PacMOSSI

Pacific Mosquito Surveillance Strengthening for Impact

ANNUAL REPORT 2023

Dear Friends,

Welcome to our 2023 Annual Report.

Throughout the year, PacMOSSI has been committed to advancing vector surveillance and control efforts in collaboration with Pacific Island countries and territories. We are proud to share the progress made in strengthening regional cooperation, enhancing local capabilities, and addressing the unique challenges posed by vector-borne diseases.

A notable achievement was the successful implementation of an online, self-paced training course, engaging 410 participants from 20 Pacific Island countries. This initiative was complemented by face-to-face training workshops held in Fiji, Papua New Guinea, and Australia, providing critical hands-on training. To further support training, the organization facilitated the shipment of indoor and outdoor spraying equipment, personal protective gear, first aid supplies, and spill containment materials to Pacific Island Countries (PICs).

Significant efforts have been directed toward utilizing local vector surveillance data to inform decision-making. PacMOSSI has funded multiple operational research projects across numerous PICs to address existing vector surveillance gaps and challenges. Additionally, citizen science projects are underway in the Solomon Islands, Fiji, and Kiribati.

In collaboration with Beyond Essential Systems (BES), PacMOSSI is promoting digital data collection through purpose-built apps in Tupaia. These apps cover routine surveillance, operational research data, and information from citizen science projects.

PacMOSSI's Strategic Plan consultancy team has played a pivotal role in reviewing country strategic plans, ensuring alignment with recommended WHO best practices. Ongoing individualized technical support for national planning culminated in the endorsement of a new Samoa national vector response plan.

As we reflect on the accomplishments of 2023, we recognize the invaluable support from our partners, stakeholders, and the dedicated efforts of the PacMOSSI team. Especially, the Australian Government Department of Foreign Affairs and Trade (DFAT) Indo- Pacific Centre for Health Security for support to James Cook University, and the Agence Francaise de Developpement (AFD) and the European Union (EU) for their support to The Pacific Community. Thanks also to all of the institutions and individuals in the PICs and Australia that contributed to making PacMOSSI a success in improving the health of Pacific Islanders.

We look forward to continued collaboration and the opportunity to make a lasting impact on public health in the Pacific. Thank you for your ongoing support, and we trust that the information provided in this report will offer insight into the positive outcomes achieved by PacMOSSI throughout the year.

Warm regards,

PacMOSSI management team

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Program overview

Introduction

The PacMOSSI project is a regional partnership between Pacific Island countries and areas (PICs) and multiple international institutions working to combat mosquito- borne diseases throughout the Pacific. We focus on preventing current and emerging arboviral and parasitic diseases transmitted by *Aedes* and anopheline mosquitoes in PICs such as dengue, chikungunya, Zika virus disease and malaria. The project comprises a series of initiatives jointly coordinated by James Cook University (JCU), the World Health Organization (WHO) and the Pacific Community (SPC), with funding from the Australian and French governments and the European Union.

Our philosophy is to empower Pacific Islanders to do more with their existing resources.

