

Chhattisgarh GIS

Geographic Information System

Government of Chhattisgarh

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Executive summary

The State of Chhattisgarh is the **first state** in India to develop a comprehensive “*Geographical Information System (GIS)*” consisting of 37 layers. The State intends to provide the GIS data to all Government departments / agencies and NGO’s for identifying areas for improvement, thereby, increasing the productivity and GDP of the State. For effective use of various applications, a GIS Application Centre is also being set-up. Geographical Atlas of the state on various layers has been prepared using GIS.

The GIS can be utilised across various departments like hydrology, demographics, land maps etc. To exemplify

- The Forest Department is using the system for demarcating forest boundaries, estimation of forest density, details of vegetation, firewood, timber etc.
- The Revenue Department is using the system for digitization of land maps and online mutation of land records, the Election Office for demarcating Gram Panchayat boundaries, JanpadPanchayat boundaries, VidhanSabha boundaries, pictorial representation of census data and habitat, analysing polling trends, tracking of polling party movement and ballot box movement.
- The Hydrology Department is using the system for watershed mapping, water table mapping, demarcation of catchment areas and submergence areas, ground water simulation including site characterization, model development, post processing, calibration and visualization.
- The Chhattisgarh State Electricity Board is using the system for installation of HV lines in remote areas of Baster and Dantewada, effective planning on installation and operation of HV lines throughout the State and the Mining Department for demarcation of mining lease boundaries and identification of potential exploration mining lease areas.

So it can be seen that how GIS can be effectively implemented across various departments across the state.

GIS helps the state in:

- Time and cost saving
- Reduction in dependency
- Knowledge available click away
- Greater accuracy

Introduction

To protect and better understand the fragile ecosystem, a comprehensive GIS database has been developed by RRSSC for Chhattisgarh. The State of Chhattisgarh is the first State in India to develop this comprehensive Geographical Information System (GIS) consisting of 37 layers

Govt. of Chhattisgarh with the help of CHiPS and Indian Space Program and the Remote Sensing applications Centre (RRSSC), Nagpur set in motion the project on GIS database generation in the state of Chhattisgarh with use of high resolution satellite data specifically IRS, PAN & LISS III for updation of road map, infrastructure planning, urban development, watershed management, agriculture, forest development and to take up on priority implementation of GIS database on natural resources using Remote Sensing data and geo-referencing of village maps(cadastral) to facilitate land and water resources development.

These layers when superimposed on other layer create another set of information. Cadastral maps on the other hand will not only reduce the time utilization in furnishing information, but also chances of corruption (alleged) will be reduced to zero level.

The objectives of GIS are:

1. Inter-alia Road Information System
2. Georeferencing of villages (cadastral maps)
3. Integration of thematic information
4. Socio-economic data for the generation of action plans
5. Generation of comprehensive plan for water and land resources development
6. Generation of watershed wise site-specific and area-specific action plans for easy implementation by local bodies.

Integration of this data and the usage in various combinations can be a firm abutment for any action plan. Whole state is covered in the project and information is prepared accordingly, to suite the need. Scales of maps/data differ as per the requirement. With the help of GIS, we think of a service, select a layer and get information. Future plan of Government of Chhattisgarh is to bring all departments under the umbrella of GIS.

Overview of the project owner

Mr. Saurabh Kumar

IAS, Chief Executive Officer, Office of Chips, State Data Centre Building, Civil Lines ,Raipur, Chhattisgarh

Mr. Saurabh Kumar analysed that newly developed state like Chhattisgarh has several untapped potential resources which have to be the focus of the new development agenda. He worked on the objective of generating natural resources database for the state. He was convinced about the utility of such information system under Chhattisgarh GIS project. So he was eager to develop a scientific system of monitoring, exploitation and management of resources so as to channelize them effectively. He knew that with this kind of comprehensive system, the department can achieve two goals. Firstly, the department can easily map the natural resources using remote sensing technique. Secondly, it can assist the State in management and development of various activities. He saw that how the data from the information system can be used across various departments and how it can expedite their way of functioning. Thus, with this rationale, he guided the development of Geographical Information System with 70 layers which covered various objectives like georeferencing of villages, socio-economic data generation etc.

So under the supervision of Mr. Kumar, the project was successfully implemented and it was used by the various beneficiaries across various departments.

