

1 **Enhancing community participation in dengue control through digital crowdsourcing: An**
2 **analysis of a World Mosquito Program digital open call in Sri Lanka**

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21 Running Title: Crowdsourcing to enhance dengue control

22 Brief summary: Community participation is important for dengue research. We organized a
23 crowdsourcing open call to solicit strategies for community-led mosquito release, receiving

24 many high-quality submissions. Our data suggest the feasibility of using crowdsourcing for
25 dengue community engagement in resource-limited settings.

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41

42 **Abstract**

43 **Background:** Two crowdsourcing open calls were created to enhance community engagement
44 in dengue control in Sri Lanka. We analyzed the process and outcomes of these digital
45 crowdsourcing open calls.

46 **Methods:** We used standard World Health Organization (WHO) methods to organize the open
47 calls which used exclusively digital methods because of COVID-19. We collected and analyzed
48 socio-demographic information and digital engagement metrics from each submission.

49 Submissions in the form of textual data describing community-led strategies for mosquito release
50 were coded using grounded theory.

51 **Results:** The open calls received 73 submissions. Most people who submitted ideas spoke
52 English, lived in Sri Lanka, and were 18 to 34 years old. The total Facebook reach was initially
53 limited (16,161 impressions), prompting expansion to a global campaign which reached 346,810
54 impressions over 14 days. Diverse strategies for the distribution of *Wolbachia*-infected mosquito
55 boxes were identified, including leveraging traditional festivals, schools, and community
56 networks. Fifteen submissions (21%) suggested the use of digital tools for monitoring and
57 evaluation, sharing instructions, or creating networks. Thirteen submissions (18%) focused on
58 social and economic incentives to prompt community engagement and catalyze community-led
59 distribution.

60 **Conclusions:** Our project demonstrates that digital crowdsourcing open calls are an effective
61 way to solicit creative and innovative ideas in a resource-limited setting.

62 **Keywords:** crowdsourcing; community participation; digital engagement; infectious diseases;
63 dengue control; low- and middle- income countries

64 **Funding:** World Mosquito Program

Introduction

Dengue is a viral infection transmitted to humans through the bites of female *Aedes* mosquitoes [1]. According to a 2022 WHO report, dengue incidence has increased eight-fold over the past 20 years [2] and more than half of the world population is now at risk. One promising new tool to prevent dengue and other vector-borne infections is *Wolbachia*. A symbiotic bacteria found naturally in half of all insect species, *Wolbachia* blocks the transmission of viruses when introduced into *Aedes aegypti* mosquitoes [3-5]. A randomised controlled trial in Indonesia showed there was a 77% reduction in dengue incidence and an 86% reduction in hospitalisations in communities where *Wolbachia*-infected mosquitoes were introduced [6].

The importance of community engagement in public health interventions has been widely recognized, given its potential to improve uptake, promote ownership, and increase the sustainability of *Wolbachia* interventions [7]. A significant factor in the success of the *Wolbachia* method has been the proactive engagement of local communities in areas where mosquito-borne viruses are endemic. As these mosquitoes breed with wild mosquitoes, the proportion of mosquitoes with *Wolbachia* grows over time until it remains high and further releases are not needed. This self-sustaining, safe, and cost-effective method has been deployed in 11 countries over the past decade, reaching more than 10 million people, and its effectiveness for dengue control has been demonstrated in multiple field trials [8-10]. Community engagement, in particular, has played a vital role in the program's success worldwide to raise awareness and mobilise communities in the growing global dengue response [7].

In the digital era, technological advancements have opened new avenues for community engagement [11]. Digital tools, such as instant messaging services, mobile phone applications, websites, and social media, have broadened the reach of health interventions, creating a new landscape for community engagement in public health [12]. The integration of digital methods into public health campaigns, combined with robust community engagement, provides a promising path for future disease prevention efforts. To harness these digital opportunities, the World Mosquito Program (WMP) partnered with Social Entrepreneurship to Spur Health (SESH) to organise two digital crowdsourcing open calls on community-led release strategies and visual design. Crowdsourcing is a participatory method that invites a group of individuals to collectively solve a problem and share their solutions with the public. A crowdsourcing open call, specifically, is a public invitation extended to a wide audience – be it a community, group of experts, or the general public – to submit their ideas, solutions, or designs to tackle a specified problem or challenge [13]. Crowdsourcing approaches have been used by the United States National Institutes of Health [14], the US National Academies of Science, Engineering and Medicine [15], and the WHO [16]. The WMP/SESH open call focused on harvesting ideas and identifying community-led implementation strategies for releasing *Wolbachia*-infected mosquitoes to achieve maximum community engagement, ownership, and efficiency. The visual design open call aimed to identify high-quality wordless instructions that could be used in diverse settings, outlining the community-led breeding and release of *Wolbachia*-infected mosquitoes using boxes designed for this purpose. This mixed methods analysis assesses the process and outputs generated from the first digital crowdsourcing open call. Visual instruction submissions from the second open call are displayed in Appendices.

