Learning Across Vector-Borne Diseases:

Transferable Lessons for Malaria Elimination

APMEN Case Study

APMEN | Asia Pacific Malaria Elimination Network

malaria consortium

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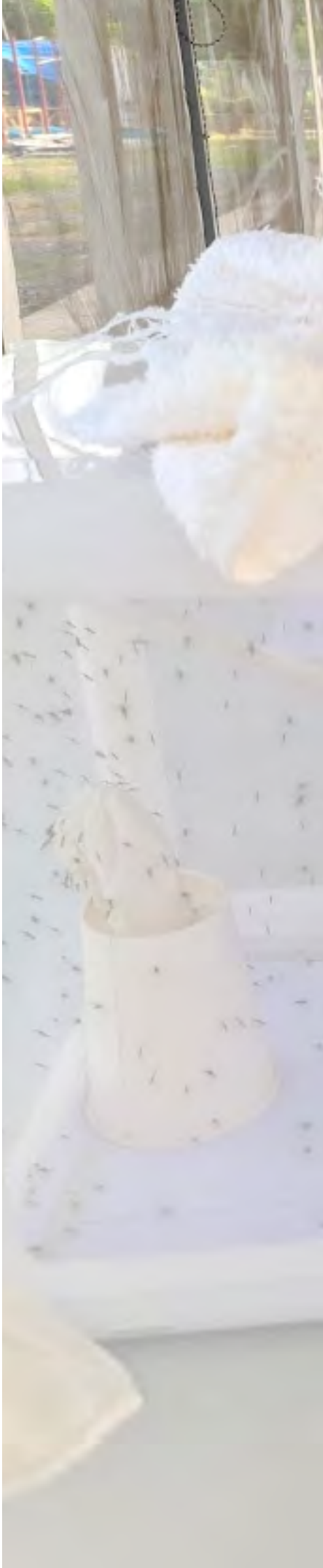

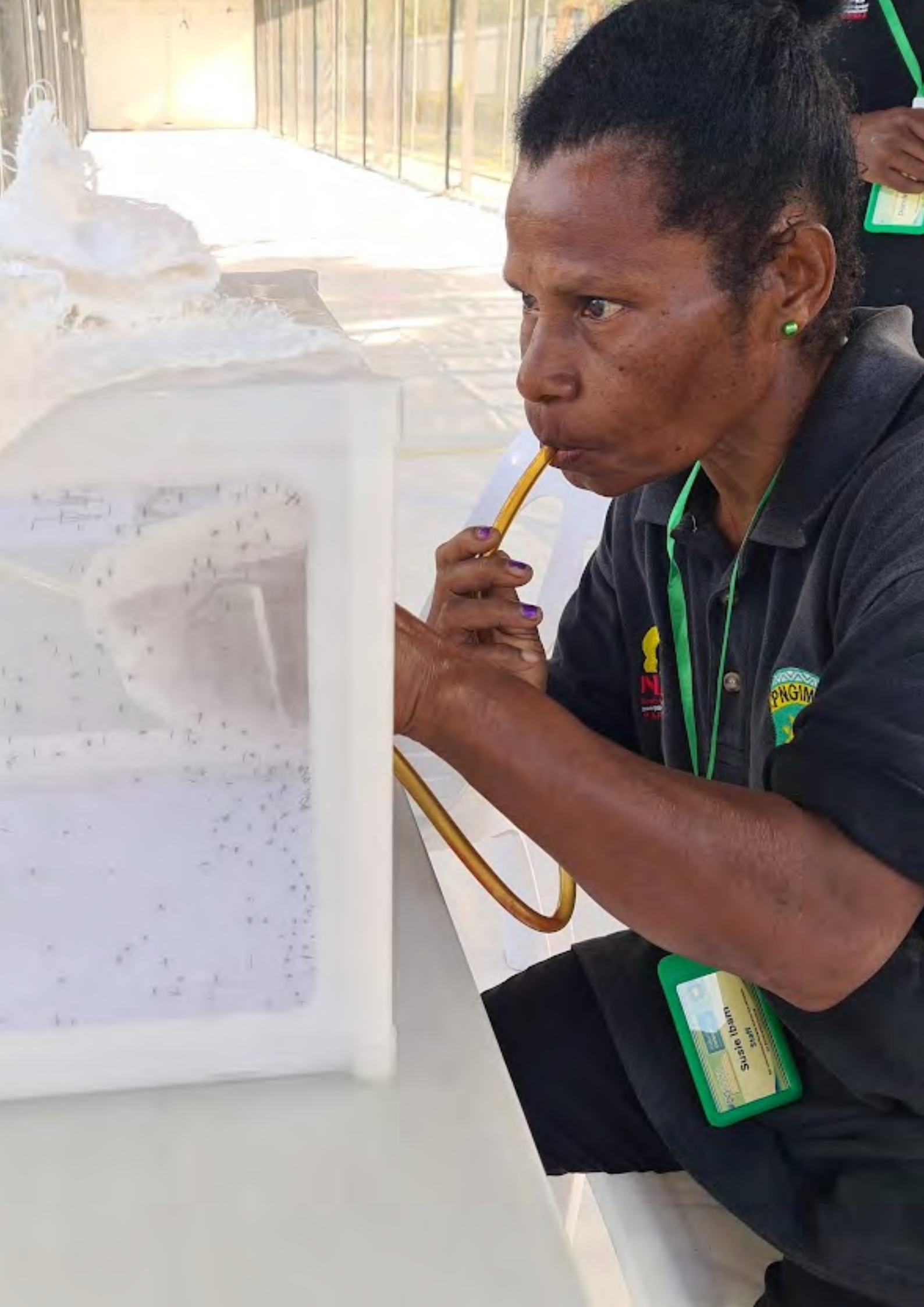
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I. Executive Summary

