This paper presents a new doctrine of acute pneumonia , based on known medical science advances and additional own researches of the author.Changing ideas about the nature of the disease led to the revision of the principles of medical care to this category of patients.Clinical testing of new approaches to the treatment of the most aggressive forms of pneumonia not only confirms the feasibility of such audit views and methods of influence,but also suggests the possibility of the guaranteed prevention of complications of the disease.





Igor Klepikov was born and studied in the USSR. Pediatric surgeon of the highest qualification in Russia and Israel with experience of over 40 years. Currently retired, lives with his family in the United States.

978-3-330-35250-6

Igor Klepikov

Acute pneumonia: a new look at the old problem

LAP LAMBERT Academic Publishing

Igor Klepikov

Acute pneumonia: a new look at the old problem

Igor Klepikov

Acute pneumonia: a new look at the old problem

LAP LAMBERT Academic Publishing

Imprint
Any brand names and product names mentioned in this book are subject to trademark, brand or patent protection and are trademarks or registered trademarks of their respective holders. The use of brand names, product names, common names, trade names, product descriptions etc. even without a particular marking in this work is in no way to be construed to mean that such names may be regarded as unrestricted in respect of trademark and brand protection legislation and could thus be used by anyone.

Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
ISBN: 978-3-330-35250-6

Copyright © Igor Klepikov
Copyright © 2017 International Book Market Service Ltd., member of OmniScriptum Publishing Group
All rights reserved. Beau-Bassin 2017

Table of contents

Applications of Gis in Epidemiology and Entomology 11
Global Positioning System (Garmin R6300)..... 12
Review of Literature. 14
Data Product - Liss-IV Image Products (IRS-P6.LISS.IV) 17
IRS Data Products & Services 20
Resolution 20
3.9.3 Spatial Resolution 21
Elements of Image Interpretation 22
Image Interpretation 24
Image Classification Techniques in Remote Sensing 24
Vectorization 25
Important Vector-Borne Diseases 31
Conclusion 35
Acknowledgement 35
References 36
List of Abbreviations 43

APPLICATION OF GIS, GPS & RS TECHNOLOGY FOR IDENTIFICATON OF INFECTED AREAS FOR VECTOR BORNE DISEASES - INDIA

Gujju Gandhi[1], Jayanth Chapla[2], J.N. Rao[3] and Shaik Hafeez[4]

1-Dept of Zoology, 2&4 Dept of Botany, Osmania University,Hyderabd,Telangana State,India.

3-JSS Medical College & Hospital, Mysuru, Karanataka, India.

Corresponding Author: Gujju Gandhi

Mail Id: ggandhiphd@gmail.com

Contact No: +91 9346423178 & +91 9290650047

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 to perform in any other system. Based on regions the distribution of vector borne disease cases were represented on density maps which were calculated for each Primary Health Centre (PHC). As more number of vector borne diseases cases were rampant in the backward areas, we have focused our attention towards the Khammam tribal agencies of Telangana state, India. Which are identified through GIS & GPS techniques, also help in pinpointing the infected areas or person for further treatment processes. Our main aim is to map the vector borne diseases, density areas by using above 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 2011-2015. Our main aim is to identify and to report the causes for malaria and dengue cases to the concerned authorities, for educating the tribes in taking preventive measures such as keeping the surrounding environment clean, dry, fully clothed, use of anti mosquito repellents etc.

Keywords: Geographical Information System, Global Position System, Remote Sensing and Vector borne diseases.

Introduction:

In 21st century, vector-borne diseases (VBD) such as Malaria, Dengu, etc have emerged as a serious public health and global health hazard in most of the developing countries including India. Worldwide malaria affects 3.5-5.0 billion people and has devastating effects on health and development with at least one million deaths taking place annually, Centre for Disease Control, (CDC) 2010. About 70-90 per cent of the risk of malaria is considered due to environmental factors which in turn influence the abundance and survival of the vectors (Smith KR *et al*., 1999). This has motivated the World Health Organization (WHO) to pursue the development of new techniques and models in which the role of environmental is fundamental. Spatial technology helps systematic and regular monitoring of the earth's environmental conditions furnishing large amounts of spatial and temporal data. Such information together with appropriate field studies can prove very fruitful for early detection and timely response to disease management.

Mosquitos and other insects connected with aquatic habitats and water impoundments have long been recognized as pests and a public health problem. These problems can be prevented or controlled by physical (including water management), biological and chemical means. Although chemical pesticides have frequently been used

to control mosquitos and other insect pests, the techniques preferred by most mosquito control experts involve water management, source reduction, and other preventive measures. Mosquito control methods, except for chemical treatment against adult mosquitos, usually require knowledge of the location of the aquatic habitats in which the mosquito larvae are developing ("breeding"). Therefore, it is important that mosquito control projects should begin with surveys to locate, characterize, and measure the extent of these larval habitats.

It is imperative that the mosquitoes can be the cause of nuisance and death through diseases that they transmit. Therefore, it becomes a mandate for the civic facility provides to control the mosquitoes for two reasons i.e., to avoid annoyance and to curtail (control) the spread of diseases transmitted by them. Principally, mosquito control can be done by larvicidal and adulticidal approaches. Larvicidal is more convenient solution to get rid off mosquitoes. Therefore, to identify the mosquito breeding grounds is pivotal in mosquito control programme. As mosquitoes are highly diversified in their breeding habitats and spotting it becomes a real challenge for programme managers. Application of remote sensing technology and Geographical Information System (GIS) is a potential tool to explore all the minute details. Mosquito not only transmit dreadful diseases but also creates severe annoyance and become cause of concern for human beings. As mosquitoes have diversified breeding habitats it poses a challenging task for mosquito control programme. Potential larval habitats of the mosquito can be identified by using remote sensing and geographic information system (GIS) analysis.

Satellite images of previous studies have shown benefits of using remote sensing and GIS application in identification of vector habitats through landsat mapping. Though many of the workers Townshend. J *et al*., (2000), Hayes *et al.,* (1985), Linthcum *et al.,* and Masuoka *et al*., (2003). have focused on identifying and mapping vector habitats, or assessing environmental factors related to vector habitat quality, but could not target at

mosquito larvae. It is difficult to identify all the larval breeding grounds on conventional grounds, but geospatial mapping with the help of remote sensing is a potential tool to identify the mosquito larval breeding habitats just a fingertip away.

Sometimes few physical barriers may interfere with the clarity of satellite image and some mosquitoes prefer to lay eggs at vegetative habitats. For example to larval habitats of *Culex tarsalis* are often associated with vegetation growing at pond edges. More specifically, the edges of small water bodies where vegetation and other debris are concentrated are identified as larval microhabitat Rogers *et al., (*2002). Large water bodies (usually larger than 4 ha) are usually exposed to wind and generate wave action, similarly running waters such as a rivers or streams, are not suitable for mosquito breeding. Open waters like ponds and lakes are unsuitable for larva and vulnerable to predation, due to prey and predator relationship. The pixel (area) can have its effect those around it, particularly through scattering, Barnes *et al.,* (1979). However, in our study Rekha Saxena *et al*., (2009). AVHRR (Advanced Very High Resolution Radiometer) data analysis has been fallowed on identifying and creating maps of mosquito larval grounds and vector borne diseases. In the present study area, mosquito menace has been undergoing significant increase in large number of mosquito biting density. In this study we have categorized distinct water classes.

The Information System on health is the best preventive method to control the vector borne diseases, Govindraj. *et al*., (2011). 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 biological methods

or techniques are introduction of guppy and gambusia fish in water bodies and chemical method is through fogging of malathion and pyrethrum etc, applied by most mosquito control experts include water management, eradicating aquatic weeds and other preventive measures. The primary object is to identify location or an area of mosquito infected patients and mapping the areas of 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, Hay. *et al*., (2000) and Klein Schmidt. *et al* (2001).

