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Study of GIS mapping of aedes mosquito breeding sites of the areas with high breteau index at Mumbai city.

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Abstract:
Background*: Dengue virus is the most prevalent affecting2.5 billion people worldwide& India having half of them[1,2].Still nodefinitive cureavailable; so vector control is the principle strategy to fight against vector borne diseases which we can achieve with Geographic Information System. GIS application provides a graphical representation of the vectors population, their habitats, and the distance from human habitat to potential breeding grounds[3].*
Materials and Methods*: A cross sectional survey was done in convenient sampling of 105 housesof area(G North) with high BI according to Aedes survey 2018-2019 by Insecticide Dept. MCGM, Mumbai. Survey conducted from August to November 2019. Mosquito larval sampling was conducted using pipette. Mapping of larval breeding habitats and dengue transmission risk areas was developed using field data & GIS techniques.WGS 84 coordinate system was used to display digital data. Data analysis done by MS Excel & SPSS version 22.*
Results*: Out of 105 houses inspected 8 were positive. Out of 150 containers inspected 17 were positive with Breteau index 16%. It was almost similar to the findings of Aedes survey. Out of total positive containers Drums, tarpaullin, tyres& roofwere 64.7%, 17.6%,11.7% &5.8% respectively.*
Conclusion: *GIS would be easier & faster way to capture data related to disease transmission. The application of the Geographic Information Systems (GIS) to the study of vector transmitted diseases considerably improves the management of the information obtained from the field survey.*
Hence, combination of ground based sampling with modern Remote Sensor technologies could be useful guidance for targeting vector borne diseases in specific localities.
Key Word*: Aedes, GPS Handheld device, Geographic Information System, Mapping.*

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I. Introduction

Mosquito-borne diseases are the most significant public health risks globally. Dengue virus affects 2.5 billion people worldwide & half the burden is borne by India[1,2]. The Aedes mosquito is responsible for the transmission of many arthropod-borne viruses (arboviruses), including dengue virus, yellow fever virus, Zika virus, and chikungunya virus . These arboviruses pose increasing global public health concerns because of their rapid geographical spread and increasing disease burden.[1] Outbreaks exert a huge burden on populations, health systems and economies in most tropical countries of the world. DF, DHF and DSS has been identified as a re-emerging disease and already reported from 35 states including union territory by the National Vector Borne Disease Control Programme (NVBDCP) during the last decade. A total of 75858 dengue cases with 193 deaths in 2013 and 36486 dengue cases with 92 deaths in 2014 were reported by the NVBDCP from all states of the country. In Maharashtra state, 7410 dengue cases with 31 deaths in 2014 were reported by NVBDCP. Dengue and DHF are posing a problem of utmost importance to the public health of the Maharashtra state. [12] Aedes aegypti and Ae. albopictus are the most important mosquito vectors of dengue fever viruses [10]. With no definitive cure available; vector control forms the principle strategy to fight against vector borne diseases which we can achieve with Geographic Information System. GIS has been used to visualize and identify spatial heterogeneity of DF in risk by short-time interval spatial approaches (e.g. Siqueira-Junior et al., 2008), using household surveys, spatial point pattern analysis and risk factor assessments, demonstrating that low prevalence areas can easily shift to high-risk areas from one year to the next. GIS and statistical methods can play an important role in formulating control activities, assessing changes in transmission over time and determining resources to control prevalence, particularly in areas of high or persistent transmission.[12] GIS platforms promote a more rational basis for strategic planning and management in the control of diseases at the local, regional & national level[3].

GIS application provides a graphical representation of the vector population, their habitats, and the distance from human habitat to potential breeding grounds[3] . Thus effective and efficient larval control measures could be applied.

II. Material And Methods

A cross sectional survey was done in convenient sampling of 105 houses of area (G North) with high BI according to Aedes survey 2018-2019 by Insecticide Dept. MCGM, Mumbai. Survey conducted from August to November 2019. Mosquito larval sampling was conducted using pipette.

Study Design: Cross sectional.

Study Location: 53250 houses in G North Area with high breteau index at Mumbai.

Study Duration: 4 months; from August 2019 to November 2019.

Sample size: 105 houses.

Sampling method: Convenient sampling method.

