World Mosquito Program™

a subsidiary of MONASH University

ANNUAL REVIEW **2023**

GROWTH THROUGH COLLABORATION

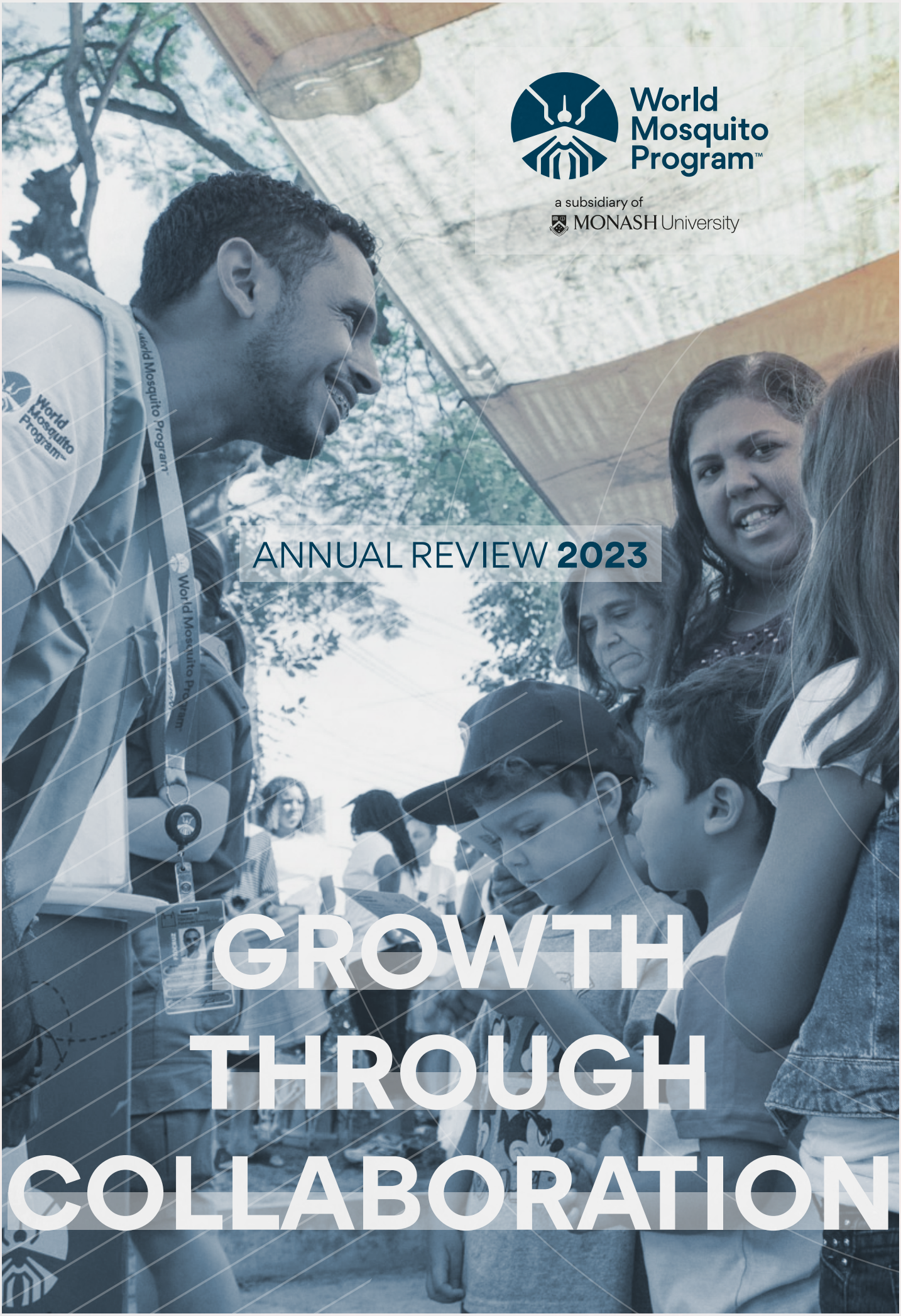


TABLE OF CONTENTS

ANNUAL REVIEW 2023

A collaboration between:

World Mosquito Program™ | MONASH University

01.

INTRODUCTION

CEO MESSAGE

Professor Scott O'Neill

We have achieved major milestones at the World Mosquito Program this year alongside our continued growth, both in terms of global impact and our technological capabilities. Our transition from an organisation focused primarily on efficacy demonstration to an organisation preparing to scale our technology continues apace, with our overarching mission being to protect the greatest number of people globally in the shortest time possible.

WMP's technology has been unequivocally demonstrated to have high efficacy and community acceptability. The excellent results from Colombia's Aburrá Valley, where we now protect more than 3.5 million people, showed the proven impact our technology can have at scale. Our largest continuous releases of *Wolbachia* mosquitoes to date have shown the *Wolbachia*-treated areas to have the lowest dengue rates in 20 years, with cases dropping by more than 95%.

Partnerships have continued to play an important role in our scaling-up plans this year. This was evidenced in Honduras, where we worked for the first time in collaboration with Médecins Sans Frontières (Doctors Without Borders), and in Indonesia and Laos, where we worked in partnership with Save the Children.

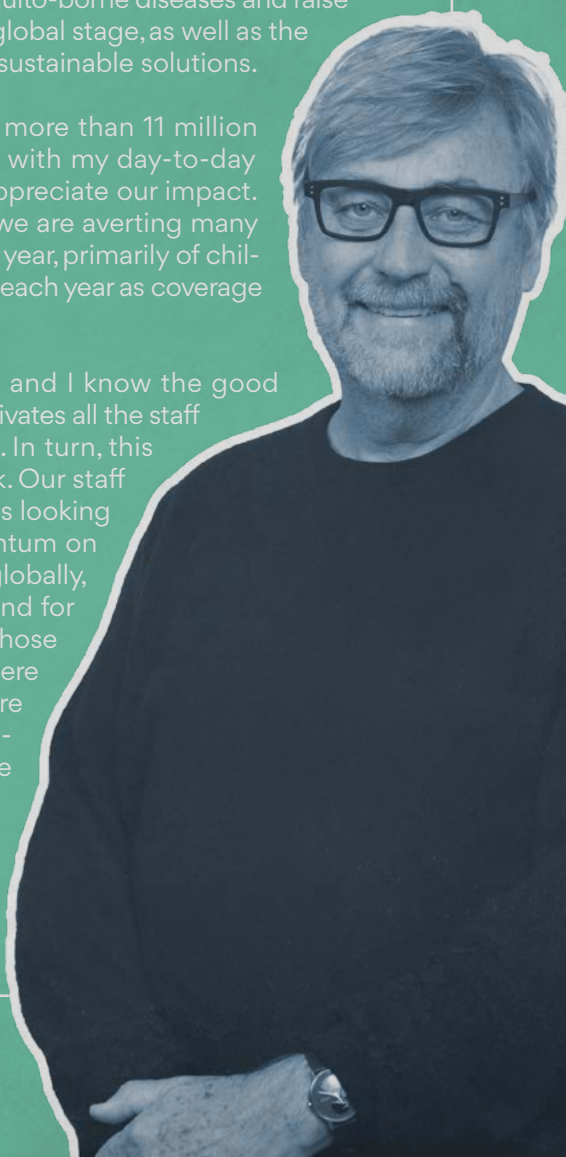
Our most ambitious plans yet are being put in place in Brazil, with the announcement that Fiocruz and WMP will partner to dramatically expand access to *Wolbachia* mosquitoes, almost 10 years after our first deployments in the country. The joint venture builds on years of collaboration between the two organisations and will help to protect many more Brazilians from mosquito-borne diseases, using our *Wolbachia* method. It will also lead to the creation of a mosquito mass production facility initially capable of producing about 5 billion mosquitoes per year, at a rate of up to 100 million per week. This comes at an important time, with Brazil reporting a record number of dengue-related deaths (1079) in 2023 and more than 1.6 million dengue cases.

Throughout the year, we expanded our deployments in existing countries and new countries in need. Deployments in Laos, El Salvador and Honduras all commenced, while coverage expanded in Indonesia, Brazil and New Caledonia. Awareness of the power and positive impact of our technology and its cost-effectiveness continues to widen globally, generating increased demand and interest in projects. This demand will take us to more new territories and continents, including Africa, where we plan to launch our first project in 2024. Our ambition is to expand operations across the continent in the coming years.

