and June 15 because these months correspond with off-peak fish and rice harvest season. It is also the wet season when fruit-laden trees attract lemurs which increases the likelihood of hunting success.

Dr. Christopher Golden says he can't foresee a solution that is a triple win for the sustainable hunting of bushmeat, lemur populations, and food security. That's why he and the MAHERY team have introduced a solution that involves alternative foods such as chickens. Studies from eastern Madagascar have found that people prefer many kinds of domesticated livestock (e.g. pig, chicken, zebu, goose, turkey, and duck) over the common brown lemur, the most desired illegally hunted wildlife.<sup>51</sup> This suggests people would be willing to eat chicken as an alternative to bushmeat—if it were an affordable and viable option.

<sup>xxx</sup> What are some places in which "sustainable hunting" is allowed and working well?

## On Poultry and Planetary Health

“If there was no disease many people would become rich,” says Jerome, shaking his head. Another resident of Antaravato, the village at the edge of Makira forest in northeastern Madagascar, Jerome’s face is barely visible in the little light radiating from his storefront. His 20 chickens have been brought inside for the night. Jerome has been rearing poultry for more than three decades. Like many people in Antaravato and villages across Madagascar, he and his chickens have faced their fair share of problems.

Over the years, Jerome estimates he’s lost more than a thousand chickens to an infectious bird fever called Newcastle disease.<sup>xxxii</sup> He isn’t alone—a Madagascar-based study found the disease causes up to 40% mortality in non-vaccinated flock.<sup>52</sup> While people consider chicken a delicious food source, viability and consistency of flock has been an issue because of this disease. Currently, bushmeat presents a cheaper and more reliable source of much-needed micronutrients.

There is a vaccine against Newcastle disease, but it can only be injected by a trained veterinarian.<sup>xxxiii</sup> In a context where people rarely leave the village for pressing health concerns, the likelihood of traveling for a chicken vaccine is slim. This injectable vaccine also needs to be refrigerated, a barrier in rural villages where the nearest fridge may be a day’s walk away.

In 2014, MAHERY approached Dr. Ando Miharifetra, head of the Department of Vaccine Production at the Institut Malgache des Vaccins Vétérinaires (Malagasy Institute of Veterinary Vaccines, referred to in short as IMVAVET) in Antananarivo, Madagascar’s capital city. With intellectual and financial support from MAHERY and the Wildlife Health Network, the IMVAVET team developed a thermostable<sup>xxxiii</sup> vaccine that could withstand the challenging conditions of Malagasy villages like Antaravato.

The newly developed vaccine comes in an inconspicuous eye dropper bottle. With a handful of rice tossed to the ground as a diversion, a man quickly scoops up one of the chickens dashing around the yard. Josiane brandishes a small eye dropper bottle and tenderly holds the chicken’s head between her index finger and thumb. A droplet lands in its eye and seconds later the bird is released, left to continue its rice pecking.

This is the scene that plays out in certain households across Antaravato and five other villages every four months. The small eye dropper bottle means the vaccine can be administered by community vaccinators like Josiane. Trial vaccination has been ongoing since May 2016, and Josiane is one of the volunteers who was trained by the IMVAVET and MAHERY teams.<sup>xxxiv</sup>

These trials have shown promising results in six rural villages in northeastern Madagascar. Data gathered between 2011 and 2018 found that village chicken populations could stabilize and grow with moderate, consistent vaccination. However, complete herd immunity<sup>xxxv</sup> against Newcastle disease would require at least 85% of all village chickens be vaccinated, something that is unlikely with community vaccination alone.

Even with a thermostable vaccine that can be administered by community members, challenges in raising village chickens remain. For one, vaccination needs to happen every four months, otherwise chickens remain at risk of contracting the disease. While relatively inexpensive per individual dose—100 Ariary, about USD \$0.03—Josiane says the cost can add up for large flocks, and is compounded by the fact that people are skeptical of the vaccine’s effectiveness.

“They say that their chickens will go blind, or that their chicken died due to vaccination,” says IMVAVET’s Dr. Miharifetra of some of the reasons why people are resistant to the vaccination. “When they say something like that we’re trained to convince them otherwise, but it’s very hard. As of right now we have failed 100% of the time.” Increasing acceptability of the vaccine through community education and outreach is an important next step for MAHERY and IMVAVET.

For Jerome, the long-time poultry farmer, the cost of the vaccine is a worthwhile investment. “Even if I raised hundreds of chickens I’d still get the vaccine because the cost of one chicken that stays alive could cover the cost of the vaccine for me. Since I’ve been part of the vaccination program no chicken has died. It’s been very effective,” he says.

<sup>xxxii</sup> Care to read more on Newcastle Virus? [Click here](#)

<sup>xxxiii</sup> All these are challenges of many types of vaccines administered to humans.

<sup>xxxiii</sup> Which is to say it doesn’t require refrigeration

<sup>xxxiv</sup> In recent years, and thanks to the work of the GAVI Alliance, vaccination rates for children have actually almost doubled! [Read more here.](#)

<sup>xxxv</sup> What is herd immunity?



*Josiane administers the vaccine against Newcastle disease. While administration of this eyedropper fluid is easier than the previous injectable vaccine (which could only be administered by trained veterinarians), Josiane still faces other challenges in convincing community members to vaccinate their flock.*



*Dr. Ando Miharifetra from IMVAVET inspects one of the insulated bags used to transport the I-2 vaccine to northeastern Madagascar. The vaccine must first be transported by plane from the capital city of Antananarivo to Maroantsetra, where it is then driven, boated, or walked into rural communities.*

The Wildlife Conservation Society is looking to chickens and fish farming as an alternative meat source to wean people from bushmeat, though their approach differs from that of MAHERY. WCS plans to establish 150 demonstration farms in the 10 Communautés de Base (COBA) where its Sustainable Wildlife Management Programme operates. The organization will provide these households with the start-up materials, training, and vaccines they need to either maintain a chicken population or start a fish farm. WCS also plans to train local veterinarians to help provide and administer a thermostable chicken vaccine in collaboration with the Ministry of Agriculture, Livestock and Fisheries.

This poultry program is the next iteration of the agricultural livelihood projects WCS has already been operating around Makira forest. Only now, MaMaBay Landscape Coordinator Andrew Kirkby says WCS is framing its programme slightly differently: “In these 10 selected sites, we want to carry out a very targeted combination of activities including forest management through good natural resource governance, livestock keeping, and sustainable hunting while improving access to veterinary and human health services. We hope that these sites could serve as an example of what is possible and provide guidance and lessons learned to expand to other sites around the park.”

## Epilogue

There are co-benefits for conservation and human health if MAHERY and WCS’ poultry and alternative protein programs are successful and sustainable. For example, chicken survival would mean families have access to a valuable and preferred source of micronutrients in their own backyard, which could reduce their reliance on wild bushmeat. In addition to curbing hunting rates for lemurs and other wildlife, chickens are raised in small areas near a family’s home, reducing the amount of forested land that may need to be cleared to raise livestock or grow crops.

From a human health perspective, healthy chicken flocks could improve food security, address the challenge of ‘hidden hunger’ in children and adults, and limit the contact people make with wildlife that could be carrying disease.

There are also socio-economic benefits to be gained. Chickens are one of the most culturally-appropriate food sources for people. Unlike lemurs which can be taboo to eat, there are few Malagasy cultural taboos that exist against chicken.<sup>53</sup> Finally, both WCS and MAHERY see the potential of poultry not only as a food source, but also as an income generating opportunity for families who want to sell surplus chickens and eggs.

Back in Antaravato, it’s time for another meal with Maman’i Aimé and Laurent. This time, it’s perhaps fitting that chicken is being served. Laurent has owned chickens since he was 10-years-old, and has had a similar experience to Jerome, raising the birds only to see them die with Newcastle disease. “Sometimes you think you don’t want to do that anymore, but when you see the chickens of your neighbor you say, oh I’m going to do that again because you get inspired,” he says.

The family eats meat once a week when the chickens are healthy. Laurent joined the vaccination program at inception and says his chickens have not been killed by the disease since. He says that today many people in the village have poultry, and that there are few people who still hunt lemurs. But it’s hard to know, and local dietary intake surveys certainly reflect that wildlife is still making it onto people’s plates. Until an alternative can be successfully introduced across the entire village, that’s likely to remain true. But today, in this moment, the family has nutritious food on the table. And with that, Maman’i Aimé says a prayer and it’s time to eat.

## Keeping Track of Who's Who

### Maman'i Aimé

*Resident of Antaravato, wife of Laurent*

### Hervé Andrianjara Amavatra

*Park Director, Masoala National Park*

### Dr. Christopher Golden

*Ecologist and epidemiologist; Assistant Professor of Nutrition and Planetary Health with the Harvard T.H. Chan School of Public Health; Director and Founder of Madagascar Environmental Health and Research (MAHERY)*

### Jerome

*Resident of Antaravato and chicken owner*

### Josiane

*Volunteer community chicken vaccinator; resident of Antaravato*

### Andrew Kirkby

*RMaMaBay Landscape Coordinator, Wildlife Conservation Society (Madagascar)*

### Laurent

*Resident of Antaravato, husband of Maman'i Aimé*

### Dr. Ando Miharifetra

*Head of the Department of Vaccine Production at the Institut Malgache des Vaccins Vétérinaires (Malagasy Institute of Veterinary Vaccines, IMVAVET)*

### Moratombo

*Former bushmeat hunter and resident of Antaravato*

### Johnnah Ranariniaina

*Manager of Livelihoods, Wildlife Conservation Society (Madagascar)*

### Charlotte Spira

*Ecological and Social Research and Monitoring Manager, Wildlife Conservation Society (Madagascar)*

### Zandrilahy

*Former bushmeat hunter and resident of Antaravato*

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*A curious brown lemur in Andasibe-Mantadia National Park in eastern Madagascar. Despite being a protected species, the brown lemur is commonly eaten in parts of the country.*

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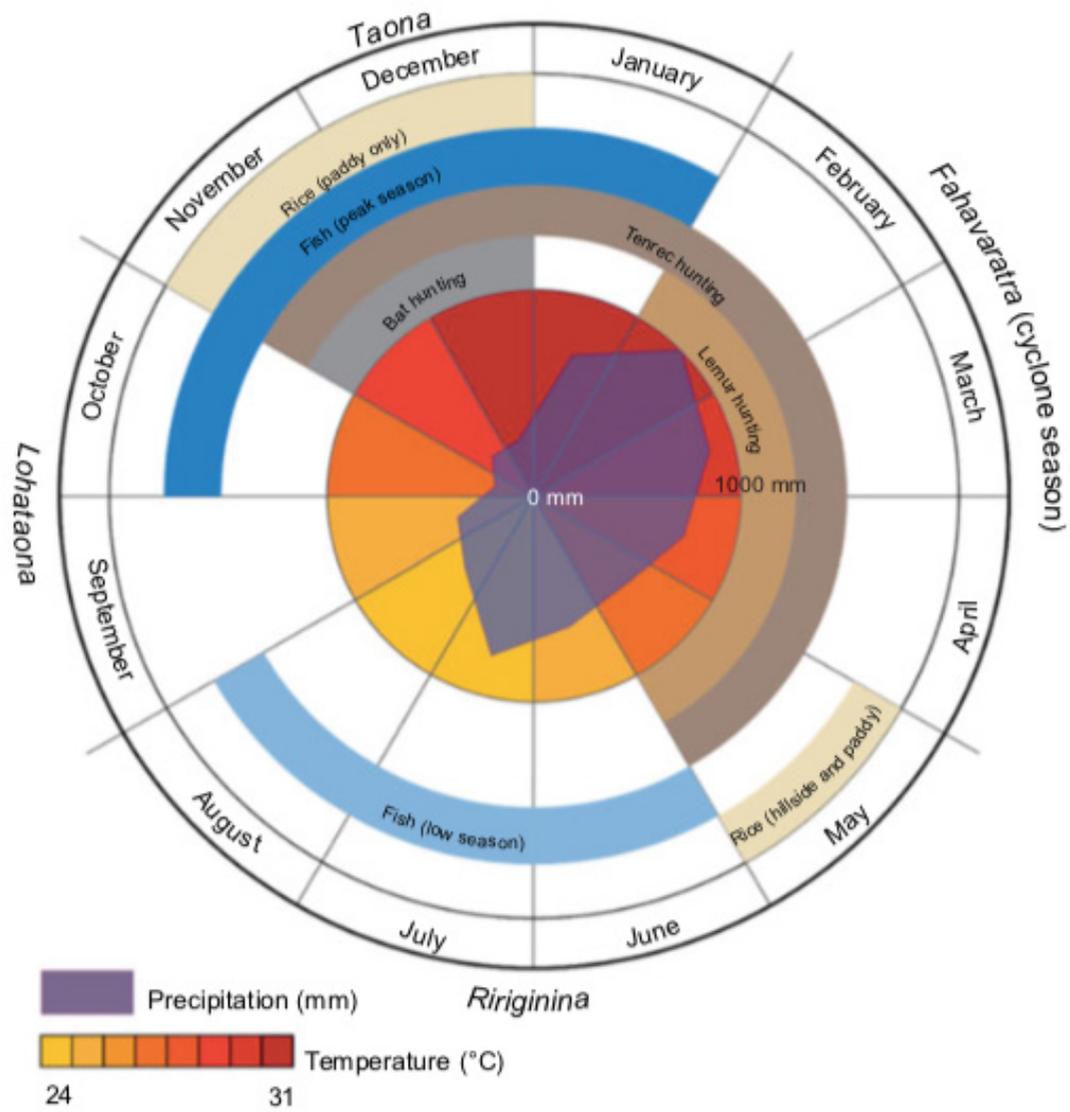
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# Typhoid and Torrents

THE LINK BETWEEN DOWNSTREAM  
HEALTH AND UPSTREAM ACTIONS

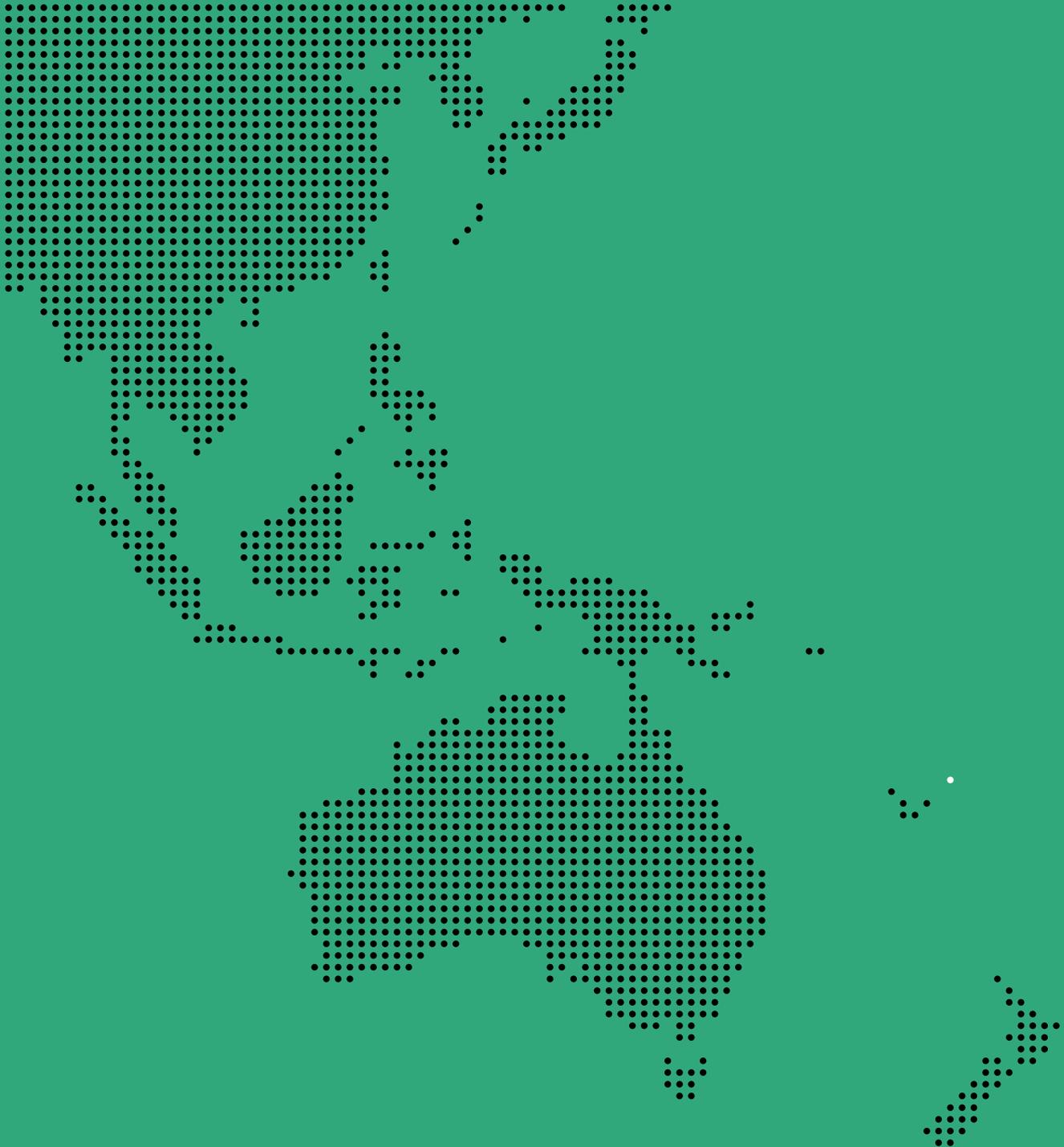
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## Executive Summary

This case addresses themes of land use change, water quality and infectious disease exposure which are also addressed in more detail in the land use and water sections of chapter 4 and the infectious disease chapter 6 of *Planetary Health: \ Planetary Health: Protecting Nature to Protect Ourselves*.

### Learning Objectives

*After examining this case, in relation to typhoid fever in Fiji, students should be able to:*

- ① Understand the interlinkages between land-use changes, river catchment areas, and human health.
- ② Analyze the role of colonial legacies and their impact on land tenure and how these interact with traditional ecological knowledge and natural resources management.
- ③ Apply an ecological approach to understanding the individual, household, local, regional, and global factors that impact health outcomes.
- ④ Design interventions that consider scale and an interdisciplinary approach to complex issues such as infectious diseases in rural Fiji.

<sup>i</sup> Regionally, in river catchments, at a community level, and within individual households.

This case study looks at how anthropogenic environmental change and human behavior at numerous scales<sup>i</sup> increases the risk of typhoid fever and the transmission of other waterborne diseases on the Pacific island nation of Fiji. This includes industrial activities such as upstream deforestation and cattle-farming, poor sanitation standards in riverside villages, and poor household practices around water, sanitation, and hygiene (WASH). The setting for this case study is rural communities on a small island nation, a setting where people are particularly dependent on healthy river catchments for their water, food, and livelihood needs.

Further, customary land tenure and *vanua* (the ways in which people identify with the land and sea) are deeply important in Fijian culture. Erosion of these customary rights can have a negative effect on natural resource management and subsequently increase the spread of disease.

In addition to better acknowledging customary rights, reducing disease transmission requires interventions at household, village, river basin, and national levels, and the involvement of community members and policymakers alike. To that end, the Watershed Interventions for Systems Health (WISH) project, led by a multidisciplinary team of academic researchers, NGO staff, and government officials, is one example of ongoing work to improve and restore river catchment health in Fiji.

*This case study is based on interviews conducted in Suva, Nadi, Nabukavesi, and Naqarawai, Fiji, in October and November 2018.*

## Introduction

Waisea Naisilisili is talking about the value of the natural world when he comes across part of it about to be destroyed. It's an October afternoon, and Naisilisili is driving a large black pick-up truck down from the highlands of Viti Levu, Fiji's largest island. Fiji is an archipelago of more than 332 islands in the middle of the Pacific Ocean.

He slows the truck to inspect the land-clearing happening near the riverbank—one man, maybe two, with chainsaws in hand. “This is my family’s customary land, and these guys are clearing it,” he explains, snapping photos of the scene. “They bought the lease and now this guy is doing big-scale farming.” Naisilisili sits back in the driver’s seat, shaking his head.

Naisilisili is a Fisheries and Operations Support Officer with the Fiji branch of the Wildlife Conservation Society. Before he was interrupted by the scene at hand, he was describing his love of nature and this land that he and generations of his family have called home: “To me, nature is identity, and to protect nature simply means you’re protecting yourself,” he shares matter-of-factly. He refers to the significance of totems—the trees, animals, and birds that ground iTaukei (Indigenous Fijians) in their connection to the Earth.<sup>ii</sup>

“Our traditional belief is that the totems signify who we are and where we are from. They’re very sacred,” Naisilisili explains. This Indigenous wisdom isn’t exclusive to his village or clan alone. Oral narratives across Fiji speak of how observations of plant and animal behavior have been used to predict an oncoming cyclone or tsunami, and offer methods of coping with these risks.<sup>1</sup> This knowledge is important for both the advice it offers and the cultural identity it supports. Naisilisili’s grandmother was a custodian of this knowledge, and his family’s connection to nature is a message Naisilisili is now passing to his own children. He and his family live in Nabukavasi, a small village located along a river of the same name.

The relationship between planetary and human well-being is nothing new to the iTaukei. A connectedness with the Earth is what has historically influenced the way in which clans manage and respect their natural resources—though those beliefs are now being tested by increased connection to the outside world, loss of community self-sufficiency,<sup>2</sup> and the pressures of economic

development.<sup>iii</sup>

Those development stressors involve a range of human activities: gravel extraction, mining, and what Naisilisili witnessed today: deforestation to prepare land for agriculture and cattle farming. These challenges are compounded at a global scale by climate change and an increase in storm severity and frequency, and at a local scale by the growing population of riverside communities with inadequate access to water, sanitation, and hygiene (WASH). These changes are more than an affront to Naisilisili’s customary land—research in Fiji has confirmed that these various scales of environmental change and behaviors can lead to freshwater contamination. As a result, villages like Nabukavesi are increasingly

<sup>ii</sup> Take a minute to try to write down what is your relationship with nature? When did this relationship start? Can you remember when you became aware that “nature” needed to be protected? How has this relationship with nature changed, and why?

<sup>iii</sup> How do you think each of these elements is playing a role as factors that are causing a disconnection between the iTaukei’s relationship with nature?



*Waisea Naisilisili during a road trip break on the way into Viti Levu’s highlands.*

affected by infectious disease transmission, especially typhoid.<sup>3</sup> This is where one of Naisilisili's colleagues comes into the picture. Dr. Aaron Jenkins has spent the past several years researching the effects of anthropogenic activities on river ecosystems and human health. A fisheries ecologist by training, Jenkins was frustrated by what he found when he first came to Fiji in 1996: sediment and nutrients from upstream activities, manure, sewage, and trash flowing into river basins. This human-produced waste wreaked environmental havoc along the coast and disturbed coral reefs and other marine ecosystems. "That's when I knew I better start working upstream so I could understand the connection between what was happening on the reef and what was going on in the river," explains Jenkins.

That run-amuck waste was having human health implications in villages like Nabukavesi where Waisea Naisilisili lives with his family. The river is an integral part of these rural, often remote communities, and people depend on it as an essential source of water for household consumption.<sup>iv</sup> "Reading the newspapers, I'd notice a particular area had been quarantined because of a massive typhoid outbreak and I'd think 'wow, the outbreak is next to this really degraded river catchment<sup>v</sup> where there were no fish and the water quality was crap,'" Jenkins recalls.

While the transmission and prevalence of typhoid fever and other water-borne diseases had been well-researched and documented in other parts of the world, there was still a question mark around the local risk factors affecting people living in isolated Pacific island countries like Fiji. Not only that, but it was still unclear how anthropogenic changes could further impact those risk factors.

Today, a team called Watershed Interventions for Systems Health (WISH) is investigating that relationship between the intersection of environmental change and human health—and is attempting to mitigate the negative health outcomes for riverside villages and the river catchments on which they depend.

<sup>iv</sup> Another case in this anthology takes us to the Senegal River Basin in West Africa, where a dependence on the river puts communities at an increased risk of contracting schistosomiasis, a parasitic disease.

<sup>v</sup> A river catchment is a low-lying area where water gathers. Also known as a river basin or a watershed, a river catchment is named quite literally after its ability to "catch" the water flowing into the region, including from other smaller bodies of water and uphill precipitation. River catchments are also where pollution, sediment, and anything upstream end up. A subcatchment is the name for a segment of a river catchment. These two terms come up frequently in this case study.



*Aerial views of a river system on Viti Levu, Fiji's largest island.*

*A view from Viti Levu's highlands down through multiple river catchments and out to the Pacific Ocean in the distance*



## A Hub in the Pacific

The Republic of Fiji is one tiny piece in the Pacific puzzle that makes up the region of Oceania. Sometimes referred to as the Blue Pacific continent, the region is home to more than a dozen island nations, the likes of which appear miniscule and isolated when looking at a map of the world. Oceania lies in both northern and southern hemispheres, and covers an area of 8.5 million square kilometers. Exclude Australia, New Zealand, and Papua New Guinea, and you have an ocean area greater than that of continental USA, with the landmass of small islands composing an area roughly the size of Cuba.

Fiji and other Pacific island nations are often considered a microcosm for the world. Their isolation, vulnerability to climate change, and size mean the feedback loops that exist between anthropogenic actions and human health are more rapidly apparent than those interactions on continental ecosystems. “Tinker with one part of an island system and almost immediately people downstream are having muddy water and getting more diarrhea. I think this is what makes small island systems an important place to do planetary health research,” says Aaron Jenkins.

Oceania includes groupings of low islands—coral atolls like the countries of Kiribati and Tuvalu which sit barely above sea level—to what’s known as high islands. High islands are characterized by steep slopes and rolling hills, a testament to their volcanic origin.<sup>4</sup>

The Pacific high islands are unique beyond their geographic immensity: their size lends itself to better water resources.<sup>5</sup> Surface water comes from freshwater rivers and lakes, and groundwater spurts from aquifers in highland and coastal areas. These water sources are also replenished by generous precipitation. The increased water availability in high islands means soil is more fertile than that of low islands, and is better suited for supporting human settlements, agriculture, and mineral extraction.

The verdant green folds of Fiji’s highlands are a stark contrast to the turquoise waters that offer a more quintessentially tropical scene. Fijian islands vary in size, from the largest of Viti Levu where the capital city of Suva is located, to more than 500 islets—the name for landmasses that are no more than rock or coral protruding from the ocean. Even Viti Levu is just 146 kilometers from east to west, and a medium-sized propeller plane will get you from the country’s main international airport in Nadi to the capital city

in a prompt 30 minutes. Press your forehead to the window and you’ll see water systems snaking their way to the coast, the geometrics of agricultural plots, overgrown logging roads and, as you land into Suva, the river delta where the muddy, brackish waters of the Rewa River belch into the Pacific Ocean. The obvious interconnectedness between interior and coastal ecosystems observed from the air becomes out-of-sight, out-of-mind as you enter the city.

Fiji’s population is becoming increasingly urban. Located on opposite coasts of Viti Levu, Nadi and Suva are the country’s major urban centers. Consistent with global trends, national census data from 2017 indicate that 55.9% of Fiji’s population<sup>6</sup> of 884,887 live in urban areas, up nearly 10% from two decades earlier.<sup>7vi</sup> The country is ethnically diverse, with iTaukei (Indigenous Fijians) making up 56.8% of the population, and Indo-Fijians<sup>vii</sup> composing another third.

Those who don’t live in coastal cities often dwell in rural river catchment areas in island interiors. That includes in Central Division, a region in the southeastern part of Viti Levu. Central Division is the most populous of the country’s four divisions, and is home to 42% of the country’s population. Here, most people live along two river corridors: the Suva-Nausori corridor near the capital city, and along the Navua River corridor that runs through various subcatchments on its path from the highlands to the coast.<sup>8</sup> Those two river corridors are part of the 26 river subcatchments that split Central Division into a quilt-work of informal boundaries.

These 26 subcatchments are the focal point of planetary health research in Fiji. Aaron Jenkins says he believes these smaller sections of river catchments are the ideal place to look not only at the public health effects of upstream land-use change, but also the environmental and socio-economic determinants of health at community and household levels.<sup>9</sup> Influenced by these many factors, Jenkins is not alone in his assessment that river catchments—and the water that runs through them—are the most appropriate place to promote community resilience and prevent the spread of disease.<sup>10</sup>

The health vulnerabilities of downstream communities are significant. Central Division residents have been exposed to typhoid fever, with 279 cases reported between 2014 and 2017. Of these cases, rural highland villages had the highest incidence rate of disease and nearly as many cases of typhoid fever as urban and peri-urban<sup>viii</sup> areas, despite having a significantly smaller population.<sup>11</sup>

<sup>vi</sup> What percentage of people where you come from live in urban areas? What percentage of the world lives in urban areas? How has this percentage changed in the last 100 years? [↘ Find out more here](#)

<sup>vii</sup> Many Indo-Fijians were first brought to the country as indentured laborers on the sugar plantations the British administration introduced during the start of their colonial rule. Fiji was a British Crown colony between 1874 and 1970. The impacts of colonialism have had long-lasting impacts on the country, from the introduction of capitalism, to the land tenure system that affects natural resource management, to the language and culture of modern-day Fiji.

<sup>viii</sup> Peri-urban areas are an intermediary between rural and urban areas.



*A young girl stands in the doorway of her home in Nabukavesi on Viti Levu. Nabukavesi is just one of many rural communities that relies on its local river when the reservoir in the village runs dry. It's also one of the villages that has faced rising typhoid outbreaks in recent years.*

## The Nested Nature of Fiji's Typhoid Outbreaks

"A few years back we had a really difficult time." These are the first words Rosa Batiri shares, sitting cross-legged on the floor of her home. Batiri lives in Naqarawai village, a community of 54 homes arranged neatly on the grassy plain that runs uphill from the Wainawene River in the highland interior of Central Division. In 2015, Batiri's youngest daughter Ruci, then four-years-old, contracted typhoid when visiting her aunt in a village downstream. "She got a fever and was really weak. I was worried," Batiri says. "Typhoid was one of the main illnesses that was happening at the time. People were getting sick in all of Fiji because of the disease."

A serious illness caused by a bacteria called *Salmonella typhi*, typhoid fever affects an estimated 22 million people worldwide each year.<sup>12\*</sup> Transmission happens in various ways, though the most common is when miniscule particles of fecal matter contaminate drinking water and food, making the disease both waterborne and foodborne.<sup>13</sup> In Fiji, the incidence of typhoid fever has been increasing since the 1990s, and rapidly so since 2005.<sup>14</sup>

Epidemiological studies have found significant differences between Fiji's typhoid outbreaks and those in the rest of the world. Take the population most at-risk. Globally, the World Health Organization considers children under five most likely to contract the disease—kids of Ruci's age. However, a case-control study in Fiji found the average age of infection to be 29-years, with Indigenous iTaukei representing 95% of that group.<sup>15</sup> Epidemiological surveys conducted by Fiji's Ministry of Health between 1995 and 2009 had similar findings, with iTaukei being affected in 82.5% of the 1,509 cases confirmed during the period.<sup>16</sup> iTaukei families are more likely to live in rural and remote communities that depend on clean river water for consumption and household activities.

Access to clean drinking water and household sanitation are two elements that affect disease transmission.<sup>x</sup> Pacific Island countries have the lowest coverage of improved drinking water and sanitation worldwide. Between 2000 and 2015 Fiji was one of 10 countries worldwide where basic drinking water access decreased.<sup>17</sup><sup>xi</sup> Statistics suggest significant water, sanitation, and hygiene (WASH) inequalities between urban and rural communities: 62% of rural Pacific communities lack access to basic water access (compared to 10% of urban communities), and sanitation coverage is below basic in nearly 80% of rural areas (compared to 29% of urban areas).<sup>18</sup><sup>xii</sup>

Urban-rural disparities have been even more apparent since February 20, 2016. That's when Cyclone Winston made landfall in Fiji, affecting more than half of the country's population.<sup>19</sup> The category five tropical storm damaged water supplies in more than 500 villages, and caused nearly \$1.42 billion in damage and loss, a third of Fiji's gross domestic product (GDP). As of late 2018 there are still interior communities whose water and electricity infrastructure are being rebuilt following the storm.



Fiji's typhoid outbreaks increase following major storm events like Cyclone Winston.<sup>20</sup> They also follow seasonable trends linked to climatic conditions—rates peak between January and June, following on the heels of the rainy season when the flooding of rivers and community septic tanks is more likely. Climate change and the increased severity and frequency of weather events are global factors that affect the spread of disease and water quality, not only in Fiji, but worldwide.<sup>xiii</sup>

*An outhouse in Naqarawai village in the highlands of Viti Levu.*

<sup>xiii</sup> The case in Santiago, Chile, also examines how climate change affects safe drinking water access in that country.

<sup>ix</sup> If you were to guess, which part of the world do you think typhoid fever is more common?

<sup>x</sup> Another case in this anthology is set in Santiago, Chile, where a contaminated river led to years of public health outbreaks. The solution that has been proposed for that urban center looks different than the approach in Fiji, but both are examples of planetary health solutions in action.

Where does the water you use come from? How is it treated? What is the governing body over the quality of that water? What laws exist in your place of origin regarding the access to drinking water?

<sup>xi</sup> Do you think clean drinking water is a human right?

<sup>xii</sup> What other diseases are higher in prevalence due to lack of access to safe drinking water?



## Oceania's Vulnerability to Climate Change

Cyclone Winston was the most severe tropical storm to affect Fiji on record, but it will not be the last. Capturing international headlines, Cyclone Winston opened the door for Fiji's climate vulnerability to be discussed on the world stage. At COP23 in November 2017, the Fijian government released the country's first climate vulnerability assessment. Among the sobering highlights: climate change could push an additional 32,400 people into poverty each year by 2050,<sup>xiv</sup> and projected sea level rise would put nearly one-third of the country's population at-risk.<sup>21</sup>

Fiji's vulnerability to climate change is reflected in Oceania as a whole. Oceania is repeatedly ranked as the highest risk region for exposure to natural disasters such as tropical storms, flooding, and sea level rise. Not only vulnerable to the disasters themselves, Oceania receives this rating because of the limited capacity its institutions have to respond to those disasters, its geographic isolation, and the relative poverty experienced by its populations. Along with four other small island nations in the Pacific, Fiji ranks among the top 15 countries facing the highest disaster risk internationally.<sup>22 xv</sup>

<sup>xiv</sup> For example, 37% of Fiji's population derives income from the agricultural sector—this is even more true for people living near or on the poverty line. With climate change affecting precipitation patterns, pest presence, and the water available for irrigation, Fiji's most vulnerable populations could be affected by just the slightest change in productivity. Not unique to Fiji, climate change will disproportionately affect the poorest people in countries worldwide.

<sup>xv</sup> Take a look at the countries with highest degree of climate change vulnerability. Where do you think they rank with respect to greenhouse gas emissions? There are many indexes that address this question, but there are common threads among them. [\ Here is one think tank's approach to measuring such risk](#)

<sup>xvi</sup> This concept is referred to as the "ecological model or approach or framework" in some academic writing.

<sup>xvii</sup> How would you apply this concept of nestedness to a disease that is more common in where you are from? Diabetes? Hypertension? Dengue?

Regional, local, and household risk factors exacerbate the effects of global anthropogenic change on typhoid transmission. Nestedness, a concept borrowed from ecology, explains the need to consider each of these scales when creating a planetary health intervention. Nestedness<sup>xvi</sup> is about assessing how actions in one environment can exacerbate the changes that take place in another. To conceptualize the idea, imagine an onion.

Just as an onion has many layers, so too does Fiji's vulnerability to typhoid transmission. Each layer represents a complex set of environmental stressors. The outer layer includes human-caused environmental changes at a global scale, including climate change which is simultaneously increasing ocean temperatures, the intensity of cyclones and other disasters, and rising sea levels. The second layer is activity at the river catchment level: forest fragmentation and the resulting erosion, the construction of dams, disposal of waste into the river, and other upstream industry that affects people living downstream. Peel away further still and you have a layer at the village-level, where inadequate sewage systems, outdated water reservoirs, and inadequate water treatment put people at risk. Household activity is at the core of the onion: food and personal hygiene practices including whether water is boiled, food rinsed, hands washed, and toilets flushed or covered.<sup>xvii</sup>



## Mass Typhoid Fever Vaccination—A Potential Solution?

Mass vaccination against typhoid fever was trialed in Fiji following category 4 Cyclone Tomas in March 2010. Part of post-disaster response involved Fiji and the Pacific Island region's first-ever large-scale typhoid vaccination program run by the country's Ministry of Health with funding from Australian Aid.<sup>23</sup> More than 64,000 people were vaccinated as part of that campaign, which also involved some community-based demonstrations on hand-washing and other sanitation practices. The campaign was most effective in three disaster-affected areas that had high levels of vaccination, and typhoid fever incidence "increased or remained unchanged in 12 subdivisions where little to no vaccination had occurred."<sup>24</sup>

As of writing, large-scale typhoid vaccination has been limited to post-disaster measures, and are not part of Fiji's national immunization program.<sup>25</sup> An assessment of the 2010 vaccination campaign concluded that more research is needed into the effectiveness of post-disaster vaccination in settings where typhoid fever is endemic, and that the "provision of safe water, adequate sanitation, and good hygiene (WASH) is the mainstay of typhoid prevention and control efforts."<sup>xviii</sup>

<sup>xviii</sup> One issue with the typhoid vaccine has been sustaining the levels of immunity it creates in a person in the long run, needing to re-vaccinate, or give booster doses every 2-5 years.

"Once you know the risk at those different layers it allows you to intervene at each. That way you're addressing the problem at multiple levels and across multiple time scales," summarizes Aaron Jenkins. Intervening in river catchment systems allow planetary health practitioners to address many nested problems at once.

*Views of Naqarawai village and its proximity to the river.*



## From Where the Water Flows

Naqarawai, the Central Division village where Rosa Batiri lives with Ruci and her other children, is a scenic spot. Reaching the community requires visitors cross a concrete suspension bridge that offers stunning views of the village on one side, and hillsides speckled with taro fields on the other. Residents gather below the bridge in the evening to play volleyball and rugby near the river's edge.

It's a 15-minute walk from the base of the bridge to reach the reservoir where Naqarawai residents access drinking water. The path runs first along the banks of the river, through swaying cassava plants, and finally, down a steep embankment approaching the sound of running water. The reservoir is a man-made tank with a two-foot high concrete retaining wall covered in tufts of green moss. Upstream, a cascade of waterfalls channels water into the reservoir; the wind blows gently through the dense forest and ferns. This water sprouts from a spring upstream, and Naqarawai benefits from being the only village reliant on this source.



*Jovili Mototabua inspects the sediment that's collected around Naqarawai's makeshift water filter.*

Once it enters the reservoir's concrete tank, water travels through the retaining wall via a valve and pipe that feeds the untreated spring water directly to Naqarawai's taps. The filtration system on that pipe is far from formal. Jovili Mototabua, head of the village's drinking water committee, crouches and removes the filter: an additional piece of piping with marble-sized holes polka-dotting its surface, and layers of steel mesh to filter smaller particles. This reservoir is characteristic of the primary way in which rural Fijian villages access drinking water.

It's also representative of some of the challenges presented by that source. Constructed in 1997, this is the second location for Naqarawai's reservoir. It was originally found further down the small stream, closer to the village. "But there were many farms in that area, and a lot of people would cross with their animals which would make the water dirty," says Mototabua of the first location. While this second reservoir site has eliminated the animal crossings that polluted the water, Mototabua says the source is still far from ideal.

For one thing, the reservoir's function is easily disrupted when there is too much rain or not enough. Mototabua says a week of heavy precipitation or a cyclone leads to the pipe getting clogged with mud and dirt; not enough rain and the water level in the storage tank is too low to feed the pipe. Water that collects sediment is also prone to transporting other nutrients and bacteria. Once gathered, that material can wash into and potentially contaminate village reservoirs and surface water sources like nearby rivers.<sup>26</sup>

Mototabua blames a logging road upstream for the increase in reservoir clogging sediment. "All the mud from the logging road is swept down the stream and collects here when it rains," he says, gesturing towards the concrete tank. "That clogs the pipe and dirties the water that does get through." That can be problematic, he says, since people often don't boil the water coming from the reservoir since there is the assumption that it's safe for drinking.

Upstream forest clearing also increases the risk of waterborne disease for villages like Naqarawai. Dense forests historically covered subcatchments in Fiji's Central Division; rivers were tree-lined and ripe with vegetation. In recent years, however, economic activities such as logging and its associated infrastructure has reduced river buffer zones—the name for the forested area fringing rivers and streams—in more than 85% of subcatchments.<sup>27</sup> Buffer zones in

<sup>xix</sup> Another case study looks at the ecosystem services provisioned by forests to people living around Gunung Palung National Park in West Kalimantan, Indonesia.

Does your country of origin have regulations on river buffer zones? Are they respected?

Central Division are “highly fragmented in 69% of subcatchments, without a single kilometer stretch of continuous riparian forest.”<sup>28</sup> This affects the ability for those forests to regulate the mitigation of floods, purify water, and limit the spread of diarrheal disease.<sup>29</sup> <sup>xix</sup>

Deforestation or other land use change can influence human settlement patterns, motivating people to live near river flood plains and other low-lying catchment areas, which can increase their exposure to contaminated water and, subsequently, disease.<sup>30</sup> Even if communities understand this added risk, many are hesitant to relocate given the relationship and cultural significance associated with the land where their families have lived for generations. While riverside economic developments reap benefits for certain parties, that often comes at a cost to rural and remote villages like Naqarawai.

Surface water pollution affects riverside villages, even those that do have access to a basic system of reservoir and tapped water supply. The water collected in Naqarawai’s reservoir tank is not always enough to provide for all the village. When the reservoir’s pipe is clogged by storms or upstream sediment, residents instead depend on surface water from the Wainawene River. Interrupted water supply and contaminated drinking water, including that which is gathered from surface water sources, is yet another commonly identified environmental risk factor for typhoid fever.<sup>31</sup>

Despite its relatively isolated location in the highlands, the Wainawene River that runs through Naqarawai is pollutant prone. This is because of activities like deforestation and cattle rearing, in addition to the behavior of the two villages that sit upstream. “They are using the same river as well, and it has caused us diarrhea, sickness, skin disease, ringworms, and scabies—these are the kinds of issues we face when there is no supply of water in the reservoir and we have to use the river,” Mototabua explains.

