



Mosquito surveillance in Rural Areas and using GIS to Counteract

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Abstract

Dengue and Malaria are diseases which are transmitted through the bite of mosquitoes from one host to another i.e. they are vector borne disease which grosses a large amount of deaths in many countries throughout the world. Various environmental spatial factors have effect on these diseases, they prosper well and transmit the parasite in moisture laden areas in warmer climates. The best ecology are near residential areas where animal and human cohabitate. These diseases have been reported for high infant mortality rate and the reports are increasing every day in our country. Our objective is to identify the ecology and the transmission of mosquitoes for reducing their production. This study provides us data from past and helps us to determine the future role of GIS integrated epidemiological indices for identifying risk areas. Various epidemiological indexes like ABER, API, SPR, SFR were studied to understand Dengue and Malaria epidemicity in UP cities and aimed to look for any link between these epidemiological indices.

Keywords: Geographic Information System (GIS), annual blood examination rate (ABER), annual parasitic index (API), slide positivity rate (SPR), slide falciparum rate(SFR), epidemiology

1. Introduction

Dengue is a mosquito born viral disease caused by the dengue virus from the bite of a mosquito. Symptoms actually start showing up after 3-14 days of infection, typically people infected with dengue virus are asymptomatic 80% and around 5% only show severe signs of illness.

Early signs of dengue include high fever, headache, joint pain, loss of appetite, vomiting and a characteristic skin rash. Though mostly the fever doesn't last beyond a week, but some cases may develop more critical condition and pose life threatening danger to the person. The situation is characterized by a drop in the Blood Platelets level, Blood plasma leakage or a severely low blood pressure. ^[1]

Malaria is mosquito born protozoan disease caused by the infection of Plasmodium parasites. it is most commonly transmitted by an infected female Anopheles mosquito. Typical symptoms of malaria include fever, fatigue, headaches and vomiting while in serious cases it causes yellow skin, coma, seizures or death. Malaria effects mainly poor, undeserved and marginalized population in outer areas which are characterized by inadequate control measures and limited access to health care services. ^[2, 4]

Dengue and Malaria are endemic in more than 100 countries and around 40 % of world population is at their risk. Mosquitoes are a major public health problem in India and they get more than 1.5 million people infected every year. It is local disease but has to be focussed in a well-planned manner. There has been found an exponential increase in the mosquito borne diseases in recent years. It is primarily because of the development of drug resistance of dengue and malarial parasites along with several other factors. In the region of Eastern Uttar Pradesh the spreading of vector borne disease becomes uncontrolled especially during rainy season. GIS could be a fantastic tool for the disease management as it has

intrinsic ability to manage spatial, non-spatial and temporal data. GIS comprises set of strategies and tools which are capable of integrating, storing, analysing, editing, and to display geographically referenced information from different platforms and sources.

For epidemiological indices: API based dengue and malaria maps of Uttar Pradesh(India) has been taken from National Vector Borne Disease Control Programme Official Website for its microscopic observation to the level of Primary Health Centres(PHC) and the Community Health Centres(CHC) for the study of area. GIS mapping is done at PHC/CHC level of the entire targeted area. The work is then mono-fragmented for obtaining annual variation of ABER, API and the SPR for various district and seasonal variation of Dengue and Malaria infected people has been generated for few District for the most recent time period up to July-2016.

2. Factors behind Mosquito Endemicity

Mosquitologists working in the field in the first half of this century, in the decades following the elucidation of the mosquito cycle in man and mosquito, found out that it was a focal disease and that the layout of the land is an important consideration in the understanding of the local epidemiological situation. The mosquito endemicity is primarily because of the development of drug resistance of dengue and malarial parasites. It may have various other reasons including on-going city developmental activities, excessive use of pesticides, indiscriminate deforestation ^[6] and demographic shifts etcetera for this enhanced rate of spreading of this disease. Factors further have been linked to the life style of different community people (especially for the local inhabited tribes), and the behaviour of mosquitoes which transmits the disease as well as climatic and other attributes. For the spreading of mosquito borne disease, factors like the proportion of infected

mosquitoes, the vector population density, nearness to breeding ground and seasonability, climatic factors such as rainfall, temperature and relative humidity are known to have a really strong influence on the biology of mosquitoes. [7] The socio-

economic and physic-chemical factors could also be one important cause of the Mosquito endemicity of the study region. [8]

