



## A PRIMARY SURVEY FOR THE NOVEL SYNTHESIS OF METHODS TO COMBAT VECTOR-BORNE DISEASES AND RELATED LONG TERM MANAGEMENT

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### AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author BG designed the study, performed the statistical analysis, wrote and hosted the software and wrote the first draft of the manuscript. Author SP provided guidance and supervision. Author DPP provided help with learning the Geospatial Information System tools. All authors read and approved the final manuscript.

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### ABSTRACT

Combating vector-borne diseases demand a multidisciplinary, multi-pronged approach due to various socio-economic factors as well as the disparities among stakeholders between different regions, even within a relatively small area of a village and its fringes. In this work, we did an initial survey to gauge the baseline knowledge about four different macro parameters in a rural area of Purba Bardhaman, West Bengal. The four macro parameters, combined, is to be used in our succeeding work for better management of vector-borne diseases in the future as well as equip the youth with parallel skills that can help them come up to date with the skills the current age demands. The study found that, based on the response, the volunteers on the specific region in that specific time were highly aware of the textbook- basics of mosquito vectors and vector-borne diseases (at equivalent 10th Grade level). They were also moderate to highly aware of personal and close family protection, while only around half reported in-situ measures undertaken by the government. For the case of technological awareness, the users of smart phones were the majority, but more constructive (as opposed to consumptive) tools such as computers were less common. The familiarity with programming tools, a very useful skill in its own right, was also low. However, the desire to learn and improve them was subjectively very high, which was a positive signal. This survey shows promising avenues for inculcating technological tools to combat vector-borne diseases in the future, which is a direction for future work.

**Keywords:** Multidisciplinary; survey; vector-borne; basic-knowledge; in-situ; technology-knowledge; personal-protection; programming-tools; socioeconomic.

### 1. INTRODUCTION

Vector-borne diseases in the context of public health are a gargantuan problem that is best chipped away using a multidisciplinary approach. It includes the

study of the vector's life cycle, distributions, pharmacological antidotes, and also the way on how the host, i.e. humans, is responding to it. The scales of such endeavors range from the individual to the community, local area to intra- and internationally.

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This brings up, among others, the importance of surveys and their records. In addition to official governmental and NGO surveys that are done in a periodic or one-off fashion, newer sources of data collection are becoming increasingly important and viable. This brings up newer opportunities to diversify the survey with an eye on the long term and inclusive development, and to include cutting-edge tools, such as technology, to be incorporated in the mix of provisions.

In this paper and succeeding work, we aim to explore some newer approaches with expectations of carving a path towards the solution where other important factors such as survey completion rate are not adversely affected, by performing a multifaceted survey initially, and then following it up with some more in-field data and introducing tools fit for the technological age.

Mosquitoes are a growing and seemingly ever-present menace to plague mankind. Its notoriety can be vividly illustrated by the fact that in the last few years, it caused the death of over seven hundred thousand people every year [1]. The piercing and sucking type of mouthparts has on its target half of the world's population [2], especially on those who cannot afford basic-tier healthcare. Plasmodium, by itself, is estimated to cause an economic loss of \$12 billion in Africa due to its far-flung effects [3]. This causative organism of malaria is however only an arrow in the quiver of the most deadly insect. Dengue is another massive problem, especially in the country of India. Zika, Chikungunya, and Yellow Fever are additional diseases that also bring devastation.

The problem of vector-borne diseases is tackled at the individual level, the local-societal level, and also on larger scales utilizing the tools sprouted from globalization [4]. In the latter two scales, we have quite a few inroads that utilize consumer technologies in the client end, while for the first many aspects are still in its infancy. As the problem is almost global in scale, transgressing boundaries of nations, and divides of race and economic conditions [5], the effectiveness of technologies that scale well should be diligently introspected. Data collected through methods of survey and observation should be heeding these problems. These are best taken in-person, so as not to introduce bias or encourage behind-the-curtain 'hunts' for the right answer, which sometimes happen for pre-declared surveys, especially for schoolchildren.

Another area of substantial importance, which is our focus in succeeding publications, is the usage of technological tools where the users themselves can act as a working stakeholder in a two-way

communication channel with a considerable degree of independence and even the possibility of expansion of methods which were previously mostly done one-way. This is our direction of future work, and this work will also be a bedrock for such endeavors. Parallel uptake of in-demand skills will also have to be taken into account as the stakeholders mostly have socio-economically disadvantaged backgrounds. Development of inclusive education channels [6] should also be included, as lower age schoolchildren can also benefit that way.