Ratu Ilaisa Kuruibua, Naqarawai’s chief, says he has tried to explain to upstream villages that what they cast into the river can affect Naqarawai’s drinking water. Ultimately, he says these messages haven’t held much weight. “When they slaughter pigs or cows the waste ends up in the river,” explains Chief Kuruibua. His wife, Sereana, has seen an entire cow’s head and bones floating down the river, in addition to diapers and vegetable peels. “Those attitudes are hard to change, even though we tell them that if the environment is healthy it brings healthy living,” Chief Kuruibua sighs.



*This reservoir and the pipe it feeds are the main water source for the village. When it’s clogged or dry, community members rely on the nearby river—which contributes to a risk of waterborne disease.*

*Returning to Naqarawai village after  
a visit to the drinking water reservoir.*



## Customary Ownership and the Link to Land Tenure

While more abstract than deforestation and land use change, the stripping of customary land ownership rights of rural, Indigenous iTaukei communities can also contribute to this detrimental behavior towards water resources.

Land tenure—and as an outcome its environmental management—is a contentious and complex topic around the world, and Fiji is no exception. Customary land is any area that has been traditionally overseen by a community-level governance system. In Fiji, the property right to own and occupy customary land exists within village clans (*mataqali*) and resource management is typically overseen by chiefs like Ilaisa Kuruibua.

Despite this Indigenous system of land tenure, the British colonial government brought a system of its own to Fiji. This meant that landscapes were at once governed by two conflicting systems: customary and colonial. Today, Fiji's government legally categorizes land in three ways: iTaukei (customary), Freehold, and Crown lands. An estimated 91% of Fiji is iTaukei land today. These are areas the British administration permanently transferred to clans and other groups of iTaukei landowners in the late 19th century—disregarding that the land was never considered theirs to give.

Community governance of iTaukei land still isn't independent. Ownership and leasing of this land is managed solely through the iTaukei Land Trust Board (TLTB), a body first established by a British colonial-era act, and one that receives a 25% commission on all leasing agreements. TLTB's lease granting motivations have been challenged in the past, with court cases often ruling in favor of the board rather than the landowners it was created to benefit. FijiFirst, the political party that was re-elected in November 2018, ran on a platform that promised the creation of an Independent Lands Tribunal. The purpose of that newly created group would be to mediate complaints between iTaukei landholders and the TLTB and, in theory, ensure iTaukei were able to gain greater economic benefit from their land.<sup>xx</sup>

Land tenure has critical implications on natural resource management. For one, colonial land ownership policies can create confusion with customary land policies, and this can affect how and by whom an environment is utilized. This is evident worldwide. In Nigeria, for example, colonial land use policies

overlain on communal policies have created significant debate about who has which rights to engage in particular practices in particular locations.<sup>32</sup> <sup>xxi</sup>

In Fiji and other Pacific Islands, *vanua* is the concept used to describe the relationship between people, land, and sea. “[That relationship] may define among other things the due of care that people have to each other, the future generations as well as the environment,” says one paper looking at the impact customary land tenure can have on natural resource management in the Pacific Islands. <sup>xxii</sup>

<sup>xxi</sup> In your place of origin, are there tensions over land tenure laws that relate to use of natural resources?

<sup>xxii</sup> What other concepts are similar to *vanua*?



Stacked mahogany sits awaiting transportation in Fiji's Central Division. An invasive species introduced by the British, mahogany trees soon became a valuable part of the timber trade. Like gravel extraction and cattle rearing, logging has affected the water quality in river catchment-dependent villages.

<sup>xx</sup> What type of land tenure laws exist in your country? How and when were they created? Are there different regimens of land tenure? Land leases? Government owned? Communally owned? National parks? Indigenous territories? Special laws for water-basin areas? Coastal zones? Protected forests?

Back in Waisea Naisilisili's pick-up truck, he says he fears this relationship and the respect for traditional *mataqali* authority is being forgotten, and that it's affecting the reverence people have for the surrounding environment. "This is how Fiji has always been governed—by chiefs from respective villages and provinces, and the children are taught to respect and listen. If the children cannot listen at home, then it's useless. Their parents and grandparents cannot advise them of the environmental connection," he says. "If we keep on the track of today, all these connections will be lost for good."

Going forward, Naisilisili suggests the government set rules that safeguard the customary laws of communities. After all, the farming activity happening on Naisilisili's customary land is not illegal—iTaukei land is available to lease through TLTB for periods ranging from 30 to 99 years.

Legally, this new lease holder has to use the land as it was zoned—for agriculture. "He needs to follow the proper rules for farming. For example, he's not allowed to farm too close to the streams and rivers. That's why I took the photo, because there's a stream nearby," Naisilisili explains. If he had his way, the scale of these developments, as well as their environmental impact, would be held to a higher level of scrutiny by the respective government ministries.

Unfortunately, this is not always the case in Fiji. "We're very good at producing laws, but not very good at enforcing them. Lease holders are not monitored or held to task," shrugs Dick Watling, a long-time environmental consultant and Founder of NatureFiji-MareqetiViti, an environmental conservation organization. He says the governance of rivers is particularly confusing.<sup>xxiii</sup>

According to Fiji's Department of Town and Country Planning, "the beds of navigable rivers and streams are Crown land," which, like iTaukei land, cannot be sold but can be made available for lease. "With the state ownership of the river it can still be pretty dicey where customary land ownership ends and state responsibility begins," Watling says. He adds that environmental impact assessments aren't always mindful of the long-term sustainability of natural resources.<sup>xxiv</sup>

While Watling believes gravel extraction from riverbeds is Fiji's most dire environmental challenge, he says the problem applies



across any industry: "there is no reason why a landowner should be responsible for a river when the government and the rest of society are not paying for it. We need proper legal structures in place [for environmental development]."

For Waisea Naisilisili, the legal structures around natural resource management already exist through the traditional *mataqali* system. He says a strong sense of customary land ownership would mean a stronger sense of environmental protection: "The majority of people don't want [industrial activities like mining] to take place because it's going to destroy the area and the livelihoods of all the people living downstream."

In addition to global and regional challenges like climate change and land use change, the loss of customary control over traditional land is yet another factor that broadly affects water quality and the spread of disease.

*An area in the Fijian highlands that has been cleared to make space for the roadway and agricultural land.*

<sup>xxiii</sup> In your own words, what is meant by governance? In the context of "governance of rivers", what is Mr. Watling referring to?

<sup>xxiv</sup> How would you include a long-term sustainability component into environmental impact assessments?

## Community and Household Sanitation and Hygiene

Confusion over land tenure and interactions between anthropogenic activities, water quality, and health occur in river catchments across Fiji's Central Division. "Coastal villages are at the receiving end of the entire catchment and they can't control the risks that are produced by upstream practices," says Marc Overmars, Chief of WASH with UNICEF Pacific. "Deforestation is one thing, but there are also cows and pathogens that go in the stream and attach to sediment particles. These go down the stream, go into the water intake, and people don't treat the water. You can boil water in a household but it's actually already too late."

Overmars' role with UNICEF Pacific is dedicated to accounting for and improving the water, sanitation, and hygiene (WASH) standards available in villages—the inner layer of the onion when it comes to addressing the risk of typhoid transmission in a nested manner.

Travel along the Queen's Road highway from Naqarawai back to the capital city of Suva and it's hard to miss the sign announcing your arrival in Nabukavesi—the village's name is emblazoned in bold white text on a billboard advertising Fiji Bitter, one of the country's most popular lagers.

Turn off the highway and the road continues along a concrete bridge crossing the Nabukavesi River. Part of the Navua River catchment that extends into the highlands, Nabukavesi is one of the last downstream communities in Central Division before the river spills into the Pacific Ocean. Along its journey, this river runs through more than two dozen villages and settlements, including Naqarawai, splitting to form smaller tributaries and creeks that serve as primary and secondary sources of community drinking water.

*The Nabukavesi River.*



Today, after a month of rain, the river passing through Nabukavesi is some four-meters wide, its current meandering lazily along green banks. Two women squat along the grassy edge washing clothes. A young girl leaps from the bridge, her flip flops bobbing next to the spot where her splash sends ripples downstream. The scene is a good illustration of the role the river plays in the lives of community members: play area, washing machine, and, when the taps are off, a source of water for drinking, cooking, bathing, and cleaning.



On one side of Nabukavesi is the home of chief Ratu Aisea Naisilisili, Waisea Naisilisili's uncle. As is customary when arriving in any Fijian village, the visit starts with a kava ceremony: the presentation of the dried kava root which is ground, mixed with water, and strained to make a drink called *yaqona*. Served in a large *tanoa* bowl, kava ceremonies are considered your passport to a village. In Fijian culture, many important topics are discussed over hours of this slightly sedative mixture. Today, one of those topics is water security.

*Waisea Naisilisili (far left) and Naqarawai Chief Ilaisa Kuruibua (far right) with other residents of the village. They're sitting around a tanoa, the name for the carved wooden bowl that holds kava, a ceremonial drink in Fiji and other Pacific cultures. It's often during rounds of kava that important matters are discussed.*

Ratu Aisea Naisilisili is the chief of Nabukavesi village



Born in 1957, Chief Naisilisili says Nabukavesi looks a lot different today. He was a teenager when the New Zealand army built the reservoir and pipe system that still supplies the village with water. At the time, the water was enough for the 20 households. Now, that water supply is exhausted daily by the 100 homes and 250 students who come from nearby villages to attend the local school. Household taps are closed mid-morning and in the afternoon to prioritize water for school use. Nabukavesi's reservoir also faces many of the same sediment clogging issues as that of Naqarawai.

There's also the issue of aging or insufficient sanitation infrastructure. That's highlighted in a village tour with Luse Mociwai. Mociwai has been a community health worker in

Nabukavesi for the past six years, and is one of two volunteers in charge of tracking village health data and advising on basic community health concerns. She leads the way past homes constructed of corrugated metal and wood slats; stray dogs basking in the sun; and large blue plastic barrels that collect and store piped reservoir water for in-home use, especially when the taps are turned off.

Down the concrete path, you pass nearly as many outhouses as homes. While not the most visually appealing part of a village tour, the type of latrine system used by a family has notable impact on typhoid fever risk. Of the typhoid fever cases included in a Central Division case-control study, 95% of people who tested positive for the disease had unimproved sewage systems or improved systems that had been damaged. Damage can be caused by the aging of infrastructure, but also by externalities like increased use due to the growing population of communities and natural disasters. When damaged, the buried steel drum systems can corrode and flood, contaminating surface water and everything in its path, including food sources.

Baulina Tabuamoli, head of Nabukavesi's women's committee, is one of the residents who has changed her behavior since the typhoid outbreaks affected her community. As part of the committee, she and other women gather weekly for communal meals of bele (a type of cabbage), cassava, taro, and other boiled vegetables with coconut milk. Large community gatherings are an important part of Fijian culture, and everyone in the village is put at risk if unhygienic food preparation is practiced. The meals served at those gatherings now involve boiled water for drinking, the washing of vegetables, and cleaning thoroughly afterwards. "Cleanliness is close to godliness, isn't it?" chimes in Elenoa Lewavunivalu, another Nabukavesi resident. "We have to be clean in everything. Prevention is better than a cure."

The role of WASH practices in the broader context of environmental changes like land use change and climate change support the need for a nested solution to improve water quality—one that addresses actions and behaviors at various scales. A new project has set out to consider these nested, water-related complexities at a household, community, river subcatchment, and national level, and get stakeholders at all levels working together in addressing them.



Baulina Tabuamoli is the head of the women's committee in Nabukavesi. Communal food preparation is common in Fijian culture, and in Nabukavesi the women's committee has taken it upon themselves to ensure everyone is using clean water to wash vegetables, clean, and cook. She's pictured with Asela, one of the younger residents of Nabukavesi.

## An Integrated Approach to Fiji's Water Challenges

For all the damage Cyclone Winston caused in 2016, the natural disaster is often seen as a turning point in the way Fiji deals with issues of water safety and water-related disease. At no time are new and multidisciplinary ways of working together more urgent than in the weeks following an emergency.

Much of that collaboration was out of necessity—Fiji had depleted its emergency WASH kits within four weeks of Winston's landfall, and was left scrambling to prioritize disaster and recovery response. The national government needed more data about water quality to do that, and turned to surveillance from the four Fijian ministries that deal with the issue. "During Winston, our lack of coordination as key government agencies working in the WASH sector showed up," says Suliasi Batikawai, a Senior Environmental Health Officer and WASH Coordinator with the Ministry of Health. Batikawai says there was duplication of services and overlap between government agencies once the recovery process began in mid-April 2016. Each agency was doing their own water sampling and monitoring.

Winston was the first time multiple sectors collaborated on the issue of drinking water safety, says Dr. Aalisha Sahukhan, the Head of the Health Protection Division with Fiji's Ministry of Health. She says the monitoring data the country needed was challenging to gather. "We had existing surveillance systems but these were often hampered by delays in the time from reporting to action, which was not helpful for early warning for outbreaks," says Sahukhan.

Post-Winston disaster response and recovery pressed the government to make monitoring more effective.<sup>xxv</sup> The country started using a World Health Organization system called EWARS (Early Warning, Alert and Response System) to better detect and respond to disease outbreaks. It has since become one of Fiji's permanent surveillance systems. The country also started creating a National Drinking Water Quality Committee and National Drinking Water Standards, and Sahukhan hopes both can be formalized through the multi-sectoral collaboration.

At a national level, Sahukhan sees an opportunity for the Ministry of Health to better collaborate with other groups focused on water quality. "While drinking water quality and the spread of disease

is our responsibility, we don't control all the moving pieces that affect water," she says. "So the ministry's role in [the Watershed Interventions for Systems Health (WISH) project] is very much addressing this responsibility while also pulling in other stakeholders who are in charge of aspects like access to water and infrastructure."



The WISH project is the latest intervention to address integrated water management in Fiji. The project launched in October 2018, and brings together stakeholders from various academic disciplines, Fijian ministries and agencies, and international and Pacific region NGOs.

*These large plastic vats are a familiar scene outside of homes in rural Fiji. While some homes have indoor taps, many families rely on these containers filled with tapped water from the local reservoir.*

<sup>xxv</sup> A silver lining of disasters and emergencies is that if done right, one can look back and learn a lot from the original response. What are some examples of lessons learnt of disaster and emergency response in your country, and how these have been incorporated in new legislation or procedures?



## An Integrated Watershed Approach in Guam

WISH isn't the Pacific Region's only example of an integrated watershed management project. Another is underway on the tiny island of Guam, a U.S. territory in the West Pacific. It's called the Guam Restoration of Watersheds initiative (GROW), and it's a project of the University of Guam's Center for Island Sustainability.

Similar to Fiji, Guam faces a number of inland challenges that affect the island's marine environments. The most urgent of those is southern Guam's badlands. Badlands are once forested areas that are now bare, with topsoil wiped away to expose bedrock that makes the regrowth of vegetation difficult. The island's badlands area has grown by nearly 9% between 1973 and 2001, and research has found that badlands are the category of land cover that contribute the largest amount of soil erosion each year—much of which ends up in waterways and coastal ecosystems.<sup>33</sup> The expansion of badlands can be attributed due to natural causes like heavy rainfall and cyclones, as well as human activity.<sup>34</sup> That activity includes irresponsible off-roading, arson fires, and invasive species such as deer and pigs.

GROW is experimenting with several creative and low-tech approaches to replant and restore the badlands. One method involves the use of sediment filter socks—sausage-shaped, biodegradable socks that stretch across a high-erosion area, preventing sediment from reaching waterways. A study on the effectiveness of this method found 19 kilometers of sediment socks, installed with 11,000 replanted trees, could trap enough sediment to allow the coral reefs of one bay in southern Guam to recover from the effects of erosion.<sup>35</sup>

Two other innovations more specifically target reforestation. Seed balls and sling stones are easily-produced creations of soil, clay, seeds, fertilizer, and compost. Dropped from drones or tossed onto the badlands by hand, the seed sling stones take root and begin revegetating erosion prone areas. “We deliberately chose native plants that were easy to recognize and gather so there's enough availability of seeds,” says Else Demeulenaere, a botanist and the Associate Director of the Center for Island Sustainability. There's also a traditional link—sling stones were historically an almond-shaped weapon crafted of limestone and clay and thrown during battles.

According to Demeulenaere, getting the community and the off-roading industry involved in badlands restoration is key. “The watersheds are so big, and we really wanted people to take reforestation into their hands, even if the degradation is often not their fault,” Demeulenaere says. “We also made it a fun activity. I think it's more sustainable to engage communities rather than just solving the problem yourself and not talking about it.”

A \$2 million project funded by the Australian government through its Indo-Pacific Centre for Health Security, WISH addresses the water, sanitation, and river catchment management tactics that could reduce outbreaks of Fiji's “three plagues”: typhoid fever, dengue fever, and leptospirosis.<sup>xxvi</sup> Just as typhoid cases are increasing in Fiji, so too is incidence of the latter two diseases. There were more than 15,000 confirmed cases of dengue fever, a mosquito-borne disease, during an outbreak in 2013-2014.<sup>36</sup> Similarly, there's been a three-fold increase in leptospirosis in Fiji, another water-borne disease transmitted when people come in contact with infected urine. Like typhoid, leptospirosis outbreaks are more common after flooding events, with 83% of cases occurring within six weeks of a flood.<sup>37</sup> Landscape changes such as deforestation and river damming are suspected to affect the spread of all three diseases.<sup>38</sup>

The WISH team is made up of 10 chief investigators from universities in Australia and Fiji, including Dr. Aaron Jenkins and Dr. Joel Negin, the WISH project lead and head of the University of Sydney's School of Public Health. WISH also brings in 10 associate investigators, experts from the Pacific Community, UNICEF, the World Health Organization, and Fijian government bodies including the Ministry of Health and Medical Services and the Water Authority of Fiji. All have worked on some aspect of health, water, or sanitation before, though this is the first time the group is gathering as part of a project with a common aim.

Building on the work of many researchers, public health officials, and NGOs in this room, WISH has determined river subcatchments to be the most relevant scale in which to investigate and intervene in water-related diseases. Over the next three years, the project will work in 18 rural and peri-urban villages in three Central Division subcatchments. A baseline survey at the beginning of the project will measure the water access and sanitation behaviors of 15 households in each of those 18 villages, and a community mapping exercise will plot where people get their water and which latrines are most likely to pollute those sources. This will allow the project to address the inner layers of the onion—the community and household behaviors that can mitigate the spread of disease.

The WISH project also relies heavily on village-level participation in data collection. An objective is to gather as much real-time information on the layered factors that put people at-risk of water-

<sup>xxvi</sup> Before moving forward, what common risk factors do you think these three diseases have?



*Dr. Aaron Jenkins—a self-portrait.*

borne and water-related diseases—those upstream, community, and household actions identified in the 2014-2017 typhoid case-control study. That information could populate a national database and, after integrating with meteorological and rainfall data—the outer layer of the onion that includes global climatic shifts—create a score for each community based on its risk of waterborne disease.

That score could then be used for informed decision-making at both a village and national level. Village-wise, community members could learn which simple actions to prioritize in order to secure their drinking water quality—anything from cleaning water tanks to repairing a leaking reservoir pipe to deciding which water source to use for cooking versus cleaning. The project also involves an education component: working with safe drinking water committees and other village groups to protect ecosystems like forests that provide natural protection from waterborne disease—the regional layer in the onion analogy.

At a national level, a risk score could be used by relevant government agencies to prioritize funding and water safety interventions before disaster strikes. Finally, when a natural disaster does inevitably occur, the national government could use the information platform to see which villages are most vulnerable to water-related disease outbreaks and prioritize emergency response. The ease of access and interpretation of this data is key—“we’re drowning in data but starved for information,” reminds one individual at the WISH project launch.

In the case of outbreaks, WISH is training a team of Fiji Outbreak Field Officers (FOFOs), a group that will rapidly respond to disease outbreaks and use the EWARS tool to do local surveillance. “If information is being regularly collected every time there’s an outbreak, then we start to learn about the conditions in which those events normally occur,” says Aaron Jenkins. “You can then program machine learning into the database and that would allow us to improve the prediction and response to water-related disease. This is what we’re thinking about in the long-term.”

*Village scenes from Nabukavesi, one of the rural communities where the WISH project could work.*



WISH is just one project to address the relationship between healthy environments and healthy people. Addressing these intersections at individual, household, and community levels is not enough. Regional restoration of landscapes can contribute to addressing poor water quality at its source. There's some history of this being successful in Fiji.

River buffer zone protection—the fringing of trees next to water bodies—and reforestation can improve an ecosystem's ability to provide critical services such as clean water. In 2017, research linking forest clearing and typhoid was successfully used to lobby Fiji's Forestry Department to commit to enforcing river buffer zone laws. These policies set aside areas ranging in width from 10 meters to 30 meters, preventing development too close to the riverbank.<sup>39</sup> That commitment came as part of the national strategy for typhoid prevention and control—a key acknowledgement of how public health research can be used to influence natural resource management and policies. Buffer zone restoration could also reduce the amount of eroded sediment that washes into streams, which could translate to healthier freshwater and marine fish species, a win for conservation, food security, and local livelihoods.

To that end, the WISH project also fits into the goals of a larger ridge-to-reef approach in Fiji. While WISH will implement and measure interventions that affect the inland health of people and ecosystems, a complementary project called Vibrant Reefs assesses how those interventions affect marine ecosystems. The project is being led by the Wildlife Conservation Society in Fiji.

Prior research has connected algae growth and coral bleaching to sediment and nutrient run-off from commercial agriculture and mining activities.<sup>40</sup> Those impacts on marine ecosystems can collapse fisheries, which affects the food security and well-being of people who depend on the resource.<sup>xxvi</sup> Vibrant Reefs intends to monitor the impact that reduced sediment runoff and improved water quality has on coral reefs and food fish. Like WISH, that information will then be used to drive policy-making—by establishing which river subcatchments should be prioritized in order to offer the best return-on-investment for inland and coastal ecosystems as well as public health.

While the restoration of physical ecosystems could reduce disease transmission, so too could the restoration and respect of cultural traditions, customary land ownership, and the agency of Indigenous iTaukei clans to manage their lands. Only then can people fully maintain reverence for that environment, treating it with the same care as past generations as opposed to with a sense of complacency. “Our villages are very unique, and there are rules of the chief that bind them,” says Waisea Naisilisili. “When outside development and worldviews come in it makes people do whatever they want to do, and that includes disrespecting the environment.”

Naisilisili is optimistic the WISH project can successfully work with local communities, and respect their cultural traditions. This, he says, is because the work deals with peoples' lives and their source of water—a key medium for physical health and cultural well-being.

According to him, projects must tap into the traditional connections clans have with their local environment. “This is the only way we can understand more, because this is our identity and this is how we connect ourselves to nature. It's always important that scientific research respects traditional knowledge,” Naisilisili says. “There is a place where the two will meet, and in this case it's that they agree on the importance of water.”

<sup>xxvi</sup> Coastal ecosystems are explored in depth in the Sri Lanka study. How does eutrophication and coral bleaching affect human health, both directly and indirectly?

## Keeping Track of Who's Who

### Suliasi Batikawai

Senior Environmental Health Officer and WASH Coordinator, Fijian Ministry of Health

### Rosa Batiri

Naqarawai resident, mother of Ruci

### Dr. Aaron Jenkins

Fisheries ecologist; planetary health researcher whose PhD focused on the environmental determinants of typhoid

### Ratu Ilaisa Kuruibua

Chief of Naqarawai village

### Elenoa Lewavunivalu

Nabukavesi resident

### Luse Mociwai

Community health worker in Nabukavesi

### Jovili Mototabua

Head of Naqarawai's drinking water committee

### Ratu Aisea Naisilisili

Chief of Nabukavesi village

### Waisea Naisilisili

Fisheries and Operations Support Officer with the Wildlife Conservation Society, Fiji; resident of Nabukavesi

### Dr. Joel Negin

WISH project lead, Head of the University of Sydney's School of Public Health

### Marc Overmars

Pacific WASH Coordinator, UNICEF

### Dr. Aalisha Sahukhan

Head of the Health Protection Division with Fiji's Ministry of Health and Medical Services

### Baulina Tabumoli

Head of Nabukavesi's women's committee

### Dick Watling

Environmental consultant and Founder of NatureFiji-MareqetiViti.

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An area of cut forest in the highlands of Viti Levu, Fiji's largest island.

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# Today's Solutions for the Future of Food

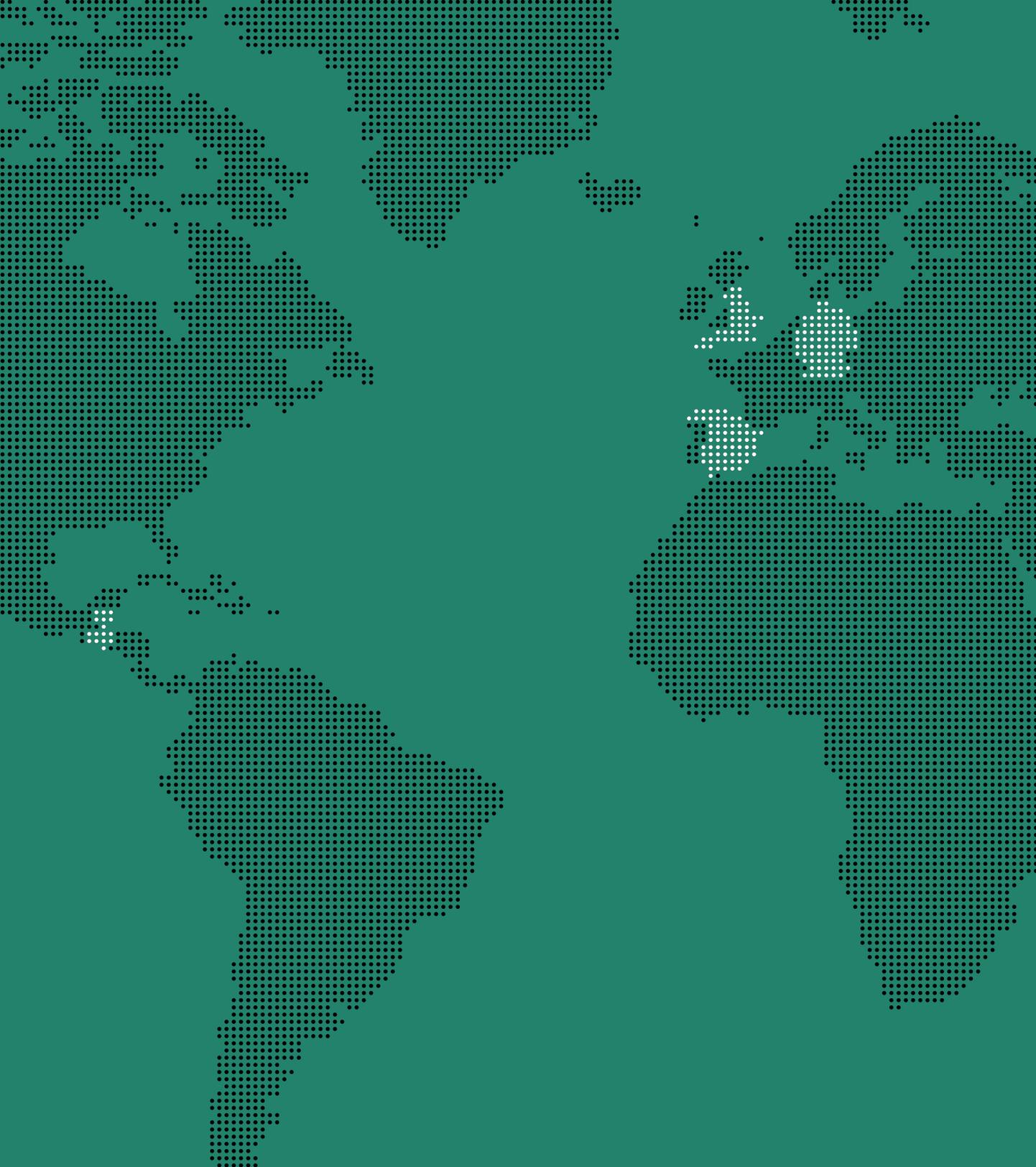
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## Executive Summary

Many of the topics addressed in this case are explored in depth in chapter 5 on nutrition and food systems in:  
↳ [Planetary Health: Protecting Nature to Protect Ourselves](#).

### Learning Objectives

*After discussing this case concerning global food systems, students should be able to:*

- ① Correlate the impacts of current food systems on Earth's natural systems and human health.
- ② Understand the role of technology, culture, governance, history, and socioeconomic status in shaping both food systems and the solutions that address current food systems challenges.
- ③ Explore the connections between personal food choices, food systems, health outcomes, and environmental impacts.
- ④ Apply a food security lens to current challenges within the food system.

A 2019 landmark report presents the need for food system change as an opportunity and an urgent call to action. The time for change is now: the food system produces a quarter of all global greenhouse gas emissions, and the world's population is projected to grow to 10 billion by 2050.

This case study focuses on a trio of strategies for redesigning the food system: the need to sustainably intensify production; promote a shift towards healthier plant-based diets; and reduce global food loss and waste. Building on scientific evidence, this case study highlights real-world examples of how individuals, organizations, and companies are putting these planetary health strategies into action.

*This case study was written based on interviews conducted in Candelaria (Guatemala), Madrid, Berlin, and London (UK) between November 2018 and May 2019.*

## Introduction

The global food system is currently unsustainable to ensure the well-being of people and the planet. As a result, an equitable and science-driven overhaul is needed to maximize benefits and minimize harm for human health and for the environment.

This call to action is urgent, especially with the world's population projected to reach 10 billion people by 2050. Globally, the food system accounts for a quarter of all greenhouse gas emissions.<sup>i</sup> Agriculture makes up 50% of the world's habitable land, disrupting valuable biodiversity and displacing communities.<sup>2</sup> Though phosphorous and nitrogen fertilizers boost crop yields worldwide, their run-off into water bodies leads to eutrophication, a dire environmental condition that deprives ecosystems of oxygen and threatens marine life. In 2019, for example, nitrogen and phosphorous run-off from agricultural fields drained into the Mississippi River, creating an 18,000 square kilometer "dead zone" in the Gulf of Mexico.<sup>3ii</sup> Other agrochemicals, including herbicides and insecticides, have negative impacts on biodiversity and human health.<sup>4</sup> Increases in atmospheric concentration of carbon dioxide is projected to affect the nutrient availability of protein, iron, zinc and certain vitamins in crops, further exacerbating deficiencies in regions of the world where people already struggle to meet their daily nutrient intake.<sup>5 6</sup> More broadly, climate change contributes to food shortages that have already triggered conflict and displacement.<sup>7 8</sup>

Global nutrition is inequitably distributed. Though enough food is produced to feed the world's population, an estimated 815 million people globally still go hungry, unable to get enough calories to meet their minimum dietary energy requirements.<sup>9iii</sup> Micronutrient deficiencies affect more than two billion people globally, and are especially prevalent in low and middle income countries.<sup>iv</sup> Derived only from a person's diet, micronutrient deficiencies are particularly harmful for children and can hinder motor and cognitive development, increase risk of blindness and infection from disease, and prevent healthy weight gain and growth.<sup>10</sup> The nutritional challenges continue: the rapidly growing burdens of obesity and metabolic diseases, including cardiovascular disease and diabetes.<sup>11</sup>

Food system challenges are not solely associated with what we eat or cannot eat—it also involves the amount of edible food that is lost or wasted along the supply chain. The Farm and Agricultural

Organization of the United Nations (FAO) estimates that a third of the food produced globally each year is lost or wasted. That equates to 1.3 billion tons valued at nearly a trillion US dollars.<sup>12</sup> This has dire environmental implications: if food waste were a country, it would be the world's third largest emitter of greenhouse gas emissions.<sup>13</sup> The issue is of particular concern in the Global North, where wealthy countries waste nearly as much food as the entire net food production of sub-Saharan Africa.<sup>14v</sup>

Structuring a food system to sustainably feed 10 billion people is no small task—but it is possible and important. "Food is the single strongest lever to optimize human health and environmental sustainability on Earth," declares the EAT-Lancet Commission on Food, Planet, Health. Released in 2019, the landmark report brought together 30 of the world's leading scientists in food systems and the environment. The report outlines science-backed strategies and targets for revolutionizing the global food system based.<sup>v</sup>

The verdict is clear: changing the world's food system is complex and demands more than a single strategy. That's why this case study focuses on three complementary pathways: edible insects as an option for sustainably intensifying food production and improving nutrition; shifting policy and young people's perceptions in order to promote plant-based diets, and letting consumers and retailers reduce food waste in a way that is convenient and beneficial for the environment and wallet.

Finally and importantly, the global food system can't be divorced from the realities and motivations of the people it's meant to feed. This is a common theme throughout the case study. A small taste of how this theme emerges: nutrition programs must be mindful of peoples' inability to access or afford traditional food or land. Those advocating for a shift to plant-based diets must not turn a blind eye to poorer populations dependent on animal-source foods for critical nutrients. Food loss and waste policies must be mindful of the power relations in the supply chain in order to equitably distribute responsibility and prevent the abuse of small-scale and individual producers. Revolutionizing the food system offers the opportunity to advocate for human and animal well-being, social justice, environmental sustainability, and more.

<sup>i</sup> What are the other big sectors that account for GHG emissions?  
↳ [Read more here](#)

<sup>ii</sup> ↳ [Care to read more?](#)

<sup>iii</sup> On the contrary, how many people in the world consume more than their necessary share? Where is this consumption the greatest?  
↳ [Explore caloric intake per country here](#)

<sup>iv</sup> What is the rate of malnutrition in your region or country of origin? Where is the problem at its worst?  
↳ [Learn more here](#)

<sup>v</sup> Think of the food production system from seed to table. Where do you think most food is wasted?

<sup>v</sup> Access the full document here:  
↳ <https://www.thelancet.com/commissions/EAT>

## Sustainable Intensification: A Big Role for Mini-Livestock?

<sup>vi</sup> Try to map where in the food system is this environmental footprint created.

<sup>vii</sup> According to the Intergovernmental Panel on Climate Change co-benefits are the positive benefits related to the reduction of greenhouse gases.

<sup>viii</sup> [Learn more about the Planetary Boundaries framework here](#)

<sup>ix</sup> Have you ever tried insects? Would you?

The food system has a significant environmental footprint.<sup>vi</sup> Changing the ways in which the world produces nutritious diets has the potential to yield a number of co-benefits,<sup>vii</sup> including improving food security in less environmentally detrimental ways. One proposed pathway is through sustainable intensification of the food system—producing more food with fewer inputs of water, energy, fertilizer, and other agrochemicals.<sup>15</sup>

↘ [Appendix: What are the environmental impacts of food and agriculture? \(Source: Our World in Data\)](#)

Sustainable intensification is important because of the influence the food system has over many of the Earth's system processes. That includes freshwater use, land-use systems, nitrogen cycling, biodiversity loss, and climate change. A planetary boundary<sup>viii</sup> exists within each of these processes—the suggested threshold within which the food system must remain in order to reduce risks for people and the environment. According to the EAT-Lancet Commission, sustainable intensification can reduce yield gaps on cropland, improve the efficiency of fertilizer and water use, redistribute the global use of nitrogen and phosphorus, offer climate mitigation opportunities, and enhance biodiversity within agricultural systems.<sup>16</sup>

So how can the world produce enough nutritious food while limiting environmental burdens? Experts worldwide increasingly present entomophagy, the technical term for the human consumption of insects, as an opportunity to accomplish many of these needed intensifications.<sup>17ix</sup>

### The Benefits of Mini-Livestock

The Food and Agriculture Organization of the United Nations (FAO) released a seminal report in 2013 detailing the potential of edible insects for both food and animal feed security. It argues that entomophagy offers co-benefits for the environment, health, and livelihoods.

Insect agriculture has been shown to have less impact on land, water, and other natural processes when compared to conventional livestock and agriculture. Take mealworms, for example. Raising a kilogram of mealworms for food produces significantly less greenhouse gas emissions and requires much less land than producing a kilogram of edible protein from beef, pork, and

chicken.<sup>17x</sup> While water use varies by climatic region, mealworms have a lower water footprint to nutritional protein ratio, and demand five times less freshwater than beef.<sup>19</sup>

Additionally, mealworm production requires less energy than that required for beef or pork (though more research is needed into reducing the energy necessary to keep larvae warm). Until then, commercially rearing mealworms uses approximately the same energy as chicken and milk production.



Higher nutritional content has been the main appeal of edible insects to date. Insects are typically high in protein, fat, amino acids, and micronutrients such as iron, magnesium, and zinc.<sup>20</sup> They also contain vitamins and chitin, which may serve as a dietary fiber. One study suggests mealworm larvae are 46% protein, contain valuable amino acids lacking in many staple crops, and possess a high level of other fatty acids and minerals.<sup>21</sup>

<sup>x</sup> Analyze these two infographics related to the total estimated average emissions for different foods.  
↘ [Across the food chain](#)  
↘ [Food types](#)

*Mealworms grow in a low-cost, lo-fi farm created in the highlands of Guatemala.*



## Canadian Grocery Chain Buys into the Buzz

The changing food system is a hot topic of discussion for Kathlyne Ross and her team at Loblaw Companies Limited, Canada's largest food retailer. "A lot of our conversation right now is focused around alternative and plant-based proteins, not only for health and wellness but also for environmental impact and animal welfare," says Ross, the company's Vice President of Product Development and Innovation.

To that end, Loblaw's flagship President's Choice brand introduced a new product in March 2018: 100% cricket powder. Ross says it meets a few key requirements: it's high in protein, rich in vitamins and minerals, and is produced using less space and water than conventional livestock. Plus, it's good for marketing. "We knew insects were getting a lot of buzz, pardon the pun," laughs Ross. "We were asking 'what can we do with a product like that to make it viable and bring it to Canadians in a more accessible way.'" Powder, as opposed to whole crickets, was eventually chosen as the presentation means of choice.

The decision to sell cricket powder wasn't made overnight. In fact, Ross says it took nearly two years of referring back to consumer surveys, speaking with scientists about the environmental benefits of edible insects, and convincing others within the company that entomophagy wasn't a fad. Rather, the cricket powder is meant to appeal to the growing demand of consumers who want flexitarian diets.

"It's about saying to consumers 'we are offering you a choice. We're always going to sell chicken and beef and there's nothing wrong with having them in your diet,' but we want to always be the brand that presents the opportunity of an alternative," Ross says. Loblaw is currently developing other plant-based protein products that will be stocked alongside the cricket powder over the next year.

The cricket powder itself comes from Canadian company Entomo Farms. The family-owned business has been producing insect protein since 2013, and sells other products like whole roasted crickets and mealworms.

"In the beginning we hoped that people's affinity to care about the environment would be enough to drive consumer change [towards edible insect products], but we learned that it wasn't going to be enough," says Jarrod Goldin, President of Entomo Farms. With 35 staff and more than 100 million crickets, Goldin suggests the company is the world's largest livestock farm.

Mindful of animal welfare, Entomo Farms retrofits former chicken barns and other industrial spaces with what it calls "cricket condos"—blocks with a large surface area where insects can hide and access fresh food and water on-demand. Expanding the market to include edible insects involved some bureaucracy, and Entomo Farms and Loblaw worked with the Canadian Food Inspection Agency to create safe procedures and protocols to farm and manufacture the crickets.

So has the buzz paid off? Kathlyne Ross thinks so. Media coverage of the product launch meant the company exceeded sales targets by over 200%—though Ross admits the company was tame in its initial production volume. "Sales are steady now. We've certainly kept the Entomo guys farming a lot of crickets," she says. "The product is not going away."

Dr. Valerie Stull is looking at the health benefits of insects beyond their nutritional value. Stull is the Principal Investigator with Mission to Improve Global Health Through Insects (MIGHTi), a collaborative research project that views edible insects as one solution to tackle food insecurity and the changing climate. She was also lead author on a study that suggests cricket powder consumption could improve gut health.<sup>22</sup> "I'm really interested in seeing if supplementing a low nutrient diet with insects could lead to not only improved micronutrient status, but improved health because of beneficial shifts in the microbiome," Stull says.

Stull believes entomophagy can play a leading role in sustainably intensifying the food system. "I think it's really exciting that insect agriculture has the potential to be both a player in the larger food system if we sustainably ramp up production, and also a player in food justice and food sovereignty<sup>xi</sup> at smaller scales because it can give people at a household level more autonomy over what they eat and what they're able to produce," she says. Even people with no land and access to only the most basic of technologies are able to start low-cost insect rearing operations.<sup>23</sup>

The intersection of food justice, increased household autonomy, and environmentally-sustainable production is important. This is especially true for food insecure countries that are vulnerable to climate change.

Insects are not a new menu option, and already factor into traditional diets worldwide. An estimated two billion people live in countries where insect eating is practiced.<sup>24xii</sup> That includes in Guatemala, where one organization is using entomophagy to promote a way for families to grow their own protein source—fewer inputs of water, land, and energy required.

### Worms are the Way

It takes a few knocks before Doña Irma Hernandez opens the white metal door of her home in the village of Candeleria, Guatemala. She has her hands full, quite literally, with her 18-month-old son, Alejandro. His three-year-old brother, Denis, runs around the family's small front room, making what seems to be as much noise as as humanly possible.

<sup>xi</sup> How would you define [food sovereignty](#)?

<sup>xii</sup> Where in the world are insects eaten? [Explore the map here](#)



*Doña Irma Hernandez watches as her two sons play with the family's mealworm farm. Constructed from low-cost and locally available materials, the farm can be kept inside the house and out-of-reach when Irma isn't harvesting mealworms for flour.*

Both boys momentarily quiet down as their mother takes a box off the shelf. Wrapped in a fleecy flower blanket is a plastic container the size of two shoeboxes. In it sits a plastic strainer, not unlike the type you'd use to drain pasta. There's a rustle of activity inside: a few dozen mealworm beetles wriggle in loosely packed oats, their shiny black exoskeletons catching the light. A handful of mealworms are already a few centimeters long. They'll be plucked out and roasted when they reach a certain size. What's the cooking time? "Until they're brown!" Hernandez laughs.