In this ever increasing complex world, it is not an easy task 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 technologies or 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, Carter., (1992) . 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, Nipada., (2005). People's poverty, farming techniques, poor infrastructure and cultural activities also contribute to the favorable conditions for developing mosquito breeding habitats, Keating., *et al* (2003). Un hygienic conditions in a tribal community and unable to protect themselves from the infections and diseases, the risk of transmission of any disease will be high. Earlier studies have proved in identifying sources of potential factors of vector borne diseases in rural areas in transmission of the disease such as the way of living, Donald . *et al.,* (2005), socio economic status of the people, Narain. *et al*., (2000) and Payment, *et*

al., (1991), livestock dependence.,Mbogo *et al.,*(1991). Cultural aspects among the residents, Roper, *et al*., (2000) and Habtewold, (2004) drainage system, Eisele, *et al* (2003) distance from lotic waters, Konradson, *et al.,* (2003) and Prathiba, *et al.,* (2012) and infectious-bite repellents, Sudhakar, *et al.,* (2006). Our primary object is to identify the location or an area infected with malaria and dengue and mapping infected villages with the help of GIS, GPS and Remote Sensing techniques. This process wills surly help the government in consulting the department of health to focus on the object and to resolve the problems of diseases.

REMOTE SENSING

Literally Remote Sensing means obtaining information about an object, area or phenomenon without coming in direct contact with it. If we go by the meaning of Remote Sensing, then a number of things would be coming under Remote Sensor, e.g. Seismographs, fathometer etc. Without coming in direct contact with the focus of earthquake, seismograph can measure the intensity of earthquake. Likewise without coming in contact with the ocean floor, fathometer can measure its depth. However, modern Remote Sensing means acquiring information about earths Land and water surfaces by using reflected or emitted electromagnetic energy.

From the following definitions, we can have a better understanding about Remote Sensing. Remote Sensing includes all methods of obtaining pictures or other forms of electromagnetic records of earth's surface from a distance, and the treatment and processing of the picture data… Remote Sensing then in the widest sense is concerned with detecting and recording, electromagnetic radiation from the target areas in the field view of the sensor instrument. This radiation may have originated directly from separate components of the target area, it may be solar energy reflected from them; or it may be reflections of energy transmitted to the target area from the sensor itself.

* * * * *

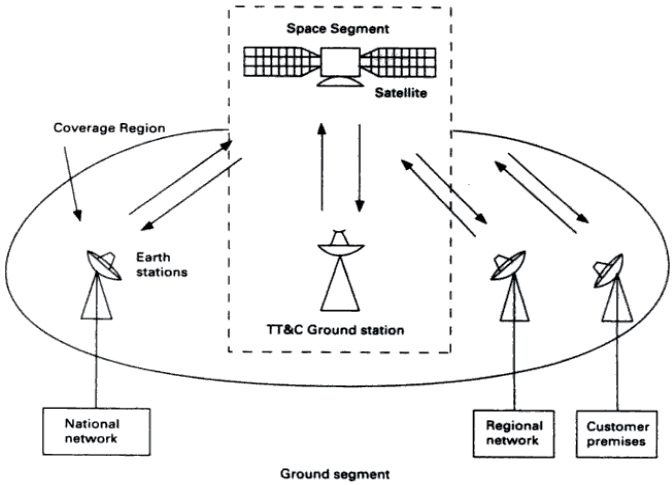


Figure 1: Diagram Show the Transmission Plat Form Sensor Data to Ground Station

Remote Sensing is the practice of deriving information about the earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, reflected or emitted from the earth's surface.

So the Stages of Remote Sensing

- A source of electromagnetic radiation or EMR (Sun)
- Transmission of energy from the source to the surface of the earth, through atmosphere
- Interaction of EMR with earth's surface.
- Transmission of energy from surface to Remote Sensor mounted on a platform, through atmosphere
- Detection of energy by the sensor.
- Transmission pf sensor data to ground station

- Processing and analysis of the sensor data
- Final data output for various types of application.

Remote Sensing data is commonly used in diverse discipline such as Agriculture, Forestry, Geology and Environment planning. In this study Remote Sensing is used to monitor environmental condition that influences the pattern of mosquito larval density Hassan and Onsi. (2004). Ceccato *et al.,* (2005).

There are a number of civilian satellite remote sensing systems operated by the U.S., France, Japan, Russia, India, and the European Space Agency (ESA) that provide regular coverage over much of the earth's surface. The systems are the primary ones that acquire visible and infrared digital data covering a range of spatial, spectral and temporal resolutions. Each of these systems have bands located in regions necessary for characterizing land cover, including difference between vegetation, water, and soil moisture (Table 1).

Table 1: Spectral regions in which visible infrared remote sensing data are typically acquired and are principal application. The systems that acquire data in each region are also identified

SPECTRAL REGION	PRINCIPAL USE	SYSTEM
BLUE	Water bodies penetration and forest type mapping	TM
GREEN	Green reflectance peak in vegetation: plant vigor assessment	TM, MSS, XS
RED	Chlorophyll absorption: discrimination of vegetation type	TM, MSS, XS, AVHRR
NEAR-INFRARED	Discrimination of vegetation type density and biomass content: water absorption and soil moisture	TM, MSS, XS, AVHRR
MID-INFRARED	Vegetation moisture content and soil moisture	TM
THERMAL	Vegetation stress analysis	TM, AVHRR

TM: Thematic Mapper. **MSS**: Multi Spector Scanner**. XS**: Spot Multi Spector.

AVHRR: Advance very high resolution radiometer.

Previous works have used remote sensing data which is commercially available. From the standpoint of developing an operational surveillance or control program, potential users need to know if appropriate data will continue to be available beyond the initial study. Although a review of all available and proposed remote sensing systems is beyond the scope of this work, it is important to comment on some of the more commonly available types of remote sensing data.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

A geographic information system (GIS) integrates hardware and software data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns and trends in the form of maps, globes, reports and charts. Arc GIS helps us to answer questions and solve problems by looking at our data in a way that is quickly understood and easily shared. GIS technology can be integrated into any enterprise information system framework. GIS is a powerful computer mapping and analysis systems for studying spatial patterns and processes which are applicable to numerous disciplines including the study of mosquito ecology. GIS has many applications to the study of vector-borne diseases, as many of the underlying processes influencing the distribution of insect vectors of disease are spatially heterogeneous.

The expansion of GIS is Geographic Information System which consists of three words, viz. Geographic, Information and System. Here the word 'Geographic' deals with spatial objects or features which can be referenced or related to a specific location on the earth surface. The object may be physical / natural or may be cultural / man made. Likewise the word 'Information' deals with the large volume of data about a particular object on the earth surface. The data includes a set of qualitative and quantitative aspects which the real world objects acquire. The term 'System' is used to represent systems approach where the complex environment (consists of a large number, of objects / features on the earth surface and their complex characteristics) is broken down into their component parts for easy understanding and handling, but is considered to form an integrated whole for managing and decision

making. Now-a-days this is possible in a very short span of time with the development of sophisticated computer hardware and software.

The data analysis of geographic locations was being done by computers in government organizations and universities in U.S.A. during the period 1950s and 1960s. The first true operational GIS, was developed by Dr. Roger Tomlinson, Department of Forestry and Rural Development, Canada. It was called as Canada Geographic Information System (CGIS) and was used to store analyses and manipulate land related data. Dr. Roger Tomlison was also known as the 'Father of G.I.S'. In 1964, a laboratory of Computer Graphics and Spatial Analysis was established at the Harvard Graduate School of Design by Howard T. Fisher.

During the last twenty years, the development of Geographical Information Systems (GIS) and satellites for earth observation have made it possible to make important progress in the monitoring of the environmental and anthropogenic factors which influence the reduction or the re-emergence of the disease. Analyses resulting from the combination of GIS and Remote Sensing (RS) have improved knowledge of the biodiversity influencing mosquito vector borne diseases. A better understanding of the stratification of the disease on the population is in–progress, Craig *et al.,* (1999) ,Snow *et al.,* (1999), Omumbo *et al*., (2004). This knowledge can help decision-makers to better allocate limited resources in the fight against the disease. This review summarizes the recent advances in GIS and RS in the prevention and fight against mosquito menace. Examples of applications in various areas of the globe are provided to support current knowledge on the use of the new monitoring and early warning systems.