Project overview

Triggers

The geographical area of Chhattisgarh comprises of 1, 35,000 sq. km with a population of 20.80 Million and density of 154 persons/ sq. km with a decennial growth of 18%. The newly formed State of Chhattisgarh is endowed with natural resources like forest, mineral resources, flora and fauna, wide range of crops and cropping patterns, and rich cultural diversity. The population of Chhattisgarh is divided in 18 districts with 146 tehsils and 20379 revenue villages. But the infrastructure in the state was not much encouraging.

In this background the project GIS was envisioned and implemented to create knowledge society where access to information and knowledge would be symmetric amongst all seekers and users may it be government sector, private sector or an individual. It was imperative to leverage technology to overcome physical and other barriers.

The main aim for the state was putting in place a set of effective system for simplifying procedure, accessing information and enhancing accountability with aim of improving accuracy as well as to create awareness among the local governments and citizens

Scope of services

- Establishment of Natural Resources database for the state of Chhattisgarh on 1:50,000 scale.
- Geo referencing of Village Maps & Development of LIS for Chhattisgarh State.
- Development of Spatial Database for Road Network of Chhattisgarh State.

On an average the cost of database generation has been worked out as Rs. 10,000/- per village for 20379 villages.

Some of the applications are:

- Prioritization of watersheds and water resources development plans of priority watersheds.
- Rural road connectivity to villages through the forest.
- Identification for suitable sites for horticulture and vegetable crops in Mahasamund Districts.
- Identification for suitable sites for developing PURA (Providing Urban amenities in Rural Areas).
- Forest Management Information System (FMIS).
- Hydrology Project of Chhattisgarh State (Funded by World Bank).
- Election Commission GIS for delimitation of constituencies.
- Identification for suitable areas for sitting industries in the state, Chhattisgarh State Industrial Development Corporation (CSIDC).
- Optimal routing of High Power Transmission Lines, Chhattisgarh State Electricity Board.
- Developmental Planning of major towns and New Raipur City of Chhattisgarh State, Department of Town and country Planning, Raipur.

Applications of geo-referenced village (cadastral) maps

- Micro-level planning and implementation of developmental activities.
- Parcel level monitoring and assessment of the impact of developmental activities.
- Crop Identification at parcel level & water levy assessment.
- Smart cards for farmers to facilitate e-governance and e-banking.
- Efficient settlement of compensation claims.
- Land acquisition and rehabilitation in infrastructure projects.
- Precision Farming.
- Land value assessment.
- Parcel level soil health cards.
- Crop Insurance.
- Community /Village resource centers.
- Digital Cadastral India

Innovation

- Database follows NRIS standards
- Meets the requirement of State Natural Resources Management System (SNRMS)
- cadastral maps are prepared for each village(20379 villages, Scale-1:4000)
- Depiction of survey boundaries with survey numbers, cultural features like transport network and natural features like drainage
- Maps have been brought under standard projection /coordinate system for effective linkage of the plans generated in the GIS environment. The work included:
 - Grid base generation
 - Map grid generation
 - Satellite data preparation
 - Creation of raster cadastral images
 - Registration of cadastral images
 - Generation and Overlay of cadastral vectors
 - Output generation

Apart from this, Computerization of land records under the modified project submitted to GOI also includes -

- a) Data entry/re-entry/data conversion of all textual records including mutation records and other land attributes data
- b) Tehsil, sub-division/district Computer centers
- c) Survey/resurvey and updating of the survey & settlement records (including ground control network and ground trothing) using the Pure ground method using total station (TS) and differential global positioning system (DGPS) / High Resolution Satellite Imagery (HRSI) and ground trothing by TS and DGPS.
- d) Computerization of the sub-registrar's offices (SROs)
 - Data entry of valuation details
 - Data entry of legacy encumbrance data
 - Scanning & preservation of old documents
 - Connectivity of SROs with revenue offices
- e) Platform: Arc GIS Server & Desktop, ERDAS Imagine
- f) Remote Sensing: IRS PAN + LISS-III
- g) Using satellite data, natural resource mapping has been carried out on 1:50,000 scales based on satellite imageries and digital processing. Chhattisgarh GIS Project' with generation of natural resources database for the state of Chhattisgarh on 1:50000 scale using IRS LISS-III data, development of spatial database for road network using IRS PAN data and geo-referencing of village (cadastral) maps using high resolution IRS PAN + LISS-III data.
- h) Data has been hosted at State Data Centre.
- i) SWAN being used for communication between different departments.

