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Consumer Indexing Under Restructured Accelerated Power Development and Reforms Programme – A GIS Based Approach

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Abstract

There are many problems with power distribution, such as the proper location and availability of electrical assets (such as poles, transformers, transmission lines, etc.). With Advances using consumer index, we can find the exact location of the consumer and through which feeder consumers are being offered. GIS GPS and remote sensing technologies help manage and analyze it as a special key. During the XI plan, the Indian government is accelerating the electricity development reform plan (R-APDRP) through the reorganization to strengthen the power sector, amending the terms and conditions as a central sector plan. The focus of the plan should be on the actual provable performance in reducing ongoing losses. Establishing a reliable and automated system for continuous collection of accurate baseline data and the use of information technology in the field of energy accounting are essential for carrying out regular distribution and strengthening projects.

In this article, user-related databases such as feeder numbers, transformer numbers, line numbers, pole counts, billing, and user locations have been placed in the attribute table of ArcGIS 9.1 software. Each consumer location is mapped using GPS and high-resolution satellite images.

Keywords:

Geographical Information System (GIS);
Global Position System (GPS);
ArcGIS 9.1 software;
Restructured-Accelerated Power-Development Reforms-Programme (R-APDRP).

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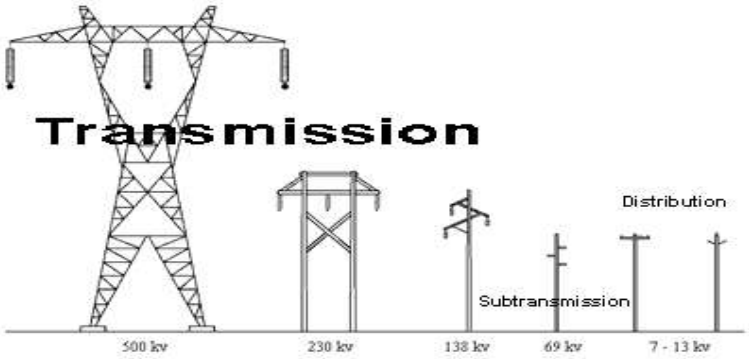
1. Introduction

The power sector is one of the important infrastructures of the Indian economy. But later on, it also faced some serious problems, such as the old wear and tear caused by poor distribution networks, deviations from the tariff structure, and huge distribution (T&D) losses largely due to complete theft and non-metering. Supply, high LT/HT line ratio, DT / lines, lack of responsibility at the feeder level and distribution settings of the State Power Bureau.

Government of India has already proposed to continue with the restructuring of the Electric Power Development Reform Plan (R-APDRP) during the XI Plan and amend the terms and conditions as a central sector plan. The focus of the plan should be on the actual provable performance in reducing ongoing losses. Establishing a reliable and automated system for continuous collection of accurate baseline data and the use of information technology in the field of energy accounting are essential for carrying out regular distribution and strengthening projects..



We used Geographic Information tools such as Arc GIS, GPS track marker, GPS path finder to generate consumer indexing.

2. Research Method

The Restructured -Accelerated Power Development Programme is planned in the 11th plan with revised terms and conditions as a central sector scheme. The focus of the program shall be on Actual ,demonstrable performance in terms of sustained loss reduction .Establishment of reliable and automated systems for sustained collection of accurate base line data, and the adoption of Information Technology ,in the areas of energy accounting will be essential before taking up the regular distribution strengthening projects, for this, we can use Geographic Information Tools such as, ARCGIS, Global mapper ,GPS track Maker, GPS path finder to generate Asset Mapping and Consumer Indexing.

R-APDRP Program Coverage:

It is proposed to cover urban areas-towns and cities with population of more than 30,000.In addition, in certain high load density rural areas with sufficient loads, works of separation of Agricultural Feeders from Domestic and Industrial ones , and of High Voltage Distribution System(11KV) will also been taken up.