We were also thrilled to share Monash University's pavilion at the 2023 United Nations Climate Change Conference (UNFCCC) COP28 in Dubai in November. It gave us a fantastic opportunity to highlight the impacts of climate change on mosquito-borne diseases and raise awareness of our technology on a global stage, as well as the urgent need to provide long-term sustainable solutions.

In 2023, our technology reached more than 11 million people. Often, I am so consumed with my day-to-day work that I fail to step back and appreciate our impact. The modelling is suggesting that we are averting many thousands of hospitalisations each year, primarily of children. And these numbers will grow each year as coverage continues to expand.

I feel very proud of this outcome and I know the good work we are doing inspires and motivates all the staff in WMP, as well as our supporters. In turn, this makes WMP a great place to work. Our staff make all of this a reality, and 2024 is looking even more promising with momentum on our side to accelerate our impact globally, strengthen existing partnerships, and for new partnerships to develop with those who share our vision for a world where children in developing countries are less disadvantaged and health systems are more resilient due to the absence of crippling disease outbreaks. With climate change now clearly contributing to worsening disease in many places, we are ready to offer a solution of hope to communities around the world.



World Mosquito Program™

CHAIR'S STATEMENT

WMP Chair of the Board
Tim Orton

The World Mosquito Program (WMP) continued to substantially grow its global impact in 2023, helping to protect more communities with our innovative *Wolbachia* method. As climate change, globalisation and urbanisation accelerate the speed at which mosquito-borne diseases move across regions, WMP's work is increasingly significant in the fight against one of the biggest global health threats of the 21st century.

It has been a year of great milestones and success for WMP. In March, the news of WMP's major partnership with Fiocruz in Brazil was hugely important in dramatically expanding access to *Wolbachia* mosquitoes across the country. It builds on years of collaboration between the two organisations and will lead to the creation of the biggest mosquito mass production facility in the world. It comes at an important time, as Brazil reported the highest number of dengue cases globally in 2023, reaching 2.9 million. I'm looking forward to seeing the progress in the year ahead.

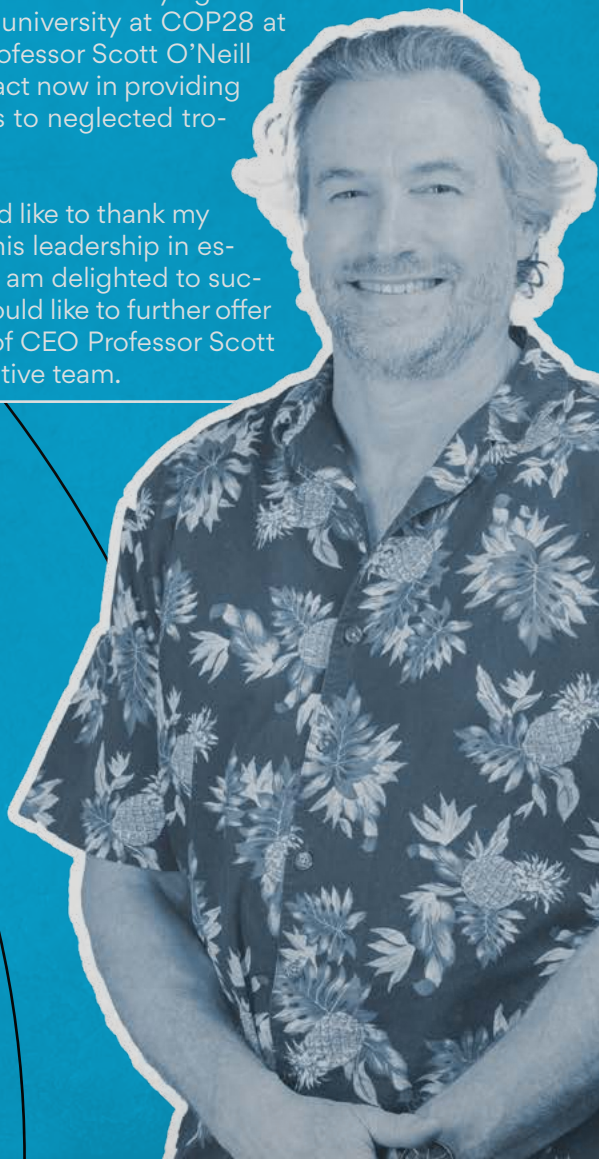
The Americas, which has about four-fifths of the world's dengue cases, broke the previous regional record for dengue with more than 4 million cases last year.

This is why WMP's joint research results with the University of Antioquia were so promising and significant in Colombia. In a year when the country faced numerous dengue outbreaks, cases dropped to the lowest level in 20 years across the Aburrá Valley following WMP's large-scale releases of *Wolbachia* mosquitoes. The results showed a 20-year low in dengue cases, with a decline in incidence rates of more than 95% in Bello, Medellín and Itagüí, truly demonstrating the effectiveness of *Wolbachia* at scale.

WMP has now been introduced in 14 countries and improved the health outcomes of communities with more than 11 million people. Our plan is to achieve similar outcomes as we have in Colombia's Aburrá Valley for many more communities numbering in the tens and hundreds of millions in the years ahead.

WMP is an important part of Monash University's global reach and impact. In joining with the university at COP28 at the end of the year, our CEO Professor Scott O'Neill highlighted the urgent need to act now in providing sustainable long-term solutions to neglected tropical diseases.

On a more personal note, I would like to thank my predecessor Peter Marshall for his leadership in establishing WMP as a company. I am delighted to succeed Peter as chair of WMP. I would like to further offer gratitude to the inspired work of CEO Professor Scott O'Neill and his dedicated executive team.



World Mosquito Program™

PARTNERS

WORLD MOSQUITO PROGRAM

The World Mosquito Program has received generous donations from organisations including government departments, individual foundations and corporations.

Donors include the Department of Foreign Affairs and Trade, the Gillespie Family Foundation, the Macquarie Group Foundation, the Wellcome Trust, the Silicon Valley Community Foundation, the Planet Wheeler Foundation, the Myer Family Foundation, EY (Ernst & Young), Grundfos Pumps Pty Ltd, Earth Corporation, the Australian National Health and Medical Research Council, Médecins Sans Frontières, Save the Children, Innovafeed, Hatch, Fiocruz, IBMP (Instituto de Biologia Molecular do Paraná) and the Bill & Melinda Gates Foundation.

The contributions of these donors have enabled the World Mosquito Program to continue protecting communities around the world from diseases like dengue, Zika, yellow fever and chikungunya. Their continued support will be crucial in bringing this innovative solution to more communities worldwide.

WMP is on a mission to reduce the global burden of mosquito-borne diseases. We invite you to join and partner with us in this critical effort to improve public health around the world. As a valued donor, passionate advocate or dedicated volunteer, your support can have a significant global impact. Please feel free to contact contact@worldmosquito.org and join us on our journey towards a dengue-free world. Together, we can make this possible.

Australian Government
Department of Foreign Affairs and Trade

The Gillespie Family Foundation

MACQUARIE

wellcome

SVCF SILICON VALLEY COMMUNITY FOUNDATION

planet wheeler

The Myer Family Foundation

EY

GRUNDFOS

Earth Corporation

NHMRC

MEDECINS SANS FRONTIERES

Save the Children

INNOVAFEED

HATCH

FIOCRUZ

ibmp

BILL & MELINDA GATES foundation

AT A GLANCE

WMP 2023

IMPLEMENTATION

5 impactful partnerships

with leading global health organisations including

- Médecins Sans Frontières
- Save the Children Indonesia
- Save the Children Laos
- Udayana University (Indonesia)
- Puerto Rico Vector Control Unit/ US Centers for Disease Control and Prevention

14 countries

have implemented WMP's *Wolbachia* method

COMMUNITY ENGAGEMENT

Average

92% community acceptance rate

IMPACT

11.4M PEOPLE PROTECTED

by WMP's *Wolbachia* method

95–97%

reduction in dengue incidence in Colombia's Aburrá Valley

0%

genetic modification

reliance on insecticides

Our approach uses naturally occurring bacteria

725K averted dengue cases

including 50,000 hospitalisations

USD$ 230M

in economic benefits from averted healthcare costs and a healthier population

COMMUNICATIONS REACH

18 billion

people reached through major media outlets across the globe

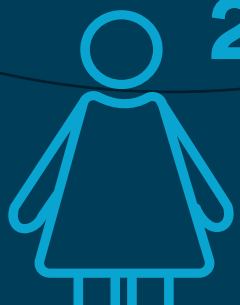
Reached more than

2.3M users across social media channels

339K people

visited our website, and we received 9 million organic impressions on search engines

STAFF



26 nationalities

represented across the program

46% of workforce were women

*All figures are up-to-date as of December 2023

02.

