Journal of Remote Sensing & GIS
Rani and Kumar, J Remote Sens GIS 2018, 7:4
DOI: 10.4172/2469-4134.1000251
Research Article Open Access

Geospatial Information Support for Power Projects

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Rec date: July 25, 2018; **Acc date:** September 24, 2018; **Pub date:** September 26, 2018

Abstract

Remote Sensing and Geographical Information System is becoming a great tool for decision support system. It can play a vital role in power sector. The Geospatial information of all the assets related to all power projects can be visualize at one platform in Geographical Information System. Which can help in flood management and equalize power distribution and control system. This can be proven as a great support to plan a new power project. The objective of the work is to geospatially integrate power generation, distribution, transmission projects and their assets and to develop geographical Information System. The study also relates and analyses the best approach in case of flash flood. The study also identifies the alternative route power supply system rather than hydro power electricity. This paper includes million unit power generation of the year 2017 and analysis by hydro power projects. In future study it will incorporate theme-based study hydro power projects, distribution lines and transmission lines using thematic maps i.e., Land Use/Land Cover, drainage, road and road map using geospatial technology. The Main objective of the paper is to focus on the importance of GIS support for power projects in spatial reference to Uttarakhand State.

Keywords: Remote sensing; Flood management; Hydro power projects; Distribution lines; Transmission lines

Introduction

Observation from satellites plays a vital role in mapping of assets, land and monitoring of natural/man made resources. It shows special importance in the context of planning. Remote Sensing technique helps in advance understanding towards local planning by providing information measurements and quantifications of natural and man-made assets [1]. The satellite imageries are useful in quick reliable mapping and monitoring of various natural resources both in space and time domain. Further Remote Sensing (RS) and Geographical Information System (GIS) are capable of creating various resources information layers in minimum time with regular updates. GIS is an innovative approach for economic development, planning and effective management of resources [2,3]. The capabilities provided by satellite imagery, digital maps and associated information makes the geographical system more understandable. RS/GIS technology is helpful in sustainable development and decision making.

It is the requirement to introduce such Information System that can integrate all minor and major power sectors for good decision support, planning management and flood management system. With the help of Space based information (Satellite Images) a Geographical Information System can be prepared [4,5]. The Information System will integrate the assets, drainage, roads related to power stations and controls on one platform. When all minor and major power generation, distribution and transmission projects will be on one platform, it will create a great help to the State Government. The information system will also be helpful to decision makers, planners and disaster management department to give their input in the field of optimum energy distribution, water distribution for irrigation and flood water management and rectification.

Areaa of Interest

The State Uttarakhand is situated in the northern part of India shown in Figure 1. It has 53,483 km^2 total Gegraphical area out of which 65% is covered with forest and 86% is mountainous. Uttarakhand is famous for its natural environment. The unique Himalayan ecosystem plays host to various species of herbs, shrubs, trees, animals and birds.

Figure 1: Location map of Uttarakhand.

The famous river Ganga and Yamuna gets birth in the Glacials of Uttarakhand. Diverse kind of vegetation is the beauty of Uttarakhand. It include the famous National parks, Rajaji National Park in Haridwar, Nandadevi National Park in Camoli, Jim Corbett National Park in Nanital District. Water is among the major natural resource of Uttarakhand. The Engineers and Scientists are harvesting its power in planned way without disturbing the ecosystem of Uttarakhand.

Power projects a review: However there are various types of energy resources are used to generate power such as Solar Energy, Hydro power, Bio Energy, gases from municipal waste and Wind Energy. The major source of energy in Uttarakhand is hydro power. The installation cost of a hydro power plant is lower than other plants and a hydro power plant can generate 100% from its intake water while the solar plant can use 20% of its solar radiation hitting the solar panel. The installation cost and maintenance of the technology is costlier.

Figure 2: Dam Situated on river Tons to generate hydro power.

The wind mills are also not supportive enough to generate optimum electricity on all geographic locations. The hydro power projects of Uttaakhand collects water from natural resources such as glaciers, rains and rivers. The electricity generated from HEP is used for consumption, irrigation, industrial use, aquaculture and navigability [6]. To harness the energy from water resources, The Government has implanted various dams on rivers. Chibro power house in Uttarakhand is the first underground power house established 1860s of Himalayan range.