Malaria elimination programmes across the Asia Pacific are entering an increasingly complex phase, where progress depends less on scaling standard interventions and more on strengthening systems that can detect, respond, and adapt to evolving transmission dynamics. At the same time, arboviral diseases such as dengue, chikungunya, and Zika have expanded in both scale and geographic range, prompting the development of innovative approaches in surveillance, outbreak preparedness, vector control, and community engagement.

This case study examines how experiences from arbovirus and other vector-borne disease (VBD) programmes can inform and strengthen malaria elimination efforts. Drawing on regional initiatives, technical exchanges, and expert insights gathered through APMEN, it identifies key areas where approaches developed for arboviruses offer practical and transferable lessons for malaria programmes, particularly in low-transmission and prevention-of-re-establishment settings.

The analysis highlights that the most valuable lessons are not disease-specific tools but system-level approaches. These include integrated surveillance that combines epidemiological, entomological, and environmental data; climate-informed early warning systems that support timely preparedness; community engagement models that place behaviour at the centre of control efforts; and locally tailored vector control strategies adapted to diverse ecological contexts. Arbovirus programmes also demonstrate the importance of sustained vector surveillance, rapid response mechanisms linked to operational decision-making, and institutional learning through structured post-event reviews.

For malaria programmes, these experiences reinforce a critical shift toward more adaptive, integrated, and people-centred systems. By selectively drawing on relevant approaches from other VBD programmes, malaria elimination efforts can strengthen resilience, improve efficiency, and sustain gains in increasingly complex transmission settings.

II. Background and Rationale

Vector-borne diseases remain among the most complex public health challenges, shaped by dynamic interactions between vectors, pathogens, human behaviour, environmental change, and health system capacity. While malaria control efforts have achieved significant progress over the past two decades, many countries in the Asia Pacific now face a distinct set of challenges associated with elimination. Transmission is becoming increasingly heterogeneous, often concentrated among mobile, remote, forest-going, and underserved populations, while environmental and socioeconomic changes are reshaping the conditions that enable transmission to persist.

At the same time, arboviral diseases have expanded in scale and intensity across the region. Dengue, chikungunya, and Zika have demonstrated the capacity to spread rapidly in urban and peri-urban environments, placing sustained pressure on public health systems. In response, arbovirus programmes have evolved quickly, developing innovative approaches to surveillance, early warning, community engagement, and vector control.

Despite differences in parasite biology and vector behaviour, malaria and arboviral diseases share important operational challenges. These include the need to detect outbreaks early, understand vector ecology in changing environments, coordinate across sectors, and engage communities in sustained behaviour change. Increasingly, the same health systems, laboratories, and vector control units are responsible for managing multiple mosquito-borne diseases, creating both challenges and opportunities for integration.