GLOBAL IMPACT

DEPLOYMENT HIGHLIGHTS

GLOBAL IMPACT

GLOBAL ACCESS

DEPLOYMENT

HIGHLIGHTS

EMPOWERING COMMUNITIES

Since the World Mosquito Program began, community engagement has been at the heart of our projects. When we build a deep understanding of communities, we can design our projects to minimise social costs and ensure community acceptance.

In 2023, we continued to nurture a sense of collective ownership over our projects by fostering extensive partnerships across sectors and empowering communities to build their defences against diseases such as dengue, Zika, chikungunya and yellow fever.

Volunteers

Our community-centric strategy was showcased in Laos in 2023. In the bustling capital city of Vientiane, Phoutmaly Thammavongsa – a local sweet seller – was just one example of effective grassroots engagement. She joined the project's efforts along with myriad other volunteers, with a desire to safeguard her community from dengue.

Volunteers like Phoutmaly hosted mosquito release containers, participated in launch and demonstration events and shared key messages about the *Wolbachia* method with their fellow community members. These volunteers formed an important part of the effort – spearheaded by WMP and Save the Children International, with the support of the Department of Communicable Disease, Lao PDR Ministry of Health – that culminated in the successful release of *Wolbachia* mosquitoes.

We recognise that for successful delivery, we must involve and empower communities. In Laos, this collaborative approach – rooted in the spirit of volunteerism – yielded an outstanding public acceptance rate of 99% and paved the way for the timely and successful completion of the project.

Partnerships

Our collaborative efforts in Central America flourished in 2023, supporting projects in El Salvador and Honduras.

In 2023, we partnered with key stakeholders including:

- Médecins Sans Frontières
- the El Salvadorian Health Ministry
- Mayor's offices
- civil protection units
- education programs
- police, fire and relief departments
- NGOs.

This broad coalition has served as a conduit to increase awareness and gain widespread acceptance across the municipalities of Tegucigalpa, Santa Ana, Chalchuapa and San Sebastián Salitrillo, with a combined population of almost 470,000. We leverage the expertise of these partners and strategically align our on-the-ground initiatives, ensuring communities have access to resources and their concerns addressed.

The reason I joined this project is that I don't want my community to have dengue any longer. By volunteering as a mosquito release container host, my hope is to free my country from dengue.

◂ **Phoutmaly Thammavongsa** – a local sweet seller and WMP volunteer (Laos)

Deployment innovation

In 2023, our journey of innovation turned to novel methods for *Wolbachia* mosquito releases – including drones and advanced ground vehicles. Our vision is of a world where everyone can live a healthy life – free from the fear and suffering caused by mosquito-borne diseases – and we want to deliver that vision to as many people as possible, as quickly as possible.

In Colombia, we pioneered an automated release mechanism that was attached to an unmanned aerial vehicle (UAV). The UAV – also known as a drone – flew over parts of the Cali project site once a week during the testing period, covering nine neighbourhoods within one commune. When combined with an automated release mechanism attached to a land vehicle, we were able to scale up the implementation of our *Wolbachia* method and expand protection to approximately 300,000 people across two communes.

The involvement of local stakeholders was foundational to the use of these revolutionary deployment methodologies. We actively engaged with them throughout the development and testing process, and they supported us in ensuring all queries and concerns were promptly addressed.

Public Acceptance Model

At WMP, our Public Acceptance Model is central to our community engagement and communications strategy. This framework describes core principles and minimum requirements for projects to secure broad awareness and support from communities before, during and after the release of *Wolbachia* mosquitoes. In 2023, we refreshed the Public Acceptance Model and began piloting the changes with a focus on:

- **earlier community understanding** – developing community profiles and conducting baseline surveys earlier, during project scoping, to drive meaningful change
- **streamlined community feedback mechanism** – simplifying and promoting our feedback system to encourage greater community participation
- **right-sized project campaigns** – designing communications that align with community acceptance and awareness levels, focusing on right-sized campaigns, not one-size campaigns
- **early CRG endorsement** – leveraging Community Reference Group (CRG) project endorsement to enhance community awareness and acceptance
- **enhanced communication of expertise and benefits** – improving the communication to the community of our delegated authorities, scientific expertise, experience and provable health benefits.

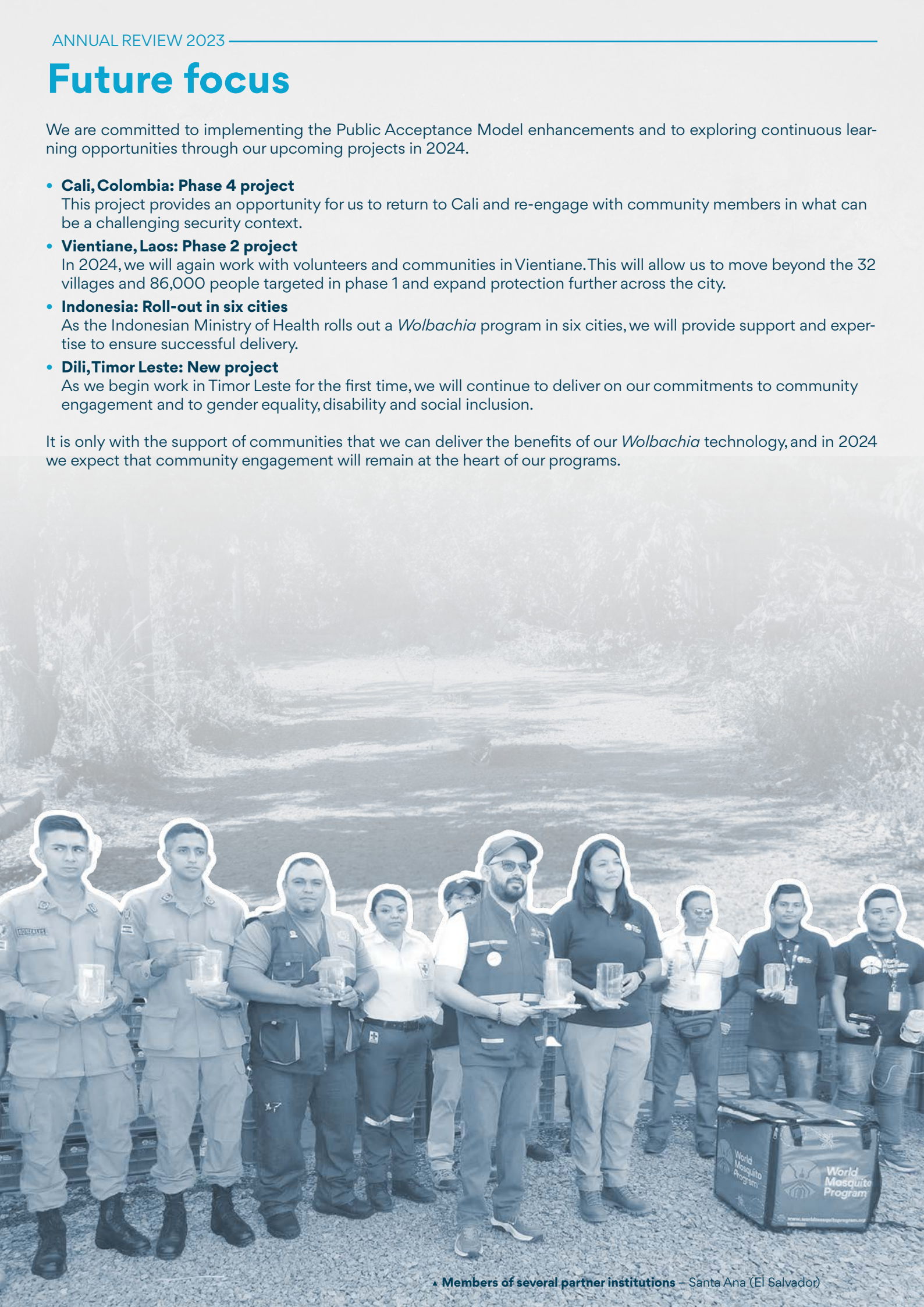
Drone releases and the team – Colombia

Future focus

We are committed to implementing the Public Acceptance Model enhancements and to exploring continuous learning opportunities through our upcoming projects in 2024.

