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Report on Design and Functional Evaluation of GIS Portals

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National Institute of Advanced Studies
Bangalore, India

Report on Design and Functional Evaluation of GIS Portals

(USGS-NATIONAL MAP, GOOGLE EARTH, BHUVAN, (INDIA) NSDI, MAPMYINDIA, PROTOTYPE K-GIS, SURVEYKSHAN AND NICMAPS)

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DST SPONSORED PROJECT ON STANDARDS, FOUNDATION DATASET AND TECHNOLOGIES FOR NATIONAL GIS

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FOREWORD

National GIS is the need of the hour in India and Department of Science and Technology (DST) is embarking on an institutionalised system that will ensure availability and accessibility to systematic and standardized GIS data and Decision Support applications to different ministries/departments and user groups. NIAS has completed a project to define the National GIS Standards and Spatial Framework and also identified key technologies for National GIS.

A major element of National GIS will be the GIS-based Portal – the one-stop access to the geographic information and applications. The success of National GIS will solely rely on "how easily and efficiently it provides data and applications services" to users – thus, user-index is a key measure of success. Globally, in portal state-of-art, those that have been efficient, reliable, robust and consistent have made the mark – many have been way-laid aside in time.

In India, varieties of Portals have been organised – those that just display images and maps in a slide-show thru those that are data-banks and collection of data holdings thru those that provide minimal analytics. Internationally too, various Portals have claimed varied level of capabilities. However, we see that the claim for "GIS Portal" is pervasive and wide and many come on the band-wagon.

The contours of National GIS Portal have been elusive and less understood. What makes a National GIS Portal? This has been a vexing question all round – with the claims being made all over, more confusion prevails rather than scientifically based definition and implementation. In this "clouded" eco-system, there has been the need of a scientific and documentary analysis of what could be the specifications for a National GIS Portal and whether any of the existing ones matches the needs.

This question was being grappled in our study for the National GIS Portal Standards. Half-way into the study, the team of researchers associated with NIAS decided to take on the challenge themselves and come with some meaningful answers. The research team decided to painstakingly analyse and assess 8 GIS Portals - USGS National Map, Google Earth, Bhuvan, NSDI-India, NICMAPS, Surveykshan, MapmyIndia and proto-type Karnataka-GIS Portal to find the answers. We were initially skeptical about this analysis and were not sure of whether the results would be meaningful and help the study. But these 3 young researchers surprised us and the team literally took on the task of "T&E team" and systematically studied and drilled into each and every functionality of these 8 Portals. They looked into the content, they analysed the functionalities, they studied the services, assessed the design, looked at reliability/robustness/consistency and, most importantly, use-index of how easy it is to use. Very soon, we had a clear picture of the depth and granularity of these 8 Portals.

Poring over more than 50, 000 page-flips on the internet, they stitch-by-stitch seamed in large number of observations into meaningful tables and documented their analysis into this report. This report is an outcome of their untiring efforts – which I think provided FOR THE FIRST TIME a

good intra- and inter-Portal comparison.

The results and observations that have been documented itself are secondary – because the purpose is not to be critical but to be analytical of what constitutes and what-is. I feel that the report is more a symbol of systematically undertaking a Portal analysis and documenting the results – something which forms the core of a good software development and T&E process. I must confess – but for this exhaustive analysis, the design perspectives of National GIS Portal Standards would have been difficult to recommend in our study report – Standards, Spatial Framework and Technologies for National GIS (R30-2015 publication of NIAS).

I urge the reader - this analysis must be seen in right perspective – it was done during July, 2014 to May, 2015 – analysis was done many times over and numerous cross-checking exercises. Now, in may, 2015 and later, the Portals themselves might undergo changes and might improve their capability and functionality – even as this report is issued out. It is also possible to expect that the team might have missed out or made interpretations that can be countered. This report documents a time-stamp of the Portals. But, I believe, that is the way of technology and product development.

The 3 researchers have, I think, gained tremendous experience and enhanced their capabilities – I think for the first time they donned the cap of "Portal Testers" and meticulously analysed bit-by-bit of the Portals and also critiqued their own work carefully. They learnt – and that is significant!! Such young researchers, there are so many more across the country, have the potential and can become the skilled expert force for National GIS and many more such nation-building activities.

I congratulate Shilpa, Vilas and Diksha for a very good work done and this excellent report. I take this opportunity to wish them the very best and hope that their knowledge and experience will further contribute in a more significant manner for national mandates in the future.

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June 9, 2015

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Executive Summary

National GIS Portal is envisaged as a national gateway for accessing all GIS services – GIS data, GIS applications and GIS Metadata. It is through the National GIS Portal that users will make smarter governance decisions, develop relationships and increase citizen engagement. As a part of looking at National GIS Service Standards, various GIS portals of the world were evaluated and assessed – to determine a "bar" that needs to be set for functionality, excellence and quality for National GIS Portal. Below is a summary of the evaluations:

- The NATIONAL MAP 2.0 Portal of United States Geological Survey (USGS) provides a "window" to US spatial data along with satellite images and has robust capabilities of GIS services – viewing and querying. USGS National Map doesn't really offer specific GIS applications – especially as it is mainly a map viewer. The most important aspect of the USGS Portal is the rich data content for the whole of US. The Portal facilitates building queries among spatial data as well as attributes data.

- Google Earth is the most widely used image and map Portal to view earth's surface and other planet's data. Google offers 1m images all over India and even 0.30m images in certain areas. Apart from images, Google Earth offers basic layers of road, railines and large volume of POI data. Ease of use is the strongest point of Google Earth as even common citizen and government agencies depend upon Google Earth. Design is very robust and the Portal is high-performing.

- Bhuvan is a "portal" of National Remote Sensing Centre (NRSC) for displaying IRS images and thematic maps – providing a "window" into the spatial data holdings of NRSC and NNRMS projects. Bhuvan has "lots of data" – mainly coming from NNRMS project outputs from 2002 onwards – this makes it more a "GIS data-bank" or a digital map REPOSITORY of NNRMS projects. Bhuvan services are just visualization tools and Bhuvan does not have integrative/ applications and decision-support capability – even basic GIS querying capability is lacking. Design of Bhuvan and its user-interface needs considerable improvements – as it is too "complex" and not uniform functionally – thus making it very difficult for users to understand and use the Portal for regular decisions. Reliability of the content and displays has major gaps – performance is quite slow and also non-uniform across modules.

- India-NSDI Portal is supposed to facilitate search on India's map/image metadata holdings – one of the earliest portals aiming to provide spatial information metadata services. A basic India administrative hierarchy is encapsulated in the Portal – but there is hardly any Metadata populated – though the schema and structure of NSDI Metadata Standards has been encapsulated.

NSDI portal does not have any GIS applications and integrative capabilities. Performance is very slow and reliability of data is a major gap.

- MapmyIndia Portal is first private map Portal in India - through which it provides "visual window" of nation-wide basic map data holdings and large amount of POI data that are constantly updated. Location-based address geo-coding has been successfully provided in many cities in the Portal. The Portal offers specialised location/navigation services and also commercial services. MapmyIndia has good basic GIS data that is well updated BUT does not offer any GIS applications/integrative capabilities.

- Prototype K-GIS GIS Portal has been developed by Karnataka State Remote Sensing Application Centre (KSRSAC) through which it provides access to its large state-wide image/map data access with tools for "displays and basic queries". The Portal has 51+ 1:50k content AND alls of these are seamless to the state of Karnataka – BUT are of different timelines (coming from different RS and GIS projects of KSRSAC). Prototype K-GIS Portal does not have applications/integrative decision-support capabilities.

- Surveykshan is a Geoportal of, Survey of India which is responsible for all geodetic, geophysical and topographical surveys and maps within India. Surveykshan displays Survey of India's Digital OSM maps in WMS format, which is at present available for 22 states of India. The Portal is quite poor in performance and reliability and continuity of data – which are not GIS-Ready. GIS Applications for decision-support is not available.

- NICMAPS is a "portal" of National Information Centre (NIC) through which it provides "visual display" of GIS data from NIC and map data from Survey of India (SOI) and other agencies along with non-spatial data holding of NIC. NICMAPS provides a "window" to full-coverage Indian spatial data along with satellite images. NICMAPS does not support any application on the portal but has advance services like Locators, Swipe & Spotlight, Elevation profile and so on. The portal is quite stable and data available on it is quite robust.

1. Background

1. National Institute of Advanced Studies (NIAS) has undertaken the study on "Standards, Spatial Framework and Technologies for National GIS" – a sponsored project from Department of Science and Technology (DST), Government of India (GOI). As part of this study, the research team has undertaken a thorough evaluation of some of the GIS Portals accessible - especially to understand and document the capabilities in the context of National GIS Portal Standards.

2. Within the ambit of research that we have carried out, we note that a GIS Portal allows sharing of GIS-ready maps, help search and discover GIS content, perform and share GIS applications, make access GIS data and also update and modify GIS content in the Portals – all of these on a web or mobile platform without use of any addition "software" resources. The Portals – either serve a public-good model and may be free for access OR may be accessible on commercial basis.

3. NIAS team has studied the following GIS Portals:

   - USGS National Map Portal (http://viewer.nationalmap.gov/viewer/)as of July, 2014 and again in April, 2015.
   - Google Earth Portal (https://www.google.com/earth/download/ge/) as of July, 2014 and again in April, 2015.
   - Bhuvan Portal (http://bhuvan.nrsc.gov.in/bhuvan_links.php) as of July, 2014 and again in April, 2015.
   - NSDI Portal (http://www.nsdiindia.gov.in/nsdi/nsdiportal/index.jsp) as of July, 2014 and again in April, 2015.
   - MapmyIndia Portal (http://maps.MapmyIndia.com/) as of July, 2014 and again in April, 2015.
   - Karnataka G2G Portal – limited time access on (http://164.100.133.66/g2g/#/Views/LoginPage.xaml) as of July, 2014 and again in April, 2015.
   - Surveykshan Portal of Survey of India – (http://www.surveykshan.gov.in/) as of November, 2014 and again in April, 2015.
   - NICMAPS Portal of NIC (http://nicpmaps.rsgis.nic.in) as of November, 2014 (in April, 2015, NICMAPS was not available as it showed "under maintenance")

4. As part of the assessment, we have looked into 4 key issues – GIS data content in each Portal and addressing granularity/details, quality, reliability, accuracy, standards adopted, updates/maintenance etc; functionalities of the Portals for assessing what are the GIS functions and

Applications capabilities that the Portals have –addressing aspects of visualization/display, query, integrative analysis, GIS Applications publishing, reliability, repeatability etc; architecture and design to look at how well the design and architecting of the Portal – addressing the robustness and functional reliability and consistency of the Portal and general aspects of usability and ease of common usage of the Portal. Each of the 8 Portal has been addressed on these parameters and the analysis documented. Hopefully, this assessment will help determine the "specifications bar" that needs to be defined for National GIS Portal and help in the design and development of National GIS Portal.

5. This report describes in detail the analysis undertaken and assessment of the 8 Portals. Each of the Portal has been described in detail. This report has been further assimilated and analysed by the NIAS Project Team and incorporated into the NIAS Project Report on National GIS Standards, Framework and Technologies of May, 2015[1].

[1] Mukund Rao, V S Ramamurthy and Baldev Raj - Standards, Framework and technologies for National GIS. A NIAS Publication R30-2015 of May, 2015.

2. USGS National Map

2.1. INTRODUCTION

6. USGS THE NATIONAL MAP 2.0 Viewer is a "portal' of United States Geological Survey (USGS) through which it provides "visual display" of USGS and various other organisations (Government & Non-Government) dataset.

7. USGS THE NATIONAL MAP 2.0 Viewer has successfully managed to display the remote sensing images and thematic maps – providing "window" into the spatial data holding of USGS and other organizations. USGS has successfully provided good content, quality and services through portal to GIS community.

8. USGS THE NATIONAL MAP 2.0 Viewer of USGS is that it provides a "window" to US spatial data along with satellite Images. However it can be compare with few other map services provider like Google in terms of location findings and routes between locations. But USGS THE NATIONAL MAP 2.0 Viewer fall apart in that term since this is core spatial data viewer with valuable services such as natural hazards and so on. If USGS NATIONAL MAP 2.0 Viewer considered being "core" GIS data viewer then Google can be considered to be "overview" of data viewer.

9. This report includes an independent test and evaluation – technical report of design and functional characteristics of USGS - USGS THE NATIONAL MAP 2.0 Viewer at - http://viewer.nationalmap.gov/viewer/ as of July, 2014 and again April, 2015.

   9.1 This is not a critic but an evaluation and observations of the portal. The analysis of the capabilities of USGS THE NATIONAL MAP 2.0 Viewer the study has been taking up by NIAS Research team to give insight into the standing-level of GIS Portal and help us to get a more standards and high-quality progression for National GIS.

   9.2 The efforts of USGS THE NATIONAL MAP 2.0 Viewer are significant since USGS have administered spatial data in "portal" format.

   9.3 The concept of evaluating the "bar" that needs to be set for excellence and quality that matches any other efforts in the world, nay, not just matched but surpasses it to make a high-quality GIS Portal of India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

2.2. USGS PORTAL DATA

10. USGS has the following project dataset:

10.1 **Base Data Layers** - US TopoAvailabity (3 layers),Geographic Names (10 Layers), Structures (10 Layers), Transportation (14 Layers), Government Unit Boundaries (18 layers), Map Indices (10 Layers), Hydrography (NHD) (13 Layers), National Land Cover Database (NLCD) (27 Layers), Elevation Availability (4 Layers), Elevation Contours – Small Scale (1 Layer), Imagery – 1 meter (1 Image), Imagery – 1foot (1 Image), Reference Polygon (Layers 12)

10.2 **Natural Hazard** - USGS US Hazard (15 Layers), USGS Stream Flow & Weather Station (5 Layers), FEMA National Flood Hazards (32 Layers), NEXRAD Weather (1 Layer), NGA US National Grid (102 Layers)

10.3 **Other Feature Data**- Scanned Topo Maps from USA Topo (1 Image), USGS Ecosystem (5 Layers), USGS Protected Area Owner (PADUS) (1 Layer), USGS Protected Area Conservation Status (PADUS) (1 Layer), USGS GAP Land Cover (3 Layers), FWS Wetlands, BLM Public Land Survey System (PLSS) (14 Layers), National Park Services (NPS) Boundaries (4 Layers)

11. In **Table-2.1** a detailed assessment of USGS has been provided. The map and images data in USGS has the following characteristics:

11.1 USGS has managed to incorporate data on portal through various sources. They not only have their own team to collect data but also collect data from various other organizations like governmental & non-governmental.

11.2 Since data available for entire country, there are various layers available with different scale. The data is available from 1:36,000,000 to 1:1,128 since layers cover entire nation till small city road. Labels have been separately maintain in group and can be switched on as user's requirement.

11.3 Two high resolution satellite images (1m and 1foot) have been integrated with different resolution; switching on both at a time covers entire nation.

11.4 Grids with different quadrangle index have been used in order to view large to small scale data.

11.5 Almost all the data is latest and keep on updating periodically. Also they maintain historical maps in the portal.

11.6 Portal has collected tabular data from other government organisation and incorporated it with spatial layer which help spatial layer to draw rich analysis reports.

11.7 USGS has its own real-time warnings & alerts data capability but crowd sourcing. Portal has connected to tidal information radio station which keeps on giving information with an interval of 15 minutes. Also portal gives warnings & alerts about natural hazards taking place nationwide.

11.8 USGS data is in GIS-Ready format. Data can be downloaded with ready to use formats like .shp & .gdb.

12. From technical perspective, USGS is very close to GIS portal with various spatial data that are put in it. From technical stand-point, USGS pleases user with making available huge spatial data and helps them in their decision making.

2.3. USGS PORTAL SERVICES/APPLICATION

13. In **Table-2.1** a detailed assessment of USGS Portal has been provided. Below is some important observation/example of the portal.

13.1 USGS doesn't really offer any application related to particular subject but has its own services which helps user to do comprehensive analysis.

13.2 Portal allows user to add their data directly on the portal. That data can be GIS Services or Google files. Since portal has wide range collection of data, by allowing user to add their data to the portal, increases the analysis skills. Today, different GIS platforms are available and with respect to that different GIS server services are available. USGS portal is compatible with those services to be added. Thus Portal doesn't limited to GIS platforms and increases of different user from various GIS platforms.

13.3 Portal facilitates building queries among spatial data as well as attributes data. Portal consist various spatial data with good amount of attribute data. Spatial query or attribute query helps user to enhance analysis skills.

13.4 Portal allow user to download data. This is one of the notable features. Downloading data is very easy and user friendly process. Though user cannot download every data available on the portal but can choose from available list. User needs to enter their email address and data download procedure can begin. Also portal has integrated special application for downloading data which is in beta version but it is positive approach from user perspective.

13.5 User can take print of their map analysis for their records or for study purpose. Portal allow user to define heading and description of the map. These maps can be printed in different formats as user's requirement.

13.6 Portal offers huge dataset to view or analyse, user can analyse their area of interest by adding & creating data on the portal. User can download that data (added/created data) in .shp format. This can help user to get the geo-referenced shapes/tags files

which is created on the portal and use it straight way on their local system. Data created on the portal can be considered as the benchmark by user to do their analysis with their data.

14. There are not any dedicated applications available on the portal.

    14.1 Thus the USGS service does not provide only map-display but also GIS integration with GIS support capability**.**

15. USGS has put good efforts on designing the portal.

    15.1 USGS does not have user log in, it is open portal to everyone. Portal has designed very well in order to make access of GIS data to any user from any industry. Portals, functionalities, tool and services and so on are well designed and very user friendly and easy to understand.

    15.2 User cannot save their data on portal or share with other user, user added data lasts till the session is on. User need to add data again with new session.

    15.3 The grouping & consistency of layer has done well and further these groups have categorized in easy understanding-access mode. The data available on the layer is very consistence and doesn't look jerky while moving or doesn't get stuck or hang while working on the maps. Even fast panning doesn't affect portal visualization.

    15.4 Help menu is very comprehensive. Help menu explains everything available on the portal and also other relevant information. Help menu has option call 'FAQ' where portal has stored information.

16. **Performance-** USGS performance is very good in spite of having huge database integrated on the portal. Arranging the layer in respective group and categorized it in group make them more stable.

2.4. SUMMARY

17. In summary, it is clear from above analysis that:

    17.1 USGS sets benchmark as GIS portal. It's a good combination of base map, satellite image & spatial data with relevant attributes.

    17.2 The display and visualization of USGS is good.

TABLE – 2.1: USGS PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	**Base Data Layers** - US Topo Availability **(3 layers)**,Geographic Names **(10 Layers)**, Structures **(10 Layers)**, Transportation **(14 Layers)**, Government Unit Boundaries **(18 layers)**, Map Indices **(10 Layers)**, Hydrography (NHD) **(13 Layers)**, National Land Cover Database (NLCD) **(27 Layers)**, Elevation Availability **(4 Layers)**, Elevation Contours – Small Scale **(1 Layer)**, Imagery – 1 meter **(1 Image)**, Imagery – 1foot **(1 Image)**, Reference Polygon **(Layers 12)**	There are total 308 layers with 60 groups which are well organised in relevant group.		Figure- 2.1
		Natural Hazard - USGS US Hazard **(15 Layers)**, USGS Stream Flow & Weather Station **(5 Layers)**, FEMA National Flood Hazards **(32 Layers)**, NEXRAD Weather **(1 Layer)**, NGA US National Grid **(102 Layers)**			Figure- 2.2
		Other Feature Data- Scanned Topo Maps from USA Topo**(1 Image)**, USGS Ecosystem **(5 Layers)**, USGS Protected Area Owner (PADUS) **(1 Layer)**, USGS Protected Area Conservation Status (PADUS) **(1 Layer)**, USGS GAP Land Cover **(3 Layers)**, FWS Wetlands, BLM Public Land Survey System (PLSS) **(14 Layers)**, National Park Services (NPS) Boundaries **(4 Layers)**			Figure- 2.3
2	Non-Spatial	NA			
3	User-ingest	Bookmarks, ArcGIS Services, KML data layer (Point, Line, Polygon)	User ingest are easy to operate. They are user friendly operation with minimum clicks		Figure- 2.4

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
B]	**VISUALISATION**				
4	Map Viewer	Map viewer has zoom slider, Scale bar, map scale and coordinates of cursor location. Map viewer can be viewed in full screen. Active tool information can be seen. There are options available to switch the base map. FAQ & portal policies has mentioned at the left bottom of map viewer. Progress bar (Loading) appears at the left corner at the bottom which shows which layers are updating while performing any query.	Map navigation tools available on map viewer are quite user friendly since it's easy to understand and use. By allowing to view map viewer in full screen mode, enhances visibility for user Its easy to change base map by making it available with individual tab. The name of base map defines the content of base map. Progress bar also give information about name of updating layer.		Figure- 2.5
5	Table Of Content	Layers are well organised in respective group. Layers are allowed to reorder in respective group. TOC can be hidden to have full screen window. TOC is a single container where portal layer, user added layer & marked as favorites can be accommodate. Groups can be collapsed and layers need to switch on to view on map. Mouse hover on layers gives a tool tip showing the display scale of the map.	The layers has grouped & categorised in very easy way which can be easily accessible by user. The available operations are possible with minimal clicks.	Over view window would have been added advantage.	Figure- 2.6

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
6	Navigation tools	Pan, zoom box, previous extent & initial extent are available. Navigation tools works very smoothly - maps and geographical names do not jerk while panning.	These tools are very easy to operate. The signs of operational symbols explain the work of it.		Figure- 2.7
7	Identify & locate coordinates	Information of location coordinates & elevation of particular point can be viewed in box. Information Box will appear on the map which will have relevant information as query. Coordinate display can be change. This allow user to choose coordinate of his choice.	This is quite simple and straight forward operation. In single click the information of respective operations appears in box. Also information box allows few more user friendly operations like buffer, get elevation & download data		Figure- 2.8
8	Measure	Area & distance can be measured by drawing polygon & line. The results appear in unit such as mile, kilometer, feet and so on. Drawn shape gives an option to download data (Polygon), zoom to that location, find out the elevation & and create buffer around it. These options make tools more user friendly.	Finding the area & distance is easy user friendly operations. The result appears in different units; that saves user's time for not repeating the procedure.		Figure- 2.9, 2.10

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
9	Buffer	Buffer can created around any shape (line, point, polygon). Buffer can be creating around the layers available on the portal. (Polygon, Line & Point). Range ring allow user to create buffer rings around the point. User can define the buffer distance around the shape in different unit. The count of rings and distance can be defined by user.	User can easily create buffer around shape (user defined/available layer). User has to fill minimum information to get desired buffer. Portal offers similar user friendly feature 'Range Ring' which is similar to buffer tool. The fixed parameter of tool makes it more easy to use.		Figure- 2.11, 2.12, 2.13, 2.14
C]	**SERVICES**				
10	Add Data	Portal allows adding external data to map window through 'Add Data' tool. User added data can be downloaded along with available data on the portal. User can add services from ArcGIS Server, WMS & WMTS. Also user can add KML files to map. There is Catalog Service Web (CSW) tool to add other services to map.	The tool available on portal 'add data' is very easy to operate. User can add ArcGIS REST Services, KML layers and some other services. By allowing to add external data on portal increases analysis capability of user's data with quantitative data of portal. Data cannot be stored on the portal for next session.		Figure- 2.15
11	Query Builder	User can build query on available service layers. Here user can build query by using operators (Mathematical, Logical).	This tool is totally guided by portal which makes easy to use for user. Each step of query tool is available with help which guides user how to use tool.	Query can be done on single layer from single group. Allowing more than single layer to be queried would enhance the chances of analysis result.	Figure- 2.16, 2.17, 2.18, 2.19, 2.20

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
12	Download Data	Data (Layers) can be downloaded on local system. Data can be downloading by defined bound box (User defined/coordinate extent), pre-defined polygons and map extent. Data can be downloaded in ArcGIS format (.gdb) and shapefile. User can directly use these file to perform their analysis. Data can be downloaded from specially developed downloading application. Nation wide data can be downloaded directly from National Dataset.	Download procedure is quite user friendly. Cart tab, in TOC, is specially designed for this. Data can be added / removed with the help of Cart option. Portal does not charge anything for downloading the data. Beta download application is good option which makes downloading procedure convenient.		Figure- 2.21
13	Print	Map can be printed in available formats such as JPEG, PDF, PNG, KML & JSON. User can print map with 2 easy steps, select print type & user can write title & description of the map.	Print is easy procedure to perform with minimum steps involved in it.	Map can have title and description. Map does not contain legends, map scale and the boundary box of the map. Allowing user to set desired extent would have been added advantage.	Figure- 2.22, 2.23

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
14	Annotation	User can add any shape or text to map with annotation option available on the portal. Shape & Annotation can be removed when it is not required. Also it can be exported in shapefile and KML. Creating annotation help user to make area of interest. Created polygon and relevant text can be seen on local system by exporting.	Annotation is well designed tool which helps user to add shape to map with minimum clicks. Similarly text can be added to map and can be customized to look good with easy available options.	Once shape is created cannot be modified.	Figure- 2.24
D]	**APPLICATION SECTORS**	NA			
E]	**GENERAL**				
15	Design/Architecture	Information of location coordinates & elevation of particular point can be viewed in box. Information Box will appear on the map which will have relevant information as queried Coordinate display can be change. This allow user to choose coordinate of as requirement. Portal has grids available with different quadrangle index to view small scale data. Data visibility option has been defined on the scale of data to avoid being clumsy.	User can easily access properties of individual layer with single click. In single click, multiple options are available. Information box appears with more option for which user doesn't have to perform extra query. Change of projection can be done in only single click and user can see the result immediately. This is single click operation. It gives liberty to user to change the coordinates from GCS to PCS and vice versa. Since small scale data is available, portal has made available small scale grids available to analyze that data.		

