Application of GIS and GPS tools and Techniques in urban Health Infrastructure Mapping: A case Study from Puri Municipality, Odisha, India

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Abstract- Health is a comprehensive process related to a country's entire growth and development. NUHM is covering 50 cities/towns in Odisha to provide primary health care services to both slums and non-slum population by adopting various approaches /innovations. The purpose of this paper is to highlight Geographic Information Systems as technology and tool having used for health infrastructure Mapping in Puri municipality. Furthermore, this mapping may act as a decision-making tool in health care and it might contribute to the formulation of policies regarding the health sector.

Keywords: GIS, NUHM, UPHC, ANM, MAS, and RKS

1.INTRODUCTION

There are several reasons why health sector is turning to Geographic Information Systems (GIS) applications, but research application is at the top of it all. The fact that this discipline involves a lot of research and data analysis means that GIS can be very helpful to a greater extent. Health is defined as not only the absence of sickness but also the capacity to reach one's full potential. It acts as a measure of one's well-being. Health is a comprehensive process related to a country's entire growth and development. Though the twentieth century witnessed a first-of-its-kind global transformation in human health, it may be difficult to describe nation's health condition in terms of a single set of criteria. Scholars generally analyze people's health by taking into account indicators such as infant mortality and maternal mortality rates, life expectancy and nutrition levels, as well as the prevalence of communicable and non-communicable diseases.

Infrastructure refers to all such activities, services, and facilities needed to provide different kinds of services in an economy. Simply put, it is the support system for the economic and social development of the country. Since India's economic reforms in 1991, the government has placed a significant emphasis on infrastructure development.

2.OBJECTIVES

The following are the major objectives to use GIS tool for health infrastructure mapping in puri city:

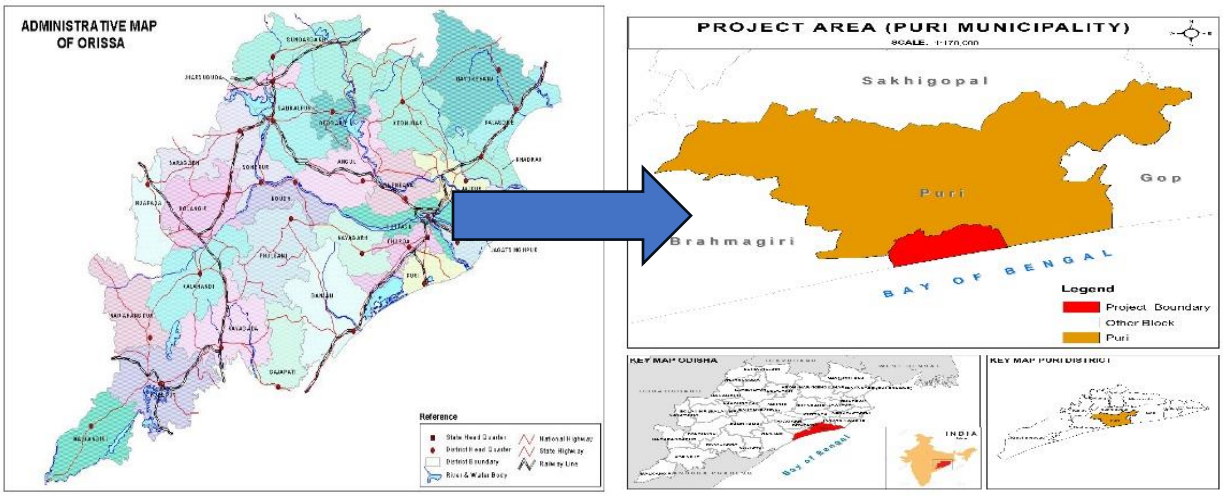
- Need based city specific urban health care system to meet the diverse health care needs of the urban poor and other vulnerable sections.
- Institutional mechanism and management systems to meet the health and health related challenges of a rapidly growing urban population.
- Availability of resources for providing essential primary health care to urban poor.
- Partnership with community and local bodies for a more proactive involvement in planning, implementation, and monitoring of health activities.

3.STUDY AREA

Puri is one of the coastal cities in India having 67 Km of coastal beach. The Puri town lies around

the latitudes 19.817743, and the longitude is 85.828629. A historic city located on the eastern coast of India in the state of Odisha. The city is famous for its cultural diversity and religious belief. The world-famous Lord Jagannath Temple is situated in puri. Puri city having population of more than 2.5 lakhs (midyear 2024) and having 63 nos. of slums contributing 30% of population to the city. In Puri town there are 30 Primary health care service platform starting from Virtual SC to UPHC (V.SC-20, Urban Health & Wellness Centre(UHWC)-5, Urban Primary Health Centre(UPHC)-5). At community level there are 57 ASHAs and 100 Mahila Arogya Samiti (MAS) are formed to look after the community activities .This holistic city consists of 32nos. of municipal wards having Ward Kalyan Samiti(WKS) – a bottom level committee for addressing different issue faced by the local inhabitants and act as convergent action.