- **Cali, Colombia: Phase 4 project**
  This project provides an opportunity for us to return to Cali and re-engage with community members in what can be a challenging security context.
- **Vientiane, Laos: Phase 2 project**
  In 2024, we will again work with volunteers and communities in Vientiane. This will allow us to move beyond the 32 villages and 86,000 people targeted in phase 1 and expand protection further across the city.
- **Indonesia: Roll-out in six cities**
  As the Indonesian Ministry of Health rolls out a *Wolbachia* program in six cities, we will provide support and expertise to ensure successful delivery.
- **Dili, Timor Leste: New project**
  As we begin work in Timor Leste for the first time, we will continue to deliver on our commitments to community engagement and to gender equality, disability and social inclusion.

It is only with the support of communities that we can deliver the benefits of our *Wolbachia* technology, and in 2024 we expect that community engagement will remain at the heart of our programs.



▲ **Members of several partner institutions** – Santa Ana (El Salvador)

GLOBAL IMPACT

Globally, the impact of the World Mosquito Program continues to grow. As of 2023, we have released *Wolbachia* mosquitoes to protect 11.4 million people in 14 countries. We estimate that 725,000 dengue cases, including 50,000 hospitalisations, had been prevented by our *Wolbachia* method by December 2023, based on published models of the global dengue burden.

11.4
MILLION PEOPLE PROTECTED
in 14 countries

Increasing urgency for effective dengue control

2023 saw an upsurge in global dengue transmission, highlighting the urgency of efforts to expand access to effective interventions like WMP's *Wolbachia* method.

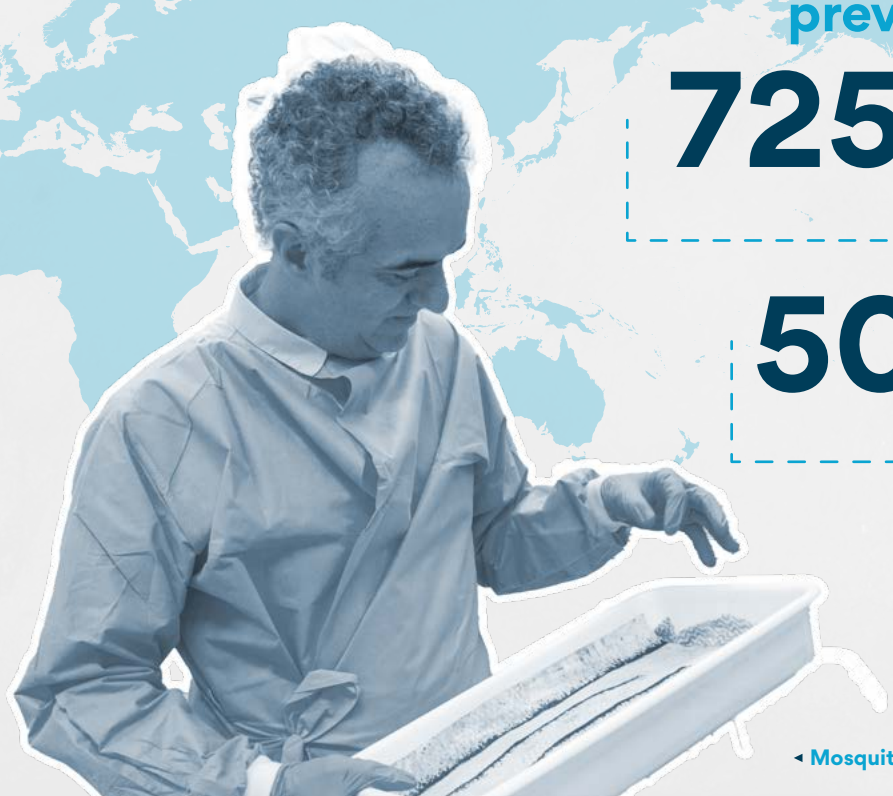
Dengue transmission in 2023

- **Globally:** 6 million dengue cases, 6000 deaths, 92 countries[1]
- **Americas:** 4.5 million cases, 2340 dengue-related deaths, highest on record[2]
- **Bangladesh:** 320,000 cases, 1700 deaths, deadliest dengue outbreak on record[3]
- **Surges in Thailand, Laos, Malaysia, Sri Lanka**
- **Central and west Africa:** multi-country outbreak[4]
- **Europe:** 125 locally acquired cases reported in Italy and France[5]

prevented

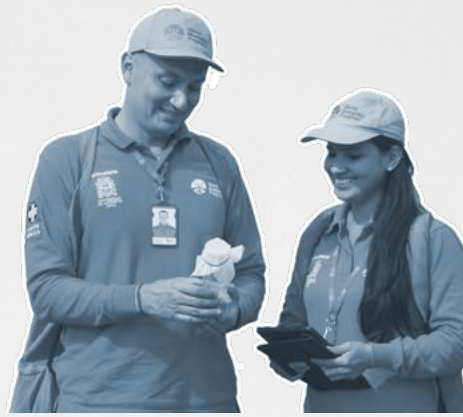
725,000
dengue cases

50,000
hospitalisations



◂ **Mosquito facilities** – Nitéroi (Brazil)

Impact at scale:
Large urban populations protected from dengue outbreaks



▲ **Mosquito release** – Aburrá Valley (Colombia)

In 2023, long-term monitoring of the entomological and health outcomes of city-wide *Wolbachia* deployments in the Aburrá Valley, Colombia; Niterói, Brazil; and Yogyakarta, Indonesia confirmed the feasibility and effectiveness of implementing WMP's *Wolbachia* method for preventing dengue outbreaks in large urban populations. In each of these locations, *Wolbachia* is stably established at a high level in the local *Aedes aegypti* population across continuous urban populations of 500,000 to 3.3 million people (continuous areas of 135–540 km^2). All of these communities have benefited from sustained and significant reductions in dengue incidence since *Wolbachia* was implemented, in stark contrast to national and regional trends.

These results highlight the scalability of WMP's *Wolbachia* method, which is critical to the achievement of our mission to protect as many people from mosquito-borne diseases as quickly as possible. Since the first deployments of the *Wolbachia* method in two small communities in northern Australia in 2011, we have continuously refined and adapted our technology, operations and partnerships in pursuit of increased scalability and sustainability, in order to maximise access for populations most affected by dengue.

Niterói, Brazil

Aburrá Valley, Colombia

Yogyakarta province, Indonesia

Local surroundings – Yogyakarta (Indonesia) ▸

Long-term, self-sustaining protection

Further evidence confirming the long-term, self-sustaining protection provided by WMP's *Wolbachia* method was accumulated in 2023, through long-term monitoring by our project partners in some of the earliest global release sites.

Australia

Monitoring by Queensland Health, in partnership with WMP, found *Wolbachia* present in more than 90% of the 2100 *Aedes aegypti* mosquitoes collected from 48 localities throughout north Queensland, Australia. *Wolbachia* releases had been completed between four and 12 years earlier.

Queensland Health's disease surveillance data shows:

- no dengue outbreaks have occurred in any *Wolbachia*-treated communities of north Queensland
- local dengue transmission has been effectively eliminated from the state, despite an uptick in imported dengue cases since the reopening of international borders in 2022.

Brazil

In the neighbourhood of Jurujuba in Niteroi, Brazil, long-term monitoring found *Wolbachia* to be present in 100% of the *Aedes aegypti* mosquitoes collected eight years after the end of releases. In Niteroi, dengue incidence in 2020–23 is the lowest it has been in 20 years, while many other Brazilian cities have experienced large outbreaks.

Vietnam

In the town of Vinh Luong in central Vietnam, *Wolbachia* was present in 92% of the *Aedes aegypti* mosquitoes collected five years after the end of releases.

Real-world evidence for impact across three continents

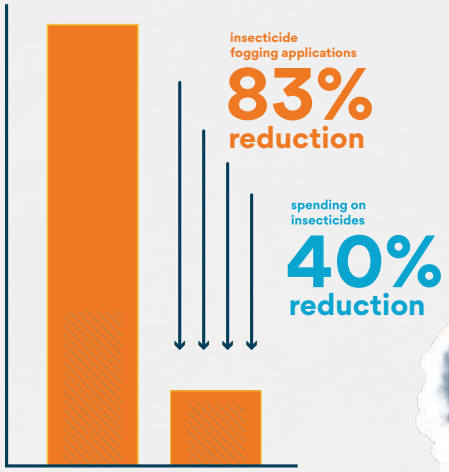
As WMP and our partners expand *Wolbachia* implementation to more cities and countries, we continue to accumulate and publish real-world evidence for the reproducible public health impact and broader benefits of our technology across diverse ecological and epidemiological settings.