Applications of GIS in Epidemiology and Entomology

Gesler W, (1986) used GIS maps while analyzing between location, environment, and disease. GIS is particularly well suited for studying these associations because of its spatial analysis and display capabilities. Recently GIS has been used in the surveillance and monitoring of vector-borne diseases,

Glass GE *et al*., (1995), Beck LR *et al.,* (1994), Richards FI. Jr. (1993) water borne diseases, Clarke KC *et al.,* (1991), in environmental health , Cuthe WG *et al.,* (1992), modeling exposure to electromagnetic fields , Wartenberg D *et al.,* (1993), quantifying lead hazards in a neighborhood, Wartenberg D *et al.,* (1992), predicting child pedestrian injuries, Bradbock L, (1994), and the analysis of disease policy and planning, Tempalski BJ, (1994). In the current research advance GIS has been used to identify mosquito larvae in water bodies where as in the previous researches GIS has used only for controlling of disease surveillance by Mapping.

In a recent study in Baltimore County, Maryland, GIS and epidemiologic methods were combined to identify and locate environmental risk factors associated with Lyme disease Glass GE *et al.,* (1995). Ecologic data such as watershed, land use, soil type, geology, and forest distribution were collected at the residences of Lyme disease patients and compared with data collected at a randomly selected set of addresses. Disease causing agents have been identified by GIS directly when we compare with previous research.

GLOBAL POSITIONING SYSTEM (GARMIN R6300)

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world.

The Global Positioning System--a satellite-based navigation system was developed by U. S. Department of Defense to provide a consistent and accurate method of determining locations. The GPS is made up of a network of 24 satellites that are continuously orbiting the earth, 24 ha day, in all weather conditions. There is no subscription or fee to use GPS services except buying receiver equipment which receives signals from minimum four GPS satellites and uses the transmitted information to calculate user's position in terms of latitude, longitude and altitude. Basic GPS consists of a single receiver unit while differential GPS (DGPS) consists of two devices-one stationary at a known location and another roving in the field which makes measurements. DGPS gives better accuracy in comparison to basic GPS operations.

The variety of analysis is presented using GIS-RS platform demonstrates and research during recent time, Tanser *et al*., (2002) and Sexena.R *et al.,* (2009). The data used for GIS-RS works is mostly provide from satellite imageries, aerial photographs, topo sheets, digitized maps and census survey, however, data specific to an application may not be readily available and have to be generated from field. GPS is the new data acquisition tool which has tremendous applications in data collection precision surveying and mapping thus enabling transfer of field generated data into office based GIS-RS system for spatial analysis.

Satellite imagery-based prediction models are useful to identify the larval breeding habitats where GPS generated ground data can be utilized to evaluate them. DGPS played key role in a study design assessing the utility of RS imageries obtained from different sources viz. Landsat TM 7, Ikonos satellites and aerial photographs combined with terrain modeling to correctly predict larval habitats of malaria vectors in a village of western Kenya highlands. One-meter spatial resolution Ikonos images identified most of the anopheline larval habitats followed by aerial photos and Landsat TM 7 images, Srivastava, A *et al.,* (2010).

Recent advance studies in geographical information and new mapping technologies have created new opportunities for public health administrators to enhance planning, monitoring, analysis and management of health system. In epidemiology GIS aids in visualizing and analyzing geographic distribution of disease with respect to time and space that is more difficult and impossible to perform in other way. GIS and GPS have created new opportunities for public health administrators to enhance planning, analysis and monitoring of vector born disease elimination.

In the field of our research Khammam Tribal aeas the data collection on sampling points was carried out parallel to the designation of modelling study areas. During the sampling, the following data were recorded: geographical coordinate; the breeding sites through GPS.

Review of Literature.

Remote sensing is an important part of the Indian Space Programme and the Department of Space (DOS), Government of India, is the nodal agency for the realization of the National Natural Resources Management System (NNRMS), the National Resources Information System (NRIS) and the Integrated Mission for Sustainable Development (IMSD), besides several other national level application projects like Crop Acreage and Production Estimation (CAPE), National Drinking Water Mission and Wasteland Mapping etc.,. In close collaboration with the user agencies. As a part of this programme, DOS has acquired the capability to design, develop and operate state-of-art multi-sensor satellite based systems comprising of space, ground and application segments to meet domestic and international requirements. The department also successfully operationalized the launch vehicle programme for the remote sensing satellites.

The larval ecology of malaria vectors has long been a neglected area of vector research (Minakawa, N *et al.,* 1999). One major reason being the challenges involved in identification of aquatic habitats in the field. With the advent of new tools like GIS-RS and GPS, the use of larval habitat maps has become increasingly popular in various applications related to management of malaria.

Remote sensing is a powerful tool for determining the landscape features and climatic factors associated with the risk of vector-borne diseases *(*Dale et al., 1998. Rogers DJ *et al.,* 2002*)*. For example, ecological parameters, particularly vegetation index. Remote sensing also can be used for determining factors affecting vector abundance and mosquito breeding sites (*De Garine et al., 2000).* In general, previous studies demonstrate the utility of remote sensing technology in the risk assessment of vector-borne diseases and vector-population monitoring at a large spatial scale. Recently developed remote sensors of high spatial resolution may be particularly useful for determining mosquito larval habitat distribution and for assisting malaria vector control. For example, the spatial resolution is 1–4 meters for *Ikonos (IKON),*

However, the utility of high-resolution satellite images for larval habitat identification and management have not been evaluated in African highlands where land-use pattern is highly heterogeneous and larval habitat distribution is spatially clustered (Minkawa *et al., 2004).* In African highlands resolution is 23m so that they did not evaluate where as in present research 5m resolution has been used and it has given exact values or results regarding larval pixel values.

The use of GIS has been already been applied for surveillance for malaria as well as targeting of vector control interventions for malaria prevention. In Israel, a national database of vector breeding-sites and population centers was created (Kitron *et al.,* 1994*)*. Appropriate control measures can then be rapidly implemented. In South Africa, GIS was used to better define malaria risk in two districts within Mpumalanga province (Booman *et al.,* 2000). By giving proper result GIS is widely using in every research field.

The use of aerial photography and manual interpretation techniques to identify and map disease vector habitats dates from 1949 (Audy, JR *et al.,* 1949). He determined that hyper endemic disease foci were associated with a vegetation type known as parang. Conventional black-and-white aerial photography was used to identify the distribution of parang vegetation, and therefore map the distribution of scrub typhus foci. The darker tone and rough texture of parang vegetation on this photography made it possible to distinguish it from surrounding types using visual interpretation techniques. In this research identification of vegetation like Pistia and Eicharnia is easily don by GIS and RS.

The first research component of NASA's Global Monitoring and Disease Prediction Program (GMDPP) investigated populations of Anopheles in the rice fields of California an accessible model for the study of anopheles vectors in irrigated rice habitats (B.L Wood *et al.,* 1994).

In 1971, National Aeronautics and Space Administration (NASA) scientists first investigated the use of color-infrared (CIR) aerial photography to identify the larval habitat of the nuisance saltmarsh mosquito Aedes solicitants (Anonymous, 1973).

CIR aerial photography has also been used as rapid methods to map land-cover in a newly created mosquito control area (V.E Wagner *et al.,* 1979). Created a geo-referenced satellite base map of Bluefield's using satellite imagery freely available from Google Earth, as described in the Methods (Aileen Y Chang *et al*., 2009).

The purpose of these studies was to identify larval habitats of mosquito that constituted a significant nuisance or public-health risk, so as to direct larval control more efficiently. Although simple and empirical, larval–habitat correlations from satellite imageries have been, and continue to be, cited as more cost-effective than conventional ground survey techniques for obtaining information on the distribution of potential larval habitats.

