ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 4, Issue, 5, pp. 1068-1080, May, 2014

International Journal of
DEVELOPMENT RESEARCH

Full Length Research Article

MAPPING AND ASSESSMENT OF POCHAMMA KUNTA SLUM USING REMOTE SENSING AND GIS

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ARTICLE INFO

Article History:
Received 08th February, 2014
Received in revised form
14th March, 2014
Accepted 20th April, 2014
Published online 29th May, 2014

Key words:
Slum,
Remote sensing,
Gis

ABSTRACT

In the developing countries, the acute problem of slum formation is found not only in the big cities but also in medium and small cities and towns "A slum is a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services"". Because of the high, proportion of slum dwellers among the urban population, the problems of urban poverty areas are of particular concern. In most of the municipal areas proper up-to-date maps of slums along with proper database and genesis of its growth are not available which create problem in developmental process. Thus, it is important to analyze the slum formation, slum morphology and impact on surroundings to improve quality of life of slum dwellers. Hence, the main aim of the project is to map the slums and identify the physical characteristics of the slum areas and to present a comprehensive picture of slums in two aspects, i.e., spatial distribution and growth, and physical infrastructural services related to slums. The slum selected for the present study is Pochammakunta (Burial ground); is a under non notified slum in Warangal municipal boundary. Cartosat_II image is used for mapping of pochammakunta. Survey slum map is used for mapping of pochammakunta. Non spatial data for this slums have been collected from the field survey with the Questionnaire. Slum spatial layers have been digitized for all the houses in GIS environment. The attribute data obtained from the field survey has been added to the spatial layers. Mapping has been done based on the facilities in a particular house and severity maps showing the condition of the slum have been generated. In pochammakunta slum all houses have severity grade poor and very poor. Pochammakunta contains 111 houses. It contain 84 'houses under kachacha, 22 under pakka, and 5 under poor condition. Hence, these slum maps based on different parameters helps the user to analyze and understand the condition easily.

INTRODUCTION

General

In developing countries, the acute problem of slum formation is found not only in the big cities but also in medium and small cities and towns. These slum areas will have the specific problems like: high population concentration and densities, severe infra structure deficits, largely uncontrolled spatial expansion of illegal or semi legal housing and squatter settlements, severe ecological strain, extreme socio-economic disparities etc. These areas are also global risk areas because they are particularly prone to supply shortages, social and political unrest, natural and man-made disasters due to their high concentrations of people, the dynamics of demographic, social, political, economic and ecological processes, and poorly coordinated administration and planning. Because of the high proportion of slum dwellers among the urban population, the problems of urban poverty areas are of particular concern. It is vicious cycle of population growth, opportunities in the cities (leading to migration to the cities), poverty with low income, tendency to be closer to work and leads to occupy any available free land in the vicinity. The key reason out of all is the slow economic progress and people in the villages may affected due to the failure of monsoon, due to lack of facilities like schools, hospitals etc. As the commercial and industrial activity needed labor with less expensive in the cities whereas: Plentiful was available in the rural area. Hence the people from rural areas were encouraged to come to cities and work. People, who migrated to the cities and found work, brought their relatives / friends and rest of the families to the cities. Unable to find housing and afford it, they decided to build their shelter closer to work. First, one shelter was built, then two and then hundreds, thousands etc. thereby occupied more government lands. Hence, these areas are formed as

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slums with minimum facilities. Conniving governments provided electricity and drinking water. Politicians looked at the slums as vote bank. They organized these unauthorized dwellers into a political force; hence slums took a bit of a permanent shape. More slums developed as more population moved to the cities. "A slum is a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services. A slum is often not recognized and addressed by the public authorities as an integral part of the city. The characteristics associated with slums vary from place to place. Slums are usually characterized by urban decay, high rates of poverty, and unemployment.

They are commonly seen as "breeding grounds" for social problems such as crime, drug addiction, alcoholism, high rates of mental illness, and suicide. In many poor countries they exhibit high rates of disease due to unsanitary conditions, malnutrition, and lack of basic health care. A United Nations (UN) Expert Group has created an operational definition of a slum as an area that combines to various extents the following characteristics: inadequate access to safe water; inadequate access to sanitation and other infrastructure; poor structural quality of housing; overcrowding; and insecure residential status. To these one might add the low socioeconomic status of its residents. Due to rapid urbanization and consequent haphazard growth, most of the cities have become congested and unhygienic. It is clear that rapid processes of accretion as a result of incessant flows of immigrants caused the present changes in aerial size of slum. In most of the municipal bodies proper up-to-date maps of slums along with proper database and genesis of its growth are not available which create problem in developmental process. Thus, it is important to analyze the slum formation, slum morphology and impact on surroundings to improve quality of life of slum dwellers. Under these circumstances, remote sensing plays a leading role by virtue of its repetitive and synoptic coverage that may become a base map for many government and semi government organization in a very rapidly growing urban area.

Role of Remote Sensing and Geographical Information Systems (GIS) in Slum Mapping

The information, technology based on remote sensing and GIS has a vital role to play for sharing information; interdepartmental preparedness, optimize response, mitigation, post- event recovery and planning. Reliable, accurate and meaningful information remains a key component of all management efforts. The satellite data is suitable for implementation of various development schemes and monitoring the spatial and temporal variability at different scales. Earlier, low and medium resolution satellite images were used for spatial analysis. With the recently available high-resolution satellite images, we are able to recognize more detailed features on the ground. The possibility of managing and monitoring the resources at faun level has thus become a distinct reality. Frequently these data must be integrated with the data from other sources to meet application requirements. Sound geo-spatial database is an important aspect for spatial decision-making process of natural resources management and development in GIS environment. However, the most important aspect is data integration of spatio-temporal and non-spatial data in support of data analysis and query. Thus, application of remote sensing and GIS has become essential component for monitoring all development activities and to support the district administration. In one of the editorial the author Joshi (India together, 23 Sep 2008) says about the importance of GIS as: Infrastructure projects are spatial activities and slum settlements are spatial entities...Hence, spatial information is essential, "GIS is a tool which allows us to use and analyses' spatial information in conjunction with relevant socio-economic information, and is therefore an ideal basis for planning", To explain the exact process, GIS integrates spatial information (maps) with any other data that have collected from the field survey. For example, a typical slum map will show you the physical features of the area, but it does not say anything about the inhabitants and their demographics. So, necessary field survey has to be done to collect relevant socio-economic information about the residents and to superimpose on the GIS maps. Based on the visual interpretation of the image and field survey slum maps can be prepared for the different physical parameters. To know the severity of the slums, a comparison can be done based on' the physical factors of a developed slum with the undeveloped slum and a map showing the severity of the slums can be prepared. A database for the slums is necessary so that the condition of each and every house can be known. Hence, a database can be prepared and labeled with the help of necessary socio-economic information, ground checks etc.

Objective of the work

The goal of this study is to locate slums and identify the physical characteristics of the slum areas and to present a comprehensive picture of slums in two aspects, i.e., spatial distribution, growth, physical infrastructural services and socioeconomic conditions of slum dwellers. The objectives can be summarized as below:

- Identification of slum areas based on the physical characteristics.
- Inventory, documentation and analysis of detailed housing patterns
- Survey of socio-economic structural patterns of the slum dwellers.
- Generation of slum maps in GIS environment.
- Creation of database and label with the help of necessary ground checks.
- Analysis of the attribute data in slum in GIS environment.

REVIEW OF LITERATURE

General

Several efforts have been made for mapping, monitoring and mitigation of Slums using the remote sensing and GIS. In this chapter, some of the literature which is found to be relevant for the present study has been discussed. A Committee on Poverty Reduction (2007) in United Nations economic and social council summarizes that urban poverty grows with urban population. Poverty reduction tools and approaches that have been developed for rural poverty reduction will not work in urban areas, because urban poverty is different in nature from rural poverty. Their document provides a broad overview of the characteristics and, if available, the extent of urban poverty, using the three dimension of poverty: lack of income,

lack of access and lack of power. It introduces policies and programmed to address urban poverty, but also shows that the available data on urban poverty in the region are not detailed enough to enable the development of effective and sustainable urban poverty reduction policies. Hence, the Committee is requested to advise the secretariat on directions for further work to enhance the understanding of urban poverty and to identify effective approaches to urban poverty reduction. Chowdhury and Amin (2006) made an attempt on Environmental Impact Assessment review for slum improvement project. Their study shows the difference that Environmental Assessment (EA) can make in such interventions and suggested mechanisms for its integration into such projects. The findings are based on a field survey that was carried out in two slums of Dhaka where infrastructure projects were implemented. In one slum, the EA process was considered in designing and locating infrastructure and in the other it was not. The survey results traced the severe problems that existed in both slums before the implementation of infrastructure improvement projects and reveal that after the intervention the situation has considerably improved in the slum where EA was conducted. In contrast, some problems still persist in the other slum where EA was not considered. To make it worse, the newly built infrastructures have even given rise to a set of new problems. In order to avoid such negative outcomes from development interventions, the paper finally develops the mechanism for integration of EA into slum improvement project.