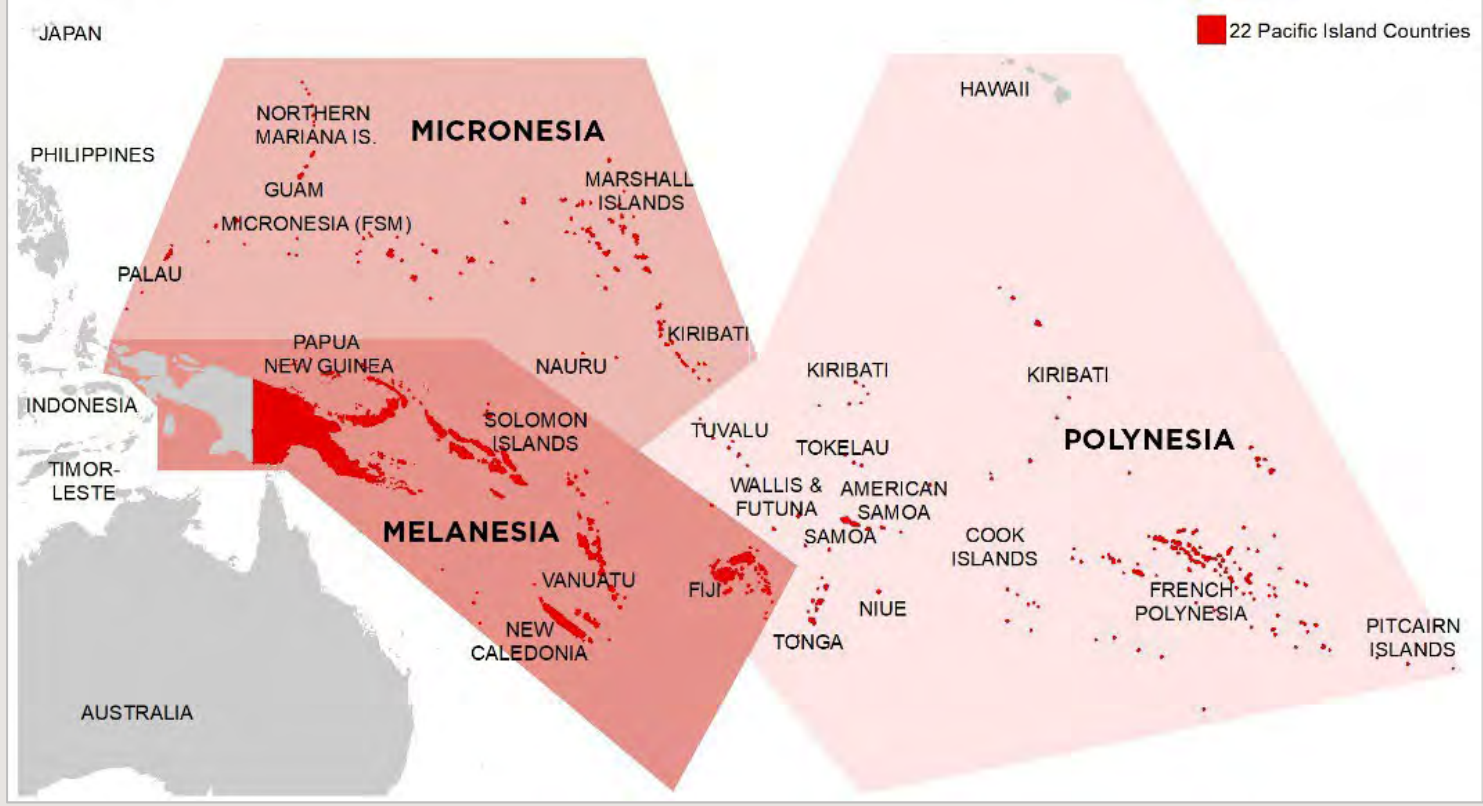
Our goal is to support Pacific Island countries to strengthen vector surveillance and control to prevent, contain and control mosquito-borne diseases and to improve the health and well-being of Pacific communities.

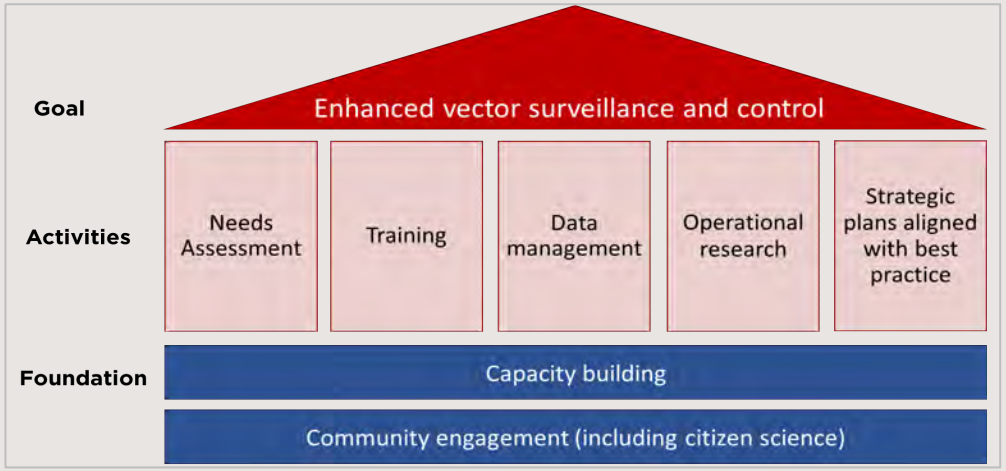
The anticipated outcome is a reduction of vector-borne disease outbreaks and their burden throughout the Pacific through sustainable increased local capacity for informed prevention, containment and effective responses.

This annual report summarises the achievements of PacMOSSI during 2023. PacMOSSI was initiated in 2020, when the COVID-19 pandemic necessitated a radical shift in program implementation to produce a highly successful program that is tackling the limited capacity in vector surveillance and control throughout the region.

