STM JOURNALS

Journal of Geotechnical Engineering

Volume 1, Issue 2
www.stmjournals.com

Electricity Distribution and Consumption Analysis of Bhubaneswar Urban Complex using GIS Technology

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Abstract

Power is a critical infrastructure for economic development of any part of the world. Management of power production and distribution is essential for holistic economic growth. For effective implementation of various developmental programmes for agricultural, industrial and urban infrastructure growth, adequate power supply is essential. Shortage of power supply is one of the major factors of low production and slow growth rate. Odisha government has taken drastic measures to improve the performance of power sector which otherwise termed as power sector reforms. One of the programmes under power sector reforms is use of IT and high-tech methods for better and judicious power distribution in urban areas. Geo-informatics plays an important role in power distribution management, network operation and database development of electricity infrastructure and network. GIS based electricity distribution database management is widely used now days by various agencies in our country. In the present study, Geomatic technique has been used for mapping and analysis of power distribution system and consumption in Bhubaneswar urban area.

Keywords: *Holistic, IT, Geo-informatics, GIS, Geomatic*

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INTRODUCTION

Odisha's power sector has been traditionally experiencing massive and chronic problem. This demand of public for urban and industrial activities is enormous. For sustainable and equitable power supply and effective distribution network planning, government has taken drastic measures to improve performance of this sector which otherwise known termed as power sector reforms. The reforms and policy specifications programs of Odisha necessitate adoption of modern technology for creation of a digital electricity infrastructure and networking database for the state. Geo-informatics plays an important role in generation of electricity infrastructure and networking database and is widely used now days by various agencies in our country. Therefore in the present study an attempt has been made to use Geoinformatics technology for mapping and analysis of power distribution system and consumption of Bhubaneswar urban area.

The need of GIS as an electricity information system is widely used among planners, decision makers and administrators due to the great potential of the analytical capabilities of GIS system. Besides this, a standard GIS package establishes link between spatial and non-spatial data. By adopting GIS technique, various spatial data like paper map, charts, making drawing, physical survey maps, satellite imageries, aerial photographs etc can converted to digital format for operations like data linking, map joining, map over laying, clipping, generation of new maps etc easily and quickly for any analysis and assessment. This digital process helps the planner and policy maker to prepare action plans, micro plan and planning schemes conveniently and accurately.

STUDY AREA

Bhubaneswar, the capital city of Orissa state, India (Figure 1) is located between 20°12′N to

20°25′N latitude and 85°44′E to 85°55′E longitude. The city is situated on the transitional zone of Easternghat upland and coastal alluvial plain near to the river Kuakhai and Daya, the distributaries of river Mahanadi. The area comes under the district of Khurda, which is the south eastern part of the state. The average height of the place is 46 m above Mean Sea Level (MSL).

It is located on the Kolkata – Chennai main South-Eastern railway line and National Highway No. 5, which is the economic life line of Eastern India. The city is 435 km. from the Kolkata and is well connected to all metropolitan cities of the country and district headquarters by rail, road, and air. Bhubaneswar along with Puri, (60 km.) the important religious centre of India and Konark (66 km), the Black Pagoda of India forms the golden triangle of tourism of eastern India.

The Bhubaneswar Development Plan area as CDP report of Govt. of Orissa consists of 205 villages. The municipal area covers 60 villages and 69 wards (Figure 2) [1].

OBJECTIVES OF THE RESEARCH STUDY

- To prepare the electricity infrastructure map of the study area this will be helpful for managers and decision maker in future.

DATABASE USED

- SOI Toposheet, Scale – 1:50,000 (No -73H15 &16), Scale – 1:25,000 (No-73H15SW &73H16NW (Secondary Data).
- Ward Boundary map (Secondary Data).
- High Resolution Satellite image like QB, PAN+MS, 0.6 m resolution (Secondary Data).
- Location identified with GPS of all stations (Primary Data).