Hernandez is one of five women who participated in the pilot program of MealFlour, an edible insect organization operating in Guatemala's western highlands. The pilot program was a six-week training course where women learned how to build a mealworm farm using readily available and low-cost materials, how to care for the insects, and how to process adult mealworm larvae into powder. The goal was for the farms to produce a weekly output of larvae that could be roasted and ground as flour. The premise in doing this was that families would have a more affordable, stable source of protein. Mealworm flour could eventually be sold, adding to overall income and helping families edge away from the poverty line.

Mealworm farms like this could offer a solution for the series of larger challenges facing Guatemala and the world. Low and middle income countries are experiencing the greatest effects of climate change. Guatemala is no exception, and the country is consistently ranked one of the world's most vulnerable to natural disasters and the effects of climate change.<sup>25</sup> As the MealFlour team wrote in a submission to *The Lancet Planetary Health*, "an effective strategy to improve nutrition and increase food security must be environmentally sustainable and adaptable to environmental change."<sup>26</sup>

MealFlour was founded in 2016 by Elizabeth Frank, Joyce Lu, and Gabrielle Wimer. The organization has since partnered with five Guatemalan organizations to address the food security challenges of protein shortages and chronic malnutrition in the country. Nearly half of Guatemalan children under the age of five are stunted, meaning they're shorter because of chronic malnutrition or repeated infections.<sup>27</sup> Guatemala has the highest rate of chronic malnutrition in Latin America, and one of the highest rates worldwide.<sup>28</sup> Globally, chronic malnutrition affects

815 million people and is responsible for 45% of child mortality.<sup>29</sup> <sup>xiii</sup> For organizations like MealFlour, it's not just about making sure people have enough nutritious food to eat, it's about creating an intervention that addresses the objectives of food security: availability, access, utilization, and stability.

### Food Security in the Guatemalan Highlands

Guatemala has a long and complicated track record with chronic malnutrition. This is especially true in the country's rural Indigenous areas where 70% of children are malnourished, compared to the already-alarming rate of 50% among the general population.<sup>30</sup> The western highlands where Irma Hernandez lives with her family is home to many Indigenous groups.<sup>xiv</sup>

Physical access to land is challenging for Indigenous communities. Land ownership is one of the most contentious issues in Guatemala and was a contributing factor to the country's civil war. Occurring between 1960 and 1996, the war pitted the Guatemalan government—a military regime installed after a U.S.-backed coup d'état in 1954—against rural Indigenous groups<sup>31</sup> who were struggling for the land that had been taken from them over the past two centuries. Those evictions continue today.<sup>32</sup>



<sup>xiii</sup> Where in the world is this a problem? Take a guess before [clicking on this link](#)

<sup>xiv</sup> Guatemala is one of the countries with a higher percentage of Indigenous peoples in the world, with around 60%. What role do you think this plays in food security?

*A recently harvested corn field in the Western Highlands of Guatemala. Food security remains an issue for many families living in poverty, despite corn and other crops being grown in most regions.*

Land ownership issues were a key reason for MealFlour's establishment in the western highlands. "We had initially designed the program to be for crowded urban areas. We viewed it as a way for people in cities to grow their own source of protein," says Gabrielle Wimer, one of MealFlour's Founders. "But the more we learned about Guatemala, the more we saw the issues with land being taken away from families and the lack of access to natural resources to produce your own food."

Agriculture is a main livelihood in the western highlands. Yet, an inability to access land means the availability of healthy food and protein remains a challenge. Indigenous farmers commonly work as *campesinos*, laborers who tend agricultural land belonging to a landlord. Pay is poor and the food grown is often sold in urban centers or to the global market, reducing what's available for local families. As a result, many household diets sustain on imported corn-based products purchased at the market, even if the entire village is growing fruits and vegetables.<sup>xv</sup>

Poverty presents a further barrier, especially in the western highlands where extreme poverty is most acute.<sup>xvi</sup> Protein sources such as eggs and beans are available in villages, though are often unaffordable.<sup>33</sup> As a result, protein supplements are a common feature of nutritional programs in the western highlands. But availability and stability of those supplements isn't guaranteed. International aid agencies donate the majority of supplements, with the national government responsible for stocking health posts and hospitals around the country. "Most times the supplements are completely out of stock or aren't distributed to where they're supposed to go because of corruption and supply chain breaks," explains Lily Bodinson, the Medical Programs Coordinator with Timmy Global Health, an American nonprofit based in the western highlands. By training women to raise and harvest mealworms, MealFlour hopes to increase food stability and reduce reliance on protein supplements that may be available one day and gone the next.

Even families who own livestock are not necessarily food secure. "When we visit families we can see that they have chickens and pigs, but it's not because they'll be eating them," says Zuri Sarai de León Pineda, a Health and Nutrition Specialist with Fundación Contra el Hambre (Foundation Against Hunger), an organization that works in 215 rural Guatemalan communities, and one of



Elizabeth Frank, Andrea Monzón, and Gabrielle Wimer. Elizabeth, Gabrielle, and another classmate created MealFlour after witnessing the shortcomings in some other global health programs. With experience in entomophagy, Andrea joined the MealFlour team in 2018 and leads the organization's expansion into other regions of Guatemala.

MealFlour's partner organizations. "Families have those animals for emergency situations. They sell them to get out of a crisis." Additionally, poor pay for *campesino* workers keeps them locked in poverty and unable to afford education, including knowledge regarding what constitutes healthy eating in the first place. Poverty can also affect utilization, the ability for a person's body to absorb energy and nutrients from food.<sup>xvii</sup>

Back in Irma Hernandez's home, she explains that protein supplements were the family's main source of protein before their involvement with MealFlour. Those protein supplements cost 9 quetzales (about US \$1.17) per pack, an expense that wasn't always affordable for the family of four. Now, when possible, Hernandez supplements the family's meals with mealworm flour pancakes. "Feeding the worms costs me nothing. I peel my carrots, I leave it a bit in the sun, and then I feed the peels to them, so I save a lot of money," says Hernandez, adding that her mealworms also eat potato peels. "I don't need to pay to go to the market. I just toast [the worms], grind them, and eat them."

Hernandez produces approximately half a pound of mealworm flour every two months. This lasts the family a week or two. "I feel like this lets some protein get into their small bodies," she says of the mealworm pancakes she makes for her sons. "If one day I do not have the worms, [Alejandro and Denis] will be missing their protein."

<sup>xv</sup> In essence, although surrounded by food crops, these villages act as food deserts. Are food deserts common where you are from?

<sup>xvi</sup> Extreme poverty rates are double for Indigenous groups in Guatemala and unlike national poverty rates, are not showing a significant decline.

<sup>xvii</sup> How do you think poverty and the ability for a person to absorb energy and nutrients from food are connected? What biological pathways may be in place?



## Dining with Chef Mario Melgarejo

Mexican chef Mario Melgarejo is one of the country's most vocal entomophagy specialists. He can regularly be found hosting workshops in culinary schools and catering private events where he serves dishes with a creative combination of insect and non-insect ingredients (cockroach flan, anyone?). Meeting Melgarejo, it's clear he's a presenter. His face smiles as he effortlessly weaves stories through the conversation.

Image (Mario and Josh): Chef Mario Melgarejo and Josh Galt (another edible insect advocate and founder of the website Entovegan) in Guatemala City.

One involves a four-course meal he once prepared for a small group. A guest had brought her young daughter, who made it through three quarters of the insect-based meal with no complaints. "But the dessert was a big garden spider with long black and yellow legs," says Melgarejo. "When she saw that caramelized on her plate with jelly she burst into tears! Eventually I talked her through it. She ate it and realized it wasn't so bad. What I said was '*tu temor tiene un sabor*' (your fear has a flavor)." Melgarejo has used this approach ever since: "when I talk to people and they're grossed out by the cockroaches and spiders, I say 'look, you're scared of them, but I'm going to show you that you can eat your fear and find it's delicious!' It's that mindset change." Melgarejo is a proponent of serving insects whole, as opposed to disguising them or using them as powder.

Melgarejo is in a good place. Mexico has an estimated 549 species of edible insects, more than any other country worldwide.<sup>34</sup> "Mexico has a taste for edible flowers, edible insects. This is prehispanic food, but when the Spanish arrived all of it was lost," he says. Since starting his entomophagy-driven culinary journey, Melgarejo has been working with home chefs in rural areas across Mexico, learning how they collect insects and how to cook them. The result is a fusion of modern Mexican food and prehistoric recipes, the likes of which can be seen on Melgarejo's Instagram.



*Irma Hernandez outside of her home in Candeleria.*

### Next Steps: Scale and Market Acceptance

Low harvest rates are an issue for Hernandez and MealFlour, and the organization doesn't have a metric to measure success. Many challenges relate to varying climatic conditions, the use of low-cost materials, and the fact that very little research exists around best practices for small-scale insect farming. The 2013 FAO report on edible insects also highlights this challenge, noting that it's only in recent years that insect farming businesses (many of them small and family-run) have been able to commercialize insects for animal feed, not to mention human consumption. The report notes more development is needed to create automated, industrial-scale rearing technology that can keep pace with the production of other traditional forms of livestock.<sup>35</sup>

MealFlour has experienced some of these shortcomings in its own work. Despite the excitement around entomophagy, the MealFlour team says this hasn't translated to research and development funding. "That's something we've been struggling with," says Gabrielle Wimer. "We saw the need for a program to actually be on the ground but there are still research questions that haven't been looked into and as a small organization we don't have enough funding to answer them."

Scaling edible insect production presents one possible solution to sustainably intensify food production. In the future, its environmental and social impacts must be further researched to maximize sustainability and acceptability. For example, while insects require less land and water to rear and feed, and are more lightweight to transport, the food industry must also prioritize energy efficient production and transportation to reduce its overall carbon footprint. As the edible insect market continues to grow, conservation and trade policies must be created to ensure insect populations are sustainably harvested. Additionally, more localized research is needed to understand the complex cultural and social structures that influence whether people are willing to eat certain types of insects and under what conditions. If edible insects are to play an increasing role in a new food revolution, these questions must be asked, answered, and addressed with attention to local context.

Edible insects are just one piece of the puzzle. As the next section of this case study discusses, a sustainable food system and nutritious diets doesn't require everyone to start eating insects—though they could be part of a healthy, plant-based diet.

### Bringing Plant-based Food for Thought into the Classroom

It may only be mid-morning, but a group of young students at Otto-Nagel Grammar School in the suburbs of Berlin, Germany, are not only talking about lunch—they're making it. Crowded around a long kitchen countertop, they stare attentively at recipes for spaghetti with tofu bolognese sauce and vegan banana chocolate muffins.

↘ [Video: Inside the Plant Powered Pupils Project](#)

These particular students have just come from their desk-filled classroom. They spent the last 30 minutes learning about the impact of their food choices and sharing what they know about plant-based diets with Kathleen Gerstenberg, an employee with food awareness organization ProVeg International, headquartered in Berlin. After talking about plant-based foods, it's time to make a meal themselves.

Down in the kitchen, the students start chopping. No one minds dicing carrots and mushrooms, or measuring various dry ingredients into the muffin mixing bowl. They're more dubious of the brown blocks of smoked tofu. "Does someone want to try it raw?" one girl asks. "Nah, not really," responds another, crumbling it tentatively with her fork.

*Not your average cafeteria! Middle school students in Berlin, Germany, prepare their lunch as part of the Plant-Powered Pupils program.*



Alexa Gnauck is not concerned by the soy product skepticism. Gnauck is the International Coordinator of the School Programme with ProVeg, one of the partners on a project called Plant-Powered Pupils. “[The project] gives pupils the opportunity to figure out for themselves what foods they like and don’t like. When children get practical there’s a different kind of openness, especially for foods they don’t know,” she smiles. The Plant-Powered Pupils project reached more than 33,000 students from 65 German schools between its launch in 2016 and July 2019.

Influencing individual behaviors and changing policy are key long-term goals of Plant-Powered Pupils and another of ProVeg’s past projects, Climate Efficient School Kitchens (KEEKS). ProVeg was one of five partners in KEEKS, a project initiated by the Institute for Future Studies and Technology Assessment (IZT) as part of Germany’s National Climate Initiative. Jointly, the projects were a winner in the planetary health category of the 2018 Momentum for Change Lighthouse Awards handed out by the United Nations Framework Convention on Climate Change (UNFCCC).<sup>xviii</sup>

Both projects catered, literally and figuratively, to school-aged children and the school canteens in which they eat. Working with children was a deliberate choice when then-ProVeg volunteer Kristin Höhlig came up with the concept for Plant-Powered Pupils. While many universities<sup>xix</sup> and other institutions had plant-based diet initiatives, she found a similar project was lacking for elementary and secondary school students.

Höhlig saw an opportunity to reach a generation that hadn’t yet developed fixed eating habits or prejudice against certain foods. “You can make the foundation for eating habits and preventing disease early on,” says Höhlig, now a Campaign Manager with ProVeg. “[Children] often have a deeper connection to animals, too. I think we lose this openness over time, but children are still very willing to talk about these topics.”<sup>xx</sup>



Cornelia Lemke, a teacher in Berlin, has used the Plant-Powered Pupils program as a starting point to discuss other types of diets in her home economics classroom. In a recent assignment, students were asked to design recipes catering to different dietary needs

ProVeg International’s mission is to halve the global consumption of animals by 2040.<sup>xxi</sup> To do this, the organization is promoting plant-based diets—a food choice that corresponds with a recently released planetary health reference diet.

### Putting Planetary Health on the Menu

“Diets inextricably link human health and environmental sustainability” writes the EAT-Lancet Commission. The Commission released a planetary health reference diet as part of its report. It’s designed so that 10 billion people can get the calories and nutrients they need in a way that ensures healthy people and protects the biosphere.

Rather than prescribing specific foods, the reference diet suggests the caloric and macronutrient<sup>xxii</sup> intake people should get from broad food categories such as whole grains, fruits, added fats, and protein sources. The vagueness is deliberate. “Local interpretation and adaptation of the universally-applicable planetary health diet is necessary and should reflect the culture, geography and demography of the population and individuals,” the Commission writes.<sup>36</sup> Translation: no two plates are the same. A planetary health diet will look different in Belgium, Kenya, Bolivia, and Vietnam.<sup>xxiii</sup>

↘ [Appendix 1: Table 1 from the EAT-Lancet Summary Report](#)

<sup>xxi</sup> Care to guess how many animals humans eat each year? ↘ [Learn more here](#)

<sup>xxii</sup> What type of macronutrients exist? ↘ [Learn more here](#)

<sup>xxiii</sup> What do you think an ideal planetary health plate would look like for you?

<sup>xviii</sup> What is the role of the UNFCCC? ↘ [Click here to learn more](#)

<sup>xix</sup> Does your institution have a program like this? If not, why not start one?!

<sup>xx</sup> Can you remember anything you were taught early on in your life while in school that has stuck with you since?

Importantly, the protein category includes much more than animal-source foods. In fact, experts say that food system sustainability demands a greater than 50% reduction in the global consumption of red meat in favor of meals that balance fruits, vegetables, legumes, and nuts.<sup>37</sup>

The urgency of the world's meat consumption crisis is growing. Despite global searches for terms like “vegan” having quadrupled between 2012 and 2017,<sup>38</sup> people are eating more meat than ever before. Meat production worldwide has increased four to five fold since 1961. This is most evident in Asia, where there has been a 15-fold increase in production over the same time period.<sup>39</sup> Two factors come into play: a growing population and rising incomes.<sup>40</sup> An increase in a country's gross domestic product (GDP) correlates to people getting a higher percentage of their daily calories from animal-protein. Protein sources that were once economically inaccessible for people are brought within their financial reach.<sup>xxiv</sup>

The need to reduce consumption of animal-source protein is not universal. While on average the world is eating nearly three times the amount of red meat suggested to stay within planetary health boundaries, over-consumption is particularly problematic in wealthier regions like Europe, increasingly parts of Asia, and North America. The average North American diet includes more than six times the recommended amount of red meat and more than twice the suggested amount of poultry and eggs.<sup>xxv</sup>

On the other end of the spectrum are countries where undernutrition is a significant problem because of micronutrient deficiencies arising from a lack of access to animal-source or nutrient-dense foods.<sup>xxvi</sup> This discrepancy in the ability to access meat and the valuable nutrients it provides demonstrates that local and regional realities, in addition to cultural contexts, matter when considering what ends up on people's plates.

Experts advocate for a shift to healthy, plant-based diets in order to reduce the global consumption of red meat. Plant-based diets, particularly among wealthy nations, have a number of human health and environmental co-benefits. A University of Oxford study estimates a shift to plant-based diets would prevent 5.1 million deaths globally per year, with the greatest reduction in mortality coming from lower rates of coronary heart disease, stroke, and cancer.<sup>41</sup> Overconsumption of red processed meat has been

connected to increased risk of type two diabetes, cardiovascular disease, colorectal cancer, and other health conditions.<sup>42</sup>

There are also economic and environmental arguments in favor of plant-based diets. For one, plant-based diets would reduce the burden on the healthcare system, and equate to annual savings of US \$735 billion by 2050.<sup>43</sup> The authors note that the reference plant-based diet in their study would also lead to 29% less greenhouse gas emissions by 2050 when compared with unchanged diets.<sup>xxvii</sup>

As an organization, ProVeg International believes there are five motivating factors for why people opt for plant-based diets: health, animal welfare, the environment, social justice, and taste. Its philosophy is that, by appealing to one or more of these motivations, people are more likely to reduce their consumption of meat and switch to a plant-based diet that is better for human health, animals, and the planet.<sup>xxviii</sup>

### Beyond Animal Welfare

Headquartered in Berlin, Germany, ProVeg International was established in 1892 as the German Vegetarian Union (Vegetarierbund Deutschland). The organization was started as a lobbying group for vegetarians and vegans in the country, the majority of whom made their dietary choice because of animal welfare.

That changed in 2017 when the organization restructured and rebranded as ProVeg International. ProVeg went from being primarily a vegan lobby group to an international food awareness organization. “Before, we were making sure vegans and vegetarians had their needs catered to and worked to attract people only in Germany towards plant-based eating. But we realized this is not the way to change the world, and that the people we needed to reach out to are the majority of the global population who are not vegetarian or vegan,” says Jens Tuijer, Chief of Staff at ProVeg International. An expanded global mindset, there are now ProVeg operations in the United States, South Africa, Spain, and three other countries.

ProVeg International updated its organizational mission to reflect its focus on plant-based diets, aiming to reduce the global consumption of animals by 50% by 2040 (50by40). One way to accomplish that outcome is for half of the world to become vegan.

<sup>xxiv</sup> For example, according to the World Bank, around 850 million people living in China are no longer living in extreme poverty.

<sup>xxv</sup> What are some health consequences of this meat overconsumption?

<sup>xxvi</sup> Case study 5 takes us to Madagascar where bushmeat plays an important role in helping people meeting their nutritional needs—but also threatens the country's endemic biodiversity.

<sup>xxvii</sup> Which parts of the meat industry do you think produce the most greenhouse gases?

<sup>xxviii</sup> Do you have any vegetarian or vegan friends? Ask them what their motivations are.

<sup>xxix</sup> [Read more about cell-based meats](#)  
↳ [Click here](#)

But the organization believes a much more realistic outlook is to instead encourage as many people as possible to be mindful eaters, reducing their meat consumption in favor of plant-based or cell-based/cultivated alternatives.<sup>xxix</sup>

An important takeaway from ProVeg’s approach is its solutions-focused messaging. “We want to replace animal-based products with plant-based or cell-based alternatives that are attractive, affordable, and available,” says Tuider. “If we find something that has the same taste and textural experience, nothing has to suffer and die for it, and the future isn’t jeopardized, people are more likely to say ‘I’ll give this a shot.’ We don’t try to tell people that sausage is bad. We say it’s great, you just need the right kind of sausage.”



A Beyond Meat burger. Photo via Pixabay.



### A Question of Taste

Taste is perhaps the most important factor motivating people to eat one food over another. The importance of taste cannot be ignored when promoting a planetary health diet.

For example, more research is needed to determine the most appetizing serving style of edible insects. They’re currently prepared in two ways: served whole or ground to create insect-based flours that can be used as additives.

Preferred serving method is deeply dependent on culture and context. Take Guatemala, where many regions consider whole insects a delicacy, a culture MealFlour hopes increases appeal and eases acceptability of its mealworm program. For now, the organization is reducing the need for other protein supplement powders through the creation of its mealworm flour. There’s the potential for whole insects, too. In Huehuetenango, another western highlands department where the organization has a partner, there’s a culture of eating spiders and *zompopos de mayo*, large ants fried with butter and served with tortillas and lime.

Another factor of taste is determining whether people are willing to eat insects that are domesticated rather than harvested from the wild. Wild insects currently make up the majority of edible insects consumed worldwide.<sup>44</sup> “If we’re farming insects and feeding them different things than they might eat in the wild it may change their taste,” says Dr. Valerie Stull. “People want to know if they’ll taste good, and if they don’t then they will be hard pressed to buy them. People’s perceptions of mini-livestock are complicated.”

Taste also matters when urging a shift to plant-based diets. In fact, a 2018 survey of American consumers found taste is the main motivator for why people switch to plant-based proteins—ranking above concerns for the environment, animal welfare, and health.<sup>45</sup>

Companies such as Impossible Foods and Beyond Meat have made tasty plant-based options mainstream. Beyond Meat’s non-genetically modified “meat” is made with proteins from pea, mung bean, fava bean, and brown rice, combined with fats such as coconut and sunflower oil, with other added minerals and natural flavors.<sup>46</sup> The American company is considered the market leader, and in May 2019 became the first publicly traded plant-based protein company. Since then, stock has surged and plummeted. Analysts attribute the volatility to the nascent market for plant-based protein and uncertainties around market demand and growing competition.<sup>47</sup>

Among other ingredients, Impossible Foods creates its “meat” with a blend of soy and potato proteins, coconut oil, sunflower oil, and heme. The company describes the latter as “the molecule that makes meat taste like meat.”<sup>48</sup> Imitating the taste of meat and even the juicy “bleed” of traditional beef has increasingly become a part of plant-based protein products, acknowledging that not everyone is reducing their meat consumption for reasons linked to animal welfare.

School programs like Plant-Powered Pupils and Climate Efficient School Kitchens (KEEKS) are two of the ways in which ProVeg is using education to influence peoples' long-term food choices. Plant-Powered Pupils is about getting kids to think critically about how the food they eat impacts their health, the environment, and animals. Another aim is to shape the taste preferences of the future generation of consumers and decision makers. If ProVeg can get 10 to 15-year-old students eating—or at least thinking about plant-based diets—there's a greater chance they'll change their long-term behavior and share their motivations with family and friends.



Further validation of the health impacts of plant-based diets has come from BKK ProVita, a German health insurance company. BKK ProVita is ProVeg's key partner in the Plant-Powered Pupils project. A traditional insurance company for more than 150 years, BKK ProVita also went through a recent transformation of core values, prompted by severe health issues faced by the company's CEO, Andreas Schöpfbeck. Following that scare, Schöpfbeck became vegan and decided to restructure his entire company to incentivize customers to adopt plant-based diets and healthier lifestyles.<sup>xxx</sup>

<sup>xxx</sup> How do you think an insurance company can incentivize its customers to choose a plant-based diet?

“Plant-Powered Pupils was one of our first partnerships,” says Michael Blasius, head of BKK ProVita's marketing and health promotion department. He says the partnership represented the company's shift from seeing health strictly as the absence of physical disease to looking at what people could do from a prevention standpoint. “Now we have a pyramid of values with physical activity, food, and mindfulness as the base and health on top, which is our core goal,” he says. “Climate and health work perfectly together once you understand the concept.”

### Institutionalizing Change

In many cases, a student's ability to choose a plant-based meal hinges on the school canteen's ability to prepare one. That's why ProVeg is one of the key partners in the complementary Climate Efficient School Kitchens (KEEKS) project. Since 2016, the KEEKS team across Germany has conducted 120 cooking trainings and educational events with over 3,000 participants. The purpose was to educate school caterers in the creation of sustainable and tasty plant-based meals. Seen as “multipliers,” those trained caterers were then responsible for transferring knowledge to their teams. In addition to focusing on what meals are made, KEEKS also addresses the how.

With the creation of a measures map, KEEKS project partners analyzed 19 ways in which school canteens could reduce their greenhouse gas emissions. The project calculated that emissions could be slashed by 40% if school canteens reduced their use of climate inefficient foods and adopted other energy-efficient behaviors and technology.<sup>49</sup>

“We saw schools make changes in what they're serving. We also had some changes in energy-saving in the kitchen,” says Malte Schmidhals, an environmental engineer with project initiator IZT. “For example, they used less frozen meals, and this saves energy from putting things in the deep freezer. We also had schools that reduced the amount of meat in a recipe.” The KEEKS project created an online database of recipes to improve the ease in switching to plant-based menus.<sup>50</sup>

While the KEEKS project has ended, ProVeg International wants to continue identifying the “big wheels” that can turn in order to shift policy around school lunches. One goal is to get more plant-based options on menus across the country. Jens Tuidier, ProVeg's

Chief of Staff, says that involves more systemic change, such as building plant-based diet training into the curriculum for school teachers and canteen staff. Challenges exist, including pushback from parents who already hold strong beliefs on how to feed and raise their children. Institutional adoption is also a slow process. Despite German Nutrition Society standards for school meals suggesting “predominantly plant-based” dishes, these guidelines aren’t mandatory and local areas are responsible for creating their own menus.

ProVeg says an indicator of success is its partnership with Sodexo, one of the world’s largest food service providers. Sodexo prepares 120,000 meals daily for more than 1,000 schools and daycare centers across Germany. During a special “Week of Action” organized by ProVeg, Sodexo says plant-based meals were ordered by students 68,669 times—11% of the total meals served in the five day period.

Sodexo kitchen staff receive twice-a-year training from ProVeg on the preparation of plant-based cafeteria meals. The company says that 90% of its schools and daycares have the possibility to offer a plant-based meal daily, and that it’s working to make that option available in all of its facilities in the coming months.<sup>xxxii</sup>

### A Final Taste Test

Back in the kitchen at Otto-Nagel Grammar School, the students are debating the merits of mushroom versus no mushroom as they top their spaghetti with the tofu bolognese sauce. Tucking into their lunch, students are asked to raise their hand if they’re enjoying the meal. All hands go up except one. “I liked the salty cheese flavor of the almond Parmesan because it was similar to what I know,” says one boy. “I really enjoyed the baking,” adds another. Would they make the dish again? “My parents would find it bad if I cut out the meat,” says Hannah, age 12. “On the weekend when I have the choice of our dinner I would pick this,” counters 11-year-old Charlotte.

<sup>xxxii</sup> Do you think something like this might work in your context? Why or why not?



Twelve-year-old Joyce is the outspoken voice of dissent. “My mom usually makes tomato sauce with beef. I expected the tofu to be similar but it ended up being quite different,” she says. “I really liked the plant-based Parmesan and pasta, and the banana muffins were alright.” Still, Joyce tried the tofu sauce and did learn some new information about the animal welfare aspect of plant-based diets.

Ultimately, this is what matters: getting kids eating and talking about plant-based foods, and when it comes to influencing their future behavior, at least offering some food for thought.

*Lunch is served—students at Otto-Nagel Grammar School get ready to test their plant-based meal.*

## Europe's Food Waste Warriors

Ensuring the global food system exists within planetary boundaries requires addressing what goes on people's plates and how it's produced. It's also about reducing the amount of food that is disposed of without being eaten.

Hotel buffets can be a large producer of food waste, but at Novotel Blackfriars in central London, England, the kitchen team is doing something about it. The breakfast buffet is winding down but there's still plenty of food: baskets of sticky pastries, bowls of fruit, and steaming trays of sausage, bacon, and eggs. While head chef Azad Choudhury says the kitchen adjusts its cooking volumes based on the number of guests, he says they generally prepare five to 10% more food to make sure they don't run out. Hot leftovers are given to staff, but cold buffet items end up in the trash.

That's when Marion Schumacher and Charlotte Bastiaanse walk in. Taking out their smartphones, a waitress swipes their screen and hands them a takeaway carton. As the guests filter out of the breakfast area, Schumacher and Bastiaanse are free to pack up whatever they want from what remains.

The two women stop by this buffet at least twice a week. It's a convenient breakfast—they work at an office just across the street. And with London food prices not getting any cheaper, the buffet offers all you can eat options for £2.50.

Schumacher and Bastiaanse are users of an app called Too Good To Go, the most downloaded food waste app in Europe. Between 2016 and early 2020, 20.7 million users in 15 European countries have rescued more than 32 million meals from the trash. The company estimates that has prevented 80,700 tons<sup>xxxii</sup> of greenhouse gas emissions from being released into the atmosphere.

Apps like Too Good To Go are one solution to an urgent problem: the FAO estimates that a third of the food produced globally each year is lost or wasted.<sup>xxxiii</sup> That equates to 1.3 billion tons<sup>xxxiv</sup> valued at nearly a trillion US dollars.<sup>51</sup> These statistics contain an unfortunate irony: in 2018 an estimated 821 million people worldwide faced food insecurity.<sup>52</sup> While food is rotting, others are struggling to eat. The conversation around food waste has traditionally been framed in three ways: the social justice aspect linked to hunger, the economic loss of that waste, and its environmental impact. ↘ [Appendix 2: Food Recovery Pyramid from EPA](#)



### The Food Recovery Hierarchy

Food waste apps like Too Good To Go are part of what's categorized as a secondary market for food waste. This means they divert would-be waste by creating either a new market or new products. In addition to food waste apps, secondary markets include everything from charitable soup kitchens to subscription food boxes for unwanted fruits and vegetables.

"These secondary market systems are a really important part of the whole [change that needs to be made to our food system]," says Martin Bowman with This is Rubbish. "But there is a need to fix the core system that is spitting out this food in the first place."

Bowman references the Food Recovery Hierarchy, the inverted pyramid that prioritizes the actions that should be taken around food waste. Developed by the United States Environmental Protection Agency, the first suggested action is to reduce waste at its source, followed by finding a way for that wasted food to feed hungry people—the purpose of secondary markets. The hierarchy demonstrates there are a number of pathways to divert food waste, and that not all are created equally.

Those environmental impacts aren't always apparent. "Food waste is a vastly overlooked driver of climate change," reads a 2018 *Washington Post* column.<sup>53</sup> The story raises an oft cited statistic: that food waste contributes 8% of total global greenhouse gas emissions due to the methane and other gases released as it decomposes.<sup>xxxv</sup> Food waste equates to a quarter of all greenhouse gas emissions produced by the food system, behind livestock and fish farms (31% of emissions) and crop production (27% of food sector emissions).<sup>54</sup> "There are some FAO stats that came out saying that if food waste were a country it would be the third largest source of emissions after the United States and China," says Martin Bowman with This is Rubbish, a United Kingdom-based organization that focuses on food that's wasted at the industrial production level.

Halving food loss and waste is one of the strategies the *EAT-Lancet* Commission identifies as necessary to create a sustainable food system. The strategy aligns with the UN's Sustainable Development Goals, calling to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" by 2030.<sup>55</sup>

Strategies to accomplish this goal look differently worldwide. Nearly all food loss in low and middle income countries happens at the start of the supply chain, during production, post-harvest, and during processing.<sup>56</sup> This is in part due to technological

<sup>xxxv</sup> In comparison, 14% of all greenhouse gas emissions are from the transport sector, which gets far more attention than food waste in the mitigation agenda.



In Madrid, Spain, a sticker at the entrance of a restaurant indicates app users can find their surplus food listed on Too Good To Go.

<sup>xxxii</sup> In comparison, the average car in the USA emits about seven tons of CO2 in a year.

<sup>xxxiii</sup> Food loss is anything that is unfit to sell or serve to people because it has spoiled at the production end of the supply chain. Food waste is characterized as items that are fit for human consumption, but for various reasons go to waste. Waste happens later in the supply chain at the retail and consumer levels.

<sup>xxxiv</sup> In comparison, an adult male white rhinoceros weighs around a one ton.

inefficiencies that affect the way food is harvested, stored, refrigerated, and transported. But Bowman from This is Rubbish says there's a risk in focusing too closely on this simple narrative. "The solution is then generally touted as a technological one—often multinational companies modernizing supply chains and the day is saved," he explains. According to Bowman, the food system also needs to address social and power distribution problems, such as the cosmetic disposal of "ugly" crops, unfair trading practices such as grocery chains delaying supplier payment in order to push through unfavorable contract terms,<sup>57</sup> and the systemic overproduction that can happen because producers are concerned about retribution if they under-supply. These are challenges that Bowman says would benefit from a regulatory approach, with legislation promoting fair trade and fines for companies that breach agreements with suppliers.<sup>xxxvi</sup>

In North America, Europe, and industrialized Asia, consumers and retailers play a more central role in what goes to waste. While these regions have the technology, money, and political power to ensure the preservation of food along the supply chain, an estimated 40% of losses are still attributed to retail or consumer waste.<sup>58</sup> The remaining losses come from earlier production stages in the supply chain.<sup>xxxvii</sup>

### The Origins of an App

Curbing food waste at the retail level is exactly what food waste app Too Good To Go is doing. Back at the buffet in central London, Marion Schumacher and Charlotte Bastiaanse have filled their cartons with an assortment of veggie sausage, croissants, cheese, hash browns, and granola. "The cafe in our office is not as well stocked as this. This is a better buffet for a better price, plus it's for a good cause," says Schumacher, adding that she and Bastiaanse work in the food sustainability field. "Convenience and pricing are important to some consumers, but what really attracted me to the app was the sustainability part because European regulation makes it rather difficult for companies to sell their food waste. I think [Too Good To Go] is a great initiative to actually make that happen."

Here's how Too Good To Go works: the app's retail partners estimate the retail value of the food that would go to waste each day—an assortment of sushi platters normally priced at €15 each, or €150 worth of buffet food, for example. Retailers then reduce

that shelf value by at least 50% and divide leftovers into a number of portions. Too Good To Go calls those portions "magic bags," partly because of the sense of mystery of what's inside, and partly because of the act taking place: food that would previously go to waste is now being saved. "Waste Warriors"—Too Good To Go's term for its users—can then buy those magic bags in the app, picking them up at the time indicated by the retailer. Too Good To Go takes a small transaction fee from each meal saved, and the remainder goes to the food retailer.

Too Good To Go was founded in 2015 by a group of young entrepreneurs in Denmark, the country where the company is headquartered. "They saw that food waste was a problem for restaurants and they realized they would buy that food if there was the chance," says Javier Miranda, Too Good To Go's Chief Marketing Officer, picking up the story. "So they decided to build a solution: at the end of the day someone would come take your leftovers and that person would pay for it, so it was a win-win-win—good for the consumer, good for the restaurant, and of course, good for the environment."

Launching its app in early 2016, the idea was quickly picked up across Europe. After a brief experiment with an open-source franchise model, the company reeled in independent operations the following year and brought on investors, a professional board of directors, and an executive team. While Too Good To Go is not yet profitable, Miranda points out that's because of rapid growth and expansion into new markets, and not because of lack of generated funds. The company has raised €16 million in private investment since its founding and is prioritizing growth from 27,000 retail partners to 75,000 by the end of 2020.

While the premise of Too Good To Go has always been to save meals that would otherwise go to waste, retail partners say they're drawn to the app for a number of other reasons, too.

### Getting Businesses on Board

Cookie Lab in Madrid, Spain, is still quiet by the time Dana Knowles arrives for the day. It's just after 10:30 a.m. and the generous sized cookies and brownies displayed in the shop's front case aren't exactly morning food, especially by Spanish standards.

<sup>xxxvi</sup> If you had the power to create policies within a food system, what would be your top priorities? And why?

<sup>xxxvii</sup> Before moving forward, think about what you do when you need to dispose of food? Is there anything you can do to reduce your food waste?

This haven of baked goods is Knowles' newest food venture. Originally from rural Arkansas, Knowles now lives in Madrid and has been operating a chain of import businesses called Taste of America for 23 years, stocking products that appeal to the homesick expat. Cookie Lab is her first foray into freshly prepared foods.

With the new business came a new challenge: food waste. While much of the excess stock at Taste of America is non-perishable and donated to food banks or charities, Knowles had a difficult time finding a home for Cookie Lab's surplus sweets. "The philosophy of the business is that everything is freshly made every day, but we still don't want to throw things away," explains Knowles.



Cookie Lab's attempts to sell leftover products weren't working. Reduced price goodies would go unsold because of fewer walk-in customers in the evening. Charities said they would accept the products, but only if they were delivered. Even giving the cookies to people on the street had logistical demands. "You need someone who will go out and do that, and as a small business we can't dedicate a lot of resources on our end," Knowles says. Posting surplus baked goods on Too Good To Go immediately resonated: "I said 'this is perfect, because I have a product that needs to be useful in some way, but it's difficult for me to find the avenue where it can be.'"

Knowles says this convenience piece is core in Too Good To Go's appeal. Unlike other food waste apps that require business owners to guess exactly which products will be left at the end of the day, Too Good To Go gives shops the freedom to add whatever products they

*The Cookie Lab is Dana Knowles' first foray into fresh foods. Knowles' has been selling 'magic bags' of leftover baked goods on Too Good To Go since she opened in September 2018, and says it's beneficial for the environment, marketing, and gets customers in at the end of the day.*



have to the magic bag, so long as they equal the value advertised in the app. It's a tool she says her staff actually want to use, and one that brings customers through the door near closing time when business slows.

Listing leftover products on the app also helps Knowles tap into the values (and smartphones) of her millennial target market. "Customers are interested in all the components around sustainability and food waste," she says. "Whether it's the source of their ingredients or animal welfare [...] I think it's all tied up in the same package of sustainability and how we can belong to a community in a more responsible way. Businesses haven't always had this financial incentive to save food, so it's good that consumers are leading that demand and the change of thinking and practice."

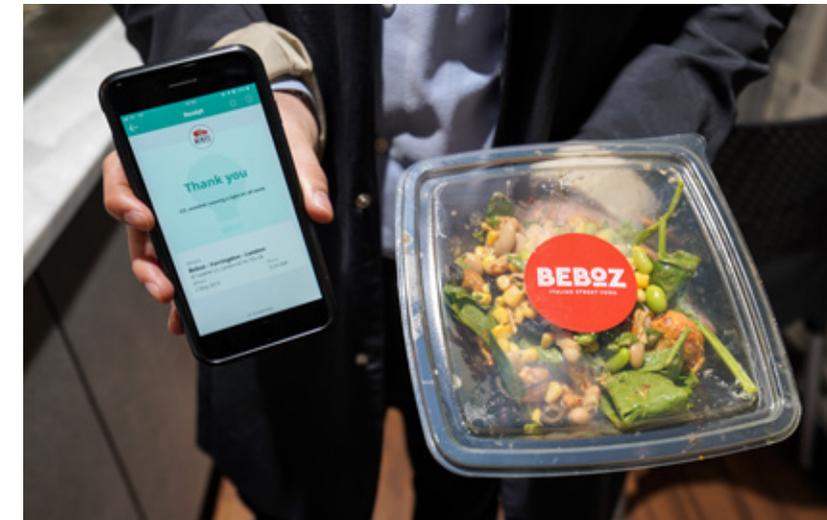
Spain also has a large number of *fruterías*: small shops that sell unblemished, perfectly shaped fruits and vegetables in orderly piles. But, as Adrian Santamaria Lagunar says, a display like this comes with a dark side.

Lagunar is the owner of Frutería Santamaría in Madrid. Surrounded by glossy stacks of fruit, he ushers towards his storage room and reveals what he says is a disturbing sight to many customers: a box of "ugly" fruits and vegetables. "What people are thinking is that if the food is ugly it is completely inedible. It's normal. You buy a computer and you don't want it to have scratches," he says.

Exacerbating the odd bruise and lump is Madrid's summer temperatures. The average July day is 32°Celsius, and three to four kilograms of food spoil daily, regardless of air conditioning. On these days, Lagunar tries to haul home anything he can to share with his two brothers, parents, and grandfather. "I could feed another family as big as ours with the food left, and on some days many more," he says. Too Good To Go offers an outlet for him to sell magic bags with the ugly produce, reducing the amount that ends up in the trash.

Lagunar says it comes down to education and marketing—changing the mindset that people have around food waste. That's starting with some consumers, he says: "an app like Too Good To Go rewrites this story. It changes the focus from people buying 'bad fruit' to people doing something positive for society by managing the food waste."

Education and marketing isn't limited to ugly fruit. It's lunchtime in London, and Too Good To Go user Matt Bannister is getting ready to pick up a magic bag from BEBOZ, an Italian street food spot. Bannister initially started using the app for convenience, needing something for dinner before heading to music shows. "Before, I'd find the nearest MacDonald's on the way to the tube station," he laughs. "Now there are multiple reasons for using Too Good To Go. It costs less, it's actually good food that's tasty, and you get the feel good factor as well knowing you've helped the environment."



*A recent Too Good To Go purchase in London, United Kingdom. To motivate its 'Waste Warriors' each Too Good To Go receipt offers users an environmental fact — for example, the amount of carbon dioxide avoided by saving a meal rather than letting it go to waste.*

Two years in, Bannister says he uses the app weekly, and regularly rescues meals with his friends and work clients. It's also prompted him to change his food behaviors in general. "I now go straight to the yellow sticker discount aisle when I'm grocery shopping. Too Good To Go has massively changed the way I look at this. Some of their marketing campaigns were quite shocking and opened my eyes. I'm more vigilant about what I'm throwing away." It's a changed perception of value, to go from waste to want.

### Too Good To Go's Food Waste Movement

Changing user perceptions around ugly produce and "less desirable" food is only the beginning. While it could focus solely on being a tech company, Too Good To Go envisions having a greater educational and policy impact. In addition to creating awareness within households and businesses, promoting education and advocating for policy

change are the four pillars of a new food waste movement Too Good To Go launched in April 2019.<sup>xxxviii</sup>

“Our job is to educate and bring visibility to a problem that is unfortunately not visible and tangible. We are not plastic,” says Javier Miranda with Too Good To Go, referring to the success campaigners have had in changing behaviors around items like straws and single-use water bottles.

