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Forest Dwellers Land Mapping System

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Abstract

Forest Dwellers Land Mapping System exhibits innovative use of technology that transformed the public delivery mechanism and provided relief to disadvantageous section of the society. In India Forest Rights Act was promulgated to provide relief to tribal who suffered because of historical injustice. Administration was in dilemma how to tackle the large number of applications. Innovative use of diverse technologies facilitated simple and reliable public service delivery. A GIS based application was developed to capture data and geo-map the claimed forest land. The data was collected on GPS enabled Personal Digital Assistant (PDA). This data was sent through a computer network to the central repository where it was maintained as a separate data layer. On GIS server this data layer was superimposed with other layers on High Resolution Satellite Images to analyze the data in a visualized manner. The data is served on net through the website of the department to all the stakeholders. The visualization is simple to be easily understood by even the lay man. The mobile mapping assisted field staff to easily survey the area. The image processing technique assisted decision makers to verify the claims. The web interface facilitated electronic storage and retrieval of spatial and attributes information. The digital title deeds along with the photograph of the claimant could be printed at a click of mouse. The application brought transparency and accountability in the system. Not a single complaint was received during the whole process about any malpractice or human intervention. It saved government exchequer a lot of cost time and efforts and ensured quick and efficient delivery. The application bagged the prestigious National E- governance Award and also Prime Minister Award for Excellence in Public Administration. The application has been used by many states.

Keywords: Forests, Tribal, PDA, GIS, Mobile Mapping.
Forest Dweller Survey System

Forest Dwellers Land Mapping System

BACKDROP

Historically the forests were owned by the forest dwellers and they not only earned their livelihood from the forest but also contributed in forest protection and regeneration. King / Emperor reserved certain forests for their "Shikar" and people were barred from inhabiting those areas so as to avoid accidental injuries to human beings. When Britishers started consolidating colony's forests, to feed precious timber to their shipbuilding and rail road industry, without caring for the rights of the forest dwelling tribes there were rebellions. This forced them to bring the Indian Forest Act 1927 having provisions for notifying their intention to reserve certain forest area and to seek claims of forest dwellers on any land included therein. After hearing such claimants and sorting the evidence presented the claim needed to be declared as valid and exclude that piece of land or otherwise before issuing final notification. But due to barrier of language, lack of literacy, hand to mouth existence, cumbersome and expensive legal system and colonial interests, colossal injustice prevailed in the process which adversely affected the lives of forest dwellers. The plight of the forest dwellers continued even after the independence as the Indian Forest Act is still in force.

It's after sixty years of independence that civil societies created awareness at the political level to rectify the historical injustice done to forest dwellers. Consequently Govt. of India enacted The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 on 29th Dec 2006 to recognize and vest rights in forest land to forest dwelling Scheduled Tribes and other traditional forest dwellers who have been occupying such forests for generations and who are the victims of historical injustice. For proper implementation of this act rules were implemented in year 2008. Thus began the journey to provide relief to the most neglected segment of the Indian population and living in geographically most disadvantageous locations and which suffered immense loss for time immemorial.

THE PROBLEM

The proper implementation of the Act was a challenging task as it involved a number of stakeholders across the vast geographical extent. Apart from administrative and managerial challenges there were many technological challenges to maintain transparency and accountability in the whole process.

Madhya Pradesh government organized an interdepartmental meeting to assess the challenges in the whole process to effectively implement the act. A strong political will and commitment on the part of the administrative machinery was shown to provide clean and effective enabling environment for the successful implementation of the act. Apart from

managerial and organizational the following technical problems and difficult situations were identified:

- The survey of huge number of claims in a short span of time using tradition methodology which involves huge equipment and manpower was found to be the major hurdle.
- Preparing and printing of maps of the forest land to be allotted was considered very difficult as the Act provides for distribution of title deeds along with map of the holding.
- Estimation of the area of the land using traditional methods was found to be difficult and time consuming and involved human discretion.
- Maintaining transparency and accountability over the vast tract and involving many levels was really a challenge.
- Monitoring mechanism at all levels for effective delivery was another big challenge.
- Maintaining database and record keeping of all the claimants manually and using traditional methodology was a tedious affair.