Remote sensing and GIS importance in slum mapping

The following are some of the papers which show the importance of remote sensing and GIS in mapping and creation of slum maps. Guistu (2006) from the tutorial "Using GIS to define Grades of Poverty" it is shown that: To establish priorities when planning the schedule for urban governmental interventions it is necessary to establish grades of poverty within squatter developments. Areas classified with the highest grade of poverty are assigned resources in the short term. When developing proposals for Los Claveles, a squatter development located in Venezuela, ARC GIS was the supporting tool for analyzing spatial and non spatial data. Data measured and categorized through urban and environmental indexes allowed the definition of categories of poverty and terms for improvement interventions. Environmental indexes measured the adequate insertion of buildings in the geography and urban indexes measured relations of built public open space, dwelling located within walking distances from schools and health services, square meters of built space per family, family size, etc The analysis included the topology of social relationships, since community ties are topologically based and permanence of community relationships grounds any sustainable proposal. Sur et al. (2004) made an attempt to identify and mapping of slums using the 1KONOS (1m and 4m) satellite images and assessment of slum environment in GIS supported by ground verification. The slums were identified on the basis of visual Interpretation and were captured manually using on-screen digitization method. Finally database was created and labeled with the help of necessary ground checks. The visual interpretation of the study area showed clearly the location and 'area' distribution of the slums. For this purpose, interpretation parameter's like, pattern (layout), shape (roof types etc), size (small, medium, big), and tone and association were used. Then the slum areas were identified and labeled after detailed ground check. Detailed mapping of a particular slum area was carried out and database was prepared with the help of a structured questionnaire (household and physical infrastructure). The parameters taken for the case study was individual condition of houses like: roof material, wall material, access to houses, drainage (water logged or not), water supply (per capita**,** stand pipes, duration of supply, and storage of water), electricity, sewerage/ sanitation and street lighting. Turkstra and Raithelhuber (2004) by their work on Urban Slum Monitoring presents that, One of the United Nations Millennium Development targets is to achieve significant improvement in lives of at least 100 million slum dwellers by 2020. To monitor progress on this target a first step is to develop an operational definition to identify slum settlements. The indicators selected are: access to water and sanitation, sufficient living area, a house with durable material on a non-hazardous location and with tenure security. They described a methodology to identify slums at the sub-city level in different regions of the world. For each of the five indicators different data sets are identified, which includes the use of high resolution satellite images. GIS models are presented to integrate the different indicators. The collaboration between ESRI and UN-HABITAT in the 1000 Cities GIS Programme and the methodology described in this paper are facilitating the use of GIS software for slum monitoring for cities in developing and transition countries.

Guzman et al'.(2002) in their project Multi-Scale and Multi-Temporal Poverty Mapping made an attempt on poverty mapping and developed Poverty Alleviation Decision Support System (PADSS) in which forms, patterns and structures of poverty at various scales and years were analyzed through Remote Sensing and Geographic Information Systems (RS-GIS). Location motivation behind informal settlements within Metro-Manila and in Ivluntinlupa include vacant lots and easements, major transport routes, water bodies, sites for vegetable gardens and job attractors, like commercial and industrial areas and informal livelihood sources. Clustering around socio economic attractors is evident from large and smaller pockets of slums. The results of National-scale' and multi-temporal mapping of poverty indices are indicative of movement of migration. A useful application of RS—GIS is also land suitability mapping like Existing land use and land cover, slope, water availability. distance to employment, development costs, Natural hazards and risks influence the appropriateness of a site for a specific or multiple purpose, especially socialized housing. These suitability maps are important inputs to Comprehensive and Sustainable Land Use Plans (CSLUP), especially towards the better integration of the marginalized into the urban system.

Closure

The literature review shows that remote sensing and GIS techniques used for mapping, monitoring and creation of geodatabase for slum areas. The methodology for the present study obtained based on the studies of Sur et al (2004) and Guisti (2006). To decrease the affects by these slums, government need a database consisting the complete information focusing their life style and facilities. The slums have to be graded showing the condition of the slums. Hence, proper plans and suggestions can be made to improve the slum

areas. By this work the slum maps can be updated along with proper database and can be used as a base map for many government and semi government organization in a very rapidly growing urban area. Based on these literature review methodology of present work has been prepared and as explained.

METHODOLOGY AND STUDY AREA

General

To achieve the goals and objectives of the present study, a framework is made for the overall model development. The methodology followed in the present study is shown in Fig. The various steps involved in the present study are as follows.

- Collection of remotely sensed data followed by processing of the satellite data and the non-spatial data for the required area of interest.
- Creation of the Geodatabase based on the data obtained by the field survey.
- Generation of the maps of the slum area based on the different parameters.
- Analysis for the created database of the selected slum area.

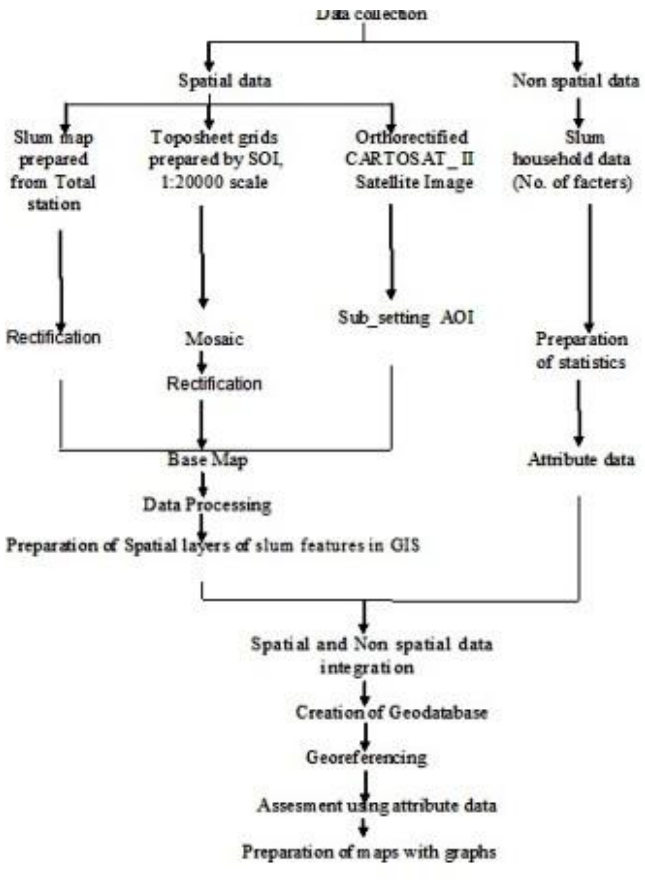

Fig Flow chart of the methodology

Fig. 3.1.

Cartosat_II image have been collected for the required area. By the visual interpretation technique the slums in the image are identified and the digitization has been carried out on slum map. Field survey with a questionnaire has obtained the demographic data of the slum. Based on the data from the survey a complete geodatabase was created. Hence, slum maps for different parameters has been generated and analyzed.

Study area

To map and create the geodatabase for slum in the present study, the area chosen is the Warangal town. As from the data obtained from the Warangal Municipal Corporation there are number of Notified and Non_notified Slums, but there are some more slums which are to be Notified by the Municipal Corporation. The area chosen to study is pochammakunta slum. The location of the study area is as shown in the Fig 3.2, 3.3.

Fig. 3.2.

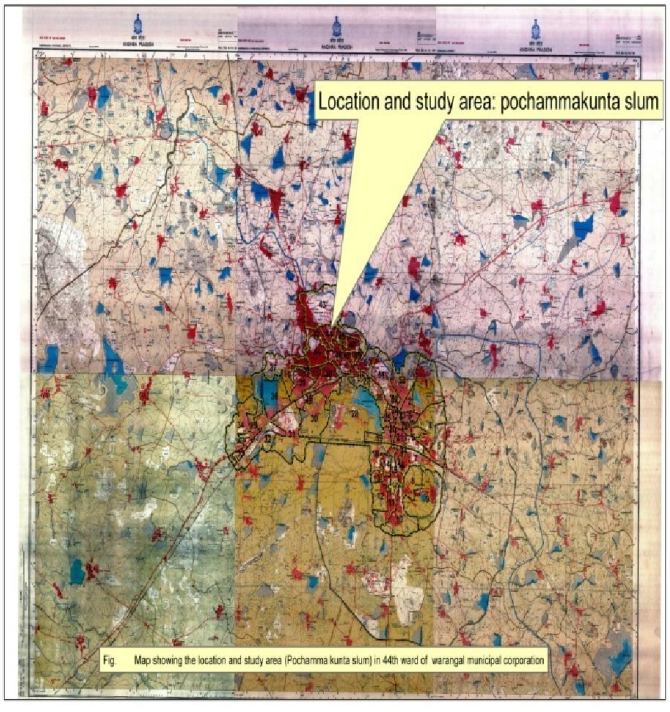

Fig. 3.3.

Fig. 4.1.

Fig. 4.2.

DATABASE CREATION AND ANALYSIS

General

On the basis of the visual interpretation and necessary field survey, the slum map has been prepared in GIS environment. A detailed map of the study area has been prepared by digitizing each and every house and non-spatial data collected on the basis of field survey has been transferred as attributes for analysis. To analyze the condition of slum, the comparisons based on the parameters has been done and visually shown as maps. Based on the availability of the different facilities, the slum area map are prepared.

Data Sets and Software's

For the study of slums High Resolution data like rectified cartosat_II satellite images, Survey of India (S01) Toposheets at 1:25,000 and Slum map of pochammakunta have been used.

Spatial Data

Images used to map the pochammakunta slum has been collected from Warangal municipal corporation. ERDAS is the software used for preparation of a continuous image. To map pochammakunta slum Cartosat_II Data has been used. The Toposheet 56 N/12/SW at 1:25000 has been collected from SOI Hyderabad.

- Toposheets and slum map are used for the preparation of the base map.
- The satellite image have been used for georeferencing. and identification of features.

The visual interpretation can be done based on the interpretation elements like tone, pattern, shape etc,

Non Spatial Data

The non spatial data considered in the present study like the demographic features of the residents of the slums are caste, sub_caste, religion, solid waste disposal, toilet, toilet users, water supply source, water tap connection electricity, fuel for cooking, Health facility drainage, house location, house usage, land tenur, living duration, house ownership, migration from, migration reason, no. of rooms in house, sanitation, water facility, accessibility, types of material used for their roof and floor, street lighting, bath room, etc. for the collection of non spatial data field survey has been made with a questionnaire. Based on the data obtained in the field survey statistics have prepared for different parameters. Hence, it is easy to make the comparison between the physical parameters which shows the severity of the slums in GIS environment.