Advent of GIS, few examples existed of maps defining the global distribution of malaria (Lysenko *et al.*, 1968). More maps were found at a regional and country scale, reflecting the more local concerns and experience of research and control personnel. Common to all historical maps is their representation of expert opinion, often aided by simple climatic or geographical iso-lines and, more rarely, limited empirical evidence. This static information failed to reflect the great spatial and temporal heterogeneity in transmission. GIS-based mapping allows methodologies to be standardized and repeated and data to be updated and, since it is digital, easily interrogated. Thus GIS moves the mapping of malaria from a largely subjective science to one with quantitative foundations. In my research data capture and mapping, associated with even the most rudimentary GIS analysis, has made evidence-based response by mosquito control programs possible, and many examples have been cited. Images provide a powerful lobbying tool and contribute towards planning and monitoring malaria control operations through community health care, targeted insecticide spraying. The perception that RS and GIS are not appropriate in technologically developing regions persists and is manifest in the form of frequent objections to the cost of image processing equipment, lack of access to imagery, expertise and ground truth and the novelty of the techniques (Bos R, 1990) (Arambaulo PV *et al.,* 1991). In the above statement old version had been used in our current research. We have used advanced version and positive result were obtained.

The current software and hardware trends in combination with the realities faced in India have given rise to essentially, two broad categories of long-term feasible GIS health applications in India. The outputs of the categories will inform one another and are not mutually exclusive and may overlap. The first category involves the use of GIS as a research tool. These applications should seek to provide new insights into the spatial dimensions of disease and new methodologies to more cost-effectively allocate resources to health services. These types of applications will normally use high-end systems with significant analytical functionality and will usually involve a significant amount of additional data collection.

The second category of long-term viable GIS application concerns the use of GIS as a health planning and management tool and for exploratory data analysis. Generally speaking this kind of system will involve a low-end GIS. The primary goal of such a system will be to simply display and overlay basic health data concerning both health care facilities and disease patterns. These systems (normally vector-based) permit rapid manipulations of spatial data and display of the results so that the

decision makers can use them for policy decisions. A further step could involve limited spatial queries and analysis such as buffering.

We have described the creation of an easy to implement system for creating spatial maps of the location of sites with predilection for larval development that uses the GIS mapping program ArcGIS available from the Global Fund. This can allow deployment of focused interventions in an efficient and cost-effective manner. Larval development sites with GPS units when available or on printed maps generated from the satellite base map and then entered into ArcGIS for further analysis.

GIS is defined as an information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data or spatial data. All methods of collecting information about earth without touching it are forms of remote sensing. Satellites, radars and aerial photographs are the different ways of acquiring remotely sensed data. GPS is a system of twenty-four satellites that allows the co-ordinates of any point on or near earth's surface to be measured with extremely high precision (Boulos MNKet al., 2001). GIS is an umbrella term which integrates wide range of datasets available from different sources including RS and GPS. Therefore, GIS is often termed as core of spatial technology having built-in power to analyze integrated dataset and to present the results as useful information to assist decision making and eradicate the mosquito larvae.

Once information on the locations of larval development sites had been input on the map using the ArcGIS software, spatial patterns among the known larval habitats, mosquito larval indices, and the previously identified larval development sites were visually analyzed for patterns. The indices we examined were the home index, container index, Breteau index, and neighborhood block index. (Garcia TCM *et al.,* 2006). Coming to the point of going on research Positive larval water bodies have been identified by using GIS through pixel values.

Data Product

LISS-IV Image Products (IRS-P6.LISS.IV)

IRS-P6, also known as ResourceSat-1, is an Earth observation mission within the IRS (Indian Remote-Sensing Satellite) series of ISRO (Indian Space Research Organization). IRS-P6 is the continuation of the IRS-1C/1D missions with considerably enhanced capabilities. The overall

objectives of the mission are to provide continued remote sensing data services on an operational basis for integrated land and water resources management.

Access to a limited amount of free of charge data to be acquired by the Linear Imaging Self-Scanning Sensor-4 (LISS-4), Linear Imaging Self-Scanning Sensor-3 (LISS-3) and Advanced Wide Field Sensor (AWiFS) on board ISRO's IRS-P6 (Resourcesat-1) was offered by ESA to European users.

LISS-4 provides VIS imagery at 5 m spatial resolution (swath ranging from 24 to 70 Km).

The LISS-IV camera is a high resolution multi-spectral camera operating in three spectral bands (B2, B3, and B4). LISS-IV can be operated in either of the two modes. In the multi-spectral mode (Mx), a swath of 23 Km (selectable out of 70 Km total swath) is covered in three bands, while in mono mode (Mono), the full swath of 70 Km can be covered in any one single band, which is selectable by ground command (nominal is B3 - Red band). The LISS-IV camera can be tilted in the across track direction thereby providing a revisit period of 5 days.

The Data products are categorized as Standard and have a system level accuracy. LISS-IV Standard Products comprise Path/Row Based products; Shift along Track product, Geo referenced products and Basic Stereo products. Path/Row Based products are generated based on the referencing scheme of each sensor. Shift along Track applies to those products covering a user's area of interest which falls in between two successive scenes of the same path, and then the data can be supplied by sliding the scene in the long track direction. Geo referenced products are true north oriented products. These products are supplied on digital Media only. Basic Stereo products comprise pairs of two images of the same City, acquired on different dates and from different angles. One of the parameters from which the quality of a stereo pair can be judged is the base/height (B/H) ratio. B/H ratio is the ratio of distance between two satellite passes and satellite altitude. Stereo products are available from LISS-IV Mono mode only. The inputs required, in addition to path/row details is B/H ratio. Two scenes selected on two different dates, satisfying the user's B/H ratio are supplied as a stereo pair. The data is only radio metrically corrected and are supplied on digital media.

Image fusion refers to the techniques that integrate complimentary information from multiple image sensor data such that the new images are more suitable for the purpose of human visual perception and for the computer aided processing tasks. The information about events in time or

location of objects in space is often obtained using multiple sensors. The fast integration or fusion of such digital images collected from multiple sources and from different remote sensors has become critical for the success of multiplatform remote sensing missions. As the image fusion techniques have been developing quickly in a number of applications such as remote sensing, medical imaging, digital camera vision and military applications in recent years, the methods that can assess or evaluate the performances of different fusion technologies objectively, systematically, and quantitatively have been recognized as an urgent requirement. Most of the earth observation Indian satellites such as IRS1C, IRS1D, IRS-P5, and IRS-P6 provide panchromatic images at a higher spatial resolution than in their multispectral mode. The difference in spatial resolution between the panchromatic and the multispectral mode can be measured by the ratio of their respective ground sampling distances (GSD) and may vary between 1:3 and 1:7. This ratio can get worse if data from different satellites are used. The objective of image fusion is to combine the high spatial and the multispectral information to form a fused multispectral image that retains the spatial information from the high resolution panchromatic image and the spectral characteristics of the lower resolution multispectral image (Manfred Ehlers). Generally, image fusion methods can be differentiated into three levels: pixel Level (iconic), feature level (symbolic) and knowledge or decision level. Of highest relevance for remote sensing are techniques for iconic image fusion, for which many different methods have been developed (Wald, L., 1997) (Pohl, C., 1998) (Zhang, Y., 2004). Many researchers have focused on how to fuse high resolution panchromatic images with lower resolution multispectral data to obtain high resolution multispectral imagery while retaining the spectral characteristics of the multispectral data and various image fusion methods have been developed.

In this research paper, emphasis is given to identify the suitable method for vegetation identification based on image fusion algorithm and NDVI of fused image. - See more at:

Data resources and study area Investigations into the present work have been carried out for Hyderabad city, Telangana State, India. For this research work, 5m spatial resolution data products of Indian remote sensing satellite sensors have been used. In order to cover the maximum range of land-use features, analysis of this work has focused on the water bodies, vegetation and urban land-use of Hyderabad city. All the work has been carried out using Arc GIS and ERIDAS.

