Policy brief on

Stopping Dengue in its Tracks: Prevention and Control in Nepal

Policy options to mitigate Nepal's rising dengue threat in a changing climate

1. Context and Importance of the Problem

Despite longstanding efforts, dengue fever has become an escalating public-health crisis in Nepal, spreading into new districts and higher altitudes, overwhelming health services, and threatening both urban and rural communities (largely urban), thus demanding an urgent policy response. Figure 1 indicates the observation that Nepal's annual dengue cases (blue bars) surged since 2019, peaking at ~54.8K in 2022, ~51.2K in 2023, and ~41.86k in 2024.[1] Since the emergence of the first dengue case in 2004, dengue incidence has been rising steadily.[2] Epidemics within 2010–2019 were relatively modest (e.g. 1000 to 2000 cases) but 2019 saw the nation's first nationwide epidemic. The outbreak of 2022 and 2023 in all provinces and 77 districts reported cases, including higher-altitudinal areas previously being considered low-risk areas.[3] Mosquito-borne diseases, including dengue, has significantly increased in recent years. Understanding the temporal and spatial variations of these diseases is essential for effectively controlling potential outbreaks. Severe dengue (hospitalizations and deaths) has accompanied this surge: 2022's 54,784 cases ended in 88 deaths (0.16% CFR),[4] 2023's 52,790 cases ended in 20 deaths (0.03% CFR), and in 2024's 41865 cases bring about 15 deaths (0.03% CFR). Such trends are driven by multiple factors. Climate change (warmer, more humid conditions) extends mosquito breeding seasons and permits Aedes mosquitoes to spread into hilly regions.[5–9] An increasing risk of malaria and dengue fever epidemics in tropical highlands and temperate regions has been predicted in different climate change scenarios. Figure 2 highlights dengue cases to months of the year 2022, 2023, and 2024 which showed that dengue rises after peak rainy season. Unplanned urbanizations, poor water/waste management, discarded tires and a permeable Indian border facilitate mosquito migration and virus importation.[10] Dengue is a mosquito-borne viral infectious disease, causes a high morbidity and mortality in tropical and subtropical areas of the world. In Nepal, the first case of dengue was reported in 2004 followed by frequent outbreaks in subsequent years, with the largest being in 2022 with more than 54000 cases and 88 deaths. It is reported that the number of dengue fever cases are soaring in Nepal spreading from the plains to more hilly regions. This might have serious public health implications in the future when combined with other factors, such as: global warming, lack of early detection and treatment of dengue, lack of diagnostic facilities, poor healthcare systems and

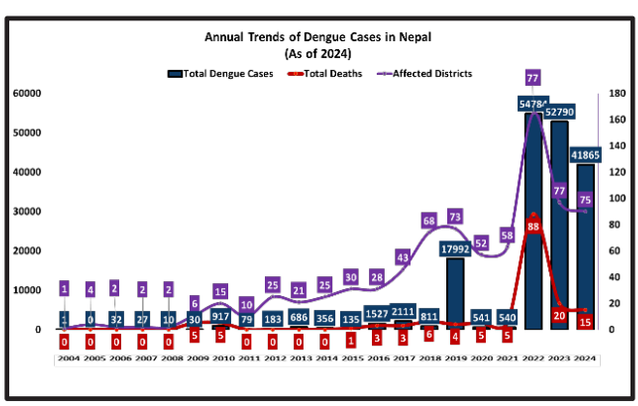

Figure 1: Annual Dengue Trends in Nepal

mosquito control strategies. Nepal, thus, needs a cost-effective mosquito control strategy for the prevention and control of dengue. The Wolbachia-mediated biological method of the dengue control strategy is novel, economic, and environment-friendly. It has been successfully trialed in several areas of dengue-prone countries of the world, including Australia, Malaysia, Vietnam etc. resulting in significant reductions in dengue incidence. Given the lack of effective vector control strategy and weak economic condition of the country along with the persistence of climate and environment conditions that favors the host (Aedes mosquito Nepal warms faster compared to global average, increasing probability of