Making the invisible visible demands working with people at many levels. Too Good To Go's goal is to collaborate with 500 educational institutions worldwide by the end of 2020. That means attending conferences, writing case studies, and creating other classroom materials for students from elementary school to university age. The company is also financing research at a university in the Netherlands looking at emissions related to food waste, and Miranda says the company is open to funding requests from university students working on other related projects.

Policy-wise, Too Good To Go is actively campaigning to change retail food waste legislation in at least five of its countries of operation by the end of 2020. At the moment, the company is focused on the best before labelling of products in Denmark, Norway, and France, the app's largest markets. “People see these labels as the deadline for food, and that's absolutely not true,” says Miranda. “There are products like dehydrated pasta or rice where this makes no sense, so we're going to either push to change the food labelling on certain products or to remove the expiration date completely.”

The European Union has the most progressive attitude worldwide towards some of these policy changes. In 2018, Martin Bowman and the This is Rubbish team led lobby efforts that prompted the European Parliament to adopt targets for food waste under its Waste Framework Directive. As a result, as of 2020 all EU member states must measure and report the amount of food wasted from manufacturing through to consumer level. While this makes the EU a global leader in this issue, the target to halve the amount of food wasted remains aspirational and non-binding.

As more retailers take measures to reduce their food waste, either voluntarily or by-law, Too Good To Go is aiming to be their outlet. Getting more retailers on board is a key step for the company's business growth. Until then, the app has more users than meals to save.

## Epilogue

Ultimately, the responsibility of changing the global food system does not fall on any one individual, government, or country, though certain regions of the world need to change their actions more than others (i.e. reduced red meat consumption in North America and across high and upper-middle income countries). Examining our food system offers the chance to reflect on many of the cross-cutting principles of planetary health. One principle, global citizenship, demands we recognize how individual and regional food choices and policies ripple outwards and affect the international community. Another principle, unintended consequences, demonstrates the need for long-term thinking so short-term food production gains don't burden future generations with environmental and human health consequences.

The science is in, strategies and targets set, examples of real-world solutions identified. The next step is for individuals, industry, and government to have the courage to change the menu at the scale required for a better future.

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*EU Campaigns Manager, This is Rubbish (UK)*

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**Adrian Santamaria Lagunar**

*Owner of Frutería Santamaría and retail partner with Too Good To Go (Madrid, Spain)*

**Marion Schumacher**

*Too Good To Go user (London, UK)*

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*Mealworms and mealworm beetles grown as part of MealFlour's pilot program in Guatemala.*

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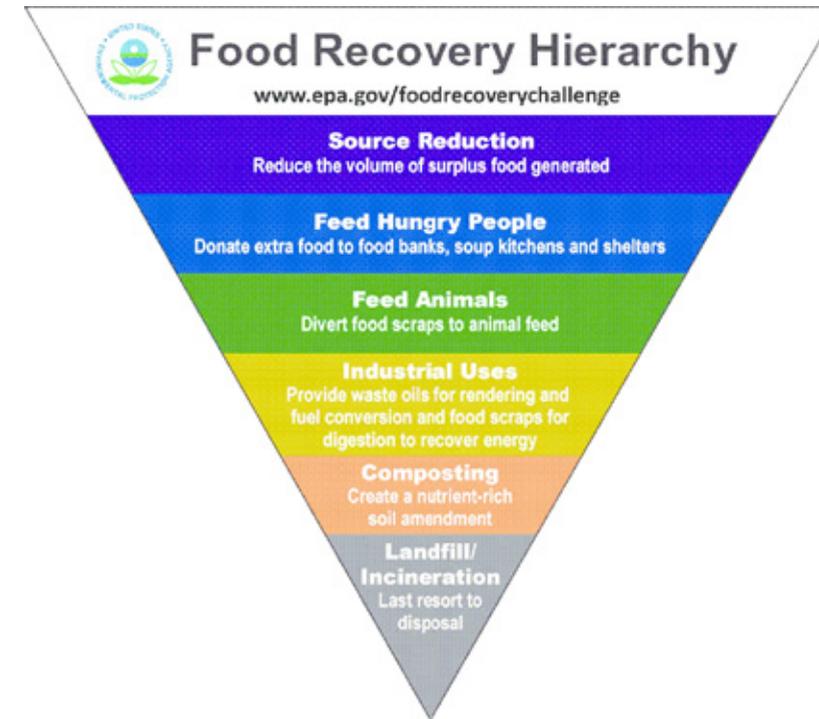
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	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
 <b>Whole grains</b> Rice, wheat, corn and other	232	811
 <b>Tubers or starchy vegetables</b> Potatoes and cassava	50 (0-100)	39
 <b>Vegetables</b> All vegetables	300 (200-600)	78
 <b>Fruits</b> All fruits	200 (100-300)	126
 <b>Dairy foods</b> Whole milk or equivalents	250 (0-500)	153
<b>Protein sources</b>		
 <b>Beef, lamb and pork</b>	14 (0-28)	30
 <b>Chicken and other poultry</b>	29 (0-58)	62
 <b>Eggs</b>	13 (0-25)	19
 <b>Fish</b>	28 (0-100)	40
 <b>Legumes</b>	75 (0-100)	284
 <b>Nuts</b>	50 (0-75)	291
<b>Added fats</b>		
 <b>Unsaturated oils</b>	40 (20-80)	354
 <b>Saturated oils</b>	11.8 (0-11.8)	96
<b>Added sugars</b>		
 <b>All sugars</b>	31 (0-31)	120

**Table 1**  
Scientific targets for a planetary health diet, with possible ranges, for an intake of 2500 kcal/day.



# Family Planning for People and Planet

A POPULATION, HEALTH, ENVIRONMENT  
APPROACH IN THE LAKE VICTORIA BASIN

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

Case studies were written and photographed by Hilary Duff with editing and support from Amalia Almada, Christopher Golden, and Sam Myers. Teaching guides were written by Carlos A. Faerron Guzmán.

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## Executive Summary

Topics of population growth and the beneficial roles of providing girls education, women's economic opportunities, and access to contraception for couples are explored in depth in chapter 3 of [\ Planetary Health: Protecting Nature to Protect Ourselves](#).

### Learning Objectives

*After reviewing this case, students should be able to:*

- ① Explain how population growth, poor resource management, and health are intertwined.
- ② Analyze how the historical and socioeconomic contexts can determine the health of ecosystems and humans.
- ③ Assess how gender, economic, and other power dynamics shape planetary health challenges.
- ④ Appraise the utility of the PHE approach.
- ⑤ Design population-wide interventions to address planetary health challenges with scalability and sustainability in mind.

This case study illustrates the relationship between population, family planning, community health, and the sustainability of natural resources in the Lake Victoria Basin, the largest lake basin on the African continent. It demonstrates how these dimensions are shaped by many factors, including human-caused alterations to the lake, access to sexual and reproductive health services, and environmental degradation.

The case analyzes the effectiveness of addressing these challenges using an integrated approach called PHE. PHE stands for population, health, and environment. Since 2012, Pathfinder International's Health of People and Environment in the Lake Victoria Basin (HoPE-LVB) has been a flagship PHE project in the region. Its approach has three arms: (a) increasing education and access to the tools that help with healthy timing and spacing of children (population); (b) improving sexual and reproductive health, in addition to sanitation and hygiene standards among families (health); (c) supporting the shift to sustainable fishing and agriculture (environment).

Using these three arms of PHE, Pathfinder's project in Uganda and Kenya has demonstrated why a comprehensive approach is necessary to address the Lake Victoria Basin's complex suite of problems. With a focus on policymaking, advocacy, and institutionalization of best practices, HoPE-LVB is a model for how district, national, and regional bodies can adopt multi-sectoral PHE approaches in their work.

*This case study is based on interviews conducted on Bussi Island, Zinga Island, and Kampala (Uganda) as well as Nairobi, Kenya in September and October 2018.*

## Introduction



*Namakula Edith, a Village Health Team member on Bussi Island.*

In East Africa, the shade of a tree provides an informal meeting place. This afternoon, there is a gathering of a half dozen young mothers. Namakula Edith, a sprightly 47-year-old who looks a decade younger, is convening. And today, she's brought props. Reaching into her family planning kit, Edith pulls out blister packs of birth control pills and rattles them in the air. But the real fun begins when it's time to talk condoms. Edith doles out a few to the women sitting tentatively on the benches around her and searches through her envelope for a slightly more phallic prop. For demonstration purposes, of course—though it draws giggles from the surrounding women and a double take from passing motorbike drivers.

Contraceptive methods and family planning are the main topics of conversation today, but the meeting also touches on the connection between family size, health, and the environment. It's a concept referred to as Population, Health, Environment (PHE). Edith finds the approach is best explained with an easy-to-grasp example. In an island village like Seeta where Edith and the women live, it makes sense for that story to start with a fish.

“Think of the resources your family needs,” Edith says. She means the food, firewood, shelter—everything essential to a family's basic survival. “If the father brings one fish and he has 10 children, it means the fish will not be enough,” she explains. “If you are many, you use a lot of things.” She goes on: “if there are fewer children, then you will need only one piece of fish to provide nutrients for your home, and the rest of the money can go towards education and healthcare. You will have fewer children, but you will be able to support them better,” she says. “And because there are fewer people at home you will not need to collect as much firewood to cook that fish, so the forest will be better maintained. Making the decision to use family planning to time the birth of your children conserves the environment around you. Your fish goes further, and so does your family,” Edith says. These are the first messages Edith uses when talking to her peers about PHE. It may be a simplification of the linkages between family size, health, and the surrounding environment, but it's a start.

Edith and these women live on Bussi Island in the Ugandan portion of Lake Victoria. It's here where Edith serves as a member of the Village Health Team (VHT), a group of government-hired community volunteers who provide the bridge between villages

and government health clinics. Accessible only via an hour-long motorboat ride from the mainland, Bussi Island is one of four focus areas for the Health of People and Environment in the Lake Victoria Basin (HoPE-LVB) project in Uganda and Kenya. A project of Pathfinder International,<sup>1</sup> a long-running sexual and reproductive health NGO based in the United States, HoPE-LVB is an example of an internationally-funded project that has been proven to support positive behavioral, environmental, and policy changes at regional, national, district, and local levels. In the case of this project, local gets really personal—into the homes and bedrooms of families across the region.

[Learn more about Pathfinder's work here](#)



*One of the wooden motorboats that transport people from the mainland and serve as commuter boats between Lake Victoria's islands.*

Just as planetary health examines how human health and the spread of disease are influenced by human-caused disruptions to the Earth's natural systems, PHE also looks at the health of people and the environment.

“The planetary health concept can be strengthened even further when it includes addressing women and men’s sexual and reproductive health rights,” write<sup>i</sup> Suzanne York and Robert Engelman, two PHE experts. York is the Director of Transition Earth and Engelman is a Senior Fellow at the Population Institute. “If couples were empowered to make their own reproductive choices, and provided with the means to choose the number and timing of their pregnancies, the resulting impact on human fertility would powerfully alter future trajectories of population growth and its environmental impacts, while also adding to the health and well-being of families and communities,” they continue. The HoPE-LVB project takes this rights-based approach<sup>ii</sup> to family planning, providing couples with the knowledge, access, and choice to plan for the timing and spacing of their children.

The “population” dimension of HoPE-LVB includes voluntary family planning and contraceptive information sessions for women and men alike. Health-wise, the project has worked to ensure women have safe pregnancies and childbirth and more recently, has aimed to reduce rates of mother-to-child HIV transmission.<sup>iii</sup> The health element also addresses minimizing disease through improved household hygiene and sanitation, and reducing the risk of respiratory conditions through the construction of energy-efficient clean cookstoves. Finally, the “E” in PHE talks about the importance of, and the best ways to, conserve the environment. That ranges from adopting sustainable fishing and agricultural practices, to diversifying livelihoods to reduce reliance on any one natural resource.

While the dimensions of PHE can be defined separately, a key element of this approach is recognizing the linkages that exist among the three—how demographic trends and poor access to sexual and reproductive health affect the environment, how the changing environment affects health, and so on. The goal is to create an integrated solution that considers the complex everyday realities of people, including barriers of poverty, culture, and health access.

<sup>ii</sup> What is the rights-based approach? Can you think of other examples where this approach is used?

According to the organization Family Planning 2020, human rights-based family planning approaches support the right of all individuals to “choose whether, when, and how many children to have; to act on those choices through high-quality sexual and reproductive health services, information, and education; and to access those services free from discrimination, coercion, and violence.” More information can be found in this resource guide.

<sup>iii</sup> What is the burden of HIV in Uganda? \ [Learn more here](#)

## Lake Victoria in the Anthropocene

Lake Victoria is the largest freshwater lake on the African continent. Its shores connect Uganda, Kenya, and Tanzania, and its catchment area extends to include the countries of Burundi and Rwanda. Today, the Lake Victoria Basin (LVB) is an integral part of the economy and culture of all five East African countries. An estimated 44 million people live in the LVB, and despite making up less than 10% of the land area, the region is home to a third of the people living below the poverty line in the East African Community (EAC).<sup>2</sup>

Lake Victoria’s positioning in the region presents several environmental and health challenges. In addition to being a transboundary ecosystem with management subject to the political will and cooperation of multiple countries, the LVB’s residents are also unique. “These are people who do not seem to belong to any country,” explains Doreen Othero, the Regional Programme Coordinator for the Integrated PHE Programme of the Lake Victoria Basin Commission, an institution created by EAC to oversee the sustainable development of the region. “The people living here cross borders, do their business, and then return home.”



*A landing site on Lake Victoria. These sites connect people who live on islands like Bussi with the mainland and other island communities. Sometimes described as an inland sea due to its immense size, Lake Victoria is essential to the health and livelihoods of millions of people living in five countries.*

That transience is because of the region's primary industry: fishing. Home to valuable ecosystems and essential natural resources, along with a rapidly growing population, the LVB sits at the crux of many human health, environmental, and economic challenges. Nothing new, the anthropogenic threats facing Lake Victoria started decades ago.

#### A Colonial Past and the Demise of Lake Victoria's Biodiversity

A small aquarium sits near the Ugandan shores of Lake Victoria. Follow the mechanical whirl of the filtration systems and you'll come across a rectangular room, walls lined with some dozen tanks, each containing a common type of fish found in the nearby waters. The invasive fish species that has forever altered the ecology of the lake sits unassuming in a tank on the left side of the room: the Nile perch (*Lates niloticus*). While the one in this tank is only a half-meter long, fish of up to two-meters in length have been fished from Lake Victoria.<sup>3</sup> YouTube videos show fisherfolk hauling huge Nile perch from their boats, the fish hoisted over their shoulders.

The Nile perch was an introduced species to Lake Victoria. Its effects on the ecosystem have been well documented by scientists, including the ones working in the buildings surrounding this particular aquarium. The aquarium is in the town of Jinja, and the researchers work with the National Fisheries Resources Research Institute (NaFIRRI), a semi-autonomous Ugandan government agency that has long had its finger on the metaphorical pulse of the lake.



*The National Fisheries Resources Research Institute (NaFIRRI) aquarium.*

The introduction of Nile perch to Lake Victoria came first through a secretive release by the Uganda Game and Fisheries Department as early as 1954. Dozens more individual Nile perch were introduced from Ugandan and Kenyan shores over the following decade.<sup>4</sup> The introduction of Nile perch favored the interests of the British colonial forces who controlled Uganda, Kenya, and Tanganyika (present day Tanzania) until the countries gained independence in the early 1960s.

The premise was that Nile perch would provide ample catch for sport fishing, while serving as a predator for hundreds of endemic but small haplochromine cichlid species. The British administration deemed these cichlids "trash fish,"<sup>5</sup> and thought they'd be much better utilized as the primary diet for Nile perch, a species with a higher commercial value.

Two decades later, the Nile perch population exploded. "All of a sudden whenever fishermen would cast their nets they were seeing a fish they had never seen before. It took over the space in the lake," says Winnie Nkalubo, a fisheries biologist with NaFIRRI. The difference in total annual fish catch was notable: the size of the fishery increased by a factor of five between the early 1970s and 1989.<sup>6</sup>



*Illicitly introduced into Lake Victoria in the 1950s, the Nile perch has had a significant impact on the lake's ecology.*

Commercial processing factories soon cropped up along the shores of Lake Victoria, intensifying fishing pressures. Those factories were responsible for preparing catches of Nile perch for mass export to Europe and the Middle East—the first time Lake Victoria fish were sold internationally. Previously, the fishery had provided subsistence food for local and regional markets, and had been a resource used in pre-colonial bartering systems.<sup>7 8</sup>

### Perch and Population

The expansion of the Nile perch market in the 1980s and early 90s attracted a gold rush-style migration to Lake Victoria. “The population pressure pushed fish stocks to the lowest level, but fishers were still in business and had to switch to illegal nets,” Nkalubo says. Illegal nets had a finer mesh, and could be used to catch younger, smaller fish. “There was an open access policy on the lake, so there was no regulation that limited the number of fishermen,” Nkalubo adds.

“In terms of economics, the introduction of the Nile perch was a blessing,” adds Herbert Nakiyende, another NaFIRRI fishery biologist. By the 1980s, it’s estimated the economic value of the fishery increased fivefold.<sup>9</sup> During that time, people living along the shores of Lake Victoria benefited from the fishery. It improved incomes, brought infrastructure to the region, and created jobs at new processing factories. Local fisherfolk could sell their catch to factory middlemen while still having enough to feed their families.

“But for conservationists [the introduction of Nile perch] was obviously a curse since we had so many extinctions,” Nakiyende expands. It’s estimated that the feasting of Nile perch contributed to a 63% decline in the number of the lake’s haplochromine cichlid species between 1960 and 2010.<sup>10</sup> Today, memory of those fish is found only at NaFIRRI, in a small building that bears the slightly tragic name “museum.” Inside, jars of formaldehyde-preserved fish are stacked on floor-to-ceiling shelves—species that currently populate Lake Victoria, and the ones that were made extinct by Nile perch.



*Jessy Lugya, a research assistant in fish biology at the National Institute for Fisheries Research (NaFIRRI), inspects the jars of now-extinct haplochromine cichlid species. The introduction of the Nile perch extinct an estimated two-thirds of the small fish living in the lake.*

The economic bubble created by the Nile perch boom soon burst. The European Union slapped export bans on Lake Victoria fish between 1997 and 1999 due to traces of salmonella, cholera, and other hygiene and chemical concerns.<sup>11</sup> Some processing factories experienced an estimated 75% reduction in operations during these bans.<sup>12</sup>

Despite temporary export bans, local and regional demand remained. Fisherfolk who had migrated to the LVB during the boom continued fishing, and it became clear there was a decline in fish stock. Nile perch biomass declined nearly 10-fold from 1.9 million tons in 1999 to 200,000 tons in 2008.<sup>13</sup> Since then, the biomass of Nile perch has recovered slightly. And yet, only 5% have reached the stage of maturation where they can breed,<sup>14</sup> indicating that fish stocks will continue to be limited.

With more than 800,000 people<sup>iv</sup> relying on Lake Victoria's fishery for direct employment and stocks declining, fisherfolk increasingly turned to illegal methods to capture what fish remained.<sup>15v</sup> These illegal methods included the use of small hooks and finer-mesh monofilament nets to capture younger Nile perch that hadn't yet reached full maturity. Catching smaller fish comes with short-term gain as they can be sold at the local market. The long-term effects on the ecosystem are more dire, and interfere with reproduction and the natural replenishing of the lake's perch population.<sup>16</sup>

The decline in fish stock also meant fisherfolk had to go further from shore to reach their catch. This increased the travel of an already transient population. The biodiversity of the lake and its ecosystems were at-risk. It was obvious that the lake's natural resources were key to maintaining livelihoods and food security—at the same time, the protection of ecosystems also affected human health.

### Fish Catch and the Rise of HIV

As Lake Victoria was experiencing the ups and downs of Nile perch supply, the region was also seeing a rise in something more ominous—the prevalence of HIV/AIDS.<sup>vi</sup>

The first case of AIDS in the Lake Victoria region was reported in 1982 in a fishing village in southwestern Uganda.<sup>17</sup> Prevalence of

the HIV virus that causes AIDS continued to rise in the region, with first cases reported the following year in Tanzania, and the year after that in Kenya.

Isiah Kisiki remembers this time well. Born on Bussi Island, he's one of the few people who grew up on the island rather than arriving as a result of the temporary boom in Nile perch supply. He recalls how people started to behave when fish stocks declined: "A lot of fishermen started fighting. Prostitution increased, domestic violence, and more drunkenness, too," he says. When it came to the spread of HIV, Kisiki remembers that many people came to the island as a way to isolate themselves. But it didn't work like that. Fisherfolk were traveling further and more frequently to get the same amount of fish. Many were living unknowingly with HIV, and would unwillingly pass the virus among multiple sexual partners across various parts of the lake.<sup>vii</sup> Kisiki says a reduction in fish stock also had detrimental environmental effects: "People had little revenue coming in from fishing and started to cut trees to burn for cooking and to sell as firewood."

<sup>vii</sup> What other conditions back then, and even today, fueled the HIV epidemic?



*Isiah Kisiki is a lifelong resident of Bussi Island. This is what fishing on Lake Victoria looked like when he was a child—before the population boom of the Nile perch, introduction of HIV-AIDS, and eventual collapse of the fishery.*

Fishing communities have always been one of the groups most vulnerable to the transmission of HIV/AIDS. While 18% of Uganda's general population was infected at the peak of the infection in 1992,<sup>18</sup> epidemiologist and former director of the country's HIV/AIDS Control Program, Dr. Alex Opio, estimates that prevalence

<sup>iv</sup> How many people worldwide depend on fish as a main source of income or dietary protein? How about in your country of origin?

<sup>v</sup> What are some of the illegal fishing methods that fisherfolk can use to increase their catch?

<sup>vi</sup> ↘ [Here is a timeline on global HIV infection since it's origin in the 1980s.](#)

viii ↘ [Take a look at this link with global distribution of HIV burden of disease](#)

could have been as high as 30% on island and fishing communities during the same period. The first survey to quantify the rate of HIV prevalence in island communities did not happen until 2011. Opio and his co-authors found the rate in island communities to be 22%—more than three times higher than the 6% prevalence found in the general population.<sup>19viii</sup>

A reason for the increased occurrence is the lack of physical access to health services, coupled with the nature and culture of fishing communities. “It was very apparent that the islands were lacking health facilities,” says Opio. More often than not, fishing communities are serviced by outreach or mobile services, as opposed to a dedicated health post. The frequency of travel by fisherfolk made it more difficult still for HIV awareness messaging to be communicated and treatment offered. “So fishermen had no knowledge or health access if they did contract the disease, making transmission rates higher,” Opio says.

High prevalence rates were paired with risk-taking behavior. Fisherfolk, Opio says, don’t live in isolation—they come to an island knowing there’s fish, and they leave their family somewhere else in the country. “They do their fishing at night and by 9 a.m. they’ve sold their catch and have money,” he says. “Then they would often either go to sleep, drink alcohol, or have affairs with the commercial sex workers who go to the island.”



Two men untangle a fishing net after unloading the day’s catch. The mesh size on this net is legal, though there are many fisherfolk in Lake Victoria who use smaller meshes, pulling in adult-sized fish while disrupting the growth of those that haven’t yet reached breeding maturity.

Compounding that spending culture is the fatalistic attitude held by many fisherfolk. “Fisherfolk see their risk of mortality coming from different sources,” Opio explains. “They see people dying of HIV, but they also regularly see other fisherfolk drown. They would say ‘if I can survive the rough waves of water, what about this HIV?’ To them, the risk of dying from infection was much less than the risk of dying while on the lake.” This fatalism translated to a resistance towards using condoms, as well as a lack of urgency to protect natural resources. Survive and catch fish on the lake today—worry about tomorrow, tomorrow. It’s a culture that’s still prevalent in island communities today.<sup>ix</sup>

### Healthy People, Healthy Planet

There are many linkages demonstrating how the protection of Lake Victoria’s ecosystems can benefit human health. The same is also true in reverse, and was a topic explored in a 2017 paper authored by Dr. Kathryn Fiorella and her Cornell University research group. That study quantified how human health and well-being in the Kenyan portion of Lake Victoria influences the capacity of people to sustainably manage their natural resources.

The findings directly contradict a common hypothesis: that sick people have less of an environmental impact. “By this logic, ill people reduce the time and effort that they put into extractive livelihoods and, thereby, their impact on natural resources,”<sup>20</sup> the paper reads.

Fiorella and her team found a more complex story. The study demonstrated that a fisher’s mental and physical health had no effect on the total hours fished per month, the number of nights spent away, or the income per hour fishing (a metric of fishing “success”). People who were sick were fishing just as much as when they were healthy. Poor physical health did, however, influence the choices people made around fishing methods and fishing location. Fisherfolk with poor physical health were 69% more likely to use an illegal method in inshore fishing areas—closer to shore locations that often served as habitat for smaller, easier-to-catch fish. Sick people were still fishing, but in even less sustainable ways.<sup>x</sup>

↘ [Appendix 1: Figure 1 from Fiorella et al 2017 PNAS Fishing and Morbidity](#)

<sup>ix</sup> This is a perfect example of how gender and gender roles can determine health and disease. Can you think of other examples? Think about where you live—does gender determine your health?



A man fishes for Nile perch and tilapia near the shores of Lake Victoria.

<sup>x</sup> Why do you think this was the case?

<sup>xi</sup> *Dagaa* (*Rastrineobola argentea*) is the Kiswahili name for the small, sardine-like fish found in Lake Victoria. Fisheries researchers attribute the rise in *dagaa* biomass to the decline in Nile perch stock, as *dagaa* was released from competitive pressure with the demise of the cichlids. Food preference-wise, it is considered less valuable than Nile perch or tilapia, as there exists a culture of eating larger table fish. The *dagaa* fishery could, however, be a way to make the lake's fishery more gender equitable, as women play a larger role in the harvest, drying, and selling of *dagaa* versus traditional Nile perch.

<sup>xii</sup> Can you think of other examples of this “negative cycle”?



### Gender Dynamics in the Lake Victoria Fishery

The introduction of Nile perch and declining fish stocks exacerbate the inequitable gender dynamics that exist in Lake Victoria's fishery. Traditionally, men are the ones who fish, selling their catch at the shore to women who manage the processing, transportation, and sale of those fish. The role of women in the fishery shifted after the introduction of Nile perch with the rise of larger packaging plants to prepare the fish for international export. To this day, women are primarily excluded from the more lucrative Nile perch market and instead take on the responsibility of drying and trading *dagaa*, a small, sardine-sized fish that has become populous in the lake. They also locally trade and process undersized Nile perch.

A 2015 paper authored by Dr. Kathryn Fiorella and her research group investigates how declining fish catch affects women. In Kenya, she found many women exchange sex for preferential access to fish.

Whereas periods of high catch means fish is plentiful and can be purchased using money alone, a declining stock means women have to compete for catch using non-cash methods. This has affected *jaboya* relationships—the Luo word used to describe fish-for-sex. Transactional sex relationships like *jaboya*, are different than sex work. They are often with a regular partner and include other benefits such as housing and emotional support.<sup>21</sup> *Jaboya* transactions typically involve a woman exchanging sex with a man in order to gain preferential access to purchase the fish he has caught. While women are conventionally excluded from the

“In contrast, methods used by physically healthy fishers require fishers to reach deep water or fish overnight to target the more sustainable mature Nile perch and *dagaa*<sup>xi</sup> fisheries,” Fiorella and her team write.

Lake Victoria's fishery is male-dominated, but it's not only the health of men that affects the sustainable use of natural resources. Nor is it only men who are impacted by the negative side effects of ecosystem destruction. Illegal fishing practices and the unsustainable management of the fishery can lead to increased vulnerability for women (see textbox 1). Poor health is just one factor that contributes to destructive fishing practices.

As illustrated in appendix 1, those fishing practices can impact family food security and livelihoods—less fish means less for families to eat. It can also increase reliance on other natural resource-based livelihoods such as charcoal-making and farming. If done unsustainably, those activities can lead to deforestation or damaging agricultural practices. Natural resource degradation and food insecurity can then increase illness, which again fuels the cycle of poor health and unsustainable natural resource use.<sup>xii</sup>

Nile perch economy, and standard prices are set by fishery managers, fish-for-sex transactions introduce the opportunity for a non-monetary bargaining chip. *Jaboya* relationships have existed for several generations due to the transient nature of the fishing industry, though exchanges are now being altered by fluctuations in Nile perch and *dagaa* catch.

These transactions are among the many factors that have contributed to higher-than-average HIV rates in the Lake Victoria Basin.

Finally, physical health and well-being hinges on gender equity. That includes women having control over their reproductive health (the ability to access contraception, avoid diseases, and safely plan for and deliver children). Removing a woman's right to make decisions about her sexual and reproductive health and limiting her bargaining power within economic systems has a negative impact on her welfare. That, in turn, has a similar impact as a sick fisherman: the unsustainable use of natural resources.

As demonstrated by Fiorella's research, environment and human health feedback loops are complex. Environmental conservation cannot be done without considering the health and well-being of the people who rely so heavily on the services provided by those ecosystems. Any project that wanted to improve the outcomes of one would have no choice but to integrate the other. This was the context in which the HoPE-LVB project began.

## The Need for an Integrated Solution

<sup>xiv</sup> What's the population density where you live?

The African continent has a population density of 36 people per square kilometer. Urbanization compounded by birth rates, however, has meant that Africa's most populated cities have dramatically higher population densities. Take Cairo, Egypt (population: 19.5 million, population density: 19,376 people per square kilometer) and Kinshasa, Democratic Republic of Congo (population: 9.4 million, population density: 19,900 people per square kilometer).

<sup>xv</sup> Population Research Bureau data says Ugandan women of childbearing age give birth to an average of 5.4 children, and that number sits at 3.9 children per woman in Kenya—both substantially higher than the global average of 2.4 children per woman.

The Lake Victoria Basin has long been shaped by changing demographics and population pressures. Even before the Nile perch boom of the 1980s, the LVB had a higher population density than the rest of the continent.<sup>xiv</sup> As of 2015, an estimated 246 people inhabit every square kilometer of lakeside in Uganda, Kenya, and Tanzania, compared to 45 people per square kilometer in 1960.<sup>22</sup> It's notable that in the case of Tanzania and Kenya, the population density in lakeside areas is two to three times higher than the density of the country at-large.<sup>23</sup> These demographic trends can be attributed to two key factors: an influx of in-migration to the fishery, particularly following the Nile perch boom, and birth rates that surpass national averages.<sup>xv</sup>

The result is 44 million people whose lives and livelihoods are intertwined with and dependent on a finite set of resources. While limiting in-migration to the region could be one way to mitigate natural resource pressures, Pathfinder International is addressing the issue through a rights-based PHE approach. The organization is ensuring that couples have access to contraceptive choice and sexual and reproductive health services. This empowers women and men to plan for the healthy spacing of their children, reduce the risk of contracting or infecting others with HIV, and live within the means of what their local natural environment can sustainably support.

### Pathfinder and PHE

'Integration' is a word that comes up often among the Pathfinder International team. In this case, integration involves multi-sectoral project objectives: to conserve Lake Victoria's natural resources, improve the health and well-being of the people who live on its shores, and provide families access to sexual and reproductive health services. Add to the list a mission to combat traditional gender roles, advocate for greater healthcare access, women's economic empowerment, and institutionalization of PHE policies at various levels of government, and you have the organization's Health of People and Environment in the Lake Victoria Basin (HoPE-LVB) PHE project. If it sounds multi-faceted, that's because it is—but Pathfinder's belief is that complexity is the only way to address complexity.

Sono Aibe, a former Senior Program Advisor at Pathfinder, has been thinking about integration since her public health career



*Namakula Edith, the volunteer team member with the HoPE-LVB project, holds up the packet of birth control she uses in her presentations with couples. Pathfinder isn't telling families to have fewer children. Rather, it gives couples access to the knowledge and tools they need to make decisions about the healthy spacing of children.*

started in 1988. One of her first projects involved creating an integrated reproductive health, environmental sanitation, and maternal health project in the Philippines, a country long considered a leader in integrated PHE approaches. “Having come from that background made me a proponent for taking a broader view of sexual and reproductive health because women’s lives are complex, and their problems are intertwined,” says Aibe. While it would be possible to dedicate entire projects solely to managing and restoring natural ecosystems, family planning, or health, the premise is that it takes addressing all three to target the root causes of a region’s challenges.

Pathfinder had already tested the waters of combining environmental and health programming by 2009 when Aibe was hired. Whether it was an HIV-focused project with a livelihood or agricultural component, or integrating HIV education and family planning, Aibe says she had an inkling that PHE programming was something Pathfinder could adopt.

What came next wasn’t easy. “There definitely was pushback in the sense that people thought [PHE] would be a mission creep. They envisioned us having to work with environmental groups, share resources, and learn about conservation terminology and monitoring indicators. There was this whole anxiety around going into a completely non-health sector,” Aibe recalls.

Another reason for Pathfinder’s apprehension was that the “population” element of PHE has historically attracted controversy. “Some environmental groups still talk about problems of environmental degradation being because developing countries are growing too fast,” Aibe says.<sup>xvi</sup> “That’s a very harmful narrative for what we’re trying to advocate for, which is reproductive health and rights, and the fact that a woman has to be given a full basket of choices and accurate information to make a decision about the number of children she wants. So there was this nervousness of ‘are we going to be working with groups promoting the value of smaller families, which is diametrically opposed to the universal access to sexual and reproductive health and reproductive rights that we stand for.’” Aibe says she firmly believed the challenges of cross-sectoral work could be overcome by partnering with African communities to hear how people articulated the linkages (an echo of the “radical listening” discussed in the Health In Harmony case study).

<sup>xvi</sup> This narrative stems from what is known as neo-Malthusianism. Care to read more? Read Chapter 2 of Betsy Hartmann’s *Reproductive Rights and Wrongs*.



#### PHE and Planetary Health

Sono Aibe and others in the PHE community say they view planetary health as a broad umbrella under which issues of human health and the environment can be discussed. “Initially when we were trying to join the conversation around planetary health it seemed skewed heavily towards climate scientists and more abstract issues that were very macro-level,” Aibe says.

There was also concern that some would misperceive PHE approaches as accusatory—suggesting they were proposing family planning as a means to curb birth rates in lower income countries in order to protect areas of high biodiversity. Aibe says this is not the case. She reaffirms that PHE approaches advocate for individuals’ sexual and reproductive health rights as opposed to prescribing the number of children families have.

Ultimately, planetary health and PHE approaches are working towards similar messaging: that integrated solutions and multi-sectoral collaboration are the best way to achieve the United Nations’ Sustainable Development Goals. “[PHE] is an acknowledgement of direct connections between the reproductive health of individuals—women, men, and youth—along with the well-being of communities in remote, biodiversity-rich areas, and the health of the natural environment upon which all life depends,” say Suzanne York and Robert Engelman in a [blog post](#) summarizing the topic.

Just as Aibe faced challenges in introducing the PHE concept to Pathfinder International, the country teams faced their own unique start-up obstacles with HoPE-LVB—namely, the need to work across so many sectors. According to Dorah Taranta, Project Manager for HoPE-LVB in Uganda, starting a PHE project meant the organization needed to find partners in sectors beyond health. That meant reaching out to ministries of all backgrounds: water and environment, agriculture, education, gender, and others. “It was really a learning project,” says Taranta of HoPE-LVB. “We had all these activities and objectives based on the funding proposal, but then we had to fit in and achieve everything. Many times we came back to the drawing board to say ‘what did we do right and what went wrong. Are we really doing integration or are we still different sectors working in the same room?’”

Taranta says there was a “whole shopping list” of indicators at the start of the project—nearly 35 points the team had outlined to measure the impact of the project. The challenge was creating indicators that demonstrated integration: how family planning lessons were being used in farming. How energy efficient cookstoves affected health and the environment. “It was about bringing best practices from one sector into the other and looking at how one affected the other,” Taranta says. “Then we had to make sure the communities also understood it this way.”

These integration needs meant HoPE-LVB was an iterative process. Partners from various sectors were brought on board and dropped if they weren't a good fit for the PHE approach; donors and their demands changed from phase to phase. "That calls for a lot of patience, especially when you're leading a project. You are like this small punching bag where everyone is saying 'we asked you for this,'" Taranta laughs, explaining that HoPE-LVB's approach would sometimes shift to satisfy donor and partner demands. "It's complex, but very interesting work."



### A PHE Approach in Madagascar

A well-studied Population, Health, and Environment initiative is the work of Blue Ventures in Madagascar. Blue Ventures was founded as a marine conservation organization in 2003. Its first intervention was working with fishing communities to temporarily close a small area of their fishing ground to octopus fishing—octopus is a marine species that recovers rapidly with protection. Through the temporary closure and resulting recovery of octopus populations in these sites, Blue Ventures demonstrated to communities that they could generate quick profit by protecting their marine areas for a short period of time. It made a business case for locally-led conservation.

"Rather than international companies coming in and telling people who have fished off these coasts for generations that they can't fish anymore, we're turning this on its head—making marine management pay for coastal communities," says Vik Mohan, Blue Venture's Medical Director. "Protecting fisheries means better income for people, so they want to protect those areas." Similar to HoPE-LVB's advocacy towards community by-laws, this protection involved the creation of local regulations using *dina*, the name for customary Malagasy laws.

Blue Venture's family planning and maternal health program was introduced in 2007 in response to community members highlighting their unmet health needs—especially those linked to reproductive health. Maternal and child health was poor and couples were having more children than they wanted. Women and men were seeing the connection between their family size and depleting fish stocks. Today, family planning and other maternal health services are offered either by community support workers or through strengthened government-led clinics. Blue Ventures also partners with international organizations like Marie Stopes, USAID, and Population Services International to improve access to health services for the communities it serves.

For more information: Blue Ventures ([www.blueventures.org](http://www.blueventures.org))

When it came time to apply HoPE-LVB's PHE approach in the communities, the focal point of that integration was peoples' homes.<sup>xvii</sup>

<sup>xvii</sup> Take a moment to think through if a PHE approach is needed where you live and how it would be implemented.

### A Model Household Approach

<sup>xviii</sup> The HoPE-LVB project works in two sites in Uganda and two sites in Kenya. In Uganda, it is Wakiso District (home to Bussi Island) and Mayuge District; in Kenya, the project operates in Siaya County and Homa Bay County.

*A model household on Zinga Island, nearby to Bussi. The HoPE-LVB project encourages model households to intersperse food crops and other plants, creating shade and balancing nutrients. The small trough in the back of the garden is used to store excess rainwater.*



Drive a motorbike along the red dirt roads of Bussi Island and you start to notice some key differences between households: a rubbish pit sitting at the edge of the property, a dish drying rack, a garden containing various crops and fruit trees, the size of which provide ample shade for homeowners and their guests. On Bussi Island and the other three lakeside regions where HoPE-LVB operates, <sup>xviii</sup> homes with these features are most likely model households—living demonstration sites that illustrate the project's PHE interventions.

The model household concept is not new. It has existed in past PHE projects outside of Pathfinder's work, as well as in other global health and development programs. What Pathfinder staff say is different is that the positive behaviors exhibited in HoPE-LVB model households protect human health and the environment in ways that are specific to the needs of Lake Victoria communities. "In PHE you need to look at what ecosystem you're conserving, what are the health issues of the people living around there, and what are the demographic issues in that area," says Dorah Taranta. Only then can a project address the intertwined pressures faced by that community.

A home visit is the best way to see a model household in action. Namuyaba Margaret and her husband, Kayemba Taddeo, sit on wobbly blue plastic chairs in the shade of their generously sized

mango tree. Margaret and Taddeo are one of four original model households in Gombe Village on Bussi Island, and the couple live with their five children who range in age from six to 17-years-old. The eldest, Helen, is kneeling off to the side, scrubbing aggressively at the family’s laundry. Home visits are nothing new for the couple—one requirement of becoming a model household is an agreement to talk and tour neighbors and other officials so they can learn about the benefit of integrated PHE activities. The integrated nature of the model household was what originally appealed to the couple: “other projects came with only one intervention, but HoPE came with three: P, H, E,” Taddeo says.



*Namuyaba Margaret and her husband, Kayemba Taddeo, stand outside their home on Bussi Island. The brick building is where the family sleeps, and the wooden structure is the area where Margaret makes the family’s meals.*

It’s hard to overlook the PHE interventions when you visit Margaret and Taddeo’s property. Taddeo walks behind the red brick structure that serves as the couple’s one-room home. Onions, tomatoes, and collard greens that go by the local name *sukuma* grow in the shade of a banana tree. Kitchen gardens are a feature of every model household, and ensure families have access to a healthy source of vegetables. Beyond the kitchen garden is a small shack, its walls

made of worn wooden slats. Inside is the energy efficient cookstove where Margaret prepares the family meals. Training to build these cookstoves is offered by the HoPE project. Whereas cooking would typically be done over an open fire with less efficient means of burning wood,<sup>xi</sup> these clean cookstoves require only two to three branches per meal. The design of this particular stove funnels smoke outside the small cooking space, reducing the risk of cardiorespiratory disease caused by smoke inhalation<sup>24</sup> and the opportunity for cooking pots to spill on unsupervised children.<sup>xx</sup> This more efficient stove is also used by families to boil drinking water.

Outside the cooking area is a dish drying rack raised from the ground for sanitation purposes. Beyond, a latrine is located an appropriate distance from the home. Latrines are challenging to build in the sandy soils of Bussi Island, but HoPE-LVB links families like Margaret and Taddeo with government funding and other NGOs that focus on that specific infrastructure.



<sup>xi</sup> The HoPE-LVB baseline study found that 81% of households in its Uganda and Kenya sites relied on firewood as their main source of cooking fuel.

<sup>xx</sup> Worldwide, how many people cook with open fire stoves, and how many people cook with enhanced means?

What is the burden of disease due to this risk factor in Uganda and worldwide? [Learn more here](#)

*One of the clean cookstoves that has been constructed as part of the HoPE-LVB project.*



A tippy-tap in action.

xxi Can you list some examples of water-borne illnesses? Are they still prevalent where you live? If not, what measures are currently being taken to prevent them?

