“USE OF GEO SPATIAL TECHNOLOGY FOR CROP DIVERSIFICATION IN HIMACHAL PRADESH”

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Abstract:
Remote sensing and GIS has emerged as an effective tool for the macro and micro level mapping of natural resources. Himachal Pradesh being a state with highly diversified terrain ranging from low hills to high mountain ranges has provided a challenge in the agriculture from further enhancing and utilising the latest technologies as compared to the rest of the states. This results in promoting the shift from traditional agricultural practices to much more diversified agriculture. Crop area diversification essentially advocates moving away from growing a single crop to a number of crops in different combinations in the same piece of land. It has been recognized as an effective strategy for achieving the objectives of food and nutritional security, income growth, judicious use of land and water resources, increase in external input use efficiency and thus, sustainable agricultural development and environmental improvement. In this current study the spatial databases of various project sites have been prepared and such as topography, soil type, land cover. The sites have been chosen and with satellite imageries will be used to monitor the changes from the time to time. The study provides an extensive inventory of the assets being constructed in various project sites which can be accessed and reviewed using the internet on the field and by the beneficiary farmers at the project sites. A web Base GIS portal has been developed using the ESRI Arc server web services technologies which can be updated and queried for any project site and the information can be gathered for any particular asset. The portal thus developed provides transparency in and can be used to easily check on the various activities being carried out under each project site. The base line datasets are superimposed over the satellite imageries to identify the immediate changes on the ground. This type of methodology is first of its kind in the state under which the model is being framed to carry out micro level mapping in agriculture.

Keywords: GIS, Arcserver, Web portal, Agriculture.

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Introduction

Himachal Pradesh (HP), situated in the Western Himalayas, has majestic mountains, fertile valleys, perennial rivers, precious forests, invaluable flora and fauna, tremendous wealth of resources, minerals, very rich culture and diverse customs and manners. The state of HP is situated between 30° 22′ 44″ to 33° 12′ 40″ N latitude and 75° 45′ 55″ to 79° 04′ 20″ E longitude (Fig. 1) and occupies an area of 5.57 million ha.

Himachal Pradesh is a hilly state with a general increase in elevation from west to east and south to north ranging from 250 m to 7000 m. One-third of its area remains snow covered for about seven months in a year. This snowy part of the state is the source of three major rivers – Beas, Ravi, and Chenab, while Satluj and Yamuna Rivers originate from Tibet and Yamnotri, respectively. Its climatic conditions vary from extremely hot to severe cold regions like Chamba, Kinnaur and Lahaul-Spiti. Dharamsala and Palampur in Kangra district receive the highest precipitation next to Chirapunji (highest rainfall in the world), while areas like Spiti almost have no rainfall during the winter season.

The HP Crop Diversification Project aims at promoting crop diversification in the target area of five districts (Bilaspur, Hamirpur, Kangra, Mandi and Una) in the State of Himachal Pradesh, through development of necessary infrastructure such as irrigation facilities and farm access roads, along with develop or rehabilitate existing facilities in approximately 210 irrigation schemes in the area to bring additional area of 3,712 ha under assured irrigation, and will construct or improve 100 km of 147 access farm road etc. In order to see all the project sites along with their activities (taken or accomplished), there was requirement of GIS based Single Window System and later on use the system for monitoring. Remote sensing and GIS has emerged as an effective tool for the macro and micro level mapping of natural resources. With the increased resolution in RS data the accuracy in mapping has increased multifold and further these data may be uniformly overlaid on the geographical maps of the region or locality with various GIS packages. In order to have people’s viewpoint in the validation of ground level truths and actualization of planning and management of natural resources the PRA/RRA (Participatory Rural Appraisal/ Rapid Rural Appraisal) exercises are very useful. These exercises are helpful in identification of the sites for the construction of water harvesting structures, mapping the potentiality of the natural resources and most important thing is that it ensures people’s participation in the management of natural resources. Thus, the participatory RS and GIS is the need of hour for micro level planning and management.
Objectives

Development of WEB based GIS portal to be used as an interactive platform for regular updation of the following GIS datasets for the 210 sub projects located in five districts of Bilaspur, Hamirpur, Kangra, Mandi, and Una with following specific deliverables:

i. Generation of dynamic spatial data for all layers of Detailed Project Report (DPR) & their uploading on WEB GIS Portal.
ii. Porting of completed DPRs’ work, preparation of spatial data of all the actual constructed structures/assets generated
iii. Geotag images of structures/assets actually constructed at project sites or any other field data shall be incorporated in Web Portal.
iv. Monitoring of the implemented schemes over the time thereby identifying the GIS based change detection using time-series satellite imageries (depending upon availability of cloud free data of study area/season ) or using Khasra wise attribute data of the study area.