The work that includes a two-way communication channel should include aspects of deep-rooted psychology that drive human behavior, as illustrated in previous works [7,8,9]. As we have created prototypical software with possibilities of two-way communication and have distributed it to the survey participants with smartphones who desired to get it, we incorporated some aspects that appeal to the lower-tiers of Maslow's hierarchy [10]. Those appeals are mostly related to the second-bottom-most tier, which includes aspects of "safety", which is in-response to the massive damage to human populations vector-borne diseases bring. Usage of the said hierarchy was previously used in work related to Geographical Information Systems which have a voluntary component [11]. Usage of gamification, which was used in other related work, was instrumental in creating comprehensive frameworks. Our work also includes the aforesaid feature to widen its appeal.

## 2. METHODOLOGY

In our survey, we made a final selection of 146 people from a pool of 155 volunteers divided into 3 zones in the rural area including Nabagram and its fringes (Pin: 713166) under the district of Purba Bardhaman. The survey was conducted during late 2018 and early 2019. A semi-structured questionnaire was utilized for the specific zones and questions were encouraged in case of any confusion. Inputs were mainly taken digitally as many of the respondents preferred answering verbally. In 3 zones, all the respondents were adults of working age. The survey was not declared in advance to prevent their knowledge from straying away from the baseline through academic and related preparations, or a desire to appear particularly knowledgeable. The rural location had the possibility of hosting interesting and diverse information, for several reasons, which include:

1. The geography and economy of the region: Predominantly lying in an extensively flat and agricultural land, with the prominent crop being paddy, the area is very well under the ambit of

vector-borne disease control in the context of public health.

2. Governmental drives and initiatives were lacking in degree, as compared to more urban areas and towns. Here the survey possibly had a higher scope of contribution to useful results for proposed solutions.
3. Although the literacy rate was high, knowledge about the mosquito control and protection methods, apart from the basic ones such as the use of mosquito nets and smoke in the form of *dhuna* (incense), seemed to be lacking in a casual introspection. Innovative and integrated approaches had a higher scope of creating a chain-effect of pertinent education in the scope of vector-based disease eradication, as well as inculcating a holistic development.
4. The participants were less homogeneous than ordinarily expected. This was mainly due to the proximity to the national highway where many factories, as well as small businesses and franchises, were set up in the last decade.
5. The penetration of technological devices was also low compared to more saturated cities in India such as Kolkata. This enabled greater chances of using new technological devices such as smartphones as creative and scientific devices rather than majorly content-consumptive devices. This penetration, going by the trends, was likely to be continued for years to come. This could mean swifter avenues to success in the context of vector-borne disease eradication, especially when coupled with the fact that government help in this area was less than adequate.
6. The lesser penetration of research initiatives in the region compared to similar regions in India, such as areas adjoining Kolkata, made way for a better relationship among the variables of the research in their supposed cause and effect.

The volunteers were put on the receiving end of the verbal questionnaire and the premise was explained subsequently so as not to cause any confusion and it was made clear that participation was voluntary and not all questions were mandatory. Some volunteers participated in digital entry one-by-one when that option was also given. Mutual discussions were explicitly prohibited verbally when the respondents were in a group setting and it was made clear that there was no right answer or grading as in an academic test, and it was a survey testing individual knowledge. Any request for clarification or further discussion was adequately attended to. Subsequent discussions were done with some after the volunteer had completed the survey.

In the context of technological literacy, the questionnaire included the accessibility of a personal smartphone in the household, the availability of a computer (in some form) in recent times, and the knowledge of programming. For the vector-borne disease awareness, the questions included if there is a “major nuisance” from mosquitoes and if the eradication drives were adequate. From personal protection, the usage of bed nets was asked about and tallied, as well as the usage of other chemicals in the house. Subjective questions were put but are left for later qualitative analysis after coupling with later data.