Software's used

The software's used in the present study is listed below with their purposes.

- ArcGIS 9.3.1 has been used for rectification, digitization and preparation of statistics.
- ERDAS Imagine 9.1 has been used for mosaic image
- Microsoft excel has been used for storing the attribute data obtained from the field survey.

Data Processing

The data processing techniques in this study are rectification of the SOI toposheet with the rectified cartosat_ II satellite image. The rectification process done is image to map rectification in ArcGIS 9.3.1.. Hence, the all features of slums are digitized and GIS maps of the slums as the cadastral base have been prepared. The base map of the study area prepared from the image is as shown in Fig 4.1 and Fig 4.2.

Database preparation

The internal land use and utility were studied through satellite imagery and field survey to find out the causes for sporadic and haphazard development of slums. The present study are for pochammakunta slum. Thus, the 'satellite imagery was found very useful in marking the layout pattern of slum, counting the buildings (structures), by-lanes, water logged areas etc. However the imagery does not show the activity within buildings, but show only the site adaptation. Detailed building uses e.g. the shops, small temples etc. could only be confirmed only during field survey. All the slum pockets

identified were transferred to base map, so as to get an overall spatial distribution and location of the slum area. In order to detect the slum area, the following factors considered were: Small sized structures with high density; tone difference to get the idea of kachcha or semi- kachcha houses that were obvious in the slum areas; irregular internal street pattern having unmetalled and mostly unpaved; Areas of wastelands, such as on banks of Rivers or Canal, along railway line and road margin is taken as association for identification. The area for the present project"has been selected based on certain factors like field visits and color printouts were taken for detailed field survey along with brief questionnaire as shown in Fig. The final maps of the pochammakunta slum has been prepared as shown in Fig 4.3.

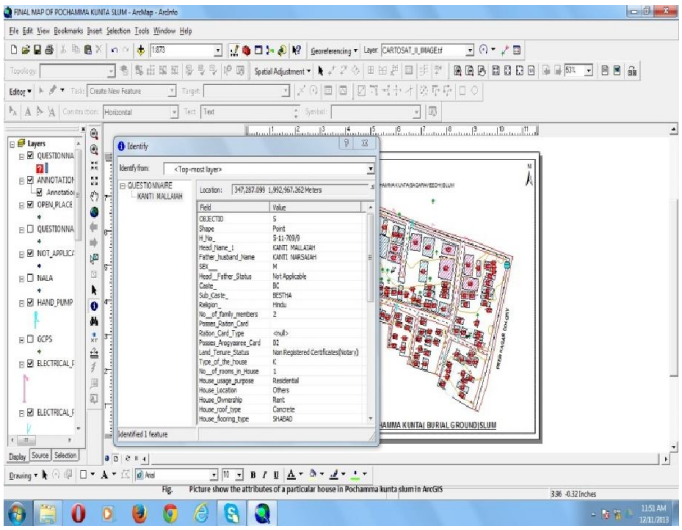

Fig. 4.3.

While attribute data obtained from the field survey has been transferred to GIS maps. Hence, a complete database has been prepared for pochamma kunta slum. The attributes given to the house for pochamma kunta slum is as shown in the Fig 4.3. The respective analysis for the attribute data has been done as follows.

Slum analysis based on the attribute data

The Slum 'Environment in the study area has been analyzed and mapped based on the following parameters. From the field survey, it was found that the total number of houses is about 111 in the study area. People who are getting loans from the government completed construction work and build temporary houses. Various parameters have been studied on the slum, which are shown by maps from Fig. 4.4.1 to Fig 4.4.26.

Summary

The present study is aimed to map and create the geodatabase of pochammakunta slum of the Warangal town. Slum maps has been prepared for the pochamma kunta. Slum maps for different parameters have been generated based on the attribute data obtained from the field survey. The analysis for the attributes in slum maps has been carried out. An index factor has been generated based on the availability of facilities for each house. Hence, a map showing the condition of the slum is prepared by the index factor.

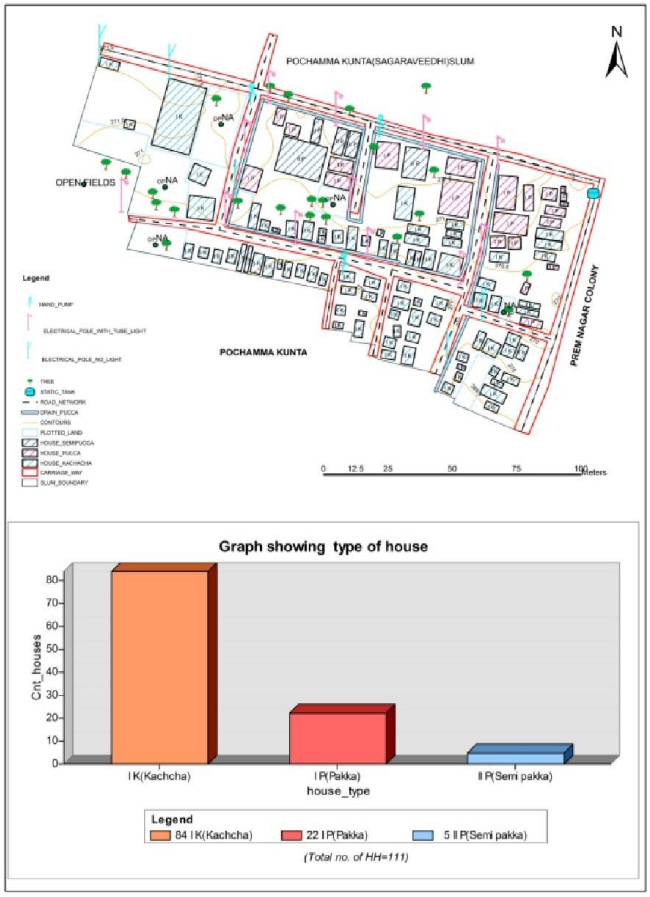

Fig. 4.4.1. Map of pochamma kuntaslum bassed on the type of house

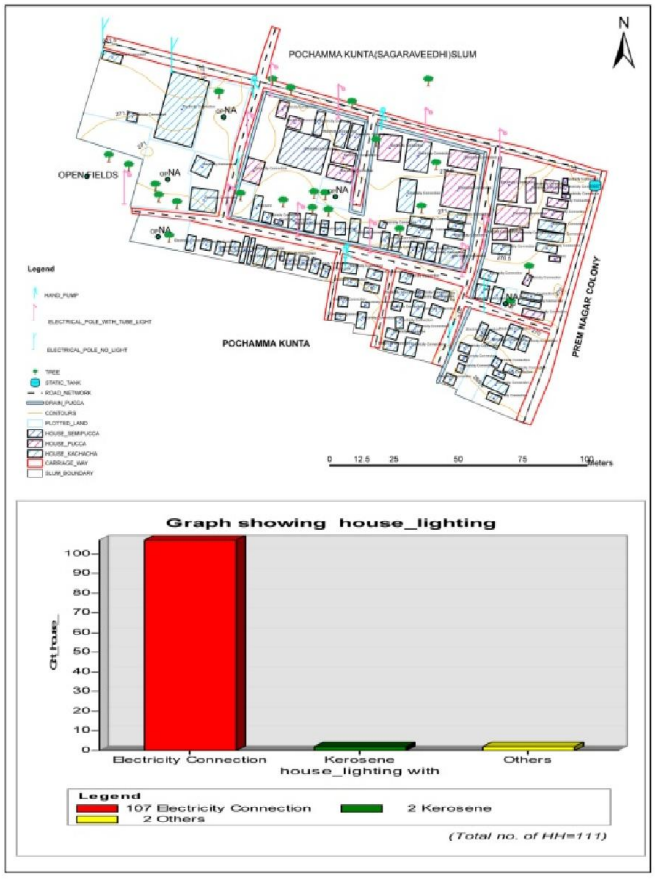

Fig. 4.4.2. Map of pochamma kunta slum based on dwellers_house lighting

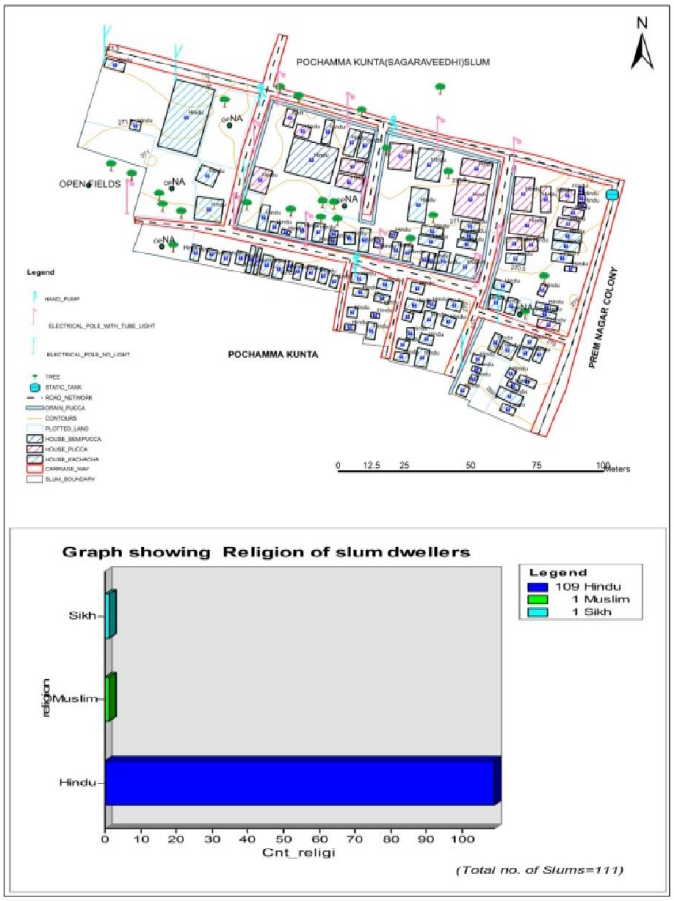

Fig.4.4.3. Map of pochamma kunta slum based on the type of Religion of slum dwellers