Modalities of the new system

Baseline study

- Chhattisgarh Geographical Information System database comprised more than 37 thematic layers for various Government Department user
- LISS III and PAN data are used separately, as well as in combinations to create precious bank of information.
- Thematic layers are prepared on 1:50000, whereas cadastral maps digitalized and fitted to a large 4000 scale.
- Rich database facilitates for early completion of the task

Implementation model

GIS was the preamble of the vast integrated, multidirectional, multifaceted plan of overall development of the state.

Various probabilities like finance, man-power resource availability were taken into account, and then certain specific data were finalized as the base data, to act as the broad platform for spicing the facts through variables.

The most feasible site for any industry is identified by layer superimposition. A layer, related to some variable is considered after superimposition. If variables are more, then they are superimposed over each other, with feasible transparency of layers concerned. This way best suited area can be sorted out easily.

Technology

(i) Description

Provides complete coverage, scope, spatial accuracy and precision, spatial and precision integrity

(ii) Interoperability

- ArcGIS Interoperability eliminates barriers to data sharing by direct data access, data translation and ability to build complex spatial extraction, transformation and loading process
- Any standard GIS data can be used for mapping ,visualization and analysis
- The Workbench application enables to build complex spatial and 3D tools for data validation, migration and distribution

(iii) Security concerns

The criteria for evaluating the existing GIS data should include foundational requirements, intradepartmental requirements, and strictly departmental requirements.

Data layers that fulfil foundation requirements are the key data layers—these are the data required by all participating departments and divisions.

The intradepartmental requirement layer is data that are used by more than one department or division.

Departmental data serve only a single department's needs.

After data layers have been graded, they should be further reviewed for

- Completeness in coverage and scope
- Detail of information contained within
- Spatial accuracy and precision of the data
- Accuracy of the information contained
- Precision
- Spatial integrity

GIS layers were created for a particular purpose, their accuracy or detail may not be sufficient for other users and applications in an enterprise GIS. Therefore, it is always a good practice to review the existing data prior to applying it for some other applications.

Security features of GIS are:

- o GIS data hosted at Chhattisgarh State Data Centre with using network and data security applications like firewall, IPS and antivirus Trend Micro.
- o Administrator limits access to end host by using a firewall.
- o A packet filter is essentially a router with secure features and it can control data flow by protocol, port security, and source-destination security.
- o SSH-VPN security from internet to inside server encryption algorithm AES (128/256 bit & 3DES) and node is tunneling from inside web server access, either http or https with defined ports (no. 80, 8080, 8090, 443, 1199, 8181, 3994, 7777)
- o For the data transfer RFP along with connectivity check ping with port no.8.
- o Data management from data counter to internet goes via MPLS VPN.

(iv) Any issue with the technology used

The sole issue is that everyone would not have access to GIS, nor would one be able to spend the time necessary to use it efficiently. To address this issue, WEB GIS becomes a cheap and easy way of disseminating geospatial data and processing tools.

(v) Service level Agreements(SLAs) have been well documented

(vi) Scalability

Language Support: Hindi/English

Software: Arc GIS Server 10.0 & Desktop 10.0, ERDAS Imagine 10.0, Map Server (Oracle Spatial, Oracle Map Viewer), Web Server Tom Cat, and Arc View 3.1.

Data base- Arc SDE, MS SQL Server 2008

Hardware: Blade Server & Workstations

New models of service delivery

- More than 54000 sheets pertaining to 20000+ villages were digitalized
- All of these digitized sheets were then geo-referenced in two years
- Generation of 37 thematic layers from ISRO data
- Development of softwares like 'Naksha', 'Gyan', for mutation and editing
- Training to frontline staff
- Legal amendments/ government circulars released

Major applications developed include:

- **Police Department (PHQ)** - Developed GIS based web Portal for the Police Headquarter to display GIS data (37 layers) and overlaying satellite imagery, Bing Maps, Relief Features, Street maps on Digitized GIS data. Providing some analysis Tools like Spatial Analysis, Network Analysis and 3-D Analysis tools for decision making.
- **Public Works Department (PWD)** - GIS based web Portal for the Public Works Department to display GIS data and overlaying satellite imagery, Bing Maps, Relief Features, Street maps on Digitized GIS data. Providing some analysis Tools like Spatial Analysis tool for decision making.
- **Education** - GIS based web Portal for the schools of all categories to display GIS data and overlaying satellite imagery, Bing Maps, Relief Features, Street maps on Digitized GIS data. Providing some analysis Tools like Spatial Analysis tool for decision making.

