



7-9 February, 2012

THEME: Geo-Budget: Enabling Sustainable Growth

Development of Health Information Database using Spatial Technologies for Japanese Encephalitis

Verma Shipra¹, Gupta R.D.²

¹ Research Scholar, GIS Cell, Motilal Nehru National Institute of Technology (MNNIT) Allahabad- 211004 (India), e-mail: shipraenvsc@gmail.com

² Professor, Department of Civil Engineering, MNNIT Allahabad, e-mail: gupta.rdg@gmail.com

ABSTRACT

Public health practices and policies are highly interrupted by the infectious disease cause by vector borne diseases. It impact on emergency response, demographic and societal changes. Vector borne diseases, including Japanese encephalitis are the leading cause of viral encephalitis through large parts of Asia with temperate and subtropical or tropical climate.

The study area covers the geographical area of 3483.8 km² of Gorakhpur district joining paddy growing Tarai area. Remote sensing data covers vast area, including inaccessible areas and thus helps in understanding the breeding and spreading patterns of vectors spatially. In the present study, 19 blocks of study area have been surveyed for vector habitats. Thematic base maps, road maps and visually prepared water logged area maps have been prepared using Survey of India topographical maps and satellite data. The attribute information has been derived from statistical data which was collected from medical offices in Gorakhpur. November 2010 Landsat satellite imagery was used to identify mosquito larval habitat. This study was carried out to develop health information by GIS and remote sensing for studying and control of Japanese encephalitis disease to provide modern means for better health management.

Key Words: GIS, Vector Borne Diseases (VBD), Japanese Encephalitis (JE), Remote Sensing

1. INTRODUCTION

Vector-borne diseases (VBD) have long been a major cause of severe human suffering all over the world. Recently, VBD globally caused major public health problem. The tropical environment, in particular, is highly conducive to the propagation of such disease. All of these, with special reference to India, have been responsible or enormous human malady ranging from disfiguring to permanent

physical infirmities, visceral damage and death (Tyagi., 1997). Almost all the vector-borne diseases have a close relationship with changes in environment, such as land topography, physiographic and human ecology.

1.1 Japanese encephalitis (JE)

JE is a leading cause of viral encephalitis in south-east Asia. Out of the 50,000 cases and 10,000 deaths reported per year, most are in young children. In areas where JE is

endemic, annual incidence ranges from 1 to 10 per 10,000. JE virus is primarily zoonotic in its natural cycle and has reservoirs in pigs, water frequenting birds (amplifying hosts) and cattle horses etc (dampening hosts). This has the potential for outbreaks and has a high case fatality rate. JE is a potentially debilitating and deadly flavivirus that is endemic in rural areas in east, south, and southwest Asia (Richards *et al.*, 2010). Recent outbreaks in the last five years (2005 through 2010) have occurred in the indigenous population and unvaccinated expatriates and travelers in India, Nepal, Taiwan, Malaysia, China, and Vietnam. An epidemic of viral encephalitis was reported from July through November in 2005 Gorakhpur, Uttar Pradesh, India. It was the longest and most severe epidemic in 3 decades; 5,737 persons were affected in 7 districts of eastern Uttar Pradesh, and 1,344 persons died. So it is needful to plan, manage the health data using GIS technology and to update the information from Remote sensing satellite imagery.

2. ROLE OF GIS AND REMOTE SENSING

Humans depend on guiding representations of the land they inhabit, and physical maps probably go as far back in history as the first settlements. Public health practices and policies needs to manage the health data management, organized the data from different source.

GIS has proved extremely useful for gauging the extent of various infections in the world. A simplified GIS supported database management tool facilitates the collection, storage, retrieval and analysis of data or public health purposes (Berquist., 2001). By utilizing a GIS, various departments can share information through databases on computer generated maps in

one location. Disease mapping is used to understand the geographical distribution and spread of disease in the past or present. Remote sensing (RS) by earth-observing satellites has become increasingly important for the analysis and integration of various data. The heterogeneity of climates and landscapes determines the distribution of vector-borne diseases. The new technologies through their propensity for powerful data collection and data handling are particularly well suited to pinpointing constraining factors. Normalized difference water index (NDWI) is proposed for remote sensing to identify vegetation liquid water from space. It gives the result of sensitive change in water content of vegetation canopies.