THE SOLUTION

Meeting the technical challenges was more difficult than the managerial and administrative difficulties. The survey of nearly two lac claims in a short span of time using tradition methodology was a Herculean task. The Revenue Department came up with the idea of using Total Station Land Survey Machine, each costing Rs 600,000. At that cost it was found to be too cumbersome, time consuming and inefficient. The proposal did not address the other challenges.

Madhya Pradesh Forest Department proposed a web based ICT solution to automate the complete business process as required under Forest Rights Act. The solution was designed and developed in house by forest department. The original application was conceptualized by Forest Department to capture the spatial (geo-location) details of land holding of forest dwellers to update the already digitized forest land records and to analyze the patterns of land holdings as a database for effective planning and management of forest lands in future after the process of FRA implementation is over.

The proposed solution uses an innovative application run on a GPS facilitated Personal Digital Assistant (PDA) costing Rs 25000 per piece only. PDA is a trendy mobile phone with GPS facility, a 2mega pixel camera and with a capability of using customized GIS based application capable of land survey and capturing other attribute data. Madhya Pradesh Schedule Tribes & Schedule Caste Welfare Department found the solution to be cost effective, time saving, handy, easy to use and covering all the aspects of the anticipated challenges of transparency and accountability.

After assessing the potential of the solution and equipment including its accuracy in land survey, the Empowered Committee headed by the Chief Secretary approved the solution. Consequently all the features as required under FRA including area calculation, geo-mapping, forest dwellers details, creation and printing of Van Adhikar Patra and digital map with photograph of claimants on it were added in the application. So the application became highly suitable and tailor made for the Forest Right Act. Tribal Department found it not only cost effective, less time consuming but also highly transparent and accountable.

THE OBJECTIVE

The main objective of the proposed solution is to automate the complete business process as required under Forest Rights Act. The automated system developed ensures:

1. Creation of electronic data base of all applicants.
2. Digital survey of land holdings including area calculation and map generation.
3. Automated generation of Van Adhikar Patra as per Act and digital map of the holding.
4. Online recordkeeping of all the claimants and their land holding.
5. Effective online monitoring of works
6. Transparency and Accountability in whole process.

IMPLEMENTATION STRATEGY

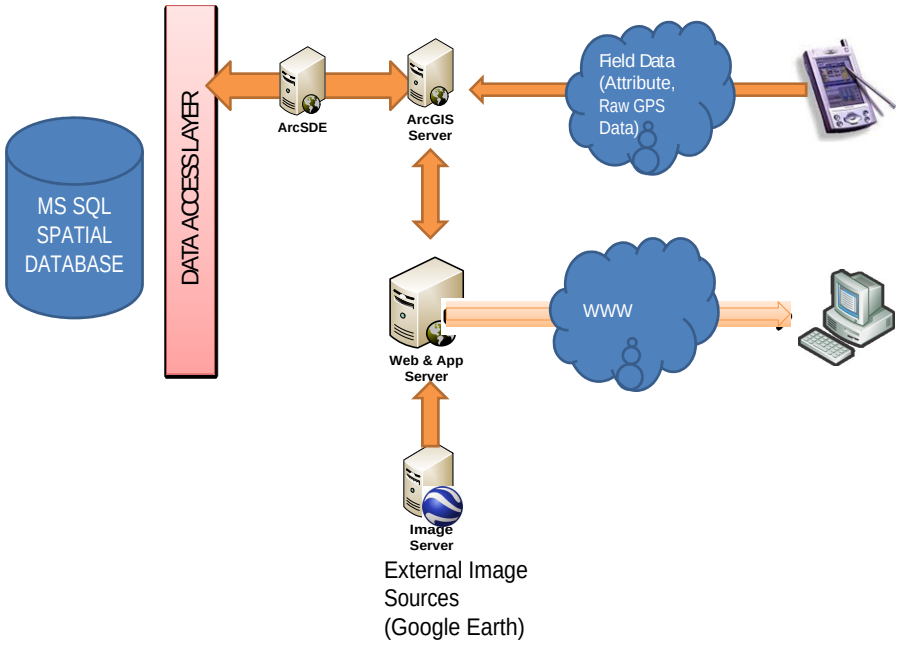
To implement the web based ICT solution following strategy was identified:

- Procurement of data collection devices (PDAs)
- Development of application
- Development of computer based communication network for data transfer.
- Creation or use of an existing Data Center / Server Farm for storage and processing of the information
- Sharpening the ICT skills of the manpower to efficiently use the application.