Methods

Digital crowdsourcing approach

The open calls were designed following standardised approaches to crowdsourcing recommended by the WHO's Special Programme for Research and Training in Tropical Diseases. Given the COVID-19 context and the flexibility and broad reach that digital technology can offer, we decided to focus exclusively on digital crowdsourcing. This included organizing all meetings using videoconference, promoting through social media, submitting ideas through a web portal, and announcing open-call finalists at a virtual meeting. We selected Sri Lanka as the site for our study due to the prior implementation experience of *Wolbachia* programs as part of the National Dengue Control Unit.

A 24-person steering committee guided the open call, finalized the judging criteria, determined the prize structure, and disseminated the call for submissions through their respective networks. Steering committee members included representatives of the project's core organisations (WMP, SESH, National Dengue Control Unit of Sri Lanka), other government representatives, community-based organisation leaders, private sector leaders, and local residents. A separate organizing committee oversaw the day-to-day activities of the open call, including developing a website, encouraging submissions, answering questions about the open call from potential participants, and assessing the eligibility of submissions.

The open call was disseminated broadly via digital channels, initiating with a videoconference hosted by the World Mosquito Program that drew a crowd of 1000 interested in mosquito-borne illness prevention and Wolbachia methodologies. During the videoconference, online co-creation sessions facilitated potential submissions and idea exchange in small breakout rooms (Supplementary Material 1). Subsequent promotion involved an assortment of targeted communication strategies. Emails were dispatched to a specific network of individuals connected to mosquito control programs. Steering Committee members received WhatsApp messages, encouraging further dissemination within their respective channels. We also organized a radio announcement on a local Tamil radio station. Social media platforms like Twitter and Facebook amplified the call in English, Sinhalese, and Tamil languages. Initial engagement efforts were focused on Sri Lanka, but later expanded globally. To ensure local participation, the project coordinator reached out to local health workers, community representatives, mosquito control leaders, and public health officials via phone calls, encouraging their submissions and wider announcement of the open call (Supplementary Material 2).

The open call was launched on 20th October 2021 and closed on 12th December 2021.

Participation was open to anyone interested in dengue control. The initial scope of the open call was limited to people living in Sri Lanka, but analytic data suggested limited online engagement with the open call website (Supplemental material 1). As a result, the open call expanded to allow submissions from anyone worldwide. Two independent organising committee members reviewed each submission for eligibility (in an eligible language and focused on the topic).

Three independent judges judged each eligible submission based on a 1-5 scale (1 as worst, 5 as best). Judging criteria for the community-led distribution strategy consisted of innovation, feasibility, and scalability: five points for innovation, twenty points across five separate criteria for feasibility (the ability to use the strategy multiple times, using a low to medium level of skill, low-cost, using local skills and resources, and the potential for self-management with low involvement from the WMP), and five points for scalability. The visual instruction open-call judging criteria included acceptability, clarity, and adaptability. A mean score was calculated for each submission (scale of 5-30 with 30 as best), and six entries were shortlisted. In the second judging phase, the shortlisted submissions were further reviewed by six independent judges, including the three shortlisting phase judges. The steering committee reviewed mean scores, and the WMP made final decisions about the prize structure. Two finalists for the community-led distribution strategy (\$3,000 per prize) open call and one finalist for the visual design open call (\$1,000 for a single prize) were recognized. A webinar announced the final prizes and answered questions. Finalist submissions were shared on the open call website.