The problem of vector borne disease across Pacific Island Countries

The Pacific is home to 11.4 million people residing in 22 countries and territories. The Pacific has seen outbreaks of dengue, chikungunya, Zika virus, malaria and lymphatic filariasis. This has a direct impact on morbidity and mortality and places a heavy toll on the already fragile health systems. Vector control interventions are essential for controlling mosquito-borne diseases. For vector control to be effective, surveillance and control of mosquitoes needs to be adapted to local conditions, aligned with best practices, and implemented by well-trained staff with sufficient equipment and resources.





PacMOSSI activities

The activities of PacMOSSI are designed to comprehensively build capacity across all aspects of vector surveillance and control to address the greatest needs of PICs. The PacMOSSI activities have been designed to all contribute to achieving the PacMOSSI program overarching goal.

The capacity of PIC vector-borne disease control programs

The Vector Control Needs Assessment (VCNA) conducted by the PacMOSSI consortium in 2021 provided a comprehensive overview of the capacity and capabilities of vector surveillance and control programs across 18 Pacific Island Countries (PICs). Vector control activities, range from traditional approaches to advanced technologies like *Wolbachia*-based biocontrol for *Aedes*.

Across the region, substantial variation in the capacity and capability of vector surveillance and control programs was found. A common underlying programmatic limitation was the absence of up-to-date strategic plans for vector surveillance as a framework for decision-making and a lack of well-trained staff, limited equipment and supplies, and limitations in data management and operational research, all of which are needed to support the wide range in surveillance and control activities being implemented by PICs.Training and capacity building were primarily delivered through on-the-job training and regional or international courses.

Notably, community engagement in vector surveillance and control activities was identified as a strength, providing an opportunity to enhance existing and new approaches. The assessment highlighted key areas for improvement, including the development of strategic plans, addressing financial constraints, strengthening governance structures, and enhancing human resources and training to build capacity for effective vector control programs in the Pacific. This information was critical in designing the activities for PacMOSSI action.

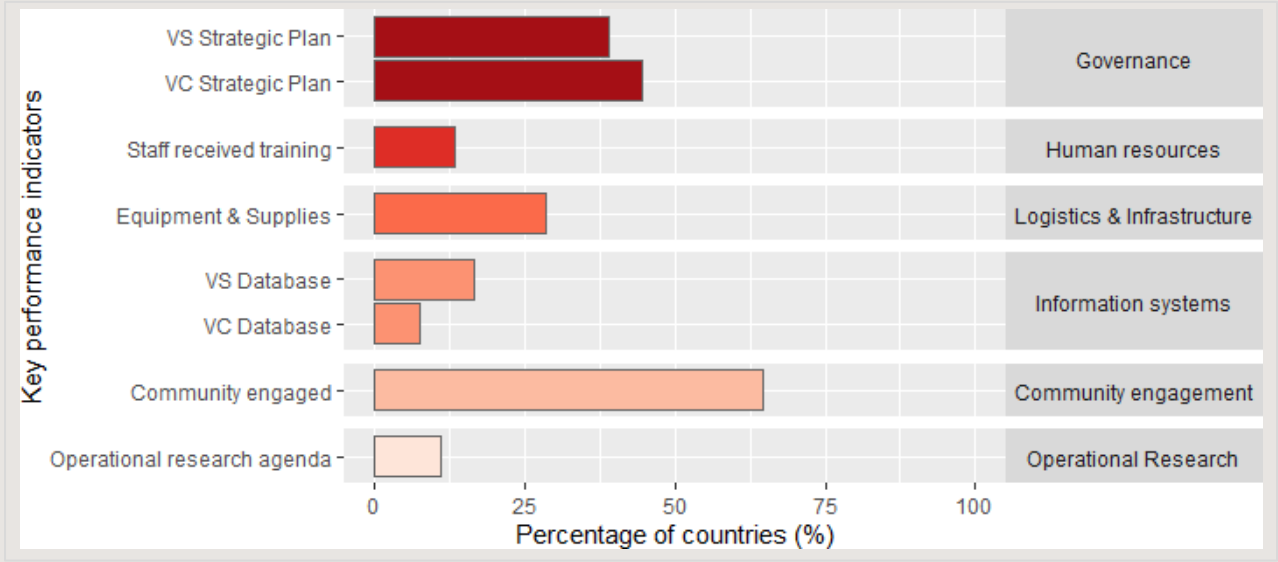


Figure: The capacity of vector surveillance and control programs targeting *Aedes* species assessed against key performance indicators for program health. Percentages were calculated using the number of countries that reported against the indicator as the denominator and the percentage of countries with sufficient capacity as the numerator.