Fig-1 Study Area Map



4. NUHM PROGRAM

Prior to National Urban Health Mission in the puri city, there are one DHH and 3 municipality dispensaries to cater the heath needs of the urban population. Patients of puri city rushing to the DHH for primary health services resulting high rush in general OPD and quality of services being hampered.

After Implementation of NUHM in the city, all the dispensaries being managed by the municipality has been declared as Urban Primary Health Centre (UPHC) by Health & Family Welfare department through Gazette Notification. After renamed as UPHC, the assessment has been done for civil, HR, equipment and instruments and subsequently the gap has been filled up by utilizing the NUHM funds.

As per NUHM mandates in each UPHC formed a Rogi Kalyan Samiti (RKS) Later it has been renamed as Jan Arogya Samiti (JAS), it conduct the governing body meeting once in every six month and Executive Committee meeting once in every two months to finalise the action plan for patient safety as well as hospital development.

To provide health services to the floating population in the city, as per statistics near about 30 thousand devotees and tourist come to puri on daily basis, keeping these population's health, One Urban Mobile Health Unit has been functional and covering all the slum and dispensing services at festival site at different place in puri town.

Community health services being strengthen after implementation of NUHM programme. As per mandate Mahila Arogya Samiti being formed at slum level , Ward Kalyan Samiti at ward level, ASHA positioned at slum , ANM positioned for every ten thousand population. Community health platform like UHND Session Sites, Routine Immunization Session Sites, fixed day site for special outreach camps has been strengthened by infrastructure setup, supplying equipment and instruments and by providing skilled based training to the health functionaries at grassroots level.

Supply chain management system from UPHC to District Drug Warehouse has been strengthened, reporting system has been strengthened and supporting supervision with monitoring of programme back to the track resulting a good outcome of national accreditation of UPHC under Kayakalp and NQAS.

5.STUDY METHODOLOGY

The following 7 steps were used for GIS and GPS based health infrastructure Mapping in Puri Municipality

5.1 Preliminary Planning and Base Map Collection from NUHM
5.2 Download Satellite Imagery from Google earth
5.3 Control Work, Image Processing and Rectification of Satellite Imagery
5.4 GPS Training imparted to the NUHM Staff
5.5 GPS based survey and Mapping
5.6 Preparation of GIS Layers and Map Composition
5.7 Ground Truth and final GIS Mapping preparation

5.1 Preliminary Planning and base map collection: Review of existing city situation, collection of all secondary data from NUHM, hard copy of municipal boundary, ward boundary maps, and slum location related data.

5.2 INDENT of Satellite Imagery from Google earth: Down loaded all satellite imagery from Google earth for puri town Map" in 1:1000 scale.

5.3 Control Work, Image Processing and Rectification of Satellite Imagery: Adequate ground control points were taken to geo-reference the Satellite imagery to achieve the accuracy required for mapping at 1:1,000 scale. Ground Control Points (GCP) were taken using GPS tools and techniques. GCPs points were chosen such that they are well identified and have sharp definition on images such as crossing of narrow roads rather than wide road if reliable recognized on image, position of culverts etc. Geographic Co-ordinate system (Latitude & Longitude) with WGS84 Geodetic Datum were used for the project. RMS values of control point observations on adjustment are to be recorded to assess the quality of control work. The satellite imageries were rectified using proper ground control points collected through high precision GPS. All pre-field mapping works has been transformed on to the rectified satellite imagery as per GPS control collected during the field work.

5.4 GPS Training imparted to the NUHM Staff: Geo Spatial team imparted GPS training to field level officials of NUM. Well-trained GPS trainers are available with the NUHM. Health department can use them in future upcoming project.

5.5 GPS based survey and Mapping: During survey time two types of data were collected i.e Spatial data and non-spatial data. Spatial data like maps and other survey report. Non-Spatial data through both primary and secondary sources. Survey team collected both primary and secondary data through GPS instrument.

5.6 Preparation of GIS Layers and Map Composition: The following GIS layers were prepared through GIS software:

A. Clinical layer

- One CHC/ 2.5 lakh urban population only in 5 lakh+ cities , 30-50 bedded hospital and First Referral Unit (FRU) level care. It would provide in-patient services and would be a 30-50 bedded facility.
- One UPHC/ 50,000 urban population, comprehensive primary healthcare service, JAS with provision of grant of Rs. 1.75 lakh . The U-PHCs are preferably located within or near a slum for providing preventive, promotive and OPD (consultation), basic lab diagnosis, drug/contraceptive dispensing services, apart from counselling for all communicable and non-communicable diseases.
- One ANM/ 10,000 urban population,Para-medical level care for RCH, Immunization, Disease Control Programs and NCD.