In 2023, our evidence portfolio expanded to include:

- publication of the successful area-wide establishment of *Wolbachia* throughout five urban centres in the Pacific Island countries of Fiji, Vanuatu and Kiribati, and preliminary signals of public health impact[6]

- preliminary evidence of reduced dengue incidence in two neighbourhoods of the Sri Lankan capital Colombo, where releases were completed in early 2021, leading the Sri Lanka Ministry of Health to recommend an expanded *Wolbachia* implementation in Colombo,[7] and to re-engage with WMP on these plans

- a dramatic 83% reduction in insecticide fogging applications by vector control teams in the *Wolbachia*-treated neighbourhoods of Yogyakarta during the 2018–20 randomised controlled trial, compared with untreated neighbourhoods. This resulted in a 40% reduction in spending on insecticides by city health authorities in 2018–19 compared with 2016–17 (an annual cost saving of USD$35,000), even before city-wide *Wolbachia* deployments were completed in January 2021.[8]



A local resident and WMP supporter – Vanuatu ▸

GLOBAL ACCESS

Dengue affects over 120 countries[9] and is increasing at an alarming rate as the globe warms. It is estimated to cost the globe USD$9 billion[10] in economic impact today and is expected to worsen in the coming years as globalisation, urbanisation and climate effects continue their onslaught on communities already marginalised with dengue and spread disease to new areas that have never seen dengue before.

estimated to cost the globe

USD$9 BILLION

in economic impact today

The World Mosquito Program featured at COP28's summit in Dubai for the first time in 2023. Climate change advocates and supporters have always focused on finding sustainable energy solutions, but the spill-over consequences on health and particularly on vector-borne diseases became a prominent feature in all climate–health discussions.

With that, the rising issue of dengue provides an opportunity to advocate for the impact of climate change and its health impacts more than ever before.

We are actively speaking to governments and regulators to expand access to *Wolbachia* Replacement Technology and to advocate for change on the international stage. We are engaging with partner NGOs, charities and funders to address the affordability gap to support our projects in low-middle-income countries and low-income countries. We are steadfast in our priorities to support countries that are heavily burdened with dengue and to provide an end-to-end and sustainable solution to establish *Wolbachia* in their environments.

Our business model is to flexibly replicate the outcomes that we have seen across the Yogyakarta randomised controlled trial and our field studies across all other countries, always meeting the main three themes below:

- cost-effectiveness
- community acceptance
- equitable access.

WMP has signed new partnership agreements in new markets in 2023, including El Salvador with funding from the Center for Disease Control and via a partnership with the Puerto Rico Vector Control Unit, and in Honduras with Médecins Sans Frontières (Doctors Without Borders). Both projects were launched in 2023 and will continue until 2024.

However novel our intervention is, we are seeing many countries where *Wolbachia* has been established enjoy reduced dengue incidence and other countries eager to implement *Wolbachia* for their communities. Our funders also recognise that their investments are translating to lasting and impactful outcomes on the ground. Beyond that, it is also about empowering community participation and government collaboration so that under-resourced communities are able to access *Wolbachia* cheaply and effectively, making every dollar of investment have a maximal impact where it really matters.

03.

IMPLEMENTATION

FROM EFFICACY DEMONSTRATION TOWARDS GLOBAL IMPLEMENTATION

MEDIA OUTREACH

WOLBITO DO BRASIL

FROM EFFICACY DEMONSTRATION TOWARDS GLOBAL IMPLEMENTATION

While we continued to accumulate evidence of our method's viability and effectiveness in 2023, we also took steps to prepare for scaling our technology globally.

To protect the greatest number of people in the shortest time possible, the World Mosquito Program is actively transitioning from efficacy demonstration towards scaling our *Wolbachia* method globally. Achieving widespread accessibility of the technology is a strategic imperative, averting tens of millions of disease episodes and preventing millions of hospitalisations, particularly in low-resource settings.

We have already made significant progress and demonstrated our capability through successful delivery of the *Wolbachia* method to millions of people in countries like Brazil, Colombia and Indonesia. In 2023, we established a joint venture in Brazil, which will produce billions of *Wolbachia*-carrying mosquito eggs at our first industrial-scale manufacturing facility. This facility will help us protect tens of millions of people across Brazil from mosquito-borne diseases and demonstrate the effectiveness of our technology on a national scale – a key step in WMP's transition.

We believe that our goal of increasing the scale of this emerging public health intervention will be essential for protecting vulnerable communities. Looking forward, we will increasingly focus on navigating complex regulatory pathways and establishing new technology and distribution partnerships. Global implementation will encompass extensive government and public engagement, securing regulatory approvals, production and distribution infrastructure development and the formation of strategic partnerships. We also believe that integrating with existing public health efforts will increase efficiency and enable the broadest possible impact. The emergence of new innovative funding mechanisms will also unlock additional resources required for governments around the world to safeguard their communities from vector-borne diseases.

> **“ Achieving widespread accessibility of the technology is a strategic imperative.**

Laboratory team members in Rio de Janeiro – Brazil ▸

MEDIA OUTREACH

The World Mosquito Program has developed strong relations with some of the most significant media outlets in the world. In 2023, we saw one of our biggest years yet for global media coverage.

60 Journalists hosted during world conference

Our Medellín facility hosted more than 60 international journalists from 25 countries during the World Conference of Science Journalists in March. The media tour resulted in more than 40 in-depth features.

1.5 BILLION people reached in April–May

Our media coverage reached more than 1.5 billion people between 1 April and 17 May, after our announcement of a partnership between WMP and Fiocruz spiked significant interest.

Widespread coverage

Media interest held pace throughout the year with strategic pitching of articles, opinion pieces, comments and quotes on news stories.

In 2023, we reached 18 billion people through our media outreach, a 206% increase from 2022. WMP featured in more than 4500 articles, a 131% increase from the previous year. When benchmarked against much larger NGOs, our visibility is on par with World Vision and Save the Children.

Highlights included

- World Mosquito Day, which was picked up by some of the biggest outlets in Asia
- our scientific results in Colombia's Aburrá Valley, which generated international attention.

The research was published in PLOS Neglected Tropical Diseases in November, but had already received widespread media coverage from the likes of The Telegraph, Nature, Science and Deutsche Welle earlier in the year.

Several high-profile media trips were organised in 2023. The New York Times visited our projects in Cali and Medellín, resulting in an excellent long-form interactive feature story. Other visitors to our Medellín facility included The Associated Press, France 24 and The British Medical Journal. We rounded off the year with an extensive feature story and short documentary on CEO Scott O'Neill's life and scientific achievements, filmed in Indonesia with Japanese broadcasters NHK Japan.

increase **206%** from 2022

We reached **18 BILLION** people through our media outreach

WMP featured in more than **4.5k articles**

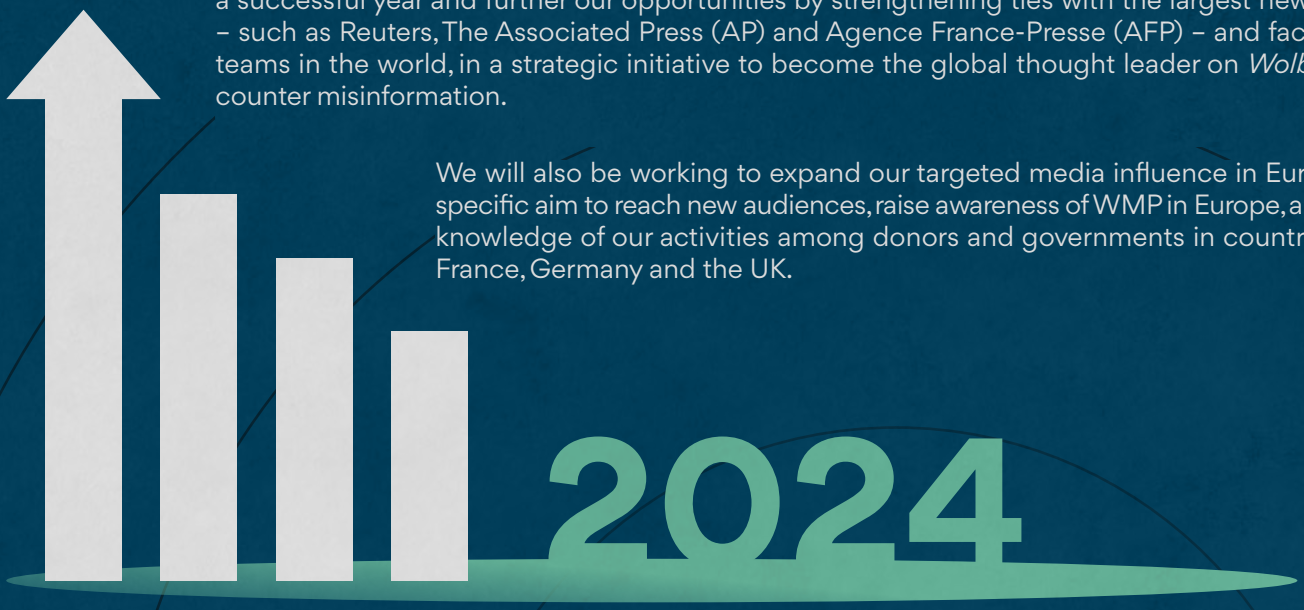
increase **131%** from 2022

Media visibility ranks alongside World Vision, Save the Children and other major NGOs