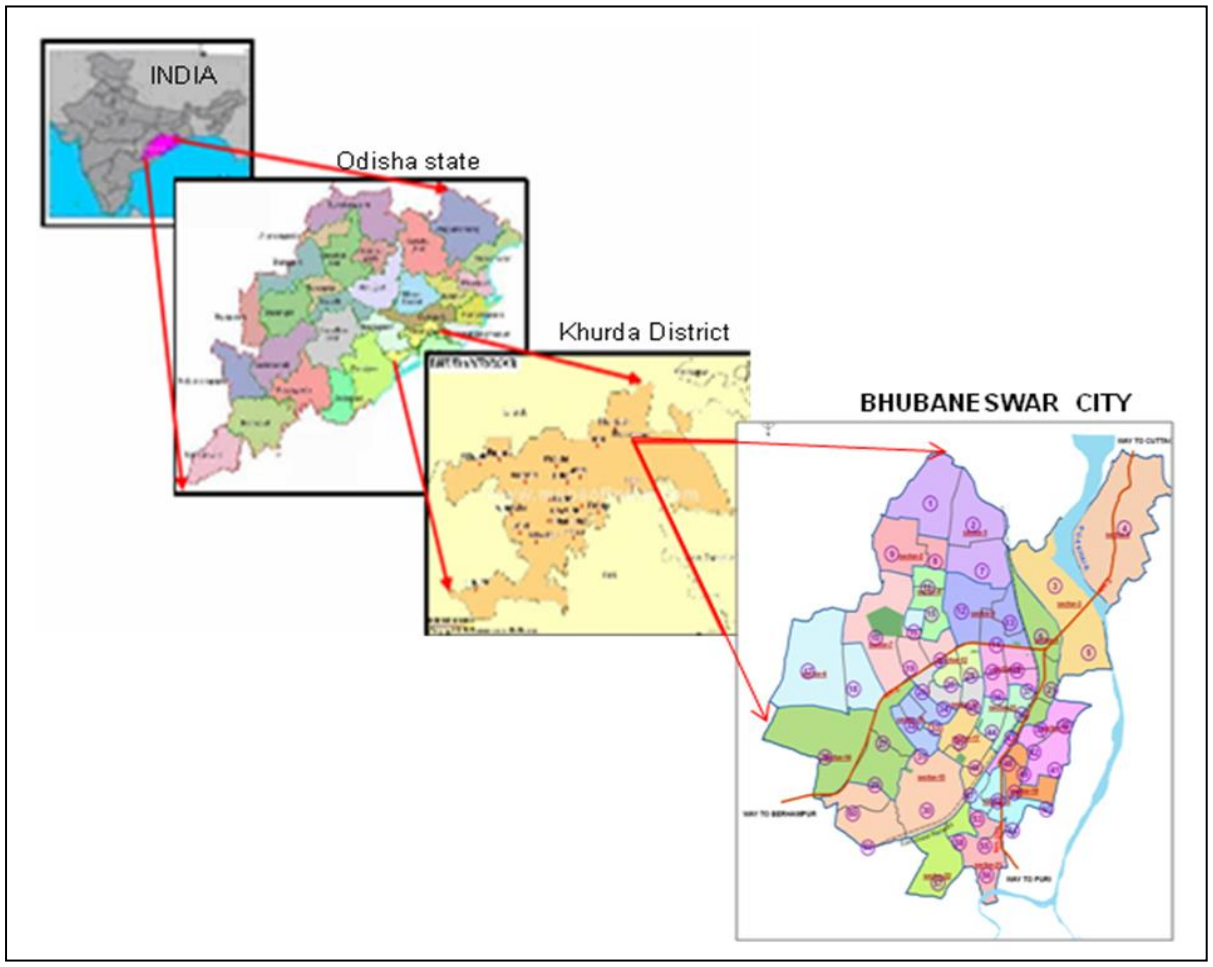


Fig. 1: *Location Map of Bhubaneswar City.*

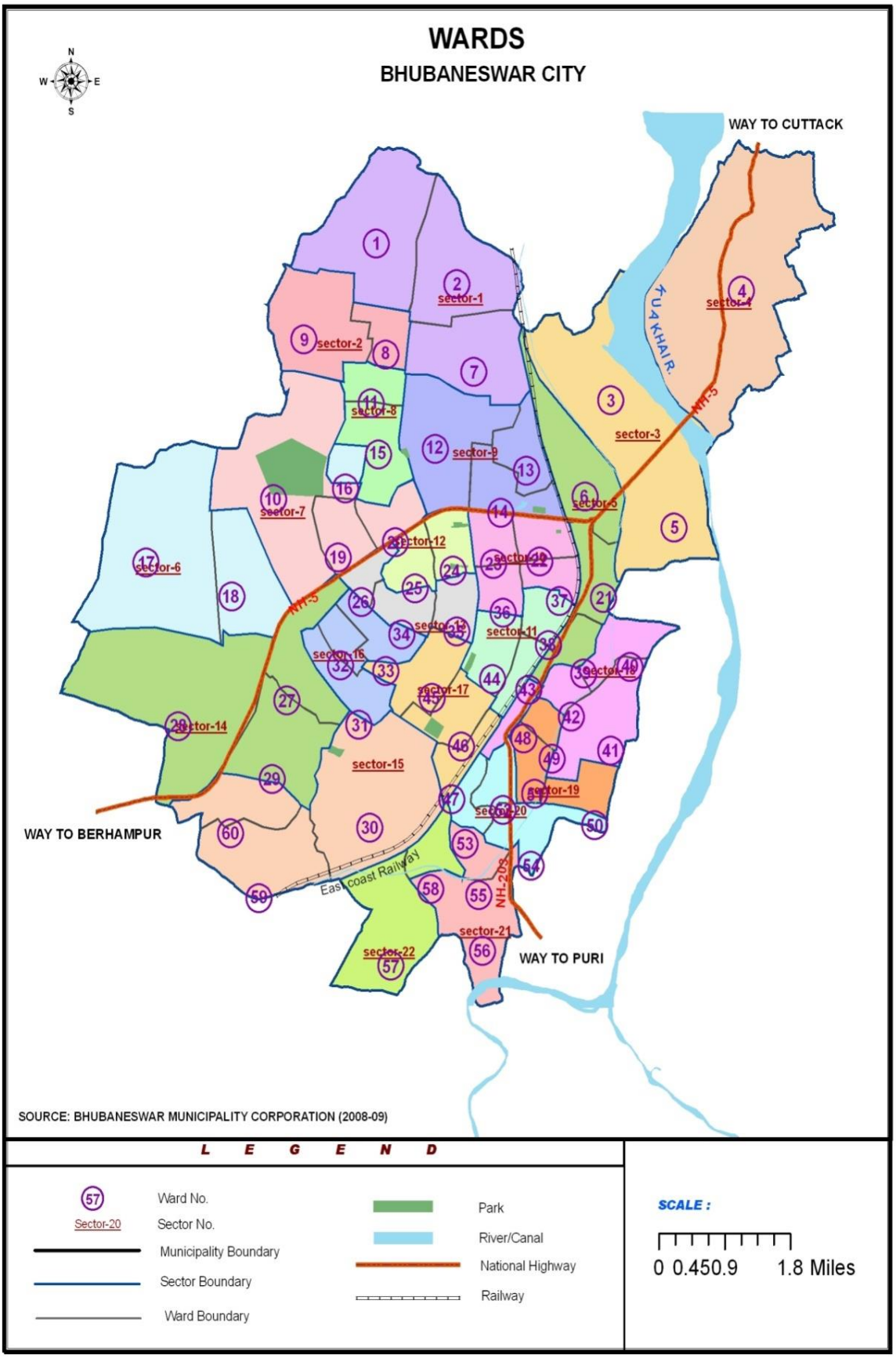
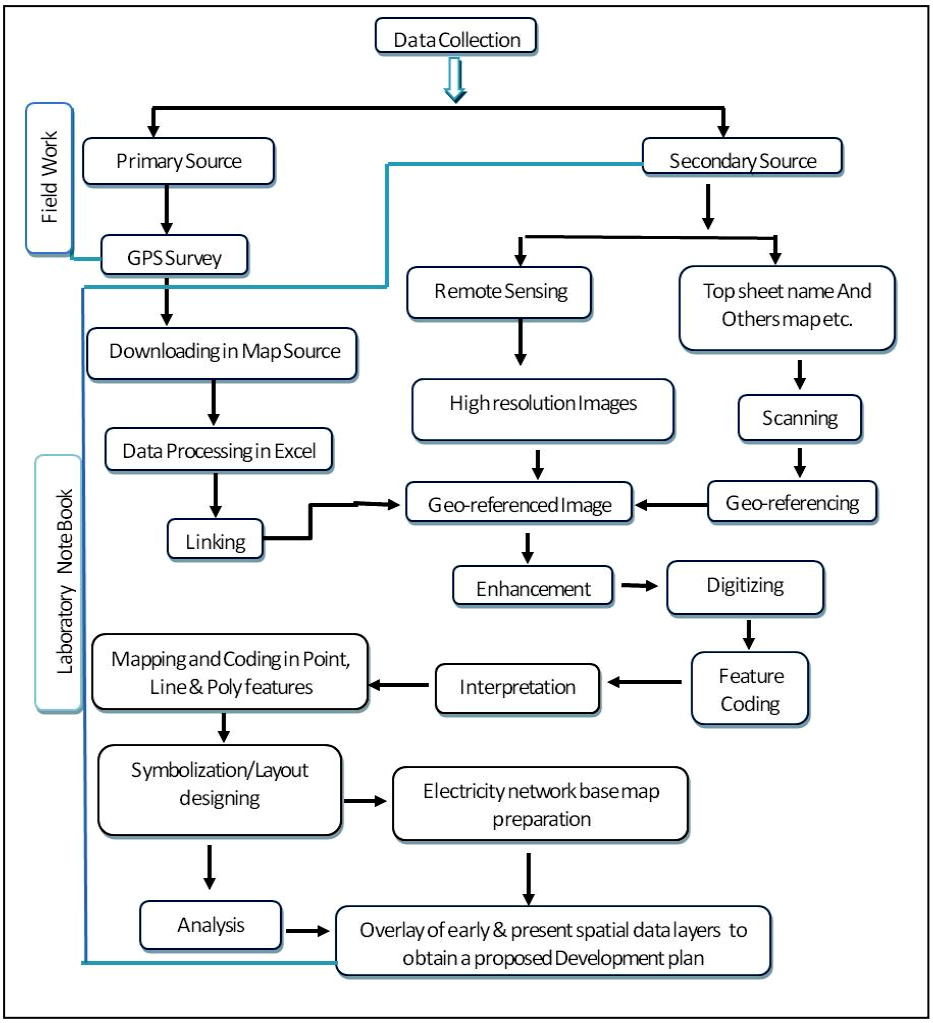


Fig. 2: *Ward Map of Bhubaneswar City.*

METHODOLOGY



DISCUSSION

A geographic Information System (GIS) is created by combining hardware, software and people together capable storing, analyzing, managing and presenting data having spatial components (Geographically referenced data). This technology has enabled users and non users alike to make decisions based on information not easily understood. GIS has played an integral role in the expansion and maintenance of the public utilities infrastructure management and development plans. They have done this by keeping accurate records of assets, with the development of the cities environmental and natural resources, implementation of emergency management processes and assuring the quality of service provided [2].

- Accurate and timely dissemination of information using standardized mapping techniques.
- Performing continual data maintenance with the use of various GIS software tools.
- Producing map layouts of existing water facilities, digitizing new as built plans, while also assisting various city departments with a host of other GIS related needs.

During the study period, the relevant data of the sub-stations were collected from field office.

Bhubaneswar electricity distribution system (Figure 3) having three Divisions. They are;

I. Bhubaneswar City Distribution Division (BCDD)–I
II. Bhubaneswar City Distribution Division (BCDD)– II
III. Bhubaneswar Electricity Distribution Division (BCDD)