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
16	Text	Name available on the portal has been categorised in terms of fonts, color & text size to define the admin hierarchy.	Text properties have well defined. Properties explain the type of admin type.		
17	Others	Portal has extensive help menu which can be consider as user manual of portal.	Help menu can be accessed by clicking question mark symbol available on portal. It has many tabs which covers entire portal usage. Portal's help menu is quite informative. It has tab called 'What's New' where they populate latest updates and going to be updated.		
18		Base map tabs	Different base maps have designed for various purposes. They are easily accessible by clicking on the name tab.		

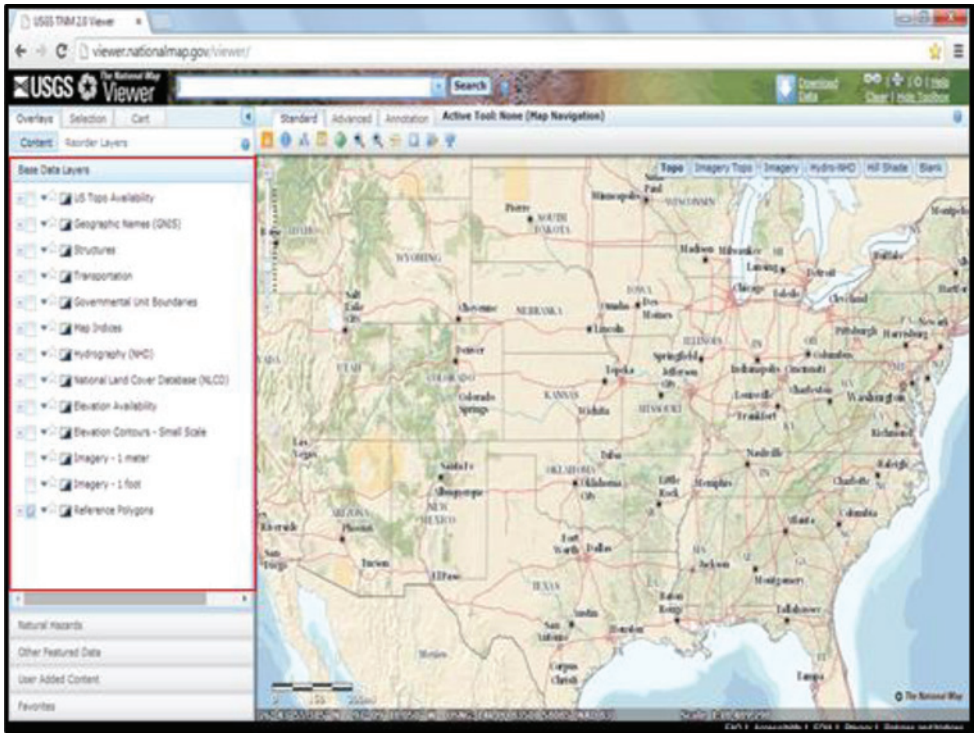


FIGURE-2.1- Base Data Layers

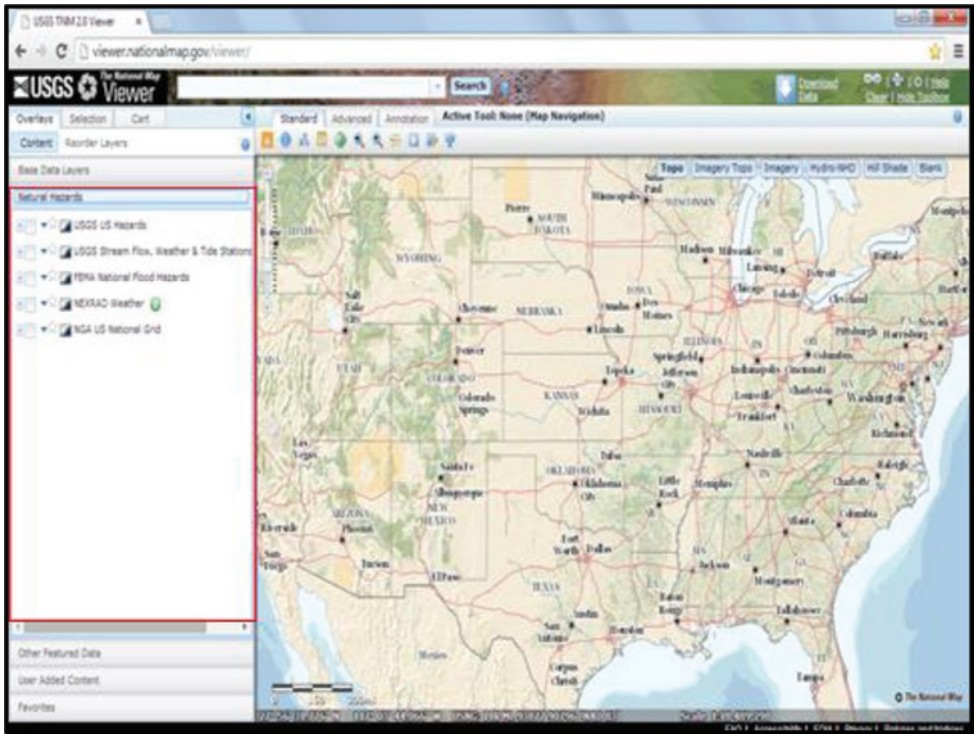


FIGURE-2.2- Natural Hazards layers

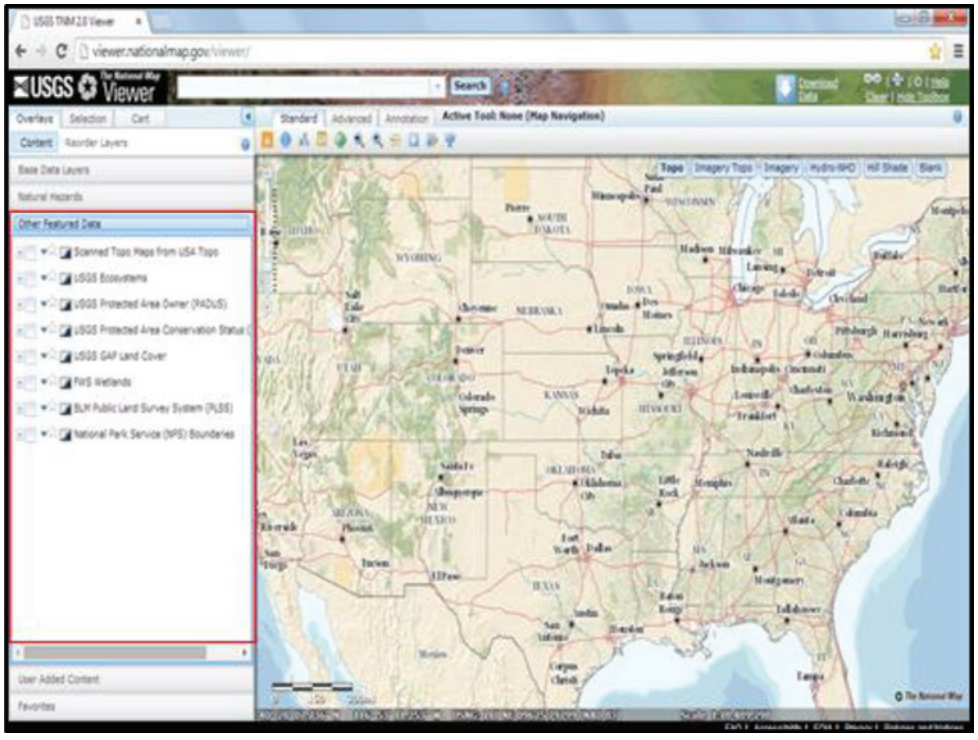


FIGURE-2.3- Other Feature Spatial Data

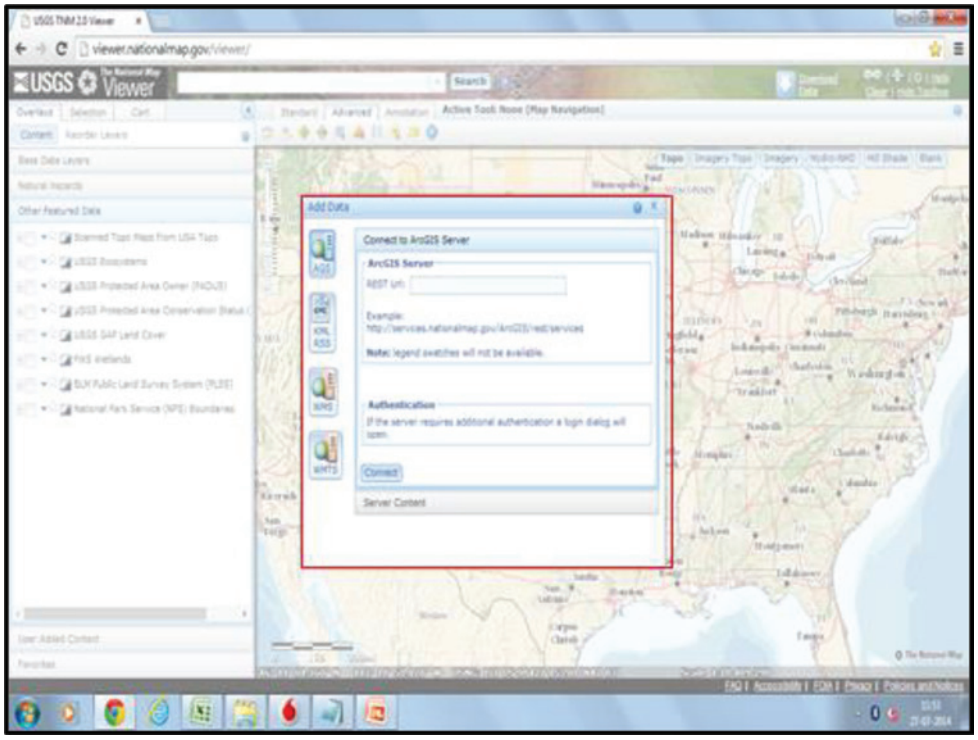


FIGURE-2.4- User Ingest Tool

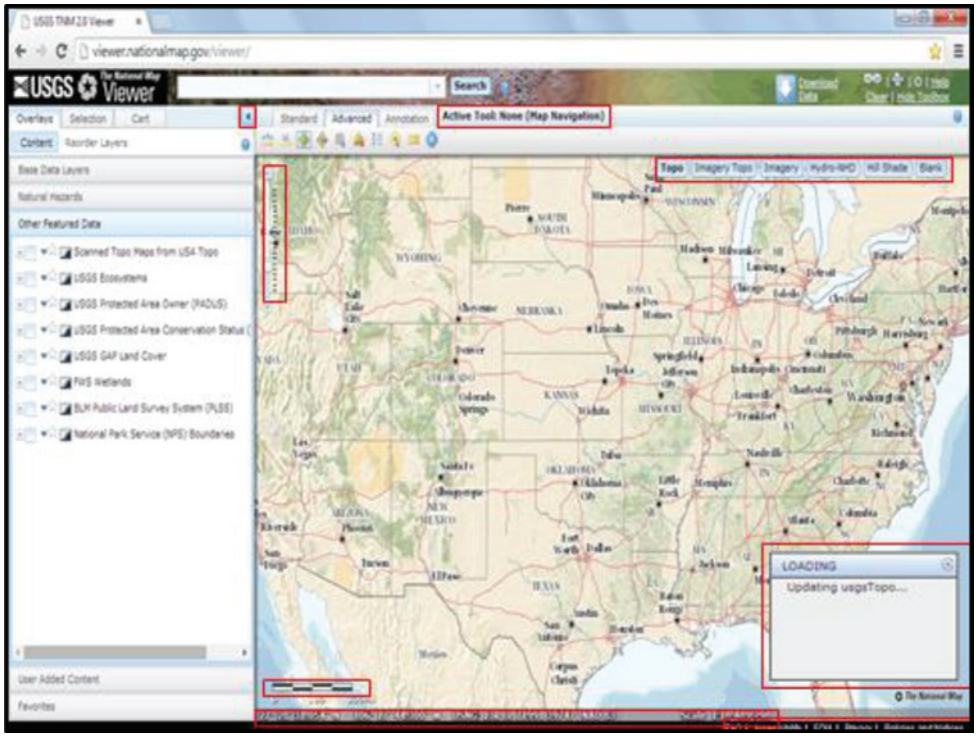


FIGURE-2.5- Map Viewer

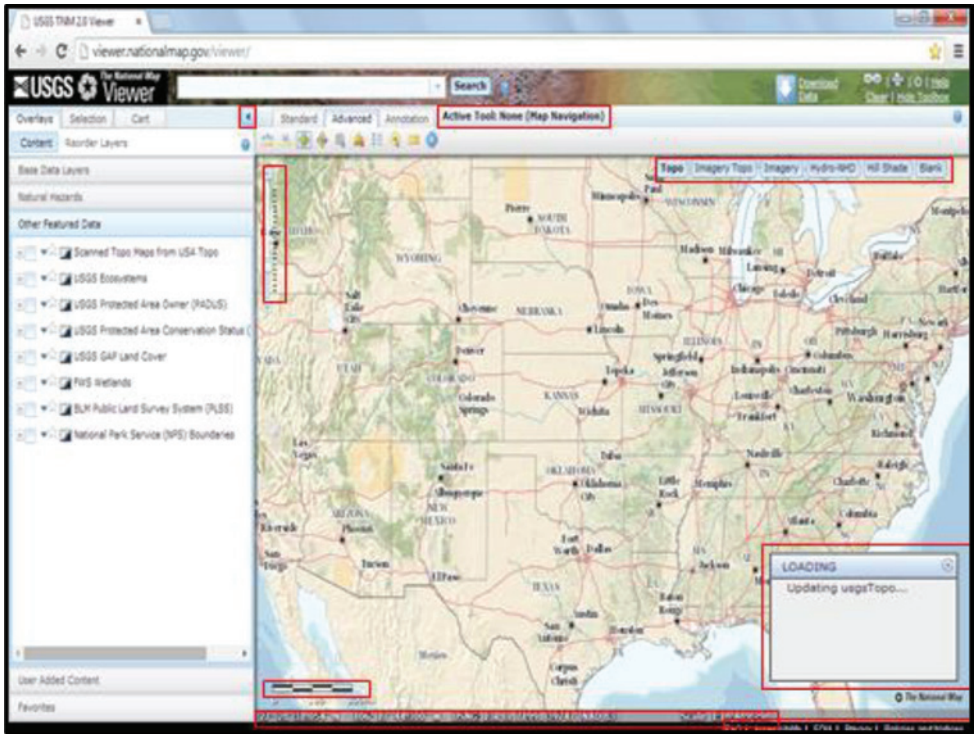


FIGURE-2.6- Categorisation of Table of Content

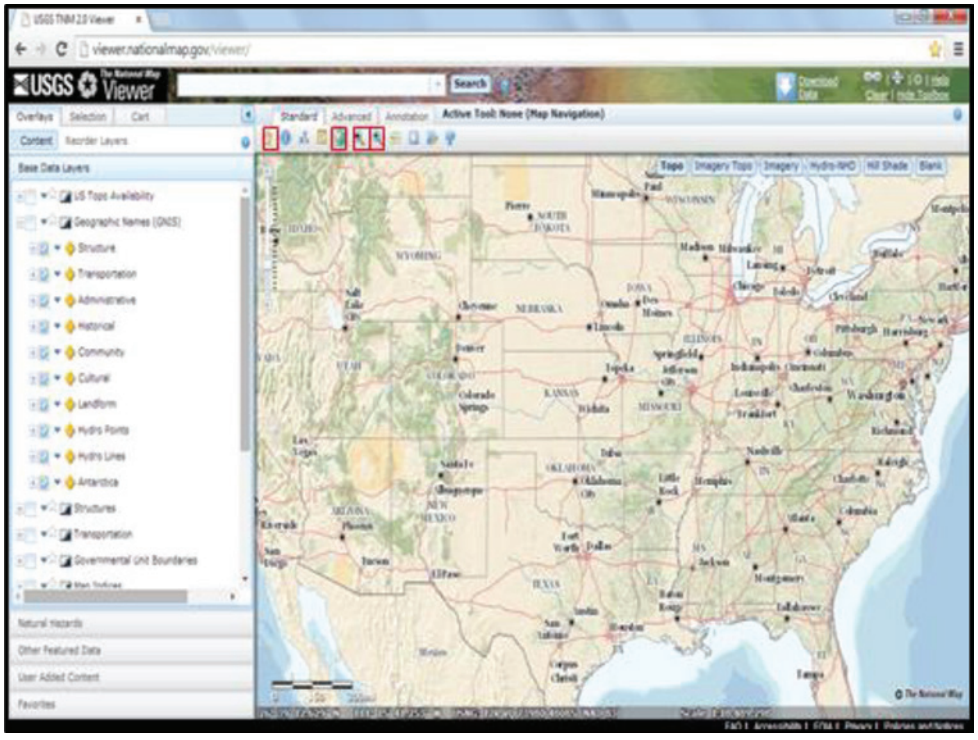