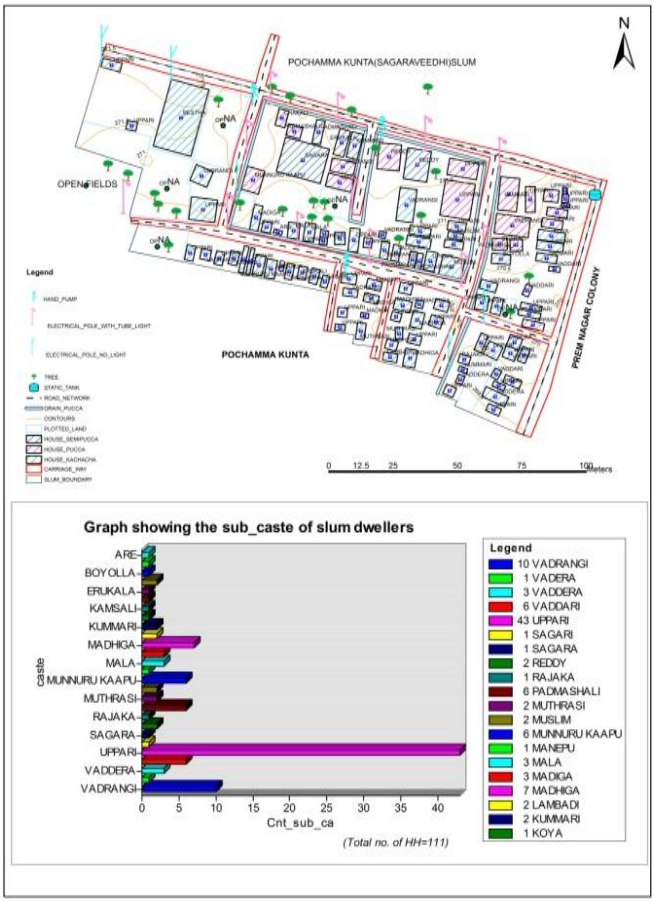

Fig.4.4.5. Map of pochamma kunta slum based on the type of sub_Cast of slum dwellers