Following actions were adopted for successful implementation of the project:

a) **Application Development Model**: The project was conceived, designed and developed in-house keeping in view the felt needs of citizens, forest dwellers, survey teams and monitoring authorities.

b) **Technology Used**: The application integrated diverse technologies viz., space technology, GIS, GPS, mobile computing, image processing, internet based communication technology with server based processing etc. into a very simple and user friendly system. The integration of various technologies is depicted below:



c) **PDA Procurement**: Madhya Pradesh government allowed Forest Department to provide 400 PDAs to Tribal Department for conducting survey under the Forest Rights Act.

d) **Server Farm**: The existing server farm of the forest department was used to host the application and to store and process the data collected from the field on PDAs.

e) **Capacity Building**: Three members from each district of the state one each from NIC, revenue department and forest department were selected as master trainers and trained rigorously at state headquarters for hands-on GPS enabled PDA devices and to accomplish the pre-survey, actual survey and post-survey stages involved in the execution of the project.

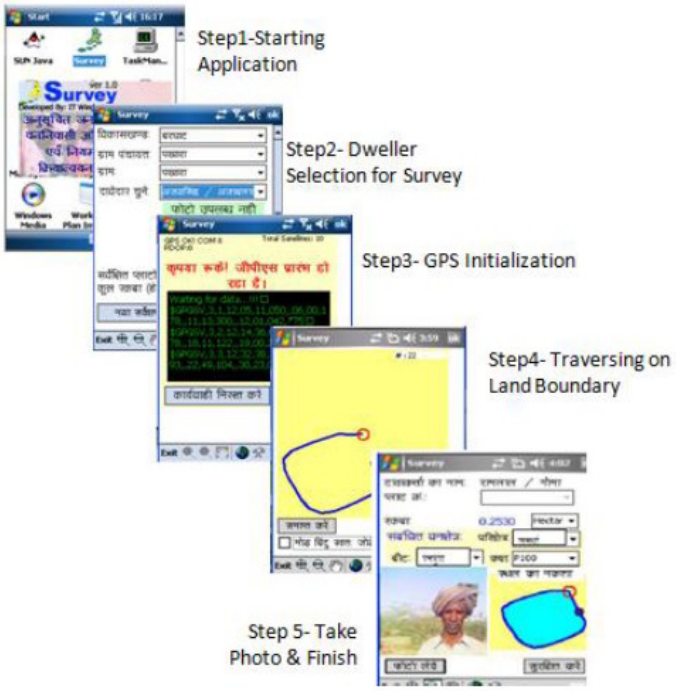
f) **Support Team**: A 3 member technical support team was made available at state headquarters for troubleshooting or providing necessary technical support to survey teams of the field.

TECHNICAL DESCRIPTION

The whole application is divided into 3 parts; mobile client, thick client & WebGIS module. The descriptions of these modules are as -

Mobile Application

The mobile application is developed for doing field survey, capturing attributes including the photograph of the forest dwellers. This mobile application can be run on any Windows CE based device which has in-built/external GPS. The application is built-on .Net Compact Framework and the GPS/GIS component is developed using Franson Tools Library and the data is stored on SQL CE database. Because of the nature of the project it focus to doing forest dwellers claims survey so the projection, datum or other GIS parameters are taken care by the application itself and user need not to worry about these complexities so that he/she focus on only doing survey. Also, the application front end is on local language for ease of use. Currently the application is supports Hindi, Gujarati and English language which can be localized further into other languages with small efforts.



Thick Client

The basic purpose of thick client is to synchronize GPS PDA (Mobile) with Server, preparation of maps for printing, exporting field survey data into other spatial formats and preparation of field survey reports. This application is developed using .Net Framework 2.0 which uses Franson Tools for GIS component and SQL CE for offline data storage. The reason for using Franson Tools is for royalty free distribution of application and SQL CE for cost effectiveness because it is free and supported by thick & mobile clients both. However, the SQLite can also be used for database for both platforms.

WebGIS Application

The WebGIS application is built-on ESRI's ArcGIS Server platform using .Net Framework. One web service is developed to import field data and convert it into enterprise spatial database using ArcObject. The application facilitates intranet users to view field surveyed data over other forestry admin (compartment) boundaries through WebGIS technology which is built-on ArcGIS Server Web Mapping Application. The Google Maps API is used to overlay field survey data over the Google Maps for easy visualization for public users. At the server end MS SQL SERVER 2008 is used as backend database.