3. STUDY AREA

The study area taken is Gorakhpur district which occupies the north eastern corner of the state of Uttar Pradesh, and is located to the north of the river Ghaghra. It is about 265 km east of the capital city Lucknow on National Highway number 28. Gorakhpur is located between Latitude 26° 13' N and 27° 29' N and Longitude 83° 05' E and 83° 56' E. Based on its geographical area, the district occupies the 15th position in the state in terms of size, covering an area of 3,483.8 sq. km.

The majority of the cases of JE epidemic came from eastern Uttar Pradesh (Gorakhpur and adjoining areas), which is the paddy growing Terai area. Uttar Pradesh (a northern state of India) lies between latitudes 24° and 31° north and longitudes 77° and 84° east (Saxena *et al.*, 2009). Figure 1 shows the location map of the study area.

4. OBJECTIVE OF THE PRESENT WORK

The objective of present work includes creating a GIS based health data set using spatial data and their attribute information particularly for Japanese encephalitis. The collected statistical dataset has been integrated in GIS using ArcGIS 10 software. The statistical information has been converted into GIS based thematic map for better visualization and interpretation. Various maps generated include block map, block population map, road network map, water bodies map, pig population map and facility of health centers, among others.

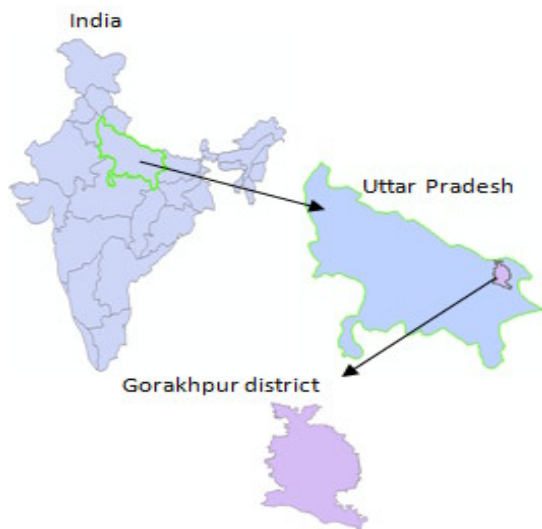


Figure 1: Location Map of Study Area

5. DATA USED

In the present work, epidemiological data and environmental data has been primarily used. The collection of disease data is based on the presence of disease symptoms in the localities. The available information is collected from Primary Health Centers (P.H.C.) and medical offices. These data is used for GIS analysis. The satellite data is also used, *i.e.*, Landsat ETM images April and November 2010.

6. METHODOLOGY ADOPTED

The various stages involved in the preparation of health dataset strategy for Gorakhpur district have been shown in the form of a Flow Chart as shown in Figure 2.