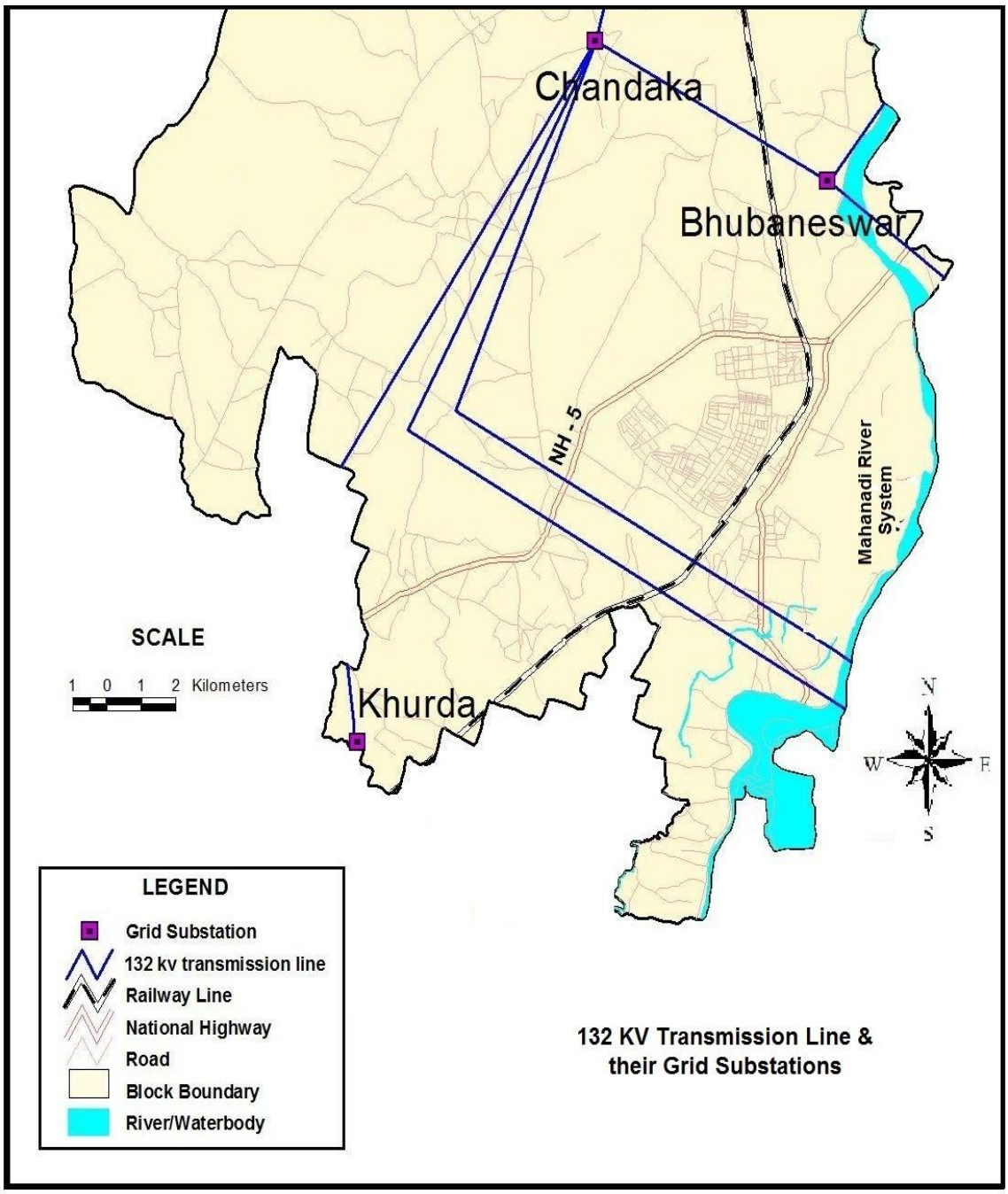


Fig. 3: *132 KV Transmission Line and Their Grid Substations.*

Each Division having eight to ten Sub-stations as shown in Figure 4. Each Division having Division Head Offices. For BCDD – I, Unit – 8 is its Division Head Office. After detailed study, it was found that the total number of consumers present under these Sub-stations are 13,621 from which there are 9,535 domestic consumers, 3,132 commercial consumers and 954 industrial consumers (Figure 5). The total load consumption in this Sub-station is 33 MW in which 11.5 MW consumed in domestic purpose, 9.2 MW for commercial purpose and 2.3 MW for industrial purpose (Figures 6, 7 and 8). The transformer capacities of these Sub-stations are 3 X 12.5 MVA. Presently, this Sub-station covers D.A.V school area, Stewart school area and its nearest peripheral area. The next Sub-station was situated in unit-6 area having 6,758 consumers from which 3,379 are the domestic consumers, 2,703 commercial consumers and rest 676 industrial consumers.