Data Collection and Analysis

Open call submissions were collected using an online submission form or email. English, Sinhala, and Tamil language submissions were all accepted. Sinhala and Tamil submissions were translated into English by bilingual speakers for data analysis. Participants could submit ideas in response to one or both open calls, and a participant could submit multiple entries. People who submitted entries were asked to provide brief demographic information. We used Facebook analytics to measure impressions (the total number of times a post or ad appears on user screens),

likes (the number of positive reactions, indicating user appreciation or interest in a post), and shares (the number of times users redistribute a post to their own networks, expanding the post's reach). Website analytics tracked the total number of visitors on a daily basis.

De-identified data from the open call were analyzed. All demographic data collected from open call participants were compiled and analyzed using descriptive statistics. We used a qualitative open coding approach to analyse emergent themes from the open call on community-led strategies for mosquito release [17]. All submissions were examined and an initial code book that contained parent and subcodes was developed by two coders (C S-P and H.B) and iteratively refined. The initial codes were developed to capture information on each proposal's goals, strategies, and justifications. Informed by the community-based participatory research framework [18] and the WHO community engagement guide [19], we refined the codes and finalised the codebook. Then two independent researchers used this codebook to conduct line-by-line coding of all submissions using Dedoose (Version 9). This coding process produced a descriptive summary to characterise community-led strategies.

Results

A total of 73 entries were submitted to the open call. Forty-six entries were community-led strategies, and 26 entries were visual instructions. For the open call of community-led strategies, 41 participants (out of 44) came from Sri Lanka, and one each came from Spain, USA and Indonesia. Twenty-eight participants (64%) were 18-34 years old. Entries were predominantly written in English (32 participants), with 11 participants submitting proposals in Sinhala and one

in Tamil. Further socio-demographic data from the strategy open call participants are listed in Table 1. The total Facebook reach was initially limited (16,161 impressions over 10 days), prompting expansion to a global promotion campaign which reached 346,810 impressions over a 14-day period. Subsequently, the number of submissions from within Sri Lanka increased. More details on social media metrics are provided in Figure 1. A summary of top-ranked submissions is included in Table 2 and Figure 2.

A total of 26 visual instruction proposals were submitted to the open call and seven were shortlisted (Figure 2). The winning submission received a total of 13.5 points out of a possible 15. The winning submission was from a Sri Lankan participant, used no words, included digitalised pictorial instructions, and was easily understandable (Figure 3). Of the six runner ups, two submitted photos of hand drawn designs, while three used digital methods and one submitted a scan of a hand drawn design. All submissions were in colour.

Three broad themes emerged from the qualitative analysis of open call submissions: how to engage the community and practical strategies for community-led release. Figure 3 presents the finalists from the visual instruction open call, using sketches to represent the key steps of the *Wolbachia* release strategies.

How to engage the community

Raising awareness about dengue control was an important component of community-led distribution strategies. This entails making the community aware that dengue control is a priority that is in the entire community's interest. The importance of raising awareness in the preliminary stages was discussed in 20 submissions. From the perspective of participants, important factors influencing awareness included community responsibility (12 submissions), perceived benefits of dengue control in the community (eight submissions), the importance of family ties (eight submissions), and valuing health (six submissions).

Many submissions emphasized the importance of digital promotion within community-led strategies. Fifteen submissions used social media to promote community-led strategies. Ideas included the use of social media influencers (three submissions), online interactive games and quizzes (three submissions), and videos/photos of mosquito box installations (two submissions). Five submissions used commercials or banners on TV and radio channels, three used posters, and three used mobile messaging. In-person events were also suggested, such as school-based workshops (six submissions), community events (four submissions), poster and essay competitions (two submissions), and leaflet distribution (two submissions).

Practical strategies for community-led distribution

A wide range of creative and community-focused options was suggested through the open call. Most submissions recommended optimizing established networks (Table 3). Fifteen submissions mentioned they would use digital tools for monitoring and evaluation, sharing instructions, or creating a community network. Six suggested mobile phone applications and two submissions

suggested a website. Seven submissions suggested using the Geographic Positioning System to map areas of high dengue burden, facilitate mosquito delivery, or track other community responses. Three submissions offered a hotline number or mobile messaging service to support participants. The use of incentives for distributors was present in 13 entries. Options included the use of certificates (eight submissions), gifts (five submissions), awards (four submissions), sticker cards for children (one submission), and priority cards for senior citizen volunteers (one submission).