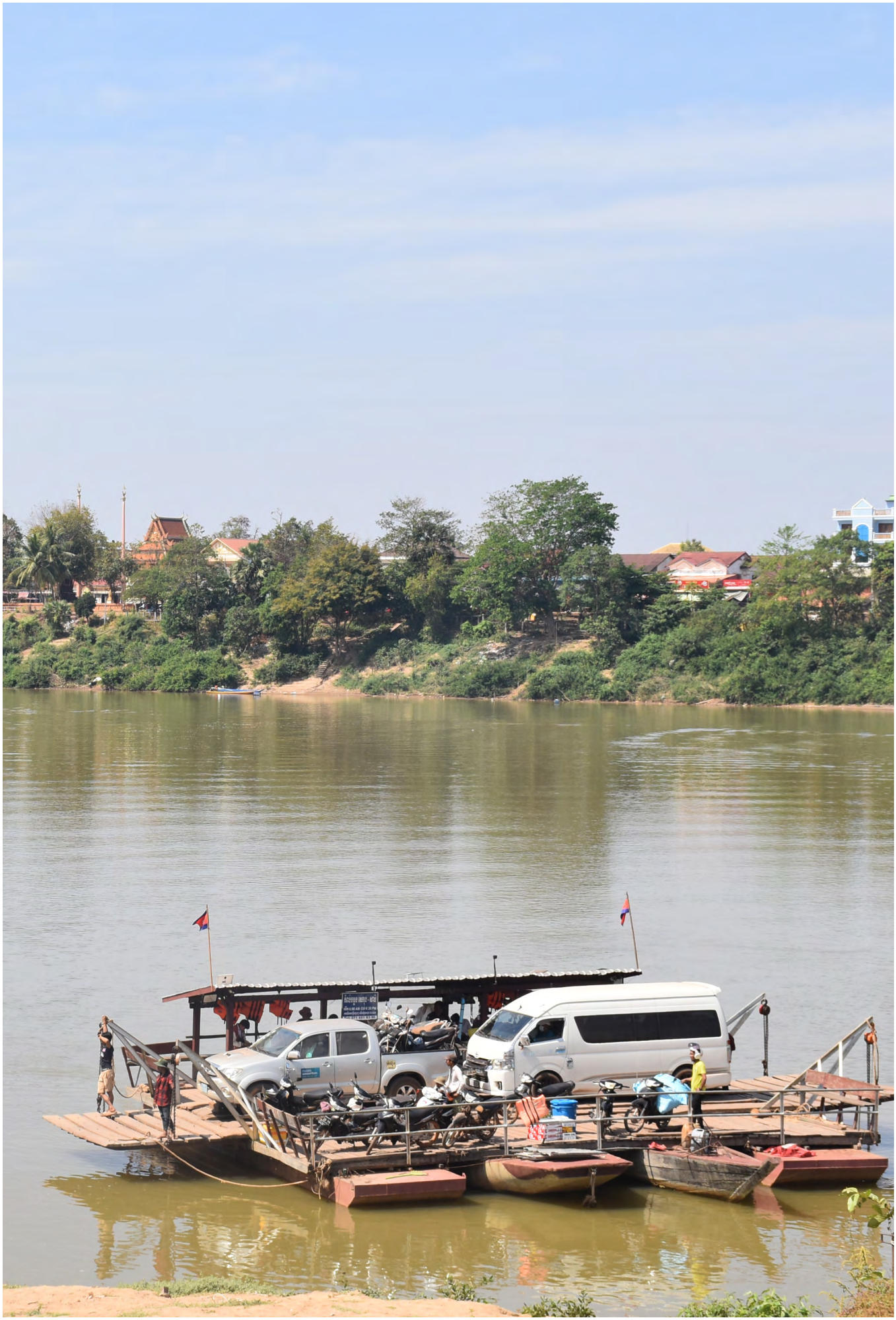
This convergence has created a clear opportunity for cross-disease learning. Rather than operating in isolation, malaria programmes stand to benefit from examining how arbovirus and other VBD programmes have addressed similar system-level challenges. The objective of this case study is therefore not to replicate arbovirus strategies wholesale, but to identify practical, adaptable approaches that can strengthen malaria elimination efforts across the diverse contexts of APMEN member states.