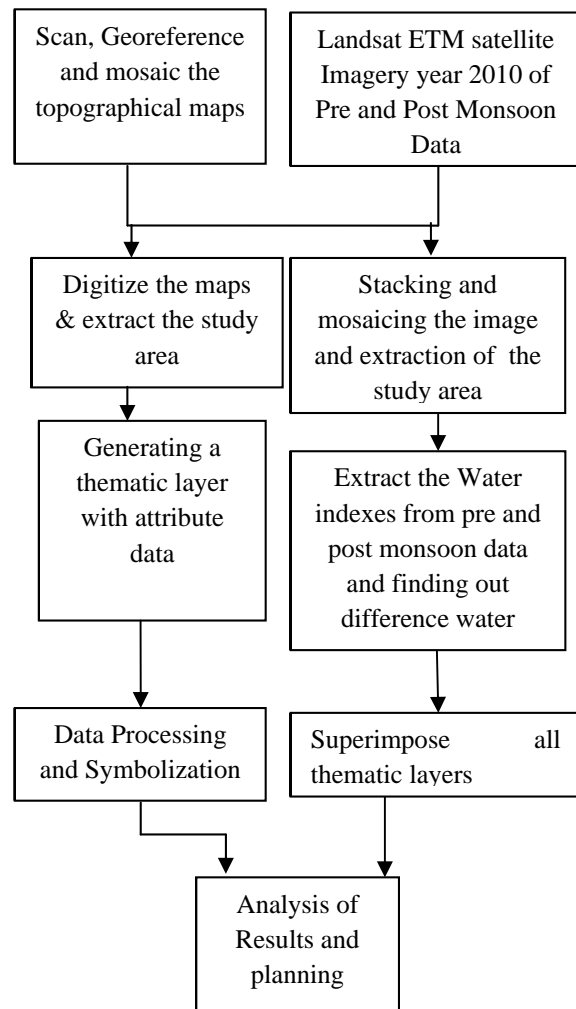


Figure 2: Flow Chart of showing the methodology adopted

7. DETAILS OF GEOSPATIAL DATABASE CREATED

The details of the work carried out for creation of database have been explained under subsequent heads:

7.1 Base Map & Road Map Preparation

Base map of the study area is prepared from Survey of India topographical maps of Gorakhpur district including topographical maps nos. 63M/4, 63M/8, 63N/1, 63N/2, 63N/3, 63N/5, 63N/6, 63N/7, 63N/9, 63N/10, 63N/11. The study area boundary, blocks area, and road network are clearly, noticeable from the base map. The block wise field survey was carried out for detailed analysis and accuracy of the relevant data. The Base map, Block of Gorakhpur district and road network of the study area presented in the Figure 3.

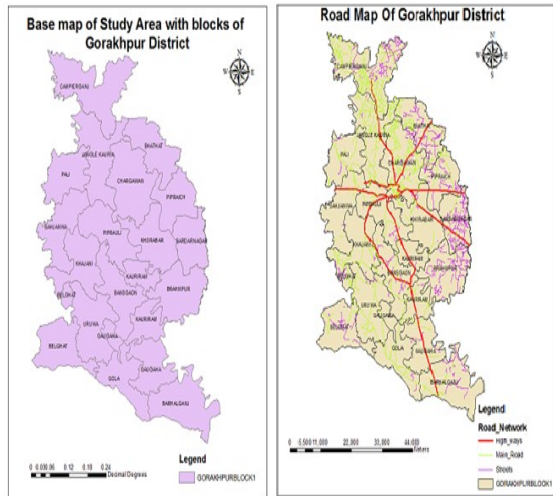


Figure 3: Base Map and Road map of Gorakhpur District

7.2 Detailed Information of Gorakhpur Blocks

Gorakhpur district contains 19 blocks with 19 PHCs having population of 3570859 (male and female) as on 2001 census residing in 440624 houses. The detailed

of human and animal is given below in Figure 4.

7.3 Distribution of Pig Population

JEV (Japanese Encephalitis Virus) is transmitted in an enzootic cycle between mosquitoes and amplifying vertebrate hosts, by primarily pigs (Fischer *et al.*, 2010). The total number of pig population in all blocks is 21715 as per District Gorakhpur Survey 2010. This is shown in Figure 5.