### 3. RESULTS AND DISCUSSION

The following results are predominantly put in percentages to avoid confusion. From the questionnaire, we can find a lot of interesting information regarding the current knowledge available to the volunteers and how further knowledge can percolate through them and, to a lesser extent, in which form. They are discussed separately for three areas, differentiated by some socioeconomic factors. One is for the “old fringe” area of the village, where the residents have been living for long, mostly multiple generations, but on the lower socio-economic development scales. The second area is termed “new fringe”, which is mostly near the highway, and has many migrants and newer settlers, including temporary workers. The third area is the “core area”, which houses mostly the relatively affluent, and long term resident, section of the village population. The distribution and surveyed areas, along with the larger water bodies which often host the vectors are marked on the maps using a simple application of Geospatial Information System (GIS).

#### 3.1 “Old Fringe” Area

When it came to the accessibility of a smartphone or a computer, the disadvantaged nature of the volunteers was immediately evident. Only 40% reported using a smartphone recently. At the verge of 2020, it was quite a low figure. On the context of usage of smartphones, it was observed that the men were using a smartphone of their own in a much higher percentage than the women. For the case of using a computer in their household, only a paltry percentage of 2% reported in the affirmative. There was not much of a disparity between the sexes in this latter case. This was probably due to the fact that households usually include one or multiple male members who predominantly use the computer. Such specific distinction, however, was not made in the questions.

In the context of at least a basic familiarity with computer programming languages, the results were

very dismal. None of the volunteers reported familiarity.

The next question pertained to vector biology. The simple question, on mosquitoes being a major nuisance in their local region, had a very decisive response on affirmative. 86% of the volunteers reported positively in this parameter. The second question was on the common use of mosquito nets in that region, where 96% responded positively. Awareness of this very important and simple countermeasure against the mosquito menace was quite a relief. On the question about individual personal protection to combat mosquito bites, except bed-nets, the results were however mixed in outlook. Only 28% of the respondents thought that it was essential, and answered they have used some of such measures, such as using mats or coils, or the very rare in use spray repellents.

On the question if they personally think that the local pest eradication drives are at least adequate, a two-third majority of 68% reported positive.

### 3.2 "New Fringe" Area

When it came to the accessibility of a smartphone or a computer, the volunteers showed a stark improvement over the "old fringe" residents. 93.75% reported using a smartphone. There was a considerable mix of migrants as well as people employed in individual and franchise businesses, which might be a reason for this drastic difference when compared with the "old fringe" residents. For the case of using a computer, a high percentage of 45.83% reported positively.

In the context of at least a basic familiarity with computer programming languages, the results were more encouraging. 14.58% of the surveyed volunteers answered that they do know some form of programming. Although on further exchange of dialog it was found that most of these were relatively simple programs on spreadsheets and related software.

The next question pertained to vector biology, as done in the previous area. The simple question, on mosquitoes being a major nuisance in their local region, fewer people answered positively compared to old fringe residents. 68.75% of the volunteers reported positively in this parameter. This might have been due to their better housing and sanitation facilities, as well as the relative lack of large water bodies in the region. The second question was on the common use of mosquito nets in that region, where 93.75% responded positively. Awareness of this very important and simple countermeasure against the mosquito menace was, again, quite a relief. On the question about individual personal protection to combat mosquito bites, except bed-nets, the results were much better than the previous area. 70.83% of the respondents thought that it was essential, and answered they have used some of such measures, such as using mats or coils, or the rarer spray repellents which sometimes also have effects of a room-freshener.