Online vector surveillance and control training

The PacMOSSI online training course in vector surveillance and control was successfully launched in 2022. In 2023 the course was completed with 8 fully online, self-paced learning modules. The training course is tailored to suit the job role and training needs of each participant and is accessible to the visual and hearing impaired. Enrolment is freely available to everyone.

The training modules are highly innovative with case studies, readings, quizzes, videos and animations to help students achieve the learning outcomes (examples shown below). The modules are published online in the Moodle learning management system (LMS) administered by the PacMOSSI management committee. Once enrolled, students have ongoing access to the course to participate in forums and to access reference materials.

The primary audience for the course is Ministry of Health (MoH) operational and managerial staff in PICs; however, the training is also being accessed by other individuals seeking to upskill in vector surveillance and control. Since March 2022, 551 participants from Oceania, Africa, Americas, Asia, Europe, and Middle East enrolled.

Images: Examples of the online vector surveillance and control training course.

Practical training workshops

Mosquito Trapping, Specimen Preparation and Species Identification

The PacMOSSI workshop in Fiji, held from March 27 to March 31, 2023, significantly advanced participant competencies in vector surveillance and mosquito identification. The course was coordinated by the Queensland Institute of Medical Research Berghofer (QIMRB) and the Fijian Ministry of Health and Medical Services. Attended by 21 participants from PacMOSSI member countries, the workshop covered diverse aspects of vector surveillance, emphasizing insecticide resistance assays,

The curriculum, delivered through face-to-face sessions, included hands-on training in mosquito identification and practical case studies. The workshop fostered collaborative learning, networking, and the establishment of a community of practice among professionals from various Pacific nations.

Outcomes encompassed a notable enhancement of skills in vector surveillance and mosquito identification, with participants poised to apply their new knowledge in their countries. The workshop's collaborative spirit contributed to strengthened regional cooperation, aligning with PacMOSSI's objectives of capacity-building and advancing public health agendas in the Pacific.

Images: Photographs taken during the practical training workshop, Fiji 2023.

Practical training workshops

Quality Assurance of Vector Control Products

PacMOSSI supported the Papua New Guinea Institute of Medical Research (PNGIMR) Vector Borne Disease Unit in Madang to conduct a regional training course on quality assurance and post market surveillance of vector control tools (VCT) between Monday 29 May and Saturday 3 June 2023. The course specifically trained health professionals in monitoring and testing the quality and efficacy of VCTs including insecticidal treated nets (ITNs) and indoor residual spraying (IRS).

PNG, Solomon Islands and Vanuatu health ministries/departments get insecticide-treated nets from different manufacturers and therefore testing these products is essential to determine whether they are really treated and efficacious in killing mosquitoes. Eight participants from these 3 malaria endemic PICs attended the training.

The course included theory to build an understanding about the importance of VCT quality assurance, and practical sessions on rearing and handling mosquitoes, and undertaking bioefficacy and chemical testing of VCTs.

Images: Photographs taken during the practical training workshop, PNG May-June 2023.

Practical training workshops

Training of Trainers for Effective Residual Spraying against Aedes

The training-of-trainers workshop was held from 9th to 13th October 2023 in Cairns, Australia. Sessions were held at 3 locations within Cairns: The Boathouse convention room at James Cook University (JCU), Cool Waters Resort, and Goomboora Park.

This workshop developed a cohort of trainers in the Pacific to assist in building spray operator capacity to conduct quality, safe and effective residual spraying. While malaria-endemic countries of the region have used this intervention against *Anopheles* mosquitoes, there is less experience in its use against *Aedes*. This workshop supported the use of this intervention to combat *Aedes*-borne diseases in the Pacific.

In attendance at the workshop were 18 participants from 12 Pacific Island countries and areas, with 11 facilitators from three organisations (James Cook University, Queensland Health, and Goizper Group) providing instruction and guidance.

Images: Photographs taken during the practical training workshop, Cairns October 2023.

In-country mentoring for vector surveillance

PacMOSSI supported QIMR Berghofer partners to provide in-country training on insecticide resistance bioassays using WHO bioassays kits and insecticides in Tonga, from 13th to 15th June 2023.

Eleven participants attended including Ministry of Health and Tongan Vector Control unit staff.

The participants discussed current vector control practices, current WHO PQ listings for insecticides, the insecticide formulations currently in storage in Tonga, and potential responses to outbreaks. The participants and facilitators discussed the challenges of procuring enough larvae and or eggs for the adult insecticide resistance bioassays, reviewed the assay techniques (using YouTube videos). Participants took part in a successful larval survey with most larvae found being *Ae. aegypti*. Nancy Tupou (BES, Tupaia) participated in the training and reviewed larval survey forms.

The larvae collected were used in larval assays for temephos resistance. WHO tube test assays using adults were also conducted.