Proposed scheme:

Projects under this scheme shall be taken up in two parts:

- Part-A: Preparation of Base-line data for the project area covering Consumer Indexing, GIS Mapping, Metering of Distribution Transformers and Feeders, and Automatic Data Logging for all Distribution Transformers and Feeders and SCADA / DMS system (only in the project area having more than 4 lacs population and annual input energy of the order of 350 MU). It would include Asset mapping of the entire distribution network at and below the 11kV transformers and

include the Distribution Transformers and Feeders, Low Tension lines, poles and other distribution network equipment. It will also include adoption of IT applications for meter reading, billing & collection; energy accounting & auditing; MIS; redressal of consumer grievances; establishment of IT enabled consumer service centres etc. The base line data and required system shall be verified by an independent agency appointed by the Ministry of Power. The list of works is only indicative.

- Part-B: Renovation, modernization and strengthening of 11 kV level Substations, Transformers/Transformer Centers, Re-conductoring of lines at 11kV level and below, Load Bifurcation, feeder separation, Load Balancing, HVDS (11kV), Aerial Bunched Conductoring in dense areas, replacement of electromagnetic energy meters with tamper proof electronics meters, installation of capacitor banks and mobile service centres etc. In exceptional cases, where sub-transmission system is weak, strengthening at 33 kV or 66 kV levels may also be considered.

CONSUMER INDEXING

The Consumer Index (CI) is a method for calculating the total number of consumers in a utility and marking them as their own poles, transformers, and feeders. Through consumer indexing and network mapping, we are conducting a survey from the extreme to the extreme to obtain data. Later GIS applications developed integrated consumer and network data. The main job of the consumer index is to understand from which distribution transformers, feeders, or stages consumers get electricity.

The main purpose of the consumer index is to identify and locate all consumers on the geographical map; these consumers are obtained from the distributors. There may be an electrical connection, but it does not exist in the power company's record. This may be the case of authorized connections or unauthorized connections. On the other hand, there may be a connection in the utility record, but it may not exist on site.

3. Results and Analysis

The area chosen for the study was the Sarpavaram area in the Kakinada circle in the East Godavari district. The distribution company's installation facilities are poorly maintained, lack of proper planning networks and lack of monitoring to prevent losses and manually update consumption records. We have applied GPS and GIS technology to the region so that we can have a database of appropriate poles and transformers so we can easily identify the location of consumers and their connectivity. It can also be applied to the wiring of wires or cables, choosing the size and location of the transformer.

A. Following steps are involved in the study:

- Collection of Existing hardcopy maps and Digital files
- Catalog / Indexing (metadata) of the data collected.
- Geo-reference the hardcopy and softcopy datasets on the base map.
- Digitize the network details from the geo-referenced hard copy maps
- Adjusting / orienting the existing vector data to the base map based on the association of existing vectors
- Establish the total network and data validation based on the collated dataset

Process:

1. Boundary demarcation & satellite data procurement process
2. GPS Control Survey – Planning
3. Data Usage and Issues
4. After the first validation from APEPDCL the consumer indexing begins in manual format.
5. From the verification sheet, the consumer belongs to each LT pole is noted manually.
6. The manually collected information is converted to digital format using arc GIS software.