Table 1

Affected States/UTs	2014		2015		2016	
	C	D	C	D	C	D
Andhra Pradesh	1262	5	3159	2	3376	2
Arunachal Pradesh	27	00	1933	1	13	0
Assam	85	0	1076	1	5715	4
Gujarat	2320	3	5590	9	7869	14
Haryana	214	2	9921	13	2489	0
Karnataka	3358	2	5077	9	5833	8
Kerala	2575	11	4075	25	7204	12
Madhya Pradesh	2131	13	2108	8	3134	12
Maharashtra	8573	54	4936	23	6708	32
Orissa	6433	9	2450	2	8377	11
Punjab	472	8	14128	18	10475	11
Rajasthan	1243	7	4043	7	3632	16
Tamil Nadu	2804	3	4535	12	2531	5
Telangana	704	1	1831	2	2764	4
Uttar Pradesh	200	0	2892	9	7512	42
Uttarakhand	106	0	1655	1	2146	4
West Bengal	3934	4	8516	14	17702	34
Delhi	995	3	15867	60	4393	10
D&N Haveli	641	1	1154	0	4161	2
Puduchery	1322	1	771	0	463	2
Total	40571	137	99913	220	111880	227

Dengue Cases(C) and Deaths(D) in our Country since 2014.[11]

3. Study Area

The three districts Kushinagar (Latitude 26°39'N to 27°15'N and Longitude 83°38'E to 84°15'E), Gorakhpur (Latitude 26°13'N to 27°29'N and Longitude 83°05'E to 83°56'E) and Mahraj Ganj (Latitude 26°59'N to 27°19'N and Longitude 83°09'E to 83°45'E) of the eastern Uttar Pradesh area has the

total area of 9291 Square Km (3.82 % of the Whole State). It lies in the north-eastern part of the most populated state and includes a large stretch lying to the north of the river Rapti side stream to the Gandak River and is also surrounded by other rivers of Rohini at the northern side which are the main sources of water for our study area.

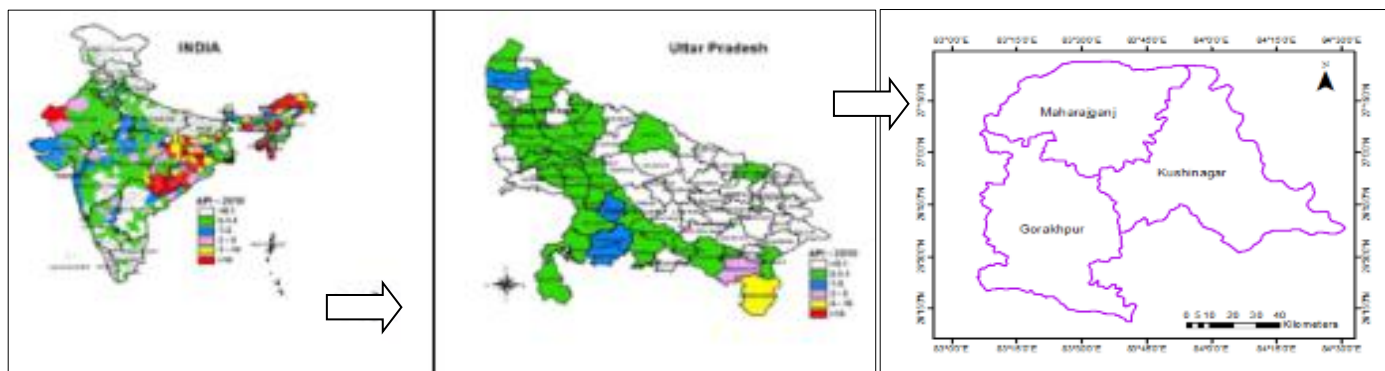


Fig 1: Location of Study Area in North East UP in India

This is 275 Km away from Uttar Pradesh’s capital Lucknow and it is also at the International border of Nepal. This study area is one among highly populated region of UP and has a population of more than 10.67 million Indian people. [3]

4. Methods

Four epidemiological indices are namely

1. ABER (Annual Blood Examination Rate) = (The total

number of smudge examined in one Year/ Total population of the study area) X 100. [9]

2. API (Annual Parasitic Index) = (Total number of cases tested positive for infection/Population size) x 1000. [13]

3. NS1 Ag test for Dengue Fever. [12]

4. SFR (Slide Falciparum Rate) = (Total Positive cases for Plasmodium Falciparum (Pf) Total number of slides examined) X100.

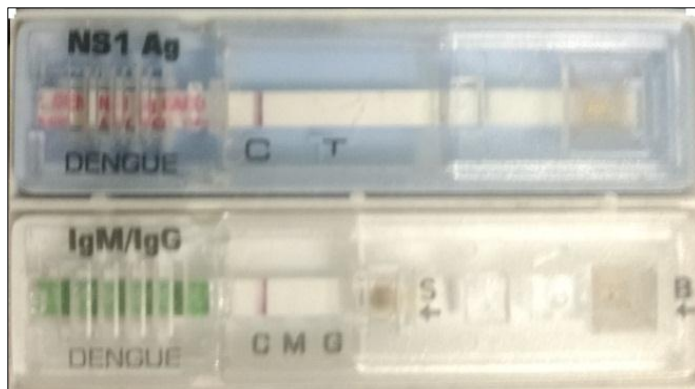


Fig 2

These have been calculated on the study area and various results were documented. Plotting has been done for ABER, 100 x API and 100 x SPR. This change presents a better picture towards establishing how ABER, API and SPR are inter-related. [9]

5. Result

The obtained result can be represented through following maps and tables.