Inclusion criteria:

1. House members who gave consent to examine their water containers.

Exclusion criteria:

1. House members those unwilling to participate.

Procedure methodology

Data were collected from Insecticide Dept MCGM Mumbai for last 2 years (2018 & 2019) & according to previous 2 yrs data, G North ward were having high Breteau Index. Survey conducted in G North area along with health worker from Pest control Office to find out breeding sites for duration of 4 months. Randomly selected the first house in that area & surveyed houses in right hand direction till we reached to desired sample size. Mosquito larval sampling was conducted using pipette. Location of houses saved in GPS handheld device.

Spatial mapping using a GPS receiver and GIS:

A handheld GPS receiver (Garmin GPS 72H) was switched on in front of the household of subject. A GPS receiver displayed the information regarding elevation, time, and receiver's current location, i.e., latitude and longitude in terms of degrees and minutes (North .o.' and East .o.'). These values was recorded. On entering the GPS coordinates in a computer with GIS software, the houses were spatially mapped.[11]

Steps for data collection using GPS handheld devise:

- **At the beginning of GPS data collection…**
  Step 1- Clearing out any existing waypoints and set to correct data display formats.
  Step 2 - Set the information about study subject ,waypoint name in GPS handheld device.
  Step 3- Log out of GPS handheld device.
- **After data collection…**
- Ensured that GPS data were collected for each house.
- Exported data from GPS handheld device.
- **Transferring GPS coordinates from GPS handheld device to waypoints:**

I. The serial cable or USB cable specific to the GPS handheld device was used to connect that device with laptop/desktop.

II. GPS coordinates for the sampled houses from GPS handled device transferred to QGIS software to store them as waypoints. These Waypoints used for mapping of areas using GIS software.

III. A computer with a serial or USB port and the following programs installed:

1. QGIS software
2. Microsoft Excel
3. The listing data for the sampled houses including the latitude/longitude coordinates (waypoints).

Statistical analysis:

Mapping of larval breeding habitats and dengue transmission risk areas was developed using field data & GIS techniques. WGS 84 coordinate system was used to display digital data. Data analysis done by MS Excel & SPSS version 22.

III. Result

Table 1. Types of container & Container with larvae

Type of Container	Total Containers inspected	Containers with larvae
Drum	90	11
Terpaullin	27	3
Tyres	23	2
Roof	10	1

- Out of 105 houses inspected 8 were positive. Out of 150 containers inspected 17 were positive with Breteau index 16%. It was almost similar to the findings of Aedes survey. Out of total positive containers Drums, tarpaullin, tyres & roof were 64.7%, 17.6%,11.7% & 5.8% respectively.