7. From each LT pole two or more consumers will be there. All the consumers are marked in sequence with service line.

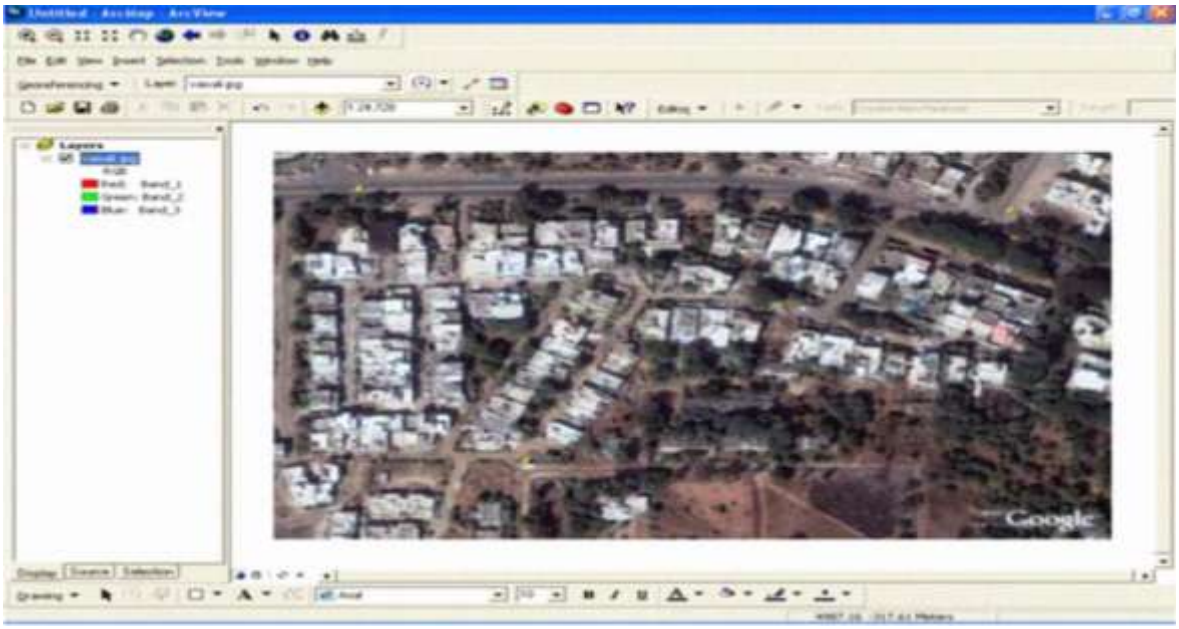
The consumer shape file provides all necessary information such as the consumer's name, address, mobile phone number, service number, instrument manufacturing, instrument model number, voltage, power, last reading of the instrument, number of appliances, etc. in the attribute table. The table shows the data collected from the site. With this information, we can determine the exact position of the Poles and the Transformers.

Table I: CONSUMER DETAILS

Pole no	Consumer no	Consumer name	Consumer address	East	North
150/11/01/01	1455454501082826	P.umadevi	69-6-146/1A	745359	256958
150/11/01/01	1455454501082827	T.satyanarayana	69-6-146/2A	745355	2569580
150/11/01/02	1455454501082829	P.V.KumaraSwamy	69-6-146/4A	745409	2569613
150/11/01/03	1455454501082828	K.Purushotham	69-6-146/3A	745344	2569502
150/11/01/05	1455454501082830	G.Jafher	69-6-146/5A	745209	2569386
150/11/01/07	1455454501082825	N.Ramachandramurthy	69-6-147/1	745337	2569441
150/11/01/08	1455454501082830	T.Ramarao	69-6-147/1A	745372	2569430
150/11/01/09	1455454501082831	P.Nagamani	69-6-147/2A	745318	2569518

The Table below shows various attribute information which is collected from the study area through field work.

Pole no	150/11/01/01	150/11/01/01	150/11/01/02	150/11/01/03	150/11/01/05
Consumer no	1455454501082826	1455454501082827	1455454501082829	1455454501082828	1455454501082830
Consumer name	P.umadevi	T.satyanarayana	P.V.kumaraswamy	K.Purushotham	G.Jafher
Consumer address	69-6-146/1A	69-6-146/2A	69-6-146/4A	69-6-146/3a	69-146/5a
Meter no	2826	2827	2829	2828	2830
Meter type	Electronic	Electronic	electronic	Electronic	Electronic
Phase	1	1	1	3	1
Billing amount	1408	1277	1287	1089	1020



The Figure 1: shows the high resolution image of Kakinada with help of Google earth pro.

Now this image which has Geo-referenced by the use of ArcGIS9.1 Software & the Geo-referenced image is shown in Figure 2.

