DISEASE VULNERABILITY AND CONTROL MAPPING USING GEOSPATIAL TECHNOLOGY –A CASE STUDY FOR TRIBAL BLOCKS OF RAYAGADA DISTRICT, ODISHA

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ABSTRACT

Importance of health with respect to all living beings needs no special mention in the contemporary society. However, due to lack of awareness and health care services, many parts of our nation are still gravely affected due to several diseases, mostly the rural areas in general and much in particular in tribal villages. Most of the regions in India have still poor health protecting infrastructure facilities and as a result of which majority of the rural population is suffering from many diseases that could have been controlled with proper understanding of the disease causative process and the preventive measures. In order to provide with better health care facilities in the PHCs, a data base of the disease causing agents and the remedial measures in the form of GIS maps will help in regularly monitoring the health level of rural public. An attempt has been made to map most prevalent diseases in rural and tribal regions (Selected Blocks) spread over Rayagada district of south Odisha state and further attempt to develop a health care information system for the tribal regions considered. A well set methodology has been derived to find out the Disease vulnerability index for the selected blocks. The sum of the product of the weightage and rating will result in an index which is referred as "*Disease Vulnerability Index*" (*DVI*) and this index is evaluated specific to the diseases considered. Data analysis has been done for disease vulnerability mapping considering Environmental Parameters, Parameters that favor the sustenance of D.C.Vs (Climatic factors), and Parameters that resist the growth of D.C.Vs (General Sanitation & Drainage). Each of the Disease causing agents and disease spreading means has been assigned with a weightage factor indicative of the disease causing potential. Based on the relative Levels of disease causing agents, each parameter has been assigned with a ranking on a 1 to 10 scale to assess the vulnerability level of the parameter at a certain location. Finally Disease control and combat map has been derived.

KEY WORDS: Disease Mapping, Disease vulnerability index, Geospatial Analysis, PHCs

INTRODUCTION:

Importance of health w.r.t. all living beings needs no special mention in the contemporary society. However, due to lack of awareness and health care services, many parts of our nation are still gravely affected due to several diseases, mostly the rural areas in general and much in particular in tribal villages. This is due to the illiteracy among these tribes, remoteness of the villages they live in, lack of clinical / pharmaceutical infrastructural services and the age old practices adopted for curing with reluctance for undergoing current day advanced treatment methods. As a result of all these factors, most of the tribal population in our country are falling a prey to several water borne and vector borne diseases.

Recent advances 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 analysing geographic distribution of disease with respect to time and space that is more difficult and impossible to perform in other way. GIS and Global Positioning System have created new opportunities for public health administrators to enhance planning, analysis and monitoring of vector born disease elimination.

Most of the regions in India have still poor health protecting infrastructure facilities and as a result of which majority of the rural population is suffering from many diseases that could have been controlled with proper understanding of the disease causative process and the preventive measures. In order to provide with better health care facilities in the PHCs, a data base of the disease causing agents and the remedial measures in the form of GIS maps will help in regularly monitoring the health level of rural public. In the paper, such an attempted have been made to map most prevalent diseases in rural and tribal regions spread over two districts in south Odisha state and further attempt to develop a health care information system for the tribal regions considered. The Rayagada district

has been selected of South Odisha. 5blocks of the district have predominant rural and tribal population. From a preliminary study it has been observed that the general health conditions of these rural and tribal public are deteriorating due to the prevalence of certain diseases, which could have been prevented with a little understanding of the disease causing process and the preventive steps. It has also been observed that there is no proper data base pertaining to these diseases in these regions.

STUDY AREA:

The study area lies between 19°0'00" to 19°58'00" latitude and 82°54'00" to 84°0200" longitude. It covers a total Geographical area of 7584.7 sq.km. As per 2001 census, total population of the district is 8,23,000 in which 1,17,524 (14.28 %) are SC, 4,61,209 (56.04 %)are ST and 2,44,266 (29.68%) are OC. Density of population is 116 person/ sq.km. Literacy rate of the district is 35%. Sex-ratio has been found is 1029. In the District of Rayagada more number of blocks has tribal population and it is a real requirement to provide health care services to all the tribal population in those blocks. Present study only 5 blocks of the district which are the neighborhood hinterland regions of the institute, which also incidentally have large tribal population in the state. The blocks selected are of Rayagada(B. Cuttack, Gudari, Munigada, Kashipur and K. Singpur) District (Fig. 1). The below given maps indicate the basic health information of these districts as per the report of NRHM study of Govt. of India.
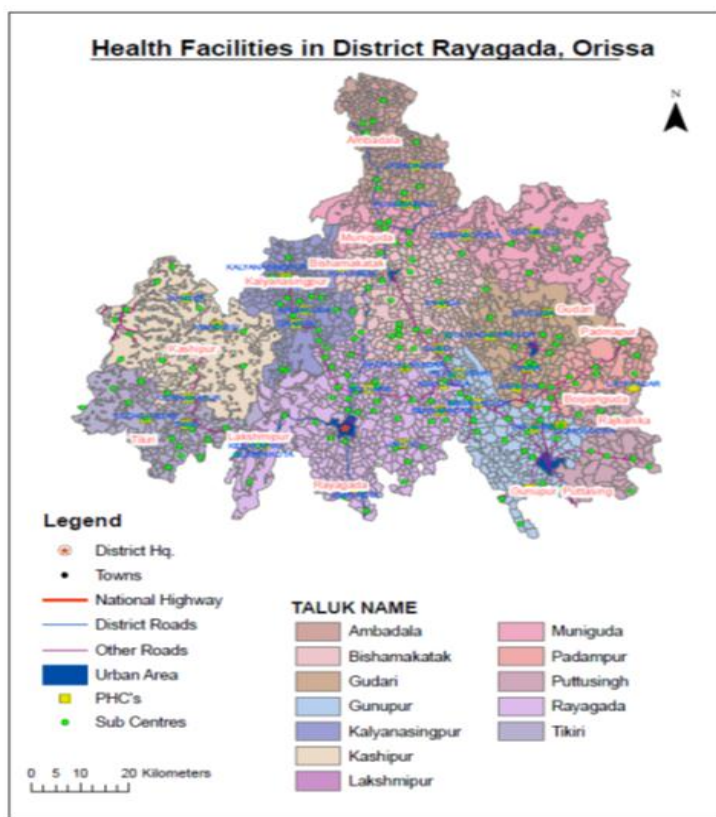

Fig No:1 Study area location

OBJECTIVES:

1) Identification of most prevalent diseases causing health impairment in the tribal population in the study area.

2) To map pockets those are most vulnerable for the diseases and evaluate disease vulnerability index for the study area.

3) To prepare disease vulnerability index map and control and combat map for the study area.

METHODOLOGY

Disease causing agents and disease spreading / controlling parameters have been identified and are assigned with an overall weightages based on their potential impact. (1 to 10 scale). A questionnaire has been developed in consultation with district medical authorities for the identification of the parameters and their impact level.

Depending on the nature / level of each of the parameters in a particular village, a rating is fixed. (1 to 10 scale). The sum of the product of the weightage and rating will result in an index which is referred as "*Disease Vulnerability Index*" (*DVI*).A similar index is arrived by using the disease controlling parameter and the same is termed as Disease control Index

DVI is given by the expression:

$DVI = \sum_{i=1}^{n}[P_W]_i \text{x} [P_R]_i$ where

$[P_W]_i$ = Weightage assigned to i^{th} influencing parameter,

$[P_R]_i$ = Rating of the ith influencing parameter in a particular village and

n = total number of parameters.

The magnitude of DVI will reflect the relative vulnerability at a village and the values of DVI has been mapped for the selected block in the study area. The map thus generated is known as the disease vulnerability index map .Similarly Disease Control and Combat Index have been derived considering Controlling Parameters.