Major dams and their capacity in Uttarakhand are described below:

S.N.	Name of Dams	Purpose	Location	Height and Length	Total Volume content of Dam (cumec)	Design Flood (cumec)
1.	Baigul Dam (1986)	Irrigation	Udham Singh Nagar on Baigul and Sukhli River	h:13.7 m, l:15300 m	567	
2	Baur Dam (1883)	Irrigation	Bajpur, US nagar on Ganga River	h:17.98 m, l:9500 m	8252	1416.43
3	Bhimtal Dam (1883)	Irrigation	Bhimtal, Nainital on Ganga River	h:48.5 ft, l:500 ft		45
4	Dhauliganga Dam (2005)	Hydroelectric	Dharchula, Pithoragarh	h:56 m, l:315	980	
5	Dhora Dam (1960)	Irrigation	US Nagar, Kichha River, Ganga Basin	h:15.63 m, l:9610 m		549
6	Haripura Dam (1975)	Irrigation	US Nagar, Bhakhra River	h:10.98 m, l:7.980 m	980	
7	Ichari Dam (1972)	Hydroelectric	Dakpathar, Dehradun, Tons River	h:59 m, l:155 m	181.9	13500
8	Lakhwar Dam	Hydroelectric/Irrigation	Dehradun, Yamuna River	h: 204, l:451	4166	8000

9	Koteshwar Dam	Hydroelectric	Tehri Garhwal, Bhagirathi River	h:97.5 m, l:300.5 m	560	13240
10	Maneri Bhali Dam (1985)	Hydroelectric	Maneri, Uttarkashi, Bhagirathi River	h:39 m, l:127 m	13.7	7500
11	Nanak Sagar Dam (1962)	Irrigation/ Drinking/water supply	US Nagar, Ganga River	h:16.5 m, 19200 m	209690	1600
12	Kalagarh Dam (1974)	Hydroelectric	Kalagarh, Pauri Garhwal on Ramganga River	h:128 m, 715 m	10000	12121
13	Tehri Dam (2006)	Hydroelectric	Tehri Garhwal on Bhagirathi River	h;260.5 m, l:575 m	27980	15540
14	Tumaria Dam.	Irrigation	US Nagar on Phika River	h:15.5 m, 10000 m	2024	

Table 1: Purpose and capacity of Dams in Uttarakhand.

There are more than 250 hydro power stations (in operation and under construction) situated on various rivers in State Uttarakahnd as shown in map (Figure 1) below. The interconnectivity of these dams can be assessed for flood control, irrigation and uninterrupted power supply. In Uttarakhand the distribution lines substations are more than 300 and transmission line substations are around 50. These figures (Figures 2-5) and their geospatial locations can support in well planning of energy distribution in the State. The gross line length in circuit Kms. as on 31.05.2014 is 1882.878 Km. Using geospatial locations of power sub stations it is possible to assess the generated and required energy in a particular area [7]. In the upcoming papers the detailed description of million unit energy generation as per energy requirement per head in Uttarakhand State.

Filling part or all of a reservoir's capacity during a flood peak may be cost-effective. Twenty percent of large dams are designed, partly or entirely, for this purpose, and many other dams have or may have a useful impact on flood peaks. The Table 2 shows the total volume content of Dam in a year is 256,557.6 cumec and the Flood Design is 73511.43 cumec. It means dams can accumulate 73511.43 cumec surplus water in flood situations.

S.No.	Name of Plants	Capacity	Generation (In MU)
1	Chibro	240	785
2	Khodri	120	355.649
3	Dhakrani	33.75	129
4	Dhalipur	51	186.768
5	Kulhal	30	124.206
6	Tiloth	90	394.746
7	MB-II	304	1276.584
8	Chilla	144	811.937
9	Ramganga	198	249.548
10	Khatima	41.4	212.778
11	Pathri	20.4	135.278
12	M.Pur	9.3	56.444
13	Galogi	3	6.978
	Total		4725.267

Table 2: Major hydro power house in Uttarakhand.