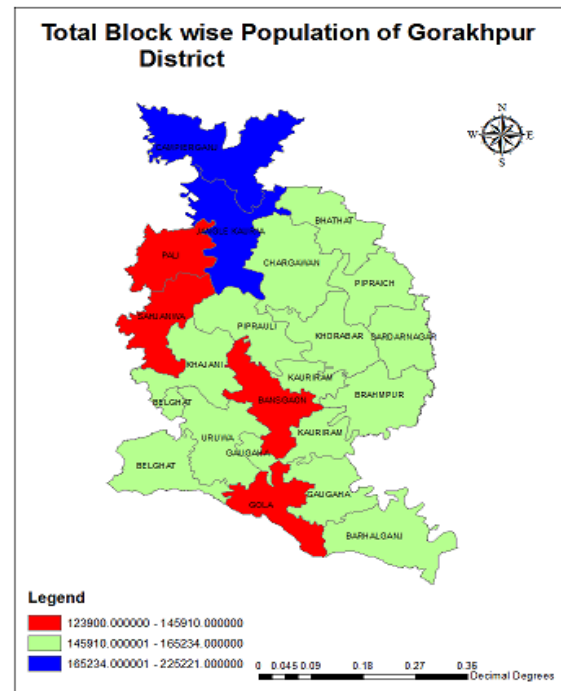


Figure 4: Block wise total Population

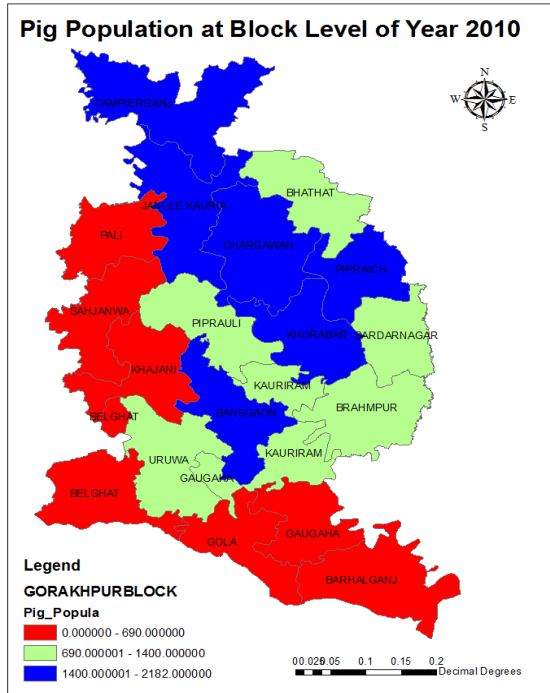


Figure 5: Block wise Pig Population

7.4 Identification of Disease Habitats

LANDSAT ETM Satellite Image 2010 on 50,000 scale for delineating disease vector. For creation of water abundance area, creation of base map, water bodies, vegetation cover, population diversity, paddy field used the technique of image processing and visual interpretation and Water indices for assessing the condition of disease vector.