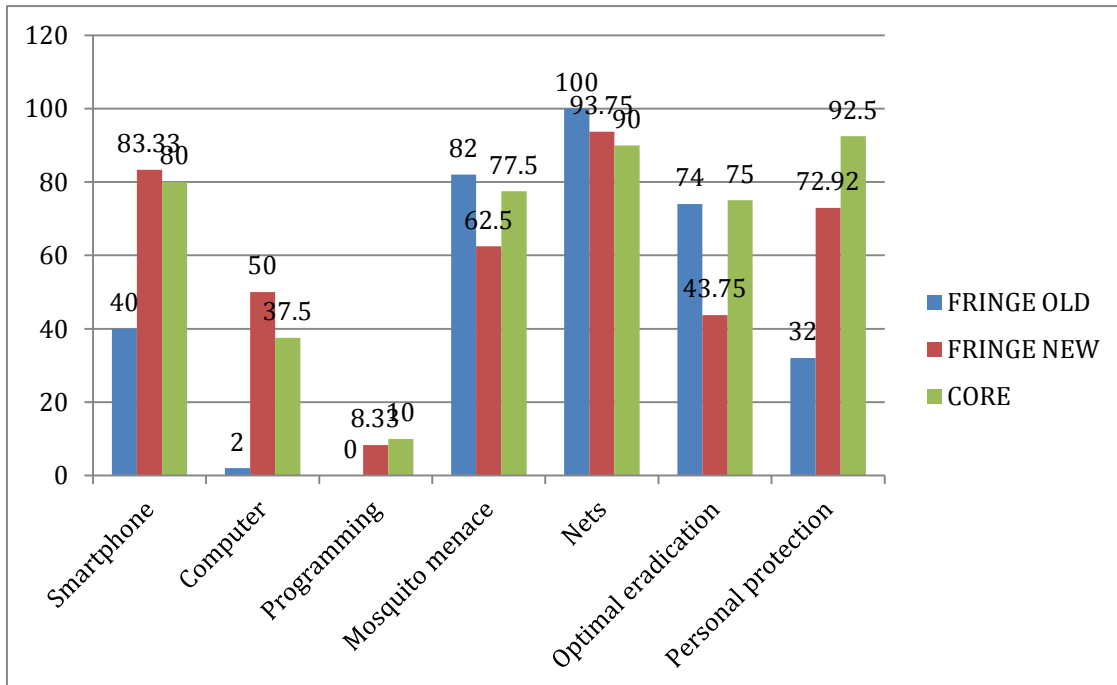
On the question if they personally think that the local pest eradication drives are at least adequate, a two-third majority of 41.68% reported positive.



**Fig. 1.** The "core" area is highlighted in blue, the "old fringe" in yellow and "new fringe" in green. Corresponding major water bodies are also highlighted



**Fig. 2.** The "core" area is highlighted in blue, the "old fringe" in yellow and "new fringe" in green. Corresponding major water bodies are also highlighted



**Fig. 3.** Chart showing the difference between the three areas based upon user responses on seven parameters.

*All figures are in percentages. Subjective data were taken separately*

### 3.3 “Core” Area

The “core area” showed a slightly lower smartphone usage rate at eighty percent compared to the “new

fringe” areas. The usage of a computing device, which includes laptops and desktops, stood at 37.5%, quite lower than the previous area. Familiarity with programming languages showed a relatively high

percentage of 10%, but like other areas, the survey was taken among working age adult population who volunteered. 77.5% of the surveyed population mentioned mosquito menace as, at least “concerning” to “very concerning”. Bed nets usage was very high, and upon further subjective question the non-users were found to have been using aerosol based vapor mosquitocides. Satisfaction with eradication drives were high at 75%, and usage of other personal protection, such as mats, coils and the aforesaid aerosol-based vapor mosquitocides were so far the highest among the three groups at 92.5%.

#### 4. CONCLUSION

One of the long-term possible insights is that there was a shortage of technological aids like computers in the households, but the rate of individual smartphone ownership was quite high and both of these parameters are expected to grow in the future, as per global and country-specific trends [12].

This initial study hints that a multidisciplinary approach in tackling mosquito-borne diseases in the specific and adjoining region is indeed possible. On one side, economies permitting, government initiatives and other related community measures can be further bolstered. On the other hand, usage of technological tools to further aid the young and working age people to reduce the burden of vector-borne diseases, as well as empowering them with the lateral skills of analytical thinking, and a lot along those lines, can also be possibly done. The authors are keen on introducing such tools among the population in the near future as the continuation from this initial survey. One such tool already developed by the author is an application termed “*Mosa-Domon*” (“Subjugation of mosquitoes”, in literal translation to English), which is developed in the local language of Bengali and hosts a wealth of information about mosquito-borne disease control and basic biology of the species. Found at ‘<https://bishnu.itch.io/mosa>’ [13], the application also has a retaining mini-game inside it so that the users, especially of the younger age group, are encouraged to use the application more. It is hoped that it would aid in better bottom-up approach in the fight against mosquito borne diseases, especially with more such tools in the near future. The skyrocketing rate of mobile internet penetration in India, which culminated in more internet users in rural areas as opposed to urban ones for the first time [14], can be very well used to its advantages through these ways.

#### CONSENT

As per international standard or university standard, respondents’ written consent has been collected and preserved by the author(s).

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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