B. Communitization (Community Process) layer

- WKS - Ward level forum to plan and implement program with convergent manner under the Chairmanship of ward Corporator/ Councilor
- ASHA - For 200-300 households in Slums (1500 slum population) facilitate the community services

- MAS - For every 50-100 households in Slum communities (500 slum population) facilitate the demand generation

5.7 Ground Truth and final GIS Mapping preparation: All the maps were validated by the NUM staff and then shared to other line departments for further analysis and application

6. STUDY OUTCOME

The following GIS maps were generated through Arc GIS software:

Plate-1

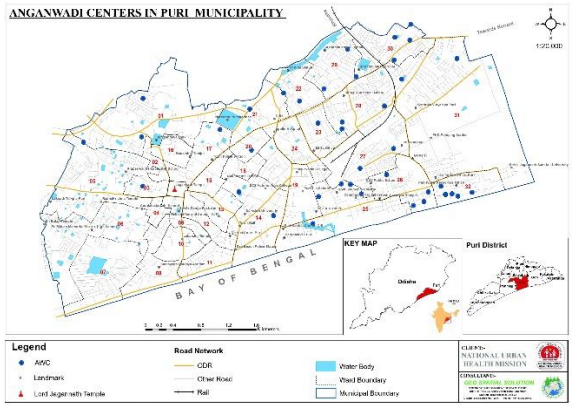


Plate-2

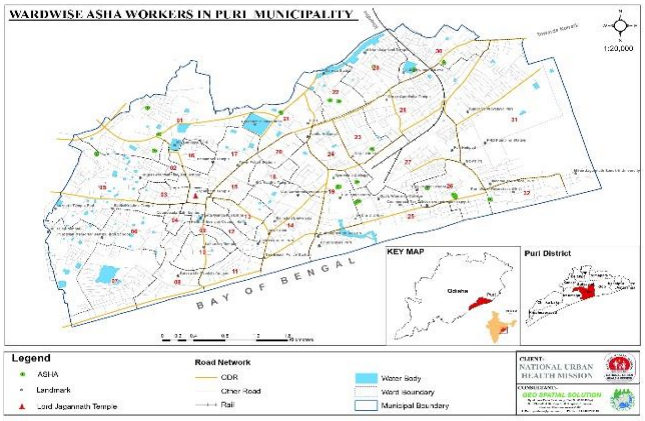


Plate-3

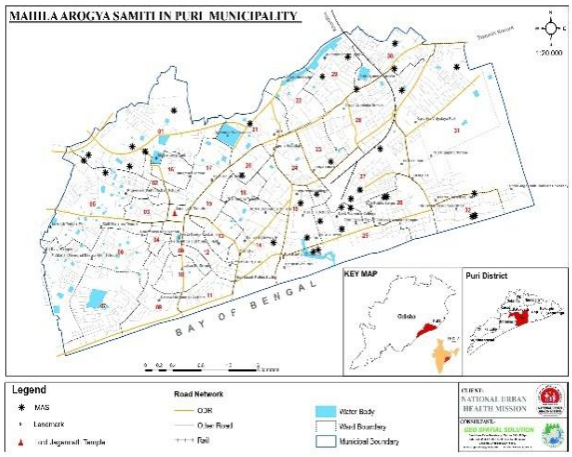


Plate-4

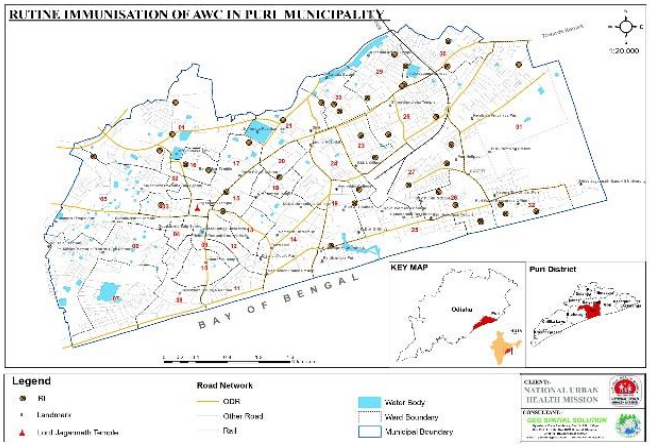


Plate-5

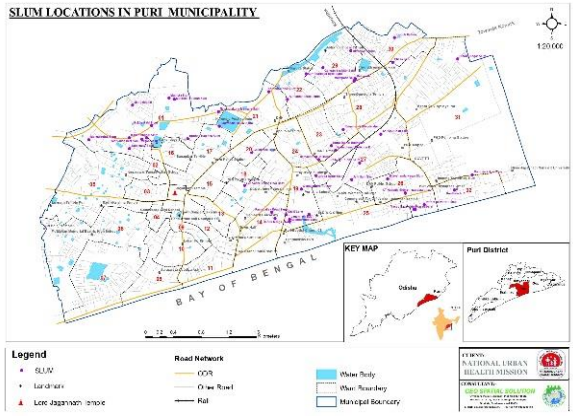


Plate-6

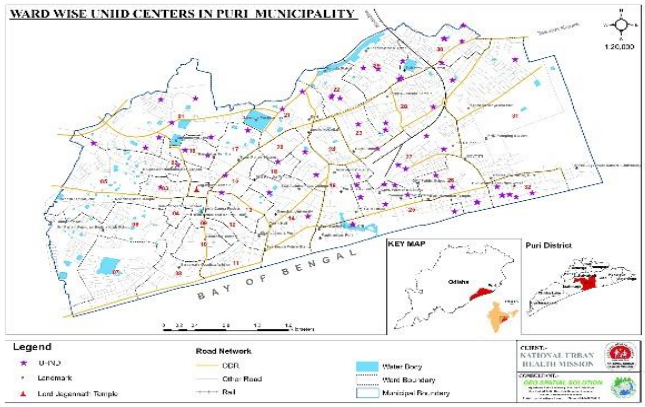


Plate-7

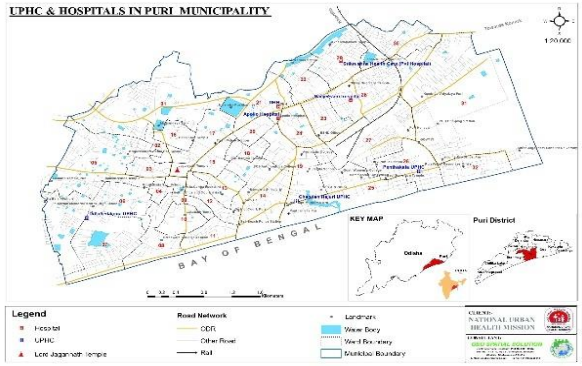
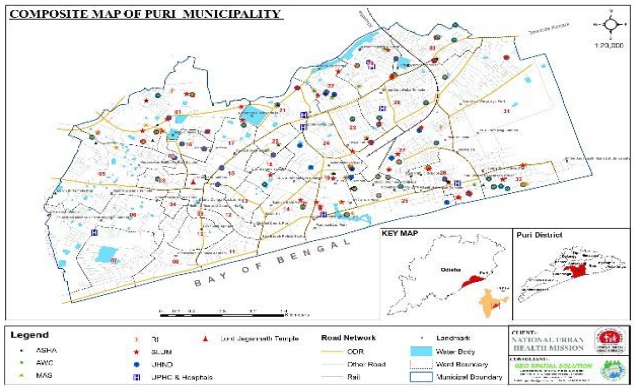


Plate-8



Puri municipality has been implementing various programs in the field, to digitalise the process and to identify various gaps for better monitoring and program implementation, GIS has been adopted by the municipality to:

- Identification of health services Gaps in a high-density city.
- Determines new location for setting of/ starting of new health services/facilities
- Tracking disease outbreaks in a slum/ wards
- Managing disease outbreaks with proactive measures
- Health risk assessment of a particular area
- Monitoring and evaluation of programme
- collection of demographic as well as socio economic information
- disaster planning like sending ambulance / drone to appropriate place