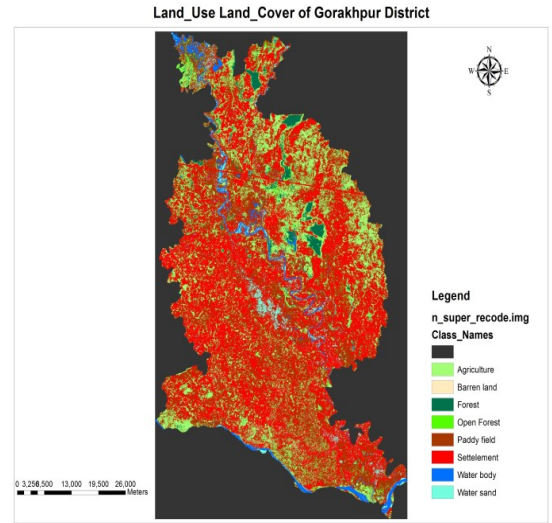


Figure 6: Land use and Land cover map of study area

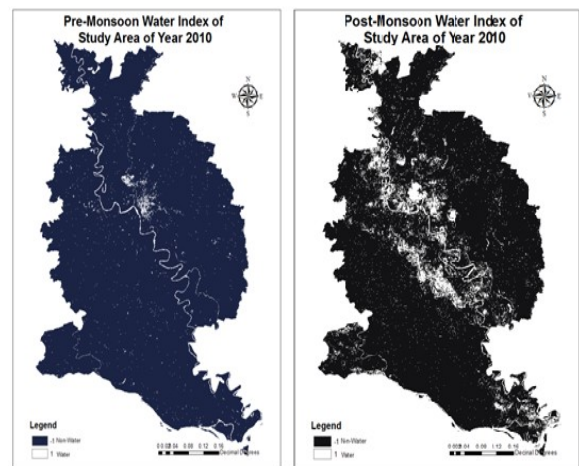


Figure 7: NDWI of Landsat Images from pre and post monsoon data

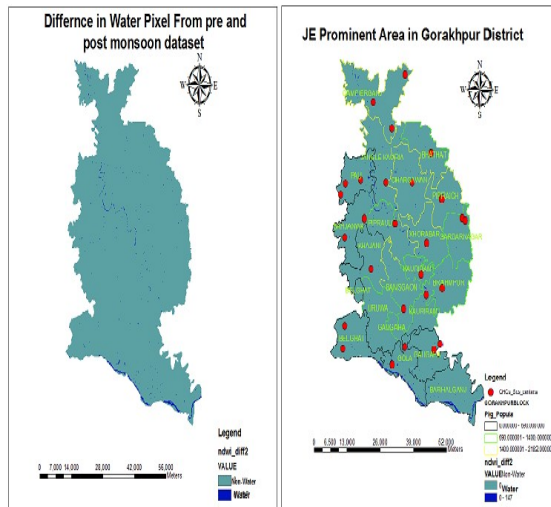


Figure 8: Difference in water indices from pre and post monsoon data and the most prominent area of JE disease

8. CONCLUDING REMARKS

The analysis of data in the present study reveals the details about health and sanitation awareness in rural people. Their living behavior near the pond, river and water body creates more disease habitation due to the pig habitation too. The available health facility is insufficient due to the presence of habitat population and their surrounding impact.

As poor transportation, and water management and sanitation are the main reason to facilitate the disease habitation. The study by using GIS and remote sensing helped to extract the update information and prepare the data for disease control and management strategies.

This geospatial database is update and contains the latest information through which health planners can perform their task of epidemiological mapping more efficiently.

REFERENCES

1. Bergquist N.R. (2001) Vector borne parasitic diseases: new trends in data collection and risk assessment. Elsevier. *Acta Tropica* 79 (2001) 13–20.
2. Fischer M., Lindsey N., Staples E.J. (2010) Japanese Encephalitis Vaccines Recommendations of the Advisory Committee on Immunization Practices (ACIP)., *MMWR*, Vol. 59 / RR-1.
3. Kanojia P.C., Shetty P.S. & Geevarghese G. (2003) A long term study on vector abundance and seasonal prevalence in relation to the occurrence of Japanese encephalitis in Gorakhpur district, Uttar Pradesh, *Indian J Med Res* 117, March 2003, pp 104-110.
4. Parida M., Dash V.P., Tripathi K.N., Ambuj, S.S., Saxena P., Agarwal S., Sahni K.A., Singh P.S., Rathi K.A., Bhargava R., Abhyankar A., Verma K.S. Rao V.P. and Sekhar K. (2006) Japanese Encephalitis Outbreak, India. *Emerging Infectious Diseases* Vol. 12, No. 9.
5. Richards E.E., Masuoka P., David B., Klein A.T., Kim C.H., Anyamba A. and John G. (2010) The relationship between mosquito abundance and rice field density in the Republic of Korea, *International Journal of Health Geographics* 2010, 9:32.
6. Saxena S.K., Mishra N., Saxena R., Singh M., Mathur A. (2009) Trend of Japanese encephalitis in North India: evidence from thirty-eight acute encephalitis cases and appraisal of niceties. *J Inf. Dev Ctries*, 3(7): 517-530.
7. Tyagi B.K. (1997) Emerging and Re-emerging Vector-borne Diseases in the Thar Desert, North-Western Rajasthan, India. *Regional Health Forum*, Vol. 2, No. 1.