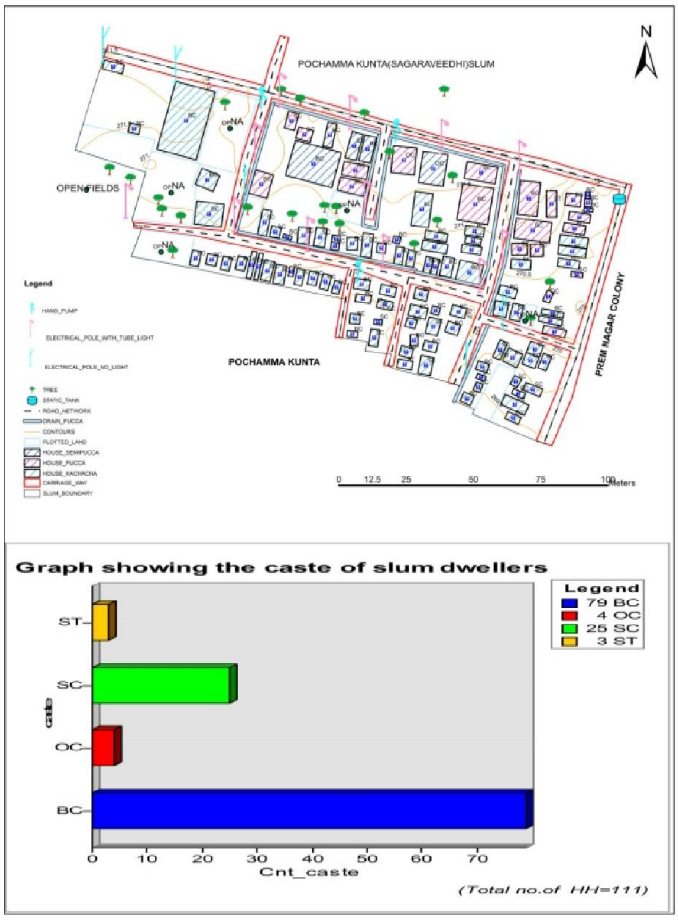

Fig.4.4.4. Map of pochamma kunta slum based on the type of Cast of slum dwellers

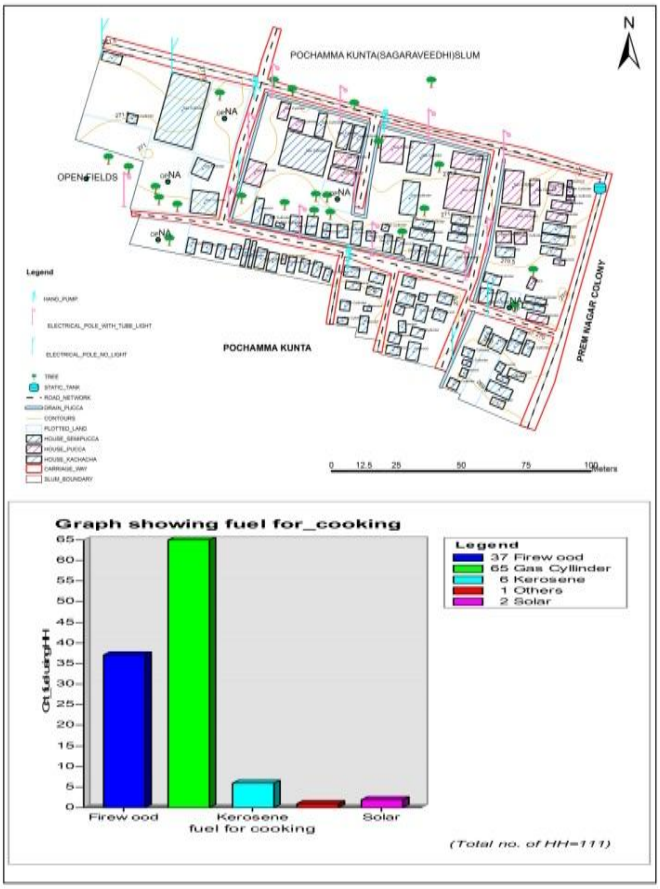

Fig.4.4.6. Map of pochamma kunta slum based on dwellers_fuel for cooking

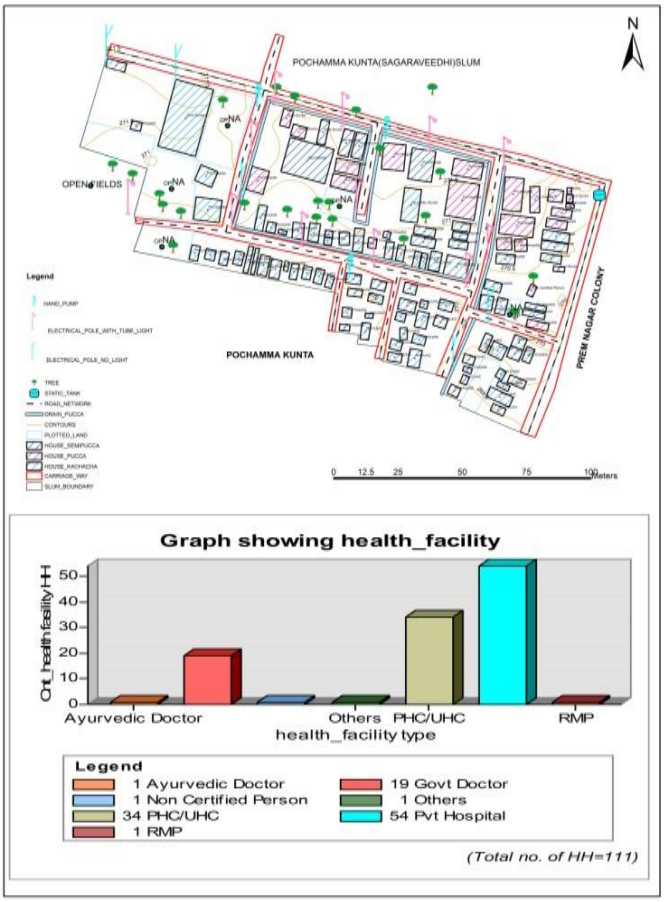

Fig.4.4.7. Map of pochamma kunta slum based on health facility type

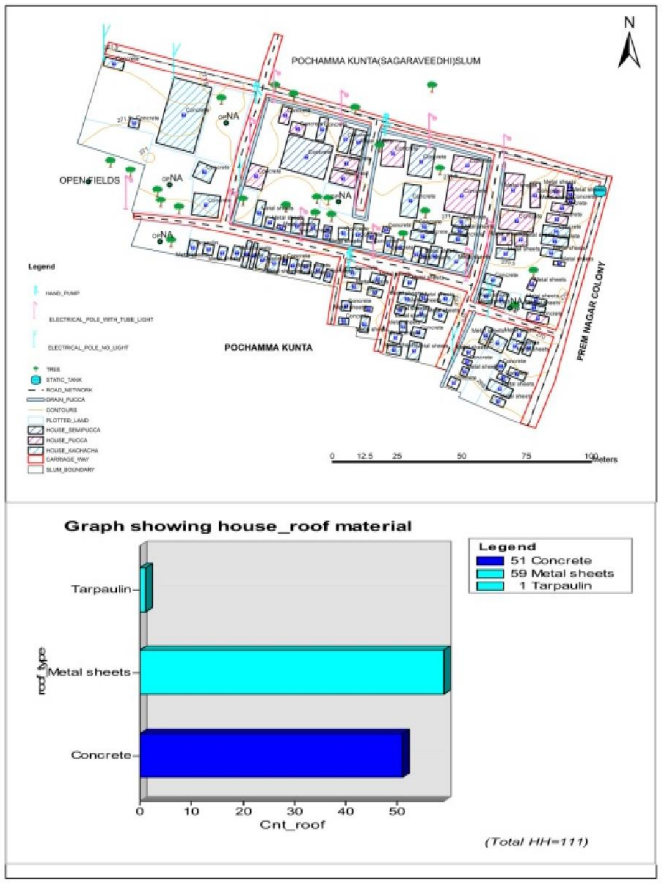

Fig.4.4.9. Map of pochamma kunta slum based on the roof material of house

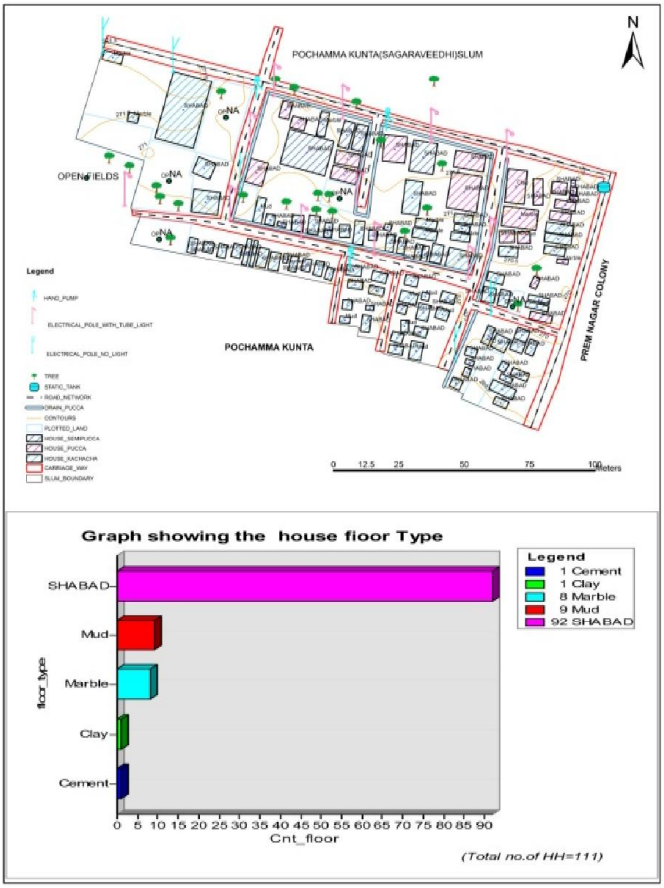

Fig.4.4.8. Map of pochamma kunta slum based on the floor type of the house

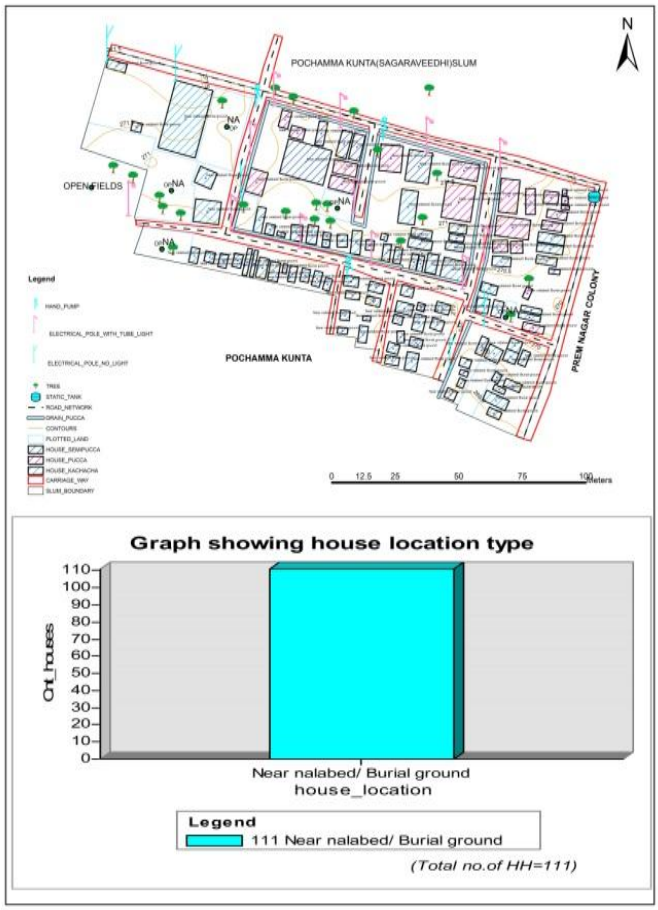

Fig.4.4.10. Map of pochamma kunta slum based on house location type

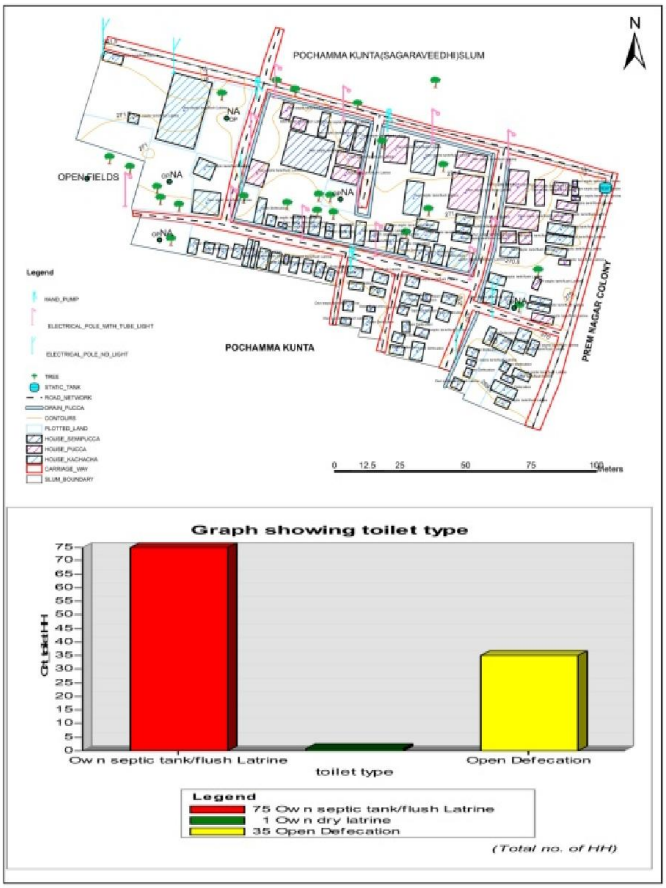

Fig.4.4.11. Map of pochamma kunta slum based on dwellers_toilet type

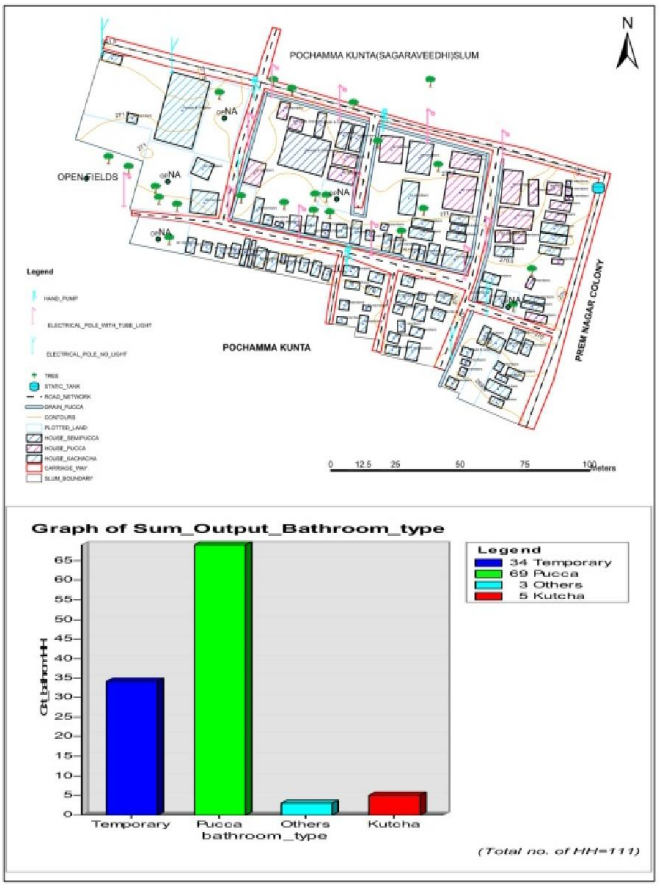

Fig.4.4.13. Map of pochanmma kunta slum based on dwellers_Bath room type

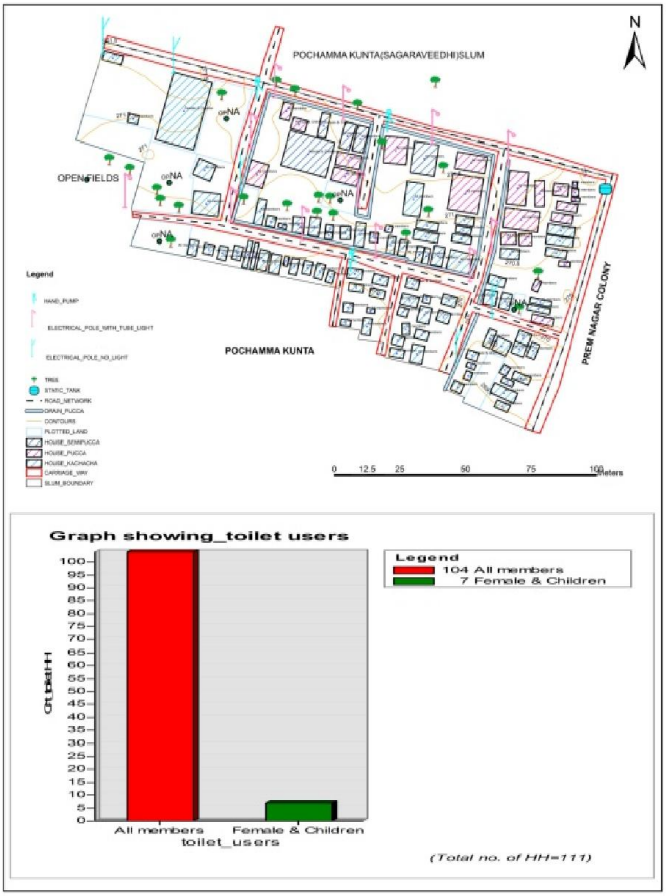

Fig.4.4.12. Map of pochamma kunta slum based on dwellers_toilet users

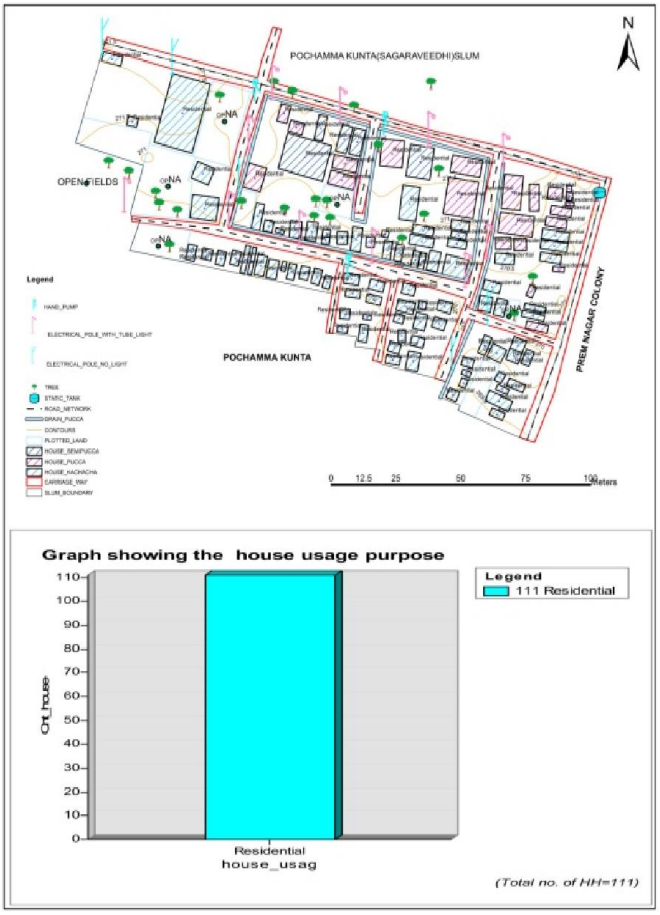

