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Locating The Vector Borne Disease Areas With The Help Of Gis & Gps Technology : In India

Gujju Gandhi[1]*, J Chapla[2], JN Rao[3] and Kante Krishna Prasad[1]

[1]Department of Zoology, Osmania University

[2]Department of Botany, Osmania University

[3]JSS Medical College & Hospital, Mysuru, Karanataka

Research Article

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***For Correspondence**

Gujju G, Department of Zoology, Osmania University, Hyderabad, India, Tel: 91+9346423178.

E-mail: ggandhiphd@gmail.com

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ABSTRACT

Recent advances in geographical information, mapping technologies have created great opportunities for public health administrators for better planning of programme, field monitoring, and analysis of epidemiological data and management of health system. Epidemiology Geographical Information System (GIS) and Global Positioning System (GPS) helps in visualizing and analysis of geographic distribution of disease, with respect to time and space, which is difficult and impossible to perform in any other system. Based on regions the distribution of vector born disease cases were represented on vector born disease density maps which were calculated for each Primary Health Centre (PHC). We have selected Khammam district of Telangana state, India, as the district is an agency (tribal) area with more number of infected cases. Our main aim is to map the vector borne diseases, density areas by using GIS techniques. Remote Sensing data was also used to identify the favorable indicators of malaria breeding areas. Vector born disease (VBD) were highlighted in this study such as Malaria and Dengue. The work was carried out between the years 2011-2014. Our main aim is to identify and to report the causes for malaria and dengue and report the matter to the concerned authorities.

INTRODUCTION

In 21st century, vector-borne diseases (VBD) have emerged as a serious public health hazard in most of the developing countries including India. The Information System on health is the best preventive method to control the vector borne diseases [1]. Most of the developed countries applied Geographical Information System in their policy levels to mitigate the vector borne diseases problem. In India, applying GIS in health sector has just begun. Mosquitos and other insects related to aquatic habitats have long been recognized as root cause for public health problems. These problems can be prevented or controlled by physical (including water management), biological and chemical means. The techniques applied by most mosquito control experts include water management, eradicating aquatic weeds and other preventive measures such introduction of anti-mosquito fishes. The primary object is to identify location or an area of mosquito infected patients and mapping them that is areas in different village. Integrated use of RS and GIS has been successfully demonstrated by many workers in mapping of malaria risk zones in different parts of Africa [2,3].

In this ever increasing complex world, it is not surprising for the public health researchers to intricate and to solve the vector borne diseases. An inter-disciplinary approach may have a scope to discover new methods. Recently, GIS has emerged as an important component of many projects in public health and epidemiology work. Epidemiologists have traditionally used maps when analyzing associations between location, environment and disease. GIS has been used in the surveillance and monitoring of vector-borne, water-borne diseases, health, analysis of disease, policy and planning in an area, identification of high risk health groups, planning, programming of activities, monitoring and evaluation of disease control [4]. Vectors are hosts for much dangerous disease, the prevention and control measures cannot be effective for long without addressing the vector directly. Vector densities are high in rural when compared to urban areas due to favorable habitats [5]. People's poverty, farming techniques, poor infrastructure and cultural activities also contribute to the favorable conditions for developing mosquito breeding habitats [6]. Unhygienic conditions in a community and unable to protect themselves from the diseases, the risk of transmission of any disease will be high in the tribal areas. Earlier studies have proved in identifying sources of potential factors in rural areas that help in transmission of the disease such as the way of living, socio economic status of the people, livestock dependence

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[7-10]. Cultural aspects among the residents, drainage system, distance from lotic waters, and infectious-bite repellents [11-16]. Our primary object is to identify the location or an area infected with malaria and dengue and mapping infected villages.

OBJECTIVES OF THE STUDY

The main aim is to identify the vector borne disease location (VBS), in different villages and tribal areas of Khammam district, Telangana State, and mapping the infected areas by using Geographical Information System (GIS), Global Position System (GPS) and Remote Sensing (RS) techniques.

STUDY AREA

The study was carried out in the year 2011-2015, in and around Bhadrachalm and Kothagudem regions of Khammam district, south Telangana, extending an area of 161.11 sqkm, lies between the 17.6700°N latitude and of 80.800°E longitudes. The district comprises several mandalas which are infected with vector borne diseases. Malaria,Dengue and Chickengunia. The mandals are, Bhadrachalm, Kothagudem, Kukkunoor,Charala, Julurupadu,Kamepally and yellandu which are further sub divided. **Table 1** shows the infected patients of the vector borne diseases data for the year 2014 with reference to villages.

Table 1. Village wise Vector borne disease year of 2014.