Images: Photographs taken for the QIMR Berghofer training in Tonga, June 2023.

Enhancing responses to vector-borne disease outbreaks

During 2023 the PacMOSSI program procured and shipped crucial vector surveillance supplies to 17 Pacific countries and Timor-Leste. Aligned with the needs assessment results, standardized equipment packages were supplied to each country identified as requiring entomological supplies.

The first shipments included Ovitraps, BG Sentinel traps, Microscopes, and other equipment and consumables required for robust vector surveillance and control.

Additional shipments of indoor and outdoor spraying equipment, personal protective equipment, first aid and environmental hazard containment supplies were shipped late in 2023.

This strategic approach not only addressed immediate needs but also fortified the long-term capabilities of the participating nations in managing vector-related challenges.

Images: Equipment packages shipped to countries to improve Vector Surveillance and Control capacity.

Citizen science

PacMOSSI has collaborated with the University of New South Wales and the University of Queensland to develop a citizen science initiative to enhance Aedes mosquito surveillance across Pacific nations. The program encourages participants to create mosquito traps at home and collect *Aedes* mosquito eggs. These eggs are sent to in-country health officers for analysis, providing a better understanding of the spatial distribution of potential arboviral-carrying mosquitoes.

The citizen science initiative is currently operational in Solomon Islands and Kiribati, with plans to commence in Fiji. The initiative is tailored to meet specific needs and leverage local opportunities in each country. In Solomon Islands, the initiative is integrated into the public health degree program of the Solomon Island National University (SINU). The program has successfully engaged 340 high school students, who have reared 916 mosquitoes to adulthood and identified *Aedes albopictus* and *Aedes aegypti* mosquitoes in various locations. In Kiribati, village nurses led the initiative, engaging 30 households in South Tarawa. A knowledge-attitude-practice survey found that engagement in a two-way dialogue about arboviral transmission and risk was motivating and led to increased knowledge and behavior change among participants.

The citizen science initiative not only emphasizes community-driven strategies in disease surveillance but also demonstrates a commitment to south-to-south mentoring. The mentoring effort in Kiribati, led by experienced Hugo Bugoro from SINU and Adam Craig from UQ, focused on supporting citizen science and enhancing local capacity in vector surveillance techniques.

Images: Photographs taken during the face-to-face Citizen Science training in Kiribati in October 2023.

Improved data management and use

BES actively supports the PacMOSSI project through its Tupaia platform, utilizing the MediTrak digital survey tool for real-time reporting on tupaia.org. Developed collaboratively with partners and in-country vector surveillance teams, standardized digital data collection forms cover adult mosquito collection, larval surveillance, insecticide resistance assays, and product efficacy monitoring.

In 2023, six countries submitted PacMOSSI-related surveys, with BES providing in-country support and training in four nations. Further, subject matter experts from QIMRB conducted a MediTrak pilot in Tonga, focusing on insecticide resistance bioassay training. Adaptations to existing data collection forms were made for a PacMOSSI Operational Research project exploring the efficacy of mosquito trapping methods in six countries, with the modified form showcased in online demonstrations in September 2023.

Tupaia now hosts 23 surveys, 26 dashboards, and 39 map overlays dedicated to PacMOSSI projects. In a significant enhancement in August 2023, QR code functionality was integrated into Tupaia, allowing mosquito traps to be labeled with distinct QR codes. This feature simplifies the retrieval of unique codes for geotagged traps or field stations by scanning within the Meditrak mosquito analysis survey. The QR code functionality was demonstrated in preparation for a pilot test in Fiji's Environmental Health Unit under their Citizen Science project in September 2023. BES's commitment to innovation also extended to the introduction of DataTrak, a desktop version of the MediTrak survey tool, in November 2023, further facilitating data collection for projects like PacMOSSI.

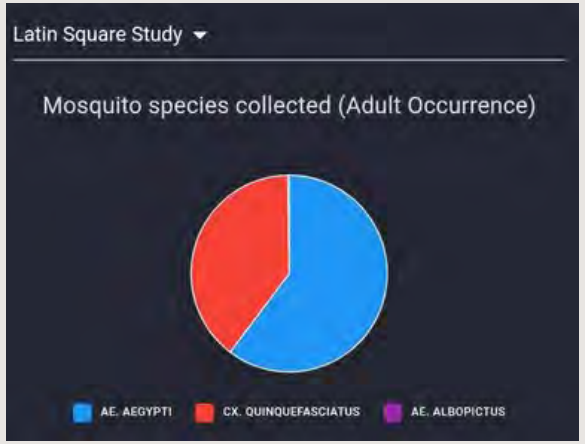


Image source: Tupaia MediTrak surveys and dashboard pie chart.