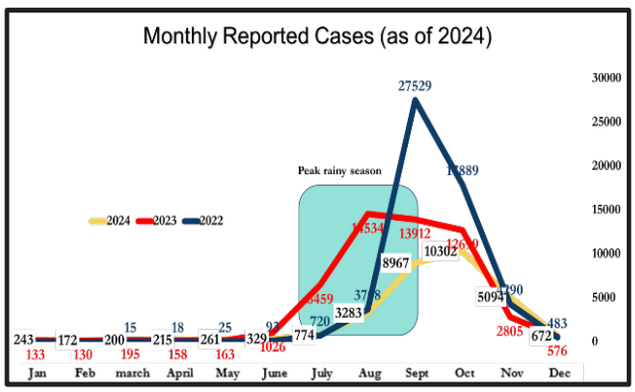

Figure 2: Monthly Dengue Cases in Nepal

dengue to spread to higher elevations and making dengue outbreaks more pronounced.[11] Dengue's influence is broad: affecting children and working-age people, leading economic burden to families (lost work, healthcare costs) and overwhelms health facilities. Stakeholders range from local communities (rural/urban residents) to national health agencies, international partners (WHO, NGOs), as well as cross-sector interests (tourism, environment agencies). This urgent scope of the problem demands holistic and coordinated policy intervention. Since multiple stakeholders and agencies are involved like Human, environment, vectors, communities and to better understand the epi triad (Host,Agent and environment) holistic approach which is the One Health has to be taken into consideration.

2. Methods

This policy brief has been prepared using the same literature-review approach as Lamichhane Dhimal et al.,2024 in Climate Resilient Health Systems: A Case Study of Climate Change and Dengue in Nepal[12] and carried out expert consultation by circulating drafts and supporting documents via email to relevant stakeholders and incorporating their feedbackd for finalization.

3. Policy Options

We consider four broad approaches to dengue prevention and control in Nepal

Integrated Vector Management (IVM):

IVM is an established tool to mitigate mosquito density and dengue risk.[13,14] This leverages on existing infrastructure as Nepal have already introduced IRS for malaria control. Scale up traditional mosquito control (environmental cleanup, Biological larvicide, insecticide spraying) combined with targeted measures (e.g. Targeted Indoor Residual Spraying (TIRS), space spraying) along with urban planning (drainage, solid waste management). MoHP/EDCD-led campaigns (e.g. "Search and Destroy") would systematically eliminate breeding sites (standing water) in highly exposed areas. Larvicide-treated containers or TIRS could be deployed in high-risk zones that are the cluster or municipalities where the disease burden is maximum and declared as the hotspot from the municipalities. It is the complimentary approaches as mentioned by the national guiding documents (National Guidelines of Prevention, Control, and Management of Dengue in Nepal 2019).[13] Inter-agency coordination (health, urban planning, sanitation) will be necessary. However, IVM is resource-intensive and the insecticides used hold the risk of resistance development and non-target consequences.

Biological/Technological Innovations (Wolbachia & Vaccination):

Introduce new technology: release Wolbachia-infected Aedes mosquitoes and introduce dengue vaccination for target groups. This can be achieved by releasing Wolbachia-infected mosquitoes at hotspot urban areas (e.g. Kathmandu) for reducing dengue transmission long-term. Introduce WHO-recommended dengue vaccine; however, WHO has recommended two dengue vaccine till now not as public health campaign approaches but as the choice of country with specific situation. In dengue epidemiology Neals's position is in the fast emerging and rapid expansion paradigm. So, the vaccine still is not applicable for the country like Nepal. Still we do not have the population based sero prevalence data on dengue.[15] However, these are expensive to introduce as Wolbachia programs require specialized entomology capacity and public acceptance and regulatory approvals from several organizations. Moreover, vaccine rollout requires cold-chain, multi-dose schedule, and surveillance for coverage, raising a question for long-term efficacy and serotype coverage.