The functionality & development tools matrixes of these 3 modules are as –

Module	Development Tools / Libraries / Database	Functionality
Mobile	• Microsoft .Net Compact Framework 2. 0 • SQL Compact Edition • Franson Tools	• Field Survey • Area Calculation • Attribute (Including Photograph) Capturing & Tagging with Plot
Thick Client	• Microsoft .Net Framework 2.0 • SQL Compact Edition • Franson Tools • Google Earth Plug-in	• Synchronization PDA With Server • Data Verification • Printing Maps on Specified Scale • Exporting of Field Data into other spatial formats like ESRI Shape File & Google KML
WebGIS	• Scripting on ASP.NET • Microsoft SQL Server 2008 Spatial • ArcGIS Server Standard Enterprise • Data Import/Export Functions Using ArcObject • Google Maps API • Image Server	• Forest Dwellers Claim Registration • Survey Party Management • Web Mapping • Overlaying Field Data on Google Maps • Exporting Data into Various Spatial Formats like ESRI Shape File and Google Earth KML

Coverage (Geographical)

The project was implemented in all the 50 districts of Madhya Pradesh spread over 300000 square kilometers of geographical area. The project was also replicated in state of Gujarat and Uttar Pradesh.

BENEFICIARIES OF THE INNOVATION

The real beneficiaries of the project and the content and services offered to them were as follows:

- More than 2, 00,000 Scheduled Tribes and Other Traditional Forest Dwellers of Madhya Pradesh. These beneficiaries got the service of land survey in their presence in a most transparent confident and assured manner. The land survey task included the photograph of the claimant which brought confidence in delivery mechanism.
- MP Tribal Welfare Department the Nodal Agency to implement the Forest Right Act 2006. All the content was made available on line on the web for proper planning and monitoring of the implementation of the FRA. They could monitor the progress of implementation from district to right up to the last unit that is the survey party by drilling down to the even an individual claimant.
- The 50 District Level Committees (DLC) the implementing agency in the district. The content served had the facility to monitor implementation at block village and even claimant wise information so that district collector can evaluate the performance of the survey parties. The DLC could print the title deed in the prescribed format immediately after the case was cleared by it without doing any manual writing or mapping work as the entire database was available in digitally form on the servers and is easily retrievable.
- MP Forest Department. The Forest department could get the digital information of the land being given to forest dwellers on their digitized and seamless spatial data. This facilitated the department to counter the false and unwarranted claims and also to study the pattern of forest land being distributed. It also facilitates them to identify the forest area most prone to encroachments.
- The 10000 village level Gram Vanadhikar Samiti. The system helps them to properly map the claimants and conduct survey for only the legitimate claimants. It also checks the discretion on the part of Samiti members to include or exclude names under local pressure.
- The 175 odd Survey Parties who conducted the land survey. It was easy for them to carry out survey only for those claimants whose names appear in the hand held devise. It saved them of all the expected allegations that land is not surveyed properly and that the area is not calculated accurately as the whole process was automated.

Result Achieved/Value Delivered to Beneficiaries:

- **Citizen centricity and relevance**

The application was designed keeping in view the objective of the Forest Right Act that it's the forest dwellers the most illiterate and disadvantageous group who are the primary beneficiary of the Act. Therefore their satisfaction and confidence in the delivery system was given the outmost importance. Consequently processes of land survey, mapping of land, area calculation, and preparation of adhikar certificates with photograph on it and creation of digital maps & publishing them on website was fully automated. Adhikar certificates with maps were printed immediately after completion of field survey.

Honorable Chief Minister Distributing Van Adhikar Patra

- **User Convenience**

The beauty of the application is that it has the most friendly user interface at the front end. All the users of the application do not have to make extra efforts to use the machine or various components of the application. All the functions are drop down menu driven and users have just to select the right option. The application is so user friendly that even the claimants used the machine with lot of excitement and their joy is seen to be believed when they saw their photograph on the PDA along with the digital map of their area.