Epidemiological study

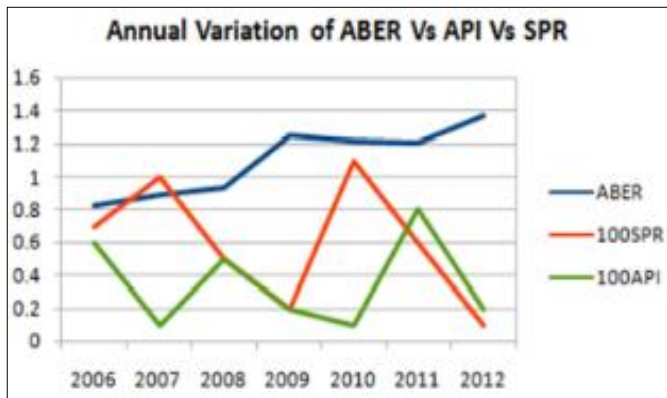


Fig 3: Annual Variation of ABER Vs 100 API for Gorakhpur District

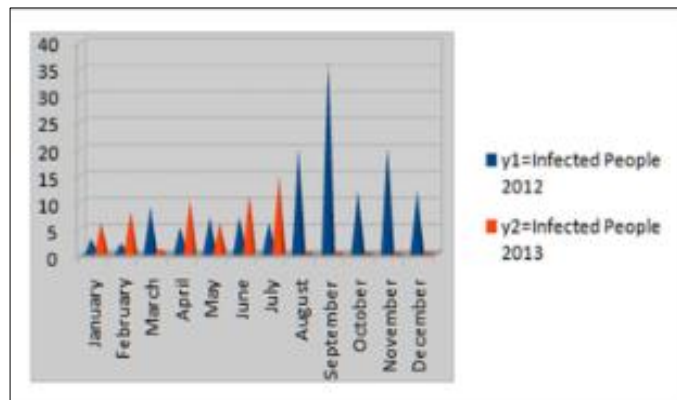


Fig 4: Seasonal Variation of API for Kushinagar District

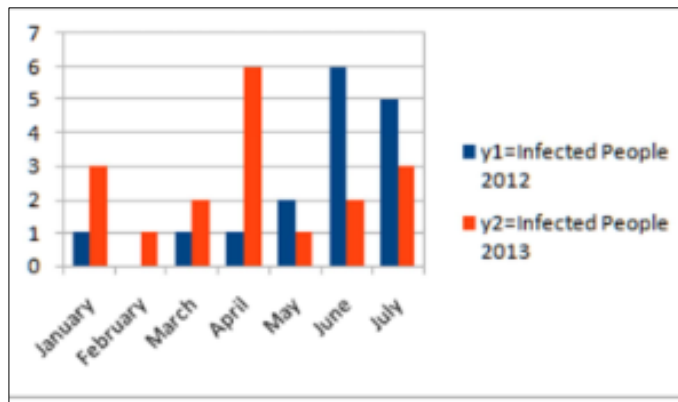


Fig 5: Seasonal Variation of API for Maharajganj District

6. Discussion

Based on the study it can be inferred that

1. It is observed that Dengue and Malaria cases are more around the rural masses than the urban, indicating socio-economic divide and bad medical treatment measures in rural and village remote areas.
2. It is maximum in region that is in between two forests.
3. Measure of dengue and malaria in a community is calculated through ABER. It reflects the efficiency and adequacy of detection mechanism. A minimum ABER of 10% of the population/year was fixed under MPO and API < 1.3. The areas with Annual Parasitic Index (API) ≥ 2 per 1000 person/year have been categorized as areas with high risk in India, and thus they should be put up for the vector control.
4. The SPR provides a different method for the estimate of temporal changes in dengue and malaria epidemic. The SPR can provide a fast and cheap method of evaluating the burden of mosquito diseases in a population utilizing the medical facilities.
5. The most interesting observation is that the study area is negative for Plasmodium falciparum while it was positive for Plasmodium vivax.

7. Conclusion

- From the collected data we can say that for mosquitoes to breed they require a particular climate, temperature and stagnant water (within which to lay their eggs).
- Thus if we use GIS and Satellite Imagery in such a way that we find the hotspots of their breeding sites then we could safeguard ourselves from mosquitoes by cleaning those areas thus counteracting against them.
- This way we will be able to reduce the number of patients of Dengue and Malaria and the deaths caused by them.

8. Future Work

From the study it can be inferred that there is a wide spectrum of possibilities over which GIS can be attributed to mosquito control measures. Its application as an operational planning aid is an extension of geographical observation to promote better program management at both the state and national levels.

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