FIGURE-2.7- Navigation Tool

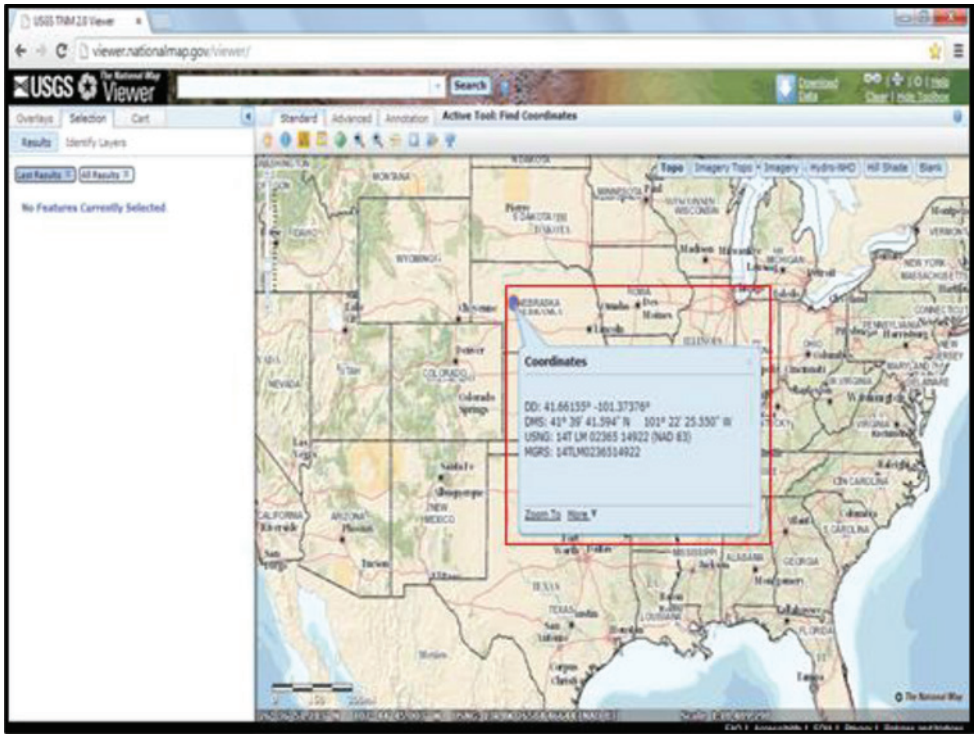


FIGURE-2.8- Identify & locate coordinates Tools

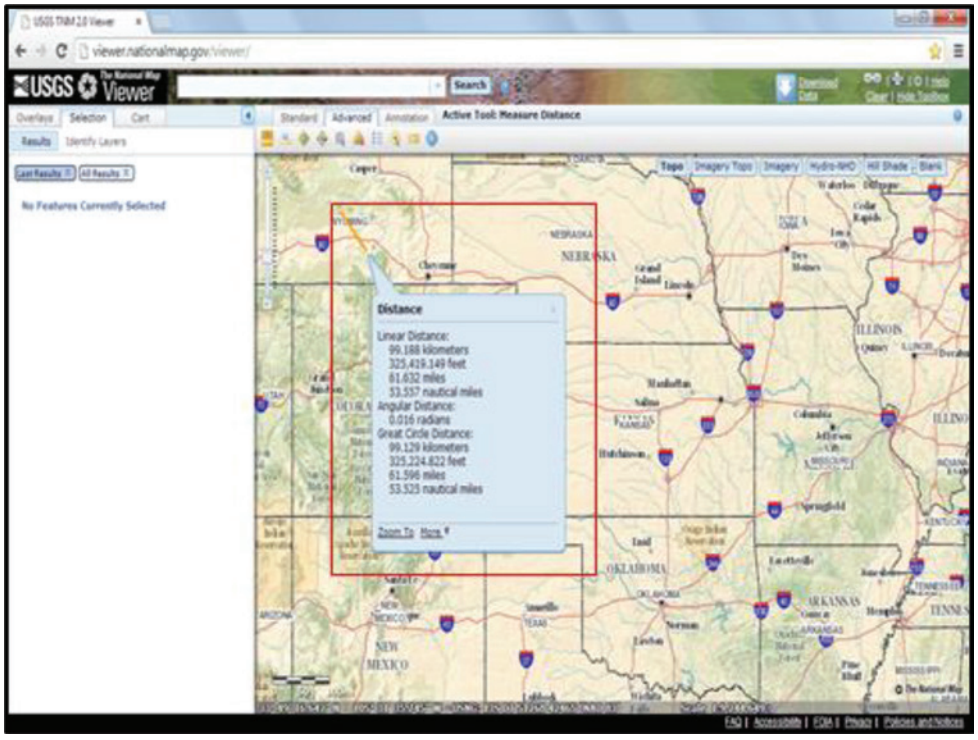


FIGURE-2.9- Distance measurement using Measure tool

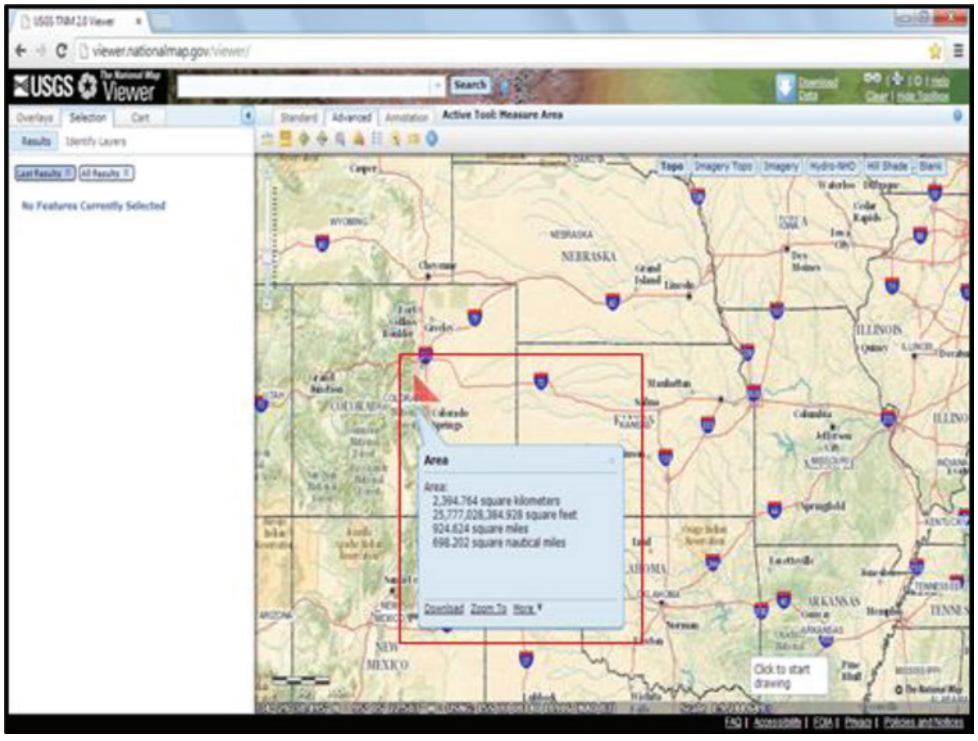


FIGURE-2.10- Area measurement using measurement tool

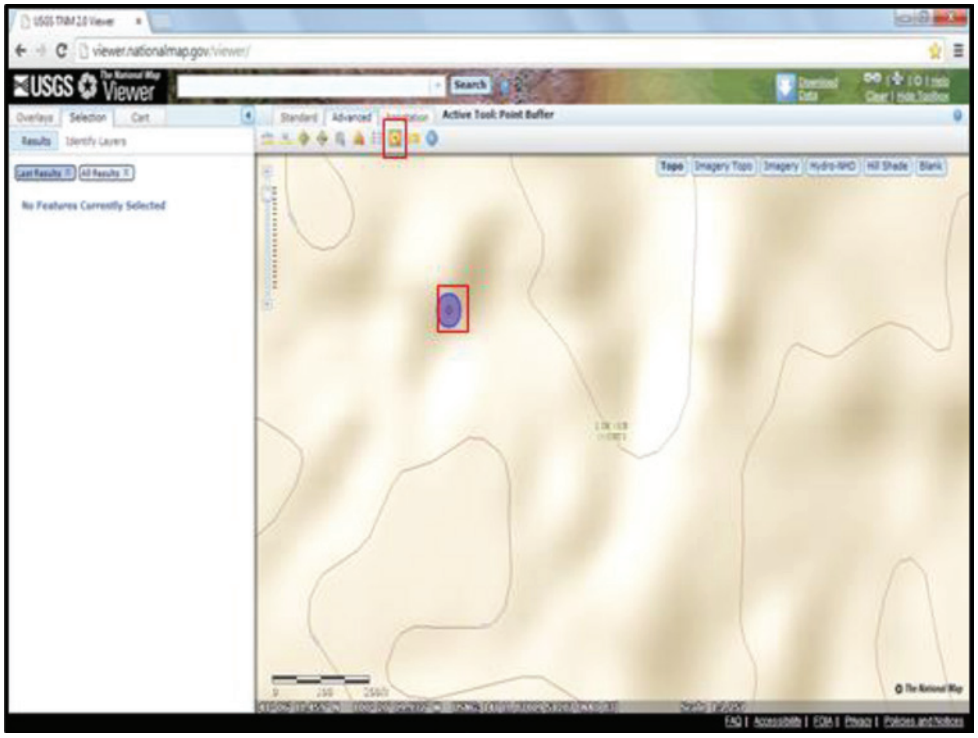


FIGURE-2.11- Buffer Tool functionality using line, point, polygon options

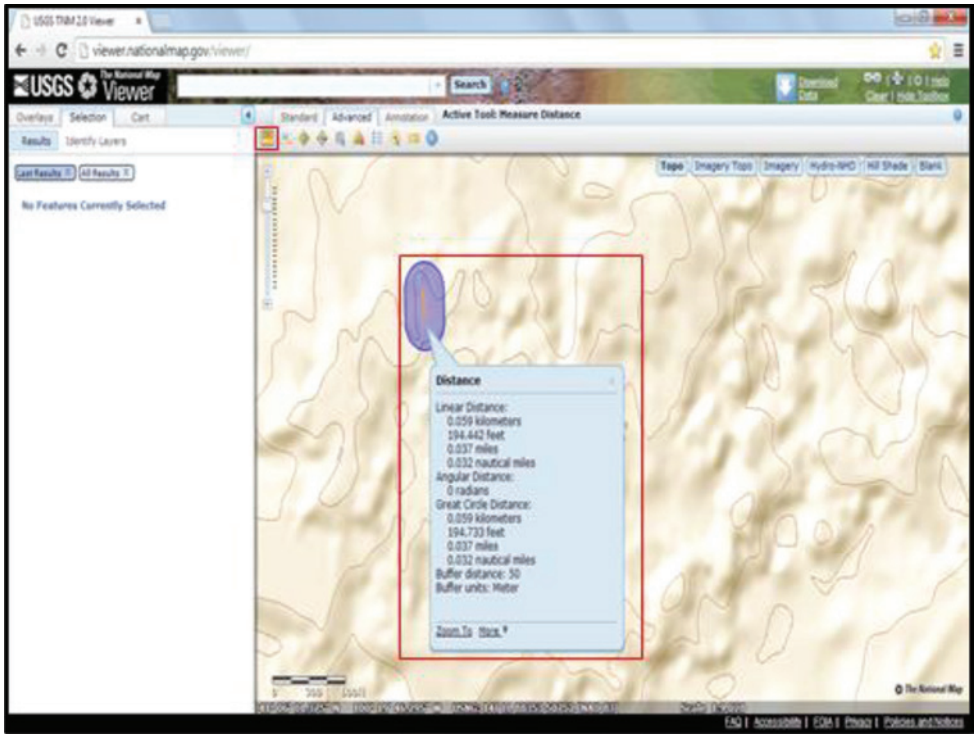


FIGURE-2.12- Buffer tool with layers (Line)

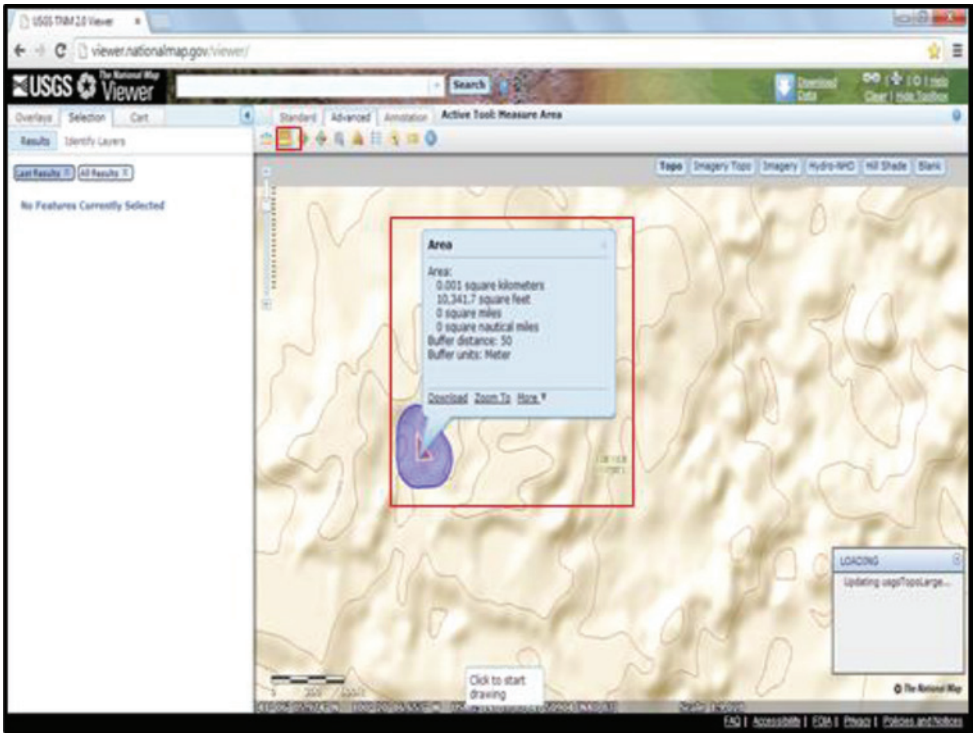


FIGURE-2.13- Buffer tool with layers (Polygon)

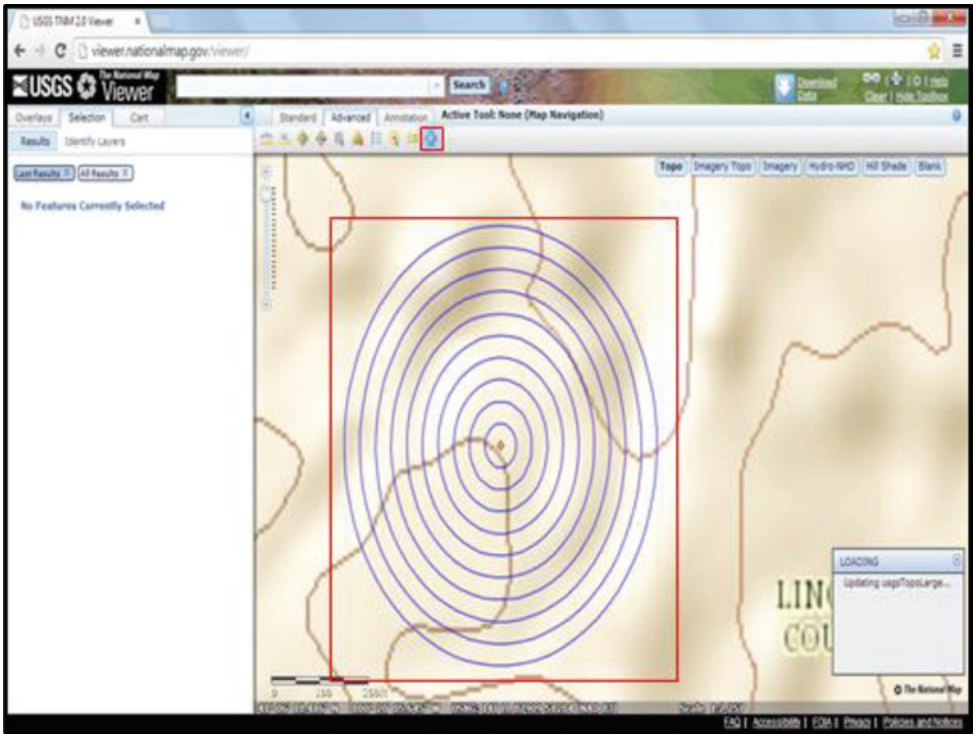


FIGURE-2.14- Buffer using Range ring around the point

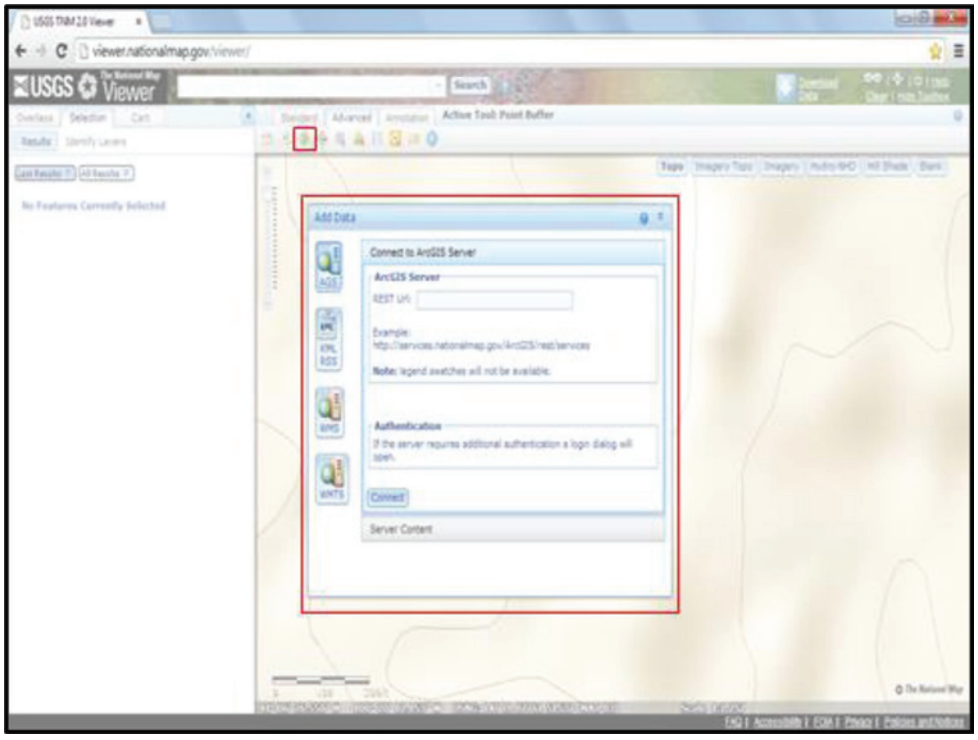


FIGURE-2.15- Add Data Tool

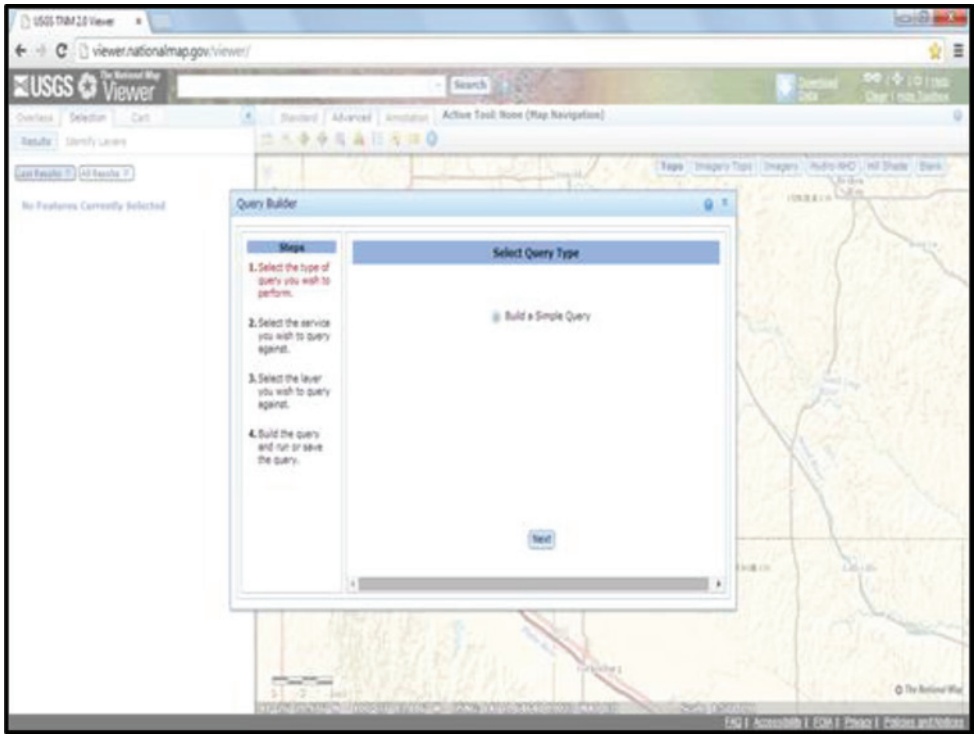


FIGURE-2.16- Query Builder tool- first step "Select Query type"

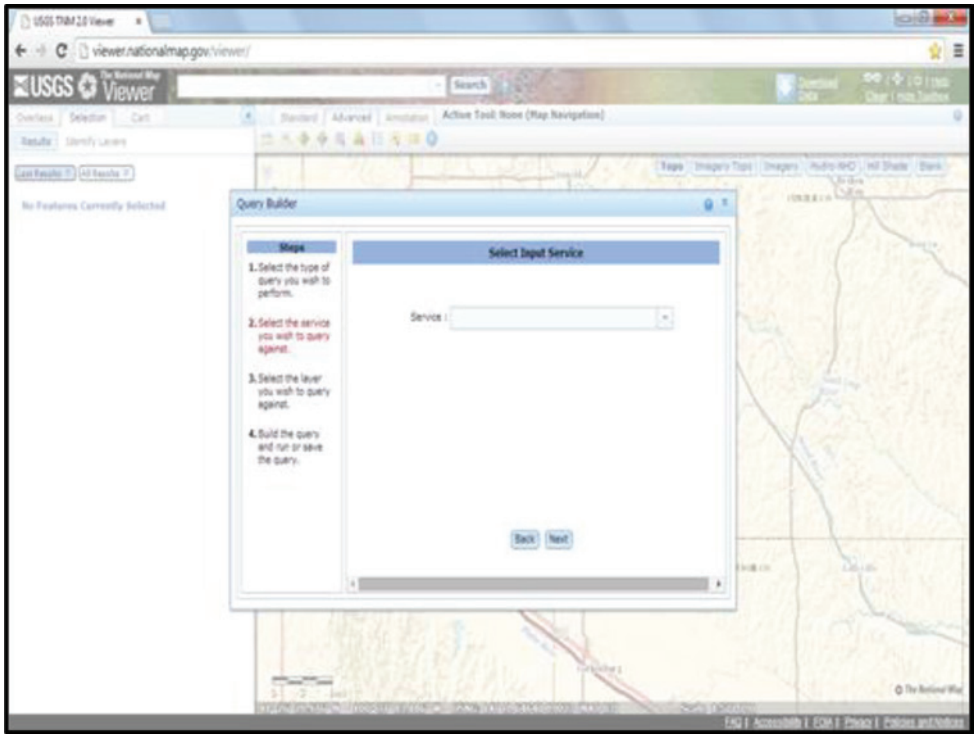


FIGURE-2.17- Query Builder tool- second step "Select Input Service"

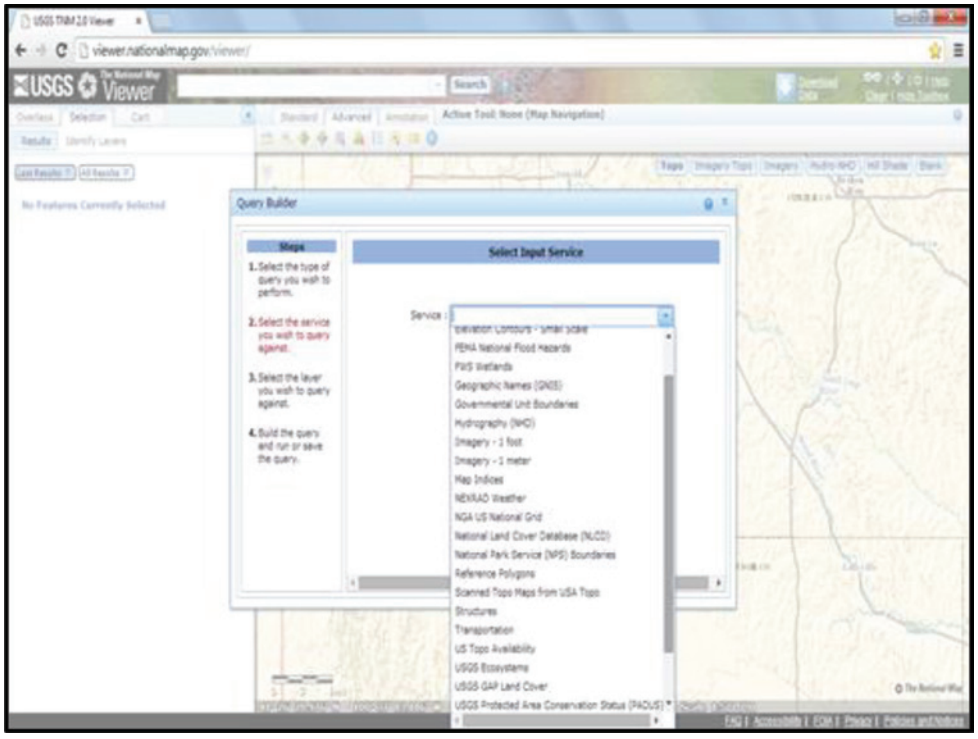


FIGURE-2.18- Query Builder tool –Second step with the list of services

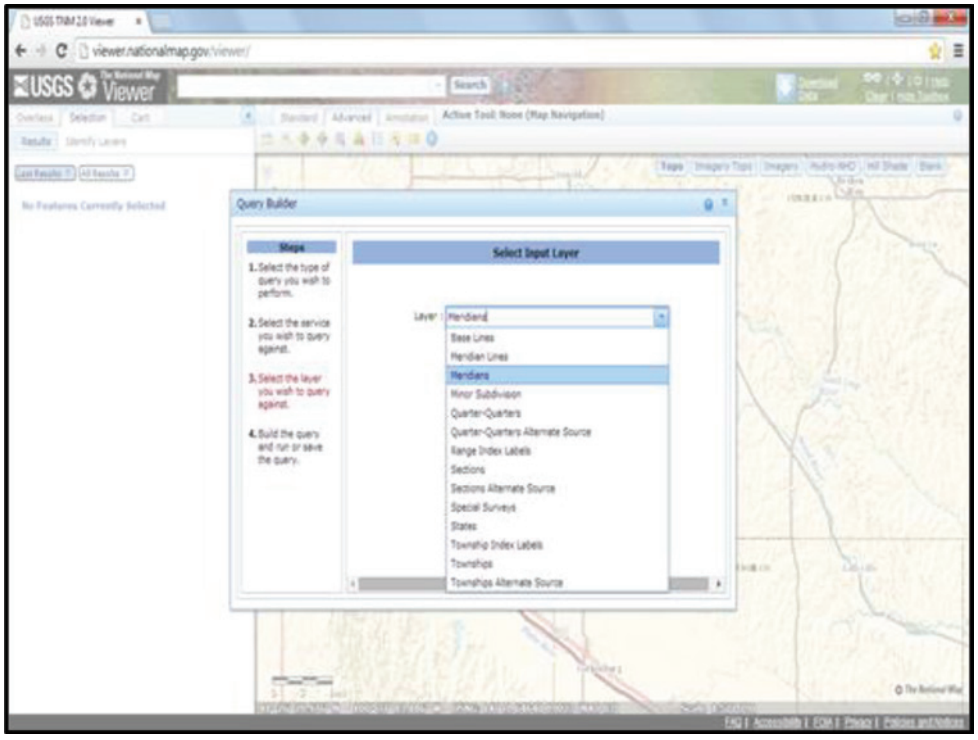


FIGURE-2.19- Query Builder tool -Third step "Select theLayer"