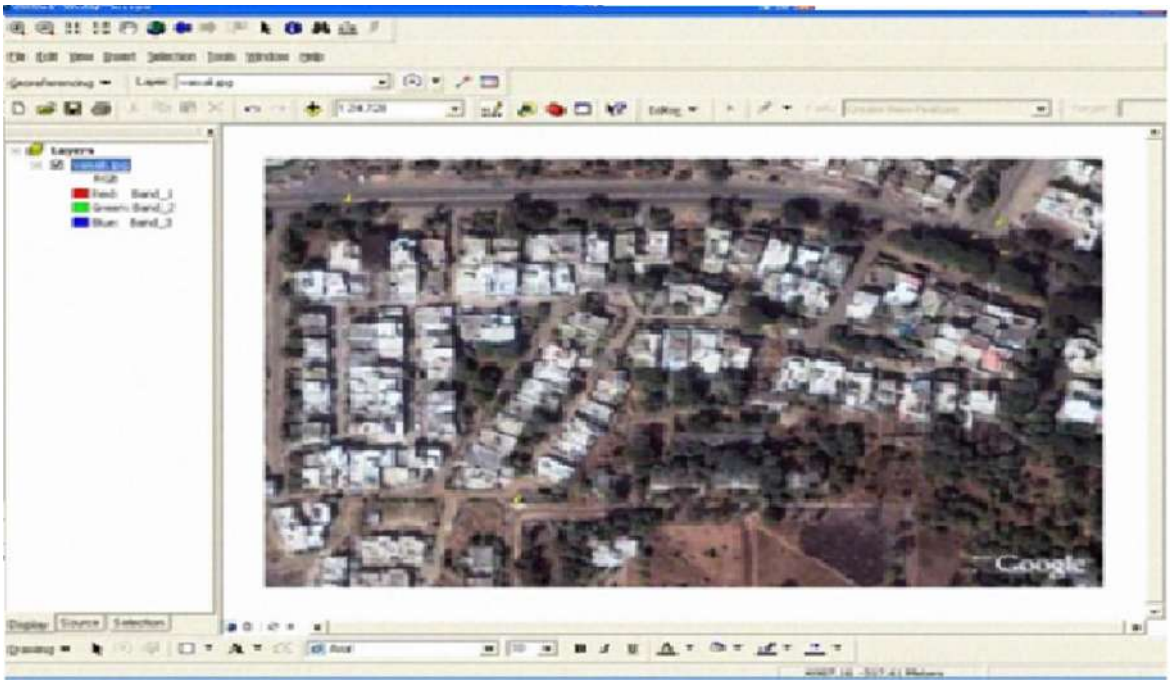


Figure 2: rectified image

Once data imported from the DGPS hand receiver sets, data converted to shape file and spatial location of Distribution Transformer as below