III. Conceptual Framing: From Vertical Programmes to Integrated Systems

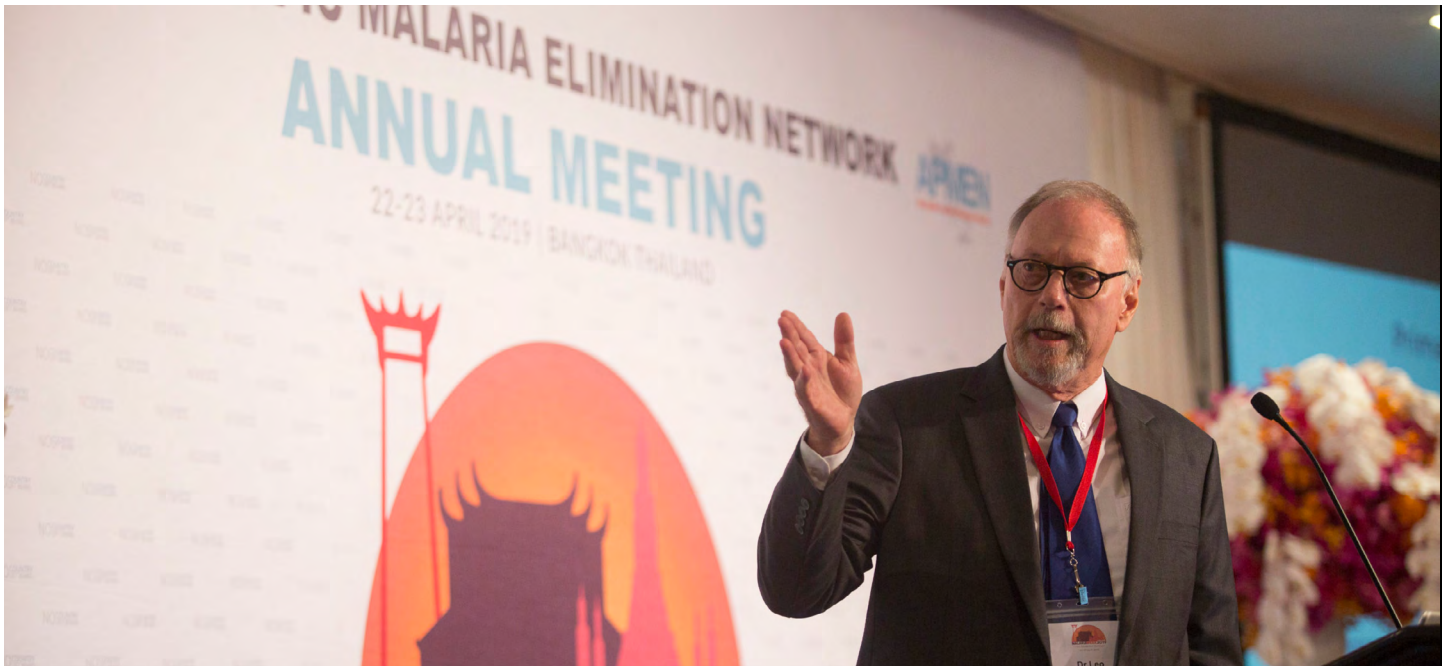
Historically, disease control programmes have been organised around vertical, disease-specific structures, with dedicated systems for surveillance, vector control, and response. While this approach has delivered important gains, it can also produce fragmentation, duplication of effort, and inefficiency, particularly in settings where multiple vector-borne diseases coexist and where health system resources are constrained.

Many arbovirus programmes have increasingly moved toward integrated approaches, recognising that surveillance infrastructure, entomological capacity, and operational responses can be shared across diseases. This transition is most evident in the development of multi-disease surveillance platforms that consolidate epidemiological, entomological, environmental, and climate data within a single analytical framework. Rather than treating surveillance as a passive reporting function, integrated models position it as an active component of control that informs decision-making and triggers proportionate response.

This shift reflects a broader evolution from intervention-focused programmes toward system-oriented approaches. Vector control in this framing is no longer limited to standard tools applied uniformly, but is adapted to local ecological and social contexts and incorporates environmental management, community action, and targeted operational planning. For malaria elimination programmes, this framing raises a central question: which elements of these integrated approaches are most relevant to malaria, and how can they be meaningfully adapted to different operational contexts? The sections that follow address this question by examining key experiences from arbovirus and VBD programmes and drawing out their implications for malaria elimination.



IV. Key Case Experiences and Transferable Lessons



4.1 Integrated Surveillance Systems

A defining feature of modern arbovirus control has been the shift from disease-specific surveillance toward integrated, multi-disease systems. These platforms combine epidemiological, entomological, environmental, and climate data to provide a more comprehensive understanding of transmission risk. In several settings, arbovirus and malaria surveillance have been linked through shared institutional structures responsible for monitoring multiple mosquito-borne diseases.

Singapore provides a strong regional example. The National Environment Agency operates an integrated surveillance system, the NEA Dengue and Zika Programme, that combines epidemiological monitoring, entomological data, geospatial analysis, and environmental inspections to support risk-based interventions and rapid response. The Philippines offers a complementary model through the Philippine Integrated Disease Surveillance and Response (PIDSR) system, which consolidates reporting for notifiable diseases, including dengue and malaria, across all levels of the health system. This unified platform supports timely outbreak detection and response in diverse settings, including island provinces where malaria transmission risk remains.

For malaria programmes approaching elimination, these experiences highlight the importance of treating surveillance as a core intervention rather than a routine reporting function. Integrated systems enable earlier detection of outbreaks and importation-related risks while improving efficiency through shared infrastructure, expertise, and resources across vector-borne disease programmes.