DATA ANALYSIS:

The research work is based on availability of data related to rural health care services in the district and geographical accessibility of the health services. Important factor which considered for baseline and monitoring study are rural population, service area of health centres, available health centres, roads. All the spatial and non-spatial data are integrated into GIS environment for storage, retrieval, manipulation, analysis. The capability of GIS to overlay separate map layers of same geographical area to produce a composite or new map of the study area combining the characteristics of the various maps has explored in GIS. In overlay analysis the location is held constant and several other variables are simultaneously evaluated. The data analysis has been done and various parameters and rating found out. The relative weightage assigned to various parameters are tabulated below (Table 2A , 2B & 2C)

TABLE 2A. Parameters & their relative impact - Disease vulnerability map generation

Nature of Parameters	Parameters	Weightage	Remarks
I. Environmental Parameters	a) Presence of Disease causing vectors	High	More Vulnerable
	b) Water bodies	High	Impact is more
	c) Toilets & Sanitation within the Dwellings	High	Poor Sanitation worsens the situation
II. Parameters that favour the sustenance of D.C.Vs (Climatic factors)	a) Rainfall	Low	Normally less impact on sustenance of D.C.Vs
	b) Temperature	Medium	Higher temperatures may favour the growth of D.C.Vs
	c) Humidity	Medium	Higher humidity is many times favourable for the growth and sustenance of D.C.Vs
III. Parameters that resist the growth of D.C.Vs (General Sanitation & Drainage)	a) General Sanitation in the Village	Medium	Considered to have a medium influence in resisting the growth of D.C.Vs.
	b) Type of Dwellings	Low	Normally the type of built houses will not have much influence on the D.C.V growth.
	c) Drainage & Roads	Medium	Considered same effect as of general sanitation in the village.

TABLE 2A. Parameters & their relative impact - Disease Control Map Generation

Nature of Parameters	Parameters		Weightage	Remarks
I. Health Awareness Parameters	a)	General Literacy	Low	Though literacy is important, the literacy level being normally low in the region, the level of literacy is considered to have a low impact.
	b)	Health Awareness Programmes by Govt & Voluntary Organisations	Medium	The health awareness camps & programmes though will educate the public its impact is considered towards motivation for better health care. Hence a medium impact is assigned.
	c)	Vaccination crogrammes conducted	High	If regular vaccination is carried out, it will have a high impact in controlling the spread of diseases.
	d)	Availability of ASHA & ANGANWADI Workers	Medium	Availability of the ASHA & Anganwadi workers will ensure continuous awareness creation and thus considered to have a medium impact on awareness creation.
	d)	General Treatment & Religious Beliefs	Low	Since the diseases of highly critical nature, the type of treatment and the religious practices will have a low impact.
II. Preventive Parameters	a)	Symptoms Identified & Reported	High	Early identification and reporting of cases will have high influence in preventing the spread of the disease.
	b)	Location of PHC	Medium	Although the proximity of PHCs will control the spread of the disease, the general facilities within rural health centres will not improve the situation of controlling the disease and hence a medium weightage assigned.
	c)	Availability of 108 Services	High	Ready availability of 108 services will enable quick ontrol on the spread of the disease.
	d)	Accessibility of Medical Practitioners	Medium	Effect same as that w.r.t the PHC location.
	e)	Availability of Qualified Pharmacist	Low	General availability of qualified pharmacist in tribal villages is far from reality and hence this parameter will not have significant influence on controlling the disease.
	f)	Road Connectivity with Headquarters	Medium	Better road connectivity will provide a better chance to control the spread of the disease and hence a medium weightage is assigned.

TABLE 2C. Parameters Rating

Q. No.	Category of parameter	Rating Assigned				Remarks
		(a)	(b)	(c)	(d)	
3	PHC Location	1	4	8	10	If present within village less vulnerable
4	Medical shop location	1	4	8	10	
5	Availability of Registered. Medical Practitioner	1	4	8	10	
7	Surface drainage system	1	4	8	10	Presence of canals provide better drainage
8	Habitat type	10	4	8	1	Presence of RCC habitats better clean climate
9	Sanitation in village	1	4	8	10	Better sanitation better control