Supporting country-led operational research

PacMOSSI is actively promoting Operational Research (OR) through a multifaceted approach. In addition to providing a comprehensive training module, the initiative has established a Small Grants Scheme to facilitate country-led OR projects, a multi-country Operational Research project, and in-country mentoring to foster collaboration and capacity building.

The Small Grants Scheme, launched in conjunction with the PacMOSSI Operational Research training module, serves as a critical avenue for Pacific Island Countries (PICs) officers to design, implement, and report on practical and relevant operational research projects. The scheme has successfully funded seven projects across the Pacific Islands involving Kiribati, Marshall Islands, Palau, Papua New Guinea, the Solomon Island and Vanuatu. Each project contributes unique insights, collectively advancing vector control and surveillance strategies in the Pacific region.

Furthermore, PacMOSSI is steering a significant multi-country OR project focusing on the feasibility and performance of three Aedes mosquito sampling methods. This collaborative effort involves six countries—Kiribati, Samoa, Tonga, Cook Islands, Fiji, and Solomon Islands. The project aims to provide valuable insights that will shape policy and program decisions regarding the selection of optimal traps for routine and survey-based mosquito surveillance in the Pacific.

The operational research endeavors are complemented by in-country mentoring, exemplified by Tessa Knox's visit to Vanuatu and Adam Craig's visit to Kiribati. These meetings play a crucial role in fine-tuning project proposals, facilitating research and ethics clearance, and ensuring alignment with financial protocols. By fostering individual projects and a collaborative regional initiative, PacMOSSI is actively contributing to the enhancement of vector surveillance and control strategies across the Pacific Islands.

Images: Photographs of the Multi-Country Operational Research project implementation, trapping methods

Alignment of country strategic plans with best practice

PacMOSSI's strategic planning efforts are developing effective vector surveillance and control plans in PICs. With support from the Bill and Melinda Gates Foundation, a "*Framework for National Vector Surveillance and Control Plans in the Pacific*" was crafted as a cornerstone for strategic plan guidance. This involved a thorough review of country-specific plans, culminating in a regional workshop with representatives from 14 Pacific Islands to enhance their national plans.

The strategic planning aimed to align evidence-based plans with WHO recommendations that are tailored to each nation's unique attributes. Individualized alignment support was provided to Samoa, Tonga, Vanuatu, Solomon Islands, and Fiji. Samoa, Fiji, Vanuatu and Tonga have made significant progress or completed their plans. Samoa officially launched its *National Strategic Plan for the Control of Mosquitoes and Mosquito-Borne Diseases* on November 30, 2023 during the 15th Annual Health Sector Forum, marking the first time that Samoa has a national strategic plan focused on vector surveillance and control activities. PacMOSSI is providing ongoing support for Fiji and Tonga to finalize their plans by early 2024, to advance vector control efforts in the Pacific.

PacMOSSI remains focused on providing support to countries in their strategic planning endeavours.

Top image: Launch of the Samoa National Strategic Plan, November 2023.
Bottom image: Meeting with Tonga MoH and stakeholders for development of the Tonga Strategic Plan, March 2023.

Sustainability of our approach

The PacMOSSI approach prioritizes sustainability by empowering countries to take charge of their own long-term strategic plans. This includes implementing measures to minimize transmission risk, prevent or contain incursions of introduced mosquitoes, and engage the community to transition from a vertical to a more horizontal program. Effective planning and response based on local data is also encouraged. Through strategic planning, policy reform can be facilitated, resulting in deep and lasting transformations.

Limitations and gaps in program capacity identified in the vector control needs assessment were addressed in 2023 through:

Training in vector surveillance and control staff through:

- Online interactive training portal
- Regional face-to-face workshops
- South-to-south mentoring
- In-country “one-on-one” training

Boosting equipment and supplies through:

- Provision of surveillance and control supplies identified in the vector control needs assessment
- Maintenance of a stockpile of vector-borne diseases outbreak response equipment and supplies

Boosting human resources through:

- Citizen science projects

Improving evidence-based strategic plans through:

- Mentoring to develop or update plans aligned with WHO recommended best practices
- Support for operational research grants to address program limitations

Achievements

Meetings and presentations

The PacMOSSI Annual meeting was in Nadi, Fiji 9-10 May 2023 and bought together representatives from 12 Pacific Island Countries. The meeting showcased the latest work of Pacific Island Countries in mosquito surveillance and control and raised awareness of the need to enhance preparedness for future mosquito-borne disease outbreaks.