- Track the movement of grassroots level Health functionaries in the community
- Part of vulnerability assessment in the slum

Major achievement under GIS mapping under NUHM, Puri

- Able to bring all health service centre in a composite map.
- Easily trace the UHND session & RI session in the slum
- Proposed new health facility on the base of GIS based MAP of the city
- COVID hotspot area identified and planning done to control the spread bcoz of GIS
- Community institution (MAS) and ASHA being selected newly due GIS mapping
- Activity of NUHM programme being monitored properly due to GIS
- City flood due to heavy rain being managed properly

7.CONCLUSION

With the help of GIS software, the above maps were created in 1:1000 scale using high resolution google satellite imagery and time series data (GPS survey) of all physical features of the town, collection and superimposition on base map. Review of existing situation, collection of all available data from NUM, in soft copy and hard copy including municipal boundary, ward boundary, road network, water bodies, etc for preparation of city Base Map. After preparation of base map, other thematic maps were prepared i.e ASHA, AWC, MAS, RI, SLUM, UNHD, UPHC and composite map. The entire GIS and GPS digital data are being used by NUM project as well as future project. Also, it would be utilized to assist in strategic planning, monitoring, evaluation and impact assessment of the project. This health infrastructure mapping would be helpful to academician, researcher, Planners and Decision makers for future city planning and management.

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survey. The survey was conducted during the year 2021.

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