4.2 Climate and Environmental Intelligence

Arboviral disease programmes have been at the forefront of developing climate-informed early warning systems that integrate meteorological, environmental, epidemiological, and entomological data to anticipate periods of elevated transmission risk. These systems are designed not only to predict outbreaks but to link early warning signals directly to predefined, operationally actionable responses.

Viet Nam's UNDP-supported Integrated Early Warning System for Dengue illustrates how satellite-derived precipitation and atmospheric pressure data can be combined with health and environmental information to generate subnational dengue forecasts, enabling authorities to act before transmission peaks occur. This approach exemplifies the shift from reactive outbreak response toward anticipatory preparedness. APMEN's own TechTalks webinar on dengue early warning systems further demonstrates the strong regional interest in translating these experiences to malaria across the Asia Pacific.

For malaria programmes operating in seasonal or climate-sensitive environments, the principal lesson is the practical use of climate information to drive decisions at the right time. Early detection of weak epidemiological signals consistently proves more operationally valuable than long-range forecasts, and early warning systems only deliver results when directly linked to specific response actions such as intensified surveillance, or targeted vector control.

4.3 Community Engagement and Behaviour-Driven Control

A distinguishing feature of effective arbovirus control programmes is the central role accorded to community engagement. Because Aedes arbovirus vector mosquitoes breed primarily in domestic and peri-domestic environments, sustained behaviour change at the household and community level is indispensable to control. Arbovirus programmes have consequently moved beyond one-off awareness campaigns toward continuous, participatory approaches that foster local ownership and accountability over the long term.

Vietnam's dengue control programme illustrates how community participation can be institutionalised through regular clean-up campaigns, household-level source reduction activities, school-based engagement, and local volunteer networks. These efforts have helped embed vector control behaviours within communities as sustained practices rather than temporary outbreak responses. Key programme approaches and scientific findings are documented in peer-reviewed literature, including work published in The Lancet, and are further contextualised within the WHO Global Vector Control Response 2017-2030.

For malaria programmes in elimination settings, this experience reinforces the need to reposition community engagement as a core programme component, not a supplementary activity. As transmission declines, risk perception often diminishes, making it increasingly difficult to sustain preventive behaviours and prompt care-seeking. This lesson carries particular urgency in settings where residual malaria transmission persists among mobile, forest-going, and marginalised populations, where technical solutions alone are insufficient and programmes must engage communities as genuine partners.

4.4 Larval Source Management and Urban Vector Control

Arbovirus programmes have built substantial experience in managing vectors across complex urban and peri-urban environments, where Aedes mosquitoes exploit small, often transient water containers in close proximity to human settlements. Control strategies accordingly emphasise larval source management, including source reduction, environmental sanitation, and targeted larviciding, underpinned by community participation and active local government engagement.

Singapore's programme is well-documented in peer-reviewed literature as a model of how environmental management, urban planning, regulatory enforcement, and intersectoral coordination can be systematically combined to reduce mosquito breeding opportunities at scale. For malaria programmes, these approaches are increasingly relevant in light of the emergence and spread of ***Anopheles stephensi***, a vector capable of exploiting urban water storage systems in ways that traditional tools such as indoor residual spraying and insecticide-treated nets may not adequately address. WHO guidance on larval source management for national malaria programmes is available through the WHO publications page. Arbovirus experience provides a practical and transferable model for expanding malaria vector control to include environmental management and community-based interventions tailored to local ecological conditions.

4.5 Vector Surveillance as a Core Intervention

Sustained investment in vector surveillance is a hallmark of effective arbovirus programmes. Continuous monitoring of vector species composition, breeding ecology, behaviour patterns, and insecticide resistance provides the analytical foundation for adaptive decision-making and targeted intervention It is closely integrated with operational planning and intervention targeting, making it a functional driver of programme performance.

APMEN has recognised the importance of entomological surveillance through sustained regional investments in capacity strengthening. Through its flagship vector surveillance training programme, the network has supported countries in developing the technical skills needed to generate evidence for effective vector control and malaria elimination. In addition, practical resources such as the PacMOSSI's Standard Operating Procedure for Vector Surveillance, Processing and Storage, provide standardised field guidance that can be readily adapted by national malaria programmes across the region. More comprehensive and broader-ranging materials for malaria vector surveillance training and guidance can be found in the Entomological Surveillance Planning Tool (ESPT). The ESPT processes and methods described therein have been adopted by vector-borne disease control programmes in multiple malaria-endemic countries in Africa and Asia.