Fig 1. Line diagram showing container type analysis

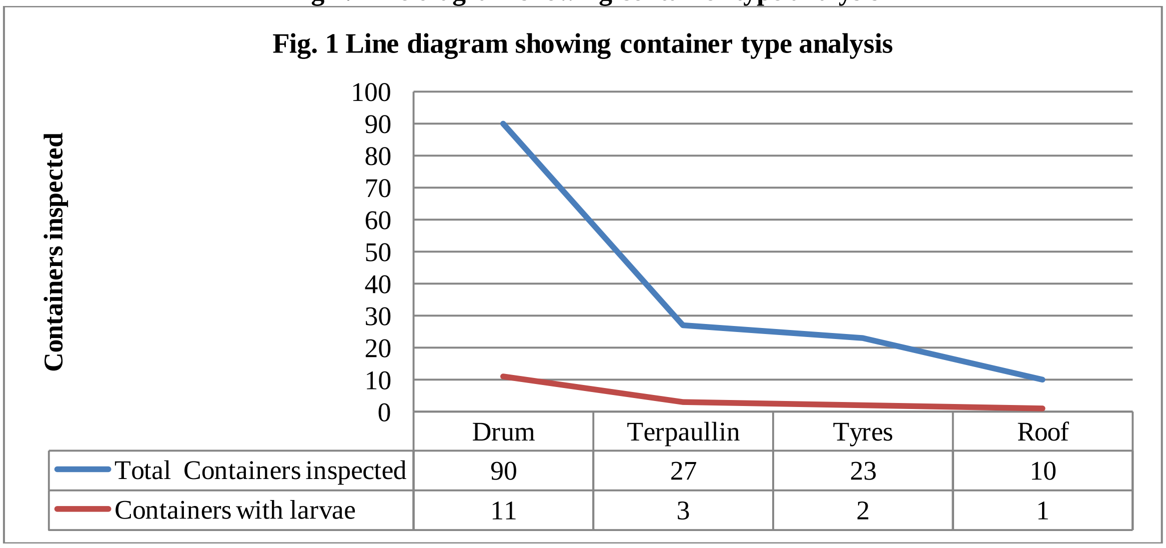


Fig 2. Pie diagram showing percentages of positive containers