Growth planned for 2024

Our momentum is growing, with a number of major news outlets highlighting us as 'ones to watch' in 2024, and we will continue to make strategic pitches and nurture new relations. We aim to build on a successful year and further our opportunities by strengthening ties with the largest news agencies – such as Reuters, The Associated Press (AP) and Agence France-Presse (AFP) – and fact-checking teams in the world, in a strategic initiative to become the global thought leader on *Wolbachia* and counter misinformation.

We will also be working to expand our targeted media influence in Europe, with a specific aim to reach new audiences, raise awareness of WMP in Europe, and increase knowledge of our activities among donors and governments in countries such as France, Germany and the UK.



Media highlights in 2023

France 24: ¿Más mosquitos, menos dengue?: Wolbachia, la bacteria que resuelve la ecuación (December 9, 2022)

The Telegraph: Dengue cases fall to 20-year low in region where scientists release 'virus-blocking' mosquitoes - by Sarah Newey (April 11, 2023)

The Associated Press: Special mosquitoes are being bred to fight dengue. How the old enemies are now becoming allies - by María Verza and Maddie Burakoff (September 14, 2023)

The New York Times: Unleashing a New Weapon on the Mosquito: A Mosquito - by Stephanie Nolen and Eleanor Lutz (September 29, 2023)

The British Medical Journal: The mosquito factory fighting disease - by Mun-Keat Looi (October 11, 2023)

Nature: Dengue rates drop after release of modified mosquitoes in Colombia - by Mariana Lenharo (October 27, 2023)

Deutsche Welle: Dengue rates plunged after release of lab-altered mosquitoes - by Clare Roth (October 31, 2023)

Science: Down With Dengue - by Derek Lowe (November 7, 2023)

PLOS Neglected Tropical Diseases 17(11): Reduced dengue incidence following city-wide wMel Wolbachia mosquito releases throughout three Colombian cities: Interrupted time series analysis and a prospective case-control study - by Ivan Dario Velez, Stephanie K Tanamas, Maria Patricia Arbelaez, et al (November 30, 2023)

NHK Japan: Battle Against the Mosquito: Scott O'Neill / CEO, World Mosquito Program (December 7, 2023)

WOLBITO DO BRASIL

NEW JOINT VENTURE PAVES THE WAY FOR NATIONAL DEPLOYMENTS

In 2023, the World Mosquito Program – together with our partners – established a new joint venture to expand access to *Wolbachia* mosquitoes across Brazil and demonstrate the effectiveness of our method on a national scale.

Wolbito do Brasil will produce and sell billions of *Wolbachia*-carrying mosquito eggs and provide deployment services on demand to ensure successful implementation of the technology in the field. This is a critical step towards achieving our purpose, to protect the greatest number of people in the shortest time possible from mosquito-borne diseases transmitted by *Aedes aegypti* such as dengue, Zika, chikungunya and yellow fever.

Incorporated as a joint venture company in December 2023, Wolbito do Brasil S.A. is owned in equal shares by WMP Brasil and Instituto de Biologia Molecular do Paraná (IBMP), a subsidiary of the prestigious Brazilian government research agency Fundação Oswaldo Cruz (Fiocruz). This formal partnership builds on years of collaboration between WMP and Fiocruz, including deployment of *Wolbachia* mosquitoes – known as wolbitos in Brazil – in five Brazilian cities to protect a total of 3.2 million people. The joint venture will help to protect many more Brazilians from mosquito-borne diseases using WMP's innovative *Wolbachia* technology.

> Fiocruz President **Mário Moreira**
>
> **"The idea is that we can immediately expand the current production and to provide wolbitos eggs to the Ministry of Health, state and municipal governments to help control arboviruses in municipalities considered more critical and with high transmission of arboviruses.**

Brazil has the highest number of dengue cases globally, as well as Zika and chikungunya outbreaks, making it a high priority for WMP's intervention. As we demonstrate the scalability of our method across a major country, we also expect other high-priority regions, such as South-East Asia, will seek to replicate this success over the coming decade.

Local surroundings – Niterói (Brazil) ▸

▼ **Mosquito mass production facility** – 3D model

Mosquito mass production facility

In 2022–23, WMP led a major capital project with world-class partners Hatch Engineering (Canada) and Innovafeed (France) to design an industrial-scale mosquito egg facility that will ensure Brazil has an adequate supply of *Wolbachia* mosquito eggs over the next 5–10 years. At over 3000 m^2, it is set to be the largest facility in the world to produce *Wolbachia* mosquitoes and will have the capacity to produce approximately 5 billion eggs per year. Over 10 years of activity, these eggs can help to protect tens of millions of people across Brazil from mosquito-borne diseases transmitted by *Aedes aegypti* such as dengue, Zika, chikungunya and yellow fever.

Beyond the protection provided by *Wolbachia* mosquitoes, the biofactory will bring additional benefits to communities in Brazil. The facility is expected to directly generate approximately 200 new jobs, and indirectly generate an additional 600 jobs. The Wolbito do Brasil biofactory will be located in Curitiba in the State of Paraná, in an industrial complex that contains manufacturing facilities owned and operated by IBMP. After commencement in Q1 2024, construction will continue throughout the year with a ramp-up period through Q4 2024 into Q1 2025. Production facilities will be operational to enable releases in new areas from early 2025.

> **The construction of the Wolbito do Brasil biofactory represents a major advance in the fight against arboviruses in the country.**
>
> **We are experiencing a very challenging epidemiological scenario in relation to dengue and chikungunya and, along with other alternatives, our wolbitos will be able to reduce the impact of these diseases.**
>
> Wolbito do Brasil CEO
> **Luciano Moreira**

Ongoing protection in 2024

As work begins on the mass production facility, deployments of *Wolbachia* mosquitoes will continue throughout Brazil. The Ministry of Health, through the Health and Environment Surveillance Secretariat, announced the implementation of the *Wolbachia* method in six new municipalities:

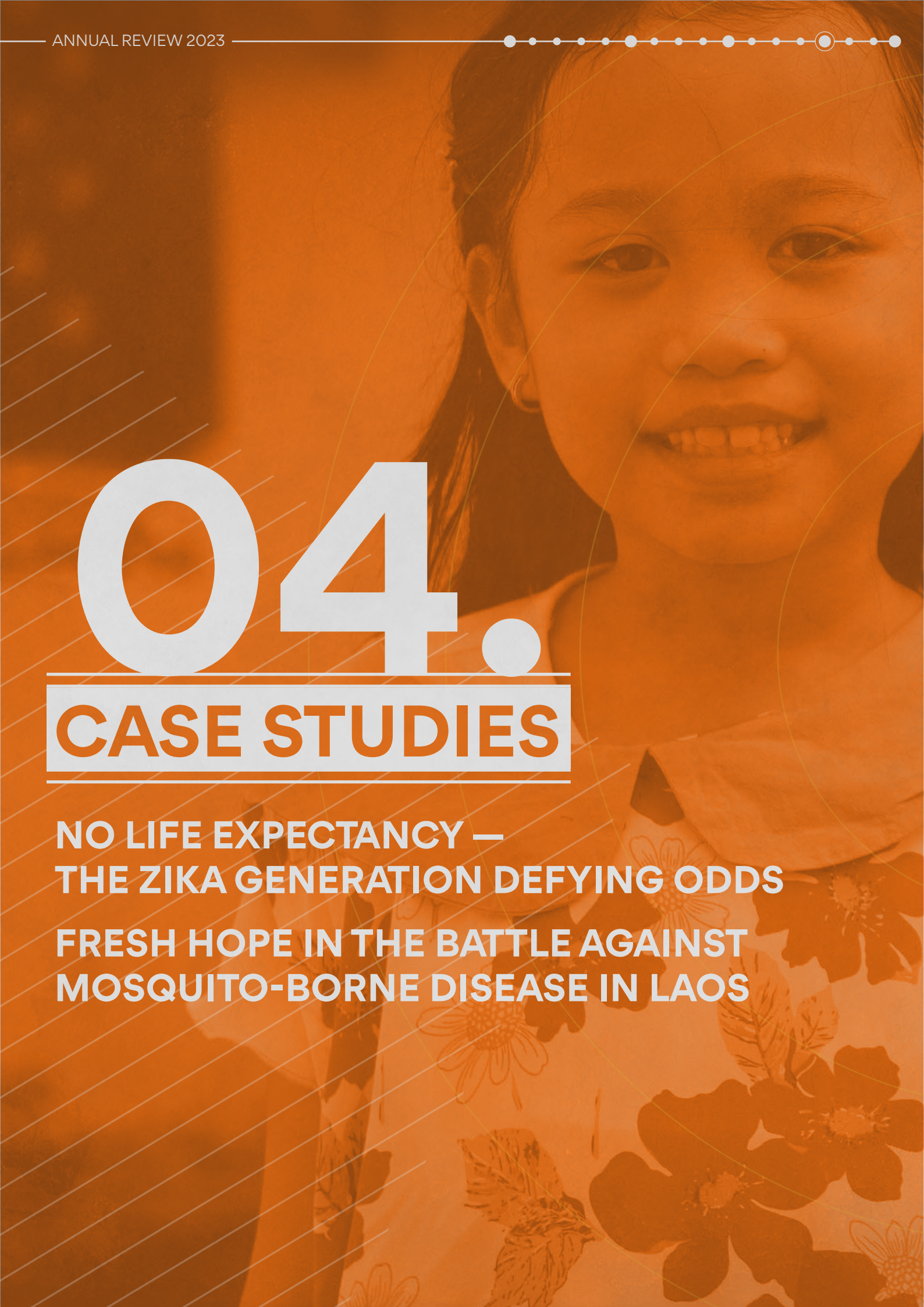
- Joinville (SC)
- Foz do Iguaçu (PR)
- Londrina (PR)
- Presidente Prudente (SP)
- Uberlândia (MG)
- Natal (RN).

By the end of the releases, 1.7 million people in these municipalities will be protected.

By the end of the releases

1.7M people

in these municipalities will be protected.



04.

CASE STUDIES

NO LIFE EXPECTANCY — THE ZIKA GENERATION DEFYING ODDS

FRESH HOPE IN THE BATTLE AGAINST MOSQUITO-BORNE DISEASE IN LAOS

NO LIFE EXPECTANCY

THE ZIKA GENERATION DEFYING ODDS

When an outbreak of the Zika virus swept across El Salvador in 2016, Silvia never thought she'd be one of the many pregnant women who it affected.

"It was a very difficult moment for us," she reflects. "The time came to accept it, to look forward to our daughter's future."

Today, her daughter Francisca is one of many young people in the small Central American country who has defied the odds and lives with the devastating impact of the mosquito-borne illness.

Grappling with Zika outbreak

The Zika virus infection identified in Brazil in May 2015 was found to be associated with Guillain–Barré syndrome, a rare medical condition that affects the nerves, causing numbness, weakness and pain.

The infection swiftly raced through the Americas at lightning speed. And by February 2016, not long before Francisca was born, the virus was declared a public health emergency of international concern by the World Health Organization (WHO).

◂ **Silvia and her daughter** – El Salvador

The link between Zika and microcephaly – a condition where a baby's head is much smaller than expected – alongside other neurological disorders had prompted the WHO to act, and was the first time a mosquito-borne virus was known to cause severe birth defects.

But after the Zika epidemic did not turn into a global pandemic, El Salvador and the rest of the world moved on. To date, a total of 89 countries and territories have reported evidence of mosquito-transmitted Zika infection.

A forgotten generation

Down a dusty dirt track in the verdant surroundings of her home in Metalío, western El Salvador, Silvia recalls how doctors told her Francisca had "no life expectancy."

One of the worst affected countries by the Zika virus, El Salvador reported more than 11,400 suspected cases in 2016. Fearing the consequences of the virus for newborn babies, the Ministry of Health issued its recommendation to women: "Don't get pregnant until 2018."
For a country barely 200 km in length and with one of the strictest abortion laws in the world, Zika hit communities harder than any could have ever imagined.

> **"Don't get pregnant until 2018.**

Silvia was one of more than 350 pregnant women in El Salvador to discover that they and their babies were infected with the virus. Francisca was diagnosed with congenital Zika syndrome, which can cause severe microcephaly, decreased brain tissue, and joints with limited movement.

Many others have difficulty swallowing and breathing, and problems with the retina and optic nerve, as well as other symptoms that emerge as the child grows.

"The doctor told us that Francisca's head was watery and that she won't live long," says Silvia. "She has shown me that she is a very brave person."

The lasting impact of Zika

At that time, health promoters and doctors in Metalío were frantically spreading messages about the risks of Zika – and how to prevent getting infected.

Wilber Stanley Perez remembers the outbreak like it was yesterday. As a health promoter in Metalío, he claims to have reported the first national case of Zika.

NO LIFE EXPECTANCY

THE ZIKA GENERATION DEFYING ODDS

"What surprised me most was the impact," he comments. "And the magnitude of the outbreak on children, who suffered the most."

He recalls how difficult it was supporting families through pregnancy and how one patient personally impacted him.

"She was 26 years old, and her daughter was born with microcephaly, who is alive today, but maintains special care," he says. "The mother and father suffered when they saw her being born and that had a great impact on me because as a health promoter you are very close to the family. People were really afraid of Zika."

In the seven years since the major Zika outbreak, Perez has seen changes in the community in terms of awareness and prevention habits. However, many parents are still in need of regular counselling. He emphasises how prevention education and cleanliness are so important.

"Let's always keep our homes clean, keep the sinks and the yard clean, and avoid these mosquito-borne diseases which are so common here in the coastal area."

Zika origins

Despite the virus still circulating at a low level in Latin America, as well as in Asia, attention and funding has dwindled. No vaccine is yet available for the prevention or treatment of Zika virus infection, and scientists still can't quite get to the bottom of how a virus that was first identified in a Ugandan forest more than 75 years ago, arrived in Brazil in 2015.

Previously, Zika had mostly circulated in monkeys in Africa and Asia. The few rare cases (most notably on the Pacific island of Yap) that were detected in humans were all relatively mild. Yet two distinct waves of possible Zika virus infection extended across the whole of Brazil in 2015 and 2016. More than 1.6 million notified cases were reported, of which over 41,000 were in pregnant women – 1950 confirmed infection-related microcephaly.

"The outbreak was a complicated chess game," says Dr Sylvain Aldighieri, who was the Pan American Health Organization (PAHO) Incident Manager during the epidemic.

"There were many moving parts, all of which were constantly evolving, making it much more challenging for scientists to study and understand."

The epidemic's emergency status was lifted in November 2016. In its aftermath, more than 3700 children were born with birth defects.

A large study, published in *PLOS Medicine*, reported that women infected with Zika virus during early pregnancy were 17 times more likely to have a child with microcephaly. And another in *The New England Journal of Medicine* found that babies born with congenital Zika syndrome were at more than 11 times greater risk of dying during the first three years of life than those born without.

In recent years, other studies have looked at how the Zika virus can halt an embryo's development in the earliest stages of pregnancy, while researchers at the La Jolla Institute for Immunology in the US discovered that the Zika virus can mutate to become more infective – and potentially break through pre-existing immunity.

The research published in *Cell Reports* suggests the virus could easily shift, creating new variants that may prove effective at transmitting the virus, even in countries which have built up immunity from previous outbreaks of the mosquito-borne virus.

Honduran pain

Bordering El Salvador on the north-east, Honduras also saw the repercussions of the outbreak, with more than 32,000 Zika cases in 2016. Valery Desiree Hernandez Lemus was in her early twenties, and heavily pregnant with her son Alessandro at the time.

"I found out through an ultrasound that I had Zika two weeks before he was born," she says from her home in Tegucigalpa, the capital city of Honduras.