| 10	Toilet facilities in village	1	4	8	10	Better type of toilets (with septic tanks) better control
11	Road facilities	1	4	8	10	Black top & RCC roads provide better control
14	Existence of schools	8	4	1	10	Higher educational facility better awareness
16	Anganwadis / Health care units	1	4	8	10	Proper organization better awareness
17	NGOs operating	1	4	8	10	If covered by NGOs better awareness
18	Vaccination Programmes	1	4	8	10	Regular vaccination better control
19	Health awareness camps by Govt. and NGOs.	10	8	4	1	More frequent camps better control & awareness
22	108 services	4	8	10	1	Availability in close proximity control spread
25	Types of treatment (Religious based)	10	8	4	1	Treatment based on religious beliefs lead to more ignorance and more vulnerability
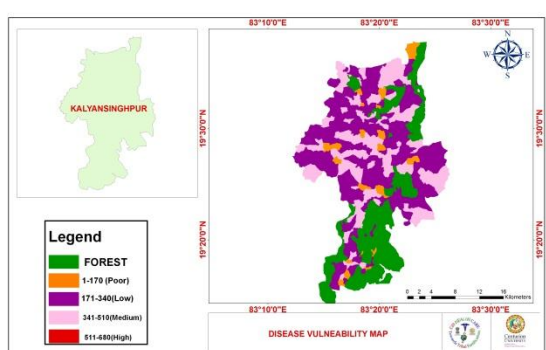
Fig 2a
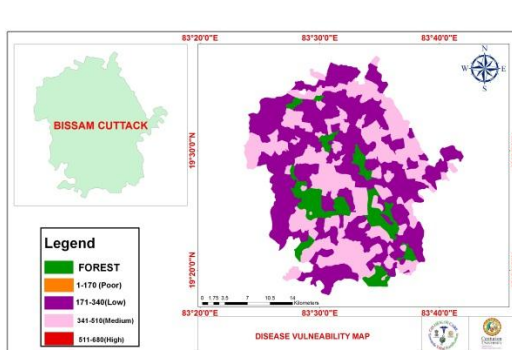
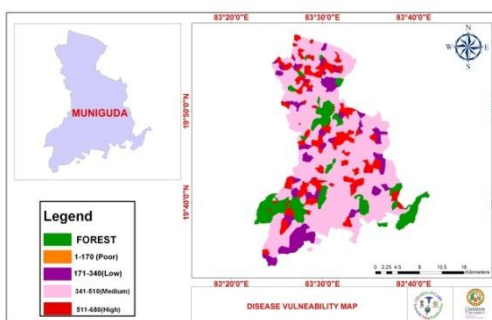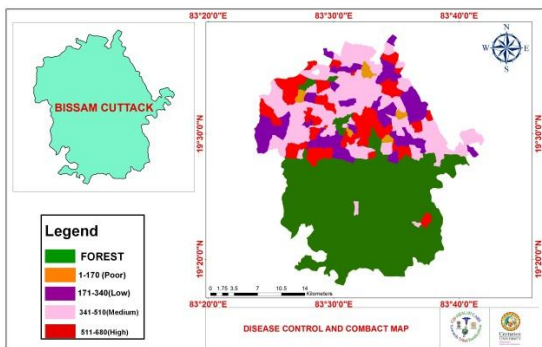Fig 2b
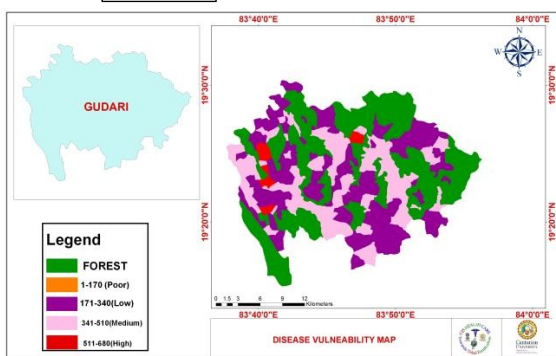
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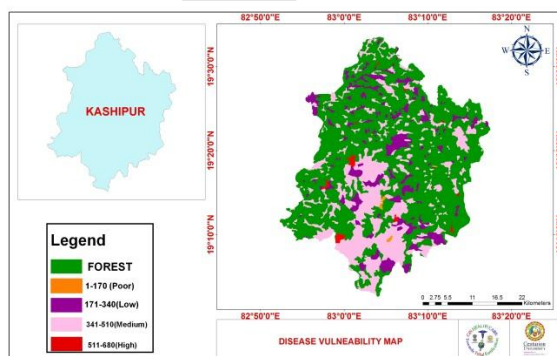
Fig 2d