Seventeen entries used monitoring as part of their community-led strategy. Options included paper lists, using a QR code and mobile app, or using photographic proof (four submissions). However, only three submissions recommended regular progress reviews, and a further three formally analysed the data collected to inform ongoing operations.

Discussion

Our data suggest that crowdsourcing approaches can identify innovative implementation strategies and visual instructions in a resource-limited setting. Moreover, a digital open call was an effective way to engage the community. Our open call identified many community-led implementation strategies to facilitate mosquito release. Several submissions were deemed high-quality according to independent judges in the crowdsourcing open call and have informed WMP operational planning for future release projects. This manuscript extends the literature by focusing on digital crowdsourcing, leveraging detailed quantitative digital analytics, and implementing the project in a middle-income country.

Our data suggest that a digital open call was feasible to solicit ideas on *Wolbachia* community-led distribution and visual instructions. This finding is consistent with non-dengue crowdsourcing research demonstrating that open calls help identify new ideas that are relevant to the local community [20]. While other research has used crowdsourcing for mosquito surveillance [21], these projects have not partnered with the community to identify locally relevant solutions and implementation strategies. Given that the community-led mosquito distribution strategies will rely in large part on community strengths and networks, providing a formal mechanism for robust community engagement aligns with WMP goals and World Health Organization recommendations. One previous cluster randomised controlled trial demonstrated how community-led strategies could drive effective dengue control programs [22], our study further emphasizes the power of community engagement, but through a digital lens. Our research suggests that digital crowdsourcing, such as the open call, can also generate innovative, locally relevant strategies for the distribution of *Wolbachia*-infected mosquitoes. These strategies, including the utilization of schools and existing vector control staff, aligned with those identified in the previous trial, demonstrating the consistent value of community-led initiatives in different contexts. These open call submissions provided more granular implementation strategies to accelerate expansion for future release projects in the Sri Lankan and other contexts.

Our crowdsourcing open call used Facebook analytic data to adapt our digital promotion strategies. This finding is consistent with data from other crowdsourced projects in low-resource settings that harnessed Facebook analytics to monitor community engagement over time [23].

Although initial engagement with the WMP open call website was weak, we expanded the scope

of the open call beyond Sri Lanka and increased online advertising to encourage website viewership. Subsequent analytics suggested more widespread interest within Sri Lanka, which was also supported by many domestic submissions. Analytics from social media platforms and websites can help identify the participation of key subgroups and inform strategies tailored for those subgroups. Tailored open call promotion on social media may have helped expand the number of people who view the call for submission. However, we did not capture data on how many participants were encouraged to contribute through each promotion strategy.

Our study has several limitations. First, we received fewer submissions from Tamil people compared to Sinhalese people. This may have been because Tamil people are primarily located in the less dengue-affected north and eastern regions [2] or have less robust health communication. At the same time, we included native Tamil speakers on all groups, allowed submissions in Tamil, and organized Tamil-specific promotion via radio. Second, we do not have data on the effectiveness of the community-led implementation strategies that were identified through the open call. At the same time, at least five independent individuals assessed each submission and previous crowdsourcing methodological guidance recommends this approach [25]. Third, due to COVID-19 restrictions, we moved the promotion from offline and digital models to only digital approaches, limiting our ability to organize offline community engagement. We anticipate that implementing a similar open call in the post-pandemic era may be easier and result in more submissions. Fourth, the open call deadline coincided with the period just before a major holiday. This may have decreased the total number of submissions. .

This study has implications for research and programs. In a post-pandemic world, our competition design could be further enhanced. Interactive, in-person elements such as workshops or 'idea hackathons' and physical exhibits of submissions could be incorporated to stimulate public interest and engagement. Moreover, direct outreach in communities could provide richer, more contextually appropriate solutions. More implementation research on strategies for community-led distribution of *Wolbachia*-infected mosquitoes is needed. Pilot studies, quasi-experimental studies, and randomized controlled trials are essential to understand this process better and inform broader population-based *Wolbachia* research. Cost-effectiveness analysis of community-led distribution is also necessary. Social science research to further refine community engagement will be important as *Wolbachia* methods expand in scope. From a program perspective, this study underlines the feasibility and acceptability of digital crowdsourcing open calls as a strategy for community engagement in Sri Lanka and beyond. The participatory methods could be used in other low- and middle-income countries where there are few resources for community engagement. The digital methods that we identified suggest alternative routes for engaging youth. More organizational support will be needed to increase participation from older adults and other vulnerable groups. While we effectively utilized digital methods in this study, future endeavours could aim for a blend of digital and traditional engagement methods to reach a wider demographic spectrum, leveraging the strengths of both approaches.