Other applications developed include:

- Industry Department : Industry Map and Irrigation map for Raigarh, Surguja, Janjgir Champa, Korba districts.
- Serriculture Department : Detailed map demarketing information for soil type, texture, soil depth, water bodies, forest cover for all districts.
- Veterinary department : Information regarding the labs and specimen located in Raipur.
- PHED : Map delivered for Mahasamund containing information of Rock type, soil type, ground water, soil depth.
- Zila Panchayat, Dhamtari : New Tahsil boundary demarcation – village name updation, lab to land list, web based solution for various departments concerned.
- NRHM : Database preparation of different centres like SC, PHC, CHC, Dist.
- CRPF / PHQ : Complete information showing physical map for Bastar Division.
- State Housing Board: Initial maps for Dhamtari, Ambikapur for Vikas Nagar Yojna.
- Zila Panchayat, South Zone : Villages proposed for agricultural zone, structures water bodies, which are silted under Integrated District development plan.

- Town & Country Planning : Cadastral Maps & Planning area maps, complete town planning
- State Atlas covering various layers for all districts including 9 newly formed districts
- SIRD : Watershed informative maps, village preparation for Bastar, Kawardha, Mahasamund, Bagbahara, Saraipali, Pithura
- Bhatiya Coke Pvt. Ltd. : Cadastral maps for 3 villages with road, rail and water body for coal mining
- Power Grid : Power lines for Raigarh, Champa, Raipur, Korba, Ambagarh Chowki to Dhamda, Korba to Lailunga, Bilaspur, Champa-kurcha line, Durg, Raipur-wardha line, Korba-Jabalpur, Korba-Dharmjaigarh
- Zila Panchayat, Bilaspur : District, Tahsil and village boundary maps for web hosting
- WRD : Cadastral maps across Mahanadi basin
- Krishi Viidhyala : Task for cadastral work information
- Indian Oil : 202 village cadastral map preparation
- IG, Raipur : Map for CRPF Division
- NTPC : Application planning area map.

Citizen centricity

- Time and Cost saving
- Physical movement of data reduced nearly to zero
- With this huge repository of information, departments are using the data for their planning
- Identifies area of improvement thereby, increasing the productivity and GDP of the State

Efficiency enhancement

- Increase in time and cost efficiency
- Time and cost savings for the key stakeholders (various government departments)
- Specific innovative ideas implemented in eGov area
- User Feedback and project assessment mechanism
- Third party overall project audit mechanism-Regional Remote Sensing Service Centre is a part of Indian Space Research Organization, so that related to all audit like system as well as financial or administration audit done by RRSSC, Nagpur.

User convenience

- (i) Service delivery channels (Web, email, SMS etc.)
 - Deployment of necessary hardware and network equipment.
 - Installation of softwares
 - Development of web based applications
- (ii) Completeness of information provided to the users,

Work flow Management for approval of Mutation and automatically dividing the land parcel as per the mutation details submitted by the Patwari

(iii) Facility for online/offline download and online submission of forms,

- Citizens can access and take printouts of Khasra Boundaries from KIOSKS.
- Online submission of the mutation details by Patwari's.

(iv) Status tracking

- Reports on Transactions of Mutation.

Impact on the stakeholders

Value delivered

(i) To organization

- Prioritization of watersheds and water resources development plans of priority watersheds.
- Rural road connectivity to villages through the forest.
- Identification for suitable sites for horticulture and vegetable crops in Mahasamund Districts.
- Identification for suitable sites for developing PURA (Providing urban amenities in Rural Areas).
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- Developmental Planning of major towns and New Raipur City of Chhattisgarh State, Department of Town and country Planning, Raipur.
- Vidhan Sabha and Lok Sabha booths
- Road Information System
- Shiksha Mission for school information system.
- Police and paramilitary forces for deployment and movement

(ii) To citizen

- More than 20000 villages have been covered under this project.
- Digital Cadastral maps of all the villages of the State prepared.
- Apart from Khasra, naksha land parcel is also being provided at Tehsil/Blocks
- Comprehensive GIS based atlas has been prepared for the State with various layers.