Access to clean cookstoves and improved household water, sanitation, and hygiene (WASH) standards are part of the health element of this PHE approach. HoPE-LVB's baseline study found that just 41% of people had access to a protected drinking water source. Lake Victoria filled the gap, and was the main source of usable water for activities like drinking, washing, cooking, and disposing of waste.<sup>25</sup> By 2018, six years after the baseline study was conducted, WASH standards had improved in sites across Uganda and Kenya, even in non-model households. This was due to the construction of new latrines and education around handwashing practices. These interventions reduced the risk of water-borne diseases in households. In fact, one Pathfinder publication noted that not a single HoPE-LVB model household in Uganda was affected during a 2015 cholera outbreak in the Lake Victoria region.<sup>26xxi</sup>

While a latrine and other features of a model household require families to invest some of their savings, a USAID external review of HoPE-LVB noted that “some of the most important PHE outcomes are the least costly, with some requiring no up-front capital expenditure whatsoever. This is a valuable lesson of high applicability to other potential PHE sites.”<sup>27</sup> One example is a low-cost innovation found outside Margaret and Taddeo's latrine. It's called a tippy-tap, and it's fashioned from an old jerry can, a piece of string, and a small stick. Taddeo steps gingerly on the stick and the string tips the bottle, enabling family members to wash their hands without touching a dirty surface.

Other interventions were low-cost because they related to behavior shifts rather than the creation of new infrastructure. “Before, people were only focused on earning money and didn't understand how to make the best decisions for their family's health,” explains Jackie Nakajubi, one of two HoPE-LVB field staff in Uganda. Nakajubi focuses on health and family planning while her counterpart, Stellah Mbatudde, covers environmental conservation. “People would fish and sell everything because of the amount of money they could make. As a project we tried to ask them to start with themselves first, including when it came to eating fish,” Mbatudde explains.

### Changing Perceptions of Sexual and Reproductive Health

Other behavioral shifts related to family planning. “We used to think about planning our family but didn't know how,” says Margaret outside her home. “We would hear the rumors about family planning, like that if I used contraception I'd give birth to a child with a defective brain. This scared us off, but the education we got from HoPE helped shed those fears.” Margaret now takes birth control in the form of an implant, and the couple has chosen to not have another child.

Margaret is not alone in her contraception fears. Back in Seeta Village where Village Health Team (VHT) member Edith has finished demonstrating how to properly fit a condom over her phallic wooden prop, she's just opened the session to questions.

“Is it true birth control will sit undissolved in my stomach and cause a tumor?” asks one woman. Edith swiftly pops one of the pills from its blister pack and puts it in a cup of water. Moments later she passes it around, pointing out that the pill has dissolved into the liquid. The women nod their heads. Just as model households demonstrate the visible benefits that PHE can bring to a home, education around family planning requires the same level of learning by example.

Edith says regular educational campaigns are key in encouraging contraception uptake. “You go to church once, but you need to keep preaching the gospel,” she explains. “So yes, I have trained these women on family planning before, but I need to continue training them. For example, you can't teach all four to five methods in one go, so each session needs to focus on a different method.”

Beyond education, considering the religious beliefs of Ugandan and Kenyan communities is important. Both countries are deeply religious, with an estimated 85% of the population identifying as Christian. Across sub-Saharan Africa, religious leaders have a platform to share their message, and it isn't always one in favor of family planning. For example, one Catholic archbishop in Kenya started a campaign against contraception because he claimed it harmed women, was “unbiblical,” and “encouraged unfaithfulness in marriage.”<sup>28</sup> There's an audience for this kind of message: a 2014 poll found that 38% of Ugandans and 33% of Kenyans deemed contraceptive use immoral.<sup>29</sup> Another study done in Mwanza, a Tanzanian community on the shores of Lake Victoria, found



Nakajubi Jackie and Mbatudde Stellah are Pathfinder's field officers for the HoPE-LVB project in Uganda. While Jackie comes from a background in sexual and reproductive health and Stellah from one working in conservation, the two women regularly find themselves talking about both areas—that is the purpose of a PHE project, after all.

that religious tradition affected the way couples perceived family planning.<sup>30</sup> It was clear that the HoPE-LVB project had to tailor its approach to not only consider education around family planning, but religious beliefs as well.

### Improving Access and Building Healthcare Demand

Once their misconceptions are debunked, HoPE-LVB has also made it easier for community members to access family planning methods. Almost half of pregnant women surveyed during the project's baseline study said they would have preferred to get pregnant later or not at all.<sup>31</sup>

Baseline data also found that less than 1% of respondents received their contraceptives from a community-based clinic or outreach service. This meant they had to travel to a public health center, often accessible only by motorbike or, on smaller islands, by traveling to the nearest large island. Despite short-acting methods of contraception<sup>xxii</sup> being provided for free at these centers, the financial cost of reaching them often restricted physical access. This was compounded by the fact that husbands wouldn't allow women to make solo clinic visits.

One approach to these challenges might have been to open a series of HoPE-LVB facilities offering contraceptives. Rather, the project prefers to build the capacity of existing community groups for this role, and advocates for better services to be offered by government health facilities for long-term sustainability and country ownership.<sup>xxiii</sup>

In her role as a Village Health Team member, Edith is one of the community members who has received capacity training through HoPE-LVB. In isolated island communities like Bussi, VHT members are often the only public health professional women can see. Pathfinder offered VHT members 10-days of family planning training when the project began. Following that training, VHTs can distribute condoms and provide birth control to women who have already been given the medication by a trained health worker. They're also trained to offer follow-up and support—listening to a woman's concerns during contraception use or pregnancy and referring them to a health worker when needed.<sup>xxiv</sup>

<sup>xxii</sup> Short-acting methods of contraception include the birth control pill, patch, and vaginal ring, all which involve the release of hormones.

<sup>xxiii</sup> This is an approach called capacity building, or health system strengthening, and it seeks to eliminate duplication of efforts, and provide long-term sustainability. [Learn more here](#)

<sup>xxiv</sup> Do community health workers exist where you live? What are their main roles?

The upgraded hospital on Bussi Island.



Advocacy-wise, the project wanted to provide families more contraceptive choice and guaranteed access. With short-acting methods of contraception available for free from the government—albeit with the previously mentioned access barriers—the second phase of HoPE-LVB successfully advocated at the district and national government level for free access to long-acting and permanent methods of contraception. That includes intrauterine contraceptive devices (IUCDs) and implants for women, and vasectomies for men. With this success, HoPE-LVB has offered thousands of Couple Years of Protection (CYP)<sup>32</sup> to families in Uganda and Kenya. It has also facilitated more than 118,000 visits to facilities and communities for contraception between 2012 and 2017.<sup>33</sup> Not solely used to help couples plan pregnancies, contraceptive use has also been linked to reduced maternal and child mortality and lessened risk of developing certain cancers.<sup>34</sup> Finally, HoPE-LVB also improved the health information management systems in each country to ensure government clinics always had a range of contraceptive methods in stock.

Pathfinder staff acknowledge these successes were possible because of their work with already-established government-formed groups like Village Health Teams. Partnering with existing groups was a strategic decision. “These groups have a common goal as to why they're together, so it's easier than picking individuals and forming a group here and there,” says Stellan Mbatudde, the conservation field officer in Uganda. “If you form a group, it dissolves at the end

of the project, so we worked with existing ones for sustainability.” It was also a matter of trust. Despite being Ugandan, project staff Jackie and Stella were at first seen as outsiders from the capital city. “When people get someone of their own giving them testimony about family planning or fishing then they understand it better,” says Jackie Nakajubi.

That community sensitization and working with existing groups is the way HoPE-LVB took on one of its most challenging tasks: deconstructing the traditional gender roles in which men normally dealt with natural resources and women with sexual and reproductive health.

### Rewriting Gender Norms

Despite its place along the world’s largest freshwater fishery, Kyanjazi landing site on Bussi Island is remarkably quiet. A half dozen wooden boats have been pulled onto the shore, paint peeling and faded in the equatorial sun. Fisherfolk stand around, cigarettes dangling as they untangle fishing nets and repair their boats. A man in knee-high rubber boots navigates his motorbike over loose sand. It’s early in the morning, and yet the final packing preparations are already being done on the catch of the day. Taddwa Lawrensio picks up a two foot-long tilapia fish, his fingers pressing into the gelatinous eye sockets. Today’s catch is meager. A large woven basket mounted on the back of a motorbike is all that’s needed to carry the fish to another landing site where they’ll be sold on Uganda’s mainland.

Lawrensio is the chairman of Kyanjazi’s Beach Management Unit (BMU). BMUs were created by the government in 2006 with the goal of curbing illegal fishing activity, protecting fish breeding zones, and training fisherfolk on sustainable practices. HoPE-LVB works with BMUs to encourage members to more sustainably use the lake’s resources and diversify their economic activities. Perhaps unexpectedly, topics of family planning come up. By adopting this approach, the project offers positive reinforcement to the idea that men can be involved in the conversation around sexual and reproductive health and family planning, and that women can make decisions regarding the natural environment. Untangling these deeply entrenched gender norms is called a “gender transformative approach.”



“Usually men would say these topics of contraception are for women,” Stelah Mbatudde explains. Men would also say they were often suspicious about maternal health and the desired aims of family planning. “As fishermen we were not using family planning. We thought people were telling us not to give birth,” says Lawrenzio, staring out at the water. “Now we know women should go to safe delivery services which prevents our children from getting HIV.” HoPE-LVB also works with Beach Management Units to provide boat fuel so women in need of specialized delivery services can easily reach mainland hospitals.

Project success wouldn’t be possible without buy-in from both men and women. “For community level change, women are important pillars, but if you’re not talking to men you won’t change things because of the paternalistic nature of our societies,” said one Pathfinder team member. Following the second phase of the project (2014-2017), model households in Kenya were 20% more likely to discuss the number and spacing of children, and in Uganda, it was a 34% increase. Three-quarters of families only started having these conversations during HoPE-LVB.<sup>35</sup>

Once men understand the importance of sexual and reproductive health, they become advocates who encourage and support women in their access to health services. This is a significant change from previous attitudes when men were reluctant to allow their wives and daughters to visit health facilities. In the past, health center visits may have come through referral from a Village Health Team member. Now, HoPE-LVB has created champions in men and other non-traditional groups. Health referrals from Beach Management Unit (BMU) members increased 43-fold between 2012 and mid-2014. Referrals also rose from farming group members over the same time period.<sup>36</sup> Further, a September 2018 internal review of the first and second phases of HoPE-LVB found that the number of women delivering babies in healthcare facilities had greatly increased, as did HIV testing and immunization for children under five. Health referrals from the traditionally male-dominated BMU and farming groups contributed to this rise in service use.

While Lawrenzio received family planning training through his role with the BMU, HoPE-LVB recognized the need to start these challenging conversations in comfortable settings. That’s where the project’s campfire outreach sessions came in. Fire blazing and maize roasting, men would slowly approach the gathering and

bring up topics of conversation—including questions about family planning that were then addressed by health workers in attendance. By pairing environmental conservation information with messages about healthy timing and the spacing of pregnancies, boys and men in HoPE-LVB communities showed increased knowledge about family planning.<sup>37</sup> And they were willing to talk about it with their friends and wives, too.

Education and social acceptability are two ways to increase access to maternal healthcare for women. Another is empowering women with greater agency, and raising the status of women within their communities and homes—something that has proven to have a positive impact both on families and the environment.

Consider Namudu Annet who, at 38-years-old, holds many titles in her village on Bussi Island: model household, leader of a young mother’s group, BMU member, and mother of seven. Annet says the negative stereotypes that exist around the roles of women are beginning to change. So too are the places where women are allowed to speak up—while there were some female BMU members before HoPE-LVB started, she says a woman’s place was still very much within the home.



*Namudu Annet and a few of her children outside of their home on Bussi Island.*

Annet hasn’t always felt a sense of empowerment. Pregnant with her first child at the age of 16, she was expelled from her family’s

home. “I was seen as an outcast and a waste in my family,” Annet says. “The boy who got me pregnant couldn’t look after me, and so I was a burden to his family and turned into a housemaid.” That relationship didn’t work out, and Annet moved to Bussi Island 18 years ago with her current husband.

Many of HoPE-LVB’s interventions empower women with the dignity and skills that Annet didn’t have as a young mom. Women get skills training for free, and then apply those skills to create a sustainable income-generating activity. “We gather young mothers together and teach them to immunize their children and other skills, like how to build clean cookstoves, make *mandazi* (a fried bread snack), and soap. That income means they don’t have to depend on their husbands,” Annet says. The scale of these income generating activities is notable: more than 25,000 energy efficient cookstoves had been built by women in Uganda and Kenya by the end of HoPE-LVB’s second project phase.<sup>38xxv</sup>

“When our husbands realized we could bring income into the family, they started respecting us more,” says Annet. A USAID review of HoPE-LVB supports this claim—it found that the majority of respondents from Uganda and Kenya say their relationship with their partner had improved as a result of income-generating activities.<sup>39</sup>

Further, a woman’s access to sexual and reproductive health and rights is explicitly tied to her long-term ability to work. Studies have shown that female participation in the labor force among women aged 25 to 39-years-old can decline by 10 to 15% with each additional child.<sup>40</sup> Research into the value of HoPE-LVB’s PHE integration also found that women who earned additional income “frequently invested in sustainable income-generating activities, such as tree nursery management or beekeeping, in addition to other investments such as school fees.”<sup>41</sup>

Linked to the ability to work is a woman’s bargaining power within her home. Following HoPE-LVB, women have more freedom to engage in discussions about the sustainable use of natural resources. They are also more likely than before to become members of traditionally male-dominated spaces such as Beach Management Units, farming groups, and tree planting projects. Similarly, men have become more invested in sexual and reproductive health. But the question remained: do PHE integrations actually work?

## Does PHE Integration Work?

Educating people to consider and value the connection between population, health, and their surrounding environment is one of the key objectives in HoPE-LVB’s theory of change.

Research supports and quantifies the effectiveness of the project’s integrated efforts. A 2018 paper authored by Samuel Sellers for *Environmental Conservation* looks specifically at HoPE-LVB’s four sites, and Pathfinder’s hypothesis that a PHE approach could be used to deconstruct established gender roles, increase income, save family time, and improve community cooperation. Each of these factors improve conservation and health outcomes.

Here’s an example from Sellers’ research on how PHE integration helped prompt a shift to sustainable livelihoods—especially important since a large percentage of Uganda and Kenya’s populations are youth of working age.

Following the first 2.5 years of the program (2011-2014), model household couples reported having more time because of the project’s interventions. That increased time came through three pathways: people needed to care for fewer children because of their ability to use family planning to space their pregnancies; were sick less often because of increased access to healthcare; and because they had to spend less time collecting firewood for energy efficient cookstoves. “This additional time was often devoted to livelihood activities such as beekeeping, tree planting, or gardening, all of which the project has provided training in [...] and most of which are likely to have positive or at least neutral conservation outcomes,” Sellers writes. In other words, more free time translated to reduced pressure on vulnerable natural resources like firewood and fisheries.<sup>xxvi</sup>

↘ [Appendix 2: Linkages between project interventions and improved maternal health outcomes and natural resources management, from Samuel Sellers’ integration paper](#)

Another HoPE-LVB hypothesis was that the more sustainable use of natural resources would lead to people recognizing the benefits that come with a healthier lake or reforestation. The theory was that couples may reconsider their family size in order to reduce strain on the environment. While Sellers’ research found people were starting to understand this connection between birth rates and environmental sustainability, no family had specifically chosen to not have a child because of it.

xxv How would you define women’s empowerment? What different approaches would you take to achieve this goal?

xxvi In your community, if people had more time, would this translate into better environmental outcomes? Why or why not? What would need to change for positive environmental outcomes?



A tree nursery that has been started on Zinga Island as part of the HoPE-LVB's reforestation efforts.

Interestingly, family planning concepts have changed the way fisherfolk look at their fishing activities. “When you don’t illegally fish, it gives some time for the young fish to grow which means they’ll be bigger and able to breed other fish later. It connects to family planning—we now plan for the lake,” explains Lawrenzio, the head of the Beach Management Unit.



### The State of the Lake

Population pressures and illegal fishing are two of the many challenges being faced by Lake Victoria and, in turn, the people who depend on the lake for their livelihoods, water, and food.

Algal blooms (eutrophication) have also been a threat since they first appeared in 1986.<sup>42</sup> Scientists have connected the increase in algal blooms to the extinction of several haplochromine cichlid species due to the introduction of Nile perch.<sup>43</sup> These extinctions affected the food chain in Lake Victoria, reducing the fish species that historically moderated the amount of vegetation and animal decay in the lake. Algal blooms reduce oxygen in the water, killing fish species and compounding matters of overfishing. Lakeside population growth also plays a role: the more wastewater and other effluent that enters the lake, the more the nutrient content favors the growth of algal blooms.<sup>44</sup>

Prior to extinction, the haplochromine cichlid species also fed on *Biomphalaria* and *Bulinus*, two species of snails that serve as an intermediate host for schistosomiasis,<sup>45</sup> a parasitic disease that, in the Lake Victoria region, goes by the name of bilharzia.<sup>xxvii</sup> As schistosomiasis was not well documented prior to the introduction of Nile perch, the connection has not been confirmed but is plausible.

<sup>xxvii</sup> Another case study in this anthology looks at how land use management and dam construction in the Senegal River Basin in West Africa has affected the spread of schistosomiasis in the region.

Annet, the mother of seven, says she also uses concepts of family planning in her garden. A cluster of *matooke* trees grows around the back of her house. It is here that Annet says people are able to first grasp the concept of PHE. “The more *matooke* trees you have growing next to one another, the smaller the bunch of bananas they produce,” she explains. “You need to thin your banana plantation to get a bigger bunch. This is the same with family planning—if you have a smaller family then they’re often healthier because of it.”

This community-level change demonstrated by Lawrenzio and Annet is a key part of HoPE’s local-level advocacy. A longer-term goal of HoPE-LVB was to make sure these changes remained once the project ended—and that they could be used to inspire new PHE projects across the region.

In Kenya's capital city of Nairobi, the jacaranda trees are flowering, their distinctive purple blooms arching over the roadway. Pathfinder International's Kenyan office sits down a road like this. Inside the boardroom surrounded by PHE literature is Pamela Onduso, the organization's Youth, Advocacy, and Partnership Advisor in Kenya. An expert in reproductive health, family planning, and PHE programming, Onduso has worked with Pathfinder for over two decades.

Onduso supports Pathfinder's Kenya office in resource mobilization, sexual and reproductive health program implementation, and sustainability efforts. The latter includes dealing with the inevitability that accompanies any international development project, including HoPE-LVB: what happens when funding finishes and the project must end? Knowing such a future was on the horizon, the Pathfinder team designed HoPE-LVB with sustainability and scalability in mind. This meant finding ways to get policymakers at all levels to understand PHE and adopt its integrated development practices into policies and programs.

To that end, Pathfinder partnered with ExpandNet, a global network of public health professionals and scientists who develop strategies to scale public health solutions. ExpandNet has worked with the HoPE-LVB team from the beginning to plan, implement, and expand the PHE approach to benefit more people and support long-lasting policymaking.

That meant engaging target communities through public, private, and faith-based organizational partnerships to pilot diverse PHE integration models, monitor implementation, and plan for expansion based on successful, evidence-based interventions. In its first three years, the HoPE-LVB project succeeded in fostering a high degree of ownership among government stakeholders in both Kenya and Uganda. Community, district, national, and regional stakeholders were briefed about the project early on, told about the proposed model household interventions, and asked about their own pressing needs and obstacles.

This participatory exercise shaped the project in significant ways.<sup>45</sup> For example, it informed the decision to include district and county officials in environmental conservation activities. Doing so boosted project buy-in and the approval of new local by-laws. Building for scalability (anticipating to expand the project to new

communities and add more model households) also helped HoPE-LVB grow to a larger geographic area during the second phase (2014-2017), though the approach was tweaked to meet different local contexts and settlement patterns.

Next came the creation of PHE steering committees in the two Ugandan districts and two Kenyan counties where HoPE-LVB operates. Committee members come from multi-sectoral ministries whose work links to PHE efforts. Pamela Onduso says those steering committees have been key to earning acceptance at county and district levels of governance, which bridges the gap between community decision-making and national policy. "Everyone can see the problem, but you can't begin to break it down and see how your different perspectives and resources can contribute to a solution until you have a common understanding and platform to bring you together," she says of the steering committees.

When it comes to engaging various levels of government, PHE adoption is a long-term process. Onduso explains that advocating for PHE and sexual and reproductive health requires tact and good communication skills.

Just as HoPE-LVB employed diverse strategies to effectively engage communities, there are also best practices when it comes to advocacy with the public sector and faith-based organizations. That means that while Pathfinder International frames HoPE-LVB as a "rights-based approach" to sexual and reproductive health, it also wants to avoid misinterpretation of what services fall under the category of family planning. As a result, increased access to contraception and the concept of healthy timing and spacing of pregnancy are promoted within the framing of helping communities improve their health and livelihoods, as well as conserve critical ecosystems. Knowing which messaging to use has been key in making PHE advocacy a success.

Strategic local, national, regional, and global partnerships have also helped. In 2015, HoPE-LVB signed a Memorandum of Understanding (MoU) with the Lake Victoria Basin Commission (LVBC), a specialized institution of the East African Community (EAC).<sup>xxviii</sup> One of the roles of the LVBC is to coordinate the design and implementation of an integrated PHE program across the Lake Victoria Basin, applying integrated solutions to interlinked health

<sup>xxviii</sup> EAC countries in the Lake Victoria Basin include Kenya, Uganda, Tanzania, Rwanda, Burundi .

and environment challenges. “We use evidence from HoPE-LVB to advocate to change policies in each of the relevant ministries, and now there is an EAC PHE Strategic Plan,” says Doreen Othero, the Regional Programme Coordinator for the Integrated PHE Programme at the LVBC. “Without that evidence we would not have convinced our ministers.”

#### Projects Precede Policy

Evidence from the HoPE-LVB project has also helped Andrew Tiondi, a bureaucrat with Uganda’s National Population Council, and Coordinator of the country’s National PHE Network. Like Onduso, Tiondi collaborates with government officials in various ministries and jurisdictions to adopt a multi-sectoral approach to solving some of the country’s development challenges. Raised in a fishing community in northern Uganda, Tiondi understands some of the environmental pressures villages face. Not all policymakers have the benefit of that firsthand experience, and concepts like family planning and improved latrines can go over the heads of bureaucrats sitting in a bustling capital city. That’s why field visits to model households are important.

Government officials understand once they see the model households in action, Tiondi says. “The PHE model households address important issues the government is grappling with: preventative health by having basic sanitation interventions in place, health and nutrition, and the fact that Uganda’s population is increasing but its land and resources are finite,” Tiondi says. Ultimately, there are mutual benefits to be gained from HoPE-LVB cooperating with the national government, and vice versa. For the government, the project’s community-level interventions help reach every household in a way national or district-level programs may struggle to do, particularly in rural and isolated fishing communities. From HoPE-LVB’s perspective, support from national government leaders is needed to work with district level staff in departments like community development, culture, and health.

Uganda and Kenya have recently finalized their national PHE strategies. Now, government PHE champions like Tiondi can work to weave PHE values into specific ministerial policies related to health, water, environment, and beyond. It may seem like a lot of paperwork, but these policy pieces are needed to institutionalize the value of integration and advocate for greater budget allocations

for PHE projects. “Some officials are still cagey about the multi-sectoral approach, and questions arise about how we will pool resources,” Tiondi says. “But they’re not looking at the bigger picture. As a government you may not be able to deliver an outcome because you need other players to play a role in that delivery.”

As with any initiative, more funding is needed to support PHE integration across the Lake Victoria Basin. Pathfinder and its collaborators still struggle with single sector funding: “everyone always looks at which budget PHE activities should come from—Conservation? Health? Planning?” says Dorah Taranta, HoPE-LVB’s Uganda Project Manager. Meanwhile, Doreen Othero of the Lake Victoria Basin Commission remains hopeful that the PHE integration efforts started by HoPE-LVB can be continued, even without donor funding. “That has been my main worry, and I’ve told Pathfinder many times that they need to build capacity of the people who will be here beyond the project life cycle,” she says.

There are some positive signs of financial support in Uganda. The national government has pledged 4 billion Ugandan shillings (about US \$1.5 million) to start PHE model households in the Mount Elgon region of Kenya and Uganda. The area bears similarities to the Lake Victoria Basin: large family sizes and environmental degradation, though in mountainside communities. “While several LVBC environmental programs have been implemented in this area before, it was realized that there was the need to pay attention to the link between environmental challenges in the basin and community health issues,” Othero says. “Previous challenges were addressed vertically: per sector, and in silos.”

Ultimately, Pathfinder International is confident HoPE-LVB has demonstrated that a PHE approach is needed—and possible—across multiple complex ecosystems, socioeconomic contexts, and geographies. “In the past, people thought PHE was a little boutique project,” says Sono Aibe, the Pathfinder International Senior Advisor who first led the way for the organization’s PHE efforts. “Thankfully, I think Pathfinder was able to fill that gap, demonstrating scalability, institutionalization, and the advocacy for new policies.”

## Keeping Track of Who's Who

### Sono Aibe

*Former Senior Program Advisor at Pathfinder International, PHE specialist*

### Namudu Annet

*Model household and mother, Bussi Island*

### Namakula Edith

*Village Health Team Member, Bussi Island*

### Dr. Kathryn Fiorella

*Assistant Professor, Department of Population Medicine and Diagnostic Sciences at Cornell University*

### Isiah Kisiki

*Life-long resident of Bussi Island*

### Taddwa Lawrensio

*Community health worker in Nabukavesi*

### Stellah Mbatudde

*HoPE-LVB field staff in Uganda in charge of environmental conservation*

### Jackie Nakajubi

*HoPE-LVB field staff in Uganda in charge of health and family planning*

### Herbert Nakiyend

*Fisheries biologist, NaFIRRI*

### Namuyaba Margaret and Kayemba Taddeo

*A couple and model household family on Bussi Island*

### Winnie Nkalubo

*Fisheries biologist, NaFIRRI*

### Pamela Onduso

*Youth, Advocacy, and Partnership Advisor, Pathfinder International Kenya*

### Dr. Alex Opio

*Epidemiologist and former director of Uganda's HIV/AIDS Control Program*

### Doreen Othero

*Regional Programme Coordinator for the Integrated PHE Programme at the Lake Victoria Basin Commission*

### Dorah Taranta

*Project Manager for the HoPE-LVB project in Uganda*

### Andrew Tiondi

*Coordinator of Uganda's National PHE Network*

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*A mother and her child on Zinga Island in the Ugandan portion of Lake Victoria.*

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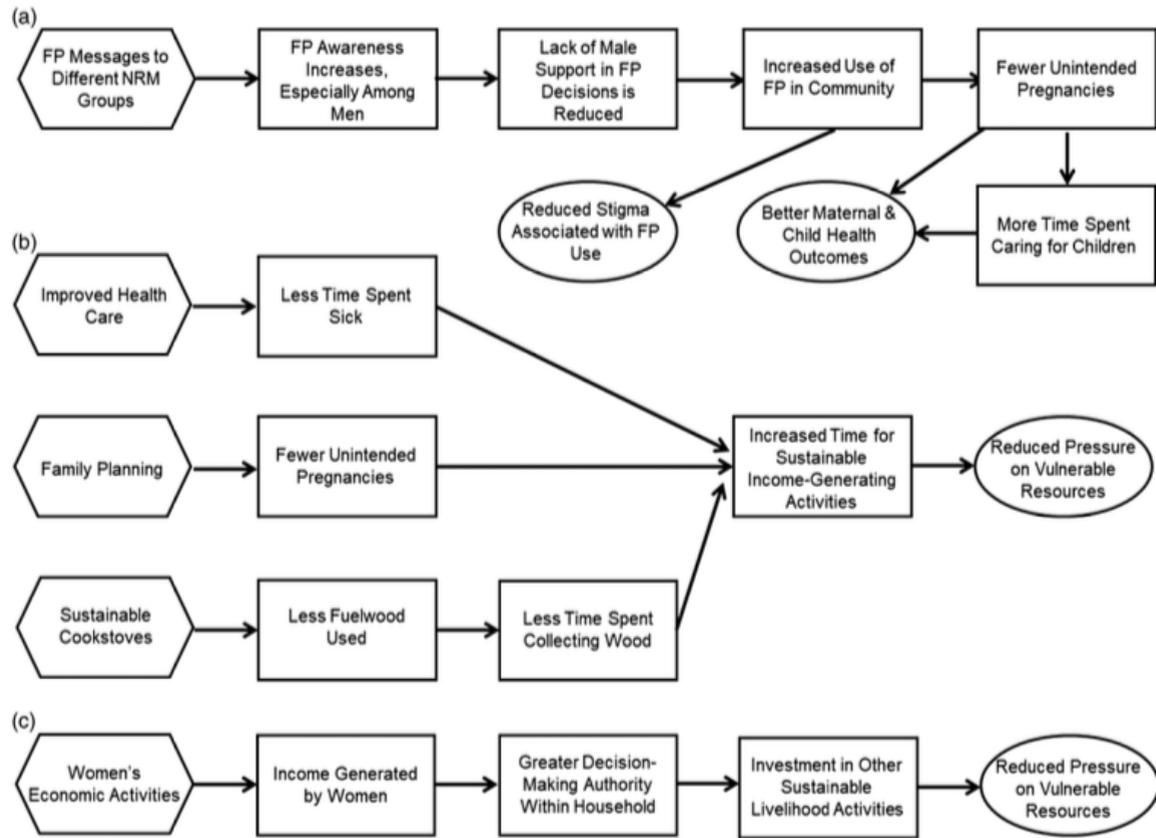
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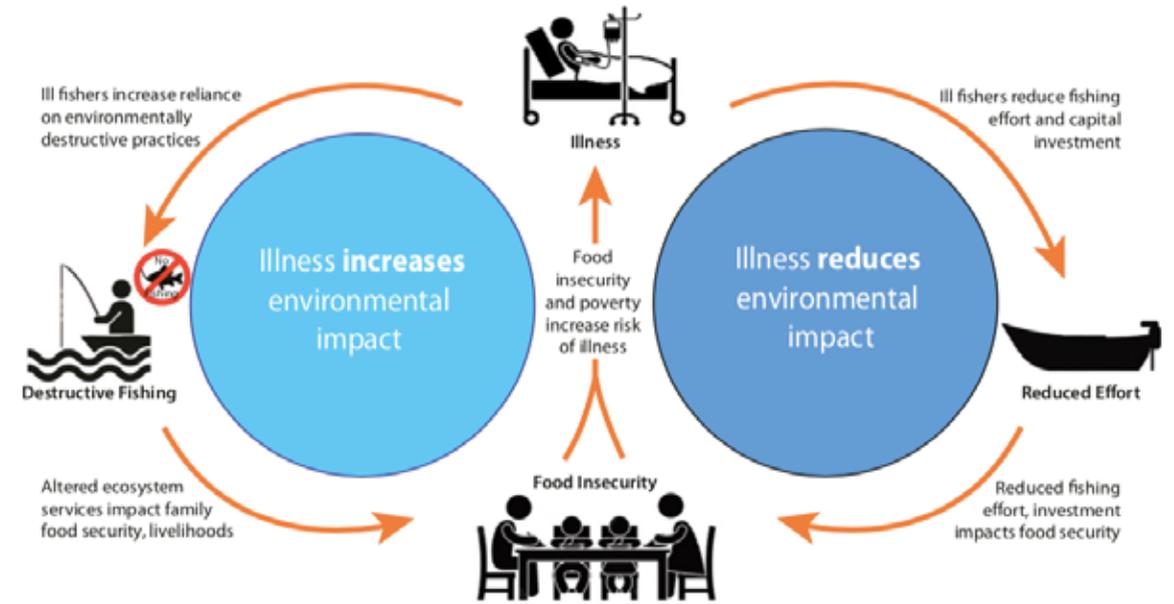
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### Acronyms

AIDS – Acquired immunodeficiency syndrome  
BMU – Beach Management Unit  
CYP – Couple Years of Protection  
EAC – East African Community  
FP – family planning  
HIV – Human immunodeficiency virus  
HoPE-LVB – Health of People and Environment in the Lake Victoria Basin  
IUCD – intrauterine contraceptive devices  
LVB – Lake Victoria Basin  
LVBC – Lake Victoria Basin Commission  
MoU – Memorandum of Understanding  
NaFIRRI – National Fisheries Resources Research Institute  
NGO – non-governmental organization  
RH – reproductive health  
PHE – population, health, environment  
SRH – sexual and reproductive health  
VHT – Village Health Team  
WASH – water, sanitation, and hygiene.



**Fig. 1.** Results chains depicting linkages successfully described with midterm review data. Hexagons represent a component of the project's intervention, rectangles depict short-term outcomes and ovals illustrate longer-term effects resulting from these outcomes. (a) Results chain displaying linkage between providing FP messages to NRM groups and improved maternal health outcomes. (b) Results chain displaying linkage between time-saving activities and reduced pressure on vulnerable resources. (c) Results chain displaying linkage between women's income-generating activities and household-level NRM choices. FP= family planning; NRM = natural resource management.



**Fig. 1.** (Right) Traditional and (Left) alternative pathways linking human and environmental health in fishing communities. In the face of illness, households may alter their pressure on environmental resources to increase their reliance on destructive practices or curtail their harvest effort. These feedbacks portend sharply different environmental consequences of human illness, even as outcomes for households remain similar.

# Coastal Conservation Takes Root

EDUCATION AND ECONOMIC AGENCY AS A WAY  
TO PROTECT SRI LANKA'S MANGROVES

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

Case studies were written and photographed by Hilary Duff with editing and support from Amalia Almada, Christopher Golden, and Sam Myers. Teaching guides were written by Carlos A. Faerron Guzmán.

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## Executive Summary

Further discussion of ecosystem services and its limitations as a framework are discussed in the ethics section of chapter 17 in [\ Planetary Health: Protecting Nature to Protect Ourselves.](#)

### Learning Objectives

*After examining this case, students should be able to:*

- ① Identify the main threats to mangrove ecosystems.
- ② Analyze the importance and connections of mangrove ecosystems in relation to human health.
- ③ Appraise the utility of the ecosystem services framework.
- ④ Develop projects, programs, and policies that consider complex social and environmental contexts, while being inclusive of community members.

This case study takes us to Sri Lanka, where mangrove ecosystems play a central role in the lives of people residing in coastal fishing communities. An important breeding, feeding, and shelter zone for fish and other marine species, intact mangroves are key in ensuring food security. Additionally, healthy mangroves safeguard coastal communities from the full severity of storms and natural disasters. Mangroves also mitigate the effects of climate change by being highly productive ecosystems for carbon sequestration. Despite providing these services, Sri Lanka's mangroves have been threatened by civil unrest, large-scale economic activities such as industrial prawn farming, and unsustainable, small-scale household use.

This case study looks at why an approach to mangrove conservation must be considerate of coastal communities and the complex factors motivating their interactions with mangrove ecosystems. The Seacology-Sudeesa Sri Lanka Mangrove Conservation Project educates stakeholders at both the community and government level about the financial and health benefits of intact mangroves. The program also focuses on the economic well-being of coastal communities which, combined with an increased understanding of mangroves, has emboldened people to become environmental activists.

By pairing grassroots empowerment with scientific research into mangroves, the two organizations have shifted government perception of the ecosystem. This effort has led to a core policy win: lobbying the Sri Lankan government to become the first country worldwide to nationally protect its mangroves.

*This case study is based on interviews conducted in Colombo, and Sri Lanka's Northwestern and Northern provinces in January 2019.*

## Introduction

It's mid-morning, and Douglas Thissera sits on the bow of a small motorized boat pattering through the Chilaw Lagoon. Found off the west coast of Sri Lanka, the lagoon's shallow waters are a brackish blend of freshwater from inland rivers and saltwater from the nearby Indian Ocean. Squinting in the already-sweltering sun, Thissera steadies his digital camera, zooming in to focus on the water's edge. To an untrained eye, Thissera is documenting a thicket of unremarkable shrubs and greenery. But those who live along this body of water know better: the Chilaw Lagoon is home to nearly every mangrove species found in the country. It is towards a group of these plants that Thissera is directing his gaze.

*Douglas Thissera, Sudeesa's Director of Mangrove Conservation, documents the mangroves in the Chilaw Lagoon, not far from the Sudeesa headquarters.*



Often mistaken for a single type of tree, mangroves are any group of plants that grow in intertidal areas like the Chilaw Lagoon—environments where terrestrial and marine ecosystems meet, and where fresh and saltwater mix. Mangroves survive in these muddy, salty environments because of a number of genetic adaptations, including their most recognizable feature: a distinctive series of prop roots that increase the tree's stability and appear as dozens of narrow stilts jutting out of the green shrubbery and into the mudflat. Pulling the boat closer to a grouping of mangroves, Thissera points at the shiny surface of the leaves, glossiness that helps reflect intense sunlight. The stubby fingers growing upward out of the mud are another adaptation: respiratory roots that transport oxygen into parts of the root system buried in mud.

Less visible are the salt secreting glands and the miniscule micro-filtration systems that allow the roots to extract freshwater and secrete excess salt. While each of the 22 species of mangroves found in Sri Lanka are adapted slightly differently, they share these important survival features.

Sri Lanka is not the only place where mangroves are found. Mangrove ecosystems exist in most tropical countries, and the distribution belt runs as far north as parts of Florida and southern China, and as far south as the Tropic of Capricorn. What's notable in Sri Lanka are the novel approaches that have been taken towards the sustainable management and conservation of mangroves.

Thissera is one of the people responsible for that shift. Directing the boat away from the mangroves and back into one of the lagoon's canals, Thissera looks at ease. That's perhaps due to familiarity—he's lived next to this lagoon his entire life and has been fishing here since 1974, when he was just an 11-year-old boy. In the past decades, his role has also been one of protector: defending the mangroves from deforestation and destruction.

Now, his defender role has an official title: Director of Mangrove Conservation with Sudeesa, a small fisherfolk federation that originated along the shores of this very lagoon. Together with a team of coastal residents, a collection of community-based organizations and, since 2001, a partnership with an American non-profit environmental conservation organization called Seacology, Sudeesa has turned the tides on the behavior that was putting the country's mangroves at-risk. A loss of mangroves would mean an inability for coastal communities to benefit from their many important services, including providing a breeding ground for food fish species and offering coastal protection from storms and natural disasters.

Today, the mangroves in the Chilaw Lagoon—and the others found in Sri Lanka's 82 major lagoons—are nationally protected by government policy. In 2015, Sri Lanka became the first country in the world to nationally protect its mangrove ecosystems. Sudeesa and Seacology were at the forefront of making that happen.



*Distinctive mangrove roots are clearly visible on this mudflat in northern Sri Lanka.*

## The Pearl of the Indian Ocean

<sup>i</sup> Sri Lanka is the fourth largest producer of tea in the world, after China, India, and Kenya.

Sri Lanka is an island country in South Asia, located off the southeastern tip of India. Despite a land area smaller than the majority of American states, the teardrop-shaped island is geographically diverse. Mountain peaks and valleys dominate the central and southern regions of the country. Many of those interior hillsides are covered by commercial tea plantations—a cash-crop industry introduced when Sri Lanka, then called Ceylon, was a British Crown colony. Ceylon tea remains the country's largest export today.<sup>1i</sup> The hill areas flatten into coastal plains, countryside dominated by fluorescent green rice paddy fields which produce the staple food of Sri Lankan cuisine. Then, there's the 1,700 kilometers of coastline. Sandy beaches rim the island and a series of lagoons, estuaries, and canals dip inland, providing the ideal environment for mangrove ecosystems like the ones found in the Chilaw Lagoon.

↘ [Appendix I: Map of Sri Lanka \(source\)](#)

Sri Lanka's 14 coastal districts are some of the country's most populous regions, with people concentrating in urban centers like the capital city of Colombo, Galle and Matara in the south, Batticaloa in the east, and Jaffna in the north. An estimated 25% of the country's population of 21.44 million live along the ocean, and the coast is home to nearly two-thirds of Sri Lanka's industry, with marine fishing and aquaculture making up the brunt of that economic activity.<sup>2</sup> Extreme poverty rates have dropped from 13% in 2002 to less than 3% a decade later, and the country has one of the lowest extreme poverty rates in the region.

### Sri Lanka's Civil War

The end of Sri Lanka's 26-year civil war is one reason for the decrease in extreme poverty. Occurring between 1983 and 2009, the civil war was a conflict between the Sinhalese majority Sri Lankan government, and the Liberation Tigers of Tamil Eelam (LTTE), a group known more commonly as the Tamil Tigers. The latter was fighting for an independent state to be created in the north of the country. More than 100,000 soldiers and civilians were estimated to have died, particularly during the final months of the civil war.<sup>3</sup> By the end of the conflict, hundreds of thousands were forced from their homes, becoming either internally displaced persons or refugees, most commonly in Tamil Nadu state in southern India.<sup>4</sup> These effects were felt more acutely by the Tamil minority living in conflict areas in the Eastern and Northern provinces. In the latter,

an estimated one in three people were displaced at the height of the war.<sup>5</sup>

The conflict also took an environmental toll that made it difficult for people returning home to resume environment-dependent livelihoods. For one, mangroves in the Northern Province were extensively cleared to allow for better lines of visibility between opposing forces. Inland, returnees found that many agricultural areas still contained unexploded landmines and that irrigation for farming was affected by contaminated waterways and wells.<sup>6</sup> And while Jaffna district, the largest in the north, had contributed a quarter of the country's marine fish production in pre-war years, production dropped to as low as 3 to 5% in 2002.<sup>7</sup> Post-war resettlement has meant pockets of extreme poverty remain in Sri Lanka, with three of the poorest districts found along the coast of the Northern and Eastern provinces.<sup>8ii</sup>

<sup>ii</sup> Those three coastal districts are Mullaitivu (28.8% in extreme poverty), Mannar (20.1%) and Batticaloa (19.4%).

Kapila Gunarathne, the National Coordinator of the International Union for the Conservation of Nature's (IUCN) Mangroves for the Future program says the lengthy civil conflict and the need to make money in the years following meant development often took priority over mangrove protection.

↘ [Drone Flyover: Mangroves from Above](#)

"When mega projects came, poorer families saw they could have a livelihood from that project. They were not in a healthy economic position to oppose them," Gunarathne says of economic development he saw while working in the Eastern Province immediately following the war. "People just wanted to survive. Because of the poverty and this weak link between mangroves and the coastal community it allowed groups to invest money and do projects as they wish."