For malaria programmes, particularly those in elimination settings where transmission may be focal and unstable, understanding vector behaviour becomes critical to maintaining gains and preventing resurgence. The arbovirus experience reinforces that vector surveillance is most valuable when its findings are systematically translated into operational responses rather than filed as routine reports.

4.6 Data Systems and Decision Support

Arbovirus programmes have increasingly invested in digital data systems that support timely analysis and operationally relevant decision-making. Integrated platforms allow epidemiological, entomological, environmental, and climate data to be consolidated and translated into actionable information products that guide programme managers at national and subnational levels.

Brazil's municipal dengue surveillance systems demonstrate how integrated information platforms enable local authorities to identify transmission hotspots, allocate resources efficiently, and coordinate rapid responses. This approach is grounded in PAHO's Integrated Management Strategy for Dengue Prevention and Control, a regional framework that has guided multisectoral, data-informed dengue programming across Latin America and the Caribbean for over two decades. A more recent peer-reviewed study further documents how Brazilian municipal health authorities have built integrated surveillance systems that combine epidemiological and entomological data to support real-time decision-making at the local level.

For malaria programmes in the Asia Pacific, the principal lesson is the importance of moving beyond data collection toward structured data use. The value of surveillance ultimately lies not in the volume of information generated but in ensuring that information is directly and routinely applied to programme action. Strengthening such systems requires both technological investment and the development of human capacity in data analysis, interpretation, and communication. Further background on structured data-gathering and use is available from the APMEN malaria-vector data-training course at orene website.

4.7 Innovation and New Tools

Arbovirus control programmes have demonstrated a consistent openness to innovation, including the introduction and field evaluation of new tools such as biological control methods, Gene-drive initiatives, Wolbachia-based mosquito deployments, and novel surveillance technologies. These innovations are piloted in targeted settings, assessed for operational feasibility, cost-effectiveness, and community acceptance, and then scaled progressively based on evidence.

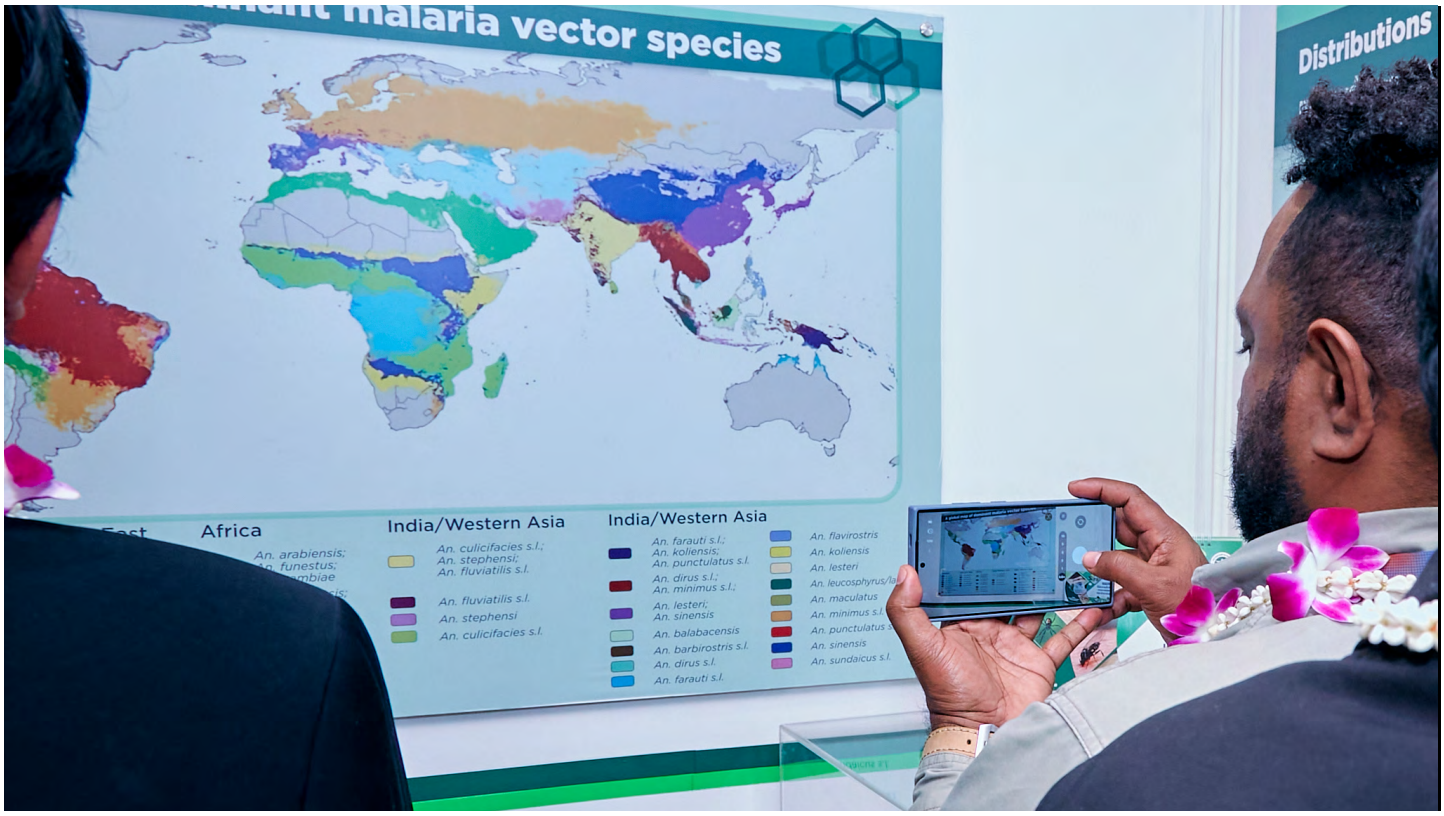
Indonesia's Wolbachia programme has become one of the most recognised examples of vector control innovation globally. Combining rigorous scientific evidence with structured community engagement and careful operational planning, the programme demonstrated substantial reductions in dengue transmission and has catalysed wider regional interest. At the global level, the WHO Global Arbovirus Initiative, launched in 2022, provides a strategic framework that explicitly positions innovation and new approaches as a core pillar of arbovirus control, encompassing advances in vector genomics, biological control, novel surveillance tools, and cross-sectoral research partnerships.