Other meetings attended by PacMOSSI representatives:

- Pacific Vector Network meeting in Hawaii in June 2023.
- Digital Health Forum hosted by BES in Nadi, Fiji.
- The Asia-Pacific conference on Mosquito and Vector Control in Chiang Mai, 27-30 November 2023.
- The regional medical entomology training at the Pasteur Institute of New Caledonia in December 2023.

Resources

- A guide to mosquitoes in the Pacific
- Adult identification key
- Training of the trainers guide for vector control
- Framework for national surveillance and control of *Aedes* vectors in the Pacific
- Standard operating procedures for vector surveillance
- Operational research guide

Online vector surveillance and control training

The PacMOSSI online training course in vector surveillance and control now has over 410 participants from Oceania (including Australia) enrolled. To date, 65 participants from Pacific regions have completed the first 5 modules of the course.

Practical training workshops

Several face-to-face vector surveillance and control training workshops have been conducted during 2023:

- A workshop on vector surveillance and mosquito identification was held in Fiji 27-31 March 2023 with 21 participants.
- A workshop on quality assurance of vector control products to was held in Madang, Papua New Guinea, in late May – early June 2023 and attended by 8 participants from PNG, Solomon Islands, and Vanuatu.
- A “train the trainer” workshop covering Indoor Residual Spraying was held in Cairns in October 2023 with 18 participants.

Enhancing responses to vector disease outbreaks

Standardised packages of Vector surveillance equipment were procured and shipped to 17 Pacific Island countries and Timor-Leste, supported by the results of the needs assessment which assisted to identify which countries required entomological supplies. Additionally, indoor and outdoor spraying equipment and personal protective equipment , first aid kits and environmental hazard containment supplies are currently being shipped.

Citizen science

The citizen science pilot study has successfully commenced in three countries, Solomon Islands, Fiji, and Kiribati. A PacMOSSI Ovitrap Analysis digital data collection form was programmed into Tupaia by BES to capture key components of this Citizen Science activity including egg trapping, larvae rearing and mosquito identification.

Data management

BES has provided in-country support/training for PacMOSSI to four countries, and six countries are actively using Tupaia for vector surveillance.

Tupaia now has 23 separate surveys, 26 dashboards and 39 map overlays for PacMOSSI projects. A desktop version of the MediTrak survey tool was released, known as DataTrak, and new QR code functionality was integrated into Tupaia allowing labelling of mosquito traps with distinct QR codes.

Operational Research

The operational research grant scheme was launched and two calls for country led Operational Research proposals were made, with seven projects from six Pacific Island countries awarded small grant funding to assist with implementation.