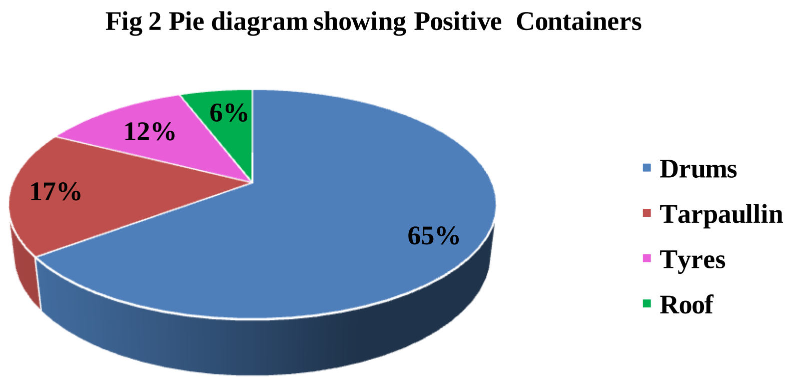


Image 1. Mumbai wards showing Aedes Breteau Index 2018 year

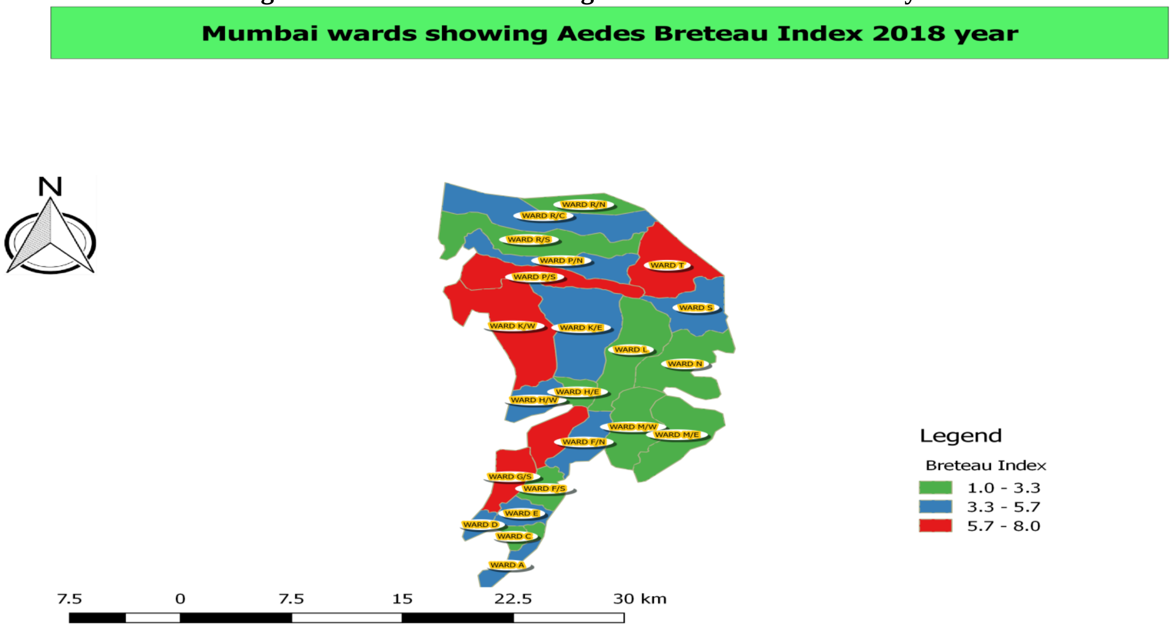
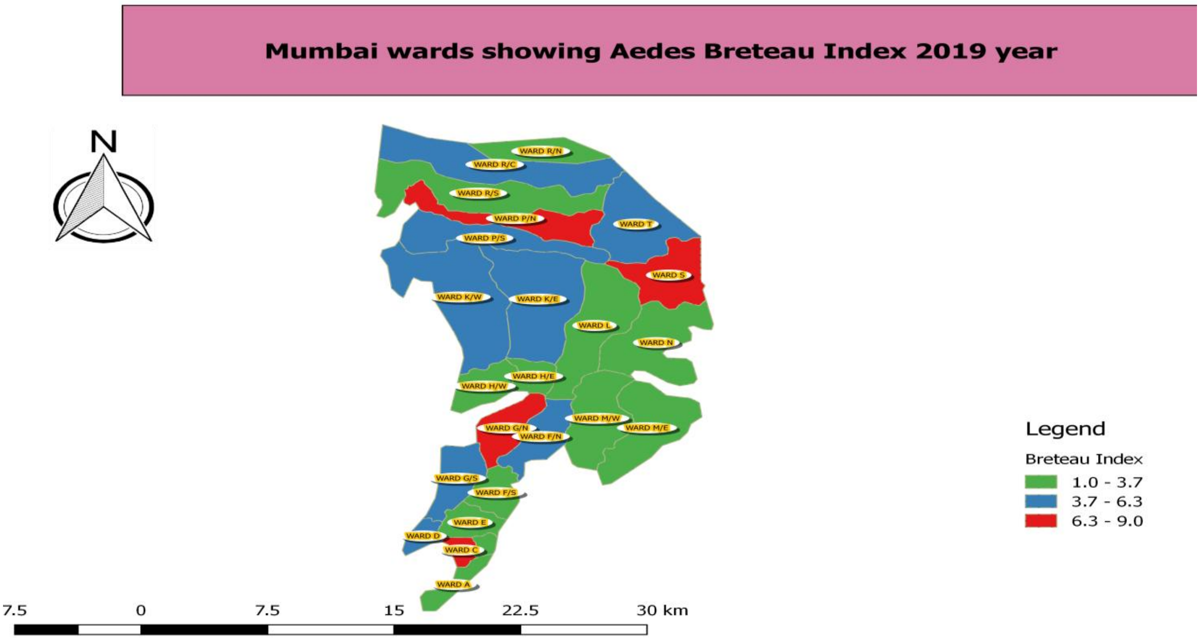