Fig.4.4.14. Map of pochamma kunta slum based on the usage purpose of the house

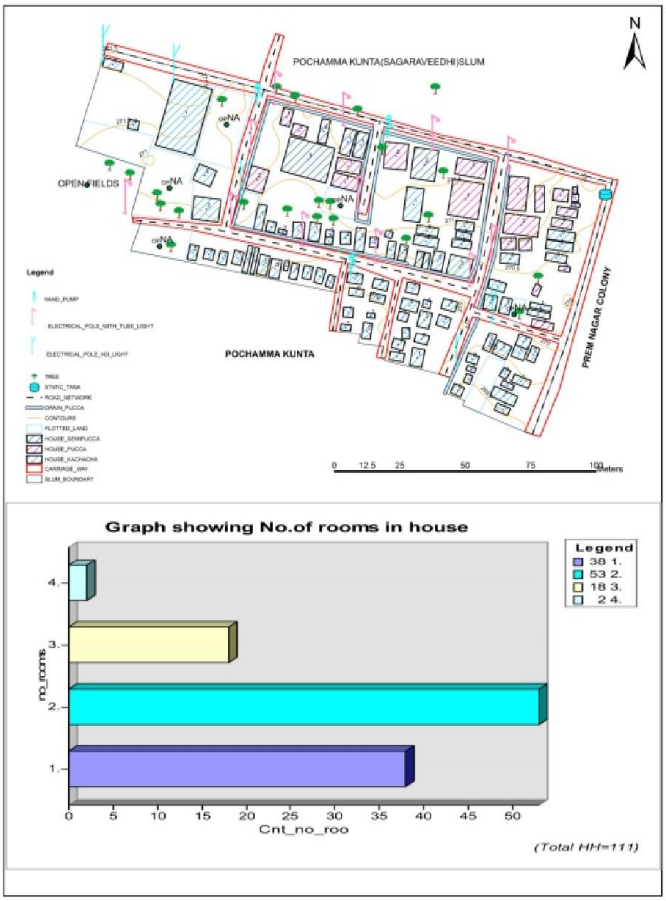

Fig.4.4.15. Map of pochamma kunta slum based on the no. of rooms in house

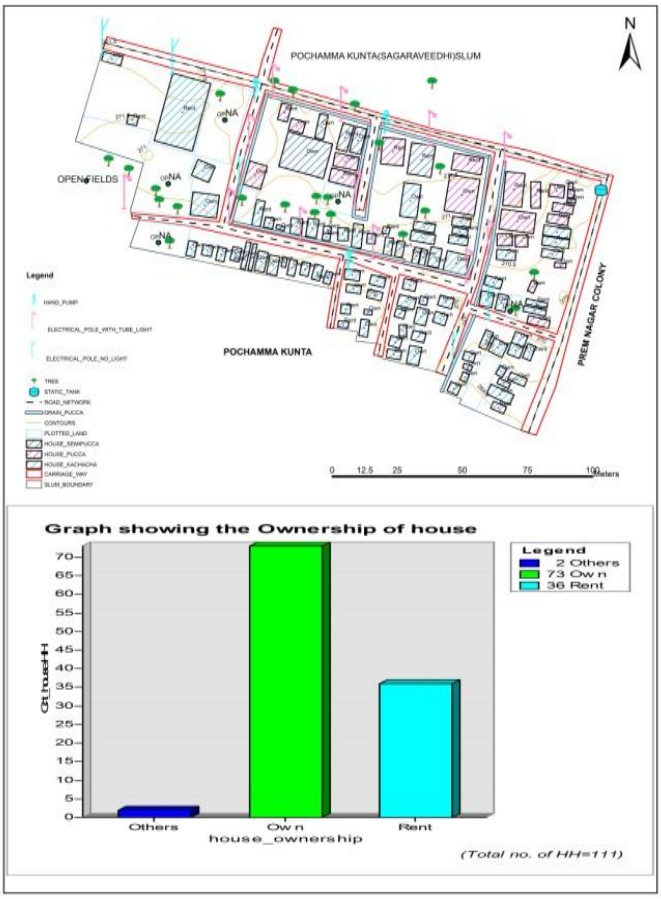

Fig.4.4.17. Map of pochamma kunta slum based on dwellers_house ownership

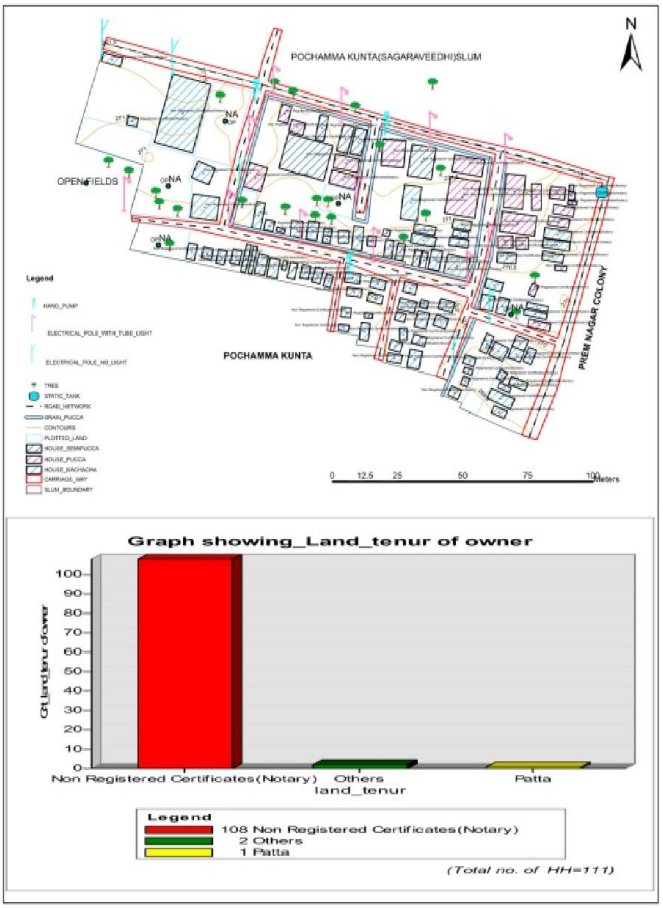

Fig.4.4.16. Map of pochamma kunta slum based on dwellers_land tenur of owner

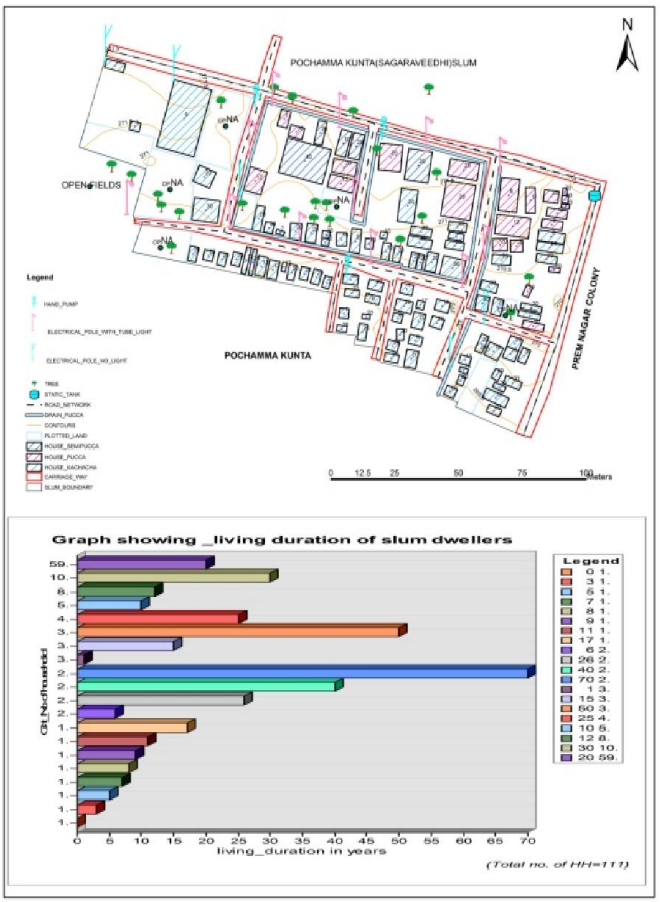

Fig.4.4.18. Map of pochamma kunta slum based on the living duration of dwellers

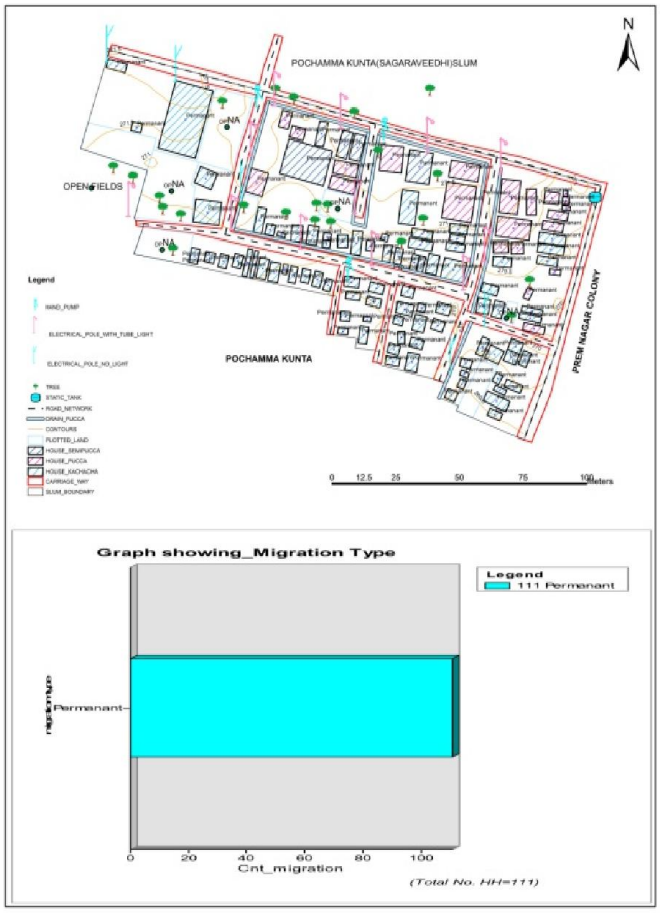

Fig.4.4.19. Map of pochamma kunta slum based on dwellers_migration type

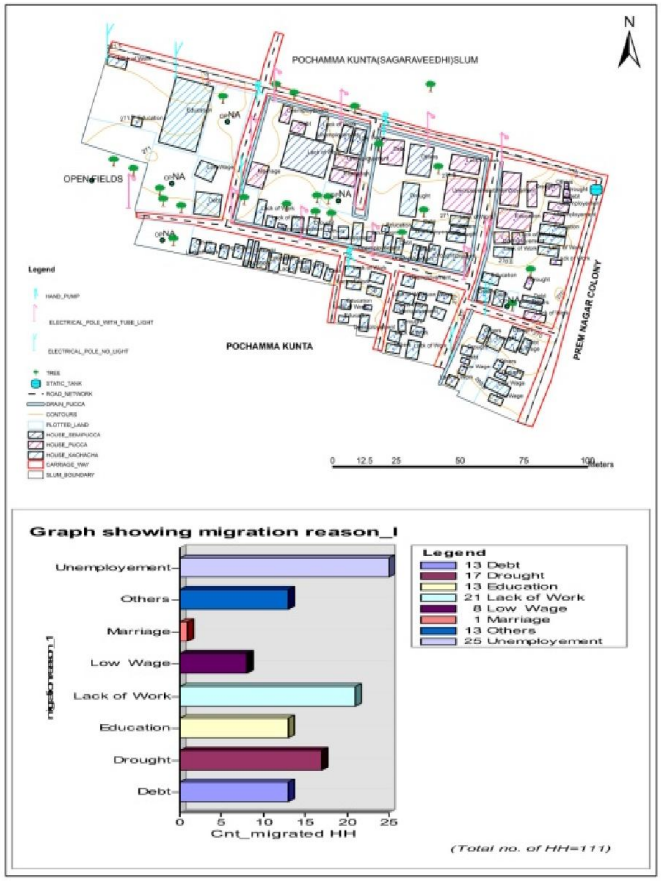

Fig.4.4.20. Map of pochamma kunta slum based on dwellers_migrationreason_1

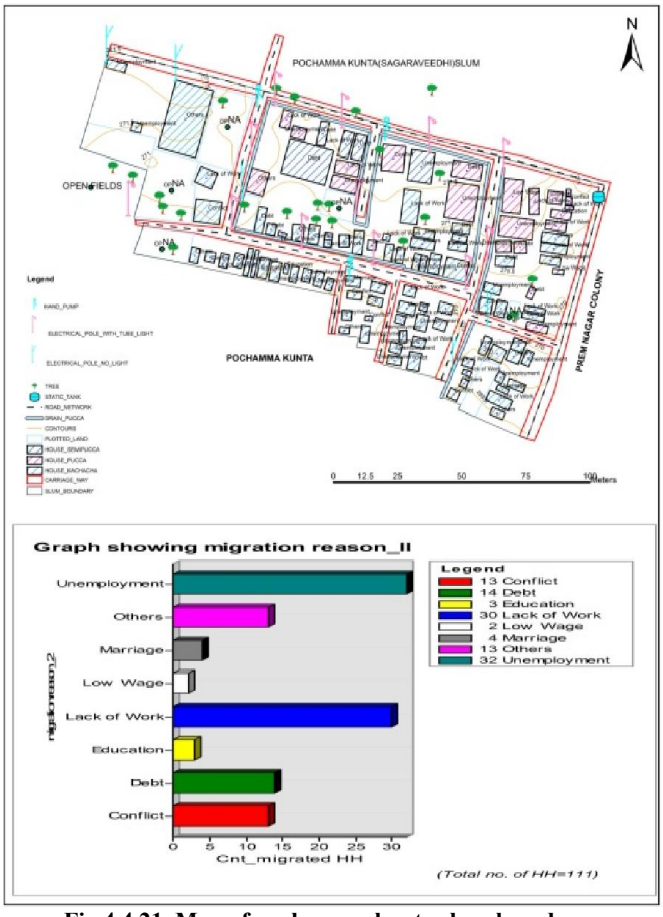

Fig.4.4.21. Map of pochamma kunta slum based on dwellers_migrationreason_2

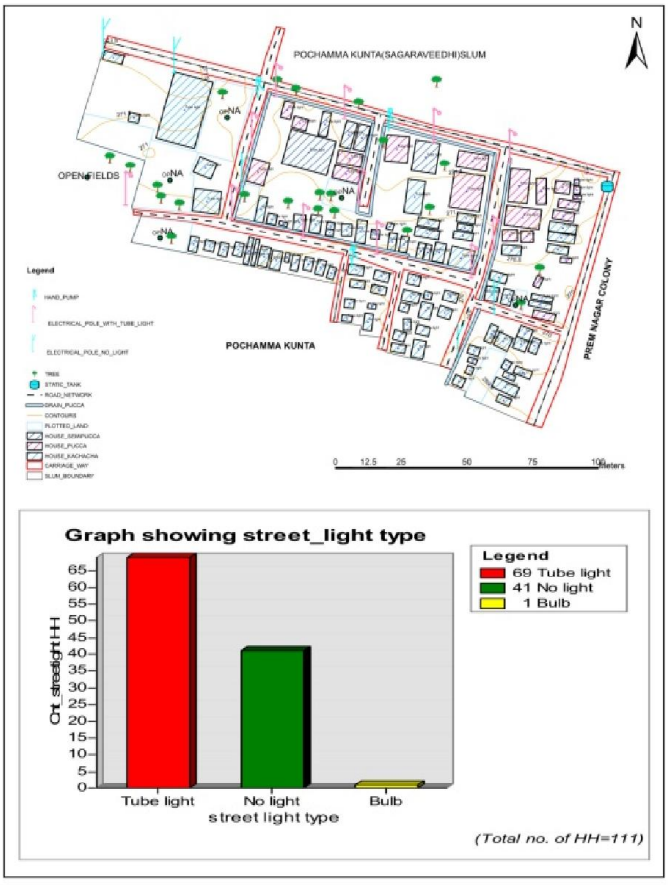

Fig.4.4.22. Map of pochamma kunta slum based on street light type

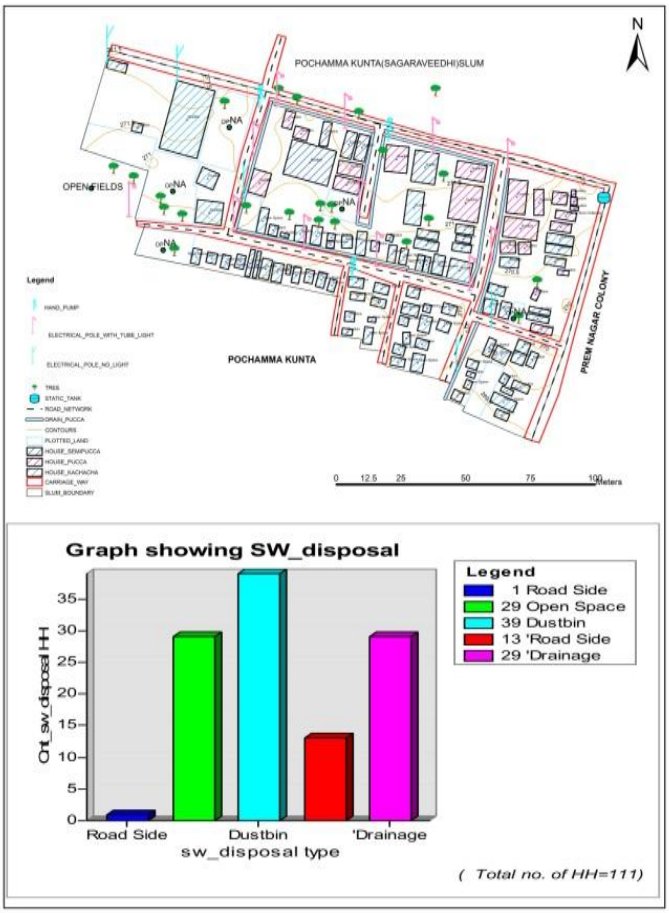

Fig.4.4.23. Map of pochamma kunta slum based on lolidwaste disposal type