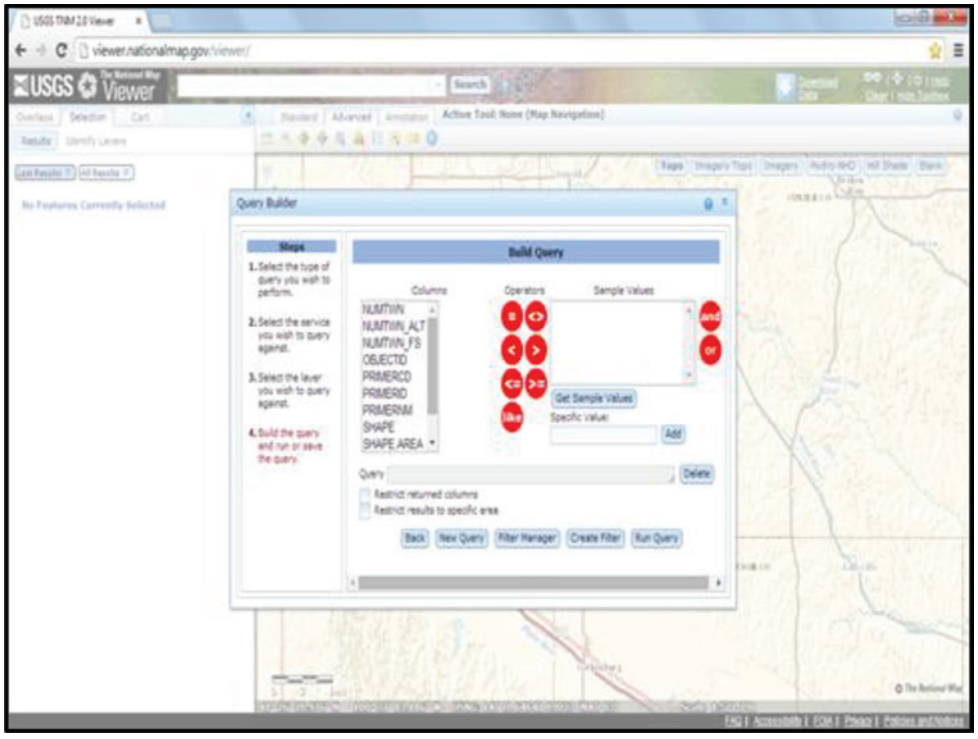


FIGURE-2.20- final step of Query Builder tool

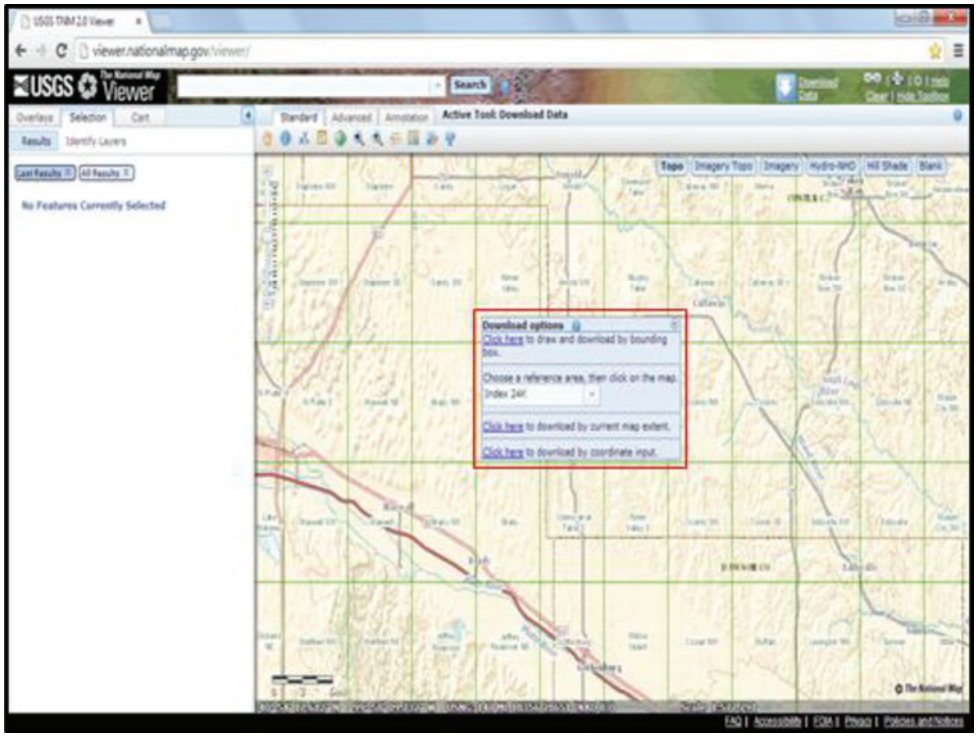


FIGURE-2.21- Download Data using defined bound box

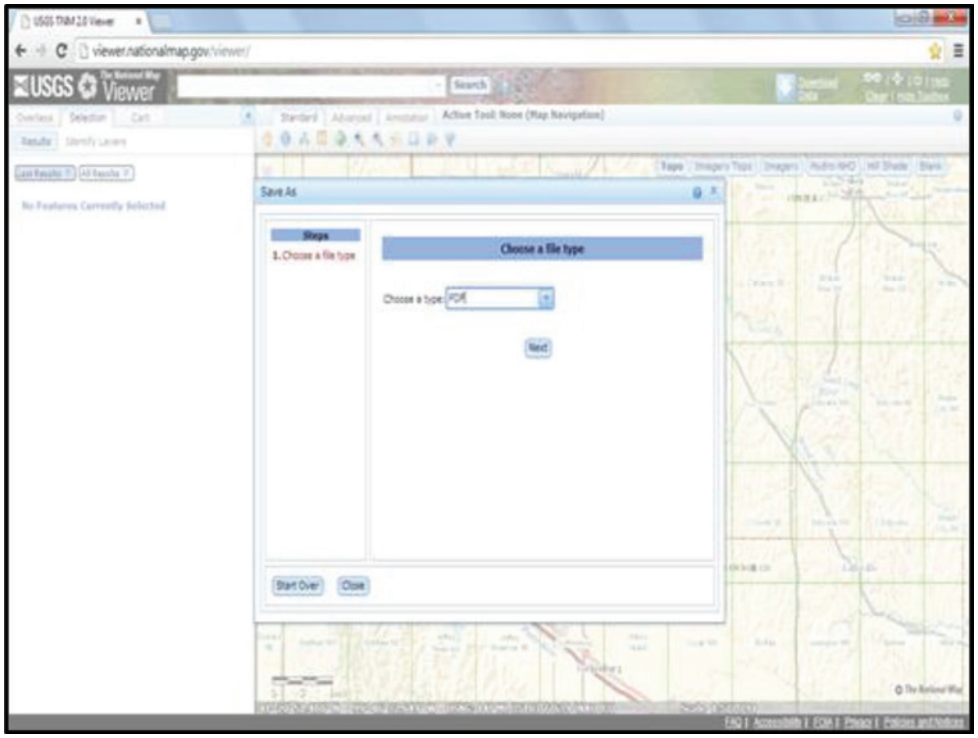


FIGURE-2.22- Print Option using "Choose a file type"

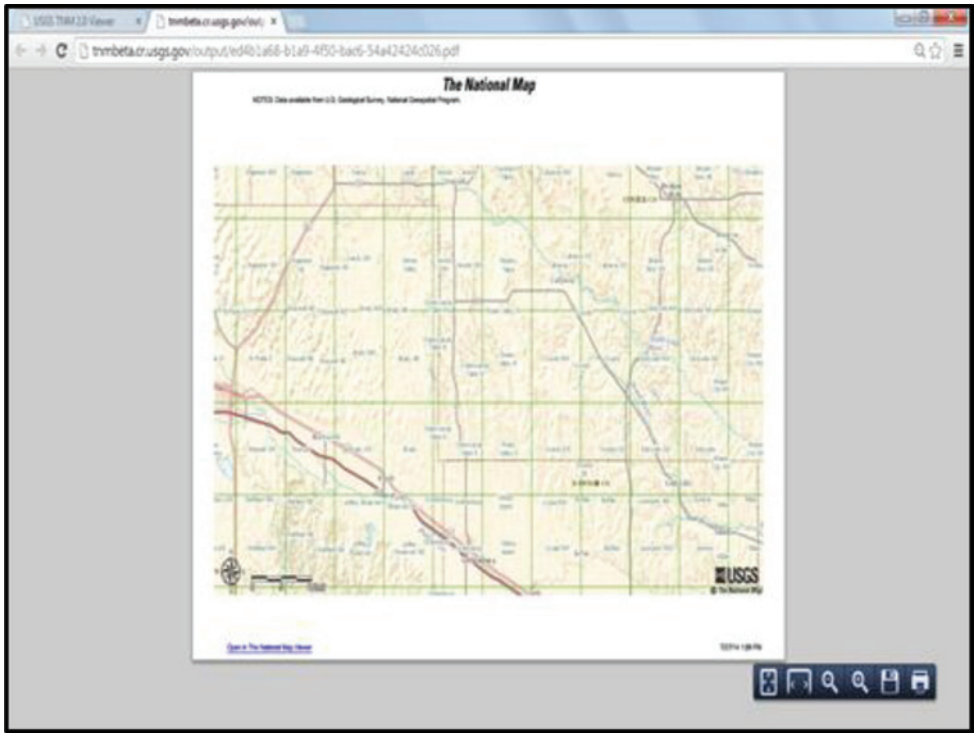


FIGURE-2.23- pdf output of print

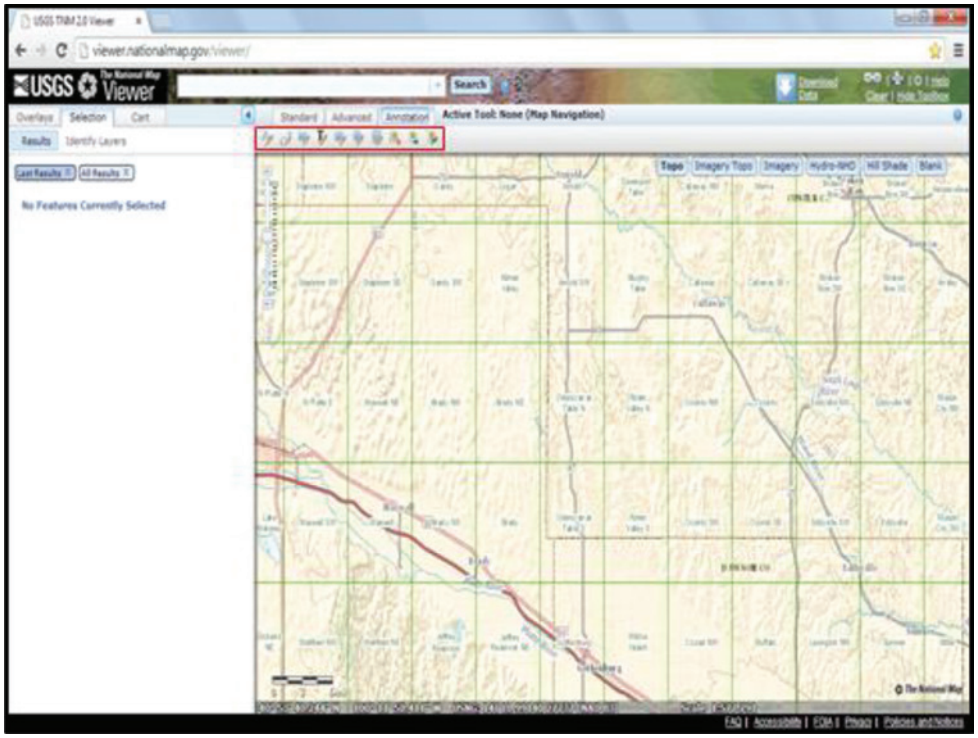


FIGURE-2.24- Annotation Tool

3. GOOGLE EARTH

3.1. INTRODUCTION

18. Google Earth is 3D software used to view earth's surface and other planet's data. Maps in Google Earth are created by superimposition of images obtained from satellite imagery and aerial photography. User can explore layers created by other Google Earth users or create their own layers to display data and other information.

19. Google Earth comes in two different licenses, Google Earth Pro and Free Version. Google Pro is mainly for business use. When compared with non-commercial version, Pro has more functionalities like High resolution image saving and printing capabilities, Importing GIS and Spread sheet data, Additional Measurement tools which includes polygon, Circle, 3D Path, 3D Polygon and HD Movie-making capability.

20. Google Earth stand prominent among other online virtual globe providing companies like Bing, NASA World Wind, City Surf Globe, ArcGIS Explorer, Earth3D, Worldwide Telescope, OpenWebGlobe, MapJack, gvSIG 3D, osgEarth, ossimPlanet.

21. This report includes an independent test and evaluation - technical evaluation report of design and functional characteristics of GOOGLE EARTH 7.1 and GOOGLE EARTH 7.1.4.1529 free version downloaded from website- https://www.google.com/earth/download/ge/ as of July, 2014 and again April, 2015.

    21.1 In order to make a high-quality GIS Portal for India under National GIS, A study was carried out on various International GIS portals. Google Earth is one among them.

    21.2 We have considered India as our point of Interest. Layers and features available in Indian area have been evaluated.

3.2. GOOGLE EARTH DATA

22. In **TABLE-3.1** a detailed assessment of Google Earth has been provided. Google Earth has a following Dataset.

    22.1 Google use 30m multispectral Landsat which is pan sharpened with 15m panchromatic Landsat imagery data as a base image of latest 2015.

    22.2 Google earth provides latest – 2015 high resolution (0.6m) data for major cities of India. Image dataset varies from year 1972 -2015.

22.3 Major Data providers of satellite imagery for Indian area include CNES, Digital Globe, Spot Images, and TerraMetrics.

22.4 Administrative boundaries are limited up to State boundaries only.

22.5 Road Layers include NH, SH, Country roads and Streets. Names of highways, streets appear along with the roads.

22.6 Places of Interest layer can be put around 40-50 different categories. Broadly it can be classified into Places, Business, Transit Stations and Recreational.

22.7 3D building sketches are available for some geographic areas, which gives user photorealistic feel of the building.

22.8 Geo-Tagged data available from different website related to ocean, Weather, Environmental study, others.

22.9 Google Earth doesn't contain any thematic layers.

23. In **TABLE-3.1** a detailed assessment of Google Earth has been provided. The map and image data in Google Earth has the following characteristics:

23.1 Google Earth free version contains base level GIS layers which are much used for individual or personal use. Pro Version has much business orientation with image downloading, movie making, HD printing capabilities.

23.2 Images in Google earth are updated on continuous basis. Most of the areas cover current imagery-2015, However Google Earth says, it provides less than 3 years data.

23.3 Google Earth Terrain layer- which gives 3D elevation data of natural feature like mountains, gorge. However this elevation data is not available for buildings.

23.4 Crowd sourced Traffic data provides live traffic updates. User can also ingest data like photos, videos, locations and can share information with Google earth users.

23.5 Information about different locations from popular websites are linked which gives more insight about it. Website like Wikipedia, Panoramio, Discovery channel etc is integrated.

23.6 Satellite Images from NASA, European Space Agency are also available. Earthquake data from USGS is present.

23.7 Google Earth has its own file format called KML/KMZ to store data such as placemarks, network link information etc.

23.8 Google Earth contains street view data for many cities around the world, which gives 360° panoramic view of streets where user can navigate through streets of the city. However this feature is not available in Indian region due to security concerns.

3.3. GOOGLE EARTH SERVICES/APPLICATIONS

24. In **TABLE- 3.1** a detailed assessment of Google Earth has been provided. Below are some important observations/examples of Google Earth's **services/applications**:

    24.1 Google Earth contains basic GIS services like search, measure, overlay, save and navigation tools for visualization purpose. Google Earth allows zoom level upto 200m.

    24.2 Tools have properties for advance setting which makes them more unique than just basic operational tool.

    24.3 User friendly services like search, get direction for driving, transit, walking and Add placemarks are more popular tools among citizens. Citizens make use of these tools for their day to day activity. User can personalize the view by setting home location.

    24.4 Collaboration/Embedding services are provided through Email and Google Earth API.

    24.5 Image services provided in Google Earth pro version serves as a base for GIS data creation.

25. Weather Services from weather.com gives current local temperature and weather conditions along with 2 days weather forecast for that particular area. Cloud pattern display services from geostationary Earth- orbiting and low Earth-orbiting satellites. Radar images-Not available for India.

26. User- Ingest Services in Google Earth free version is through tools to add point, poly, line and also overlay images. KML & KMZ files can be added. Whereas in Pro version importing option is available for importing address, imagery, vector data, generic text files, geographic coordinates in various available formats.

27. Save, Print and Measurement services even though available, have more customized options in Pro version. Other planet data services make Google Earth more unique in its kind.

28. There is NO GIS APPLICATIONS present in Google Earth.

29. In **TABLE-3.1** a detailed assessment of Google Earth Design and Architecture has been provided. Some of the notable observations are:

    29.1 Google Earth is very easy to install and use. User registration is not requires to download and use the software.

    29.2 Google Earth's has reliable visualizing interface along with other services. There are user custom options for styling added data; Help is vast and easily understandable.

29.3 Testing and robustness are of extremely high quality- There are no software errors or any malfunctioning of the tools.

29.4 Google Earth is also available as free mobile application in ios and android.

29.5 Google earth is built on C++ software. Google Earth provides Plug-in and JavaScript API which let user to embed Google Earth into web pages.

30. Performance wise Google Earth is unbeatable. Here are some observations.

30.1 Caching concept has been used. As a result layer rendering is fast. There is an option for the user to change the RAM and hard disk cache storing capacity which can influence on performance.

3.4. SUMMARY

31. In summary, it is clear from above analysis that:

31.1 Google Earth is not “serious “GIS portal. It can be used for base level operations.

31.2 Looking at Google Earth’s design prospective one can follow Google Earth for its “public” friendly tools and its operations.

31.3 Speed and Robustness are appreciable things.

31.4 Google doesn’t contain any major Decision supporting applications

TABLE –3.1: GOOGLE EARTH PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
A]	**CONTENT**			
1	Spatial	**Borders Layer(Polygon, Point)** like International Borders, Country Names, Coastal Lines, 1st Level Admin Boarders(State/Provinces), 1st Level Admin Names(States/Provinces), 2nd Level Admin Regions(Countries) **Label Layer(Point)** like Populated Places, Islands, Geographic Features, Water Bodies, Coastal Names, **Places Layer (Point),** **Roads (Centre-Line) Layer(Line)** **Parks/Recreation Layer(Polygon)** like Parks, Golf Courses **Water Body Outlines Layer(Polygon)** **Local Places Names Layer (Point),** **Transportation Layer (Point) like** Airports, Rail, Subway, Bus, Waterway **Traffic (point) Layer** **IMAGES** **Base Satellite Imagery:** Landsat image	Administrative layers exist only upto State level. There is no further availability of admin layers.	Figure –3.1
2	Non-Spatial	**NA**		
3	User-ingest	Google Earth contains User-Ingest data. It is also possible for the user to add data through the tools. Available User-Ingest layers are: User created **Photos** linked from Panoramio, 360 Cities, Everytrail, Gigapan Photos, Webcams.travel, Wikiloc websites. User created **3D models** linked from Google sketchup website- Photorealistic layer User populated **Utilities** like Parks,/Recreation Areas, Water Body Outlines, Places coming under categories like (Bars/Clubs, Coffe Shops, Dining, Lodging, Banks/ ATMs, Gas Stations, Grocery Stores, Major Retail, Movie/DVD Rental, Pharmacy, Shopping Malls, Fire, Hospitals, Libraries, Post Offices, Police Stations, Places of Worship, Government Buildings, Museums, Schools)	There is a Clear representation of information with full address and for few others- information along with the photos.	Figure –2.2, 2.3, 2.4

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
4	Geo-Linked Data	**Ocean** related data linked from respective websites. Layers includes-- Explore Ocean, ARKive:Endangered Ocean Species, Cousteau Ocean World, Marine Protected Areas, Dead Zones, Ocean Sports (Surf, Dive, Kite Surfing Spots) **Weather** related data which includes Image of Cloud pattern from US Naval Research Laboratory and Weather condition and Forecasts data from weather.com websites **Information from various websites which includes photos, videos, Imagery layer** like Discovery Networks, Earthquakes, Google Earth Community, NASA(Astronaut Photography of Earth, Satellite Imagery, Earth City Lights), National Geographic Magazine(Feature Article & Photographs), Rumsey Historical Maps(Map Finder),European Space Agency(Earth beauty, Phenomena seen from space), Wikipedia, DigitalGlobe Featured Imagery, Spot Imagery, DigitalGlobe Coverage(DG Coverage-(2002-2010) with Cloud Cover(0-10%, 11-50%, 51+%)	We can get International level ocean related information for Indian places. And data from several Agencies like NASA, European Space Agency, USGS etc	Figure –3.5, 3.6, 3.7, 3.8
5	Others	Apart from Earth, google also contains other planet data. **Mars Data-**Spacecraft Imagery of Mars, Mars Gallery, Historic Maps, Rovers and Landers, Travel Guide to Mars. **Moon Data**- Featured Satellite Images, Place Names, Moon Gallery- Apollo Missions, Guided Tours, Historic Maps, Human Artifacts. **Sky Data**- Current Sky events, Backyard Astronomy, Featured Observatories, Historic Sky Maps, Sky Community.		
B]	**VISUALISATION**			

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
6	3D/ 2D Map viewer	Map viewer displays both 3D and 2D data. Status bar shows Lat/Long, Elevation, Scale bar, eye altitude, Overview map. "Tour Guide"- user can see images and videos of map display area. In order to get full area display in the screen, user can hide the table of content. User has privilege to customise the 3D view in Google earth. The available customising options include Texture colour, Label /Icon Size, Graphic mode, Lat/ Long display mode, overview map Size etc.	With all available options user can visualize data easily and customise options make it more user friendly.	Figure –3.9, 3.10
7	Navigation Tools	3D/2D Navigation tools are available like Rotate/Tilt with indication of North arrow, Pan, Street view, Zoom slider with Zoom-in, Zoom-out facility. There is also an option to change the settings to control the Navigation behavior like fly speed, mouse wheel Speed etc.	The ease of using navigation tools is very good. With extra settings option available for navigation makes it even friendlier.	Figure –3.11
8	Search Pane	User can Search for places, Get directions, view list of recent searches (History), Copy search results to the Google Earth My Places folder, Copy search results to the clipboard as KML and Print search results. Search operation can be done using Post Code, Street Name, Town, Neighborhood, City, Long/Lat values. Results of Get directions can be viewed for Cars, Bus, bike or by walk routes. Results can be saved and printed. Elevation along the boundary of the searched place can be seen as a graph.	Searching a place is very easy as it provides several options to input a data and results in very less time. Getting information like road type, distance and time required to travel along with the search results, user finds it very useful tool to plan their schedules	Figure –3.12, 3.13

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
9	Places Pane	Place pane is mainly the container of the user added data. Here user can also search from content of added data. User can easily organise the data into containers (folders). User can Save the content as KMZ /KML file into there local system or post data to google Earth Community and also Adjusting the Transparency of the added data.	Data added being organised, used and shared from a single panel gives user a easy management facility of contents.	Figure –3.14
10	Layer Pane	Layer Pane is the container of all the available layers in Google Earth.	User finds it easy to operate on the layer. All the layers are arranged hierarchically. Hierarchy exists upto 4 levels.	Figure –3.15
C]	**SERVICES**			
11	User ingest Tools	User can create Point, Line and Polygon data in Google Earth through "**Add Placemark**", "**Add Path**", "**Add Polygon**" tools. Here we also have an option to add 'Name', 'Description' (Weblink and Image), for the added item. User can also Change Style and color of label and icon. User options to Customise icons for placemarker, defining opacity option, other styling options for polygon, and line are available. We can also get the measurement of Length drawn while creating the line. Lat long and time information can be recorded with added content with just a single click in the available property called "Snapshot view"	User ingest service are great with the available tools. It is very easy to add content to the portal. User customising options are added advantage.	Figure –3.16, 3.17, 3.18
12	Overlay	User can overlay images of different formats (jpg, bmp, tiff, tga, png, jpeg, gif, ppm, pgm) with "**Add Image overlay**" tool. Information about image can be described by adding Weblink and Images. We Can add Kml, Kmz , COLLADA model files, GPS files	User friendly options to customise the overlayed image like Rotate image, move the image, and resize image make overlay operation more easy.	Figure –3.19

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
13	Record	User can "**Record tour**"- the simulation of the data and Images with voice recording. User can save and share the recorded video. User custom options like Time adjustments, Fly options, Camera Tilt angle, range, speed etc.	It is easy to create record and share the path or simulation with other people.	Figure –3.20
14	Historic Images	Google earth provides user satellite images from previous years through "**Historic image**" Tool.	This option makes user to make the change detection. Viewing Satellite images are very easy, as it provides 'timeslider' which displays year and time of the satellite imagery.	Figure –3.21
15	Universe Data	User has an option to view Earth, Sky, Mars, Moon data. Google earth also has an option to Show Sunlight across landscape	Google earth share lot of information regarding Earth, Sky, Mars, and Moon with Images and videos which makes it more unique in this aspect. Sunlight across lanscape can be used for shadow analysis.	Figure –3.22, 3.23
16	Ruler- Measurement	User can measure distance between two points and multiple points on the ground using "**Show Ruler**" Tool. We can get various measurement units in Cm, m, Km, In, Ft, Yard, Miles, Nautical miles, smoots formats.	User finds it easy to get values in different formats without need of any manual conversions.	Figure –3.24
17	Save and Share	User Can "**Saveimage**" in Jpeg format. He can "**Print"** the current view and also has an option to send **"Email"** Attachment of current view of the screen as an Image or KML. Posting into Google Community Forum requires Sign In. User is provided with options to Email, i.e. through Microsoft outlook or with Gmail.	It is easy to save, print and Email the data.	Figure –3.25, 3.26
18	Switch to Google Maps	"**View in Google maps**"- Google earth display area can also be viewed with Google maps.	Connections to google earth are made within the software without switching to any new browser.	Figure –3.27
D]	**APPLICATION SECTORS**	NA		
E]	**GENERAL**			

No	Category	Major Observations	User Friendliness/Difficulty	Screen Shots
19	Design/ Architecture	Search, User added Content and Layers are in single Panel with Collapsible button format.	User finds it easy to see all the data in one container window, need not open more dialogue boxes or containers for doing these operations.	
		Switching On/Off of Label layers	This option makes user to view the data clear and without ambiguity in viewing different type of data.	
		Layer rendering is Fast	There is no delay or difficulty in rendering of the layers in the portal.	
		Online Help Content provides images and video	User guide is provided with easy understandable steps.	
		Labels appear according to the scale of the map.	Readability is good.	
20	Text	There is option to view Labels (Text) according to their national language.	User can view data in native language.	
21	Others	Street View data is available in most of the major cities of Canada, Mexico, Denmark, South Africa, Japan, Spain, Norway, Finland, Sweden, France, the UK, Republic of Ireland, the Netherlands, Italy, Switzerland, Portugal, Taiwan, and Singapore.	A very user friendly Google Street View provides 360° panoramic views where user can navigate through the streets and get each and every detail of the area.	