Name of the Mandal	Name of the village	No. of Malaria cases	No. of Dengue Cases	No. of Chickunguniya Cases
Charla (PHC)	Bhumylanka thanda	14	04	Nil
	Devanagarm thanda	12	01	01
	Laxmi Colony	6	Nil	Nil
	Dosillapalli	05	05	Nil
	Rallagudem	12	Nil	01
	Regulapadu	14	06	01
Kamepally(PHC)	Thallagudem	02	04	Nil
	Pinjarimadugu	06	12	Nil
	Mucharla	08	01	Nil
	Jasthupally	03	Nil	02
Kuchumanchi (PHC)	Bhagathvrdu Thanda	05	Nil	03
	Jujlaropeta	12	Nil	01
	Perika Singaram	09	01	Nil
Kukkunur (PHC)	Dacharam	01	Nil	Nil
	Ravikunta thanda	14	02	01
	Nallakunta	08	Nil	01
	Besthagudem	14	Nil	Nil
	Arvapally	12	03	02
	Marripadu	17	01	04
Gundala	Settipalli	10	05	02
	Galabha	12	06	01
	Sembunigudem	25	02	01
	Laxmipuram	23	02	Nil
	Chinthapadu	24	Nil	01
Aswaraopeta	Donikunta	14	02	03
	Gangaram	15	Nil	02
	Gurral Cheruv	16	01	Nil
Wazeedu	Mandapaka	17	01	02
	Jangalapalli	14	01	01
	Pusuru	12	Nil	03
Yellandu	Gandhinagar	18	Nil	02
	Romped	16	01	01

Sembunigudem was recorded with highest number 25 malaria cases followed by, Chinthapadu - 24 and Laxmipuram – 23 and lowest is Dacharam with only 1. Pinjarimadugu is prone for Dengue with highest number 12 cases, chinthapadu, gangaram and pusuru villages are with nil reports, coming to chickenguniya the highest cases were recorded in marripadu with 4 cases and nil in 10 villages. The table shows the highest number of malaria infection is predominant when compared with other to dengue and chickenguniya **(Figure 1)**.

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Figure 1. Shows the Khammam district – Location of study area.

METHODOLOGY

The maps were geo-referenced to real world co-ordinate system with respect to known reference point, based on geographic latitude and longitudes. Spatial data were digitized using Arc GIS version-10.2 software. All the areas covered under were edited and removed digitization errors such as overshoot, undershoot, dangles, and labels for each polygon. Database was generated based on disease incidence report and linked with the vector layer. For GIS platform geo-referenced digital map of villages/tahsils/ districts were taken in to account. A three tier database was constructed district wise, tahsil wise and village-wise. Vector borne diseases (VBD) data for five years – from 2011to 20015 were included in the village mappings, were used for further analysis in formulation of control strategies. The survey questionnaire included socio economic status of the villagers, environmental conditions, health facilities and locations of the breeding sites of mosquito larvae. About 1000 random samplings were done in each village which was geocoded using the Garmin-630 GPS. The data were later imported into the Arc GIS- 10.2 version for further processing. IRS - LISS-IV Remote Sensing data was used to identify and mapping the disease prone areas.

IMPORTANT VECTOR-BORNE DISEASES

Malaria

Malaria exists in every tropical and subtropical landscape across the globe, sometimes making seasonal excursions into temperate areas as well. The protozoan parasites that cause it have more complex genomes, metabolisms and life cycles than almost any other vector-borne threat. This complexity makes them a difficult target for interventions such as drugs and vaccines because the parasite's shape-shifting ways allow it to evade chemical and immunological defenses. They pose a moving target as well, intentionally changing their outer coating during each phase of their life cycle and creating a diverse antigenic and metabolic wardrobe through sexual recombination, an engine of diversity creation unavailable to simpler microbes such as viruses and bacteria.

Dengue Fever

Dengue virus in many ways seems to be the obverse of malaria. While malaria transmission occurs most frequently in rural areas, Dengue is a city disease. While the Anopheles vectors of malaria bite mainly at night, the Aedes vectors of dengue bite mainly in the daytime. While an initial malaria infection generally produces the most severe symptoms, a second infection of dengue can be much more dangerous than the first, when it involves a different serotype of the virus. Dengue fever can be painful (hence its nickname of "break bone fever") and debilitating but is generally not life threatening when first acquired. However,

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severe manifestations arise in areas where more than one of the four main strains of the virus coexists. Becoming exposed to a second, different strain of the virus can provoke a severe immunological reaction called Dengue Hemorrhagic Fever (DHF), which can carry a significant risk of death, especially in children and younger adults. Presently, about five percent of the hundreds of thousands of people who acquire DHF die, although prompt and effective medical care can greatly reduce this case fatality rate.