For malaria programmes, this experience underscores the importance of maintaining a culture of innovation, particularly as existing interventions face limitations associated with insecticide resistance and evolving vector behaviour. Arbovirus programmes suggest that innovation is most effective when it is integrated into routine programme development rather than treated as a separate track, enabling systems to continuously adapt in response to emerging operational challenges.

Table: Summary of Transferable Lessons

Arbovirus/VBD Experience	Relevance for Malaria Elimination
Integrated surveillance systems	Stronger elimination and prevention-of-re-establishment surveillance
Climate-informed early warning	Anticipatory response and preparedness planning
Community-driven vector control	Sustained engagement in low-transmission settings
Larval source management	Urban malaria and ***Anopheles stephensi*** response
Sustained vector surveillance	Evidence-based vector control decision-making
Integrated data systems	Faster operational response and resource allocation
Innovation and new tools	Adaptation to insecticide resistance and emerging vector challenges

V. Cross-Cutting Enablers



The experiences of arbovirus and other VBD programmes make clear that technical interventions alone are insufficient without the enabling systems and institutional capacities to deploy them effectively. Across the case examples reviewed, **strong governance structures** emerge as a foundational requirement, facilitating coordination across sectors including health, environment, urban planning, and local government. Such coordination is essential for addressing the environmental and social drivers of transmission that operate beyond the direct mandate of health ministries alone.

Workforce capacity is an equally critical enabler. Effective programmes require skilled personnel in entomology, epidemiology, data analysis, and increasingly climate science. Continuous training and structured knowledge exchange are necessary to ensure that technical capacity can adapt to evolving operational demands, a function that APMEN actively supports through its regional training and knowledge-sharing platforms.

Partnerships across sectors and institutional boundaries also play a central role in sustaining programme performance. Arbovirus programmes frequently engage academic institutions, research organisations, and community-based groups to support evidence generation and strengthen programme implementation.

Finally, **sustainable financing and genuine programme ownership** are necessary to maintain long-term capacity, particularly in low-incidence settings where competing health priorities may erode political commitment and resource allocation over time.