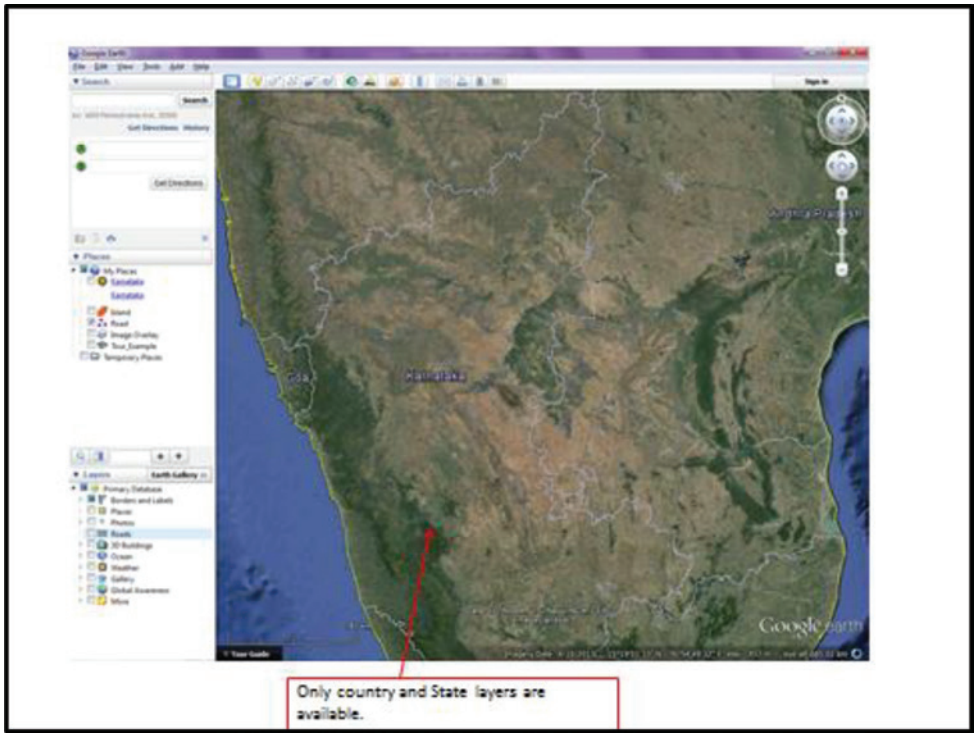


FIGURE-3.1- Content of the Google Earth

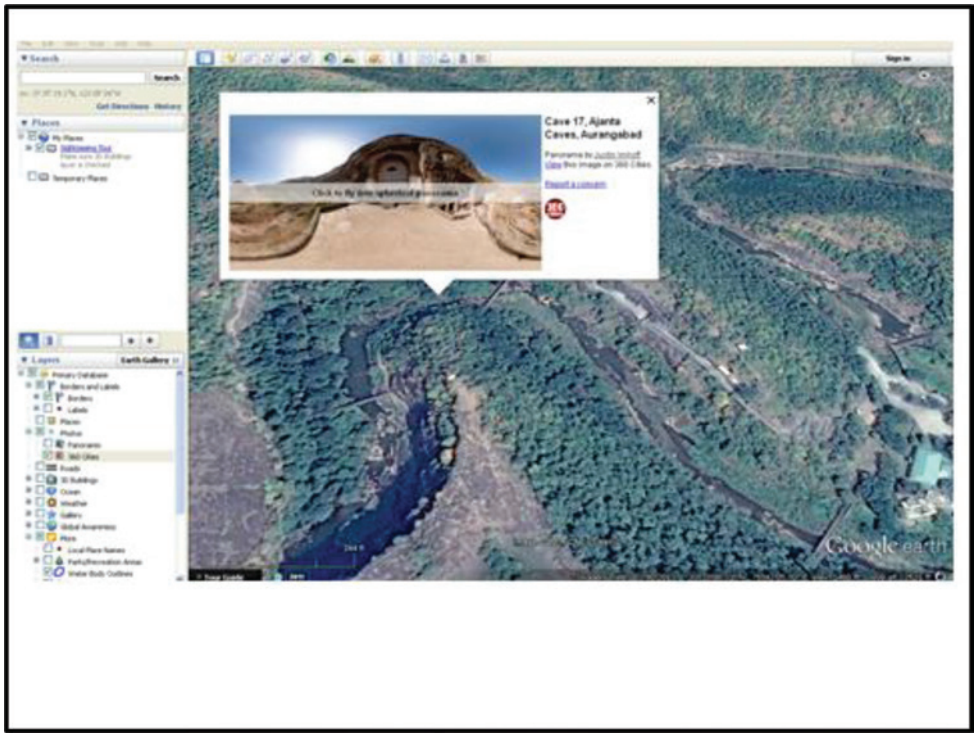


FIGURE-3.2- Point with photo in 360º view

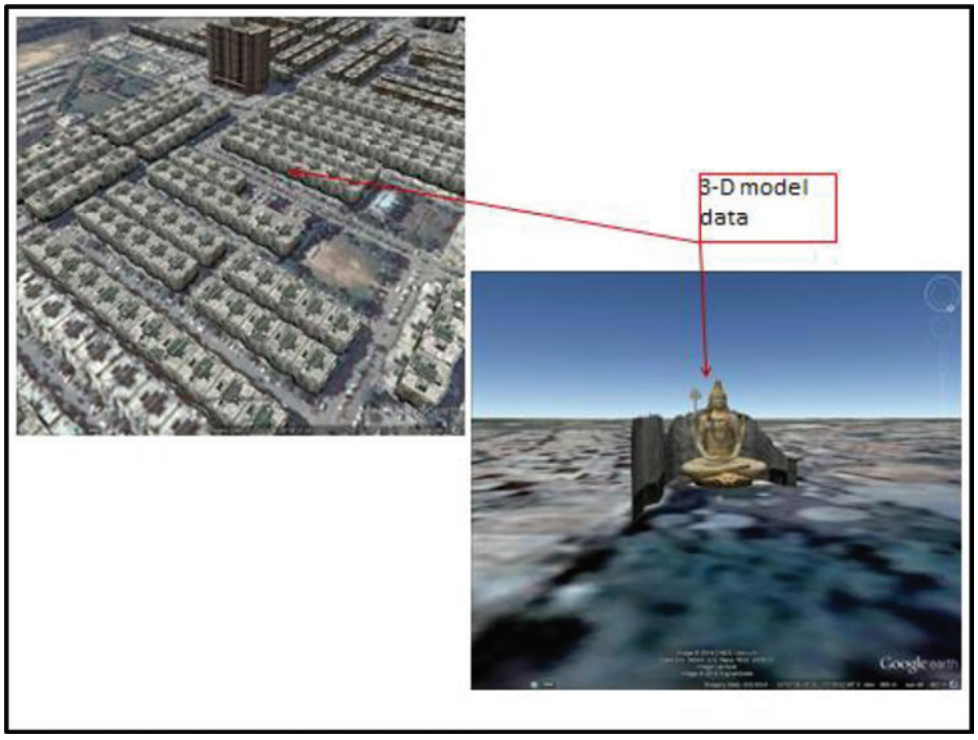


FIGURE-3.3- 3D model

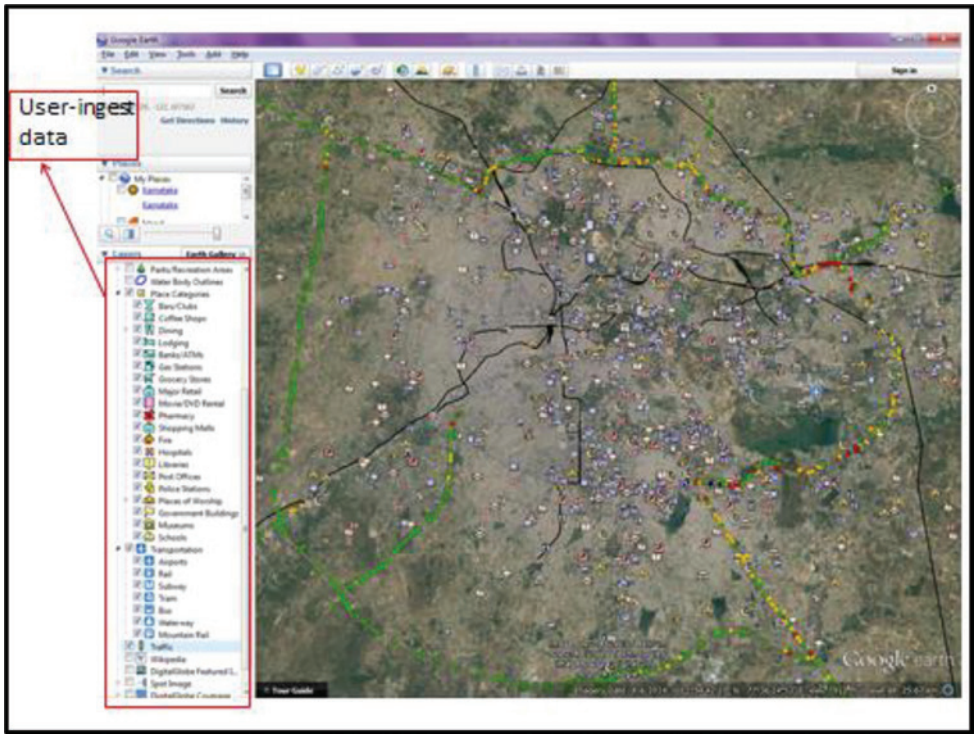


FIGURE-3.4-User Ingest data

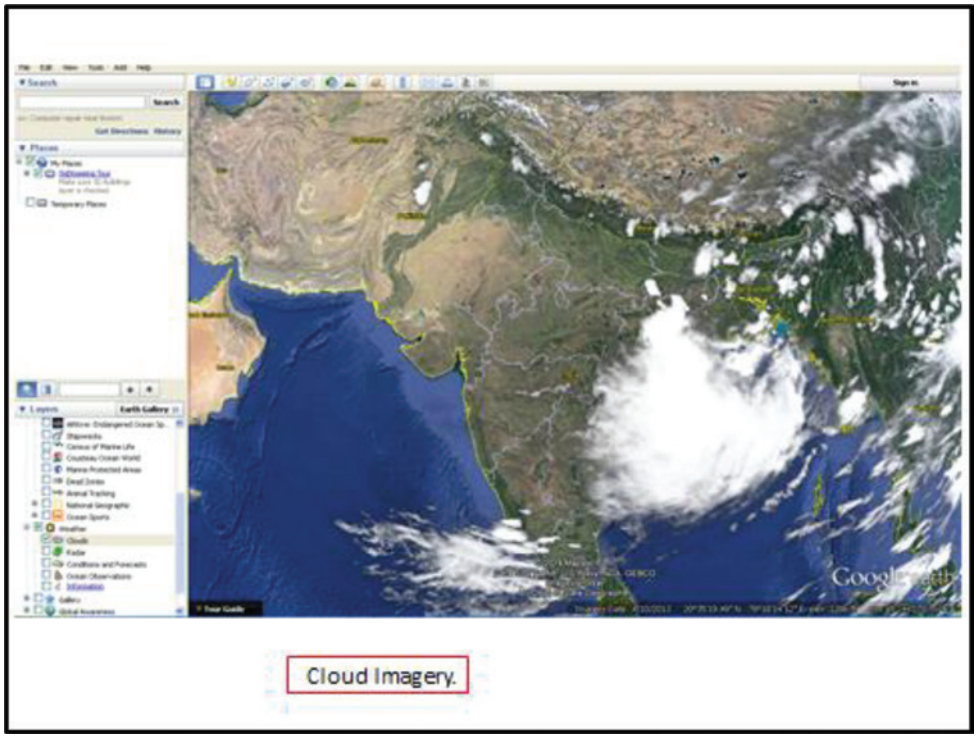


FIGURE-3.5- Cloud Imagery

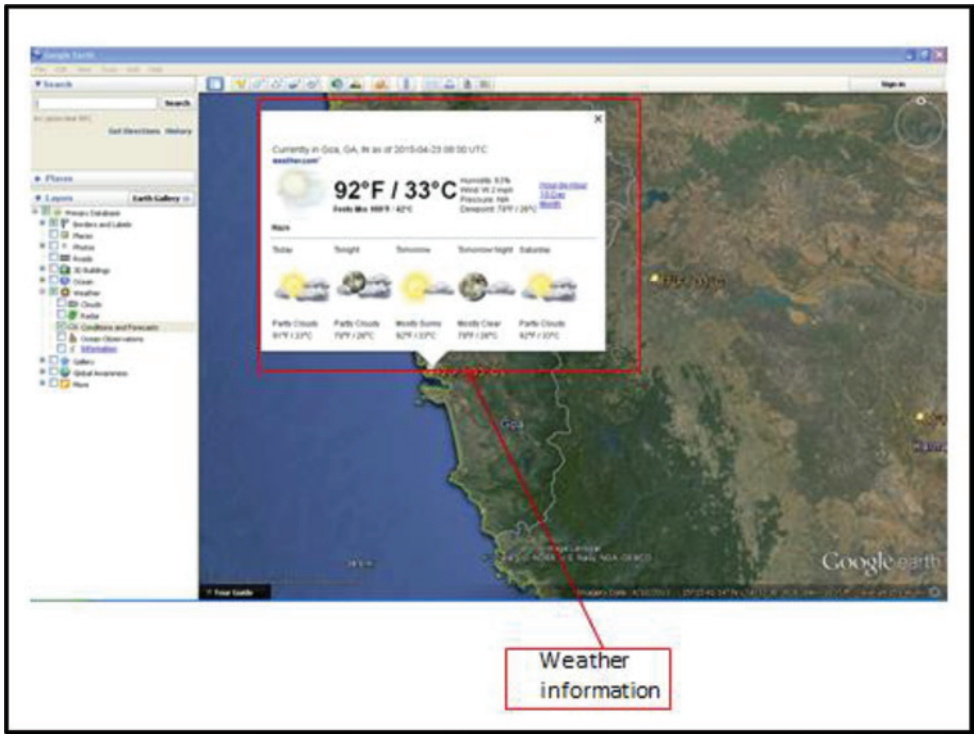


FIGURE-3.6- Weather Information

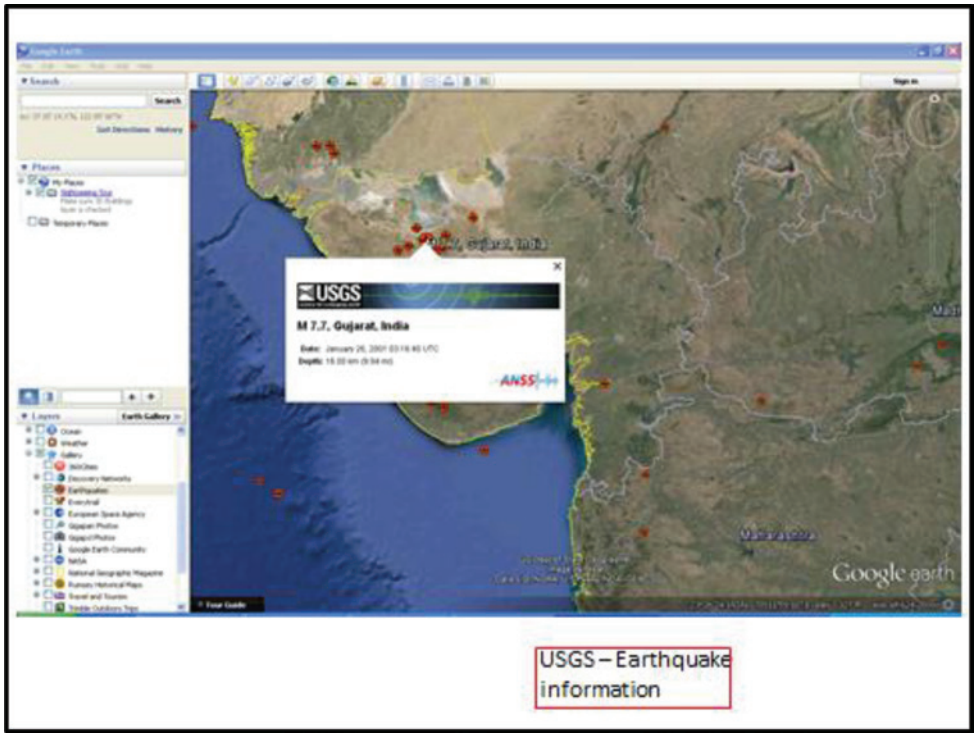


FIGURE-3.7- Geo-Linked USGS Earthquake Information

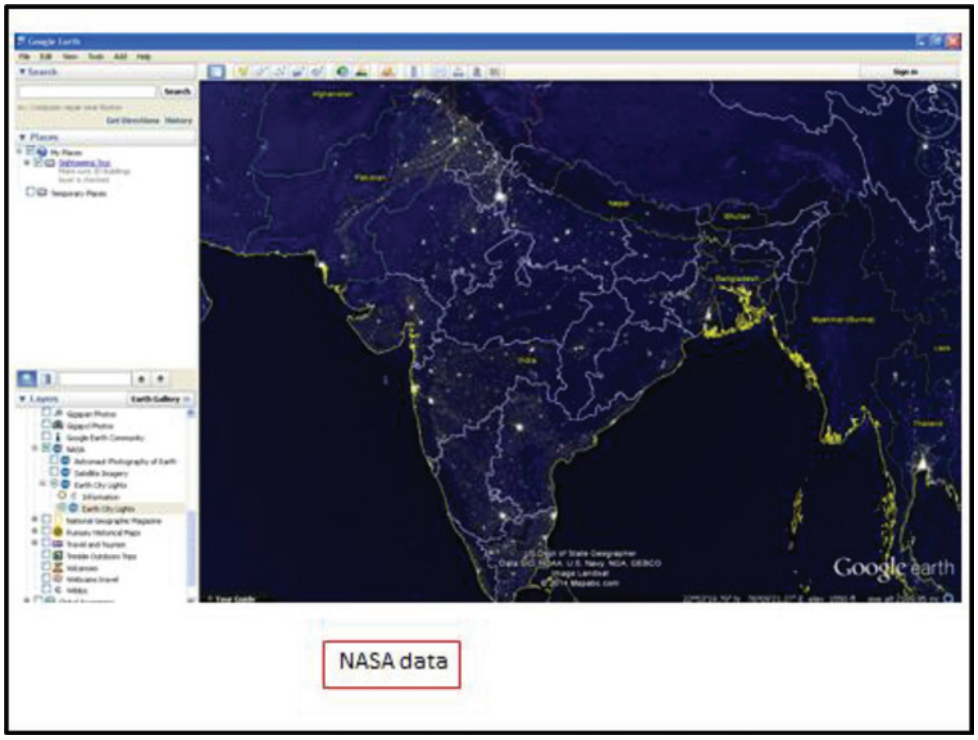


FIGURE-3.8- Geo-Linked NASA data

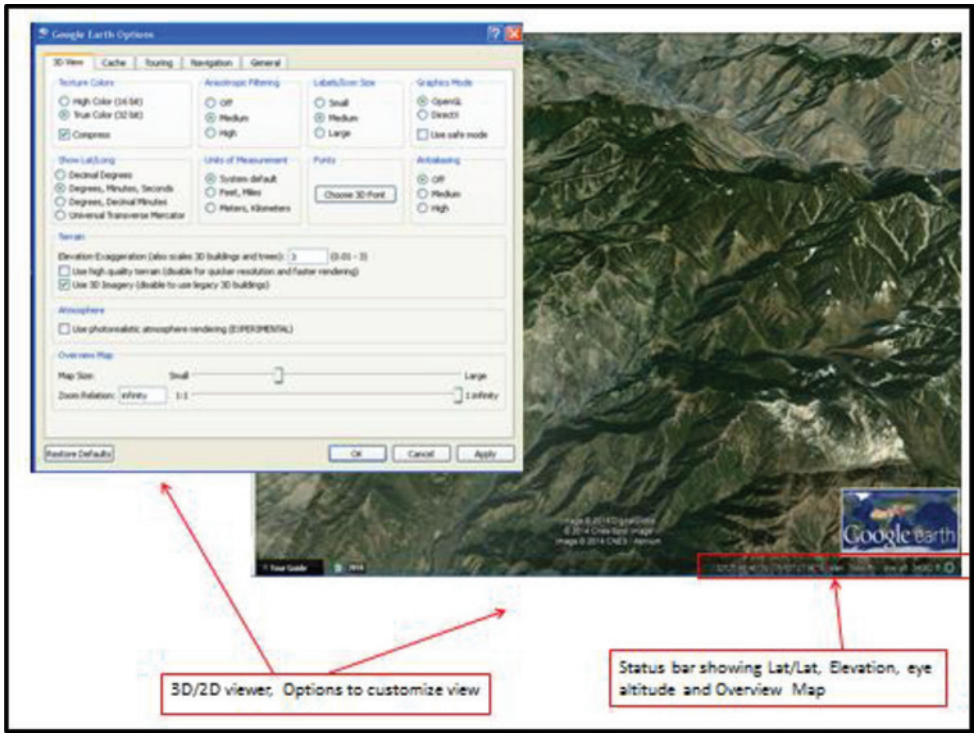


FIGURE-3.9- 2D/3D options & other information

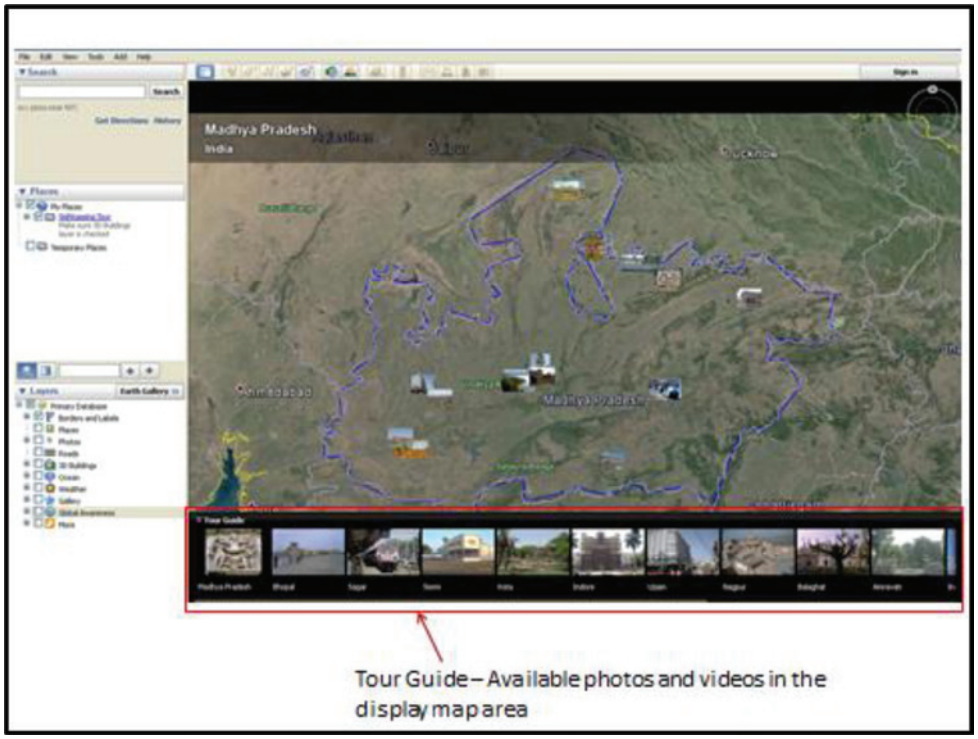


FIGURE-3.10- Tour Guide option

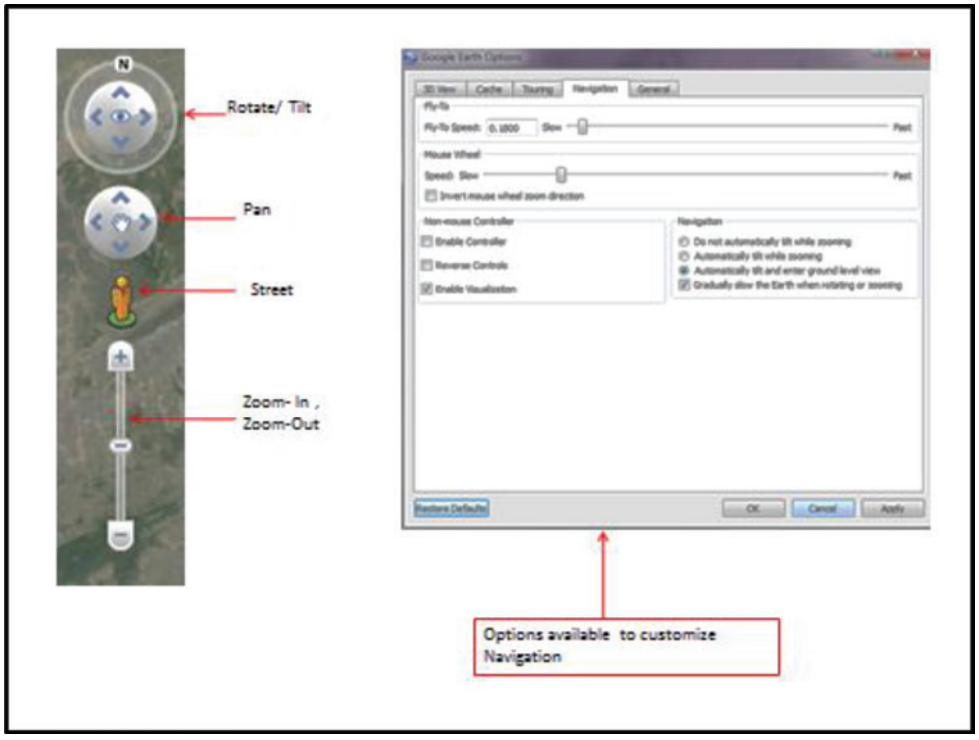


FIGURE-3.11- Navigation Tool options

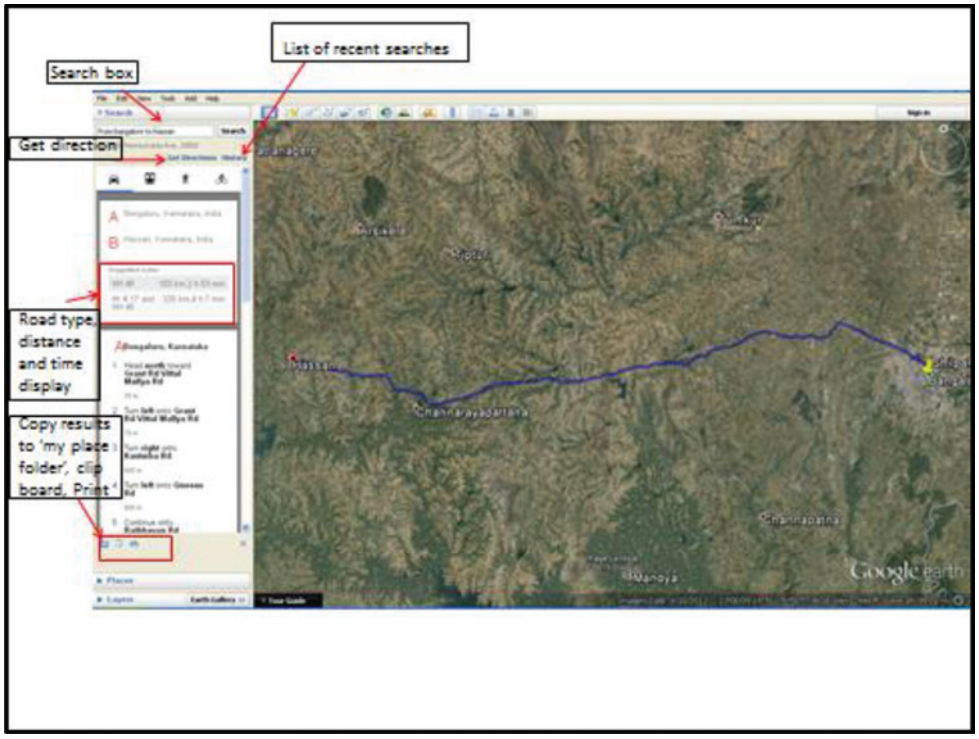


FIGURE-3.12- Search Pane options

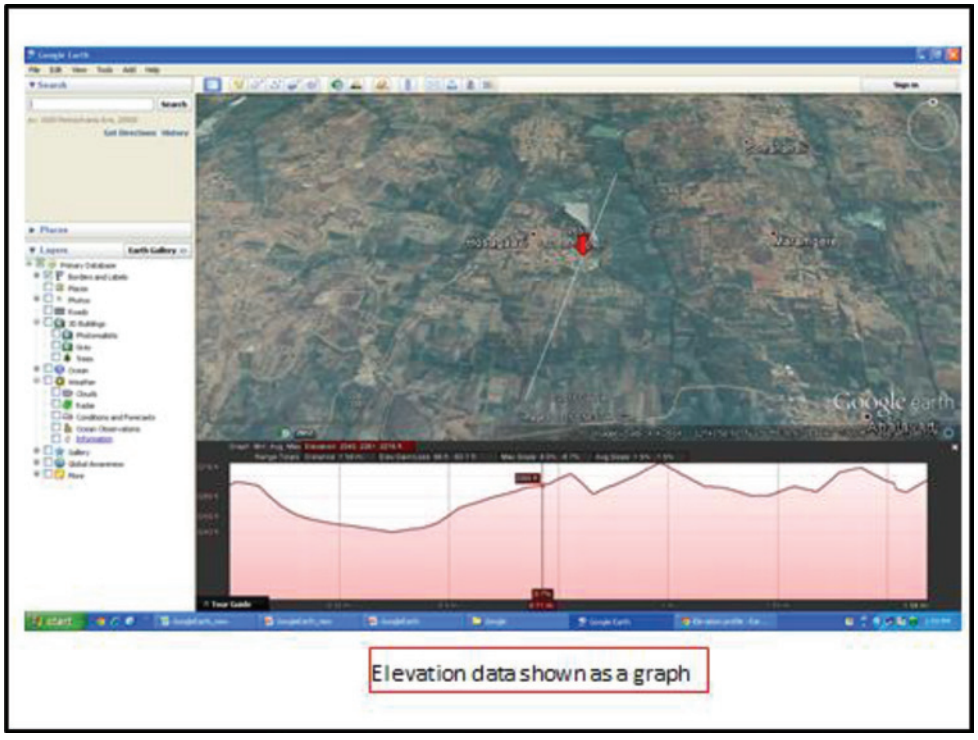


FIGURE-3.13- Elevation of 2 points

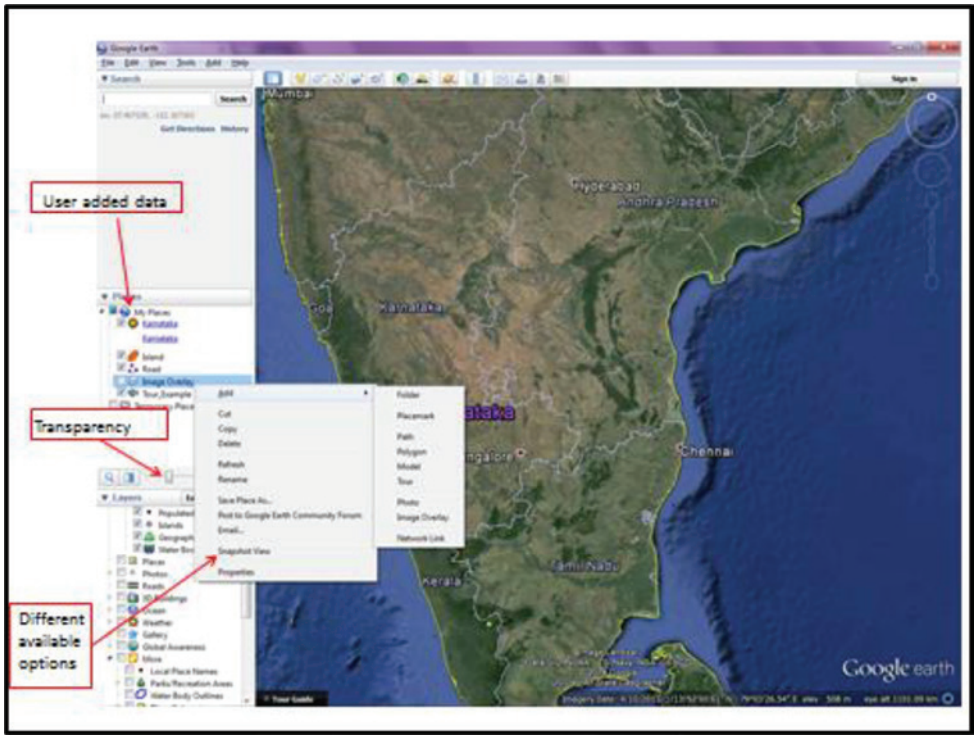


FIGURE-3.14- Options for Place Pane

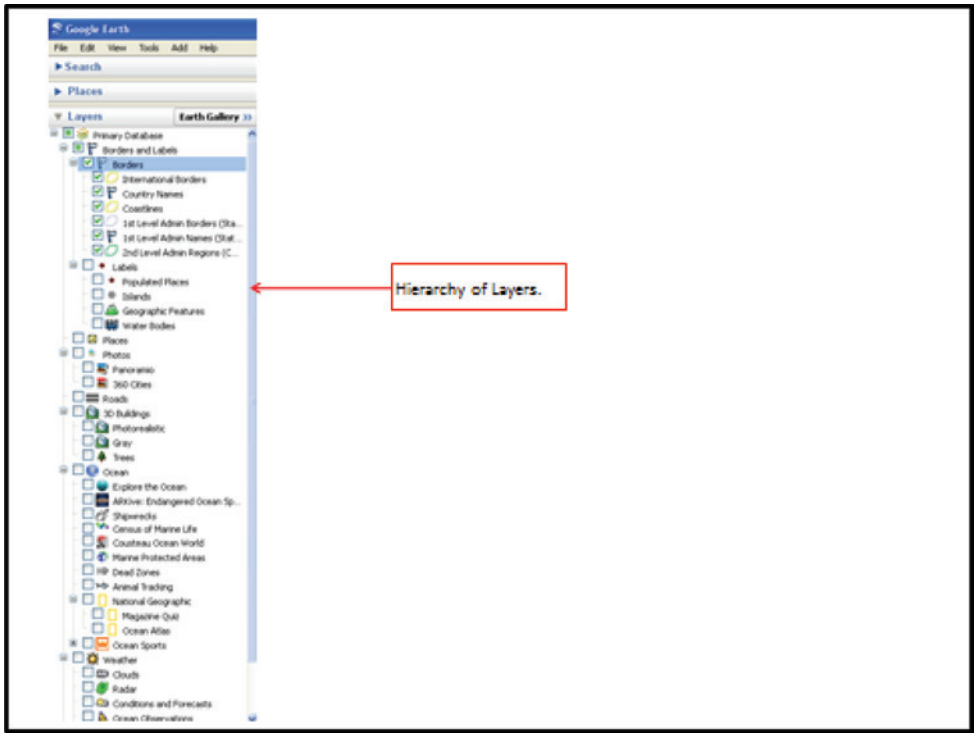


FIGURE-3.15- Hierarchical view of Table of content

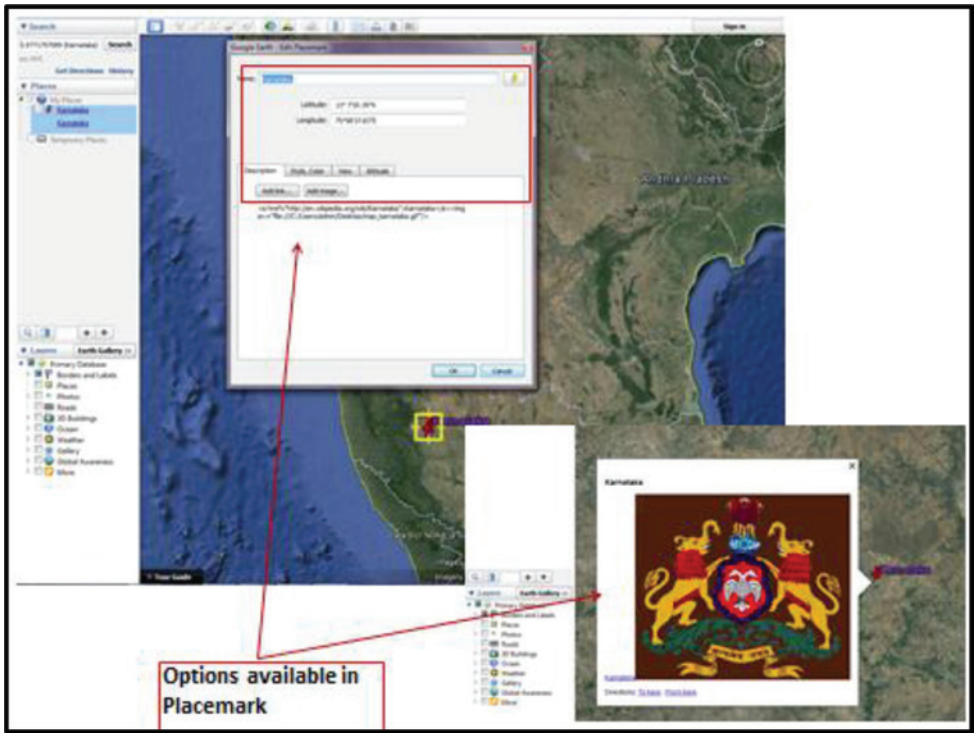


FIGURE-3.16- View of placemarker (point) tool

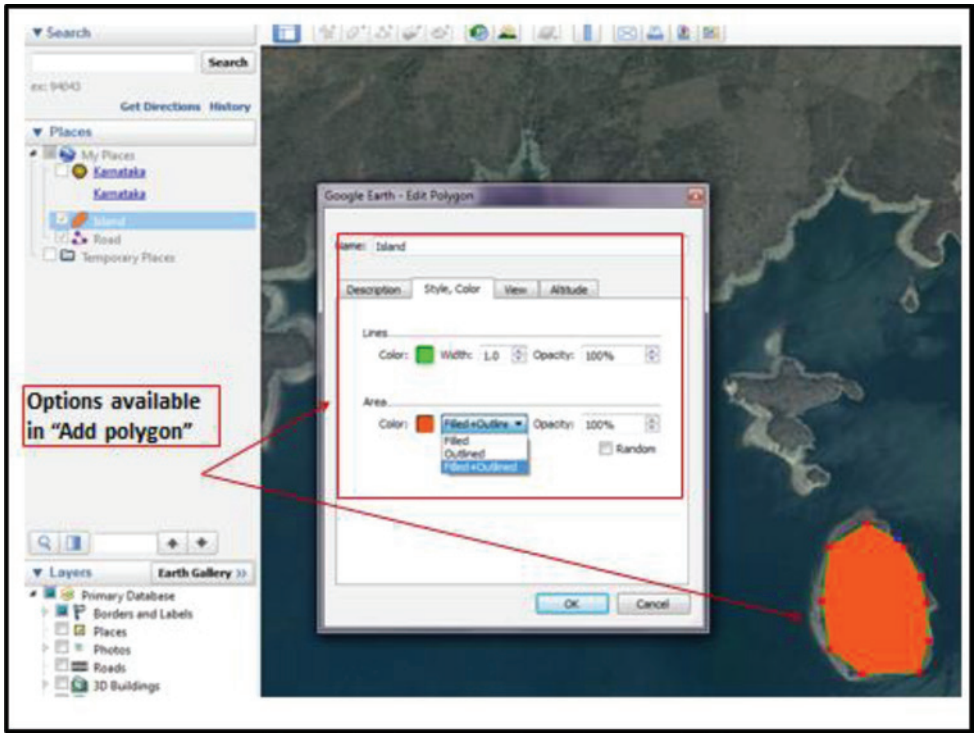


FIGURE-3.17- Option for User ingesting the polygon data

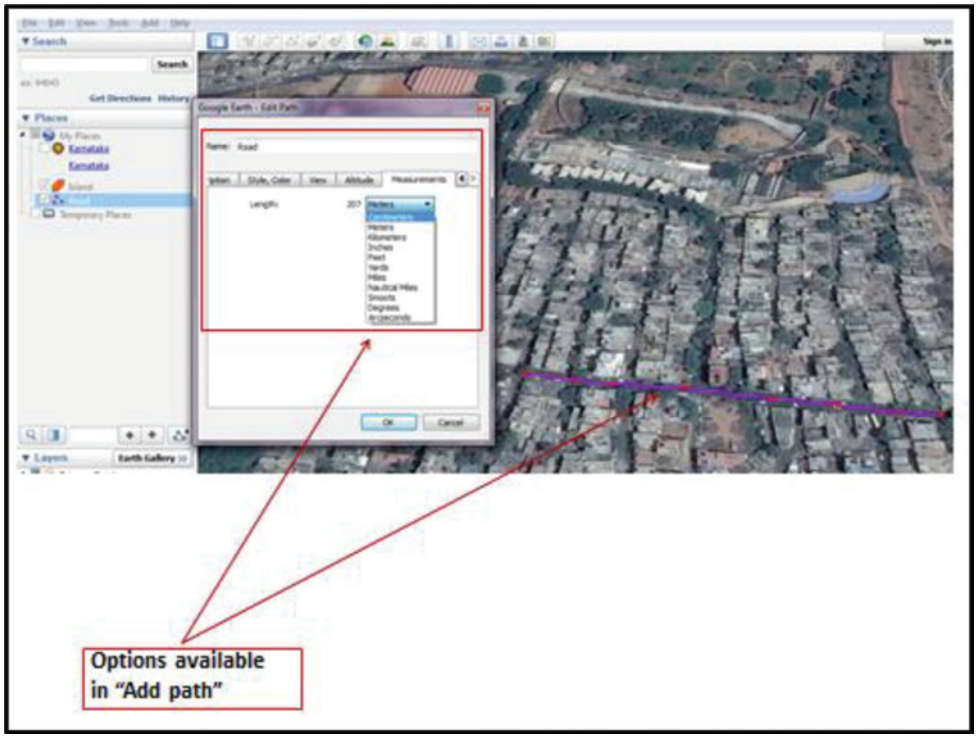


FIGURE-3.18- Options to add Line data

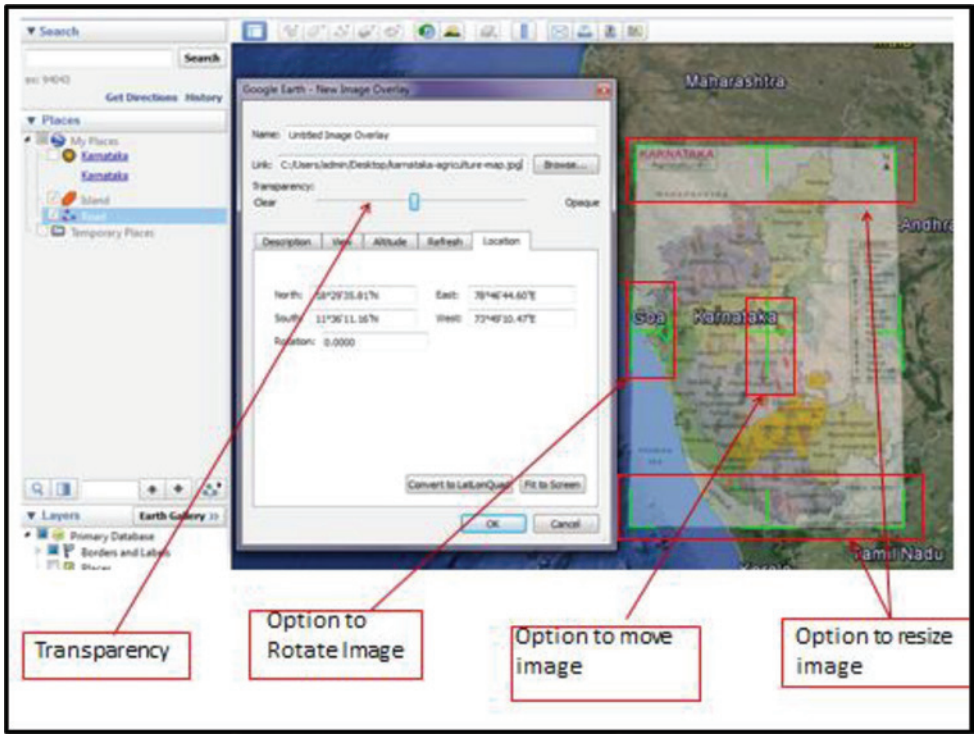


FIGURE-3.19- Overlay tool options

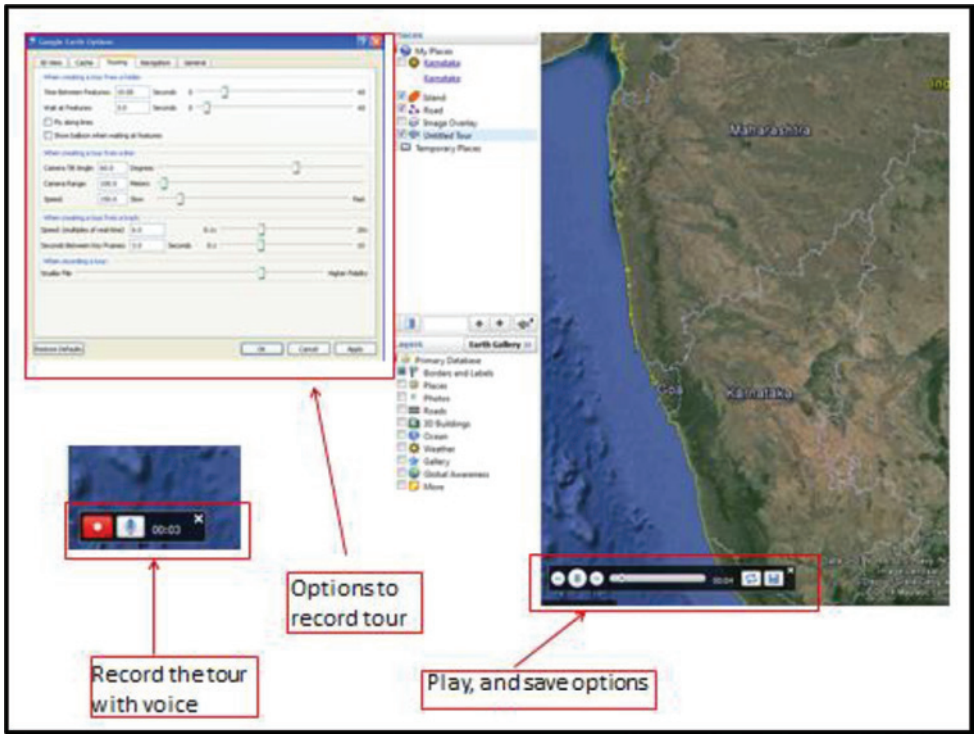


FIGURE-3.20- Option available in Record tool

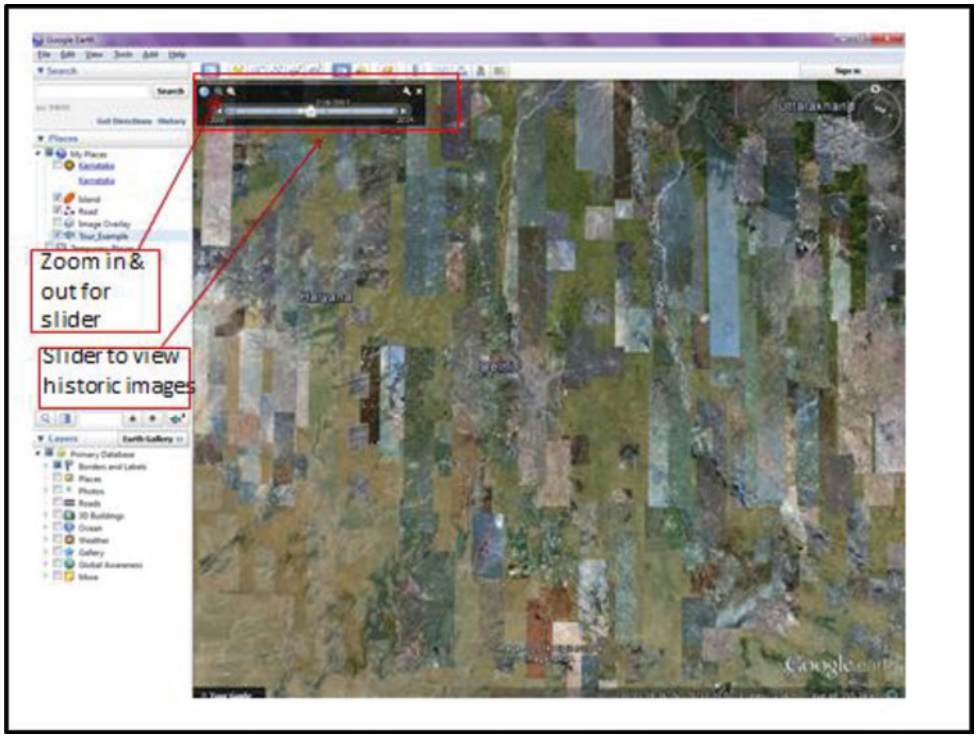


FIGURE-3.21- Historic view options

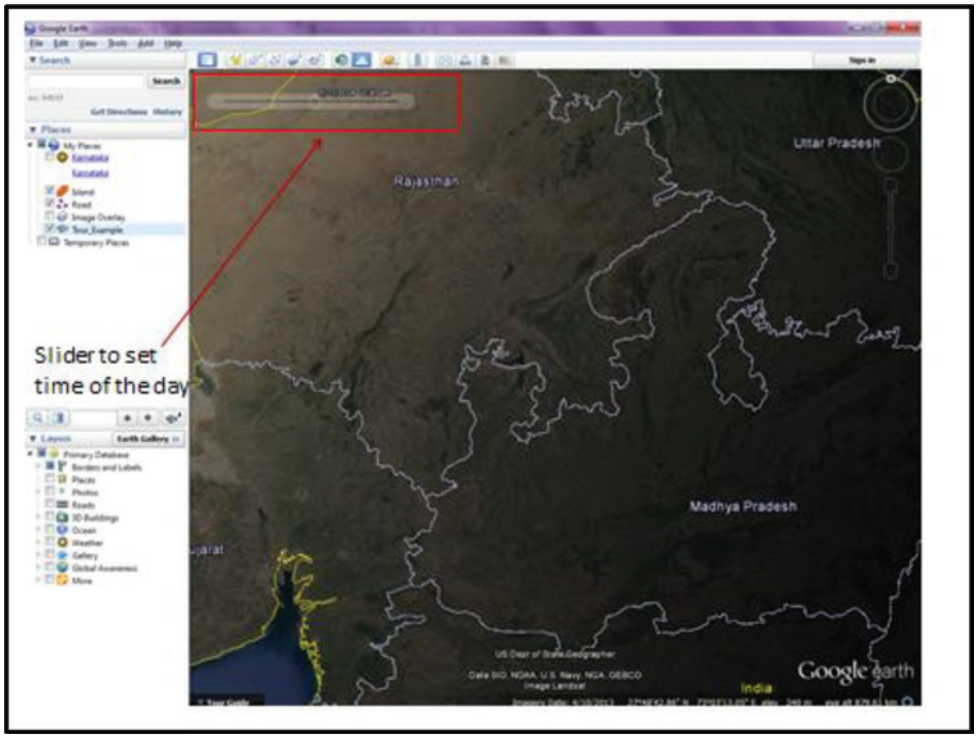


FIGURE-3.22- shadow analysis tool

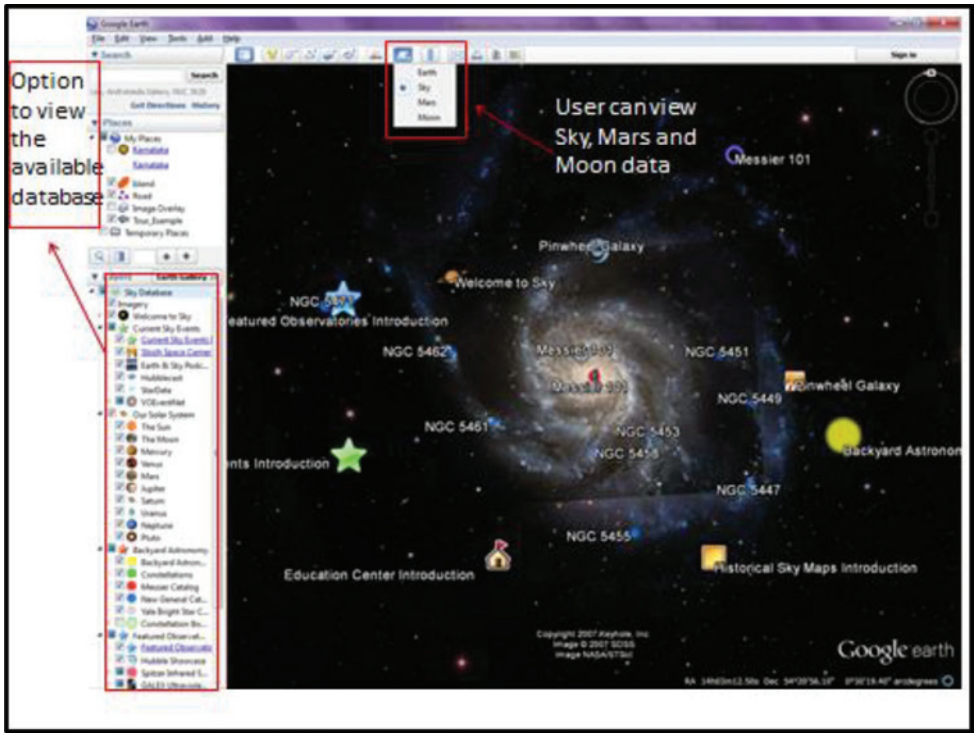


FIGURE-3.23- Universe data (Moon, Mars, Sky)

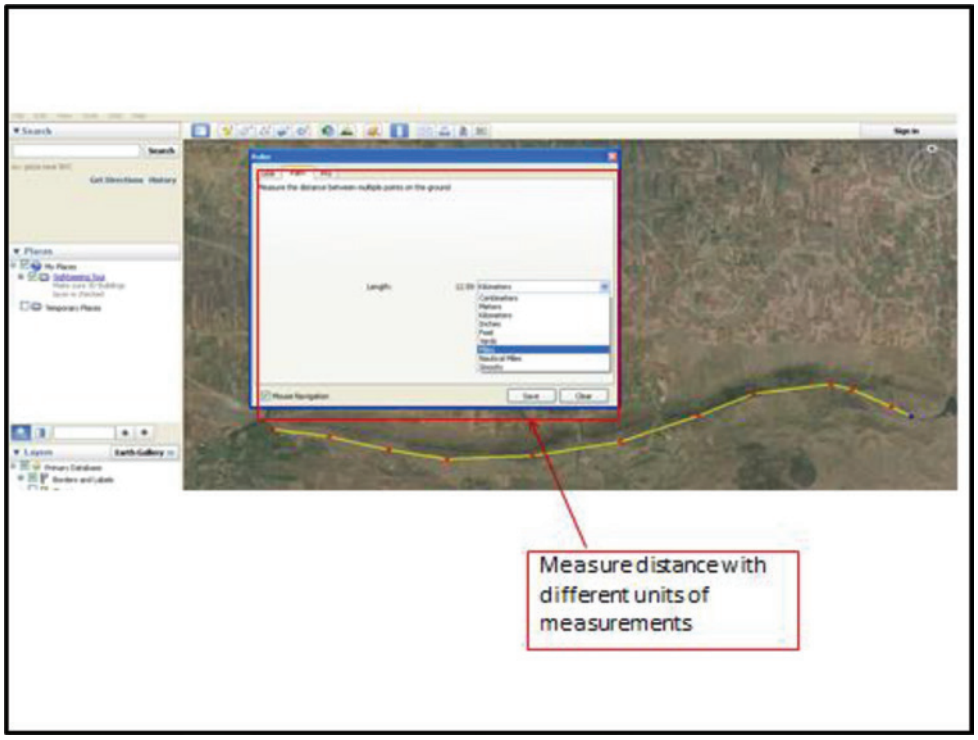


FIGURE-3.24- Measure tool with different units

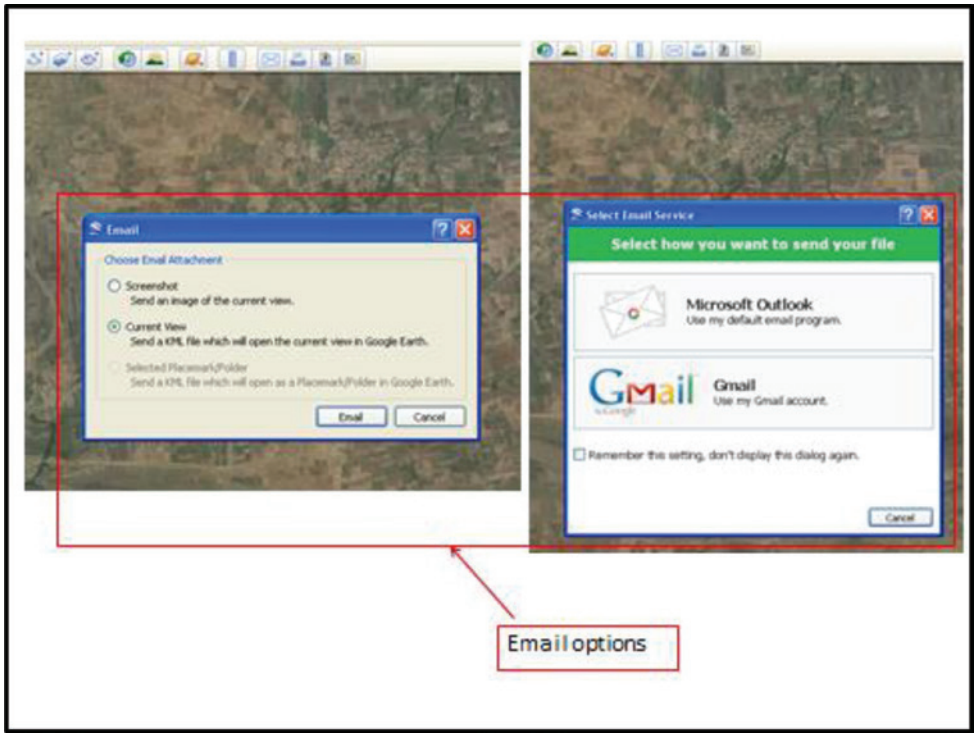


FIGURE-3.25- Email options

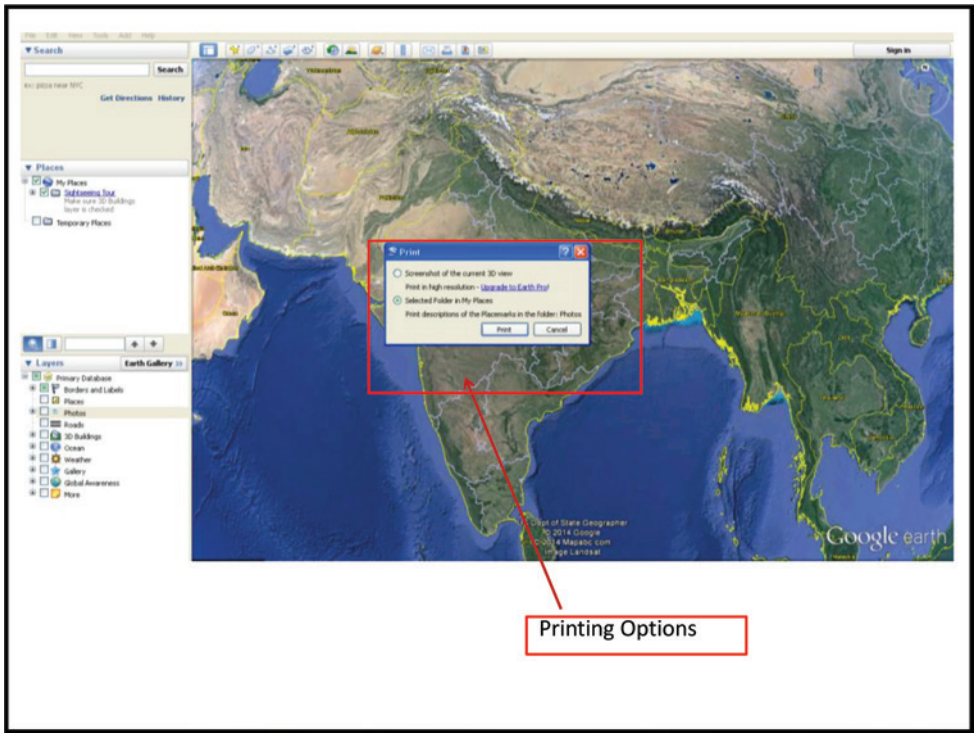


FIGURE-3.26- Printing tool options

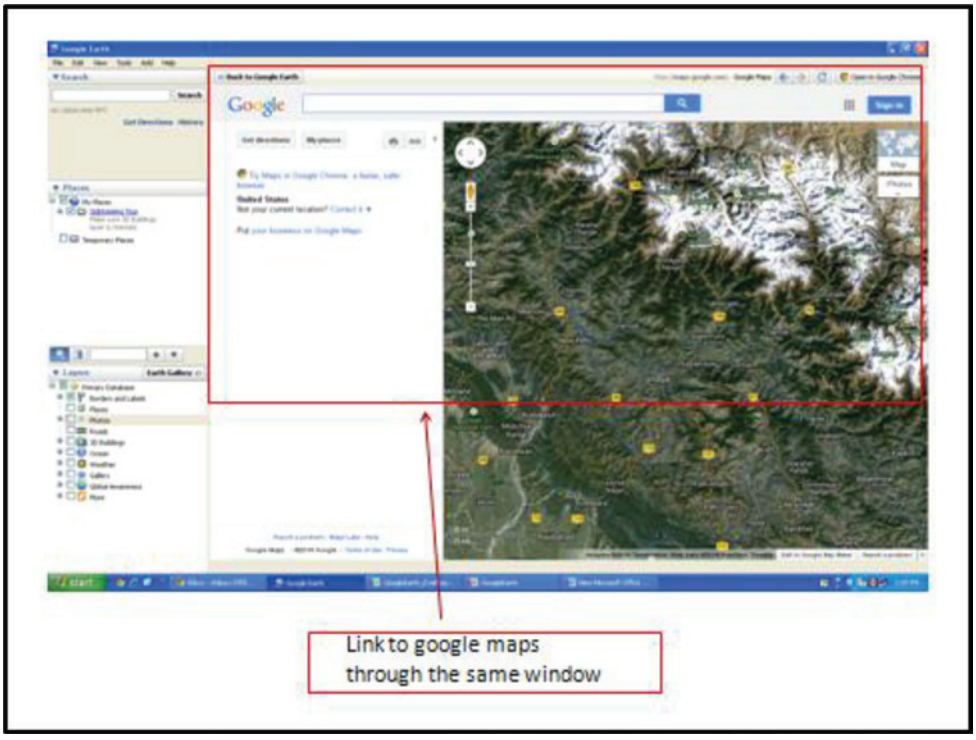


FIGURE-3.27- Linked view of Google Maps in Google Earth

4. BHUVAN PORTAL

4.1. INTRODUCTION

32. Bhuvan is a "portal" of National Remote Sensing Centre (NRSC) through which it provides "visual displays" of NRSC and NNRMS datasets.

33. Bhuvan is the first successful initiative for displaying IRS images and thematic maps – providing a "window" into the spatial data holdings of NRSC. To that extent, the initiative is laudable and appreciable. However, the content, quality and services of Bhuvan have a lot to improve – especially with the advanced state of web-mapping and GIS services technology in the world.

34. Yet another positive of Bhuvan is that it provides a "window" to Indian data- and is pitched against the US Google initiative and a comparison is always drawn between the two. While comparison between the two is technically in-appropriate, the very design and capability of Bhuvan has a lot to desire as a high-quality Indian "product offering".

35. This report includes an independent test and evaluation - technical evaluation report of design and functional characteristics of BHUVAN at - http://bhuvan.nrsc.gov.in/bhuvan_links.php as of July, 2014 and again April, 2015.