IRS Data Products & Services

Earth Observation (EO) from satellite platforms is proved to be an indispensable tool for natural resources mapping, monitoring and management, including environmental assessment at global, regional and local levels. This is particularly due to multi-platform, multi-resolution, multi-temporal and synoptic viewing capabilities from space platforms. Remote Sensing Satellites were commissioned as an integrated facility with Data acquisition and Product generation at Shadnagar complex of National Remote Sensing Centre (NRSC), formerly known as National Remote Sensing Agency (NRSA), for Landsat MSS data reception, way back in 1979. With the availability of data from the operational Indian Remote Sensing Satellites (IRS), from 1988, NRSA started disseminating IRS satellite data to the user community.

The National Remote Sensing Centre, of the Dept. of Space (DOP), Govt.of India (GOI), is the focal point for distribution of remote sensing satellite data product in India and its neighboring countries. NRSC has an earth station at Shadnagar, about 55km from Hyderabad, to receive data from almost all contemporary remote sensing satellites such as IRS-P4, IRS-1D, IRS-1C, IRS-1B, Landsat-5 and NOAA series of satellite.

The data is recorded at Shadnagar on High Density Digital Tapes (HDTs) or CD-ROMs or 8 mm Exabyte Digital Tapes depending on the mission, and archive providing data product to users as and when order are received.

Resolution

It is the minimum distance of separation between two objects that could be resolved by an optical/mechanical/electrical instruments otherwise it is the ability of the sensor system that can distinguish is the smallest size of object. It can be studied under three heads and this area.

1. Spatial Resolution
2. Temporal Resolution
3. Spectral Resolution

3.9.3 Spatial Resolution

Among the three kinds of the resolution, spectral resolution is the most important in the image interpretation. The reflected radiation of the terrain is recorded on specific bands range of wave frequencies. Each one of these bands can transmit particular frequency of electromagnetic radiation and can record specific thematic information such as vegetation, soil, water bodies. The following are the important elements in the image interpretation and one should familiar with these eight elements before starting an image interpretation.

1) Tone/ colour
2) Size
3) Shape
4) Texture
5) Pattern
6) Shadow
7) Association
8) Site/Location

Hear privies studies based on resolution. The resolution, about 0.45 ha (1.11 acres), and the rectilinear grid arrangement of the Landsat reflectance data are not ideally suited for precisely delineating the complex growth patterns of many of the Lewis and Clark Lake plant communities and aquatic mosquito habitats (Richard O *et al.,* 1985) because they often are small, noncontiguous, irregularly shaped, heterogeneous localities. Therefore, the classification scheme of vegetation components comprised units with more than one species and it followed previously used concepts for classifying plant mosquito associations (Kuchler, 1967). The technical refinements that will result in greatly improved satellite sensor resolution have already been developed (Schnetzler, C.C *et al.,* 1979). A 30-metre resolution is now available from Landsat 4, which was launched in 1981. Further evaluation with current technology, development of guidelines for its use, and determination of budgetary requirements are logical prerequisites to implementing the use of remote sensing as a tool in combating the vectors of selected diseases. Improvements in resolution will greatly increase the potential for using remote sensing data for planning and conducting operational mosquito control programmes. Including the capabilities to monitor the water's depth would also be important in delineating the portions of aquatic habitats most likely to have mosquito larvae.

ELEMENTS OF IMAGE INTERPRETATION

1. **Tone/Color**

Tone can be defined as each distinguishable variation from white to black. Color may be defined as each distinguishable variation on an image produced by a multitude of combinations of hue, value and Chroma. Many factors influence the tone or color of objects or features recorded on photographic emulsions. But, if there is not sufficient contrast between an object and its background to permit at least detection, there can be no identification. While a human interpreter may only be able to distinguish between ten and twenty shades of grey; interpreters can distinguish many more colors. Some authors state that interpreters can distinguish at least 100 times more variations of color on color photography than shades of gray on black and white photography.

Examples of tone: Examples of color:

2. **Resolution**

Resolution is defined as the ability of the entire photographic system, including lens, exposure, processing, and other factors, to render a sharply defined image. An object or feature must be resolved to be detected and/or identified. Resolution is one of the most difficult concepts to address in image analysis. Resolution can be described for systems in terms of modulation transfer (or point spread) functions; or it can be discussed for camera lenses in terms of being able to resolve so many line pairs per millimeter. There are resolution targets that help to determine this when testing camera lenses for metric quality. Photo interpreters often talk about resolution in terms of ground resolved distance, the smallest normal contrast object that can be detected and identified on a photo.

3. **Size**

The size of objects can be important in discrimination of objects and features (cars vs. trucks or buses; single family vs. multi-family residences, brush vs. trees, etc.). In the use of size as a diagnostic characteristic both the relative and absolute sizes of objects can be important. Size can also be used in judging the significance of objects and features (size of trees related to board feet which may be cut; size of agricultural fields related to water use in arid areas, or amount of fertilizers used; size of runways gives an indication of the types of aircraft that can be accommodated).

4. **Shape**

The shape of objects/features can provide diagnostic clues that aid identification. The Pentagon building in Washington is a diagnostic shape. Man-made features have straight edges that natural features tend not to. Roads can have right angle turns, railroads do not.

Texture

The frequency in change and arrangement of tones is a micro image characteristic. The visual impression of smoothness or roughness of an area can often be a valuable clue in image interpretation. Water bodies are typically fine textured, while grass is medium, and brush is rough, although there are always exceptions.

5. **Pattern**

Pattern is the spatial arrangement of objects. Pattern can be either man-made or natural. Pattern is a macro image characteristic. It is the regular arrangement of objects that can be diagnostic of features on the landscape. An orchard has a particular pattern. Likewise, the network or grid of streets in a subdivision or urban area can aid identification and aid in problem solving such as the growth patterns of a city. Pattern can also be very important in geologic or geomorphologic analysis. Drainage pattern can tell the trained observer a great deal about the lithology and structural patterns in an area. Dendritic drainage patterns develop on flat bedded sediments; radial on/over domes; linear or trellis in areas with faults or other structural controls.

6. Site

How objects are arranged with respect to one another; or with respect to various terrain features, can be an aid in interpretation. Certain aspect such as topography, geology, soil, vegetation and cultural features on the landscape are distinctive factors that the interpreter should use when examining a site. The relative importance of each of these factors will vary with local conditions, but all are important. Just as some vegetation grows in swamps others grow on sandy ridges. Agricultural crops may like certain conditions. Manmade features may also be found on rivers (e.g. power plant) or on a hill top (observatory or radar facility).

7. **Association**

Some objects are so commonly associated with one another that identification of one tends to indicate or confirm the existence of another. Smoke stacks, step buildings, cooling ponds, lakes, Rivers, transformer yards, coal piles, railroad tracks = coal fired power plant. Arid terrain, basin bottom location, highly reflective surface, sparse vegetation.

IMAGE INTERPRETATION

Before going to image interpretation for landforms identification and classification, one should have a little exposure to the concept of remote sensing, imager and its characteristics, elements of images interpretation. A brief description about the concept of remote sensing and image interpretation is presented below.

IMAGE CLASSIFICATION TECHNIQUES IN REMOTE SENSING

- Unsupervised image classification
- Supervised image classification
- Object-based image analysis

Pixels are the smallest unit represented in an image. Image classification uses the reflectance statistics for individual pixels. Unsupervised and supervised image classification techniques are the two most common approaches. However, object-based classification has been breaking more ground as of late.

Supervised Classification

Supervised Classification Example: IKONOS Supervised Classification Example: IKONOS.

The user selects representative samples for each land cover class in the digital image. These sample land cover classes are called “training sites”. The image classification software uses the training sites to identify the land cover classes in the entire image.

The classification of land cover is based on the spectral signature defined in the training set. The digital image classification software determines each class on what it resembles most in the training set. The common supervised classification algorithms are maximum likelihood and minimum-distance classification.