Villagers Using Mobile Mapping Technique

- **Cost to User**

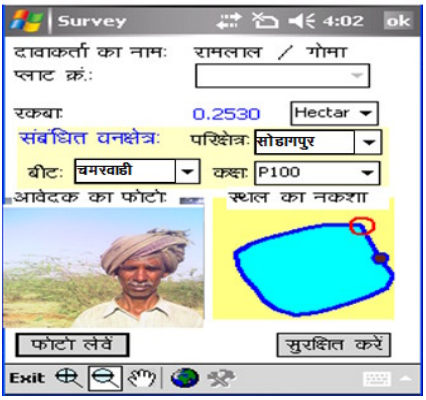
The new and innovative methodology reduced the cost of implementation of the Act. The accuracy of survey and map and calculation of area is also far better than the traditional method which is within +/- 5% of permissible limit. There is no cost to beneficiaries as this is a free service offered by the Act. It has been estimated that government exchequer was saved of almost Rs. 6 crores.

- **Sustainability**

The project is highly sustainable as it has been operating for more than two years and many more states are adopting the system because the operation and maintenance cost is very low in comparison to enormous benefits.

- **Appropriateness of context**

The application fully meets the aspirations of the Forest Dwellers. The best tools and practices have been adopted for the first time in an innovative manner be it survey using GPS be it electronic land record keeping and be it giving digital maps on title deeds to claimants. All this has been done smoothly and seamlessly. The practice has been naturalized and absorbed locally by all the users in different parts of the country.



Digital Record Keeping

- **Enhancement of Efficiency**

The application strongly exhibit efficiency enhancement almost in all the tasks which were automated. The kind of time and efforts which have been saved is reflected from the fact that some states have yet to begin the process while the job in MP is almost over. This has improved the public faith in the government delivery mechanism.

The process automation has reduced learning curve of field staff and eliminates the necessity of high skilled man power like surveyors and GIS personnel thus saving time.

In the new system, map creation and area calculation, both are machine (GPS PDA) based. Therefore, the chances of manipulation or manual errors were eliminated. Thus reliability of delivery mechanism has been enhanced.

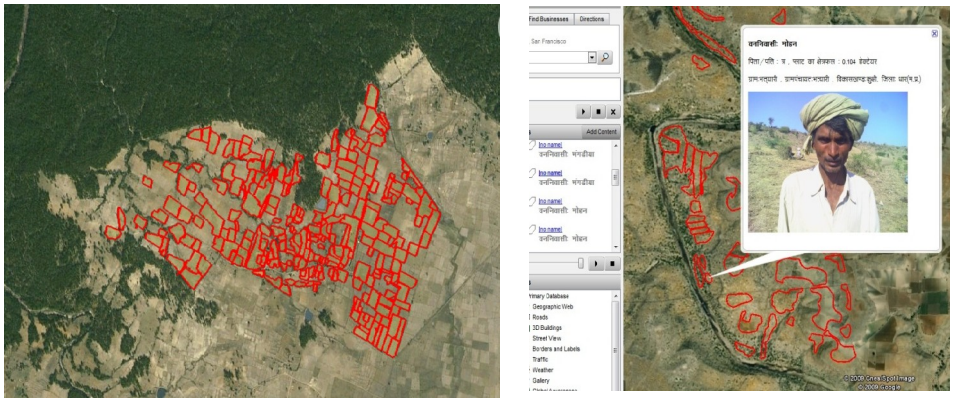
The system also provides facility to all stakeholders to view the survey details of each dweller including his/her photograph and location of their land holdings on High Resolution Satellite Imageries. Supporting details have been made available to the concerned agencies for audit trails. Thus transparency has been enhanced.

- **Innovation**

The uniqueness and innovativeness of the project is mainly reflected by its characteristics of integration of various technologies which is based on technology components such as:

- Space technology
- GIS & GPS
- Mobile Computing using GPS enabled PDA (Personal Digital Assistant)
- Internet Technology
- Centralized Server based processing
- MIS

Visualization for Social Audit



- **E-Inclusion**

The application exhibits e- inclusion of masses, different user groups and departments and states and even the electronic and other media. As a result the use of GIS and GPS and Satellite Imageries came from the lab conditions on the palm top of the people for the first time in the country thereby making e inclusion an accepted phenomenon.

Conclusion

The system has opened new possibilities in terms of design & delivery of services. In fact it is a completely new and novel service which has brought relief to both frontline staff and the managers and decision makers. The system has paved the new ways to manage environment/ natural resources. It has shown the path that integration of various technologies can bring lot of ease in monitoring the land based key programmes and services of the government sector both G to G and G to C.