35.1. This is not a "loud critic" of Bhuvan – but is a just analysis of the capabilities of Bhuvan – the study has been taken up by NIAS Research team to give insights into the standing-level of Indian GIS Portals and help us to get a more standards and high-quality progression for National GIS.

35.2. We salute the efforts of Bhuvan – the first-of-its kind in India and that has made a telling impact in the satellite image scenario. The Bhuvan team deserves all kudos for what has been achieved.

35.3. But we want to evaluate the "bar" that needs to be set for excellence and quality that matches any other effort in the world, nay, not just matches but surpasses it to make a high-quality GIS Portal of India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

36. In coming days, we hope to also bring out such evaluation for other GIS Portal services in India and ultimately make an impacting design statement adoption for National GIS.

4.2. BHUVAN DATA

37. Bhuvan has the following project datasets - detail list of data layers are provided in **TABLE –4.1**:

37.1. Cartosat-1 DEM for whole country of 2006-2008 time-frame (DEM are of ~10-30m elevation accuracy)

37.2. Resourcesat-1, 23 and 56m images for whole country of latest 2011

37.3. Oceansat images of 1km resolution of 2013

37.4. Broad and average cyclone, wind, NDVI etc data.

37.5. Landuse on 1:250k and 1:50k scale of 2011-12.

37.6. Wasteland maps on 1:50k of 2006 time-frame

37.7. Geomorphology, Lineament, Flood hazard, salt affected land, water-bodies etc on 1:50 k scale of 2006 time-frame.

37.8. City-GIS on 1:10k for 153 cities

37.9. High resolution (1m) image of 225 cities.

37.10. 1:10k Landuse and base maps of 2010 vintage for about 50-60% of area

37.11. Points of Interest data-User defined data (very sparse and disparate and un-systematic)

38. The map and image data in Bhuvan has the following characteristics:

38.1. Bhuvan data are all outputs of different user-funded project data pertaining to specific project goals – thus they are records and database of specific projects done under NNRMS. Most of them are not systematic nation-wide GIS-Ready data.

38.2. All the Bhuvan data of NNRMS maps are of 2000-2010 vintage and maps generated at different times – there is very little 2015/Current/Updated data in Bhuvan-NNRMS holdings. Because of the different time-lines of data, any present situation analysis is extremely difficult.

38.3. Almost 60-70% of Bhuvan-NNRMS data is on coarse-level (1:250000 or 1:50000 maps) and just about 10-20% data is on detailed scale (of 1:10k).). No data of larger than 1:10000 scale is available from Remote Sensing images in Bhuvan Thus wide-ranging scale-differences of Bhuvan data is a major limitation for usage of Bhuvan data for Decision-Support as correlation and match is difficult. Non availability of large scale information for city GIS is a major gap even though satellite images of 0.3 data is available commercially today- thus applications that need 1:8000 or 1:4k, 1:1k are not possible.

38.4. Many of the data of Bhuvan-NNRMS data cover the whole country – mainly administrative boundaries, some layers on 1:250k scale and landuse/wasteland on 1:50k scale, apart from atlas information, are only available for the whole country. Almost 30 datasets are not available for the whole country. Thus, Bhuvan data are patchy and limited geography coverage (arising from project study areas) posing great difficulty for national applications and usage across the country's geography.