1. Supervised Classification Steps
2. Select training areas
3. Generate signature file
4. Classify

Let's say water is the feature that is to be extracted from a high spatial resolution digital image. A user may decide to choose all blue pixels in that image. But other pixels in the image may be mistakenly classified as water. This is the reason why unsupervised and supervised image classification has a water and vegetation. The spatial resolution of the imagery is an important factor when selecting image classification techniques. Low – medium spatial resolution: Pixels and objects are similar in scale. Traditional pixel-based and object-based image classification techniques perform well. High spatial resolution: Objects are made up of several pixels. In this case, object-based image analysis is superior to traditional pixel based classification.

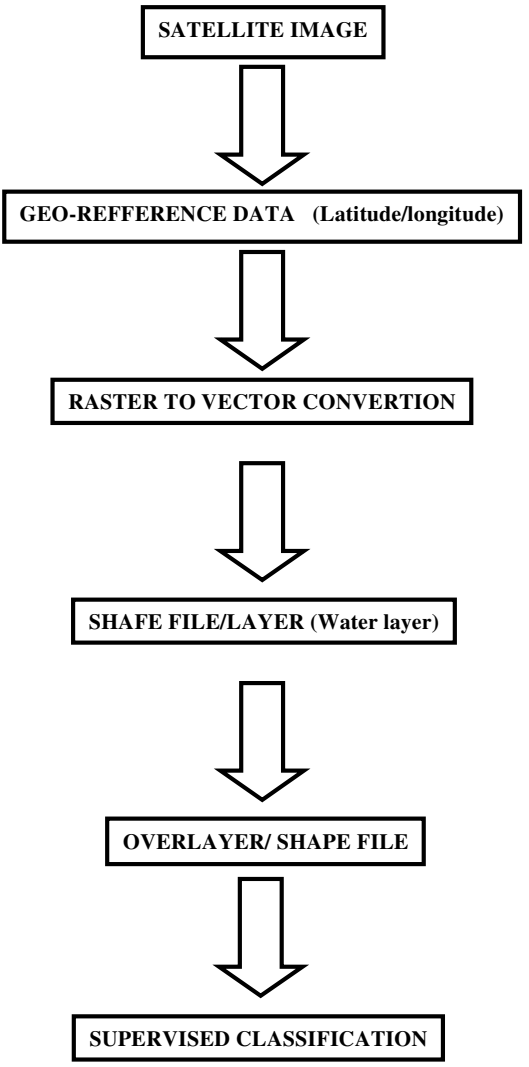
That is object-based vs pixel-based classification. Color infrared high spatial resolution satellite imagery and medium-spatial resolution satellite imagery was used. Overall, object-based classification outperformed both unsupervised and supervised pixel-based classification methods in this study. The higher accuracy was attributed to the fact that object-based image classification took advantage of both spectral and contextual information in the remotely sensed imagery. This study is a good example of some of the limitations of pixel-based image classification techniques.

VECTORIZATION

Toward good utility the raster form created must be converted – preferably by automated means – to vector format. During the visualization of mosquito breeding sites on image according to our present knowledge, the manual interpretation yields the best results, due to filtering out uncertainty created by automated methods.

In vector format, points, lines and area entities are stored by using coordinate system. A point is stored by single (no 95 pixel values) coordinate (Fig. 2). A line entity is stored by connecting a series of points into chains. Likewise, larval area entity is stored by connecting a series of points into polygons. The number of points used to show spatial features is important in vector format, because it influences the accuracy of spatial features.

The raster and vector format have their own advantages and disadvantages. Raster data led themselves for use with remotely sensed data, because digital remote sensing data are already presented in raster format. Compared with the raster GIS, some of the vector GIS operations are more accurate.


SATELLITE IMAGE
GEO-REFFERENCE DATA (Latitude/longitude)
RASTER TO VECTOR CONVERTION
SHAFE FILE/LAYER (Water layer)
OVERLAYER/ SHAPE FILE
SUPERVISED CLASSIFICATION

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 sq.km, 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 etc. The mandals are , Bhadrachalm, Kothagudem, Kukkunoor,Charala, Julurupadu,Kamepally and yellandu which are further sub divided in villages Table-1 shows the infected patients of the vector borne diseases data for the year 2015 with reference to villages.

Table-2 Village wise Vector borne disease year of 2015

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 fallowed by, Chinthapadu -24 and Laxmipuram – 23 and lowest is Dacharam with only 1. Pinjarimadugu is prone for Dengue with highest number of 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 -2] shows the highest number of malaria infection is predominant when compared with the other to dengue and chickenguniya.

Plate-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/tehsils/districts were taken in to account. A three tier database was constructed district wise, tehsils wise and village-wise. Vector borne diseases (VBD) data for four 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 were geocoded using the Garmin-630 GPS. The data was 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

1. 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.

2. Dengue Fever

Dengue virus in many ways seems to be the obverse of malaria. While malaria transmission occurs most frequently in rural areas, Dengue dieses mostly reported in cities, *Aedes* mosquito cause of dengue diseases bites mainly in the daytime. While the female *Anopheles* vectors of malaria bites mainly at night times. 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 is “breakbone fever”) and debilitating but is generally not life threatening when first acquired. However, 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 young 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, WHO,(1999) 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^{O}C and 70-80% of humidity is favorable for the vector breeding for malaria, dengue and Chikunguniya, Watson, (1998). Geo-spatial analysis provides the information of land influence the vector borne disease cover,Palaniyandi., *et al* (2014) [19] The year wise distribution of the disease and annual number of human affected by vector born disease from the year 2011-15 shown in [Table-3].

Table: 3- Year wise data showing of Vector born 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.

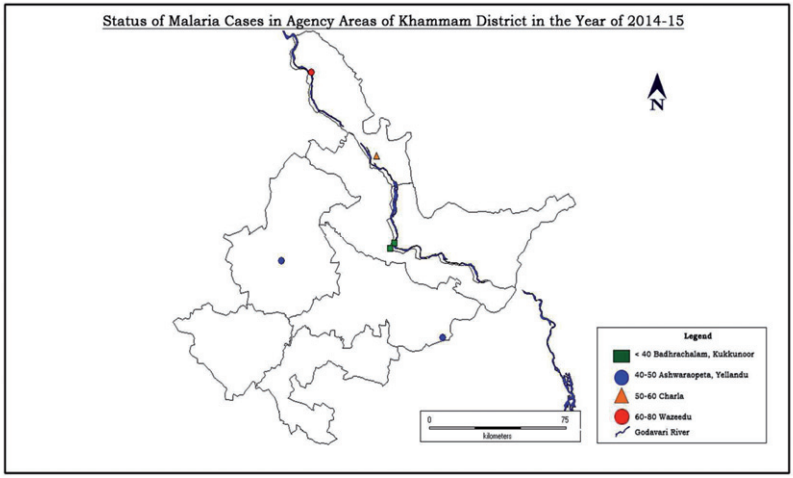


Plate-2 sources of malaria diseases

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 plate 2. The lack of proper sanitation planning 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. The school children take bath in the open areas of school premises which lead to water stagnation and formation of water pools, such places have more chances for mosquito breeding. This is main root cause for spreading vector borne diseases.