Digital crowdsourcing open calls can be a powerful force to engage local communities and amplify the voices of local communities. This open call helped identify community-led mosquito release strategies and visual instructions to aid field deployment.

References

- 1 Simmons, C. P., Farrar, J. J., van Vinh Chau, N. & Wills, B. Dengue. *New England Journal of Medicine* **2012**; 366: 1423-1432.
- 2 World Health Organization. Dengue and severe dengue. Available at: <https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue>. Accessed 10 January 2023.
- 3 McMeniman, C. J. et al. Stable introduction of a life-shortening Wolbachia infection into the mosquito *Aedes aegypti*. *Science* **2009**; 323: 141-144.
- 4 Moreira, L. A. et al. A Wolbachia Symbiont in *Aedes aegypti* Limits Infection with Dengue, Chikungunya, and Plasmodium. *Cell* **2009**; 139: 1268-1278.
- 5 Walker, T. et al. The wMel Wolbachia strain blocks dengue and invades caged *Aedes aegypti* populations. *Nature* **2011**; 476: 450-453.
- 6 Utarini, A. et al. Efficacy of Wolbachia-Infected Mosquito Deployments for the Control of Dengue. *New England Journal of Medicine* **2021**; 384: 2177-2186.
- 7 O'Neill SL, Ryan PA, Turley AP, et al. Scaled deployment of Wolbachia to protect the community from dengue and other aedes transmitted arboviruses. *Gates Open Research*. **2019**; 2:36.
- 8 Pinto, S. B. et al. Effectiveness of Wolbachia-infected mosquito deployments in reducing the incidence of dengue and other *Aedes*-borne diseases in Niterói, Brazil: A quasi-experimental study. *PLoS Negl Trop Dis* **2021**; 15: e0009556.
- 9 Indriani, C. et al. Reduced dengue incidence following deployments of Wolbachia-infected *Aedes aegypti* in Yogyakarta, Indonesia: a quasi-experimental trial using controlled interrupted time series analysis. *Gates Open Res* **2020**; 4:50.

- 10 O'Neill, S. L. et al. Scaled deployment of Wolbachia to protect the community from dengue and other Aedes transmitted arboviruses. *Gates Open Res* **2018**; 2: 36.
- 11 Tan, R. K. J. et al. Digital approaches to enhancing community engagement in clinical trials. *NPJ Digit Med* **2022**; 5:37.
- 12 Cao, B. et al. Social Media Interventions to Promote HIV Testing, Linkage, Adherence, and Retention: Systematic Review and Meta-Analysis. *J Med Internet Res* **2017**; 19:e394.
- 13 Tucker, J. D., Day, S., Tang, W. & Bayus, B. Crowdsourcing in medical research: concepts and applications. *PeerJ* **2019**; 6:e6762.
- 14 Nguyen, T. B. et al. Distributed human intelligence for colonic polyp classification in computer-aided detection for CT colonography. *Radiology* **2012**; 262:824-833.
- 15 US National Academy of Science, Engineering, and Medicine. Healthy Longevity Challenge. 2020. Available at: <https://nam.edu/initiatives/grand-challenge-healthy-longevity/>. Accessed 10 January 2023.
- 16 Kpokiri, E. E. et al. Social Innovation For Health Research: Development of the SIFHR Checklist. *PLoS Med* **2021**; 18:e1003788.
- 17 Cannella GS, Pérez Michelle Salazar, Pasque PA. Critical qualitative inquiry foundations and futures. London: Routledge; **2016**.
- 18 Wallerstein, N. & Duran, B. Community-based participatory research contributions to intervention research: the intersection of science and practice to improve health equity. *Am J Public Health* **2010**; 100 (1):S40-46.
- 19 World Health Organization. Community engagement: a health promotion guide for universal health coverage in the hands of the people. **2020**. Available at: <https://apps.who.int/iris/handle/10665/334379>. Accessed 10 January 2023.