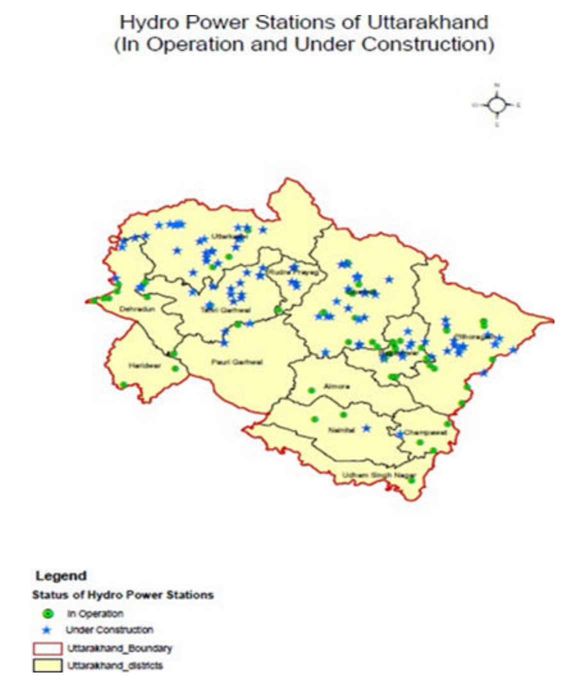

Figure 3: Map of Hydro Power Stations (In Operation and Under-construction) in Uttarakhand.

Citation: Rani A, Kumar R (2018) Geospatial Information Support for Power Projects. J Remote Sens GIS 7: 251. doi: 10.4172/2469-4134.1000251

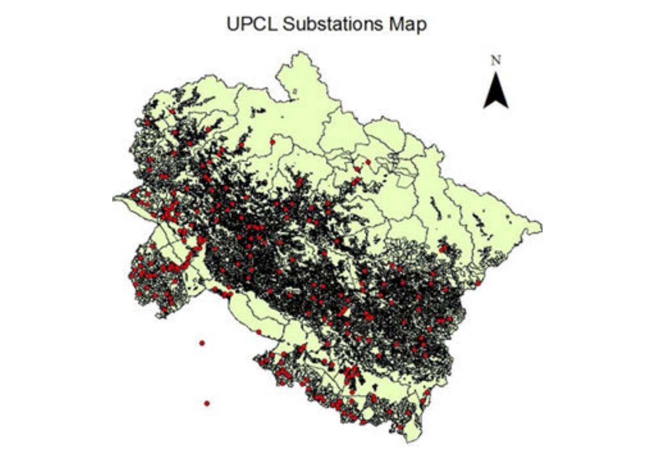

Figure 4: Power distribution 33/11 substation of UPCL.

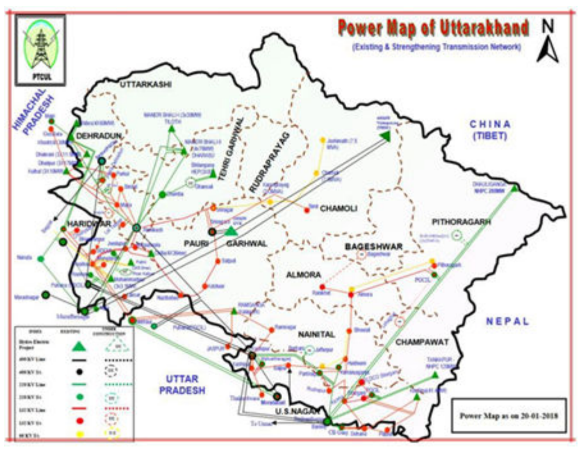

Figure 5: Transmission lines of Uttarakhand.

Methodology and Implementation

The work is divided into three phases:

Phase 1: Data Collection,

Phase 2: Mapping,

Phase 3: GIS based web application development.

The work execution process is sown in Figure 6. Today the data collection activity uses various mobile applications. In this Work an android application with required attributes of dams, rivers, substations, and lines is evolved. The Android app is using open source data kit for online/offline data collection. The Prototype of work model is shown in Figure 7.