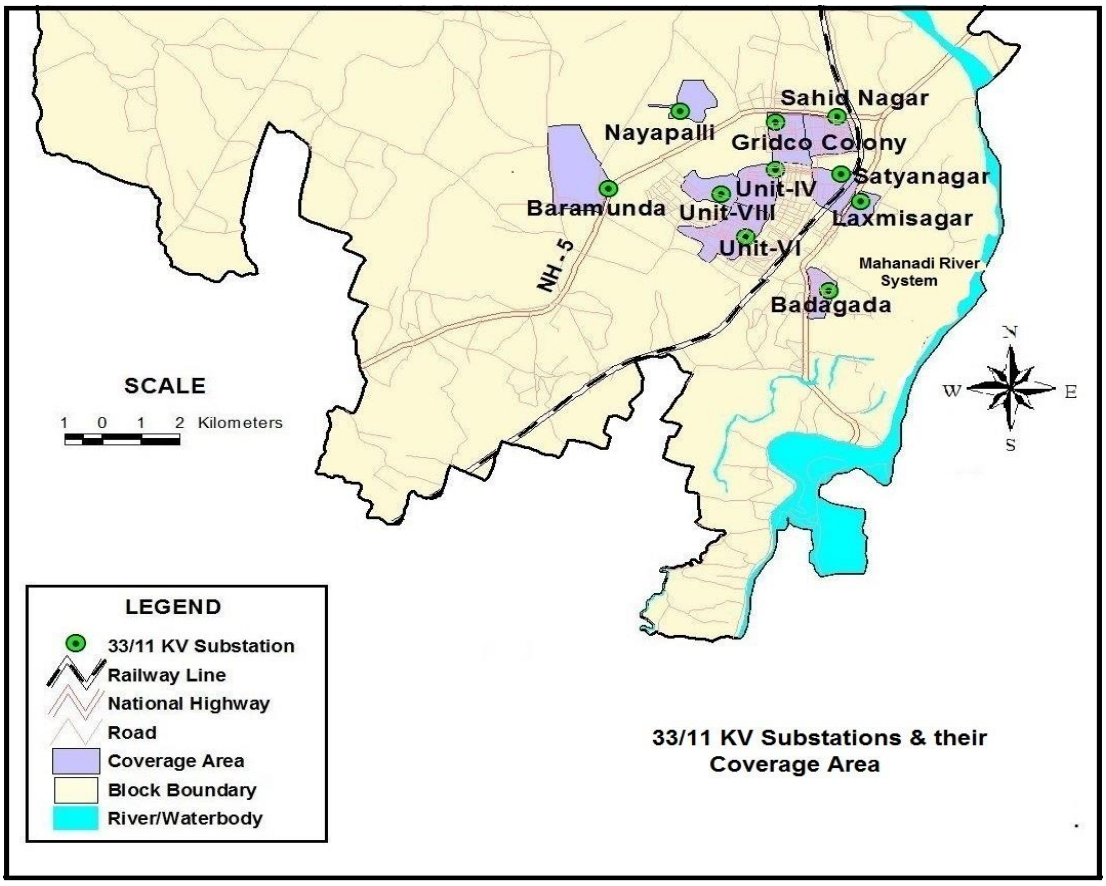


Fig. 4: *KV Substations.*

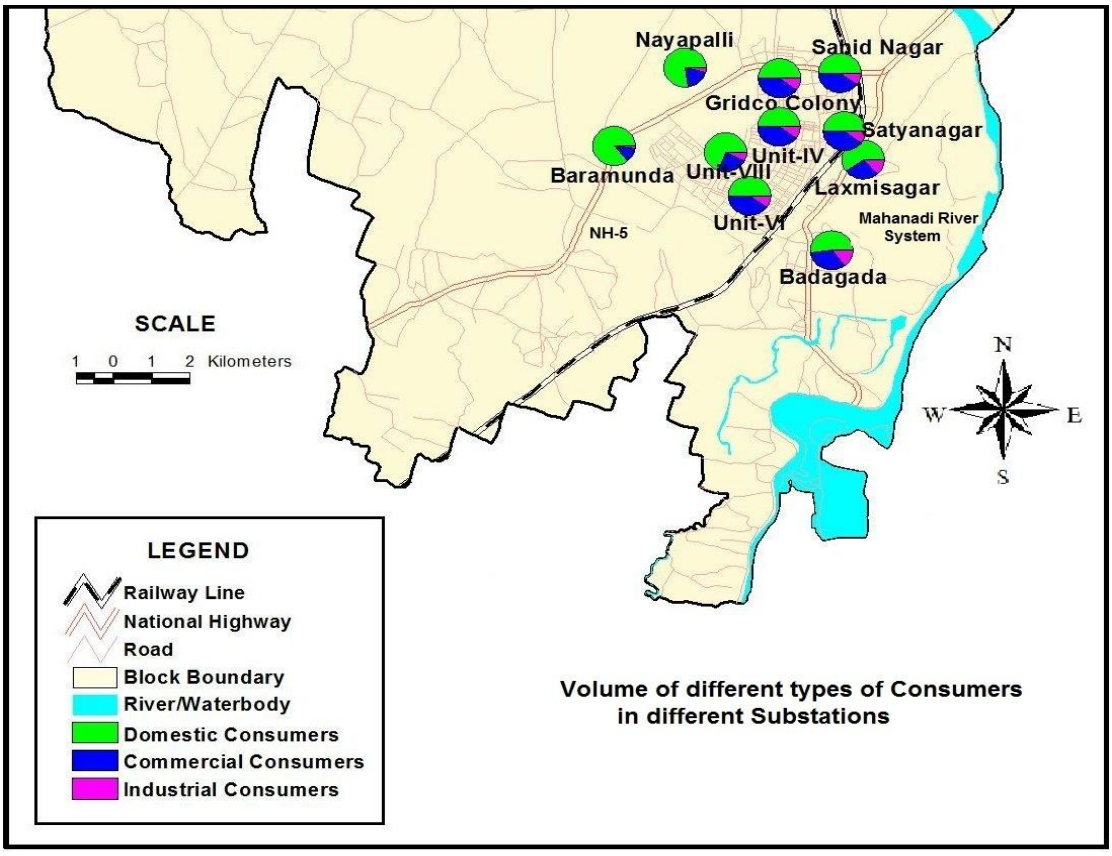


Fig. 5: *Volume of Different Types of Consumers in Different Substations.*

The total load consumed in this Sub-station is 10 MW from which 5 MW load used for domestic purpose, 4 MW load used for commercial purpose and 1 MW load is used for industrial purpose. This Sub-station covers Forest Park area, Suryanagar, Gopabandhu square area etc. The next was situated at unit 4, Bhoumya Nagar having transformer ca pacity 2 x 5 MVA. The total consumers of this Sub-station are 3,644 out of which 1,822 numbers are domestic consumers, 1457 numbers are commercial consumers and 365 numbers are industrial consumers. The total load consumption of this Sub-station is 11 MW in which 5.3 MW load used for domestic purpose, 4.6 MW load used for commercial purpose, 1.1 MW load used for industrial purpose. The total area coverage of this Sub-station belongs to Madhusudan Nagar, Bhoumya Nagar area etc. Next one was