- 20 Wang, C. et al. Crowdsourcing in health and medical research: a systematic review. *Infect Dis Poverty* **2020**; 9:8.
- 21 Mwangungulu, S. P. et al. Crowdsourcing Vector Surveillance: Using Community Knowledge and Experiences to Predict Densities and Distribution of Outdoor-Biting Mosquitoes in Rural Tanzania. *PLoS One* **2016**; 11:e0156388.
- 22 Andersson, N. et al. Evidence based community mobilization for dengue prevention in Nicaragua and Mexico (camino verde,the green way): cluster randomized controlled trial. *BMJ* **2015**; 351:h3267.
- 23 Glennie, M. et al. Engaging Remote Aboriginal Communities in COVID-19 Public Health Messaging via Crowdsourcing. *Front Public Health* **2022**; 10.
- 24 Malavige GN, Jeewandara C, Ghouse A, Somathilake G, Tissera H. Changing Epidemiology of Dengue in Sri Lanka—challenges for the future. *PLOS Neglected Tropical Diseases*. **2021**; 15(8).
- 25 Han, L. et al. Joint international consensus statement on crowdsourcing challenge contests in health and medicine: Results of a modified Delphi process. *BMJ Open* **2021**; 11(11).

Table 1: Socio demographic information from open call participants (N = 44)

Demographic factors voluntarily declared on submission form		Number of submissions (%)
Age	Under 18	2 (4)
	18-34	28 (64)
	35-49	14 (32)
Submission date	1 Nov to 15 Nov	9 (20)
	16 Nov to 30 Nov	18 (41)
	1 Dec to 15 Dec (extension)	17 (39)
Submission language	English	32 (73)
	Tamil	1 (2)
	Sinhala	11 (25)
Geographical location	International	3 (7)
	Central Sri Lanka	8 (18)
	Northern and North-Western Sri Lanka	4 (9)
	Southern Sri Lanka	7 (16)
	Western Sri Lanka	20 (46)
	Eastern Sri Lanka	1 (2)
	Unknown	1 (2)
Gender	Female	22 (50)
	Male	21 (48)
	Not disclosed	1 (2)
Level of education	High school degree	4 (9)
	Undergraduate degree	21 (48)
	Postgraduate degree	12 (27)
	Other education	3 (7)
	Not disclosed	4 (9)
Ethnicity	International	2 (5)
	Sri Lankan	9 (20)

	Sinhalese	16 (36)
	Tamil	3 (7)
	Unknown	14 (32)
Disability	Physical health	...
	Mental health	1 (2)
	None	37 (84)
	Unknown	6 (14)
Submission type	Individual	35 (80)
	Group submission	9 (20)
Submission format	Google form	36
	Other (e-mail, post...)	8

Table 2: Description of the two winning submissions for the community-led strategies open call in Sri Lanka.

Title	Distribution strategy and implementation plan	Adjuncts and tools	Objectives
Prevent Dengue in Sri Lanka & Worldwide - Innovative Idea Proposal	<ul style="list-style-type: none"> - Electricity and water meter checker, door-to-door distribution - Midwives and Grama Sewaka network distribution, particularly for rural areas - Distribution by children at Scouts and Girl Guides clubs - Vesak festival – hang a lantern as well as a mosquito box during festivities 	<ul style="list-style-type: none"> - Creative instruction leaflets in multiple languages - Social media engagement - Mobile app for participants and community members, to share experiences and support operations - Mark and reward participating households 	<ul style="list-style-type: none"> - Inform and educate the community - Incentivise participants and distributors using rewards (branded gifts, ‘community protector’ award) - Coverage mapping and data collection for monitoring and evaluation
Community-led Distribution Strategy for Mozzie Boxes through a Delivery System	<ul style="list-style-type: none"> - Use the well-developed postal delivery system for door-to-door distribution - Use Grama Niladhari, Public Health Inspectors and Public Health Midwives to educate the community and recruit volunteer households 	<ul style="list-style-type: none"> - GPS mapping and mobile tracking of mozzie box deliveries - Optimise national postal services to deliver mozzie boxes via motorbikes, three wheelers, cars, etc. 	<ul style="list-style-type: none"> - Avoidance of large gatherings post-pandemic - Use of well-developed pre-existing networks and structures

Table 3. Themes from textual submissions to the crowdsourcing open call.