While development and jobs are necessary, Gunarathne and other mangrove advocates in Sri Lanka say they should not come before calculating the value lost by destroying mangrove forests. Balancing the conservation of any ecosystem with economic development becomes more clearly justified when people understand the many ways in which those ecosystems support people and planet.

## The Value of Mangrove Ecosystems

<sup>iii</sup> ↘ [Click on this link](#), to see a world map from the World Resource Institute and Global Forest Watch to determine where mangroves are located (make sure to zoom in!)

<sup>iv</sup> That's only 0.1% of the world's terrestrial land. However, around 3% of the world's population live near a mangrove. For more information, ↘ [read the Atlas of Ocean Wealth](#).

<sup>v</sup> Total forests account for around 40 million square kilometers. Mangroves are about 0.3% of total forest cover globally.

Mangroves are found along tropical and subtropical coasts in 118 countries worldwide. According to a 2010 study using satellite data to plot the worldwide distribution of the ecosystem, three quarters of mangroves are located in just 15 countries, the majority in Southeast Asia. Less than 10% are in protected areas.<sup>9</sup> Globally, figures estimate that between 20% and 35% of mangrove area has been lost since 1980.<sup>10</sup> The extent of that loss is greatest in low income countries across Asia.<sup>iii</sup>

According to most recent data from a 2010 Forest Department survey, Sri Lanka is home to approximately 157 square kilometers of mangroves<sup>11</sup>—though figures in recent years have estimated the extent may be double. Either way, mangroves make up less than 10% of the country's total forest cover,<sup>12</sup> and a small percentage of the global mangrove extent of 137,760 square kilometers.<sup>13</sup><sup>iv</sup> More than 20 species of mangrove trees are located along the narrow coastal belt, with the largest distribution in the Northern and Eastern provinces, and Puttalam Lagoon in North West Province. In Sri Lanka, coastal management and ownership falls under the responsibility of various government departments, though historically coastal communities have been able to access and utilize the areas for their own needs.

↘ [Appendix 2: Distribution and extent of mangroves in the coastal districts of Sri Lanka \(source\)](#)

While mangrove area may be minimal in comparison to other types of forest, Dr. Mala Amarasinghe says it's a mistake to focus on area alone.<sup>v</sup> A Professor of Botany at the University of Kelaniya near Colombo, Amarasinghe is one of Sri Lanka's leading mangrove researchers. "If we go just by the number of mangrove species and where they are found, we forget their critical importance for life on Earth," she says. Instead, Amarasinghe wants people to determine the ecological value of mangroves based on the services they provide. "We need to know how much value we are going to lose when we convert these wetlands into something else," she says.



*Dr. Mala Amarasinghe has dedicated her entire career to studying Sri Lanka's mangrove ecosystems.*

Every natural ecosystem has value beyond what people can tangibly see and sell. "Natural resources are produced and reproduced through a complex network of ecological processes," Amarasinghe wrote in a 1997 research paper.<sup>14</sup> These processes include photosynthesis and decomposition. While both are required for life on Earth, this natural productivity has zero value in today's market. In other words, a piece of mangrove wood can be sold for a certain financial figure, whereas it's much more difficult to put a dollar figure on the value that would have come from keeping that tree alive.<sup>vi</sup>

Other examples of this tension exist worldwide (and in this case study anthology): cutting down the rainforest may allow for billions of dollars to be extracted from new oil palm concessions, but disregard the role those forests played in provisioning clean water for communities. Over-exploitation of a marine area may reap short-term benefits for some, but those benefits may pale in comparison to the costs of reduced food production or tourism revenue in the long term.

The way society assesses the services produced by nature has evolved over time. In 2005, the Millennium Ecosystem Assessment popularized the term 'ecosystem services,' which categorized the four services produced by nature: provisioning, regulating, habitat (also known as supporting services), and cultural. This categorization proved to be an influential way to attach a dollar

<sup>vi</sup> Before moving forward: If you were tasked to put a monetary value on an ecosystem like a mangrove, how would you go about it?

figure to some of the invisible and undervalued functions of ecosystems. That value could then be directly compared to the value pegged to commercial market use.

However, a criticism of the ecosystem services framework was that it was too economics-focused. In recent years, the academic and policymaking community has moved towards a new way of framing the values offered by the natural world. The latest framework, created by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), uses the term ‘nature’s contributions to people.’

It recognizes that many groups, particularly Indigenous communities, reap significant non-material benefits from natural systems. This framework also includes perspectives from social sciences, the humanities, and other disciplines, in an aim to understand how cultural context dictates the relationship people have with nature. By shifting this framing, the aim is to more effectively emphasize the non-material (or ‘priceless’) value that nature has for certain groups of people—for example the role natural systems can play in shaping cultural identity or providing spiritual connection and inspiration for communities.<sup>vii</sup>

<sup>vii</sup> Does nature have any “special” value for you? Is nature part of your identity? Why, or why not? How do western worldviews differ from indigenous worldviews regarding nature?

*Shanika Lakmali and her three daughters behind their home in Kalipatiya. While her family does not rely on the mangroves for their livelihood, Shanika does enjoy taking her three girls to walk among and admire the mangroves.*



Apart from potentially undervaluing the non-material values of natural systems, a second criticism of the ecosystem services framework is that it can only account for the services that have been quantified. Because science is ever evolving, our understanding of the biology and ecology of natural systems can never represent a full tally of the values associated with a functioning ecosystem. Ethnobotanists and biologists are discovering new compounds with value to medicine and manufacturing; biological solutions, evolved over millennia, can form the basis for biomimicry in manufacturing and design.

*Appendix 3a / 3b: Two IPBES figures – the evolution of ecosystem services and the non-material, material, and regulating categories of ‘nature’s contributions to people.’ ↘ [Link to 3a](#); ↘ [link to 3b](#) (source)*

Currently, the value of Sri Lanka’s mangroves has been assessed using the older model of ecosystem services, and advocates say it is still this economic-focused outlook that has the most influence on policymaking and conservation efforts in the country. To that end, one ecosystem services study places the value of mangroves in Southeast Asia, including in Sri Lanka, at an average of US \$4,185 per hectare per year,<sup>15</sup> which is \$418,500 per square kilometer. Drawing on data from four dozen studies on Southeast Asian mangroves, this calculation valued ecosystem services such as fuel wood, fisheries, coastal protection, and water quality.

Based on this figure and the estimated 157 square kilometers of mangrove extent mentioned earlier, Sri Lanka’s mangroves provide more than \$65.7 million in annual material value. This figure would arguably be higher today if the assessment also accounted for the non-material value of mangroves.

Mangroves also play an integral role in the country’s Blue Economy. A term coined by the World Bank to explain the “sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health,”<sup>16</sup> the concept acknowledges how the three are deeply intertwined.

People residing in Sri Lanka’s coastal communities reap the greatest benefits from the Blue Economy and the contributions provided by mangroves—they’re also the ones who are disproportionately affected when they’re destroyed.

## Food Security and Sustenance

The waters that fringe Pappamoddai are a serene juxtaposition to the flurry of activity happening at the small weighing stations along the shore of the Northern Province town. The sun has just risen. It's prime business hour. Men hoist fish-laden nets from their boats and dump the night's wriggling catch onto the concrete floor. Birds swoop into the scene, eagerly sampling the remnants of crab legs and fish scum that stain the floor of the boats. Large blue nets have been spread across the road and bushes, left to dry before the next day of fishing. This is a daily routine for the fishermen in Pappamoddai, and for Jacopillai Thomai, it's the way he's started the better part of the past 45 years.



*Crabs, prawns, and fish—and in turn, the people who fish and eat them—depend on healthy mangrove ecosystems. This is part of the daily catch by a fisherman in Sri Lanka's Northern Province.*



### Brush Park<sup>viii</sup> Fishing in the Negombo Lagoon

Dr. Menake Gammanpila is verifying the scientific value of these traditional methods. He says Indigenous knowledge passed down from father-to-son has been used to create the best practices that help brush park fishers maximize their yields. That includes:

- Installing brush parks near main canal segments to allow them to better come in contact with migratory fish routes;
- Harvesting the brush park within 30 days of installation;
- Releasing young fish that may be caught in the brush park to allow them to reach maturation;
- Using branches from different mangrove species depending on the species of fish or prawn a fisher is attempting to catch.

By verifying the value of this Indigenous knowledge, Gammanpila is using his research to find a compromise between unwritten customary fishing practices and government rules and regulations. “The government should understand this traditional knowledge, otherwise they compete with it. We can use this knowledge for management strategies to conserve these fishing activities,” he says.

After all, he says the government and fishing communities are working towards the same goal: conservation. “The brush park fishers are not doing any harmful activities to destroy the mangroves. They know the importance of those resources and they are not going to destroy those things. The government and brush park fishers should be sitting at the same table to discuss decision-making for the lagoon.”

“The prawns and fish breed and grow in the lagoon area under the mangroves,” Thomai says, crossing his arms and looking down at a stray dog nuzzling its nose in a drying net. Today, his personal catch is 15 kilograms of small prawns. During other seasons he can bring in as much as 50 kilograms at a time. Not the best day, he shrugs.

<sup>viii</sup> Brush parks are one of the traditional fishing methods used in the Negombo Lagoon. [Click here to see what brush parks look like.](#)

Mangroves support the breeding, feeding, and nursery location of many fish species. For example, some fish lay eggs in mangrove ecosystems. Once those eggs hatch, the fish larvae swim into the complex stilted root system, which protects them from predation, strong waves, and temperature variation. Aside from physical protection, mangroves also play a key role in marine food chains. Certain species feed on the mollusks and other invertebrates that grow in the mangrove mud. Within the lagoon, decaying leaf litter supports the growth of the phytoplankton and zooplankton, which are eaten by bottom feeding fish.<sup>17</sup>

The life cycles of mud crabs and tiger prawns, two commonly harvested types of aquatic fauna in Sri Lanka, are also inherently linked to mangroves. In studies further south from Pappamoddai, 70 commercially valuable species of finfish and crustaceans have been documented in mangrove ecosystems.<sup>18</sup> This connection has been drawn elsewhere in the world, including in the Florida Everglades, where a decline in critically endangered goliath grouper fish was linked to a decline in mangroves.<sup>19</sup>

↘ [Appendix 4: Life cycle of Tiger-Prawn \(\*penaeus monodon\*\)](#)  
(source: [Seacology-Sudeesa Mangrove Museum](#))

Fishermen like Thomai understand the connection between their livelihood and mangrove health. Thomai is also happy to be back at the coast after he and his family were displaced during the civil war. The conflict forced the family inland and restricted Thomai's access to the coast—his family had no income during that time.



Fisherman Jacopillai Thomai.

After 2009, they resettled in Pappamoddai and Thomai resumed fishing. The environmental destruction from the civil war had left notable impact.

“I saw areas with no mangroves where the sand and dirt was in the lagoon, and there was no way to pass in our boat. It is much more difficult to collect fish in these areas. The mangroves stop the sand from going in the water,” Thomai notes. Like Douglas Thissera, Sudeesa's Director of Mangrove Conservation, Thomai's knowledge comes not from a formal education, but lessons learned from his father and decades of fishing experience.

Anecdotally, Thomai says his life wouldn't be the same without mangroves. “It is the perspective of us fisherfolk that the mangroves are our gift from God. They are our livelihood base.”

Coastal fisheries play a key role in supporting human health and well-being. Along with rice, fish is a staple food in Sri Lanka's coastal communities and increases the intake of protein and micronutrients such as iodine, vitamin D, and omega-3 fats.<sup>20</sup> While fish are an important source of these micronutrients for people worldwide, they're especially vital to coastal communities where access to other food sources may be limited or prohibitively expensive. Eating too few micronutrients has been linked to nutritional deficiencies and non-communicable diseases, as people turn to processed food that is often less expensive and more easily accessible.<sup>21</sup>

Fisheries also provide an important livelihood. FAO figures estimate that 59.6 million people worldwide are employed by primary fishing activities and production, including aquaculture.<sup>22</sup> Another paper estimates global marine fisheries could support up to 260 million full-time and part-time jobs, with 210 million people employed through indirect sectors such as manufacturing and processing.<sup>23</sup> In lower income countries, small-scale fishers like Thomai make up the majority of the fisherfolk.<sup>ix</sup>

The livelihood opportunities presented by healthy mangroves extend beyond direct fishing activity. The provisioning service of mangrove ecosystems in Sri Lanka also includes the collection of firewood, use of bark in creating fishing nets, home construction, fruit collection, and traditional medicine.

<sup>ix</sup> Although small scale fishers account for 90% of the fishery workforce, they represent only about 50% of the total catch. Source: Mora et al. 2009.

*A mangrove-fringed fishing site in Sri Lanka's Northern Province.*





## The Medicinal Properties of Mangroves

Mangroves have played an important role in traditional medicine in Sri Lanka, and scientists are now studying the implication the species could have on modern medicine.

Scientists at the University of Colombo in Sri Lanka are researching how extracts from the leaves and stem bark of select mangrove species could be used to improve human health. In adapting to their hostile, high-salinity environments, research shows mangroves develop unique compounds that could be useful in creating new cancer treating drugs. The hypothesis is that the cytotoxicity (toxic to living cells) of the leaf and stem bark extract could be used to limit the spread of breast cancer cells and hepatocellular carcinoma cells, commonly associated with liver cancer. The conclusion was that extracts from certain types of mangroves found in Sri Lanka could be used for cancer therapy.<sup>24</sup>

The research also highlighted a variety of traditional medicinal uses of mangroves in the country, from the treatment of diabetes, hepatitis, typhoid, and ulcers, to more common ailments such as diarrhea, nausea, and vomiting.

### Tsunami Mitigation

An important environment for water and food access, 90% of Sri Lanka's coast is considered vulnerable to tsunamis and storm surge.<sup>25</sup> In the case of these natural disasters, mangroves offer vital protection.

The regulating ability<sup>x</sup> of mangroves received a tragic public relations boost in the months following December 2004. On December 26 of that year, a tsunami triggered by a 9.0 magnitude earthquake off the Indonesian island of Sumatra devastated countries across Asia, including Sri Lanka. More than 35,000 people died in the country and over half a million were displaced.<sup>26</sup> Waves extended as far as two kilometers inland, wiping out entire towns along Sri Lanka's eastern and southern coasts.

<sup>x</sup> Which is to say the name for the category of ecosystem service.



*The tsunami damage in Sri Lanka following the 2004 tsunami. Photo by MediaJet, via Wikimedia Commons*

Something became apparent as the country took toll of the damage: coastal communities that had intact mangrove forests had been less affected than those with no mangroves. This was true of communities not only in Sri Lanka, but in the South Indian state of Tamil Nadu and in coastal Indonesia.

The mangrove roots and stems absorbed the hydraulic force of the tsunami waves, converting it into vibration energy and reducing its impact on homes and communities.<sup>27</sup> As for the influx of water, it was channeled into the networks of mangrove creeks, reducing flooding and saltwater intrusion into inland agricultural fields. Natural vegetation and landforms that have the ability to mitigate the effect of waves and storm surges have been given the name 'bioshields.'<sup>28</sup>

Nasiva was one of the Sri Lankan communities offered natural protection from a bioshield. The small village is found in Batticaloa district, one of the east coast districts most affected by the tsunami. A sandy beach, coconut palm plantation, and the Odu Lagoon are found in the 800 meter stretch between the coast and the village. In 2004, that lagoon was rimmed with a five to six meter belt of mangroves. It was these mangroves that bore the brunt of the waves that pounded the shore.

Post-tsunami environmental assessments found a high level of damage to those mangroves: prop roots completely uprooted and plants permanently left leaning because of the force of the waves. “The damage observed to mangroves visibly decreased as their distance from the sea increased,” noted an International Union for the Conservation of Nature (IUCN) assessment. “It was also observed that where mangroves were dense and thick, the damage was generally limited to the frontline 2-3 m.”<sup>29</sup> The tsunami caused no human casualties in Nasiva, and only minor structural damage to homes—a far cry from villages razed by the tsunami. The six-meter waves had dissipated to just 40 centimeters by the time they reached the community.

Nasiva wasn’t the only village to benefit from a mangrove bioshield. The IUCN assessment revealed less inland damage in other coastal areas with thick belts of mangroves. This natural security feature is not exclusively linked to mangrove ecosystems—sand dunes and other varieties of trees were also found to offer protection,<sup>30</sup> though trees were less likely to survive in the weeks following the tsunami due to increased soil salinity.<sup>31</sup>



### Carbon Sequestration and Climate Change

It’s not only Sri Lanka’s coastal communities that benefit from the ecosystem services offered by mangrove ecosystems. Mangroves are also one of the most effective ecosystems for carbon storage, making them a key player in global climate change efforts. With a growing interest in carbon financing, Sri Lanka has the potential to tap into these funds through mangrove conservation.

Researchers in the country are currently focused on measuring the amount of carbon sequestered by the Sri Lanka’s mangroves. One such study was performed in the Negombo Lagoon in Sri Lanka’s North Western Province. The lagoon has 3.5 square kilometers of mangrove forests, which were found to annually absorb the amount of carbon dioxide emitted through the combustion of more than 7.7 million liters of gasoline.<sup>xi</sup> The amount of carbon stored in mangroves varies based on species (Sri Lanka has more than 20 species) and the soils in which they grow. This makes it difficult to estimate the economic value provided by this carbon storage service.

While mangroves can mitigate the effects of climate change, climate change can also impact mangrove ecosystems.

Sri Lanka has minimal tidal range, meaning the difference between high and low tide is no more than 0.7 meters in most of the country. Changes in sea level would affect the intertidal areas in which mangroves have adapted, disrupting the salt and freshwater balance. “Brackish areas will become more salty and there will be no space for mangrove areas to move inland because of encroaching development,” says one official with the International Union for the Conservation of Nature (IUCN).

The risk of increased sea level intrusion is met by one of potentially less freshwater. Sri Lanka has three climatic zones: wet, dry, and intermediate. The largest extent of mangroves is found in the dry zone, making them vulnerable to changing weather patterns. Precipitation levels have declined in 13 out of 15 monitoring stations across the country since the 1950s,<sup>32</sup> and a reliance on rain-fed agriculture means the natural flow of freshwater rivers could be redirected in order to supply irrigation systems. Both sea level rise and the possibility of decreased water reaching coastal lagoons will impact the health of mangrove ecosystems in the long-term.

<sup>xi</sup> This annual amount is still just a fraction of the amount of gasoline used in the United States each day—7.7 million liters of gasoline is the equivalent to just over 2 million U.S. gallons. Figures from the U.S. Energy Information Administration report that 391.71 million gallons of gasoline are used daily in the United States. (<https://www.eia.gov/tools/faqs/faq.php?id=23&t=10>)

### Mangroves Under Threat

<sup>xii</sup> Aquaculture is the controlled cultivation of aquatic animals and plants, usually for food.

Conservationists in Sri Lanka say the 2004 tsunami opened the eyes of everyday people and the government to the value of healthy mangroves. While there is some pre-2004 evidence of people planting mangroves along the shoreline to lessen the effects of monsoon storms and prevent erosion,<sup>33</sup> this behavior was limited. “People only thought earlier of the value that could come when you change mangroves into some other type of land use,” says Kapila Gunarathne with IUCN. “After the tsunami, mangroves were discussed more deeply and widely, and became popular.”

This popularity wasn’t always the case, however, and mangroves have historically faced human-caused destruction.

Dr. Mala Amarasinghe, the mangrove researcher at the University of Kelaniya, was starting her career when Sri Lanka’s mangroves faced their first large-scale threat. It was 1982, and Amarasinghe had just become the first junior scientist hired by the National Aquatic Resources Research and Development Agency (NARA) to study the country’s mangroves. She was starting from scratch, researching an ecosystem that she says was relatively unknown and undervalued by decision makers in the government’s environmental agency.

That lack of understanding aligned with a period of development in Sri Lanka. By the mid-1980s, shrimp farming had already yielded economic success in Thailand, the Philippines, and Indonesia.<sup>34</sup> The shrimp industry was not new to Sri Lanka, though had previously involved wild prawns, not those raised through aquaculture.<sup>xii</sup> The first semi-intensive aquaculture farms were trialed in the country’s Eastern Province in the 1970s, but the industry didn’t boom until the ponds used for shrimp farming started cropping up across the Northwestern Province a decade later, inspired by the economic success of neighboring countries.<sup>35</sup>

*An aerial scene of industrial-scale shrimp farms near the Chilaw Lagoon in northeastern Sri Lanka.*



That was problematic for mangroves and the people who relied on their various ecosystem services. The ideal territory for intensive shrimp farming is also the environment in which mangroves exist: coastal areas with a large amount of interchange between fresh and saltwater. Due to the salinity of soil, mangroves were considered unsuitable for agriculture, and as a result, undeveloped.<sup>36</sup> This was the classification given to mangrove areas by the local government, meaning the forests were viewed as areas yet to be converted into something of value. According to Amarasinghe, that made it easy for land to be sold to shrimp farmers—if it was sold at all. Improper monitoring of the industry meant that a large number of farms set up in the first years were unauthorized and established wherever state land was available.<sup>37</sup> No environmental impact assessment was necessary.

The economic value of shrimp farms was undeniable. The industry was growing across Asia, where aquaculture production of shrimp increased by more than 420% between 1984 and 1994.<sup>38</sup> Shrimp quickly became one of Sri Lanka's most important exports, with export value almost tripling between 1990 and 1998.<sup>39</sup> These exports infused the country with much-needed foreign exchange earnings—convertible currencies that come only from the sale of goods on the international market.

*Douglas Thissera gestures at a place where ponds for shrimp farming have led to deforestation of the natural mangrove ecosystem.*



In the beginning, intensive shrimp farming was seen purely through the lens of economic benefit. Unfortunately, coastal communities were not benefiting from the development happening in their lagoons. “The investors were mostly from outside the area, and they thought employing the villagers would lead to problems with them stealing harvest. To avoid that, they brought in migrant labor from elsewhere so the locals didn’t get jobs,” describes Amarasinghe. Not only did coastal communities not get a stake in the farming—they also couldn’t count on the shrimp feeding their families. The majority of prawns were shipped to Japan, the United States, and the European Union, which remain three of the largest import markets of shrimp today.<sup>40</sup>

The inability to benefit from jobs in this new and lucrative market was a factor motivating locals to create illegal shrimp farms.<sup>xiii</sup> By 1999, nearly half of all shrimp farms in the Northwestern Province were unauthorized, meaning they had been started without any approval or environmental assessment.<sup>41xiv</sup>

While Sri Lanka's contribution of shrimp to the global market was insignificant when compared to exports from Thailand and other parts of South Asia, the amount of land being converted by industry was substantial. Take in Puttalam district in Sri Lanka's west coast. Mangrove distribution in the lagoon was 11.81 square kilometers in 1981. That area decreased by more than half over the next decade.<sup>42</sup> By this time, Amarasinghe and her colleagues at NARA were creating zonal plans to advise the government on areas where shrimp farms were and were not recommended. Coupled with a newly introduced environmental impact assessment, the technical advice was ignored by the government. “After a couple of months we would visit the places we mapped and saw the area was under a shrimp farm. It was so frustrating,” Amarasinghe remembers. She left NARA in 1997, determined to instead quantify the value of mangrove ecosystems in a way policymakers would understand.

### Poverty as a Determinant of Environmental Destruction

While Amarasinghe was dealing with the shrimp farm expansion at a government level, Douglas Thissera and his fellow fishers in the Chilaw Lagoon were witnessing the changes before their very eyes. The shrimp farms were just the latest example. Mangrove areas along the western coast were being converted into residential lots, and around Bentota, a town in the southwest, into hotels. Salt

<sup>xiii</sup> Do you eat shrimp? Are you aware of its origins? Fishing technique? Species?

<sup>xiv</sup> Remember, Sri Lanka was going through a period of civil conflict, and during which institutions usually get weakened.

farming had started to dominate the eastern coasts. All the while, people living along Sri Lanka's lagoons were continuing with their traditional use of the mangroves: home construction, bark collection to extract tannin for fishing nets, and firewood use.

Unlike industrial shrimp aquaculture, these traditional uses were primarily for household means. Bark collection was the only traditional use that also had a commercial market.<sup>43</sup> It's important to note the difference between the value coastal communities glean from mangroves when compared to their larger commercial use by external stakeholders. Fisherfolk use mangroves to meet their subsistence survival needs—namely food and shelter. This is inherently different than the purely economic value gained by larger-scale market activities, though both can lead to overexploitation.

Whether it was limiting small-scale mangrove destruction or opposing industrial development, Thissera often mobilized the community to help the police arrest the people doing these activities. There were no government policies to preserve mangroves per se, and when traditional avenues of justice weren't sufficient, Thissera says he and the other fisherfolk would sometimes use displays of force, taking the perpetrators' boats as a way to enforce conservation.

*Boating among the mangroves in Northern Province, Sri Lanka.*



<sup>xv</sup> Can you think of other examples in which this is the case? How about in your home country?

## Mangrove Conservation Takes Root

*Dr. Anuradha Wickramasinghe is the Founder of Sudeesa, the Small Fishers Federation of Lanka. In nearly three decades of work, Sudeesa has partnered with communities, government bodies, and international organizations in order to create programs and incentives to protect mangrove ecosystems.*

“The struggle to conserve mangrove ecosystems was a part of life,” Thissera recalls, sitting in his Sudeesa office overlooking the lagoon where he once fished. “The young people always struggled with the conservation component because the fishing community is not just limited to conservation activities, but also income generation.” Like Thomai, the fisherman in Pappamoddi, fisherfolk understood, to an extent, the value of mangrove ecosystems, but they also knew they needed materials for their home, food to feed their family, and money to survive. This is one of the reasons why poverty is a determinant of environmental destruction—it forces people to choose short-term gain over long-term benefit.<sup>xv</sup>

It's also why a conservation-only approach to mangrove protection would not work, says Dr. Leela Batuwitage, Seacology's Field Officer in Sri Lanka, and a retired high-level bureaucrat with the country's Ministry of Environment. “Environmental conservation as a standalone may be seen as a luxury for poverty stricken communities, without paying due attention to their social well-being,” she says. “I always advocate strongly for environmental conservation and I experience the difficulties. If you read Buddhist principles, they really are about sustainable development, which is to say: take the middle path. We need to use our natural resources but be careful to conserve as well.”

It was the early 1990s when Dr. Anuradha Wickramasinghe began to appreciate the striking connection between people and mangrove ecosystems.



Born and raised in Kandy, a city in Sri Lanka's interior hill country, Wickramasinghe had spent his research and career thus far focused on conservation management of the forest and water resources that surrounded his hometown. In 1989 he was urged by a former professor from St. Francis Xavier University in Canada to head out of the hills and towards the coast.

Thirty years later, Wickramasinghe recalls one story with ease: he was walking along the river near an estuary and coastal bed when he saw a mother carrying a fish basket under her arm. Her young son was running down the beach. Suddenly the mother stopped and took something from the water and put it in the soil. The boy asked "mom, what are you doing?" and the mother said "son, this is the mangrove plant. The fish comes because of this."

Wickramasinghe was struck by what he heard. "This is the real rural peoples' Indigenous knowledge about the mangroves—they know that they're vital for livelihoods and fish breeding," Wickramasinghe surmises. "It was because of this moment that I focused my entire dissertation on this connection."

Wickramasinghe's dedication to mangroves has continued far beyond his dissertation. In 1992, Wickramasinghe was standing by the Chilaw Lagoon when he first met Douglas Thissera. They discussed the mangroves, Thissera's experience as a fisherman, and the challenges faced by fisherfolk communities. Together with other fisherfolk from the lagoon, they established the Small Fishers Federation of Lanka (SFFL, more commonly known as Sudeesa), a network dedicated to protecting the mangroves in 20 villages around the North Western Province. As with Wickramasinghe's initial research, Sudeesa continued working with women and children in fishing communities, and he became the first Chairman (Director) of the organization.

#### **A New International Partnership**

In 2001, Wickramasinghe fielded a telephone call from an American number. On the line was Duane Silverstein, the Executive Director of Seacology, a non-profit environmental conservation organization based in Berkeley, California. Established in 1991, Seacology's mission is to protect "the threatened habitats of the world's islands by working directly with local communities to both conserve their natural resources and improve their quality of life."

The call from Silverstein was congratulatory in nature. Wickramasinghe was informed he had been awarded that year's Seacology Prize in recognition of Sudeesa's mangrove conservation work. The annual prize recognizes one islander worldwide who has committed to preserving the environment and culture of their home country. With the title came a cash prize of US \$10,000, an amount that went towards setting up a mangrove center in Sri Lanka's Southern Province.

The Seacology Prize was the start of a partnership that has continued until today, and has developed into the largest project of both Seacology and Sudeesa. The latest iteration of the partnership, the Sri Lanka Mangrove Conservation Project, started in 2015. Funding for the five-year, \$4 million project comes from Seacology and a grant from the Global Resilience Partnership. Other recent recognition has come in the form of the UN Climate Change Secretariat's Momentum for Change award, where the project was a winner in the planetary health category.

Seacology had long-recognized the importance of mangroves, and was partnering with other organizations on small-scale mangrove projects in the Philippines, Micronesia, Kenya, and Tanzania, in addition to Sri Lanka. By 2015, they wanted to go larger-scale.

"Country-wide protection was what we wanted," says Karen Peterson, Senior Manager of Special Initiatives at Seacology. "It was a fortunate time for this project in Sri Lanka because of the war being over and people in these coastal communities really eager for some new infusion of resources and attention to help them get back on their feet."

The project's large-scale ambition garnered the skepticism of some, including Kapila Gunarathne with the International Union for the Society of Nature. Gunarathne says he thought it would be more effective for Seacology and Sudeesa to identify smaller case study areas, places where the project could work with different ethnic groups to understand incentives and motivators around conservation, introduce various mangrove livelihoods, and observe local economic and climatic stressors. Sudeesa's Chairman, Dr. Wickramasinghe, saw it differently: mangroves are located around the entirety of the country's and so the Sri Lanka Mangrove Conservation Project had to be comprehensive in its coverage area.

Expanding well beyond Sudeesa's initial work with 20 communities in a single district, the project now operates in 1,300 villages across the country's 14 coastal districts. While the scope of the project has expanded, Sudeesa's approach remains the same. The organization has always worked with fisherfolk communities and vulnerable women, and recognizes not only the need for conservation, but also the important role education and economic empowerment must play.

The goal of the Sri Lanka Mangrove Conservation Project was to find a way for this same grassroots approach to be scaled across coastal communities across Sri Lanka, including those far from Sudeesa's main headquarters in the Chilaw Lagoon.

The organization knew it wouldn't be viable to have a staff member in each community and that leadership needed to come from a local level. To that end, the project created community-based organizations (CBOs) in coastal villages across the country. The CBOs have an average of 10 members, comprised of women who live in the same community.<sup>xvi</sup> Today, 12,000 women are part of 1,300 CBOs in coastal villages across Sri Lanka, a key accomplishment of the project. The project chose to empower women for various reasons: despite men formally being the head of household in Sri Lanka, women are often the ones who manage the family, finances, and make day-to-day decisions. CBO membership prioritizes vulnerable women: those who are widowed or disabled—a particularly common occurrence in the Northern Province due to the civil war—and those with low incomes, large families, or who have dropped out of school.

Two dozen of these CBO members have gathered at the side of a house near Kalpitiya, a town on Sri Lanka's west coast. They're taking part in one of the main CBO activities: five days of training dedicated to mangrove conservation, CBO management, and business planning. Shaded by swaying palm trees, they watch as a Sudeesa trainer shows booklets, posters, and then a mangrove propagule.<sup>xvii</sup> The teachings are broad: explaining the components of the environment, that trees absorb carbon dioxide and produce oxygen, and about global warming and how these women can play a part in reducing it by planting more mangroves. The vast overview of basic scientific concepts may seem simplistic, but it's more than most CBO members have ever learned in school—if

## The Seacology-Sudeesa Approach

<sup>xvi</sup> Why do you think they chose women to be the heads of these CBOs?

<sup>xvii</sup> A propagule is the seed of a mangrove used for replanting.

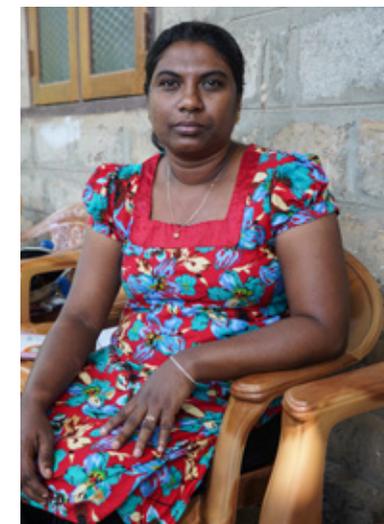
they had the opportunity to study at all. The training later goes on to explain the species of mangroves found in Sri Lanka, and the role they play in fish breeding and tsunami protection. The women nod their heads, and a few kids sit on their mothers' laps, eyes fixed on the glossy posters.



*A group of women in Kalpitiya in Sri Lanka's North Western Province learn how to propagate a mangrove seedling. Just one aspect of the five days of training, the training from Sudeesa also introduces concepts of environmental protection and business skills development. To date, 12,000 women across Sri Lanka have received this training.*

Manjula Nibsi is one of those CBO members. The training is happening next to her home, and she hurried through her daily housework, laundry, and cooking so she could attend the day-long event. It helps that CBO members receive an allowance of 2,500 Sri Lankan rupees (about US \$14) to attend the five days of training. Despite her lack of prior education, Nibsi knew mangroves were important to her family's well-being. "My father and two brothers fish in the lagoons and mangroves. I didn't know many things, but I understood that fishing is their livelihood, and that the mangroves were where they do that. The income they make from catching crabs and big fish helps pay for my children's school activities."

The goal of the environmental education is not to make experts out of Nibsi and her peers. Instead, it's a first step towards getting them to shift their outlook: understanding that the mangroves are not only a place that can provide for them, but also an environment that needs protection in order to keep providing these benefits.



*Manjula Nibsi outside her home in Kalpitiya.*

### The Dual Benefits of Economic Empowerment

Improving the economic well-being of women in the CBOs is another integral facet of Sudeesa's approach. Two days of Sudeesa's training are dedicated to financial skills, and women are taught to create a business plan for a current or new small enterprise. Once they've completed training and a business plan, each woman is awarded a 15,000 Sri Lankan rupee (approximately US \$84) microloan to put towards her business or getting a larger loan from a formal banking institution. Sudeesa had been offering training and microloans before 2015, but the amount has since doubled and the payback model changed.<sup>xviii</sup>

While not a substantial amount of money, the purpose of the microloan is to help women start or expand a business in order to earn income and better support her family's needs. That includes having the financial means to stop cutting mangroves for firewood. In exchange for the microloan and business training, women commit to protect and replant local coastal belts. Each CBO is responsible for protecting 85,000 square meters of mangroves (an area the size of about 12 football fields). They also commit to replanting an additional 25,000 square meters, which is around 3,500 mangroves. The mangrove seedlings come from Sudeesa's own nurseries or are grown by CBO groups.

"The microloan is a catalyst that says the project can look after them economically," says Dr. Leela Batuwitige with Seacology. "It is the foundation for further education." Not only that, but women are busy. That's why a sustainable solution can't solely add another task to a woman's plate—insisting she replant and protect mangroves, for example. By offering the microloans, business training, and environmental education, Batuwitige says the project aims to more thoughtfully acknowledge the everyday priorities, challenges, and education levels of communities.

"People, especially those living in poverty, need holistic solutions. Otherwise it is like five blind men with an elephant. One touches his leg and he thinks it's a log. Another touches his ear and thinks it's a fan. But they are all missing the bigger picture—that it's an elephant," Batuwitige describes. Focusing exclusively on conservation, finance, or education alone is the same. "It's not only about looking at one perspective but to see the whole animal. Then we can better understand," she concludes.

These days, microloan granting ceremonies are a regular occurrence for the Sudeesa team. On any one day the team may be visiting a handful of communities, awarding the bright yellow envelopes that contain a new microloan.



*After completing their five days of training, women are given a microloan to start or expand an existing business. These women in Moonrampiddi village have just received their yellow envelopes. Repayments are made into a rotating fund managed by their community group, as opposed to paid back to Seacology or Sudeesa.*

Judi Andonitte is a recent microloan recipient. A mother of four whose husband was left disabled after the civil war, Andonitte is the primary breadwinner for her family. She's spent the past five years working as a tailor, and also teaches sewing to other women and girls in Moonrampiddi, her Northern Province village. Andonitte plans to use the microloan to buy a second sewing machine, and hopes to eventually employ another woman from her village. Not just an infusion of capital, Andonitte says the financial training from Sudeesa has taught her how to incorporate bookkeeping skills into her business.

Sudeesa's microfinance program has some key differences from other microloan institutions in Sri Lanka. For one, it avoids the predatory lending practices that plagued parts of rural Sri Lanka, particularly after the civil war. Microfinance companies had been charging as high as 70 to 80% interest rates on loans, and in 2018 the national Ministry of Finance had to step in and write off the debts of more than 45,000 women who had become overburdened by high interest rates.<sup>44</sup>

<sup>xviii</sup> What are micro-loans? Why are they important to break the cycle of poverty?

<sup>xix</sup> The interest rate ceiling of microloans in Sri Lanka is nearly twice this, at 35%.

CBOs who receive Seacology-Sudeesa microloans decide on their own payback scheme and interest rates—the recommended period is one year with 18% interest.<sup>xix</sup> Loans are repaid directly to the CBO, creating a rotating fund of repayment plus interest that members can continue to borrow from in the future. This is different than Sudeesa’s past lending model and the one held by most microfinance companies, where payback is to the institution itself. Sudeesa created this new policy based on the lessons learned between the project launch in 2015 until the change was implemented in 2018.

Members say CBO-management of the microloan allows groups to factor in emergencies or other financial hardship. “A community member might be in trouble if her husband passes away, and she may be unable to repay the amount for a few months. The CBO is free to look at the situation of that affected community member and make a decision about her payment,” explains Annet Primrose Fernando, the coordinator of Sudeesa’s microfinance program. The program has an extraordinary 96% loan repayment rate,<sup>45</sup> and the Sudeesa team supports CBOs as needed.

*A visual illustration of the financial and physical support provided by the microfinance program. Arujodi Kulendran, a Sudeesa staff member, is pictured with a CBO recipient.*



### Education and the Mangrove Museum

Sudeesa goes directly to communities for the one-time CBO training. But when it comes to the project’s other key educational efforts, the purpose is for visitors to come to them.

There’s a new set of buildings along the shore of the Chilaw Lagoon where Dr. Anuradha Wickramasinghe and Douglas Thissera first met in 1991. The largest and most recent addition is the Seacology-Sudeesa Mangrove Museum—the world’s first museum dedicated to the coastal ecosystem. Constructed as part of the Sri Lanka Mangrove Conservation Project, the museum opened on July 26, 2016, in celebration of the second-annual World Mangrove Day.

The museum has since received more than 14,800 visits from students of all ages and nationalities, government representatives, community members, researchers, and other groups. Similarly, the Mannar Training Center in Northern Province was opened in July 2018 with funds from the Global Resilience Partnership. Land for the museum and the Northern training center was donated by the government, a testament to Sudeesa’s cooperation with local officials. Both boast various infographic displays about the role of mangroves, a nursery area with thousands of young propagules, and, in the Chilaw Lagoon location, rows of cases displaying the dozens of fish and crustacean species that live in mangrove ecosystems.



*The Mannar Training Center is a museum, training, and meeting space for mangrove conservation groups.*

This education and economic empowerment approach was what first attracted Dr. Mala Amarasinghe from the University of Kelaniya to Sudeesa. Disenchanted by what she saw as the Sri Lankan government's disregard for Environmental Impact Assessments and the advice of scientists in the 1980s and 1990s, she realized the solution needed to come from the community. "When I saw what Sudeesa was doing, I said 'oh, this is what should be done' because they were straight away dealing with communities and were aware of their problems and aspirations," she says. In addition to her role with the University of Kelaniya, Amarasinghe works closely with Sudeesa and the organization's Scientific Forum to provide the research basis to understand the role of mangroves and their ecosystem services.

*Display cases in the Seacology-Sudeesa Mangrove Museum near the Chilaw Lagoon. The windows look out onto mangroves at the edge of the lagoon.*



Sudeesa's approach is a compromise between the status quo top-down environmental management and grassroots management, Amarasinghe adds. "Top-down management hasn't done anything in places like the Chilaw Lagoon. The government has the infrastructure, institutions, and laws but it still hasn't worked," she says. "The grassroots communities have common sense and understanding that the mangroves are important for their own survival, and that has driven them to protect them. Sudeesa is trying to combine these two."<sup>xx</sup>

Dr. Wickramasinghe, Sudeesa's Chairman, sees the organization as a bridge between community perspective and government policy. "At policy-level meetings, we inform the government about what

the community is feeling, which helps them make decisions. We are connected to all areas because of our network," he says. That network includes the substantial connections Sudeesa has with fisherfolk across the country and the professional relationships Wickramasinghe built with government officials throughout his school and working years. A government official with Sri Lanka's Ministry of Mahaweli Development and Environment says working with the Seacology-Sudeesa project is the most direct way the ministry receives input from the community.

Ultimately, Sudeesa aspires to make itself redundant by strengthening the role of community members as enforcers. At a community level, fisherfolk communities and women's groups have developed a sense of ownership and responsibility for the mangroves. That has prompted people to report mangrove destruction to government field officers—representatives from the departments of wildlife and forestry who have the power of legal enforcement. Sudeesa offers a day of mangrove conservation training to those officials in order to enhance their understanding of the value of the ecosystem. Today, even the Sri Lankan navy has gotten involved with replanting efforts.

### **From Community to Country-wide**

Sudeesa's connection to local, district, and national levels of government has been valuable. Ultimately, it is still the responsibility of the Forestry Department and the Wildlife Conservation Department to monitor the coast and enforce mangrove cutting. While community members can report mangrove destruction, their comments would be legally inconsequential if not for the understanding and buy-in from the government.