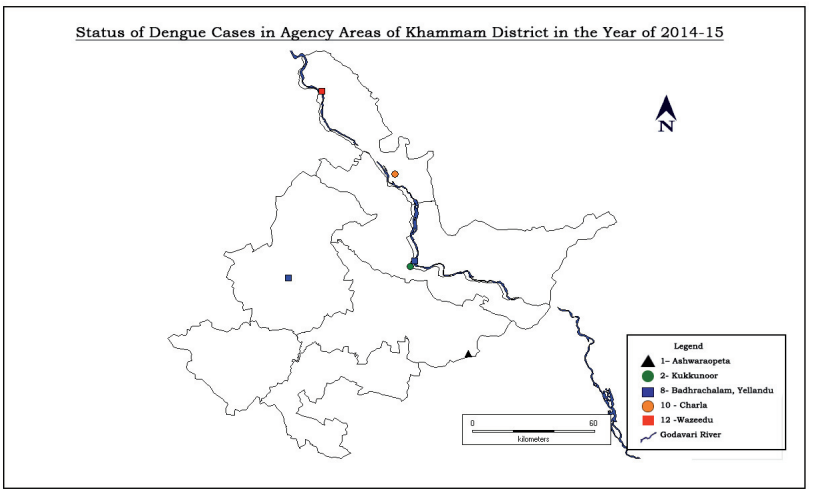


Plate-3: Status Dengue cases in the Khammam district tribal area in year 2014 and 2015 respectively

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 cases of dengue were recorded in urban area of the Badhrachalm, Kothagudem, Yellandu and Palavancha mandals of khammam District, where sanitation conditions such as open drainage system, that is no close sewage system, formation of pools that is stagnation of water near the public taps, were the taps leaked forever, washing cloths, cleaning utensils etc, lead to formation of permanent stagnant water, which is fine place for the mosquito to breed.

Conclusion

Malaria and dengue are very serious tropical diseases among other vector born 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 mosquitoes spread of diseases.

Presently the other disciplines of GIS are not only in health sector also includes state of forest vegetation, planning for transportation, attending emergency services , forecasting for natural calamities, hazards , marketing, archaeology, land survey, and identification of crime location etc . Geographic positioning system (GPS) and geographic information system (GIS) technologies are now available for mapping larval habitats.

Acknowledgement:

We thank the Primary Health Centers of Khammam District in sharing the information with reference to Vector borne diseases, also the District Collector for the providing survey maps

References

- Audy, JR, 1949. A Summary Topographical Account of Scrub Typhus 1908-1946, Bulletin No. 1. The Institute for Medical Research, Kuala Lumpur, Federation of Malaya.
- Barnes, and W. Cibula, “Some implications of remote sensing technology in insect control programs including mosquitoes”. Mosq. News 39,271-282, 1979.
- B.L Wood, Global monitoring and disease prediction program Sistema Terra, 3 (1994), pp. 38–39.
- Beck LR, Rodríguez MH, Dister SW, Rodríguez AD, Rejmánková E, Ulloa A, Meza RA, Roberts DR, Paris JF, Spanner MA, Washino RK, Hacker C, Legters LJ: Remote sensing as a landscape epidemiologic tool to identify villages at high risk for malaria transmission. Am J Trop Med Hyg 1994, 51:271-280?.
- Boulos MNK, Roudsari AV, Carson ER. Health geomatics: Anenabling suite of technologies in health and healthcare. J Bio Informatics 2001; 34: 195-219.
- Braddock M,Lapidus G,Cromley E,Cromley R,Burke G, Branco L. Using a geographic information system to understand child pedestrian injury. Am J Public Health 1994; 84:1158-61.
- Carter, J. R. "Perspectives on sharing data in geographic information systems." Photogrammetric Eng and Rem Sen, 1992 58(11), 1557- 1560.
- Ceccato PS, Connor J, Jeanne I, Thomson MC. Application of geographical information systems and remote sensing technologies for assessing and monitoring malaria risk. Parasitology 2005; 47(1): 81–96.
- Centers for disease control and prevention. USA: Malaria facts (updated 2010 April 11). Available from: http://www.cdc. gov/malaria/facts.htm, accessed on May 15, 2012.

- Chang, Maria E Parrales, Javier Jimenez, Magdalena E Sobieszczyk, Scott M Hammer, David J Copenhaver and Rajan P Kulkarni. Combining Google Earth and GIS mapping technologies in a dengue surveillance system for developing countries.. International Journal of Health Geographics 2009, 8:49.

- Clarke KC, Osleeb JR, Sherry JM, Meert JP, Larsson RW. The use of remote sensing and geographic information systems in UNICEF's dracunculiasis (Guinea worm) eradication effort. Prev Vet Med 1991; 11:229-35.

- Craig MH, Snow RW, le Sueur D (1999). A climate-based distribution model of malaria transmission in sub-Saharan Africa. Parasitology Today 15(3): 105-111.

- Cuthe WG, Tucker RK, Murphy EA, England R, Stevenson E, Luckardt JC. Reassessment of lead exposure in New Jersey using GIS technology. Environ Res 1992; 59:318-25.

- Dale PER, Ritchie SA, Territo BM, Morris CD, Muhar A, Kay BH: An overview of remote sensing and GIS for surveillance of mosquito vector habitats and risk assessment. J Soc Vector Ecol 1998, 23:54-61.

- De Garine-Wichatitsky M: Assessing infestation risk by vectors. Spatial and temporal distribution of African ticks at the scale of a landscape. Ann N Y Acad Sci 2000, 916:222-232.

- Donald P.A., Wilbert M.G., Barbara L. Spatial analysis, GIS and Remote Sensing application in the health, Ann Arbor Press, 2005. Chelsea, Michigan.

- Eisele T.P., Keating J., Swalm C., Mbogo C., Githeko A., Regens J.L., Githure J.I., Andrews L. and Beier J. C. Linking field based ecological data with remotely sensed data using a geographic information system in two malaria endemic urban areas of Kenya. Malaria Jr , 2003. 2:44.

- Garcia TCM, Espino C, Bravo AMS, Aldigheri S, Zamora N, Jimenez R, Corea R, Balmaceda A, Lugo E, Amador JJ, et al.: Indicadores Entomologicos. In Normas Nacionales de

Prevencion, Manejo, y Control de Dengue. Volume 1. Managua, Nicaragua: Ministerio Nacional de Salud; 2006: 30-31.

- Gesler W. The uses of spatial analysis in medical geography: a review. Soc Sci Med 1986; 23: 963-73.
- Glass GE, Schwrtz BS, Morgan JM III, Johnson DT, Noy PM, Israel E. Environmental risk factors for Lyme diseases identified with geographical information systems. Am J Public Health 1995; 85:944-8.
- Glass GE, Schwrtz BS, Morgan JM III, Johnson DT, Noy PM, Israel E. Environmental risk factors for Lyme diseases identified with geographical information systems. Am J Public Health 1995; 85:944-8.
- Govindraj.M,R.S.Ganeshkumar,M.Selvaraj,L.MacklinRani,P.Kumar,P.Suganthi,I.P.Sunis,V.Thenmozhi and B.K.Tyagi.2011.Development of New Methodologies Using Remote Sensing and GIS Technique to Control Vector Borne Diseases for Sitheri Hills ,Dharamapuri District,Tsmil Nadu.
- Habtewold T. Interaction between Anopheles, cattle and human: exploration of the effects of various cattle management practices on the behavior and control of Anopheles arabiensis in Ethiopia. PhD Thesis. Greenwich: University of Greenwich, 2004,U.K. 249 p.
- Hassan AN, Onsi HM. Remote sensing as a tool for mapping mosquito breeding habitats and associated health risk to assist control efforts and development plans: A case study in Wadi ElNatroun, Egypt. J Egypt Soc Parasitology 2004; 34(2): 367–82.
- Hayes, R. O., E. L. Maxwell, C. J. Mitchell, and T. L. Woodzick. 1985. Detection, identification and classification of mosquito larval habitats using remote sensing scanners in earth orbiting satellites. Bull. World Health Organ. 63: 361-374.
- HaySI, OmumboJA, Craig MH, SnowRW. Earth observation, geographic information system and Plasmodium falciparum malaria in sub-Saharan Africa. Adv Parasitol 2000; 47: 173 215.

- Keating J., Macintyre K., Mbogo C., Githeko A., Regens J.L., Swalm C., Ndenga B., Steinberg L., Kibe L., Githure J.I. and Beier J.C. A geographical sampling strategy for studying relationships between human activity and malaria vectors in Urban Africa, Ame. Jr Trop Med Hyg, 2003. 68(3): 357-365.