Fig 2e

Fig 2a, b,c,d,e Showing Disease vulnerability map of selected blocks of the study area
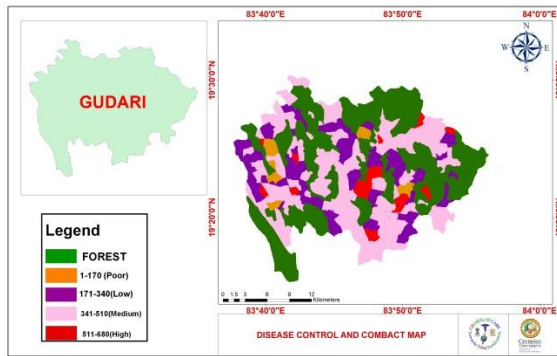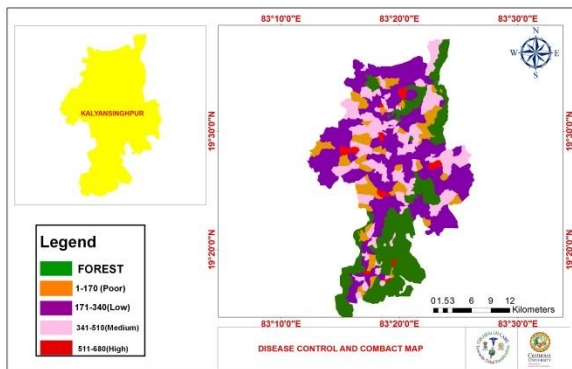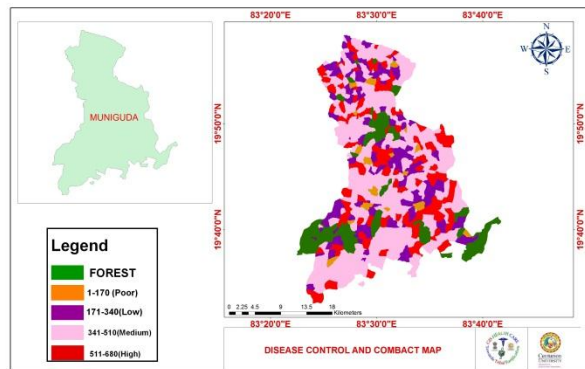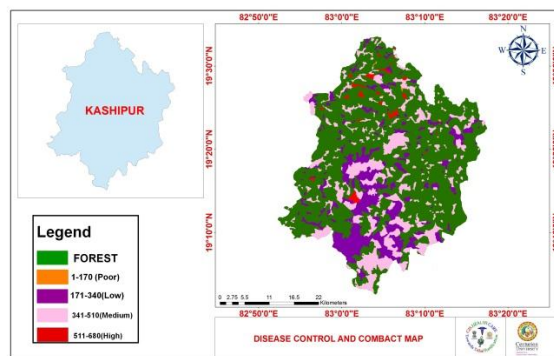
Fig 2a

Fig 2b

Fig 2c

Fig 2d

Fig 2e

Fig 2a, b, c,d,e Showing Disease Control and Combat map of selected blocks of the study area

RESULT AND CONCLUSION

The purpose of this research is to address the various problems and provide new solutions for health information sharing. The handling of data heterogeneity, lack of available data and tools, and methods of health information representation constitute continuing challenges. In the development of a public information and disease surveillance network, issues of data publishing and user access are important concerns. GIS mapping technologies can generate maps for health in desktop or Web applications. Health geography is already indispensable for public health surveillance, seems useful to identify inequities in health care delivery, and to efficiently help allocate and monitor healthcare resources. The mapping technologies can create interactive interfaces for users, with the support of GIS basic functions such as zoom in, zoom out, pan, and hyperlink. GIS, remote sensing, and global positioning system technologies have all been increasingly applied to health applications. The use of GIS technology can inform health officials and the public about emerging health threats, and assist their decision making at all levels. A geospatial-enabled approach has been proposed in this study for semantic health information retrieval. To allow the access of health maps and processing functionalities, Geospatial Web Services are proposed to facilitate loosely coupled architecture design for cross-platform health data and function sharing. General Disease Vulnerability maps have been derived separately for 5 Blocks of the Rayagada district. Disease control and combat maps are also generated for these blocks. With the help of disease control and combat map, necessary decision regarding deployment of service/measures can be taken up by the local administrative staff. In future an attempt will made to develop an information management system for assigned of services and control measure.

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