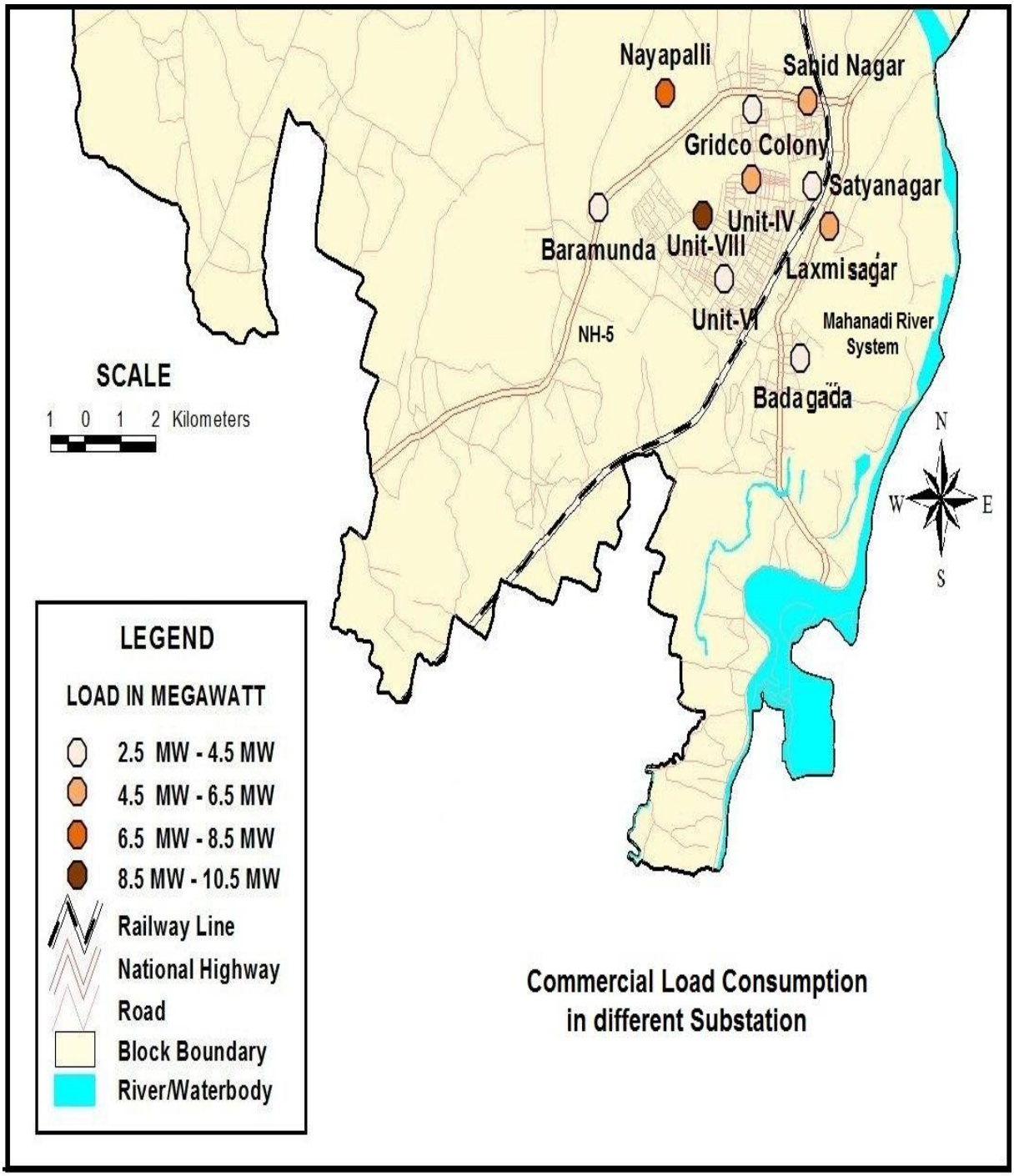


Fig. 6: *Commercial Load Consumption in Different Substations.*

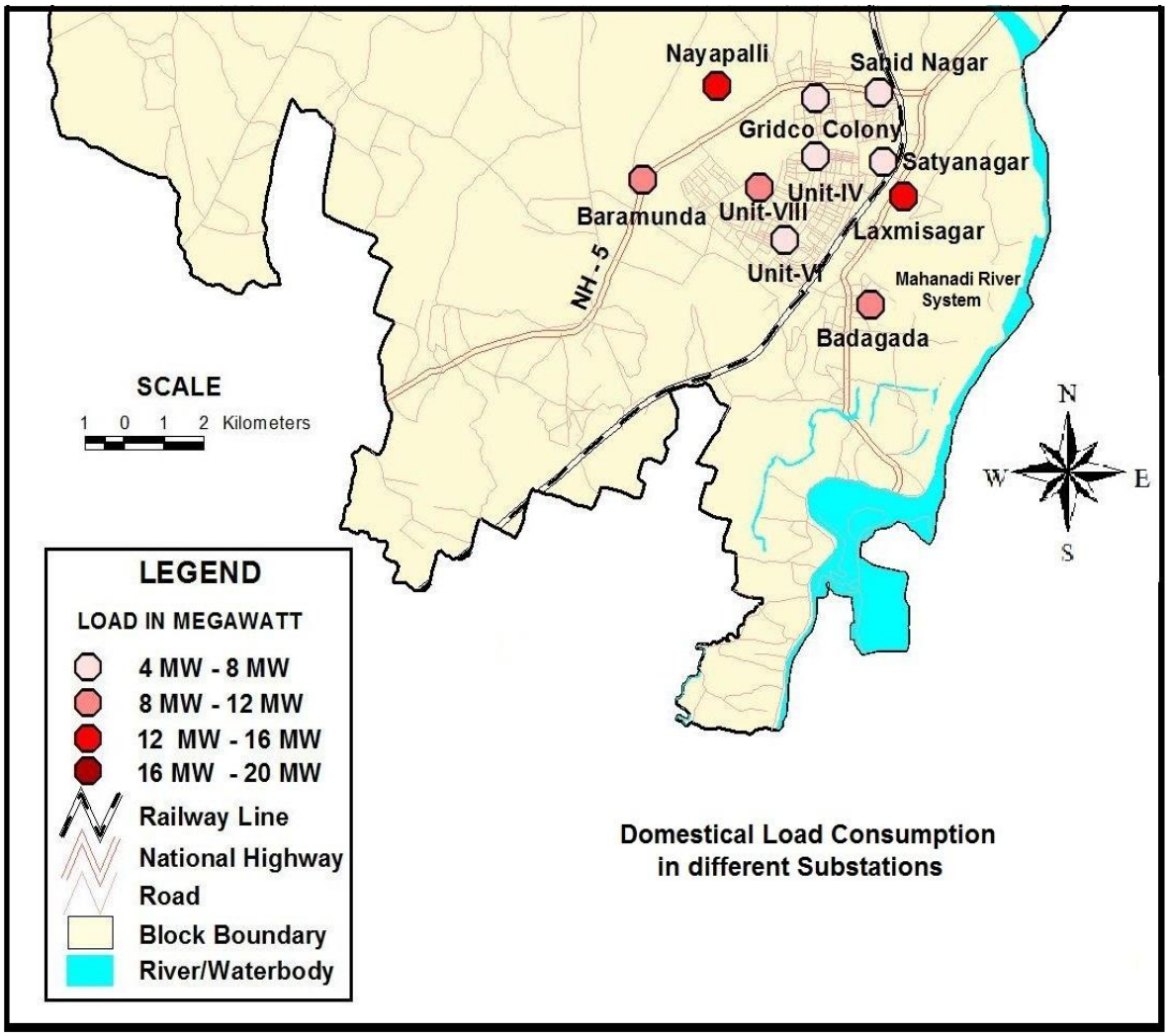


Fig. 7: *Domestical Load Consumption in Different Substations.*

Satyanagar Sub-station having transformer capacity of 1 X 5 MVA + 1 X 8 MVA. The total number of consumers of this Sub-station is 5,324, in which there are 2662 number of domestic consumers, 2128 number of commercial consumers and 538 numbers of industrial consumers. The total load consumed for this Sub-station of 9 MW in which 4.5 MW load consumed for the domestic purpose, 3.6 MW load consumed for commercial purpose and 0.9 MW load consumed for industrial purpose. It covers Satyanagar Punjabi colony area and Toshali Plaza area [3–5]. The second Division was BCDD-II and the office is situated at Nayapalli. This Sub-station has two power transformers having transformer capacity 2 X 8MVA+1 X 5 MVA. The total number of consumers under this Sub-station was 8,210 from which there are 6,294 domestic consumers, 1553 commercial consumers and 363 industrial consumers. The total load consumed in this Sub-station was 30 MW from which 20 MW load is used in domestic purpose, 8 MW load used in commercial purpose and 2 MW load used for industrial purpose. The coverage area belongs to Nayapalli, Salia Sahi area etc. Similarly, the next Sub-station which was situated at Baramunda having transformer capacity of 2 X 8 MVA. The total consumers of this Sub-station is 5,027 in which 4,312 number of domestic consumers, 594 number of commercial consumers and 121 number of industrial consumers. The