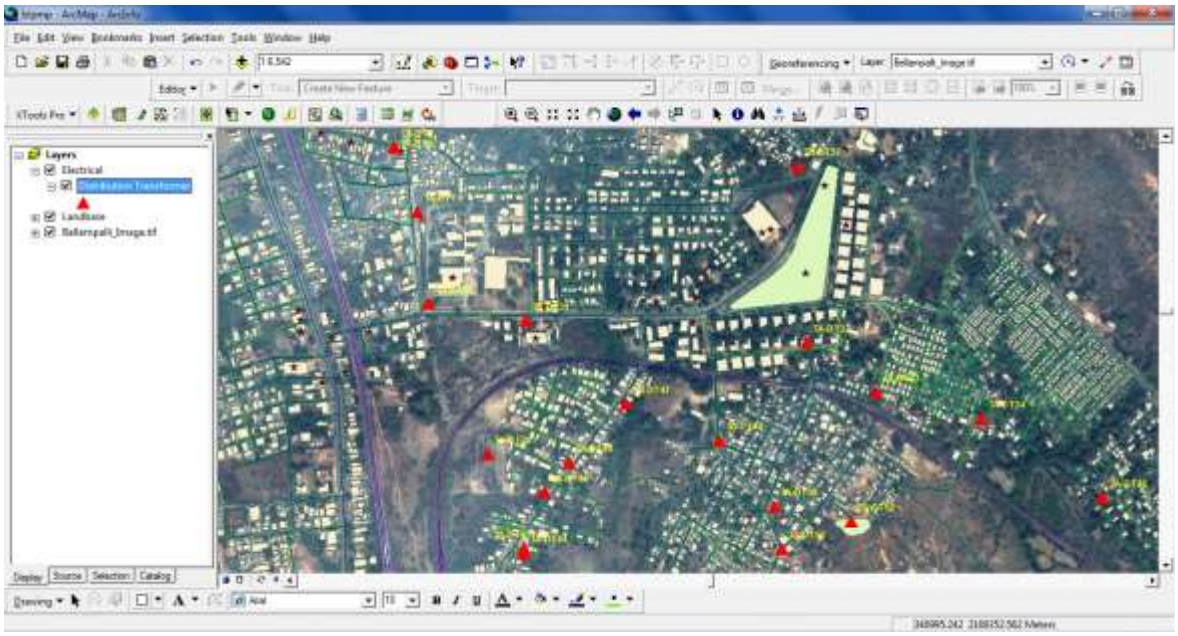


Figure 3: Data imported from DGPS hand receiver set.

Figure 4 the houses of various consumers have been digitized with the help of ArcGIS9.1 Software. After digitizing the consumer houses image typically looks like this:

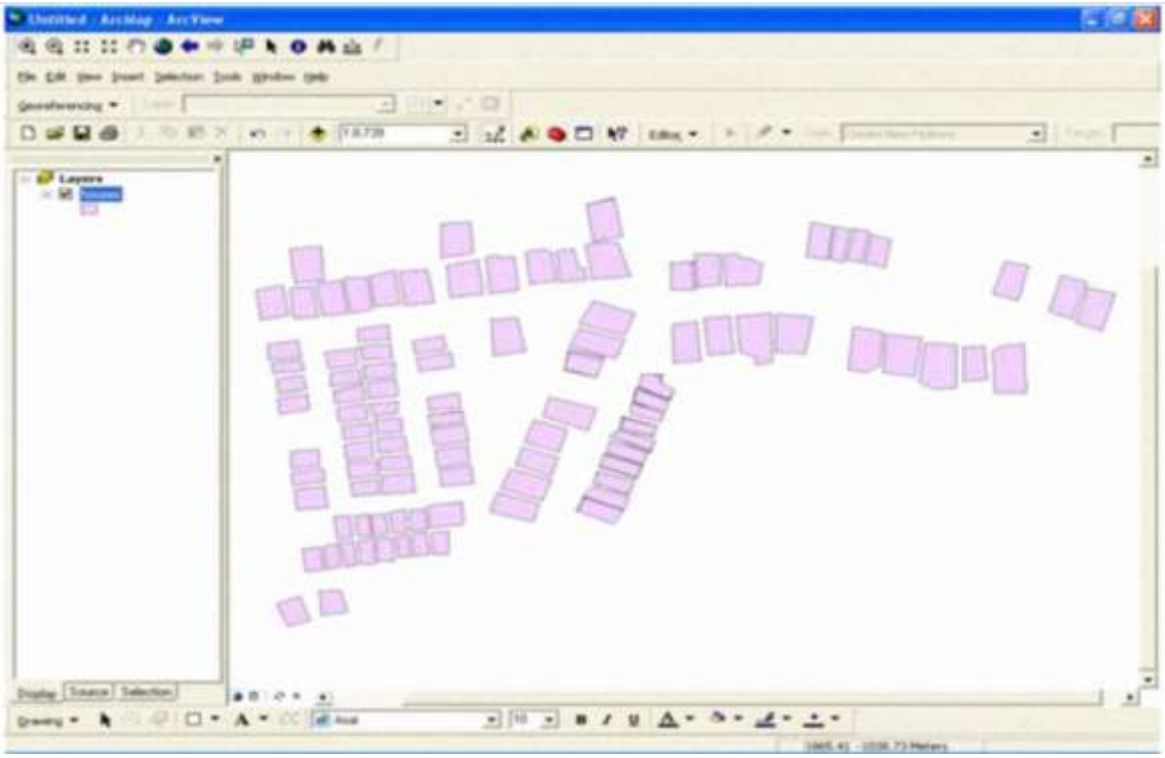


Figure 4: digitized image of various consumer houses

With the help of Table V, various attributes have been stored in attribute table through ArcGIS9.1 Software. By storing data in this software we can easily get all the information about any consumer by clicking on any consumer's house and then information will be highlighted.