Image 2. Mumbai wards showing Aedes Breteau Index 2019 year



In image no 1 & 2 green colour areas showing mild breteau index, blue colour areas showing moderate breteau index & red colour areas showing high breteau index.

Image 3. Aedes breeding site survey in G/N area of Mumbai

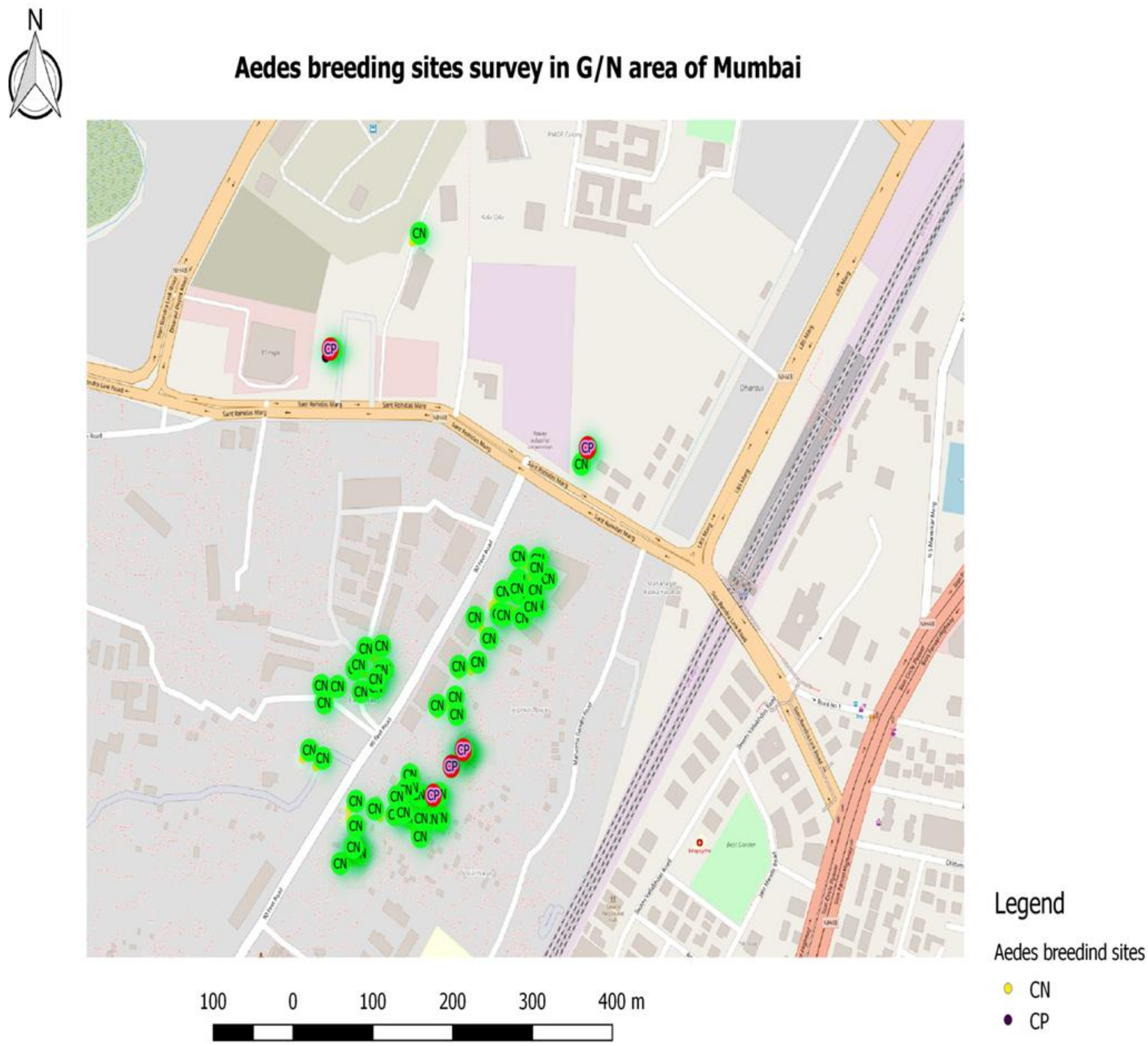


Image 3 shows houses with negative containers in green colour & houses with positive container in red colour.