Community Engagement and Education:

Involve and empower societies with awareness and cleanup campaigns, and education for personal protection. 'Search and Destroy' campaign are

only effective when it actively engages the community, as sustained vector control depends on local participation in identifying and eliminating breeding sites. This can be complemented in the month when dengue peaks usually at (Aug to Oct) and volunteer activities through enhanced outreach such as door-to-door visits with leaflets, radio/TV announcements on dengue prevention, school-based education on mosquito control, and community clean-up activities and events. Furthermore, providing training and deploying local organizations (Tole Sudhar Samiti) or health volunteers for destroying breeding sites can also be accomplished to enhance community engagement and education. Nepal's recent activities suggest possibilities. In mid-2025, >1000 youths were trained for a "Search & Destroy" dengue activities including stakeholders of recycle and recollect association, and automobile association.[16]

A government's statement of a dengue awareness month (July–Aug 2025) with weekly "Clean Friday" actions shows institutional support.[17]

Surveillance and Health System Strengthening: This can be achieved through upgrading Nepal's EWARS system through enhanced reach and health workers training for early case reporting along with case management for dengue. Furthermore, enhancing laboratory networks for serotyping and vector surveillance along with integrating dengue control with other vector-borne disease program will put the resource at optimal use. This can lead towards earlier identification of outbreaks with timely interventions. However, this requires investment in training, IT Systems, and laboratories, while coordination across ministries is also necessary.

Table: 1 Policy option being assessed using criteria of cost, effectiveness, feasibility, equity, and sustainability.

	IVM	Wolbachia & Vaccines	Community Engagement	Surveillance & Health System
Effectiveness	High: short-term impact on adult mosquitoes[18]	High: potential – e.g., Wolbachia cut dengue incidence by ~77% in trials[19]	Medium: campaigns can reduce dengue incidence when sustained[20]	Medium: does not directly lower-case counts, but critical for timely response[21–24]
Cost	Medium: High (equipment, insecticides, manpower)[25]	High: upfront (developing infrastructure, purchasing vaccines[19,26]	Low: (primarily human resources and communication materials).[27]	Medium: (data systems, training, lab supplies).[21–24]
Feasibility	High: Nepal already has malaria/IRS programs and international support[28]	Medium: Regulatory and logistical challenges; requires technical partners (e.g. World Mosquito Program collaboration[19]	High: leverages existing community structure[20,27,29]	Medium: EWARS exists but needs revision; requires inter-agency coordination[21–24]
Equity	Medium: urban interventions may reach more people; rural areas need tailored plans[30]	Medium: vaccination targets children, leaving older age groups unprotected; Wolbachia once established is population-wide[19]	High: local activities reach all socio-economic groups[20,27,29]	Indirect: benefits entire system, but rural areas may have weaker infrastructure[21–24]
Sustainability	Medium: Requires ongoing funding; risk of insecticide resistance over time.[30]	Medium: These are long-term investments. Community acceptance (especially for novel interventions) must be managed. [19]	Medium: Success depends on continual motivation and reinforcement. Complements all other strategies.[20,27,29,31]	High: Improves decision-making for all interventions[21–24]

Overall, combining interventions is most cost-effective: e.g., an integrated approach of vector control and community action, supported by improved surveillance, maximizes impact. The innovative tools (Wolbachia/vaccine) score high on long-term impact but need initial investment and pilot phases. In terms of political acceptance and feasibility, strengthening community campaigns and IVM can start immediately with modest budgets. Surveillance improvements also offer high value by preventing outbreaks.

4. Recommendations

4.1 Short-Term Recommendations (0-2 years):

4.1.1 Research:

- Prioritize short-term research on understanding the immediate impact of climate change on dengue outbreaks, focusing on vector behavior, transmission patterns, and environmental factors. Academia and research institutes should lead in commissioning rapid studies.
- Conduct implementation research that includes the effectiveness of current vector control measures (e.g., search and destroy, larviciding) and explores immediate improvements based on local contexts.

4.1.2 Interventions:

- Strengthen the Early Warning Alert and Response System (EWARS) by integrating climatic, epidemiological and entomological data to improve outbreak predictions.
- Launch immediate community awareness campaigns in high-risk areas, utilizing mass media, local languages, and digital platforms.
- Distribute rapid diagnostic kits (NS1, IgM) in rural and urban health centers to ensure timely case detection.