"I'd never heard anything about it and didn't know how it was transmitted. I didn't want to believe it until I saw my son was born with microcephaly – I'd never imagined the pain and damage it would cause."

Valery and her son – Honduras ▸

NO LIFE EXPECTANCY

THE ZIKA GENERATION DEFYING ODDS

She recalls the traumatic experience of giving birth. "It was about 12 hours of labour and very traumatic," says Lemus, who was told by doctors that her son was very unlikely to survive birth.

"It was really strange because many of the doctors had never seen a birth like it."

Alessandro is the only child in the family's neighbourhood of Buenos Aires to have been born with microcephaly. Lemus says it was hard at first to know how to treat or take care of him, but that it came with time and continued psychological support.

Lemus now spends time educating people about the health impacts of Zika. She studies public accounting at the local university and takes Alessandro with her everywhere, as many carers are too afraid to take care of him.

"The hardest thing has been to learn to explain to people that children like my son are not sick, that they are just children with disabilities," she says.

World Mosquito Program in El Salvador and Honduras

The World Mosquito Program (WMP) has recently started projects in both El Salvador and Honduras to combat mosquito-borne diseases – such as Zika and dengue – with its groundbreaking *Wolbachia* method.

In June 2023, Médecins Sans Frontières (MSF) in coordination with the Ministry of Health (SESAL), WMP, and the National Autonomous University of Honduras (UNAH) officially launched the "Arbovirus Prevention" project in Tegucigalpa.

WMP's *Wolbachia* method will be deployed in 3.3 km^2 of El Manchén, where incidence rates of mosquito-borne diseases are the highest, and aims to protect close to 87,000 people.

While releases started in August in Honduras, El Salvador's project has just been announced by the El Salvador Ministry of Health (MINSAL), targeting three municipalities including Santa Ana, San Sebastián Salitrillo and Chalchuapa.

External collaborators include the Centers for Disease Control and Prevention (CDC) and the Puerto Rico Vector Control Unit (PRVCU).

> **I hope if another Zika pandemic appears, we will do something. It is not impossible.**
>
> Paediatrician **Claudia Lara**

They will be carrying out surveillance activities and will contribute their perspectives on future implementation in other territories of the region.

WMP's *Wolbachia* releases will cover an estimated area of 31 km^2 and protect close to 382,000 people, with releases expected to start in January 2024 following community approval.

Ongoing efforts to battle Zika

Scientists are in agreement that Zika is unlikely to disappear any time soon and that the world needs to be alert to future outbreaks.

"Zika is still a public health challenge, and we must remain vigilant," says Dr Aldighieri. "Ongoing research is vital – as we understand more about how the Zika virus works and affects cells, we can look forward to a day when scientists eventually find a much-needed vaccine or treatment."

What remains certain is that Zika changes people's lives.

Silvia's greatest hope for Francisca is that she'll one day walk, and be happy and accomplished. As she stretches her daughter's legs to improve movement and relax her muscles, Silvia remains optimistic for the future.

"It fills me with joy to be told how beautiful my baby is," says Silvia smiling. "It's a very nice satisfaction."

FRESH HOPE IN THE BATTLE AGAINST MOSQUITO-BORNE DISEASE IN LAOS

"My hope is to free my country from dengue," asserts Phoutmaly Thammavongsa.

For the past 18 months, the local sweet seller and resident of Vientiane has been one of many volunteers across the capital city of Laos helping in the fight against mosquito-borne diseases.

A year-round threat in the country, dengue cases have reached more than 32,000, with 19 deaths so far in 2023. Many in Vientiane have suffered from dengue in recent years and know only too well the negative impact and knock-on effect the disease can have on both health and finances.

However, there is a real sense of optimism in the capital's Chanthabouly and Xaysettha districts, where the World Mosquito Program (WMP) and Save the Children International (SCI) with the support of the Department of Communicable Disease (DCDC), Lao PDR Ministry of Health (MOH) have recently concluded releases of *Wolbachia* mosquitoes.

Oudomshin and his daughter – Laos

The project, which started in July 2022, covered 32 villages with a combined population of roughly 86,000 people. Public acceptance of the mosquito releases and the willingness of the targeted communities to participate in releasing the mosquitoes was 99%.

Thammavongsa explains, after learning about the project and WMP's *Wolbachia* method, she was keen to get involved.

"The reason I joined this project is because I don't want my community to have dengue any longer," she says. "Dengue has a huge impact on people's lives and can kill. I wanted to volunteer to be an MRC (mosquito release container) host."

In Chanthabouly, Oudomshin knows the impact of dengue too well. Both he and his daughter were affected badly affected by the virus.

"Dengue has had a huge impact on my family," he says. "The high fever was serious along with the extreme body pain. I had no other option but to go to hospital."

The worst was not over for the 40-year-old father when he discovered his daughter, Bella, was also suffering from similar symptoms. At first, the doctors were unsure of her diagnosis. But later tests concluded it was dengue.

"I was so worried and afraid for my daughter because I know there is no medicine to treat dengue," he says. "At the time she told me how much pain she was going through. She had headaches and her body ached."

Oudomshin also volunteered to host an MRC in his home in Siswat village. He says the rainy season in particular brings many mosquitoes to his village and has a big impact on the local economy and health services.

"Dengue not only impacts my family but affects everybody in my community," says Oudomshin. "I feel very happy to help release good mosquitoes in my community. We believe this method will work and I hope that the project will expand to other communities as well as other provinces, so the country's dengue incidence will be reduced in the future.

> **"Dengue not only impacts my family but affects everybody in my community.**

FRESH HOPE IN THE BATTLE AGAINST MOSQUITO-BORNE DISEASE IN LAOS

"When people have dengue, they have to stop working and it also affects our economy and some people might have difficulty with finances. Often the age groups with the highest risk of suffering are children and older people."

In recent news, the Ministry of Health (MoH) reported that a four-year-old girl died from the virus. The health ministry said dengue continued to be a public threat and that people should keep complying with dengue prevention measures, as well as advising provincial health authorities to ensure school environments are clean.

At Vientiane High School, both 15-year-old Voipalin and 12-year-old Souphaxay believe education and awareness of mosquito-borne diseases from a young age are so important.

Voipalin recalls feeling tired with no appetite when she was suffering from dengue. "I've had dengue twice now," she says. "My brother also caught the disease. It's very serious. I missed my friends, school and had to stay in bed for weeks – I was sick for nearly four months."

Souphaxay's best friend was ill and in hospital with dengue for a week. He describes how she was admitted to hospital and missed many classes.

"Everybody can get dengue and I'm very scared of getting it now too," says Souphaxay. "I want every person to be aware of it and protect themselves from getting dengue. I hope in the future less people get the disease and it will no longer be in our country."

Initial monitoring of *Wolbachia* establishment in the project areas is showing promising results. Post-release monitoring will continue for two years to monitor *Wolbachia* frequency in the mosquito population and the dengue incidence using the existing dengue surveillance system in Chanthabouly and Xaysettha districts.

Project coordinator Phoutmany Thammavong thanked the community for their engagement throughout the releases. "We would like to sincerely thank the community in Vientiane Capital for their engagement in the project delivery," she says.

> **"I missed my friends, school and had to stay in bed for weeks.**

"They participated in hosting the mosquito release cups, joined our key events and shared key messages about the *Wolbachia* method. Without their support, we wouldn't have been able to achieve what we have."

At the end of the long-term monitoring period in 2025, the impact of *Wolbachia* on public health outcomes will be assessed and reported to all relevant stakeholders.

Dr Ammaline Vongsitthi, Head of Health and Nutrition with Save the Children International, says the project has been a great partnership between the international children's charity and WMP.

"Save the Children has a long history of working in Laos, so it was excellent to start a new project with WMP battling mosquito-borne diseases in the country," says Dr Vongsitthi. "A big part of the appeal is providing sustainable long-term positive health outcomes for the country. My main hope is the project is successful and that way it can be expanded to other provinces in Laos."

A school student shows support for the World Mosquito Program – Laos ▸

06.

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ACKNOWLEDGEMENTS

WORLD MOSQUITO PROGRAM

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An electronic version is available at https://www.worldmosquitoprogram.org

Please contact us at contact@worldmosquito.org with comments, suggestions or requests.

April 2024

◂ **WMP's executive leadership team** – Bali

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Back to

- Page 12
- Page 12
- Page 12
- Page 12
- Page 12
- Page 15
- Page 15
- Page 15
- Page 16
- Page 16

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