Image 4. Aedes breeding site with positive containers in G/N area of Mumbai

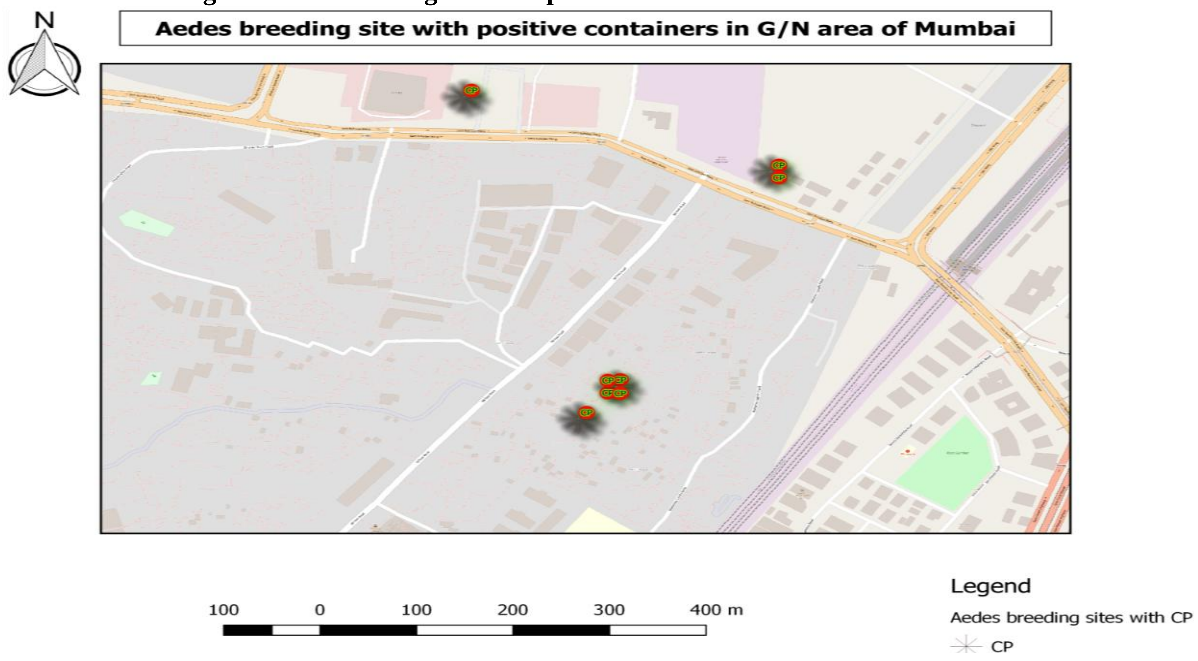


Image 4 showing 8 houses with positive containers presented in red colour.

IV. Discussion

We inspected 105 houses and found 8 houses to be positive. 17 Out of 150 inspected containers were positive with Breteau index 16%. Out of total positive containers Drums, tarpaullin, tyres & roof were 64.7%, 17.6%,11.7% & 5.8% respectively.

Getachew D et al(2018)[1] surveyed 301 houses in Dire Dawa city of these, 208 houses were positive. Overall 750 containers were inspected among which 405 were positive with BI 23.8%. These were (33.33%)tires, (24.19%)plastic drums,(16.04%) barrels, (19.01%) jerricans[1]. **Ferede G et al (2018)**[6]. surveyed 384 houses in the towns of Metema and Humera of these 98 were positive. Overall, 566 containers inspected 186 (32.9%) were positive with BI 48.4%. Positive containers were discarded tires (57.5%), mud pots (30.0%), mud dishes (21.7%), ditches (21.1%), and plastic containers (14.8%). **RK Singh et al (2015)** [2]. recorded breeding in constructed sites in ground level cemented tanks (3.0) followed by desert coolers (1.7), discarded tyres (1.5) and cemented tanks (1.3). In addition, breeding of Aedes was also observed in broken glass- -wares (1.0) and iron drums/tubs/tanks left in open spaces in houses during survey (1.1).

As shown in image 1 & 2 we can visualize areas with constant high breteau index at a one glance & plan strategies for vector control accordingly. Similar finding observed by **Hassan M. Khormi et al (2012)**[12], areas with various risk levels were identified in different geographic locations (districts) for the different epidemics (years) using Getis-Ord Gi*. The districts depicted with dark and light red shades were found to comprise high and medium spatial clusters with high and medium risk levels, respectively. The DF spatial patterns were similar over most of the study period, especially in the high-risk areas in the old Jeddah districts. Based on a combination of environmental and socioeconomic variables, such as DF cases, mosquitoes capture, population, population density, neighbourhood quality, monthly spatio-temporal of DF incidence and the depth of subsurface water levels, a model of DF risk was developed. The application of these tools improves our understanding of the monthly spatio-temporal risk, which provides the foundation for control management.

In this study as shown in image 3 & 4 analyzed the area with houses having risk of transmitting the disease with their locations. Similar findings reported by **Rohani Ahmed et al (2011)**[5] A clear association was observed in the study areas between the distance to potential breeding sites and the variability in An. maculatus s.s. larvae. The study showed that An. maculatus s.s. was identified from breeding sources within 400 m from the nearest villages. A negative association was observed between the distribution of An. maculatus s.s. habitats and the distance to the nearest house, suggesting that An. maculatus s.s. prefer laying eggs in habitats near houses. Geographic Information System (GIS) and Remote Sensing (RS) are increasingly used for the study of spatial and temporal patterns of vector-borne diseases.

V. Conclusion

GIS would be easier & faster way to capture data related to disease transmission. The application of the Geographic Information Systems (GIS) to the study of vector transmitted diseases considerably improves the management of the information obtained from the field survey and facilitates the study of the distribution patterns of the vector species.

Hence, combination of ground based sampling with modern Remote Sensor technologies could be useful guidance for targeting vector borne diseases in specific localities.

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