38.5. All of Bhuvan data is not up-to-date (2015) – because they are project-linked and more a database of records.

38.6. SIS-DP project where 6 layers of 1:10000 maps is just available for 18 states in a limited manner and these are 2010 vintage – thus there is no update-orientation.

38.7. Under NUIS project Bhuvan has ~ 150 towns' data which is of very limited manner.

38.8. Village-wise limited census parameters data is available for 2001 & 2011 is available for 28 states. Because the complete census tables are not linked, the usage for village level applications is very limited.

38.9. Bhuvan does not have ministry/department/user tabular data geo-tagged (Say, MNREGA data; JNNURM data; Tourism statistics; National Statistics; 2011 Census data etc) and this can pose serious limitation for decision-support for ministries.

38.10. Bhuvan has now got the module for real-time crowd-sourcing data collection – however there is hardly any citizen data that has been captured. Further the module to capture the data can be substantially improved to make it widely usable. Thus, linkage to e-services and citizen services (especially any Complaint Management Services) cannot be undertaken.

38.11. Bhuvan data available on Portal are not in GIS-Ready format – direct access is in "snapshot format" posing major limitations to GIS usage.

38.12. Bhuvan does not have decision support capability which requires simple and complex querying, integrated analysis and data fusion capabilities. Without these critically required decision modules (which will vary for different sectors/ministries), the usage of Bhuvan is very limited and is mainly restricted to display and visualization

39. FROM A TECHNICAL PERSPECTIVE, BHUVAN IS JUST A 'COLLECTION OF DIFFERENT MAP DATA THAT ARE PUT INTO A DATA-CONTAINER". FROM A TECHNICAL STAND-POINT, SUCH "DISPLAY DATASETS" HAVE VERY LIMITED VALUE FOR SERIOUS GIS APPLICATIONS AND DECISION-MAKING (except maybe for reference to old time-line status).

4.3. BHUVAN SERVICES/APPLICATIONS

40. In **TABLE –4.2** a detailed assessment of Bhuvan Portal has been provided. However, here are some summary of observations/examples of the **limited nature of Bhuvan 2D Portal** :

40.1. It displays old (2008-10) IRS 2.5/5.8m resolution images AND high-res limited number of city-image visualization capability. It has tools for display/query – distance query, measure, overlay data, WMS etc – all of these are just display and visualization. Again just display of "what data that is available".

40.2. Bhuvan 2D shows only 28 states village boundaries – again a limited dataset.

40.3. Roads from landuse do not match with roads on images or roads on wasteland – thus, making "multiple roads" an accuracy miss-match and poor quality. Similarly, with water bodies, cities etc.

40.4. Because data has just been collated from different sources, there are clearly visible registration and match problems – posing difficulties for GIS analysis if used as it is.

41. As is seen in **TABLE-4.2**, Bhuvan offers no qualifiable **GIS Services Capability** (but is just limited to rudimentary display of maps and displays old disaster – flood/drought etc layers; thematic display):

41.1. It has 1:250000 and 1:50000 scales of landuse/cover; 1:50000 soils data; 1:50000 scale Wasteland and very limited districts of SIS-DP and NUIS cities on 1:10000 scale. Thus, very varied and coarse details.