(iii) Other stakeholders

Data is provided to companies, organizations as per their requirement, planning and for research purpose.

Sustainability

a. Financial model

This project is funded by the Department of Panchayat & Rural Development, Government of Chhattisgarh for the creation of database, later it is distributed to all Panchayats. Monitoring of the most areas can be daily routine. R & D can also be performed at any level. For cadastral maps also, updation is a click away after which verification will take place. AMC of the software and other maintenance will be the task for respective users.

In future, data will be hosted at the state data centre at Raipur. Access will be provided to the user as and when needed-but in different limitations (read only/read and write/add only/editable version). For cadastral maps, the accessibility will follow the normal existing route-but obviously online.

b. Technology maintenance

Front end maintenance has been done by CHiPS officials and if any data base related problem occurs, the team of RRSSC and CHiPS officials resolves the queries.

c. Disaster Recovery Center

For probable disaster, one complete set of the entire database is kept with CHiPS in the form of CDs. RRSSC Nagpur is another point where the data are available; IPR obviously rests with Government of Chhattisgarh. Databank is used for planning purposes, and is updated at regular intervals. RRSSC Nagpur is also using the databank for R&D and for academic purposes.

d. Project management team (full time department officials/ consultants)

Project is headed by CEO CHiPS. Routine reviews, updations, making available whatever information is sought and progress of the project is taken care by Executive Board and PS (IT). A separate GIS cell has been set-up without any financial support from state.

Annexures

EXHIBIT - Comparative Analysis of earlier Vs new system

The collaborative project between CHiPS, Government of Chhattisgarh & R.R.S.S.C., ISRO/DOS, Nagpur. Chhattisgarh InfoTech and biotech Promotion Society (CHiPS), an autonomous organization under the government of Chhattisgarh, has resulted in a collaborative program 'Chhattisgarh GIS Project' with the objectives of **generation of natural resources database** for the state of Chhattisgarh on 1:50000 scale using IRS LISS-III data, development of spatial database for road network using IRS PAN data and geo-referencing of village (cadastral) maps using high resolution IRS PAN + LISS-III data. Having been convinced about the utility of such an information system under Chhattisgarh GIS Project, Government of Chhattisgarh generated resources of around 20 crores. The project is funded from the Gram Panchayats through the 'Basic Plan', 'Jawahar Gram Samrudhi Yojna' and other resources of Panchayat, amounting to Rs. 10,000 per village, in two financial years. Deliverables have been handed over to all Panchayats. GIS data is being provided to all Government departments / agencies at nominal cost for identifying areas for improvement, thereby, increasing the productivity and GDP of the State. GIS data is also being given to Private industries / institutes on payment of charges

Separate GIS Cell has been created. eDistrict project to be incorporated with GIS-Kiosks centres which will be the delivery points for providing Khasara, B1 & maps by the Land Record Department for the urban areas. CSC or Gramin CHOICE centres will be the delivery points for the rural areas. For every six villages there is one CSC (Common Service Center).

Proposal has been submitted to State Government for setting up of Geoinformatics Lab with the increasing demands from various Govt. departments and other agencies for-

1. Opportunity to reduce sets of manual maps held and associated storage costs.
2. Faster and more extensive access to geographic information.
3. Improving analysis e.g. of areas, distances, patterns, etc.
4. Better communication of information to public officers, members.
5. Improving quality of services.
6. Better targeting and coordination of services.
7. Improving productivity in providing public information.
8. Improving efficiency in updating maps.
9. The ability to track and monitor growth and development over time.
10. Improving ability to aggregate data for specific sub areas.

The objective of Geoinformatics Laboratory is to provide-

- Database generation, dissemination and technology promotion in the region to ensure use of information technology to end user (government departments, NGOs , academic institutions and to the public at large),

- To create awareness on the applications of the remote sensing and GIS in diverse resource areas
- To ensure reliability of resources information in appropriate formats for the use in state
- To generate thematic information and socio – economic data base in standard procedure and formats for easy retrieval and analysis
- To design and develop scientific approaches for optimizing resources utilization through integrated resources management,
- Periodic monitoring, updating and maintenance of natural resource information on vegetation, water and land resources