- Klein Schmidt I, Omumbo J, Briët O, van de Giesen N, Sogoba N, Mensah NK. An empirical malaria distribution map for West Africa. Trop Med Int Health 2001; 6: 779-86.

- Konradson F., Amersinghe P. H., Perara D., Piyaratne M. K., Amerasinghe F.P. Towards a risk map of malaria in Srilanka: the importance of house location relative to vector breeding sites, Int Jr of Epidemiology, 2003. 32: 280- 285.

- Linthicum, K. J., C. L. Bailey, F. G. Davies, and C. J. Tucker. 1987. Detection of Rift Valley fever viral activity in Kenya by satellite remote sensing imagery. Science (Wash., DC) 235: 1656-1659.

- Lysenko AY, Semashko IN. Geography of malaria. In: Lebedew AW, editor. Medical Geography. Academy of Sciences, USSR; Moscow: 1968.

- M. Booman, Dave N. Durrheim, Kobus La Grange, Carrin Martin, Aaron M. Mabuza, Alpheus Zitha, Frans M. Mbokazi, Colleen Fraser & Brian L. Sharp. Using a geographical information system to plan a malaria control programme in South Africa. Bulletin of the World Health Organization, 2000, 78: 1438–1444.

- M. Palaniyandi, PH Anand and R. Maniyosai. Spatial cognition: a geospatial analysis of vector borne disease transmission and the environment, using remote sensing and GIS. Int Jr of Mosquito Res 2014; 1 (3): 39-54.

- Masuoka, P. M., D. M. Claborn, R. G. Andre, J. Nigro, S. W. Gordon, T. A. Klein, and H. Kim. 2003. Use of IKONOS and Landsat for malaria control in the Republic of Korea. Remote Sensing Environ. 88: 187-194.

- Mbogo C.N.M., Kabiru E.W., Gregory E.G., Forster D., Snow R.W., Khamala C.B.M., Ouma J.H., Githure J.I., Marsh, K. and Beier J.C., . Vector related case control study of severe malaria in Kilifi district, Kenya, Ame Jr Trop Med Hygiene, 1991, 60(5): 781-785.

- Minakawa, N., Mutero, CM., Githure J.I., Beier, J.C. and Yan, G. Spatial distribution and habitat characterization of anopheline mosquito larvae in western Kenya. Am J Trop Med Hyg 61:1010, 1999.

- Minakawa N, Sonye G, Mogi M, Yan G: Habitat characteristics of Anopheles gambiae s.s. larvae in a Kenyan highland.Med Vet Entomol 2004, 18:301-305.

- Narain K, Rajguru SK, Mahanta J, Prevalence of Trichuris trichuria in relation to socio-economic and behavioural determinants of exposure to infection in rural Assam. Ind Jr of Med Res, 2000. 112:140–146.

- Nipada R. GIS and Epidemiology, Jr of Med Asso, Thai, 2005. 88(11):1735-8.

- Omumbo JA, Hay SI, Guerra CA, Snow RW (2004). The relationship between the Plasmodium falciparum parasite ratio in childhood and climate estimates of malaria transmission in Kenya. Malaria Journal 3(17): 1-8.

- Payment P, Richardson L, Siemiatycki J, Dewar R, Edwardes M, Franco E. A randomized trial to evaluate the risk of gastrointestinal disease due to consumption of drinking water meeting current microbiological standards. Ame Jr of Public Health, 1991. 81:703–708.

- Prathiba M. De Silva, and John M. Marshall. Factors Contributing to Urban Malaria Transmission in Sub-Saharan Africa: A Systematic Review, Journal of Tropical Medicine Volume 2012, 2012, Article ID 819563.

- Rekha Saxena, B.N.Nagpal, Aruna Srivastav, S.K.Gupta and A.P.dash.2009.Application of Spatial technology in malaria research and control: some new insights.
- Richards FO, Jr. Use of geographic information systems in control programs for onchocerciasis in Guatemala. Bull Pan Am Health Organ 1993; 27:52-5.
- Rogers DJ, Randolph SE, Snow RW, Hay SI: Satellite imagery in the study and forecast of malaria. Nature 2002, 415:710-715.
- Roper M.H., Torres R.S.C., Goicochea C.G., Anderson E.M., Guarda J.S.A., Calampa, Hightower A. W., Magill A. J., The Epidemiology of malaria in epidemic area of the Peruvian Amazon, Ame Jr Trop Med Hygiene, 2000. 62(2):247-256.
- Smith KR, Corvalán CF, Kjellström T. How much global ill health is attributable to environmental factors? Epidemiology 1999; 10: 573-84.
- Snow RW, Craig MH, Deichmann U, le Sueur D (1999). A preliminary continental risk map for malaria mortality among African children. Parasitology Today 15(3): 99-104.
- Srivastava, A. and Nagpal, B.N. Precision mosquito survey using GIS : A case study of An. minimus--A foothill vector of malaria in India. ICMR Bull 40:41, 2010.
- Sudhakar. S, T. Srinivas, A. Palit, S.K. Kar & S.K. Battacharya, Mapping of risk prone areas of kala-azar (Visceral leishmaniasis) in parts of Bihar state, India: an RS and GIS approach, Jr of Vector Borne Disease, 2006. 43:115–122.
- Tanser.F.C. and Sueur.D.The application of geographical information systems to important public health problems in Afric.Int J Health Geograph 1:4,2002.
- Tempalski BJ. The case of Guinea worm: GIS as a tool for the analysis of disease control policy. Geographic Information Systems 1994; 4:32-8.
- Townshend, J.et al, 2000.Beware of per pixel characterization of land cover. Journal of Remote Sensing.(4) pp.839-843.

- V.E Wagner, Remote sensing: a rapid and accurate method of data acquisition for a newly formed mosquito control district Mosq. News, 39 (1979), pp. 283–287.

- Wartenberg D, Greenberg M, Lathrop R. Identification and characterization of populations living near high-voltage transmission lines:a pilot study.Environ Health Perspect 1993;101:626-32.

- Wartenberg D. Screening for lead exposure using a geographic information system. Environ Res 1992 Dec; 59:310-7.

- Watson RT . The regional impacts of climate change. An assessment of vulnerability. A Special Report of IPCC Working Group II. Cambridge, Cambridge University Press, 1998.

- World Health Organization. Geographical information system (GIS): mapping for epidemiological surveillance. Wkly Epidemiol Rec 1999; 74: 281-8.

List of Abbreviations

AOI	:	Area of Interest
AVHRR	:	Advanced Very High Resolution Radiometer
CCT	:	Computer Compatible Taps
CIR	:	Colour-Infrared
DN	:	Digital Number
DOS	:	Deportment Of Space
ERIDAS	:	Erith Resource Information Data Analysis System
GHMC	:	Greater Hyderabad Municipal Corporation
GIS	:	Geographical Information System.
GMDPP	:	Global Monitoring and Disease Prediction Program
GPS	:	Global Positioning System
HIS	:	Health Information System
Ifov	:	Instantaneous Field of –View
IRS	:	Indian Remote Sensing
LISS	:	Linear Image Self Scanning System
NNRMS	:	National Natural Resource Management System
NRIS	:	National Resource Information System
NRSC	:	National Remote Sensing Centre
RS	:	Remote Sensing
TM	:	Thematic Map



Buy your books fast and straightforward online - at one of the world's fastest growing online book stores! Environmentally sound due to Print-on-Demand technologies.

Buy your books online at

www.get-morebooks.com

Kaufen Sie Ihre Bücher schnell und unkompliziert online – auf einer der am schnellsten wachsenden Buchhandelsplattformen weltweit!
Dank Print-On-Demand umwelt- und ressourcenschonend produziert.

Bücher schneller online kaufen

www.morebooks.de

OmniScriptum Marketing DEU GmbH
Bahnhofstr. 28
D - 66111 Saarbrücken
Telefax: +49 681 93 81 567-9

info@omniscriptum.com
www.omniscriptum.com

OMNIScriptum