RESULTS AND DISCUSSION

Application of GIS in epidemiological studies help in visualizing and analyzing geographic distribution of diseases, which reveal spatio-temporal trends and patterns that would be more difficult or obscure to discover in any other applications [17]. It performs a spatial statistical task, outbreaks of diseases and environmental factors. Climate plays a major role in spreading of disease. Higher temperature of 32-35^{0}c and 70-80% of humidity is favorable for the vector breeding for malaria, dengue and Chikunguniya [18]. Geo-spatial analysis provides the information of land influence the vector borne disease cover [19]. The year wise distribution of the disease and annual number of human affected by vector born disease from the year 2011 to 2014-15 shows in **Table 2.**

Table 2. Year wise data showing vector borne diseases in Khammam district tribal areas from 2011 to 2015.

Year	Malaria Cases	Dengue Cases	Chikunguniya
2011	3171	52	Nil
2012	1153	114	19
2013	1697	57	07
2014-15	2990+290	245+14	16
Total	9301	482	42

A total number of 9825 cases were recorded from year 2011-2015 out of which 9301 cases are malaria, 482 cases are dengue and 42 cases of chickenguniya.

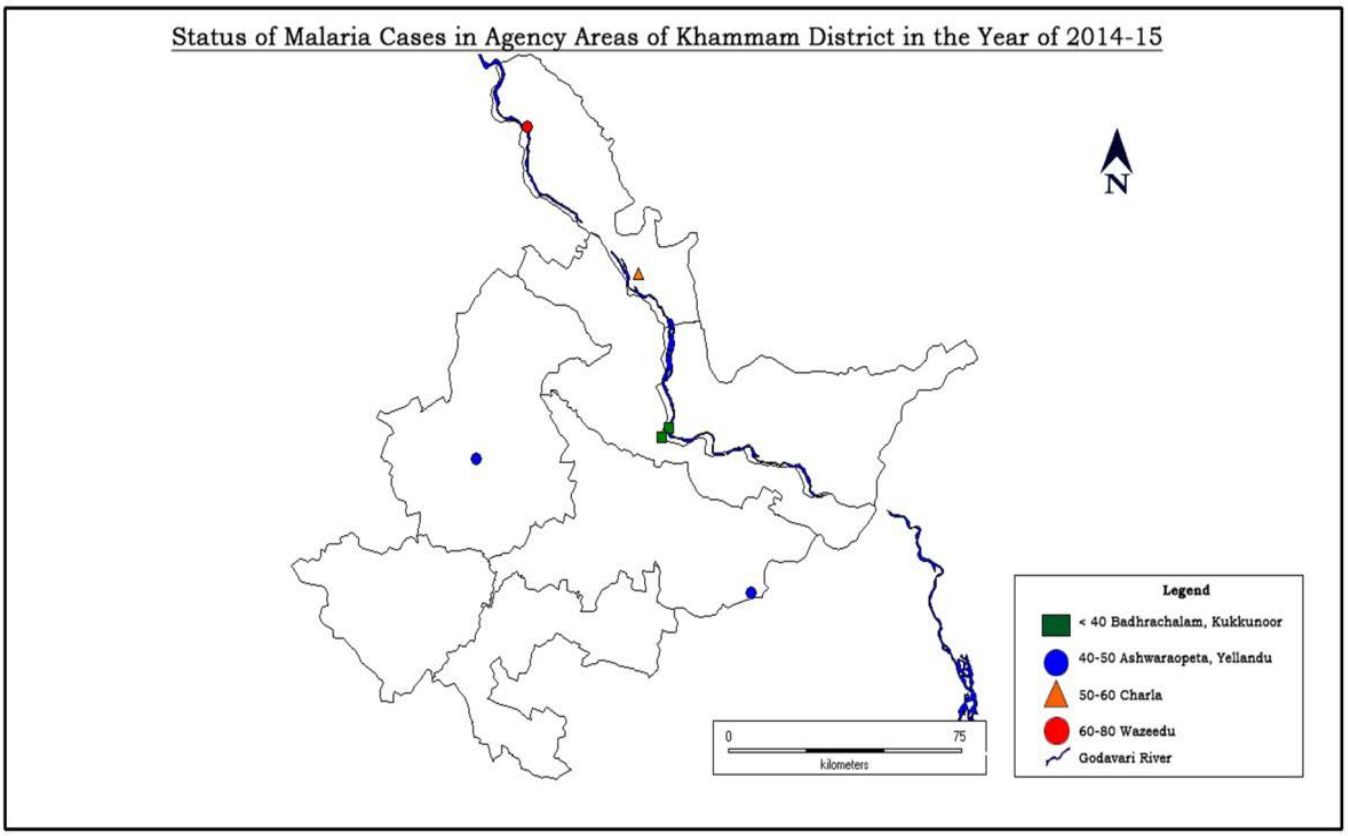

Figure 2. Sources of malaria diseases.