This analysis can be performed for any consumer .One sample result is given in the figure 4.

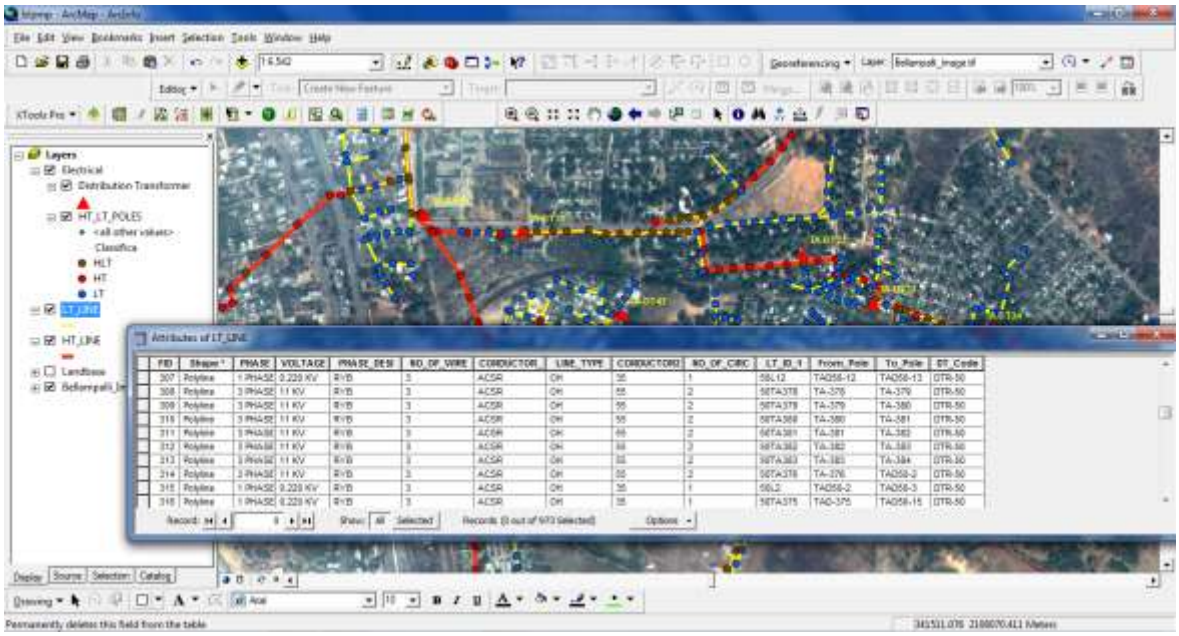


Figure 5: Representing attributes data.

After this, last step is to generate the queries in ArcGIS9.1 Software. Figure 5 gives the result for query generation. In this we gave a query to find how many consumers are connected to the pole no. 7 of transformer 11. Then which consumer is connected to pole no. 7 gets highlighted.

Figure 6: Query generation.

4. Conclusion

The current research has been conducted within a small area of a transformer user at the Sarpavaram Feeder. The proposed method can be implemented in the city of Karkina, which is very useful when dealing with consumer-related tasks, such as checking Power Theft and providing consumers with the best services by using GIS database information.

The GIS can effectively manage the distribution of power to consumers and information describing each consumer's attributes, such as location, consumption patterns, and specific consumer information through which transformers; feeders, poles, or circuit numbers are connected. Through regular updates and monitoring, GIS mapping of grid and consumer databases helps improve load management, reduce losses, better realize revenue, asset and job management, and possibly better consumer relationships.

An appropriate database management system integrated with GIS can help with solutions such as identifying each consumer and their location and their connectivity in the area. This GIS-based system not only helps identify the location of each parcel, it also provides complete information about the consumer. Through GIS, we can also analyze the bill payment status of each consumer and find the average value of annual distributed power and utility power.

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