4.1.3 Health System Strengthening:

- Provide short-term training for health workers, including clinicians, entomologists, and community health volunteers, on dengue diagnosis and management.
- Allocate emergency funds to municipalities for immediate dengue outbreak response, ensuring rapid mobilization of resources during peak transmission seasons.
- Establish dedicated positions for entomologists in key districts to support vector control and provide technical expertise for outbreak responses. Moreover, Nepal's malaria program has successfully used task-shifting, demonstrating the approach is feasible; we should therefore include the animal health sector in entomological interventions.

4.2 Mid-Term Recommendations (2-5 years):

4.2.1 Research:

- Conduct mid-term studies on the long-term sustainability and efficacy of vector control programs and new technologies such as biological control methods (e.g., Wolbachia) in local conditions.
- Explore socio-economic and environmental determinants of dengue spread, focusing on vulnerable populations (e.g., urban poor, rural residents, marginalized groups).

4.2.2 Interventions:

- Allocate budget for a pilot project of innovative interventions such as introducing new dengue vaccines or for introducing Wolbachia. This can be done by collaborating with national/international experts and funding organizations.
- Define and implement mid-term vector control strategies, including GIS-based risk mapping for targeted interventions in high-incidence districts.

- Develop standardized guidelines for municipalities to create local dengue prevention action plans, ensuring consistency in efforts across regions.

4.2.3 Health System Strengthening:

- Strengthen the health system's surveillance capacity by building entomological laboratories in all districts, ensuring accurate monitoring of mosquito populations.
- Introduce refresher training programs for health professionals to address turnover issues and ensure consistent expertise in dengue management.
- Enhance the role of entomologists within the health system, ensuring that they are integrated into local government health teams to support sustained vector control and surveillance.

4.3 Long-Term Recommendations (5+ years):

4.3.1 Research:

- Conduct long-term research on the impact of climate change on the geographic distribution of dengue vectors in Nepal, helping to predict future high-risk zones.
- Initiate studies to assess the feasibility of dengue vaccination programs in Nepal, particularly in high-incidence areas.
- Conduct effectiveness of mobile or digital application for health promotion to prevent and control transmission in communities.

4.3.2 Interventions:

- Establish long-term vector control strategies based on climate-resilient infrastructure development, focusing on sustainable urban planning and waste management to reduce breeding sites.
- Implement large-scale community-based interventions, including climate-smart agriculture and environmental management practices, to mitigate vector habitat creation.

4.3.3 Health System Strengthening:

- Build a climate-resilient health system by integrating dengue management into broader climate-adaptation strategies for the health sector, ensuring long-term preparedness.
- Develop financing mechanisms to ensure sustainable funding for dengue control, including partnerships with international donors, public-private partnerships, and local government initiatives.
- Establish a national cadre of entomological professionals embedded within the health system, ensuring their long-term role in guiding and leading dengue control and vector management initiatives.
- Scale Up Integrated Vector Control: Allocate immediate funding for nationwide larval source reduction and Targeted Indoor Residual Spraying (TIRS) efforts.
- Enhance Surveillance and Health Response: Training health workers and volunteers to report weekly case data. Furthermore, build lab capacity for serotyping.

5. Conclusion

The rise of dengue in Nepal is an emerging public health issue and demand coordinated action for prevention and control. The occurrence of dengue outbreaks constantly since 2022 exposed gaps in surveillance and reliance on only traditional control measures. To protect Nepalis' health, social and economic well-being, Nepal must act now. A unified approach that increases vector control activities and encourages community mobilization, along with piloting new tools offers the best chance to avert future

emergency situations. We call on policymakers, health officials, and community stakeholders to implement these recommendations immediately. By investing in prevention and preparedness (e.g. funding the next fiscal year's mosquito control and vaccine program), Nepal can break the cycle of dengue epidemics and safeguard its people against this growing public health threat. The ultimate solution is the realization of the threat by diseases through mosquitos so rather than focusing only on Dengue there should be holistic approach to deal with diseases spread by mosquitos.

6. Funding

The work was supported by the FA5 programme Nepal: Evidence-based vector-borne disease management and elimination of visceral leishmaniasis in Nepal (2022-2026) funded by the Directorate-General for Development Cooperation and Humanitarian Aid (DGD), Belgium.

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Recommended citation: NHRC. 2025. Stopping Dengue in its Tracks: Prevention and Control in Nepal (Policy brief). Kathmandu. Nepal Health Research Council.

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