Methodology

Geo Database Generation:

The major objective of the study was to provide an online solution that can provide spatial information that could be used for planning and monitoring crop diversification. To enhance the geospatial experience, the CGRT team implemented ArcGIS Server that maintained and published datasets and geo tagged images and other important data attributes, ensuring better data visualization at the state and national levels. The spatial database infrastructure (SDI) needed to be framed which could handle query based requests from the various clients. The SDI shall enable the instant changes and updates from various nodes at Project Management Units(PMU) located at different geographic location one at each district. GIS architecture required a platform where data visualization can become easier and can enable systematic monitoring of the standardized datasets. The detailed action plan prepared by the PMU was required to be ported on the
system. The SDI developed was required to enable the transformation from the DPR drawings from CADD outputs into the GIS architecture.

Advantages of Arc Server:

The study required an online solution to provide the spatial data that could be easily maintained and monitored at national and International agencies. Developing a system required maintenance of a dedicated database system that can easily incorporate the regular updates besides a mechanism of back ups. The system in place also required the easy publishing of spatial datasets over the internet either in the form of WMS or WFS whichever was required at the later stages. Various web based GIS solutions were explored like Mapserver, Chemleon, postgresQL for designing and implementing the SDI for the study. The major shortcoming in going to the open source solution was requirement of experts in programing who can code and encode the spatial data with the database and display the theme based output. This required of building the map files which needs to be understood and symbols for each of the asset or feature that needs to be displayed needs to manually programmed. The study also required the geotag images to be linked with each asset and this was not possible with open source solutions at one place. The storage of the media files in the database was a bit tricky to do and again required some expert programing skills. Since the study included more than 90 project sites and the programing of symbol in map file was a tedious task. The spatial database that was to be ported over the internet also required to be queried and updated form the client end (survey groups), this was also a bit tedious to do in open source solutions. The best solution that met the requirement of the study was Arc server. The advantage of using the arc server to port and publish the spatial data as service was its compatibility with arc map. Any project site was prepared in arc map and published directly on the server was easy to maintain and configure at any time as and when required. Some of the advantages of the SDI system built on arcservlet are as follows:

- Easy to port the existing shape file into the database.
- Required minimum programming skills
- Publishing of datasets at ease
- Geotagging of asset images and other document including media files.

Outputs:

ArcGIS Server and Arc Map helped in publishing datasets in project reports without having to upload them on the map server each time. It helped the survey groups to save time and complete research within deadlines. The integration of the new software solution benefited users by regularly monitoring and providing updates for each agricultural asset. The overlaying Esri maps offered CGRT an interactive platform to perform analysis and identification of the sites. With ArcGIS Server, the surveyors centrally managed the geo-data to extract important asset information and were able to simply their workflow owing to the following:

- Systematic monitoring of standardized datasets
- Instant changes and updates, which could be made at any time at the client’s end
- Regular data backups using PostgreSQL
Simplified republishing of changes at different project stages using web templates

Features of Web based GIS Spatial Information System:
Web GIS portal that is designed and developed is available at http://14.139.224.135/myapp/cgrt/index.htm with following highlights:

- Generic State Information
- Selectable Project sites based on specific DPMU - BPMU
- Information of sub-project sites
- This information is based on DPRs being provided by HPCDP. It will contain descriptive information of individual layers and their attributes (namely Khasra Boundary, Chak Boundary, Contours, Nala(Source), Bouri, Channel, Desilting Chamber, Distribution Network, Foot Path, Head Weir/Check Dam, Junction, Outlets, Pump House, Rising Main, Road, Water Storage Tank etc) of sub-project sites.
- Each layer can be independently queried for identification and description.
- Miscellaneous Information for each project (namely Action Plan Map, Salient Features, Khasra wise details) is displayed alongside the project map.
- Relevant Drawings of project (Desilting Chamber, Distribution Channel, Main Channel, Outlets, Pump House, Water Storage Tank) are also displayed alongside the project map.

Fig: 3 Main Login window for secure access to portal
Fig: 4 Project sites and attribute data on one click
Fig: 5 Action plan map(DPR) ported for each project site
Fig: 6 Geotagged Image of actual asset tagged at actual location
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