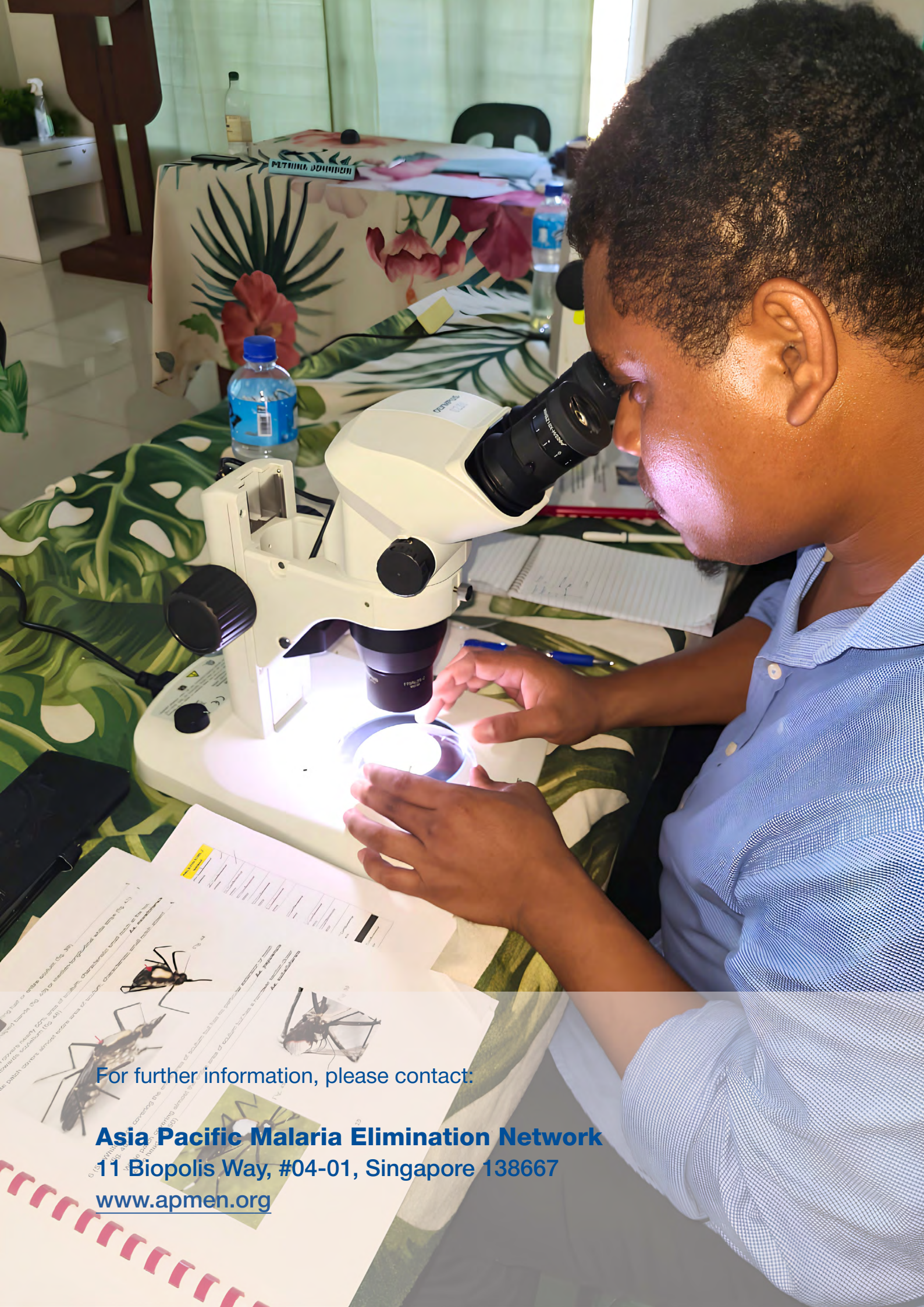
VI. Conclusion and Strategic Implications

Experiences from arbovirus and other vector-borne disease programmes reinforce a central message for malaria elimination: success depends not only on the availability of effective tools, but on the strength and adaptability of the systems that deploy them. Integrated surveillance, climate-informed decision-making, sustained community engagement, and locally tailored vector control are all examples of approaches that have emerged from arbovirus programmes and offer clear, demonstrable value for malaria elimination in the Asia Pacific.

For national malaria programmes, the most important strategic implication is the need for selective and contextually grounded adaptation. Not all approaches developed for arboviruses are directly transferable, given differences in vector behaviour, transmission dynamics, and operational contexts across APMEN member states. However, many system-level practices can be meaningfully adapted to strengthen resilience, efficiency, and responsiveness in malaria elimination settings. These include integrating surveillance across multiple data streams, linking early warning directly to operational action, treating vector surveillance as a core programme intervention, and embedding community engagement within the foundational design of elimination strategies.

Within this context, APMEN plays an indispensable role as the regional platform for facilitating cross-disease and cross-country learning. Through its training programmes, technical exchanges, and knowledge products, APMEN supports national programmes in translating diverse experiences into context-appropriate practice, strengthening technical capacity, and sustaining the institutional momentum needed to achieve and maintain malaria elimination.

By learning systematically across diseases and borders, malaria programmes can move beyond incremental improvements and adopt more adaptive, integrated approaches suited to the complexity of the current elimination landscape. This capacity for learning and adaptation will be essential to sustaining the gains already achieved, preventing resurgence, and advancing long-term elimination goals across the Asia Pacific region.



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