The most significant act of government commitment came in 2015 when Seacology, Sudeesa, and the national government signed a tripartite agreement to protect the entirety of the country's mangroves. "All the government people are supporting us because they know we always take the middle ground and never try to interfere politically," says Dr. Wickramasinghe, adding that NGOs do not normally sign agreements with the government. With that memorandum of understanding (MoU), Sri Lanka became the first country in the world to nationally protect its mangroves. This protection meant the construction of new concrete posts along the coast, demarcating mangrove areas where people cannot fish, chop wood, and do other activities without government permission. Sudeesa and its community-based organizations are still able to run mangrove conservation activities in these areas.

<sup>xx</sup> What are some pros and cons of top-down and bottom-up approaches?

*A concrete marker that indicates a coastal mangrove area has been set aside for protection.*



The 2015 mangrove declaration received substantial international media coverage. “The declaration focused a lot of positive attention on Sri Lanka at a time when [the government] could really use it,” says Karen Peterson with Seacology. “With the way Sri Lanka is growing economically, we wanted to have it out there in the universe that these mangroves are protected. I take the point that it is ambitious to protect the mangroves in the whole country, but we wanted to garner as much attention as possible so stakeholders know this is the intention.”

The recognition didn’t end with the news coverage, and in August 2018 Sri Lanka was chosen to lead a Commonwealth-wide initiative on mangrove conservation. The Commonwealth of Nations is a group of countries primarily composed of former British territories. More recently, Seacology was chosen as one of 25 organizations to showcase at Expo 2020 in Dubai—the mangrove conservation project will be the focus of that display.

Importantly, the 2015 declaration was also the first step in creating a dedicated national mangrove policy for Sri Lanka. Mangrove protection in the past had been ad hoc at best—a hodge-podge of protection under a number of policies, ordinances, and acts, each from different government departments. The national mangrove policy was drafted by a taskforce representing a number of key government departments, academics, and mangrove experts including members of the Sudeesa team.

The national policy was approved by the Sri Lankan cabinet in January 2020—a key victory bookending the mangrove protection efforts Sudeesa started in 1992. The policy is an added layer of protection for the country’s mangroves and can be used to draft new laws and government action plans. It also means mangrove protection is enshrined in law and above any changing political priorities.

The policy also includes the creation of national guidelines for mangrove restoration. As Douglas Thissera, Sudeesa’s Director of Mangrove Conservation is quick to point out, there’s an art to restoring and replanting. As a result, Sudeesa helps CBOs select which mangrove species to plant and outlines the distance between seedlings. An official from the Ministry of Mahaweli Development and Environment says a lack of expertise around replanting has been problematic in the past, and has led to small NGO projects

dissolving after they’ve met their reforestation quotas—only to have those mangroves later die. Replanting done under the Sri Lanka Mangrove Conservation Project is an exception, as women’s groups are trained and their conservation activities are recognized by law.



*Douglas Thissera*

<sup>xxi</sup> ↘ [Check out the latest CPI report here.](#) Zero on the index represents countries that are highly corrupt, with 100 being very clean.

Other challenges like corruption could also influence mangrove protection. Sri Lanka received a 38 out of 100 rating from Transparency International's annual Corruption Perceptions Index,<sup>46xxi</sup> and Wickramasinghe says it is still one of the biggest problems in the country today. Still, he remains optimistic, especially because of the declaration of the national protection and the new national mangrove policy.

"If corruption happens, we can go to the police," he says. "If the police don't listen, then we go to the court. Having the mangrove policy written is the first step and then a law will come so people know they can't cut mangroves in that area." Further, the international recognition Sri Lanka has received by being a mangrove champion—combined with community activism around mangrove protection—means people are paying attention to the decisions the government makes around the ecosystem. This public pressure and awareness may lower corruption rates.

With corruption often stemming from economic pressures, Sudeesa hopes its ongoing appraisal of the ecosystem services offered by mangroves will put mangrove protection on a level playing field with other, traditionally more lucrative means of industry. It's not about banning economic development altogether—rather, it's approving projects that are more strategic and sustainable. "There are places where prawn farming can be done, and there are places where people can do salt production, but you need to ensure these areas are not mangrove related," says Douglas Thissera, Sudeesa's Director of Mangrove Conservation. Thissera says the economic value of mangroves needs to be further quantified in order to compare dollar-for-dollar the gains and losses between economic development and environmental conservation. "There should be a balance so people know that if the natural system is destroyed then their economic activity is also in trouble," he says.

### The Art of International and Local Partnerships

Outside of the relationships formed with coastal communities and governments is the connection between Seacology and Sudeesa. The partnering of an international NGO with a grassroots organization is not a new model. What is unique is the way Seacology and Sudeesa work together on the mission of mangrove conservation, and the fact that their relationship has existed for nearly two decades. "It really takes time to understand a country, a culture, the political systems, economic structure, and volatility. There's a

lot at play that we cannot see as outsiders," says Karen Peterson with Seacology. "It's about learning what those vulnerabilities are for the sake of building flexibility into the program and being able to deal with unexpected shocks and stresses."

According to Peterson, Seacology doesn't start projects assuming it knows what communities want. "We're going to do everything we can to make sure what we're providing is really what people need, and this involves going in to the relationship with a very open mind." For the Sri Lanka Mangrove Conservation Project, that involved building on the success of Sudeesa's existing approach, while offering funding and in-kind support. Seacology has assisted in administrative and accounting practices over the course of the project, and has also directed international media and academia opportunities towards Sudeesa.

The Sri Lanka Mangrove Conservation Project ends in May 2020. Following that date, Seacology will continue to monitor CBO conservation activities and the performance of livelihood initiatives. The organization will also continue to meet regularly with government officials to track the progress of national-level mangrove conservation activities. Finally, though Seacology's financial support of Sudeesa will end, the organization will continue to fund other smaller-scale conservation initiatives in Sri Lanka.



*In exchange for the skills training and microloan, the Mangrove Conservation Program hopes women will not only conserve and protect existing forests, but replant new ones, too.*

## Epilogue

Replanting, education, and economic empowerment activities in Sri Lanka's 14 coastal districts will continue after the project's 2020 end date. One such replanting is happening after a microloan ceremony in the Northern Province. Women gingerly lift their brightly-colored sarees, unwrap the mangrove seedlings from their plastic nursery bags, and swing a hoe into the soft coastal mud.

*A mangrove replanting session in northern Sri Lanka.*



The Sri Lankan government recently reported that 22 square kilometers remain before the country's entire coastal belt is replanted. An estimated 3.2 million seedlings are needed to complete this task. That presents a next step for groups like Sudeesa—as of early 2020, its CBOs had replanted 700,000 seedlings in nearly 5 square kilometers of coastal area. Sudeesa has not yet confirmed if and how it will grow the remaining number of seedlings in its nurseries or in partnership with CBO members.

After replanting sessions, women return home to countless other household responsibilities. The hope of Seacology and Sudeesa is that defending the mangroves will continue to be one of these responsibilities, especially now that women understand the value they bring to their families. Sudeesa plans to continue supporting these CBOs even after the Sri Lanka Mangrove Conservation Project with Seacology finishes—though it needs renewed funding to do so. Dr. Anuradha Wickramasinghe has expressed an interest in preparing funding proposals for Sri Lankan government ministries and international groups like embassies and NGOs.

Sudeesa envisions an expansion of the five-day livelihood training CBO members received through its former project, offering further training on environmental law and business marketing. It's also going through the process of registering each CBO under the Environment Act of Sri Lanka, providing the groups legal recognition by the government so they can create action plans to restore and protect local mangrove areas. Building on the small financial boost offered by the original project's microloans, Sudeesa wants to help women establish a network of business cooperatives to better brand and sell their products and access support from the formal banking system. Each of these activities is to ensure women across Sri Lanka have the knowledge, resources, and agency to make their own decisions—with regards to mangrove protection and for their own lives.

In the coming years, Douglas Thissera will continue mapping the country's mangrove areas, creating a resource that government and communities alike can use to better plot areas for conservation. That, in conjunction with the research Dr. Mala Amarasinghe and others are doing to quantify ecosystem services, are tools to ensure the national protection of mangroves remain enforced as Sri Lanka's coasts face mounting commercial pressures.

As for the Seacology-Sudeesa Mangrove Museum, it could soon have a new companion. Wedged next to the mangrove nursery at the Chilaw Lagoon is a small clearing where Sudeesa hopes to construct a coral reef museum. Some fish species go into the corals and then cycle back to the mangroves, says Wickramasinghe, justifying the reason for the museum. It's one of many ways that mangrove ecosystems are connected to others, both marine and terrestrial. Those ecosystems, in turn, directly influence the health and well-being of the people who live among them. Long-term preservation demands the highlighting of this, as well as holistic solutions that consider the complex realities of people—fisherfolk and beyond.



*Mangrove seedlings growing outside the Mannar Training Center in northern Sri Lanka.*

## Keeping Track of Who's Who

### Dr. Mala Amarasinghe

*Professor of Botany and mangrove researcher, University of Kelaniya*

### Judi Andonitte

*Community-based organization member in Moonrampiddi*

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### Douglas Thissera

*Director of Mangrove Conservation, Sudeesa*

### Jacopillai Thomai

*Fisherman in Pappamoddi*

### Dr. Anuradha Wickramasinghe

*Chairman, Sudeesa*

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*Surrounded by mangroves, a fisherman sits in the shallows of Negombo Lagoon on the northwest coast of Sri Lanka. Visible to his right are the distinctive stilt roots that make up mangrove species.*

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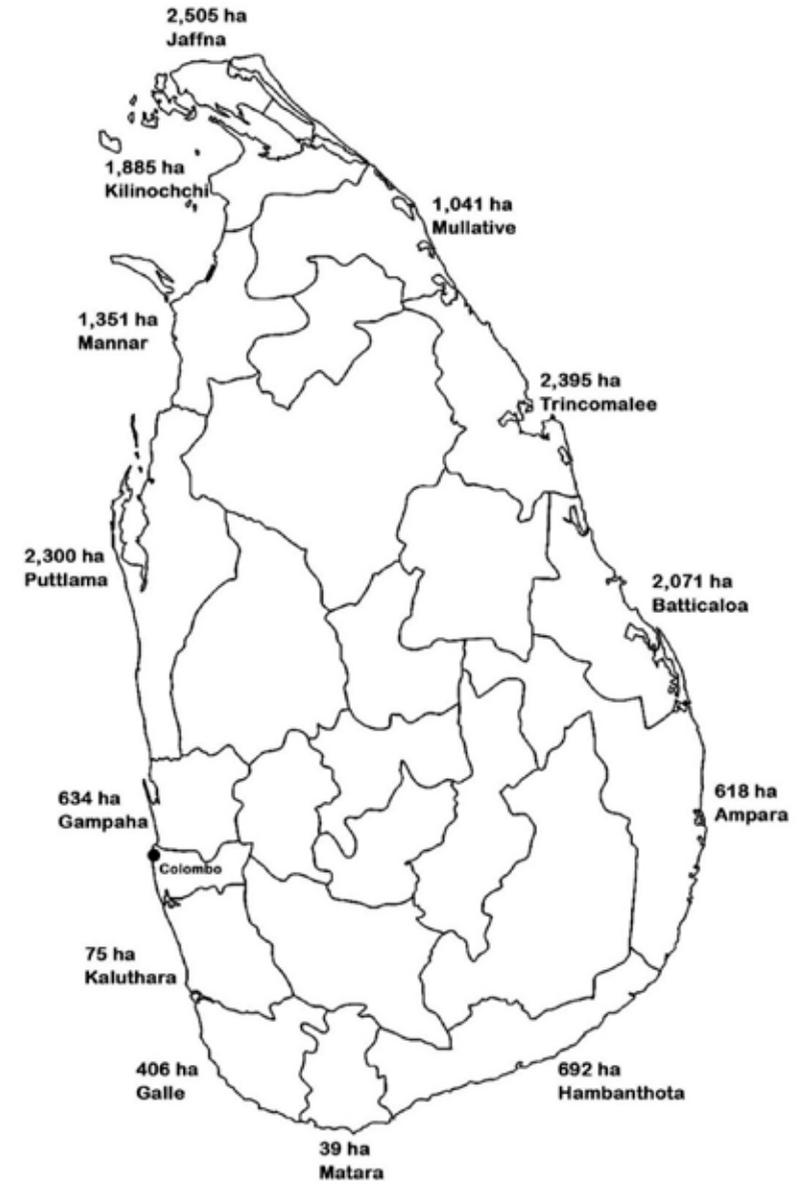
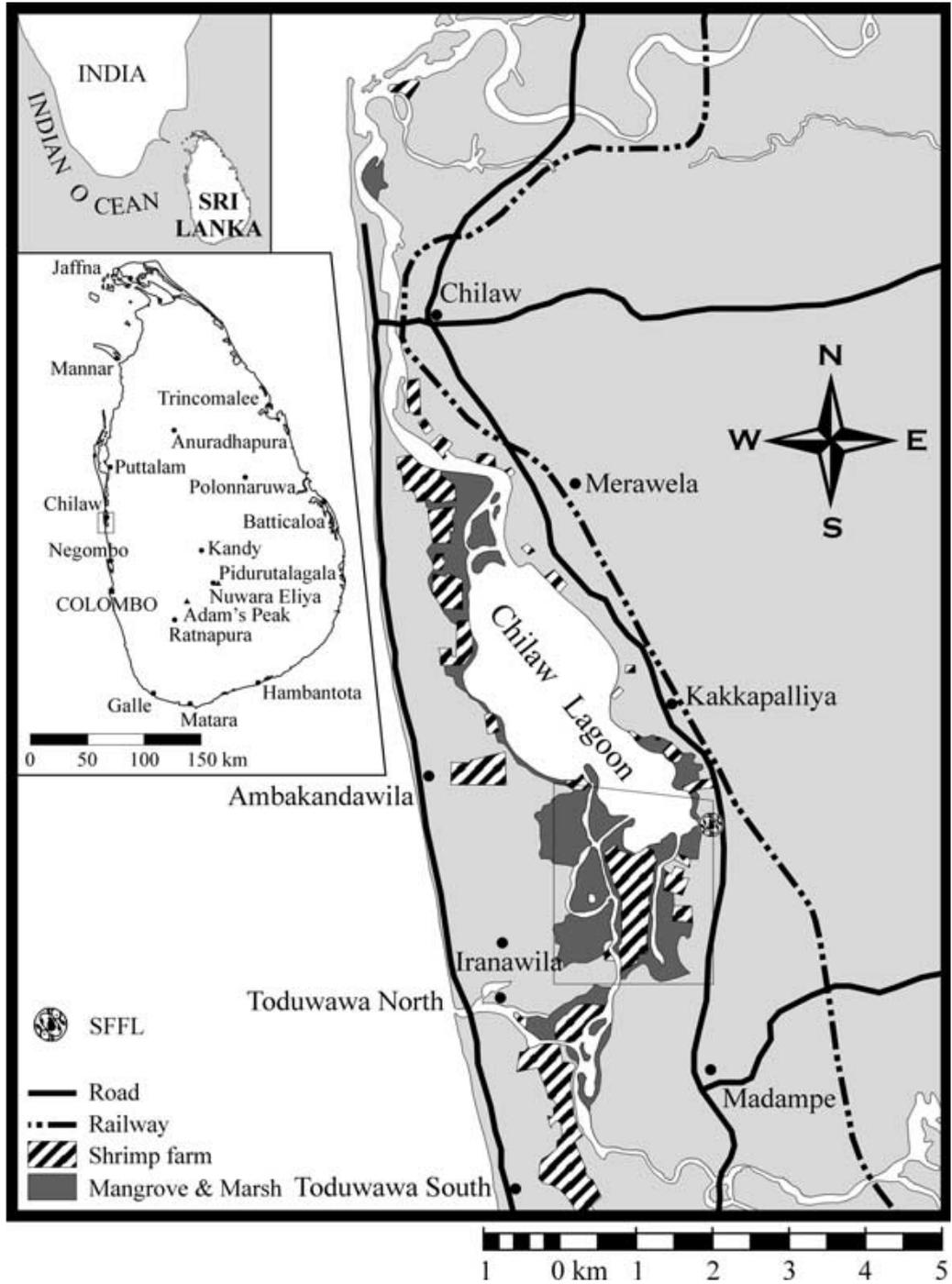
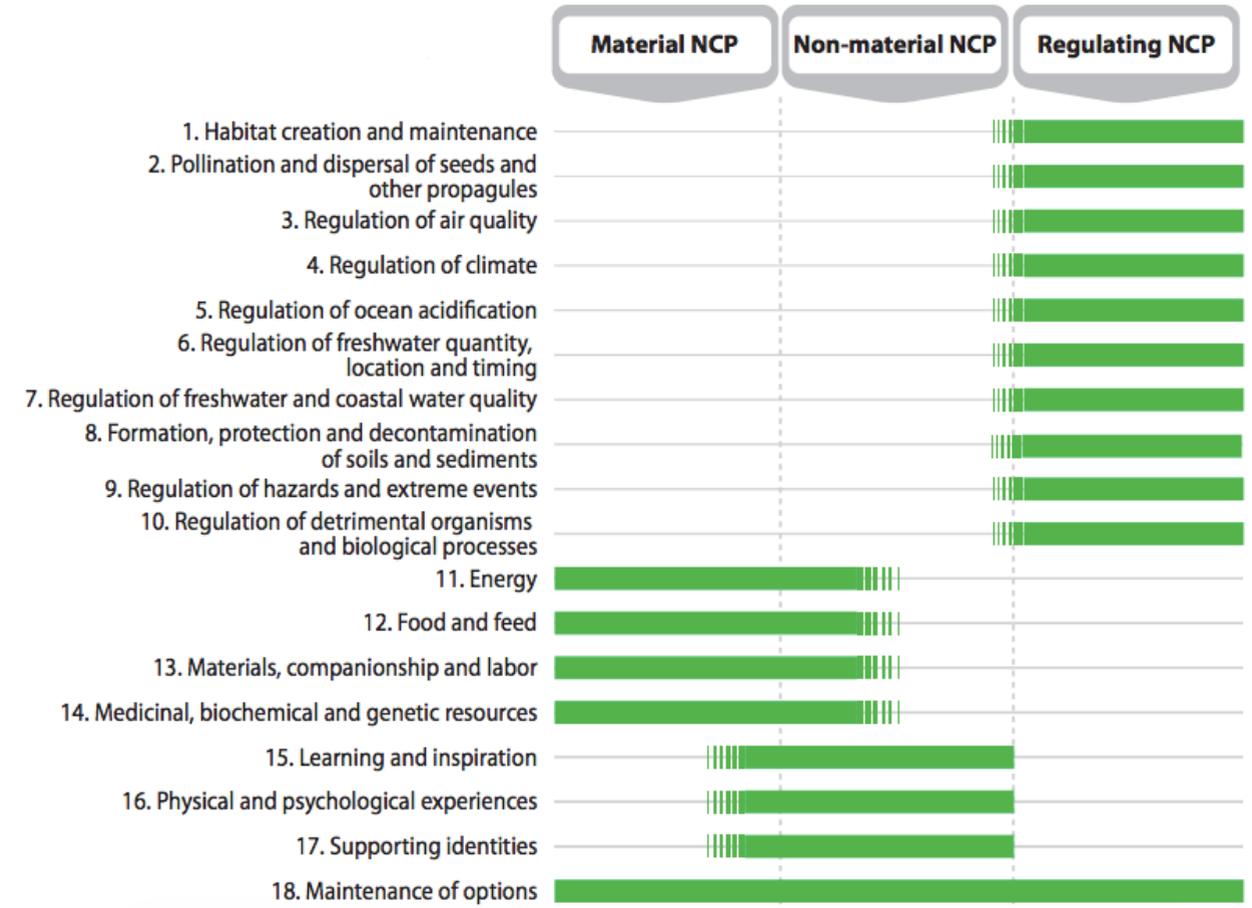
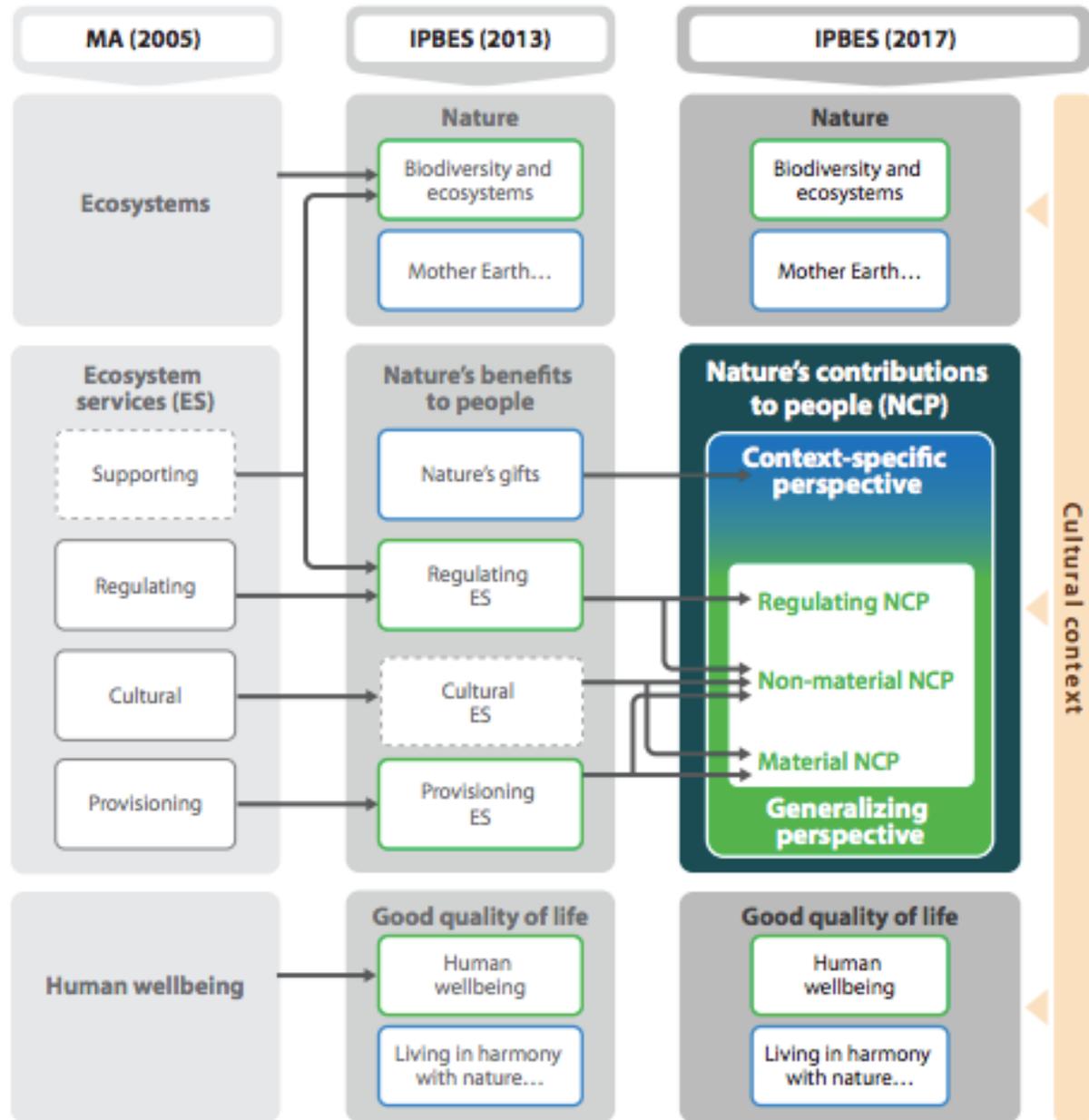


Figure 1 : Distribution and extents of mangroves in the coastal districts of Sri Lanka. (Source: Edirisinghe *et al.*, 2010)





# The Interconnectedness of People and Planet

LEARNING FROM MĀORI WORLDVIEWS

This anthology is a project of the Planetary Health Alliance ([planetaryhealthalliance.org](https://planetaryhealthalliance.org)). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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## Executive Summary

This case study addresses issues of traditional knowledge, connection to place and mental health which are also explored in chapters 9 and 18 of [Planetary Health: Protecting Nature to Protect Ourselves](#).

<sup>i</sup> As noted by Dr. Fiona Cram et al in a 2019 [report](#) on Māori health inequities, the terminology used to describe health and well-being and the act of achieving it has changed over time. *Hauora* is one term currently in use, as are *waiora*, *rapuora*, and *whakaoranga*.

### Learning Objectives

After examining this case, students should be able to:

- ① Recognize the existence of diverse worldviews and cultures, including one's cultural values, identities, and assumptions, and their effect on the understanding of others in the context of planetary health.
- ② Compare and contrast how Indigenous worldviews and traditional knowledge systems differ from dominant western thought<sup>ii</sup> concerning the relationship to the natural environment.
- ③ Describe how Indigenous worldviews and lived experiences determine the extent of the consequences of anthropogenic environmental change.
- ④ Apply intercultural principles and Indigenous knowledge appropriately to health-related actions, projects, programs, and policies.

<sup>ii</sup> Although a contentious term, for the lack of a better word, we use western thought to describe the post-colonial dominant worldviews imposed throughout many part of of the world mainly by European colonials and settlers.

Many Indigenous perspectives on health and well-being are well aligned with the emerging field of planetary health. In Aotearoa New Zealand, the Indigenous Māori population has long understood the interconnectedness between the natural environment and human health and well-being. This is reflected in Māori worldviews and their conceptualization of health and well-being: *hauora*.<sup>i</sup> *Hauora* values a number of dimensions, including the emotional, mental, social, and spiritual well-being of families. It also articulates the fluidity that exists within the Māori sense of identity: that an individual's personhood hinges not only on one's physical health, but also on the well-being and protection of their community and the natural world.

Despite this deep understanding of the integrated nature of human health and a flourishing natural environment, Māori and Indigenous people worldwide are among the groups most vulnerable to environmental change. These changes exacerbate the ongoing effects of colonialism, and the destruction of the natural world has significant implications on the physical, mental, and spiritual well-being of Māori tribes.

The New Zealand government has made some progress in recognizing and modeling Māori worldviews of health and well-being in its healthcare and natural resource policies—though many shortcomings remain. This case reiterates the importance of meaningful relationship-building and partnership in order to learn from Indigenous ways of knowing to strengthen our ability to address the unique challenges faced in the Anthropocene.

*This case study was drafted based on interviews conducted in Aotearoa New Zealand in July and August 2019. It was reviewed by Gabrielle Baker (Ngāpuhi) in September 2019.*

## A Note on Language

This case study uses the te reo Māori terms for Māori concepts. Te reo Māori, which translates to “the Māori language,” is an official language of New Zealand. Around 55% of Māori adults have some ability to speak te reo Māori,<sup>1</sup> and the language is increasingly used in official government documents and in the media.

While it’s difficult to directly translate concepts to definitions, this case study draws from the explanations received by the case study author and confirmed by the case study reviewer. Te reo Māori proficiency is one of the measures used to gauge a person’s cultural well-being.<sup>2</sup> The te reo Māori name for New Zealand, Aotearoa, is also used in this case. Both describe the island country. Finally, this case indicates *iwi* (tribe) affiliations. *Iwi* identities are listed in parentheses after the first mention of a person’s name.

We encourage readers to visit the [Māori Dictionary website](#), where you can find definitions and audio pronunciations (linked below). The New Zealand Ministry of Education has also developed a helpful [pronunciation guide](#).

## Glossary

**Aotearoa** ([pronunciation](#)) - the te reo name for New Zealand.

**Hapū** ([pronunciation](#)) - a clan or subtribe that is part of a larger *iwi* and made up of a number of *whānau* groups.

**Hauora** ([pronunciation](#)) - a Māori term for health or vigor. Typically includes four pillars: physical well-being, mental and emotional well-being (self confidence), social well-being (self esteem), spiritual well-being (personal beliefs).

**Iwi** ([pronunciation](#)) - people or nation. Iwi are the largest partition of Māori society and often compose several *hapū* which then include *whānau*.

**Kaitiakitanga** ([pronunciation](#)) - the Māori concept of guardianship or stewardship.

**Karakia** ([pronunciation](#)) - a prayer or blessing.

**Kaumātua** ([pronunciation](#)) - a respectful term used for older folks.

**Kaupapa** ([pronunciation](#)) - a theme or topic for discussion.

**Mana** ([pronunciation](#)) - a sense of authority, control, or power; a sense of “awesome.”

**Māori** ([pronunciation](#)) - Indigenous person of Aotearoa. The original inhabitants of New Zealand.

**Maramataka** ([pronunciation](#)) - Māori calendar based on the cycles of the moon.

**Marae** ([pronunciation](#)) - the courtyard of a Māori meeting house, often used for ceremonies and meetings; a significant place in Māori culture.

**Mātauranga** ([pronunciation](#)) - the body of traditional and contemporary knowledge about the world—both physical and spiritual—held by Māori. It also involves ways of knowing.

**Mirimiri** ([pronunciation](#)) - a massage; considered a *rongoā* treatment.

**Rongoā** ([pronunciation](#)) - any medicine, drug, or treatment; not always physical in nature.

**Taonga** ([pronunciation](#)) - a treasured item (physical or non-physical).

**Te Tiriti o Waitangi** (*tay tear-ee-tea oh wah-tan-gi*) - the treaty signed in 1840 by North Island *iwi* chiefs and the British Crown.

**Tikanga** ([pronunciation](#)) - a procedure or custom.

**Utu** ([pronunciation](#)) - the Māori concept of reciprocity.

**Whakapapa** ([pronunciation](#)) - to place in layers, to establish genealogy and ancestry not only with other human beings but among other species, too.

**Whakawhanaungatanga** ([pronunciation](#)) - the process of establishing relationships and relating to others.

**Whānau** ([pronunciation](#)) - extended family including multiple generations; the smallest partition of Māori society.

**Whenua** ([pronunciation](#)) - land, placenta, afterbirth.

## Introduction

<sup>iii</sup> A marae is a traditional gathering place and a sacred focal point of Māori society.

Standing next to a strip of overturned soil, Hone Moetara (Ngāpuhi) envisions the future. The strip of land is a couple hundred meters long, bordered on one side by the Paparoa Marae<sup>iii</sup> and a train track on the other. Every so often the peace of the rainy drizzle is disrupted by the rattle of a timber-filled train heading to the nearby port, a fitting illustration of the juxtaposition between Māori tradition and contemporary society.

This is the place where Moetara plans to construct a garden filled with plants and trees native to Aotearoa. He intends to use the land as a teaching tool, ensuring that *rongoā rākau* practices—the creation of remedies, medications, and tonics derived from nature—can continue and be passed on to subsequent generations. This land is in Te Puna, a rural community near the eastern coast of the country’s North Island.

Today, only a few native plants fringe the soon-to-be garden. Moetara points them out. There’s the tall *tī kōuka* (cabbage tree) whose palm can serve as a food source. The bark of the *houhere* plant is used to make hats and handkerchiefs, and is effective at coaxing phlegm from the lungs. Then there’s the heart-shaped leaves of the *kawakawa* plant, a multipurpose healer commonly used as a blood thinner, diuretic, and to open the respiratory system. Externally, it’s turned into a salve that can be applied to abscesses and other wounds.

↘ [Video: Hone Moetara introduces the kawakawa plant.](#)

For Moetara, a *rongoā* practitioner at the nearby Pirirakau Hauora health center, these plants are nature’s medicine cabinet. “You have to stand back and look at the horizon of what’s growing where,” describes Moetara of the plants and their healing properties. “If the land has been scarred, the plants that come up first are the ones you use when you scar your body. The plants growing in wet areas are the plants you use for fungal infections and athlete’s foot. It’s relating the land back to the body and the plants that are growing in those areas. We forget that. We just go to the doctor and they give us a tube of stuff.” Moetara’s *Rongoā* Planting Project is meant to recognize the many opportunities that nature presents for learning, whether it be lessons related to mental health, human biology, spirituality, ecology, and more.

A range of practices constitute *rongoā*, including the *rongoā* rākau plant remedies and *mirimiri* (massage). Sometimes these practices treat a physical malady, such as the symptoms Moetara mentioned earlier. But he and others are quick to add that the practice of *rongoā* is more than a jumble of leaves boiled in water. *Rongoā* practices are about treating a whole person, identifying the emotional, mental, community, or spiritual problems that may be manifesting in the form of physical illness.<sup>iv</sup>

<sup>iv</sup> In western societies, these practices are sometimes referred to as integrative or holistic.



This is the land that will soon become the *rongoā* rākau garden. A teaching tool for the community, Moetara says the *Rongoā* Planting Project will also help improve health, social, and environmental outcomes for the Pirirakau Hauora health center, the Pirirakau hapu (sub-tribe), and the wider community.

“There is intention in *rongoā*, it’s the love behind it,” adds Moetara. “It’s reading the person and asking how this is going to suit what is going on in them.” For example, is it best to pick from a young plant for an elderly person? Should the leaves of a female tree be harvested for a male patient? When it comes time to harvest, *karakia* is essential. Often translated to mean prayer, Moetara says *karakia* is more about mindfulness and the setting of intention—engaging with the bush before you step into it. “It’s about paying respect to Mother Earth by saying thanks before you cut anything down,” he explains. *Rongoā* can also be conversation, laughter, time spent in nature, bringing family members together—anything that makes a person feel well.

The healing properties of community and nature are two dimensions underpinning the way in which Māori and Indigenous cultures worldwide view health and well-being. Contemporary Western culture commonly views people and planet as separate

v Where in history does western thought emerge? At which points in the last 400 hundred years was this idea of people and planet being separate strengthened?

pillars, with one's sense of identity firmly pinned to their individual actions.<sup>v</sup> Māori and Indigenous cultures worldwide, however, take a broader view. For Māori, a sense of identity extends beyond the individual to include the community and their ancestral land—a recognition of the essential fluidity between human health, well-being, and protection of the natural world. These dimensions cannot exist in isolation.

This interconnectedness is an illustration of *utu*, the principle of reciprocity—a recognition that people need to value the resources the land provides. Said one stakeholder in a report on *rongoā* Māori: “There is reciprocity between man and the environment. When the language of the country is sung or chanted, the plant is revived, the land replenished. The heart, head, spirit, there is no separation, all is related, whole.”<sup>3vi</sup>

vi What are other cultures that are similar to the Māori, at least broadly, in their worldviews?

## Kaupapa Māori: The Aspirations and Philosophy of Community

vii This would be the equivalent of a foreign nation colonizing the whole American continent today and classifying us under one same culture.

One in seven people living in New Zealand identify as Māori—16.5% of the country's population of 4.7 million.<sup>4</sup> The country's Indigenous people have been broadly categorized as “Māori” since European settlers first came to New Zealand, and this single ethnic grouping continues today.<sup>vii</sup> However, many criticize this broad, all-encompassing category of Māori. “Māori is non-existent,” says researcher Apanui Skipper (Ngāti Tamaterā, Ngāti Raukawa). “Our knowledge would always be held by different *iwi*. People identify by *iwi*, not as Māori.”

Apanui Skipper in what is today known as Thames. Behind him is the sacred mountain for his *iwi*.



*iwi* is the name for the largest social unit of Māori society, and they are the independent nations or tribes that make up New Zealand. According to most recent census data, 85% of Māori identify as belonging to one of 10 large tribes, though it's estimated that there are more than 70 across New Zealand.<sup>5</sup> A single *iwi* is made up of several *hapū*—clans or sub-tribes within the larger *iwi*. *Whānau* is the smallest entity in Māori society. Not a nuclear family of two parents and their children, *whānau* are extended, multigenerational family groups.<sup>viii</sup>

Viewing *whānau* as the smallest partition of society is significant. It speaks to the value of decision making that places collective needs over individual wants. “[This generational element of relationships] causes us to always think about the future. Our children and grandchildren will reap the benefits of what we invest today in terms of energy, well-being, and prosperity,” explains Reweti Te Mete (Ngāi Te Rangī), a project manager with Ngā Mataapuna Oranga, a Māori primary health organization. Considering the broader implications of one's actions governs the relationships Māori have with each other and with the environment.

The multigenerational, collective worldviews held by Māori and other Indigenous groups worldwide are a key difference between Indigenous and contemporary Western cultures. Another difference is the way in which Indigenous peoples perceive the Earth and are affected by environmental loss.<sup>ix</sup>

viii How are “social units” organized in your culture? How long has this been this way? What elements (celebrations, holidays, beliefs, etc.) of your culture strengthen these social units?

ix Before moving forward, what do you think are some of these key differences? What are some similarities? Has this changed recently?



The Kauri tree is symbolic in Māori culture. It represents Tāne Mahuta (pictured), the Māori God of the Forest. Kauri dieback disease, caused by a mold, has been killing Kauri trees across New Zealand for the past half century. Photo via Flickr user itravelNZ.

“Environmental change means a lot for Indigenous cultures because we’re the ones who feel the impact first as the caretakers of the environment, even when the land is taken away from us [i.e. through colonization],” says Hone Moetara, the *rongoā* practitioner. “We’re the ones reading the weather patterns, what the oceans are telling us.” Moetara references the dying kauri trees in New Zealand, explaining it’s a sign that Mother Nature isn’t happy. “When you talk to other Indigenous cultures their signs are the same. The Earth is being used as a commodity and it’s a question of how do we go forward as Indigenous people to save our planet?”

### Māori Views of Health and Well-being

Each Indigenous culture has its own creation story and set of behaviors governing the interactions between people and the natural world. Many, however, share similar guiding values.

One of those values is the recognition that an individual’s health, well-being, and sense of identity depends on blurred dimensions of physical, mental, social, and spiritual well-being. For Māori, protection and care for the land of one’s *iwi* is central to spiritual well-being. When combined, each of these dimensions leads to an outlook on health that goes beyond an assessment of a person’s physical state. This is consistent with the way in which the World Health Organization (WHO) defines health and well-being. “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity,” declares the preamble of the agency’s constitution.<sup>6x</sup>

For Māori, *hauora* is one term to describe this outlook on health and well-being. *Hauora* literally translates to “the breath of life.” It’s one of the many teachings of *Mātauranga Māori*, the traditional and contemporary wisdom that has been developed and refined over the centuries in which Māori have lived in Aotearoa. It encompasses the empirical knowledge that has been gleaned from observing and knowing a natural environment, and a deep sense of belonging within it.

<sup>x</sup> This definition was created in the post-WWII era. If you were to rewrite it today, would you define it differently? How?



Through the lens of *hauora*, a number of dimensions must be balanced in order for a person and their family to be considered well and strong.<sup>7</sup> These dimensions are articulated through the many models of health and well-being that exist in New Zealand. Two of the most widely recognized are Te Whare Tapa Whā and Te Pae Mahutonga. These models have been articulated by Sir Mason Durie (Rangitāne, Ngāti Kauwhata, Ngāti Raukawa), one of the country’s most respected Māori health experts. A third model, Te *Wheke*, was conceptualized by revered *tohuna tipua* and keeper of wisdom, Dr. Rose Pere (Ngāi Tūhoe, Ngāti Ruapani, Ngāti Kahungunu). The three models share common values, and see an individual as part of a multigenerational interconnected system that includes the community and the natural world.

*The underside of a silver fern, one of New Zealand’s most emblematic native plant species. Silver ferns hold much significance in Māori culture, and some iwi (tribes) would use them as trail markers, flipping the silver side upwards in order to note the correct path through the dark. Photo via Flickr user @cogdog.*



## Two Additional Models of Māori Health and Well-being

Two other models of Māori health and well-being are commonly referenced in addition to Te Pae Mahutonga: Te Whare Tapa Whā and Te Wheke. Both are explored below and are helpful in providing context around how Māori communities conceptualize *hauora*.

### Te Whare Tapa Whā

In 1984, the Māori Women's Welfare League released a ground-breaking report, "Rapuora: Health and Māori Women." Rapuora discussed aspects of Māori health and well-being as involving interrelated physical, mental, spiritual and family (*whānau*) elements.<sup>8</sup> From there, Sir Mason Durie conceptualized the model of health called Te Whare Tapa Whā. It takes the shape of a *whare* (house). Forming the walls of the house are *taha tinana*, *taha hinengaro*, *taha whānau*, and *tapa wairua*, representing 1) physical, 2) emotional and mental, 3) social, and 4) spiritual health.

Social health (*whānau*) acknowledges the importance of the collective health of an extended family, and includes the connection people have with their ancestors and future generations. Emotional and mental health (*hinengaro*) is the ability for people to think, to communicate, and to have the safety and security of knowing they belong in the world. The dimension of spiritual health (*wairua*) is the one most commonly excluded in mainstream models of care.<sup>9</sup> Spiritual balance involves the well-being of a person's life force, referred to as their *mauri*, and a sense of belonging related to "who and what we are, where we have come from and where we are going."<sup>10</sup>

### Te Wheke

*Wheke* means octopus in te reo Māori, and this model draws its inspiration from the animal's eight tentacles. In Te Wheke, the head of the octopus represents *iwi*, *hapū*, or *whānau*, the three levels of Māori society. The tentacles of the octopus are:

- Wairuatanga – spirituality;
- Hinengaro – the mind;
- Taha tinana – physical well-being;
- Whanaungatanga - extended family;
- Mauri – life force in people and objects;
- Mana ake – unique identity of individuals and family;
- Hā a koro ma, a kui ma – breath of life from forbearers;
- Whatumanawa – the open and healthy expression of emotion.<sup>11</sup>

"The model proposes that sustenance is required for each tentacle/dimension if the organism is to attain *waiora* or total well-being," writes Dr. Catherine Love (Te Atiawa, Taranaki, Ngāti Ruanui, Nga Ruahinerangi) in a paper describing Te Wheke.<sup>12</sup> "The octopus can survive, but not function optimally, without the use of a tentacle."

Te Pae Mahutonga, Durie's health promotion model, is inspired by the te reo Māori name for the Southern Cross constellation. The constellation holds great significance in Māori culture. Just as the Southern Cross has four central stars, the Te Pae Mahutonga model outlines the four dimensions needed for people to have control over their own health and well-being. Durie expands on these concepts in a 1999 paper advocating for an Indigenous model of health promotion.<sup>13</sup>

The first dimension, *mauriora*, is about attaining a sense of cultural identity. This includes the security and means to access both physical and non-physical worlds, including traditional land, language, and cultural practices.