Distribution strategy	Number of submissions	Quotes from submissions justifying strategy feasibility
Established networks		
1. Schools and Universities	9	“Children can be the major changing agents in the society.”
Primary and secondary schools	2	“Children between [...] 11 and 16 possess the greatest desire, readiness and curiosity in [...] exploring innovative projects”
Adjuncts: specialised dengue committees, teacher training, integration into curriculums		“Schools are open in Sri Lanka [...] and children under 15 are highly affected by dengue in Sri Lanka.”
Universities	7	“a group representing all nations and all languages is required to distribute mozzie boxes and educating the public. It is advisable to use university students”
Adjuncts: inter-university competitions, volunteer recruitment		
1. Home delivery and postal distribution	7	“Delivery systems are very well developed for the commercial sector in Sri Lanka.”
2. Door to door delivery	9	“school dengue committees will educate their students [...] regarding their responsibility to hang these Mozzie boxes among their households”
Urban housing schemes	2	“Urban housing schemes, shanties and middle-class housing schemes need to be focused on as the environment is vulnerable to outbreaks.”
Utility bill door to door verification	2	“across any place in the country, the water and electricity meter checkers go from house-to-house every month.”
Mobile bread vendors	1	“Mobile bread vendors are a popular method to distribute bakery products (Choon Paan bread three wheelers)”
3. Local shops, supermarkets, through the purchase of essential goods	7	“These [supermarkets] have wide networks of outlets around the country [...] Many customers approach these places daily. So why not let them pick a Mozzie box at the counter?”

4. Textile industry and garment factories	5	“the [...] most efficient way to distribute these boxes would be to find a leading Industry in the country that employees a significant number of people and has a presence across the country.”
5. Health and social care		
Public health inspectors and midwives (community-based)	7	“they can easily target the most vulnerable communities and successfully carry out the distribution. Furthermore since they are Government officials, people have more trust on them”
Hospitals, health centres, healthcare workers	7	“boxes can be distributed to patients attending clinics [...] while educating them on the outcome of this and how to implement.”
Community pharmacies	2	“The density of pharmacies in the country has grown” ; “a close relationship [is] built between pharmacists and their clients.”
Grama Niladhari/Sevaka network (development and social care)	9	“As for rural areas, the boxes can be distributed through grama sevaka [...] as they reach out to them for their needs.”
6. Public transport hubs	6	“long distance buses [...] to popularize the Mozzie boxes”
7. Places of worship	8	“People attend faith-based events frequently and there is a strong trust that has been built between religious leaders and the population at large”
8. Societies & clubs		
Environmental societies and youth clubs	8	“Boy scouts, girl guides, and environmental society members [...] are already having some experience in field activities and can be given the leadership of organising and guiding fellow student groups”
Social clubs/networks and volunteer organisations	16	“we are going to work in new area, we want to consider starting our own social network where people can discuss the box, mission and the experience of the people those who used it before”
9. Access to free boxes	3	“Making [boxes] accessible at public places”

Cultural events

1. Community events	8	“play games in children parks and after conducting such activities give prizes (moszie boxes) to everyone”
2. Vesak festival (Buddhist festival)	2	“encourage everyone from all religions to hang a lantern, only this time everyone will hang a mosquito box [...] to save lives.”
3. Carnivals, food festivals, exhibition	5	“Most of the people are coming from out of area”
4. Occasions & entertainment venues	7	“Birthday gifts” ; “weddings/parties and film halls”

FIGURE LEGENDS

Figure 1: Social media engagement over the submission collection phase of the digital crowdsourcing open call over 8 weeks between 19th October and 15th December 2021, across the World Mosquito Program (WMP) Global, the World Mosquito Program Sri Lanka, and the In Focus Facebook pages. InFocus is Rajarata University’s media unit, which coordinates communications and social engagement within the university. They have an established Facebook page which was also used to disseminate information about the WMP open call.

Figure 2: Histogram of community-led mosquito release submissions marked out of a maximum of thirty points by three independent judges in phase one judging.

Figure 3: Histogram of visual instruction submissions marked out of a maximum of fifteen points by two independent judges in phase one judging.

Figure 4. Top six visual instruction submissions.