Streams, ponds, water tanks, nalas and different sewage zones, overhead tanks and slum areas, cattle sheds, in the Wazeedu, Charla and Aswaraopeta mandals are very much prone for malaria breeding sources. All these indicators are shown in the **Figure 2.** The lack of proper sanitation planing and avoidance behavior also added to the context. In addition, majority of the people in villages prefer to sleep in open corridors and are attracted by mosquitoes and prone for the vector borne diseases. In most of the villages the schools are built near the water tanks which are also mosquito breeding place hence the school children also infected with vector borne diseases.

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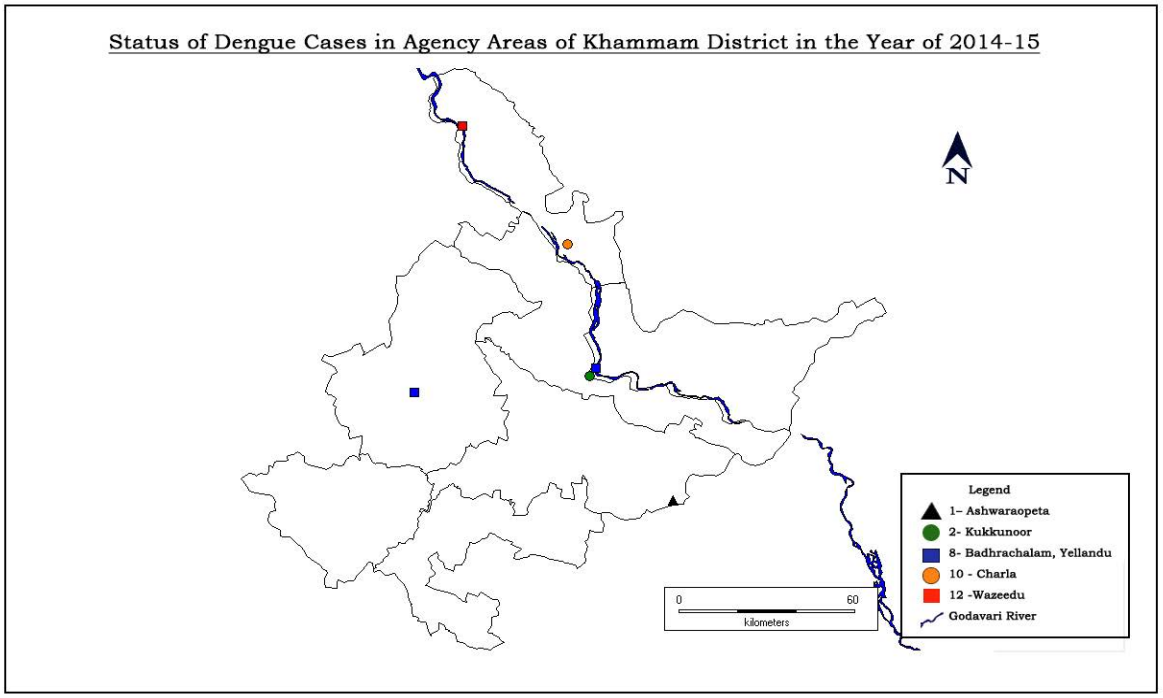

Figure 3. Status of dengue cases in the Khammam district tribal area in year 2014 and 2015, respectively.

Mandal-wise case data of VBD cases were mapped and identified clusters which require intense attention for the control of disease. In the present decade Dengue viruses have been considered as most dreadful diseases worldwide. If the dengue fever infected more than once the person's survival will be at stake. Data for vector borne diseases were collected from government PHC and Mamatha Medical College of Khammam District. Maximum number of case of dengue were recorded in urban area of the Badhrachalm,Kothagudem, Yellandu and Palavancha mandals of khammam District, where sanitation conditions and the maintenance of ponds are not up to the satisfaction **(Figure 3)**.

CONCLUSION

Malaria and dengue are very serious tropical diseases among other vector borne diseases. In our survey we have identified target variables that potentially favorable mosquito breeding sites. GIS & GPS technologies have been proved effective in data collection and presentation of disease incidence for mapping, which help us implementing immediate corrective and preventive measures. Application of GPS technology was very easy to locate the infected persons. The GIS technology helps in display, distribution of disease with different mappings of chloropleth. Maximum 250-300 cases of malaria were recorded in Khammam tribal area. Village people who live close to their agricultural field, more likely infected due to proximity of stagnant water. Block wise village mapping unit etc will help us in identifying the areas which are hot spots and highly prone for vector borne disease areas. Such maps will help in taking proper preventive measures in controlling the spread of diseases.

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