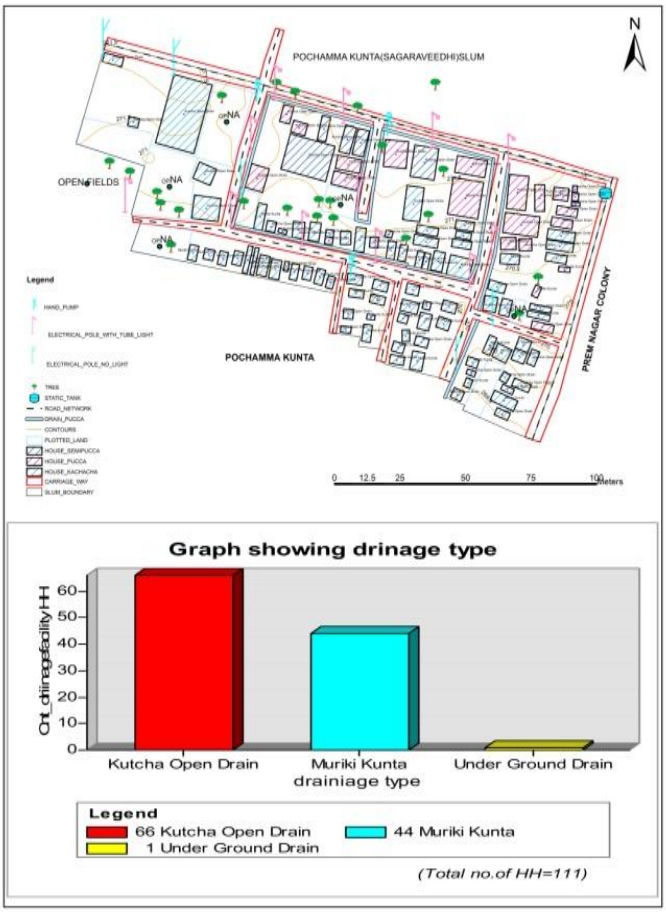

Fig.4.4.25. Map of pochamma kunta slum based on drainage type

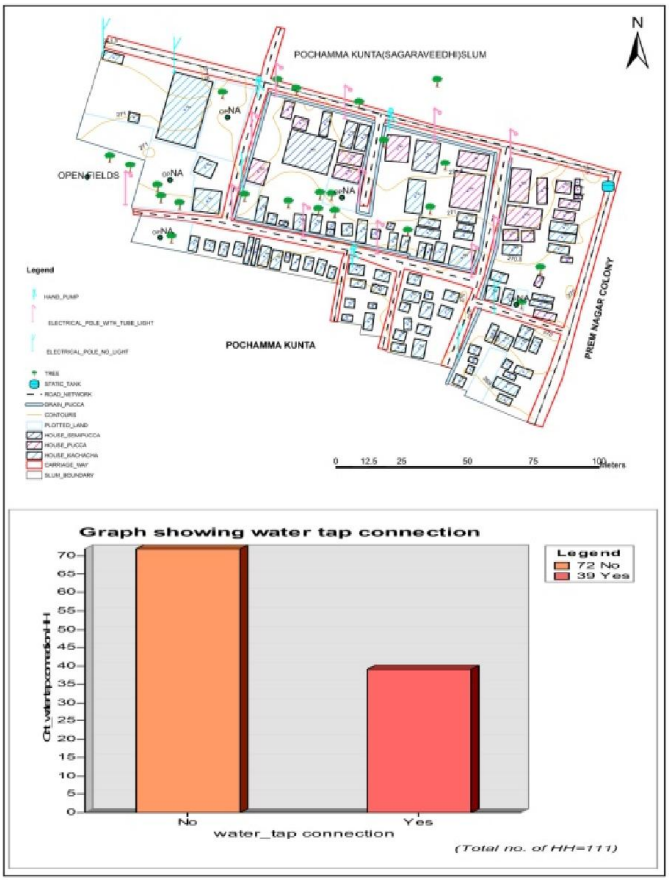

Fig.4.4.24. Map of pochamma kunta slum based on dwellers_water tap connection

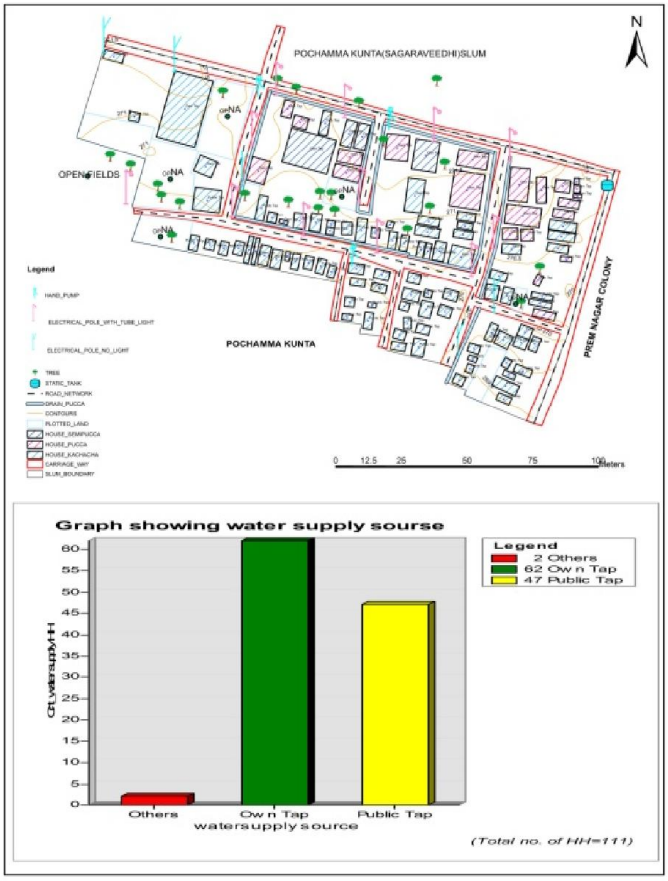

Fig.4.4.26. Map of pochamma kunta slum based ondwellers_water supply sourse

Conclusions

To study the condition of slum pochamma kunta slum has taken. From the current work, the following conclusions have been drawn:

- These slum maps for different parameters make the users to analyze and understand the condition easily.
- Quantitative analysis has been done on different parameters and corresponding slum maps were generated. Significant observations are as follows:
- Major roof materials used are_ Metal sheets, Concrete
- Major floor materials used are_ Shabad
- Major Religion of slum dwellers_ Hindu
- Major Caste of slum dwellers _BC
- Major Sub Caste of slum dwellers_ Uppari
- Major fuel for cooking of slum dwellers_ Gas cylinder
- Major Health facility of slum dwellers_ PHC/UHC, Govt Doctor
- House location_ Near nalabed / burial ground
- Toilet_ Owen septic tank/ flush latrine , Open defecation
- Usage purpose of the house: Residential
- No. of rooms in house:1-4
- Land tenure of slum dwellers _ Non_registered certificate (Notary)
- Living duration of slum dwellers:_1 to 70 years
- Migration from: Village in our state, Town in our state
- Don't have water, drainage, electric, sanitation, street lighting facilities.
- Poor accessibility.
- All the houses fall under poor and very poor category.

SCOPE FOR THE FUTURE STUDY

As the present study provides various maps based on the different parameters and a complete geodatabase of slums, it can be further extended and more detailed studies can be carried out:

- The present study is limited to one slum. It can be extended to all slums of the city and necessary development plans can be proposed.
- Prioritization of slums can be carried out to make government to start up development activities.
- Slum relocation studies can also be carried by studying the existing slums.

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