total load consumed in this Sub-station is 15 MW from which 10 MW load is used in domestic purpose, 3 MW load used in commercial purpose and 2 MW load used in industrial purpose. Its coverage area belongs to Baramunada (Ruchika market complex) area. The second was the Laxmisagar Sub-station which is situated in BED Division and its Division office situated

at Rasulgarh. This Sub-station having transformer capacity of 2 X 8 MVA+1X 5 MVA.

The total number of consumers found in this Sub-station is 10,355 from which 6,235 number of domestic consumer, 2,845 number of commercial consumers and 1,275 number of industrial consumers. The total load consumption in this Sub-station was 25 MW from which 16 MW load consumed in domestic purpose, 6 MW load consumed in commercial purpose and 3 MW load used for industrial purpose. Its coverage area belongs to Laxmisagar and Jharapara area. The next Sub-station is Baragada having transformer capacity of 3 X 8 MVA+1 X 5 MVA. The total consumers in this Sub-station is 5,428 in which 2,845 number of domestic consumers, 1,865 number of commercial consumers and 718 number of industrial consumers. The total load consumption in this Sub-station was 17 MW from which 11 MW load was consumed in domestic purpose, 4 MW load consumed in commercial purpose and 2 MW load consumed for industrial purpose. Its coverage area belongs to Badagada Brit Colony area and B.J.B Nagar area. From the above survey, it is found that there are maximum number of domestic consumers having high load consumption and minimum number of industrial consumers with low load consumption [6].