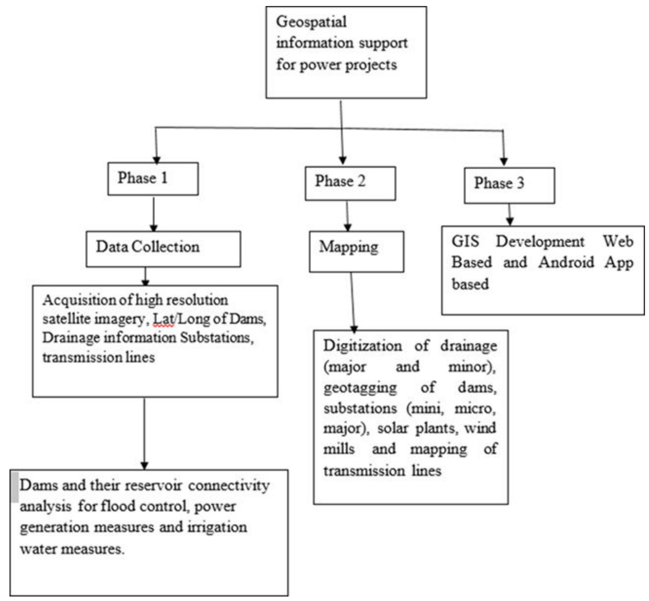

Figure 6: Flow diagram for work and execution process of project.

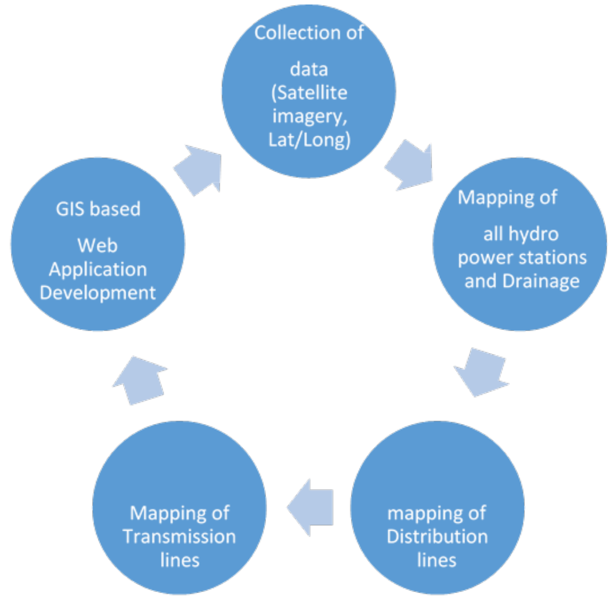

Figure 7: Model used for task execution.

Phase 1: In phase 1 all relevant required data such as information about power projects, dams, rivers, transmission lines will be gathered. Open source software and technology will be used for portal and app development. In hardware requirement computers, printer and android phone with GPS support will be used. This phase also includes acquisition of high resolution satellite imagery. For the collection of field data an app will be developed for online/offline field data collection. The Information will be updated automatically on server that can be further incorporated with GIS.

Phase 2: This phase is regarding digitization of rivers, dams, power substations, transmission lines. In this phase analysis will also be done on the basis of gathered information regarding dams and power stations for further utilization in irrigation, power generation and flood control Models, fly throws and scanned georeferenced PDFs will also be developed.

Phase 3: After completing phase one and phase two a web based geographical information System will be developed. At last the application will be converted into android app form to ease the solutions of power. Using this application several analysis such as yearly million unit power generation,

Base map and satellite imagery: Very high resolution, Geo referenced satellite imagery (CARTOSAT and LISS IV merged mosaic) will be used. Drainage, Roads and LULC will be used as base map.

Conclusion

The paper is fully successful to describe the importance of the proposed work and study. The paper has also illustrated the methodology for execution of work. The detailed flow diagram and model of execution. The project will be proven as boon for state government and related department in decision making to install new power stations, better energy distribution and irrigation. The project will also be helpful in visualization and analysis of geographical locations of substations, dams and other various assets without wasting much energy and time. Calculation of power generation over requirement will become a few second job. The Project will be proven as boon in flood controlling and water management policies.

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