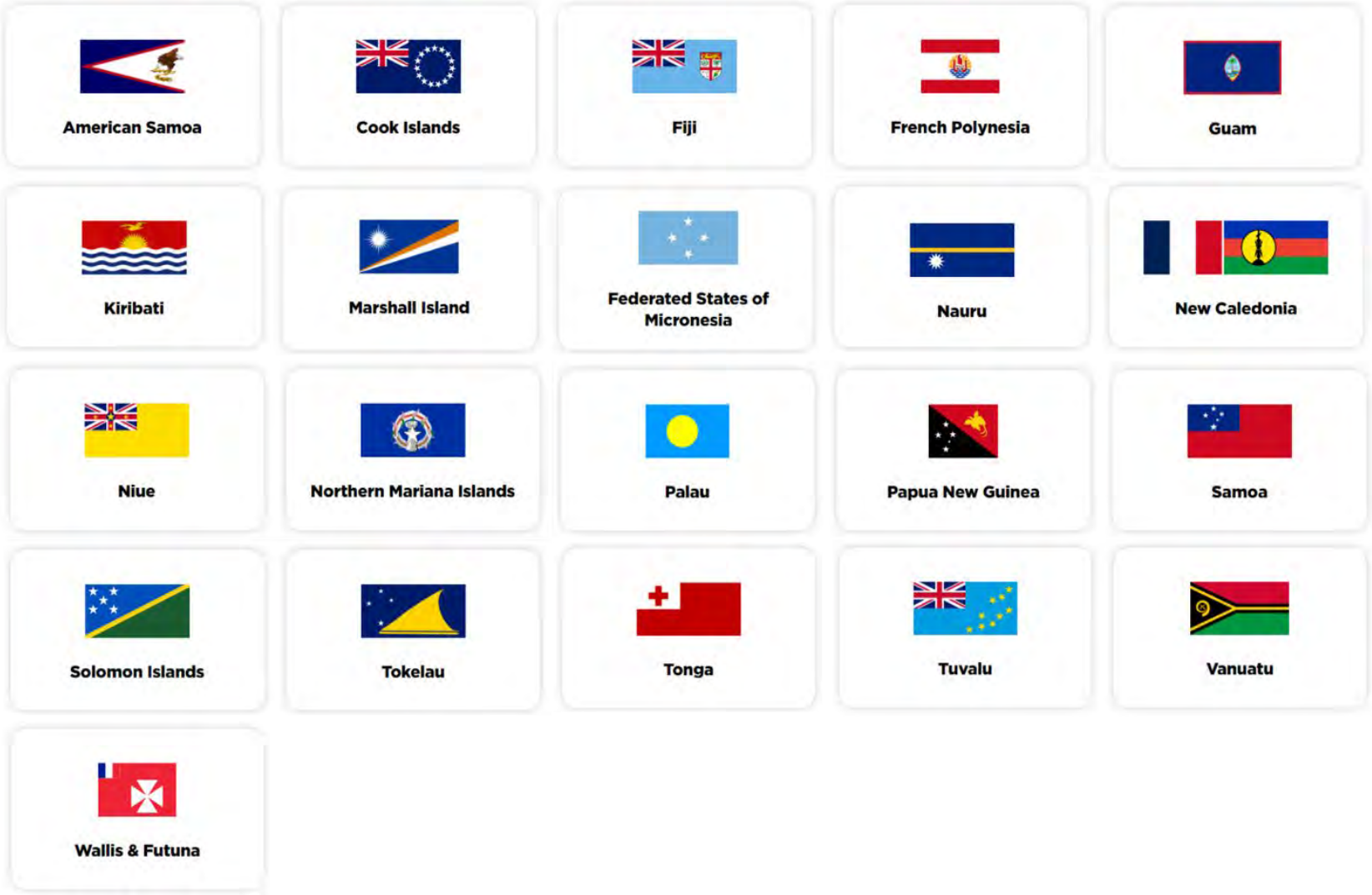
In addition, PacMOSSI is supporting a multi-country Operational Research project to compare the feasibility and performance of three different *Aedes* sampling methods in the Pacific. The findings of this study will inform policy and program decisions relating to optimal traps for routine and survey-based mosquito surveillance across the Pacific Islands. Six countries are involved in this initiative.

Country strategic plans

Individualised Alignment Support was provided to countries Samoa, Tonga, Vanuatu, Solomon Islands, and Fiji. Samoa officially launched its National Strategic Plan for the Control of Mosquitoes and Mosquito-Borne Diseases during the 15th Annual Health Sector Forum in November 2023. Notably, Samoa, Fiji, Vanuatu, and Tonga have made significant progress or completed their plans.

Project implementation

Pacific Island Countries



Institutional partners

Donors

Cross-cutting issues

Gender

PacMOSSI training course is now available online, making it accessible to anyone regardless of gender, disability status, or position in vector surveillance and control programs. Overall, 60% of registrations from the Pacific region were female, with females completing 58% of the 625 modules completed by the 410 participants from the Pacific region.

Both male and female participants were included in face-to-face training courses:

- Vector Surveillance and Mosquito ID training, Fiji, March 2023 – 8 of 21 participants were female (38%)
- Insecticide Resistance testing, Tonga, June 2023 – 5 of 11 trainees were female (45%)
- Quality Assurance of Vector Control products training, Madang PNG May-June 2023 – 2 of 8 trainees were female (20%)
- Indoor Residual Spray training, Cairns, October 2023 – 8 of 18 trainees were female (45%)

Disability Inclusion

Vision and hearing impared – all online resources are “accessible”. Accessible documents can be read by screen readers. Further, the narration and slide content are available in a large font size. Training is available to physically disabled people.

Inclusion for data management apps – low contrast colours are used during app design. The data collection apps are available for use by physically disabled people.

Strategic plans – gender and disability inclusion are integral cross-cutting issues included when updating country strategic plans with different pathways for inclusion highlighted in the strategic planning workshops.

Climate Responsiveness

Mosquito borne diseases are impacted by both climate (temperature and rainfall are key drivers of mosquito vector population dynamics) and associated national disasters in which protection from mosquitoes is diminished by housing degradation coupled with mosquito populations often increasing. Climate change increases the frequency and severity of extreme weather events, which may increase the frequency and severity of mosquito borne disease outbreaks.

Emergency responses to national disasters inform the core of the operational priorities and vector control modules. The updated country surveillance and control plans being developed includes guidance on vector surveillance and control in response to climate change and natural disasters.

www.pacmossi.org

Thank you to all involved in making PacMOSSI a success