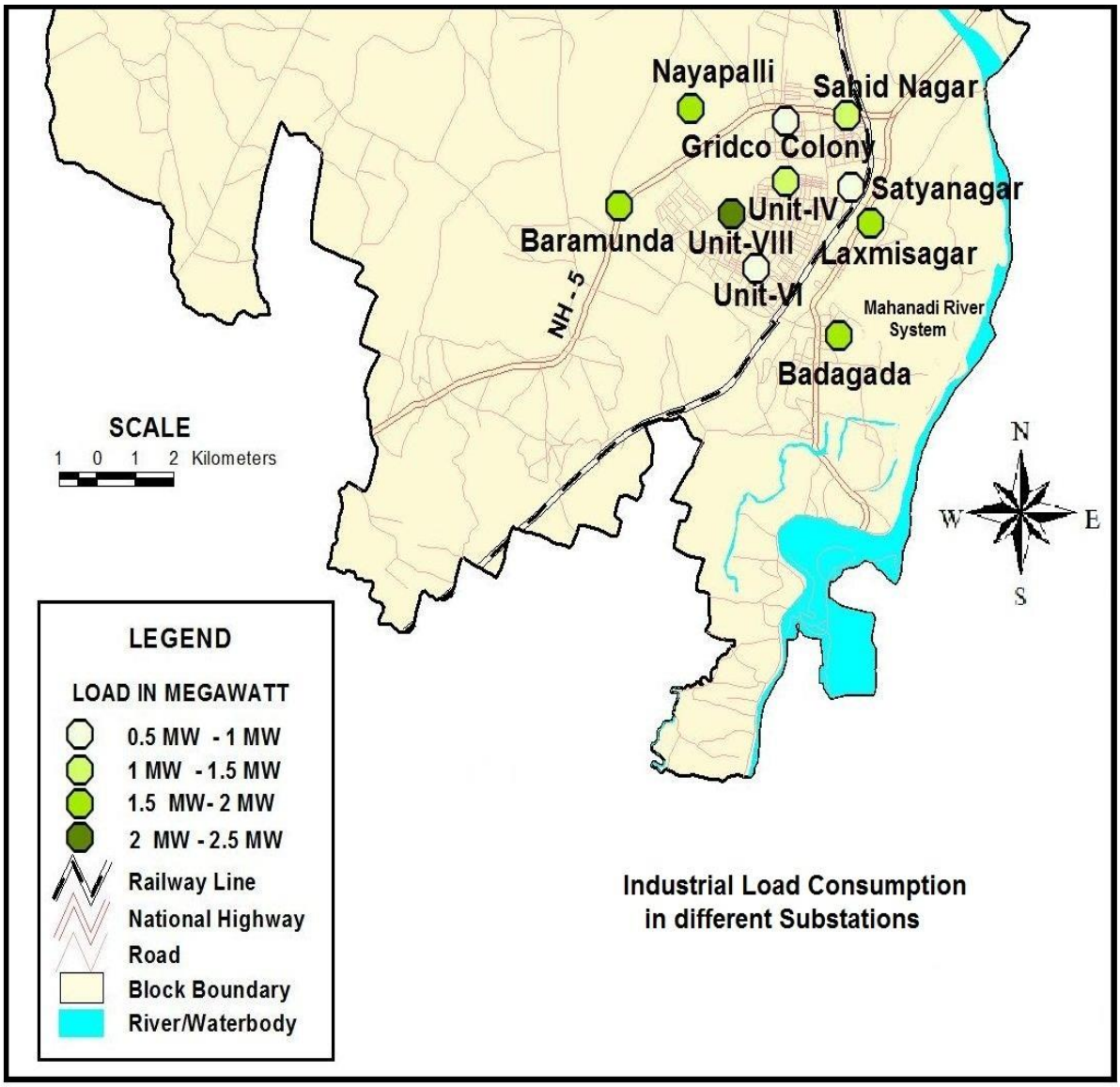


Fig. 8: *Industrial Load Consumption in Different Substations.*

CONCLUSIONS

For electricity network infrastructure mapping and consumer analysis, a network map with actual geometry and spatial dimension is highly required, which is not easy thru conventional method of mapping and data collection. Moreover the maps used for such exercise are topo maps or urban maps or planning maps which takes more time. These maps or plans are prepared as one time plan without any effort to constantly update the informations and monitoring of the activities. Using such maps and data it is not possible to prepare management plan for effective network planning and equitable distribution and its monitoring. Further; lack of use of modern Geo-ICT technology of data collection and information system, the resource managers face operational difficulties. This study was made to explore the advanced means of data collection, collation and integration for electricity, load and consumer service and planning activities. Most of the spatial information at city level are prepared by the help of Revenue or Topographic maps where information is represented schematically and are also not suitable for specific users like electrical engineers and planners. Besides, the non-availability of up to date maps and special information, there is also information shortage; and lastly information need for priority tasks like electricity network infrastructure provision and consumer service. This study emphasized on use of GIS methods for electricity network infrastructure mapping and consumer analysis with options of quick updating. The methods used in this study can be repeated in other cities and rural area of the state.

ACKNOWLEDGEMENT

The first author (A.Bhatta) is grateful to the Engineering staffs of CESU, Odisha for providing the electricity data of consumer of Bhubaneswar town to Dr.K.C.Rath, H.O.D., PG Department, Geography, Utkal University for providing Laboratory facilities to undertake this piece of research work.

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