Next, *waiora* is the harmonizing of people with their natural world and the ability to protect it. "A central element of indigeneity is the close association between people and the natural environment—land, waterways, the air, beaches, harbors and the sea, native flora and fauna. Good health is compromised where there is atmospheric pollution, contaminated water supplies, smog, random mining activities, or commercial developments that exploit the land they cover," wrote Durie.<sup>14</sup> He offers further comments on *waiora* in another paper<sup>15</sup>: "It is not simply a call for a return to nature, but an attempt to strike balance between development and environmental protection and recognition of the fact that the human condition is intimately connected to the wider domains of Rangi and Papa."<sup>x1</sup>

*Toiora* is the third foundation of Te Pae Mahutonga, and is the ability for Māori to lead healthy lifestyles. This means having the agency to overcome some of the trappings of poverty and the built environments in which Māori often live: "the number of alcohol outlets per head of population, the number of fast food outlets per head of population, the traffic density on the road that goes past the school," explained Durie at the launch of He Korowai Oranga, the Māori Health Strategy.<sup>16</sup> "Whether we're talking about the natural environment or manmade environments, we should remember that they are hugely important determinants of good health and a flourishing *mauri*."<sup>xii</sup>

Finally, *te oranga* involves a person's participation in society. This includes the ability for Māori to not only access the goods and services provided by society, but also participate in the shaping of them. Durie notes that *te oranga* is generally not met, and that



Sir Mason Durie. Photo via Flickr user Simon Fraser University.

<sup>x1</sup> In western thought, what concept resembles *waiora*?

In the Māori creation story, Rangi is the sky, and father of all things. Papa is the Earth, and the mother of all things.

<sup>xii</sup> What does the idea of *mauri* resemble?

Mauri is loosely described as someone's life force or sense of 'awesomeness'

“Disparities between Indigenous and non-Indigenous populations are well documented and confirm gaps on almost every social indicator...” including health.<sup>17</sup>

Though Te Pae Mahutonga is an oft referred model of health and well-being, health leaders say there are limitations in thinking a single model can apply to all Māori. “Well-being is culture and practice. It’s being allowed to use our cultural models as we see fit, not other people’s cultural models,” explains Cindy Mokomoko (Te Rarawa, Te Arawa), Managing Director of Te Puna *Hauora* Ki Uta Ki Tai, a mental health and addiction services organization. “There are quite a few Māori models that have been written, but we don’t even want those imposed on us. We have our own experiences and our own connections to our land and environment.”

*Hauora* and *Mātauranga Māori* are highly place-based. Learning from these models requires an expanded understanding of Māori worldviews and values, and an exploration of the relationships people have with one another and the natural world.

A person’s *iwi* (tribal affiliation) is more than a casual classification of where they’re from—that place is central to Māori identity. This is apparent from the moment of introduction. In addition to identifying their tribe, people will also commonly share the land, river, and mountain from which their tribe draws its spiritual power or *mana*. Māori are *tangata whenua*, which means “people of the land.” The term *whenua* also means placenta, illustrating just how deeply the land is seen as a motherly source of life and part of one’s identity.<sup>18</sup>

The process of introducing oneself by place is called *whakawhanaungatanga*. The concept broadly translates to mean how you relate to someone. *Whakawhanaungatanga* is used to establish trust and belonging in traditional and contemporary Māori society. In the past, it was a process to prevent sabotage between warring tribes. Today, it’s a way of sharing how your values have been shaped by the place you’re from. People can see if those values are shared with others in the room, creating the grounds for relationship-building. *Whakawhanaungatanga* is also a way to express *whakapapa*—the genealogical connection people have with their ancestors and ancestral land, and a way to communicate

knowledge.<sup>19</sup> Establishing *whakapapa* with someone new is a core value of Māori worldviews.



#### Māori Environmental Indicators

The sharing of *Mātauranga Māori* means tribes across the country have developed centuries of observation-based, empirical data to read the patterns of their local flora, fauna, and weather. Apanui Skipper is a researcher who has looked at how this traditional ecological knowledge can be used to predict natural hazards and their resulting health outcomes.

According to Skipper’s research, environmental indicators come in the form of *tohu*, signs in nature. An example of *tohu* is offered by the Pohutukawa, one of New Zealand’s most iconic trees. Around December, the Pohutukawa trees blossom with bright red bursts. “If it’s flowering from the bottom up, that’s a strong signal that it will be a dry summer,” explains Skipper. “In the middle of the year we also have the rising of Matariki (The Pleiades). The stars represent certain parts of our knowledge and we look to see if it will be a wet or dry summer. If [Matariki] is bright and clear and not hazy, we know it will be dry. This is one of our strongest signs.”

Skipper and his colleagues have also documented how *tohu* have been used to predict hazardous weather. For example, Ngāti Pare, an *iwi* in the northeast of the North Island say that if *kākā* parrots begin twisting and squawking above the forest then you know a storm is on its way. For the Ngāti Ruanui *iwi* in the southwest of the North Island, “the continuing cry of the *matuku* [bird] as it moves around at night” means floods are likely.<sup>20</sup> This traditional ecological knowledge offers an alternative source of weather information. The regular reading of these signs would inform how frugal people were with their water or food, when to prepare for a storm, or take other actions to adapt to the changing environment.

The Maramataka is another traditional tool Māori have to read the environment. Based on the lunar cycle and the stars, this Māori calendar can be used to make weather predictions on a monthly, daily, or seasonal basis. It can also inform when to best plant or harvest certain crops or animals—choices that have implications on human health.

Dr. Isaac Warbrick is an exercise physiologist who is looking at contemporary applications of the Maramataka as it relates to fitness and overall well-being for Māori families. “There were specific days around the full moon that were better for high energy activities, and there were certain days that were low energy where people would fix the fishing nets or talk in a lower voice,” explains Warbrick of past applications of the Maramataka. The Maramataka could be used equally so today, allowing people to be more in sync with the changes to their surrounding environment. “I think it’s a better way of managing our time and energies rather than this whole ‘wake up on Monday, work 9 to 5, and expect to do the same thing on Tuesday, Wednesday, and crash on the weekend,’” Warbrick says. “I don’t think [that schedule] aligns with any kind of natural environmental rhythm. It sounds kind of out there, but any scientist knows that animals and plants respond to different seasons or stages of the moon cycle. We’re the only living organism that tries to change our lifestyle while ignoring what’s going on in the environment.”

## Worldviews Grounded in Place

There are examples of groups already applying the Maramataka to their activities. Warbrick notes a Māori group that trains for the Iron Man competition in the ocean during Tangaroa days [those associated with ocean-based activities], and runs and cycles in the forest during Tāne days [those associated with forest-based activities]. They also schedule race events on high energy days and recovery sessions on those that are low energy. In other instances, he gives the example of workplaces that schedule high intensity meetings on high energy days and offers employees a shortened day on low energy ones.

Though the Maramataka shifts based on place and year, Warbrick says the most important takeaway is that people reconnect with their ability to observe and to adapt: “I would think that a lot of our mental health and stress related issues are a result of us not aligning with these natural rhythms and being able to observe what’s going on in our body, family, and environment.”

Seeing *whakapapa* in practice is best illustrated by a few stories. In his office in the science department of the Auckland University of Technology, Dr. John Perrott (Te Arawa, Ngāti Pakeha), an expert in *Mātauranga Māori*, pulls a book off his shelf. Perrott is joined by Pete Edwards (Te Rarawa, Te Aupouri, Ngā Puhī), one of his PhD students. “Moa: The Life and Death of New Zealand’s Legendary Bird,” the cover reads. The Moa was a giant flightless bird endemic to New Zealand, one that went extinct with the first arrival of Māori to Aotearoa.<sup>21</sup> The extinction of the Moa is still referenced as a reason why Māori cannot be responsible conservationists, but Perrott has an explanation for the behavior of his ancestors.



Dr. John Perrott and Pete Edwards at Auckland University of Technology.

“Moa was eradicated because Māori had no *whakapapa* to it. They didn’t see them as being relatives so they openly slaughtered them. Whakapapa is a restraining influence,” Perrott says. The connection established through *whakapapa* leads to *tikanga*, the custom and practice that governs the way you act around something. Because there was no *whakapapa*, there was no such protocol. Perrott says extinction of the Moa evolved Māori views of *whakapapa*, and continues to influence Māori-led environmental conservation to this day.

Another story illustrating the importance of *whakapapa*—and the role it can play in having natural resources legally protected—is that of the Whanganui River. There’s a well-known Māori proverb: *Ko au te awa. Ko te awa ko au.* “The river is me, I am the river.”<sup>22</sup> This proverb is used by the tribe whose traditional land lies along the Whanganui River on Aotearoa’s North Island. It speaks to the connection Māori feel to that river, and how they consider it as part of their identity. Local tribes *whakapapa* to that river and consider it one of their own ancestors, just as someone would their human descendants.



The Whanganui River (Photo via Wikimedia Commons).

*The Pohutukawa tree commonly features into Māori environmental indicators or tohu (signs).*



Rivers are of particular significance to Māori culture. “Before people die, we ask someone to go back to the place where that person is from to get water from the stream so they can drink it,” says Apanui Skipper. “It might sound simple but it’s a pretty powerful illustration of the connection we feel to that land.”

In 2017, the Whanganui River became the first river worldwide to gain legal personhood,<sup>xiii</sup> meaning it now has the same human rights as a person.<sup>23</sup> The legislation was passed by the New Zealand Parliament and represented a legal settlement to a series of historical claims that were first filed in the 1870s.<sup>24</sup> This isn’t the first or last instance of natural resources in New Zealand gaining personhood.<sup>25</sup> In 2014, Te Urewera, a large forested area, also gained environmental personhood. And six months after the Whanganui River gained legal rights, the same status was recognized for Mount Taranaki, a sacred mountain for several *iwi*.<sup>26</sup> Environmental personhood means that if the forest, river, or mountain is harmed, there are legal repercussions just as there would be if the act were committed against a human.<sup>xiv</sup>

<sup>xiii</sup> The notion of giving non-human entities intrinsic rights or “personhood” is explored in Chapter 17 on ethics of \ Planetary Health: Protecting Nature to Protect Ourselves.

<sup>xiv</sup> What other countries has provided personhood to environmental elements? What implications does this have for conservationists around the world?



#### Environmental Personhood - Where and to What Effect?

New Zealand isn’t the only place where natural landscapes have been recognized as “persona”. Shortly after the Whanganui River was granted personhood, the same legal rights were bestowed on the Ganges river in India in an attempt to curb pollution.<sup>27</sup> The Ganges is a sacred body of water for more than a billion people. A Lake Erie Bill of Rights was established after a vote by residents in Toledo, Ohio in 2019.<sup>28</sup> In July 2019, Bangladesh took environmental personhood further even still, declaring that all rivers in the country had legal rights.<sup>29</sup>

But what exactly is the process for people to, as guardians, claim legal rights on behalf of a landscape? And are those rights legally binding? Colombia presents a promising case. The South American country has recognized a number of rivers and its portion of the Amazon rainforest ecosystem as legal persons. The recognitions have led to the stoppage of mining activity along various rivers. And Ecuador became the first country to successfully uphold the legal rights of nature when a provincial government ruled that the Vilcabamba River was under threat by a road widening project. The ruling meant that areas of the river had to be rehabilitated and remediated in order to protect the environment for this generation and those of the future.<sup>30</sup>

The concept of environmental personhood is nascent, and it will take further court rulings to prove whether the granting of legal rights to landscapes goes beyond the symbolic.

One final illustration of *whakapapa* and traditional ecological knowledge relates to the sprightly *hihi* (stitchbird).<sup>xv</sup> The bird is named after the first rays of sun—*hihi*. In Māori culture, these sun rays are healing. “In this country our birds do a dawn chorus, and the *hihi* bird is one of them. They come from the darkness of the forest, go to the canopy, expose themselves to the sun, and ruffle their feathers,” shares John Perrott. “Light comes through the gaps in the canopy and you see flashes of yellow light: the *hihi* flying through the beams and capturing the healing rays of the sun. During the day it flies through the forest spreading its medicine. Healers learned from these birds, created a *whakapapa* to that, and then started using them as a way of learning about the forest. Because they were the most sensitive to the conditions of the forest, *hihi* were the first to go when it was disturbed. Māori learned very early that *hihi* were indicators of forest health and as a result, human health.”



<sup>xv</sup> In this example, environmental indicators are defined as generational knowledge that has been developed through observations of the natural environment and how its changes affect ecosystem and human health. For Māori *iwi*, many of these measures are connected to birds. Pre-human contact, birds represented nearly all of the fauna found in New Zealand. They had few predators—only bats and a few other aerial birds. Due to this lack of land-based predators, many birds evolved to be flightless. The introduction of invasive species like rats had a large impact on ground-dwelling birds. As a result, many native birds have become locally extinct, including the *hihi* which is today found only in a few island bird reserves.

*The yellow plumage of a male hihi (stitchbird) at Tiritiri Matangi, one of New Zealand’s bird reserves. The island reserve is one of the only places in the country where you can find the hihi. It was driven to local extinction on the mainland due to introduced species like rats. Today, the vulnerable species has been introduced to a few islands off the mainland, though the population remains unstable.*

While *whakapapa* may sound abstract or spiritual, Perrott explains this knowledge has been developed from empirical observations passed from one generation to the next.

### The Environmental and Health Impact of Belonging

“You’ve got to have *whakapapa* because without that you don’t have belonging and you lose your sense of something bigger,” contextualizes Pete Edwards, Perrott’s PhD student. “You then [take the environment] for granted and treat it as a commodity.”

Edwards is talking about the connection and care people must have with the land around them. He studies *kaitiakitanga*, the Māori concept of guardianship and protection of the environment and other *taonga* (treasures). He and Perrott are researching how customary *tikanga* (practice/custom) relating to the harvest of native birds could inform mainstream conservation and wildlife management policies. Not only does the research project aim to stem the decline of biodiversity, but it also aims to slow the loss of *Mātauranga* due to the passing of *kaumātua* (elders) who held this knowledge.

The late Reverend Maori Marsden, a self-described “writer, healer, minister, and philosopher” of Māori worldviews, wrote extensively about the importance of environmental belonging among Indigenous cultures. In his book, “The Woven Universe,” Marsden references a quote from Dr. Ranginui Walker, a Māori-Lebanese academic. It compares Indigenous worldviews to that of what he calls “metropolitan culture”—the dominating worldview of the west:

“[Indigenous cultures] think of themselves as holding a special relationship to Mother Earth and her resources; as an integral part of the natural order; recipients of her bounty rather than controllers and exploiters of their environment. Therefore Mother Earth is to be treated with reverence, love and responsibility rather than abuse and misuse.”

“How you perceive nature affects how you interact with it, and how you interact with it impacts your health,” says John Perrott. “Whakapapa is the starting point to personification, and this concept of seeing things [in nature] as familiar.”

Whakapapa also has a direct influence on mental health. “My background is the ocean. I studied marine science, but personally I’ve grown up next to the sea. The sea is me and I am the sea,” volunteers Pete Edwards as an example of this connection. “When my *mauri* (life force or sense of ‘awesomeness’) is not feeling the best, I jump in the sea with Tangaroa [the Māori God of the Sea]

and I know his children are there. They’re my relations, and that makes me feel better.”

### Environmental Change and Mental Health<sup>xvi</sup>

<sup>xvi</sup> For further discussion of this term and other associated terms and more general discussion of the mental health burdens associated with environmental change, see Chapter 9 on Mental Health in [Planetary Health: Protecting Nature to Protect Ourselves](#)

<sup>xvii</sup> Although *whakapapa* seems like a foreign concept, we all feel deep connections with our natural and built environment whether we realize it or not. What is a place you would feel specially concerned about losing? Think of why you chose this place, and what cultural elements define this importance.

When one’s mental health and sense of identity hinge so heavily on connecting with familiar lands and waters, what happens when those environments change or are lost? This is the question being asked today by scientists and clinicians alike—and is the unfortunate reality facing Māori and many Indigenous communities.

No culture, community, or country is immune to the impacts of environmental change—but these challenges are magnified for certain groups. Due to the *whakapapa* Māori and other Indigenous peoples have with their land, they are particularly affected by disruptions to those places. Worldwide, Māori and other Indigenous groups are some of the most vulnerable to the effects of climate change.<sup>31</sup> Those vulnerabilities can affect people’s physical health, but also their mental health and sense of identity.<sup>xvii</sup>

“Climate change is a threat multiplier [for Indigenous communities],” says Dr. Rhys Jones (Ngāti Kahungunu), a public health physician and co-convenor of OraTaiao, the New Zealand Climate and Health Council. “Māori tend to be at higher risk of any health impact as a result of social and economic deprivation and marginalization. So as a pretty general statement, anything that has an impact on health will tend to disproportionately impact Māori communities.”

Jones and his co-authors articulate the effects of climate change on physical and mental well-being in a 2014 paper. Drought, extreme weather conditions, climate change-related migration, and loss of culturally significant sites will compound already higher-than-average mental health rates and suicidal behavior by Māori.<sup>32</sup> Additionally, trauma from extreme weather events can be particularly impactful for remote and rural Māori communities. Finally, food and water contamination will make it more challenging for *iwi* tribes to access, consume, and share culturally-relevant foods. This list of negative implications is not exhaustive.



## How Climate Change Mitigation Strategies Can Deepen Health Disparities

Mitigation efforts meant to lessen the effects of climate change can exacerbate health disparities among Māori and Indigenous communities.<sup>33</sup> “If our sole focus is to reduce greenhouse gas emissions then maybe putting wind turbines wherever makes sense, even if it’s on traditional land,” offers Dr. Rhys Jones as one example of a decision that could harm people’s spiritual health.

Another example was the introduction of a regional fuel tax in Auckland, New Zealand’s largest city, with revenues intended to mitigate climate change by improving public transit. “The more progressive people were quite keen on the idea but many warned of the regressive impacts,” counters Jones. “This particularly applies to Māori and Pacific communities where people don’t live in areas that are well served by public transit, or do shift work when transit services aren’t running. They’re more car dependent out of necessity.” As a result, the fuel tax could further stress the socio-economic situation of Māori, with lessened opportunity for them to take advantage of the benefits.

Mitigation strategies aside, Jones says climate change, racism, and colonization are inextricably intertwined: “Climate change amplifies existing threats to health and human rights, and climate change itself is intimately linked to colonialism. Colonialism is at the root of the global economic system that fuels anthropogenic climate change and is responsible for the social conditions that limit Indigenous peoples’ resilience and adaptation capacity. It is not possible to understand or address the effects of climate change for Indigenous health without acknowledging and confronting colonization.”<sup>34</sup>

As a result of this history and the possibility of exacerbated harm, the onus is on policymakers to identify the potential unintended consequences of climate change mitigation measures. Others in New Zealand have written about the opportunity to introduce programs that systematically address a reduction in greenhouse gas emissions and an improvement of health equity outcomes. One opportunity could be the introduction of a sustainable energy management plan to retrofit hospitals with solar panels, modernized heating, ventilation, and cooling systems, and energy efficient lighting. The savings from that plan could then be “re-invested into collaborative community projects that create healthy, energy-efficient homes in communities with a high proportion of Māori and Pacific peoples.”<sup>34</sup>

The gradual loss or deterioration of one’s natural environment also affects emotional and spiritual health — the other pillars of *hauora*. Australian philosopher Glenn Albrecht calls these effects ‘solastalgia.’ Solastalgia is the sense of distress that comes when people witness the effects of environmental change on their home and land.<sup>36</sup> It’s a sense of longing for a place or environment that is being lost, has been taken, or no longer exists — the stripping away of a key component of one’s identity.



*Sheep farming and cattle rearing are two of New Zealand’s largest industries. Both were introduced to the island in the 18th and 19th centuries following the “discovery” of the island by European settlers. Stats NZ estimates 45% of the country’s land is being farmed for agricultural and horticultural use—sheep and cow farms make up two thirds of that land use. Though important economic drivers, these industries have also greatly affected New Zealand’s native forests, including the ability for them to be accessed by the tribes who whakapapa to that land.*

Solastalgia is similar to another term: ecological grief. Ecological grief is a condition that comes as a result of ecological loss. According to one study, ecological grief caused by anthropogenic environmental change has been linked to “acute and chronic mental health experiences, including: strong emotional responses such as sadness, distress, despair, anger, fear, helplessness, hopelessness and stress; elevated rates of mood disorders, such as depression, anxiety, and pre- and post-traumatic stress; increased drug and alcohol usage; increased suicide ideation, attempts and death by suicide; threats and disruptions to sense of place and place attachment; and loss of personal or cultural identity and ways of knowing.”<sup>37</sup>

Dr. John Perrott, the expert in *Mātauranga Māori*, says contemporary Māori use the term ‘land sickness’ to describe a concept similar to solastalgia and ecological grief. In the context of Māori communities, land sickness affects people in two ways: through the misuse of ecosystem resources (the loss of *taonga* or treasures) and Māori disenfranchisement from land management decisions (a loss of *mana* or authority).<sup>38</sup>



Hone Moetara is a *rongoā rākau* and *mirimiri* therapist at *Pirirakau Hauora* health center in Te Puna.

Hone Moetara, the *rongoā* practitioner in Te Puna, says the loss of land affects his work. For one thing, there is a lack of resources for traditional practices. “Our bush is getting further and further away from us. The seed banks are taken off the soil due to farming. We have to go out of the area to find traditional medicines. That’s really hard for our families because they’re not in a place where they can afford to search for what you should be able to find outside your backdoor.”

Ecological grief is also caused by an inability to fulfill *manakitanga*,<sup>xviii</sup> the act of being hospitable to guests. Dr. Rhys Jones offers the example of tribes who have experienced contamination of their traditional food sources or shifting patterns of availability of that food because of land use change, pollution, or climatic disruption. This not only affects Māori from a nutritional perspective “but because it’s a source of *mana* and esteem for local people. If I come from a coastal area and we have visitors, it’s a source of pride to be able to provide the local food. [...] Not being able to fulfill your cultural obligations can have negative impacts on mental well-being,” Jones says.

<sup>xviii</sup> A tribe’s spiritual power or sense of authority.

Philosopher Glenn Albrecht notes that land loss from environmental change can mimic the displacement that first happened when European settlers forcefully relocated Indigenous communities worldwide. This compounds the fact that climate change is already seen as a manifestation and intensification of colonialism. An excerpt from a 2019 article by Rhys Jones for the journal “Global Health Promotion”:

“Indeed, the worldviews, values, and systems that underpin the colonization of Indigenous peoples are also at the root of environmental changes that threaten local and global ecosystems. Modern Western societies are underpinned by anthropocentric understandings of the world and individualistic values, and tend to associate consumption with improvements in quality of life. The resulting capitalist systems have driven the commodification and exploitation of natural resources, with societies pursuing economic growth while externalizing the negative environmental impacts.”<sup>39</sup>

To understand the effect of colonization on Māori health requires some historical retrospective into the relationship between Aotearoa’s first people and European settlers.

## Aotearoa and the Crown: A Disturbance of Taonga

Māori were the first human inhabitants of Aotearoa, arriving from East Polynesia between 1200 and 1300 AD.<sup>40</sup> A seafaring people, the Polynesian explorers “discovered the country on deliberate voyages of exploration, navigating by ocean currents and using the wind and stars.”<sup>41</sup> The stars and sky continue to be of great significance to *Mātauranga Māori*. For example, the Māori calendar, Maramataka, is based on lunar cycles that dictate scheduling around planting and harvest; *matariki* is the name for the Pleiades, a cluster of stars used to signify the Māori New Year and predict climatic conditions for the coming season.

European settlers or Pākehā<sup>xix</sup> first came to Aotearoa in 1642 with the “discovery” of the island by a Dutch explorer. British explorers made three voyages to Aotearoa starting in 1769, laying the groundwork for their eventual colonization of the islands. The next half century led to the introduction of Christianity from English and French missionaries and increased access to trade. There are certain similarities between the European colonization experience of Māori and other Indigenous groups worldwide. These interactions led to the spread of infectious disease, certain groups gaining preferential access to food and firearms which escalated tribal wars,<sup>42</sup> and disempowerment and depopulation. By 1896, the Māori population was estimated at 42,000 people, a decline from a population of 70,000-90,000 half a century prior.<sup>44</sup>

A landmark event in New Zealand’s history occurred in 1840 with the signing of Te Tiriti o Waitangi, the Māori language text of the treaty between the British and North Island *hapū*. The English version, the Treaty of Waitangi, was signed later. Domestic law recognizes the two documents as the basis of the relationship between the British Crown and Māori.

However, there’s one issue: though often considered interchangeable, Te Tiriti o Waitangi and the Treaty of Waitangi are dramatically different. <sup>45</sup> “[Article 2 of] Te Tiriti reaffirms Māori *tino rangatiratanga*, which is a declaration of self-determination,” says Dr. Heather Came, whose PhD research related to Crown breaches of Te Tiriti agreement. “In the [Treaty of Waitangi] many argue that Māori surrendered their sovereignty to the British Crown.”

Both documents contain articles governing the Crown-Māori relationship. Though neither health nor *hauora* are directly

referenced in either version, Article 2 affirms that Māori remain in charge of themselves and will be able to protect their *taonga*, the name for treasured possessions including health, *whenua* (the environment) and other sacred places, *te reo* (the Māori language), *whakapapa*, and all other material and non-material treasures.<sup>46</sup> Article 3 guarantees Māori the same rights as British citizens, including health equity. More recently, the New Zealand government created a series of treaty principles that must be followed by the Crown, including the three most commonly referenced: participation, protection, and partnership.<sup>47</sup> In 2019, these principles were named reductionist and outdated.<sup>48</sup>

“Within days [the Crown] started breaching Te Tiriti and haven’t stopped,” says Came. There’s ample legal validation to back her observation. In 1975, the New Zealand government established the Waitangi Tribunal. The tribunal is the legal process that hears and investigates claims that the Crown has breached the text of either treaty. The tribunal’s 20 members are the permanent commission of inquiry charged with interpreting both texts, and the body has reported on more than 1,000 claims — though more than twice that number have been registered and await the legal process. Though recommendations from the tribunal are not binding, many have been incorporated into government legislation or used to create new institutions.

Most of the Waitangi Tribunal’s business to date has focused on claims of historical treaty breaches by the Crown, with the Tribunal hearing these claims on a geographic, district by district basis. The Tribunal has more recently started to consider claims of national significance on a thematic (or *kaupapa*) basis. The first of these looked at issues surrounding military veterans. The second *kaupapa* inquiry initiated by the Tribunal looks specifically at health services and outcomes for Māori.

The health *kaupapa* inquiry (known by its reference number, Wai 2575) began hearings in 2018 and focused initially on primary health care. The Tribunal released its report in July 2019, ruling that the Crown had failed in its treaty commitments to ensure equitable health outcomes for Māori. Another Tribunal report focused on Māori mental health was published a month later.

The tribunal references Ministry of Health statistics in its findings<sup>49</sup>: Māori are more than 2.5 times more likely to die from

<sup>xix</sup> Pākehā is the name for New Zealanders of European descent and other non-Māori. Tauwiwi is the term used for all non-Māori.

xx Before moving forward, what are the primary determinants of health that you think are playing a role in these health inequities?

cardiovascular disease and more than five-and-a-half times more likely to be hospitalized for heart failure compared to non-Māori. Māori are twice as likely to die from all types of cancer. Māori babies account for a higher number of sudden unexplained deaths, and suicide rates are higher than in non-Māori demographics. The list goes on.<sup>xx</sup>

“Māori health inequities are not only caused by health issues, but are influenced by a wide range of factors including income and poverty, employment, education, and housing – termed the social determinants of health,” states the tribunal. It also attributes inequities to the long-term impacts of colonialism, noting the ongoing existence of institutional racism.<sup>50</sup>

Claimants who testified as part of the mental health tribunal brought up dozens of issues, including the lack of culturally appropriate mental health services, the failure to accommodate *Mātauranga Māori* knowledge and *rongoā* in healthcare policy, the need to interlink mental, physical, and spiritual health, and the suppression of Māori health practices and protocols.<sup>51</sup>

Today, these health and socio-economic inequities are usually considered a common thread binding Indigenous communities, writes Sir Mason Durie, the conceptualizer of a number of Māori health models. “However, the defining element of indigeneity is not colonization, socio-economic disadvantage or political ambitions. Instead, most Indigenous peoples believe that the primary starting point is a strong sense of unity with the environment — and a healthy environment.”<sup>52</sup>

The Wai 2575 inquiry brought up much bigger questions: is it possible for New Zealand’s Western-influenced healthcare system to recognize the interconnected identities and needs of Māori tribes when the worldviews of each are diametrically opposed? What is the role of a healthcare system or its practitioners in ensuring a healthy environment?

New Zealand has made some progress in incorporating Māori worldviews in its strategies and approaches. While the system is far from perfect, it offers some examples of the first steps that can be taken to better integrate human health, well-being, and the natural world.<sup>xxi</sup>

xxi Successful intercultural health services vary from country to country, and from context to context, however, they all share some common principles. What do you think these are?

## Whānau Ora: Reconstructing Contemporary Healthcare Systems With a Māori Worldview

Recall the building blocks of Māori society. Rather than considering individuals as the smallest social group, Māori see this as *whānau* — extended, multigenerational families.

Since 2002, “Whānau Ora” has been New Zealand’s overarching effort to incorporate Māori cultural values into a health initiative. Whānau Ora is defined as “Māori families supported to achieve their maximum health and well-being.”<sup>53</sup> However, there was arguably little specific action dedicated to achieving this aspiration, leading to the establishment of a targeted Whānau Ora program by the Government in 2011.

The Whānau Ora program was led by Dame Tariana Turia (*Ngāti Apa, Ngā Rauru, Tūwharetoa*), then a government minister, and informed by a taskforce chaired by Sir Mason Durie. Durie explained the approach during an address to the Royal Australasian College of Physicians: “If *whānau* are going to be well in the future this is well outside the health sector alone. It includes education, social development, economic and employment concerns, housing. On a community level, the aim of Whānau Ora is to bring those interests together. *Whānau* don’t live their lives in silos.”<sup>54</sup>

As a result, Whānau Ora isn’t solely a health program. Instead, it aims to acknowledge the interconnectedness between people’s lives and the role that natural and built environments play in achieving overall health and well-being.<sup>xxii</sup>

xxii How would you integrate the Māori worldview if you were to co-design a health system with them? What would be the defining elements?

### A Whānau Ora Approach to Type 2 Diabetes

Adding to the list of health inequities, type 2 diabetes and its complications are more common among Māori and Pacific communities than other ethnicities.<sup>55</sup> A new Māori-designed primary care program called Mana Tū is “aiming to improve diabetes outcomes and reduce disparities in incidence, hospitalization, and mortality rates by transforming primary health care.”<sup>56</sup>

Mana Tū is overseen by the National *Hauora* Coalition (NHC), a Māori-led primary health organization. It’s one of the best examples to-date of an intervention that incorporates Māori experience and values. The program’s design addresses the social connectedness of Māori communities and acknowledges that it’s not possible to treat an individual alone.

Developed in collaboration with a diverse group including secondary care clinicians, dental specialists, nurses, social workers, *kaumātua* (Māori elders), and long-term diabetes patients, Mana Tū addresses what Dr. Matire Harwood (Ngāpuhi) says was a failure of mainstream practitioners to serve the needs of Māori and Pacific families. Harwood is the general physician who led the program's research.

“When we had *whānau* designing Mana Tū, they said ‘we don’t [go to traditional clinics] because they tell us off. They just throw more drugs at us. They don’t talk to us about what’s actually going on in our lives,’” Harwood says. “To me, that was key, that idea that doctors thought they knew best, though they likely didn’t have diabetes and may be wealthy and have good health literacy. It was them not understanding the context in which some of these people are living.”

Launched in March 2018, Mana Tū is operating with 200 people at 10 general practice clinics. Nine month data shows promising progress on key indicators: a clinically significant reduction in the group’s Hemoglobin A1C (HbA1c) and weight loss. The program has also shown benefits for entire families: “They’re more likely to go as a *whānau* for walks and take the kids to play at the park. It’s not just being physically active, but spending time together so that social engagement and bonding happens,” adds Harwood.

Mana Tū’s effectiveness will be assessed in two ways over the long-term. The first is similar to western medicine: by using clinical indicators to measure a reduction in physical disease. The second assessment will use Hua Oranga, a tool developed by Sir Mason Durie to measure Māori health outcomes.<sup>57</sup> Conceptualized around Māori models of health and well-being, tools like Hua Oranga include more qualitative markers of health and well-being.

For example, Hua Oranga gauges the mental health and well-being of an entire *whānau* as opposed to that of an individual alone. It also measures improvements in *waiora*, the sense of spirituality that exists when people are able to protect and be part of the natural world. “I think it’s really important to use some of these Indigenous health outcome tools when assessing the impact of our interventions,” Harwood says. “*Whānau* and *waiora* weren’t being captured by any of the tools we had used before.”

Mana Tū is tailored to some of the central tenants of Whānau Ora and Māori models of health. It taps into the concept of *mana*, a person’s self-authority. “Let’s use our own cultural models and cultural ways of knowing and doing to inform something like taking control of diabetes,” describes Harwood of the program’s approach.

In practice, *whānau* can personalize Mana Tū to meet their needs. It shifts a *whānau*’s first point of contact from a general practitioner to a Kai Manaaki, an appointed community case manager who is more in tune with the cultural needs of the *whānau*. The Kai Manaaki works as part of a primary health clinic team, with general practitioners administering insulin and other medication. Families meet with the Kai Manaaki twice a week at the beginning of the 12-month program in order to develop a relationship. Gradually, those meetings are held every two weeks, then in self-prescribed intervals after two months.

Despite positive research results, Harwood says her team has faced challenges in getting recognition from mainstream health clinics and funders. She notes that while a Mana Tū approach that recognizes the wider determinants of health could be applied to conditions like chronic obstructive pulmonary disease (COPD) and mental health, proposed programs that draw from Māori philosophy often face hurdles of racism and bias.

Systemic racism and bias are just two of the reasons why many are skeptical that Māori worldviews can be adopted in a colonial policy environment that was never meant to consider them.

#### Whānau Ora and Māori Models of Hauora: Reality or Rhetoric?

The Whānau Ora program has its challenges and shortcomings. Even its conceptualizer, Sir Mason Durie, admits that, telling the Royal Australasian College of Physicians that implementing the approach has been easier in communities when compared to a government policy level.

Gabrielle Baker (Ngāpuhi) has faced similar challenges from a policy perspective. Baker is a former civil servant who spent 15 years as part of the Ministry of Health’s Māori health policy team. Part of her role involved advising ministers on spending around Māori and Indigenous health, and working on the team that helped create the Whānau Ora program and the country’s Māori health strategy, He Korowai Oranga.

Baker notes the frustrations of working inside government agencies, specifically “that amazing policy was being developed but would sit on shelves and lead to very little change.” She says that despite plenty of rhetoric existing around improving Māori health equity, there remains a lack of funding, ongoing policy stewardship, monitoring, and political will to make the changes needed.

“The ideas of having *whānau*-centered interventions that support *whānau* aspirations, the kind of thing talked about in the Whānau Ora policy, would at most get a few dollars thrown at them,” describes Baker of the government’s approach to Māori health and well-being. Despite some government investment in Whānau Ora, Baker says very little changed for Māori health. Instead, greater responsibility was placed on the shoulders of Whānau Ora providers or families themselves.

The head of one Māori-led primary health organization feels similarly. “The health system in New Zealand is essentially following the British National Health Service (NHS),” says Simon Royal, Chief Executive of the National *Hauora* Coalition. He points out that the NHS is a system tailored to the needs of an individual. “That [individual view is] backed up by insurance and basically all the infrastructure of the healthcare system. All algorithms for funding or public policy are generated out of a view about the relative importance of the individual vis a vis the group. This is why the Whānau Ora concept has been significant but it’s been bastardized by the Crown because they didn’t allow Māori to roll it out.”

Royal, along with National *Hauora* Coalition Trustee, Henare Mason (Te Arawa and Ngāi Tahu), was a claimant in stage one of Wai 2575, the Waitangi Tribunal inquiry into Māori primary health care. The recent ruling of the tribunal validates the demand for a health system that is not only designed by Māori, but also managed by them. It calls for the establishment of an independent Māori health authority as a way to end the health disparities facing communities.<sup>58</sup>



Simon Royal, Chief Executive of the National *Hauora* Coalition.



Janice Kuka (Ngāti Ranginui, Ngāi Te Rangi) was another of the claimants in the first stage of Wai 2575. Kuka is the Managing Director of Ngā Mataapuna Oranga (NMO), another Māori-led primary health organization. She says the next step following the ruling is to look at what systems and models could inform the creation of an independent health authority. That could mean drawing on multiple Māori models of health or, as has been the case at NMO, designing new models based on the unique needs of each tribe. There’s also a call for the New Zealand Public Health and Disability Act to be updated to better include Te Tiriti o Waitangi.

*Reweti Te Mete, Janice Kuka, and Cindy Mokomoko all advocate for an independent, self-determined Māori health authority. They’re hopeful a 2019 Waitangi Tribunal report will open the doors for much-needed change.*



## Alaska's Nuka System of Care

Many Māori health leaders point to the Nuka System of Care as an example of a model that more holistically serves the needs of Indigenous communities. The system was created by Alaskan Native people, and is overseen by the Southcentral Foundation, a nonprofit healthcare organization based in Anchorage, Alaska.

According to Southcentral Foundation's President and CEO, Katherine Gottlieb, the Alaskan Native population historically experienced health disparities similar to those faced by Māori communities. Patients were waiting an average of four weeks to get an appointment or were only coming in for emergency care. "There was a disconnect between care for the mind and care for the body," Gottlieb writes.<sup>59</sup>

In 1975, the United States government passed the Indian Self-Determination and Education Assistance Act. That legislation was the beginning of the federal government handing over self-rule for tribal authorities across the country. Southcentral Foundation took full ownership and management of the Alaska Native Medical Center in 1999 and redesigned the services to be more culturally appropriate.

The Nuka System of Care was the result. Gottlieb says one advantage of the system is that it's more responsive to the needs of families. For example, when a recent needs assessment found there was a gap in oral health care for youth, Southcentral Foundation started building a new program with this target population in mind. Survey results that demonstrated an increased need for behavioral health and addictions services led to the creation of new substance abuse activities and more beds dedicated to the detox program.

Gottlieb wants to be clear: it's not just Indigenous communities that benefit from holistic, patient-centered systems of care. "If we started with the population we're serving to see what their highest needs are and then addressed them, it would change health disparities across the United States. [Southcentral Foundation] did this and it just so happens that Alaskan Natives are our target population," she says, adding she'd do the same thing in any other state. "Engaging a community is key to address health outcomes."

For Hone Moetara, the *rongoā* practitioner at the start of this case study, an independent Māori health authority may mean the ability for him to get funding and support to continue creating traditional medicine. That demands not only recognition of the role Māori medicines and approaches to well-being play within healthcare, but also the importance of being able to harvest from the government's Department of Conservation sites.

"It's the need for an entirely new system where we're not butting up against red tape across all systems — academia, health, and conservation," Moetara says. For Māori, it's not only about physical health but about every element of one's identity: a balance of spiritual, physical, mental, emotional, and community needs. Determining whether those needs can be met within New Zealand's existing healthcare system is still an open question. What is certain, however, is the need to better include the holistic way in which Māori derive their sense of personhood: through a connection with one another and with the land.

## Epilogue: Learning from Mātauranga Māori

There is no one approach to infuse the principles of planetary health into policy worldwide—as we’ve seen in this case, deconstructing systemic bias and entrenched silos is a significant challenge even when there is political will and a guiding holistic vision based on Māori worldviews. Planetary health practitioners by definition recognize the empirical connection between human health and the environment; this understanding and the solutions we create as a field should be deepened in learning from the values that underpin Māori and many other Indigenous worldviews of health and well-being.

*Whakapapa* reminds people of their connection to one another and to the environment, and demands learning from the past and considering the future. It also creates a sense of belonging within the world which can act as a moral lens through which to filter our actions. *Mana* outlines the importance of agency so people can be physically, mentally, socially, and spiritually well. *Tino rangatiratanga* gives families the self-determination to choose what’s best for themselves. *Kaitiakitanga* reminds us to be guardians of the natural environment. *Taonga* highlights the true treasures worth protecting: one’s natural environment, health, family, culture. Finally, Indigenous worldviews demand a respect for partnership and collaboration to understand sense of place and context when designing and implementing solutions to the challenges we face in the Anthropocene.

Ultimately, it’s about learning from *Mātauranga Māori* to remember that all of our systems are interconnected. Those connections have been evident throughout this case study anthology. A dam in the Senegal River led to an upstream spike in schistosomiasis for villages that depend on that water source. Men logging the rainforests of Borneo were doing so in order to pay for their family’s healthcare. The hunting of lemurs and other wildlife in Madagascar that has pushed species to the brink of extinction is often a necessary source of nutrition. Human behavior in Fiji’s watersheds has contributed to a higher risk of water-borne disease. Each of these cases illustrate how the health of humans and the Earth’s natural systems must be considered as a complex, dynamic whole.

A full appreciation of that interconnectivity demands empathy towards others and towards the Earth. If you don’t feel emotionally connected to the natural world through stories and experience

then you’re not going to protect it or mourn its loss, reflects Dr. John Perrott. “Part of who you are is a sense of belonging, but that comes from associating with something bigger than yourself,” he says.

Māori worldviews are but one example of how we can step away from an individual mindset and become part of a paradigm that harmonizes rather than prioritizes human health over environmental well-being.

## Keeping Track of Who's Who

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Former civil servant with the Ministry of Health's Māori health policy team

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### Pete Edwards (Te Rarawa, Te Aupouri, Ngā Puhi)

PhD student of Dr. John Perrott and researcher studying kaitiakitanga

### Dr. Matire Harwood (Ngāpuhi)

General physician and head researcher for the Mana Tū diabetes program

## Katherine Gottlieb

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Rongoā practitioner with Pirirakau Hauora

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### Dr. Rose Pere

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Finally, to Indigenous nations worldwide: it is my sincerest hope that the planetary health community can use its privilege and power to elevate your diverse worldviews and ways of knowing. Your guiding values, expertise, and stories are needed now more than ever before.



The kawakawa plant is a commonly used healer in Māori culture. The holes in the leaves are caused by the Kawakawa Looper Moth caterpillar. While the practices of healers differ greatly, one school of thought is that the more holes a leaf has, the more medicine it holds (because it's trying to heal itself).

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