41.2. It has Landuse data of 2010-11 dates and even in 2015 this old landuse information is made available- rendering any meaning and real time landuse decision making in-fructuous.

41.3. It has locations of AWS and normal display of AWS data.

41.4. It has potential fish zones data - old 2014 data, not useful as it doesn't give updates on daily basis of 2015.

41.5. It has disaster flood data of upto 2010, not current and available only for limited places, 8-9 states J&K flood information of 2015 is available for display.

41.6. It has limited displays of drought – all of old dates where it contains only NDVI and NDWI images and no analyzed datasets are available.

41.7. It has random cyclone and Earthquake data which are very sketchy display

41.8. It has forest fire information where location & images are available on for display.

42. As is seen in **TABLE-4.2**, Bhuvan Thematic Services is just nothing but DISPLAY of static maps for **users to select; browse and query (identify) the Thematic Datasets** from this portal. The Thematic services has just 7 themes of different dates from 2005/older to 2010 and none of them are current 2015 – AGAIN JUST LIMITED DATA DISPLAY. In GIS parlance, these characteristics DO NOT QUALIFY TO BE CALLED GIS SERVICES. To explain the sketchiness of data in Bhuvan here are some examples:

42.1. Urban Sprawl (20011-12) is just for some cities of just 5 states.

42.2. Flood Hazard Zone is available for just 1-2 states on 1:250000 scale of latest 2010.

42.3. Salt Affected and Waterlogging of 2005- 2006 on 1:50000 scale is just available for 18-19 states.

42.4. And so on in a very disparate and sketchy manner.

43. Further, as seen from **TABLE-4.2**, Applications claimed in Bhuvan Portal are NO APPLICATIONS that offer integration of multi-layers of maps or multi-parametric analysis BUT are just **Spatial Mashups (meaning overlay displays) for just 7 limited areas**. In GIS parlance, these characteristics DO NOT QUALIFY TO BECALLED GIS APPLICATIONS. Here are the very rudimentary applications on Bhuvan Portal:

43.1. Agriculture – just displaying newspaper and online reports of pests in village-basis for some states only and Agriculture plantation – where only tea garden locations are shown for Assam and West Bengal of 2011;

43.2. E-Governance – supposed to be De-centralized planning at panchayat level and mainly a display and visualization module of data from SIS-DP project (containing 6- Thematic layers 1:10K). Presently the module has various user-interfaces but no planning is possible because of lack of panchayat level and Asset data. Thus, the tools are symbolic and do not portray any panchayat level decision information. The module is not robust-module hangs many times; design and user interface needs improvement.

43.3. Events – mentioning and displaying images/maps of 2013 KumbhMela and Sports-displaying few stadium location of some sports and where some sporadic sports event that just display sport events – like Champions league 2011 etc.

43.4. Forestry – just displaying 2011-12 and older forest data from reports and images for just 2 states. Few more point layers like Mangroves, Core Relief, Bio-Sphere Reserves, conservations, Industrial pollution etc are present which are present only in few places.

43.5. Irrigation – where AIBP irrigation project data is displayed on image.

43.6. Tourism – displaying basic images and sketchy 2010 tourism data for just 5 cities;

43.7. Urban – mentioning Municipal Administration but having only one Ludhiana data; Urban Growth display for just 22 cities and Urban Information System returning same map display.

43.8. Rural- Maps of ground water prospects for 22 states are displayed mainly as rock types, landforms and structures without any co-relation or legend for prospects of ground water. Thus, the module hardly serves any decision support for ground water at local area or even at district/state.

43.9. School- Contains very small scale aggregated un-query able maps of weather, rainfall, population density etc. which apart from a coarse pictorial depiction is unable to serve any geography or scientific knowledge for students at any level.

44. THUS, BHUVAN APPLICATIONS/SERVICES ARE NOTHING BUT MAP-DISPLAYS AND HAVE NO GIS INTEGRATION; GIS APPLICATIONS OR GIS DECISION SUPPORT CAPABILITY. SUCH PORTAL CAPABILITIES CAN ONLY SERVE DISPLAY AND PREVIEW PURPOSES AND NOT FOR SERIOUS GIS DECISION-SUPPORT REQUIREMENTS.

45. At design level also there are tremendous in-consistencies in functions, displays and results. Some of the notable observations are:

45.1. A good professional GIS Portal design needs to be adopted for substantially improving even the display and visualization capability.

45.2. Professional design tools for GIS Portal – dashboard design, functional consistency, Help design etc is required as there is tremendous in-consistency in same functions across Bhuvan. In fact, industry-standard Portal development tools in forms of Java Portlet API, Lucene, James, and Slide are extremely useful for constructing and deploying portal applications. Tools for efficient search engine and query syntax, Apache James configuration, object to relational mapping concepts with Jakarta OJB are modern concepts that can be used and enhance GIS Portal functionality.

45.3. Testing and robustness has been poor – there are repeated breaks, disruptions, no data, bugs etc and these are not good for a professional Portal.

45.4. Help is very poor and not at all professional help. Professional Help tools need to be used.

45.5. It would be good if Bhuvan peruses some of the world's best GIS Portals – especially USGS National Map, Google Earth, CERN GIS Portal, INSPIRE Portal, Dutch Cadastre Portal, MapmyIndia Portal, OneMap of Singapore, ArcGIS Online and many others that use some state-of-art concepts; Bhuvan can learn a lot from these.

46. Performance-wise too, Bhuvan has a lot to improve. Here are some observations:

46.1. The performance is very slow – it takes almost few minutes for many GIS operations (tested using a NKN network access of Bhuvan AND 4g LTE access of Bhuvan).

46.2. Performance seems to be taking a hit as cache-technology seems poor OR server loads are not appropriate OR network access is slow – BUT net result for user is a poor performance. In our suggestion at least 10-order improvement of performance is called for.

46.3. Robustness is lacking – many times there are breaks and hanging situation, audit-trails do not pick past actions, click-minimization techniques are not adopted, HELP is poor and many other robust features are poor.

47. Looking at the overall Bhuvan portal, it looks that what has been achieved is that for the first time in India all the past NRSC/NNRMS old record maps have been as-is digitalized and made available for display which users can visualize. But there is very limited GIS querying possible. It is also very clear that there is hardly any decision support capability that can be possible from Bhuvan because it contains such old records data. Without a seamless and standardized GIS database which is constantly updated and without including ministry or ground data, Bhuvan is unable to be useful for decision support system by ministry/ states.

48. In our suggestion, below are some important architecture concepts for Portals that can be adopted:

48.1. The main concept of Bhuvan must be to present the user with a single "web page" that brings together or aggregates various content (images, GIS-data, text, attributes etc) from a number of GIS content databases across different database servers.

48.2. The architecture of Bhuvan is crucial – with a robust application server connected to a bank of database servers/storage and may be part of a clustered server environment. Cloud-technology and virtualization can improve efficiency of performance. High-capacity portal configurations may call for efficient load balancing strategies.

48.3. As Bhuvan presents GIS data (and applications???) to the user, the portal server must in reality be the front piece of a server configuration that includes efficient network connectivity to the application server.

48.4. Hopefully, Bhuvan server looks to be only a "pass through" for the user – and use of portals, application functionality are presented in any number of portal pages. For the most part, this architecture must be transparent to the user.

48.5. Load Analysis needs to be done properly - concurrent user capacity is an important issue, and Bhuvan designers need to ensure that large number of concurrent authenticated and authorized users can generate GIS data requests and get results successfully.

3.4. SUMMARY

49. In summary, it is clear from above analysis that:

49.1. Bhuvan is more a collection of available map – more a data-bank - just a collection of old, project-specific and varied data. In our assessment, Bhuvan has just ~<5% of high-value GIS content – rest 95% is just old historical data layers. Bhuvan is far away from any systematic, seamless, nation-wide GIS database that many nations/agencies are offering.

49.2. Bhuvan Portal has very rudimentary GIS display and visualization. In fact, it does not have any serious ministry/governance/citizens applications OR integrative GIS analysis and Decision Support capability at all. Bhuvan cannot address GIS Decision Support needs of governance issues – like needs of MNREGA, JNNURM, Panchayati Raj, Power, Rural Development, Planning Commission application needs, Urban Development needs and many others.

49.3. Bhuvan Portal design, architecture and infrastructure is limited and thus is very slow and erratic in performance.

TABLE –4.1: DETAILED EVALUATION OF BHUVAN DATA CONTENT

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
1	State	1976	1:250K	Yes	
2	District	1976	1:250K	Yes	
3	Taluk	1976	1:250K	Yes	
4	Settlement Location	NA	Layer generated using Satellite Images, toposheets and other ancillary data.	Yes	
5	Village	1976	1:250K	No	Bihar, Himachal Pradesh, Jammu and Kashmir- not available
6	Rail	NA	NA	Yes	
7	Road	NA	NA	Yes	
8	Parliament Constituency			Yes	
9	Assembly Constituency			Yes	
10	Panchayat boundary	NA	SOI and MoPR	No	In 35 States/UT 31 are mapped and in those only 60-70 % of the panchayat are mapped
11	Land Use Land Cover	2005-2006	1:50K	Yes	
12	Land Use Land Cover	2011-2012	1:50K	Yes	
13	Land Use Land Cover	2004 - 2014	1:250K	Yes	
14	Land Use Land Cover	2011-2012	1:10K	No	Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Haryana, Jammu Kashmir, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Mizoram, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttaranchal, West Bengal Not all districts data are available in each states
15	Urban Land Use 10K: NUIS	2006-2007	1:10K	No	~ 150 cities are available
16	Wasteland	2008-2009	1:50K	Yes	
17	Glacial Lakes/Waterbodies	2011, 2012, 2013	1:250K	Yes	Himachal Pradesh, Jammu & Kashmir and Uttarakhand
18	Geomorphology	2005-2006	1:50K	Yes	
19	Lineament	2005-2006	1:50K	Yes	
20	Flood Hazard Zone	1998-2007	1:250K	No	Assam

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
21	Flood Annual Layer	1999-2010	1:250K	No	Assam and Bihar
22	Erosion	2005-2006	1:50K	No	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh
23	Salt Affected and Waterlogging	2005 - 2006	1:50K	No	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal
24	Waterbodies	2004-2015	1:250K	Yes	Data is available from year 2004 to Mar 2015 where only few months are available.
25	Surface water bodies	NA	1:50K		
26	Urban Sprawl	2005-2006, 2011-12	NA	No	Andhra Pradesh, Chhattisgarh, Haryana, Jharkhand and Maharashtra
27	Recent Flood	2015	NA	No	Jammu & Kashmir 2015
28	Historic Flood	2006-2008 & 2010-2014	NA	No	2006,2007(Bihar),2008(Kosi Post),2010(Punjab),2011(Assam, Bihar, West Bengal, Uttar Pradesh, Orissa),2012 (Assam, Bihar, Andhra Pradesh, Tamil Nadu)2013(AP, Assam, Bihar, Delhi, Gujarat, Maharashtra, Uttarakhand, West Bengal) 2014(Meghalaya, AP, Assam, Bihar, UP, West Bengal, Odisha, J&K)
29	Flood Annual Layer	1999-2010	1:250K	No	Bihar, Assam
30	Flood Hazard Zone	2007-2014	1:250K	No	Assam, Bihar, Odisha and Uttar Pradesh
31	Aggregated Flood	2003-2013	1:250K	No	Individual layer cover information for Flood, Tsunami & Cyclone. It does not cover entire country since data is available only in patches.
32	NDVI	2008-2012 (June-Nov)	NOAA AVHRR (TOA reflectance)	Yes	

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
33	NDWI	2008-2012 (June-Nov)	MODIS VEGETATION PRODUCT (MOD13A2)	Yes	
34	Soil Moisture Index	2011&12 (June to November)	NOAA GDAS PET, NBSS&LUP soil map, Crop Parameters (FAO 56)	Yes	
35	SASI	2012(July to October)	MODIS SURFACE REFLECTANCE PRODUCT (MOD09A1)	Yes	
36	Cyclone NILOFER	30/10/14	IMD data		
37	Cyclone HUDHUD	12/10/2014	IMD data		Other layer like Cadastral Boundary-(Srikakulam, Visakhapatnam , Vizianagaram)
38	Cyclone PHAILIN	2013 October			
39	Earthquake (seismicity)	1819-2011	IMD data	No	J&K, HP, Gujarat, Maharashtra, MP, Bihar, Sikkim, Assam, Manipur, Meghalaya, Arunachal Pradesh, Uttaranchal, Andaman
40	Locations, Images	2000-2015		Yes	
41	Landslide hazard zones	NA	1:50K	No	Himachal Pradesh, Uttarakhand
42	Event based Landslide inventory	2011, 2012, 2013, 2014	NA	No	J & K, Kedarnath, Okhimath, Sikkim
43	Early Warning	2015-04-25	NA	No	Rishikesh-Badrinath, Chamoli-Okhimath, Kedarnath
44	Potential Fishing Zones	NA	NA	No	Andhra Pradesh, Odisha and West Bengal.
45	Pest Surveillance	2006-2015	Point layer	No	Andhra Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman and Nicobar and Delhi Source: Newspaper, online report
46	Tea Garden location		Point layer	No	Assam and West Bengal
47	Rubber Plantation	2011	1:10K	No	Tripura

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
48	Entry Point JFMC, GIM Plantation	NA	NA	No	Himachal Pradesh
49	GIR Eco Sensitive Zone	NA	NA	No	Junagadh
50	Biological Richness Map	NA	NA	Yes	
51	Fragmentation Index Map	NA	NA	Yes	
52	National Park	NA	NA	Yes	Nationwide information & few project based information are available(Project tiger, elephant)
53	Climate Change	NA	NA	No	No data under this heading
54	Wetland	NA	NA	No	Punjab & Himachal Pradesh (7- places)
55	Mangroves	NA	NA	No	only few places
56	Corel Reef	NA	NA	No	only few places
57	Botanical Garden	NA	NA	No	only few places
58	Bio Sphere Reserves	NA	NA	No	Index map
59	Mining	NA	NA	No	Some part of country and Karnataka
60	Conservation	NA	NA	No	West Karnataka
61	Protection - Forest Fire Location	NA	NA	Yes	Replica of forest fire-disaster management
62	Air Pollution	NA	Central Pollution Control Board (CPCB),	Yes	Index map State-wise Air Pollution (SO2)
63	Industrial Pollution	NA	Central Pollution Control Board (CPCB),	No	North & East Of India & Varanasi
64	Ganga Action Plan- Drainage network	NA	NA	No	Ganga River bank
65	Hydrological Unit- Basin Boundary	SRTM DEM	NA	Yes	
66	Hydrological Unit- Sub Basin Boundary	SRTM DEM	NA	Yes	
67	Micro Watershed	NA	Toposheets, remote sensing satellite and other ancillary data.		Portal is accessible to authorized person
68	City Built up	NA	NA	No	North & East Of India
69	Wildlife	NA	NA	Yes	
70	Circle, Division, Range, Section, Beat	NA	NA	No	Karnataka & HP States
71	Wildlife Sighting, Protected Areas	NA	NA	No	Karnataka & HP States

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
72	SAT AIBP(Project boundary, Canal Network, Structures, CartoSat Satellite)	2007-2008	1:10K	No	Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Odisha, Rajasthan, Tripura, Uttar Pradesh, West Bengal, Jammu and Kashmir and Punjab
73	Tourism GIS		Point layer	No	Amritsar, Punjab(Top Destination, Travel, Hotel, visit, food hub, religious, shopping etc) Hampi, Karnataka(Important Monuments) Badami, Karnataka(Important Temple) Nalanda, Bihar(Map) Vijayawada, AP(Hotel, Top Destinations)
74	Archeology sites		Point layer	No	All over country is available, but only for few places
75	(Municipal GIS) Zone, Block, Ward, Locality, House No	NA	NA		Ludhiana, Punjab
76	Urban Growth	1991-2014	NA	No	22 cities (Agra, Ahmadabad, Bengaluru, Bhopal, Chennai, Coimbatore, Delhi, Hyderabad, Indore, Jaipur, Kanpur, Kochi, Kolkata, Kozhikode, Mumbai, Nagpur, Patna, Pune, Surat, Thrissur and Vadodara.)
77	Ground Water prospects, Structures	NA	1:50K	No	Andaman and Nicobar, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Jammu and Kashmir, Haryana, Jharkhand, Haryana, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Puducherry, Punjab, Sikkim, Tripura, Uttar Pradesh, Uttarakhand, West Bengal
78	Watersheds		SRTM DEM		Portal is accessible to authorized person
79	ISRO Disaster Management Support Programme (RISAT-1,2,ResourceSat-2 AWiFS, Cartosat-1, CartoSat-2 PAN)	200, 2008, 2011, 2012, 2013, 2014			Bangladesh, Cambodia, China, Indonesia, Iraq, Japan, Khajakzstan, Myanmar, Nepal, Oman, Philippines, Sri Lanka, Tajakistan, Thailand, Tonga, Vietnam

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
80	Annual Rainfall		Coloured maps	Yes	
81	Monsoon Advance			Yes	
82	Monsoon Retreat			Yes	
83	Seasonal Rainfall		Coloured maps	Yes	
84	Major Rivers		Coloured maps	Yes	
85	Forest Type		Coloured maps	Yes	
86	Wildlife Sanctuary			Yes	
87	Relief		Coloured maps	Yes	
88	Population -2001		Coloured maps	Yes	
89	Population - 2011		Coloured maps	Yes	
90	Rice Growing Area		Coloured maps	No	only few places are identified all over the country
91	Wheat Growing Area		Coloured maps	No	only few places are identified all over the country
92	Coal Field & Mines		Coloured maps	No	only few places are identified all over the country
93	HVJ Natural GIS Pipeline		Line layer	No	only few places are identified all over the country
94	Major Natural Gas Reserves		Line layer	No	only few places are identified all over the country
95	Oil Field		Point layer	No	only few places are identified all over the country
96	Cotton		Point layer	No	only few places are identified all over the country
97	Iron Steel Plants		Point layer	No	only few places are identified all over the country
98	Silk		Point layer	No	only few places are identified all over the country
99	Software Tech Parks		Point layer	No	only few places are identified all over the country
100	Woolen		Point layer	No	only few places are identified all over the country
101	Bauxite		Point layer	No	only few places are identified all over the country
102	Iron Ore Export Ports		Point layer	No	only few places are identified all over the country

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
103	Iron Ore Fields & Mines		Polygon layer	No	only few places are identified all over the country
104	Manganese		Point layer	No	only few places are identified all over the country
105	Mica		Point layer	No	only few places are identified all over the country
106	Nuclear & Thermal		Point layer	No	only few places are identified all over the country
107	Soil Type		Coloured maps	Yes	
108	Airports		Point layer	No	only few places are identified all over the country
109	Railways		Line layer	Yes	
110	Road		Line layer	Yes	
111	Sea ports		Point layer	No	
112	Major Dam				Layer done not appear
113	Major Lakes			Yes	
114	Rivers			Yes	
115	Cricket (Stadium)		Point layer	No	Ahmadabad, Bengaluru, Chennai, Dharamsala, Hyderabad, Jaipur, Kolkata, Mohali, Mumbai, New Delhi, Pune, Raipur, Ranchi, Visakhapatnam
116	Badminton (Stadium)		Point layer	No	Bangalore, Delhi, Hyderabad, Lucknow, Mumbai, Pune
117	Football (Stadium)		Point layer	No	Aizwal, Bangalore, Chennai, Delhi, Hyderabad, Imphal, Kochi, Kolkata, Kozhikode, Ludhiana, Mumbai, Nagpur, Siliguri
118	Golf (Stadium)		Point layer	No	Chandigarh, Chennai, Coimbatore, Delhi, Gurgaon, Kodaikanal, Kolkata, Patna, Srinagar, Thirunanthpuram
119	Hockey (Stadium)		Point layer	No	Chennai, Delhi, Jalndhar, Lucknow, Mumbai, Trichy
120	Cartosat-1:DEM - Version-1	2006-08		Yes	1 arc Sec (~ 32 m) 2006-08
121	Cartosat-1:DEM - Version 1.1R1	2008-12		Yes	1 arc Sec (~ 32 m) 2008-12
122	Cartosat-1:DEM - Version-2R1	2005-14		Yes	1 arc Sec (~ 32 m) 2005-14
123	IMS I - Hyperspectral Imager	2008-12		Yes	2008-12

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
124	Resourcesat-1: AWiFSortho	2008, 2009 (2 seasons), 2010 (2 seasons)		Yes	56m- 2008, 2009 (2 seasons), 2010 (2 seasons)
125	Resourcesat -1:LISS III Ortho	2008-09, 2011		Yes	24 m 2008-09, 2011
126	Oceansat-2:OCM: NDVI	2011(Monthly), 2012 and 2013 (Fortnight)		Yes	1 Km 2011(Monthly), 2012 and 2013 (Fortnight)
127	Oceansat-2:OCM: Vegetation Fraction	2011(Monthly), 2012 and 2013 (Fortnight)		Yes	1 Km 2011(Monthly), 2012 and 2013 (Fortnight)
128	Oceansat-2:OCM: Albedo	2013 (Fortnight)		Yes	1 Km 2013 (Fortnight)
129	Tropical Cyclone Heat Potential	Jan 1998 – till date		Yes	Jan 1998 – till date
130	Derived Tropospheric Ozone	2010-2014		Yes	
131	Daily Ocean Heat Content of 700m Layers	Jan 2002 – till date		Yes	Jan 2002 – till date
132	Daily Ocean Mean Temperature & Heat Content of Different Layers	1998-2015		Yes	
133	Daily Tropical Cyclone Heat Potential	1998-2015		Yes	
134	Model Derived Depth of 26 Degree Celsius ISOTHERM	2013-2015		Yes	
135	Model Derived Tropical Cyclone Heat Potential	2013-2015		Yes	
136	Ocean and Wind Curl	2012-2014		Yes	
137	Ocean and Stress	2012-2014		Yes	
138	Ocean and Velocity	2012-2014		Yes	
139	AWiFS: Snow Cover Fraction	2014-2015		Yes	
140	AWiFS: Water Bodies Fraction	2004-2015		Yes	
141	Mesoscale compatible inputs for: MM5	2004-2013		Yes	
142	Mesoscale compatible inputs for: WRF	2004-2013		Yes	
143	OCM2: Albedo	2015-2013		Yes	
144	OCM2: Normalized Difference Vegetation Index - Global Coverage	2013-2014		Yes	
145	OCM2: Normalized Difference Vegetation Index - Local Coverage	2011-2015		Yes	

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
146	OCM2: Vegetation Fraction	2011-2015		Yes	
147	Snow Melt and Freeze	2009-2011		Yes	
148	Surface Soil Moisture - 2 Day	2012-2015		Yes	
149	Census Data- District Choropleth Maps, Village Choropleth Maps			Yes	
150	Election - Polling Booths	2014		No	Data not appearing
151	Topography- Slope, Contour (m)		CartoSat DEM	Yes	
152	Cadastral			No	Few state's villages
153	DEM Layer			Yes	
154	Hill Shade View			Yes	
155	Civic Amenities (41): Bank & ATM, Insurance, Credit Society, Other Financial Institute, Source, Structure, School, College/University, Training Institutions/Centres, Public Library, Other Educational Asset, Electricity & Usage, Electric Asset, Commercial, Public/Social Service, Tourist Places, Religious Places, Recreational Facilities, Feed/Fodder Manufacturing Unit, Fodder Storage House, Livestock Water Troughs, Dhobighat, Other General Asset, Anganwadi, Woman & Child Health Center, Health Center, Other Medical Facilities, Others, Postal Facilities, Telecom Facilities, Public Toilet, Garbage Disposal Site & Treatment Unit, Sewage Treatment Unit, Road Type & Structures, Road Transport Facilities, Railway Type & Structures, Railway Transport Facilities, Air Transport Facilities, Water Transport Facilities, Veterinary Dispensary/Hospital, Other Veterinary Facilities		Point layer	No	Even though Asset categories are made there are only few point found all over India
156	Governance Assets (7): Offices, Government Lodging Facilities, Others Administrative Assets, Information Centers, Training & Research Center, Observation Sites, Others,		Point layer	No	Even though Asset categories are made there are only few point found all over India

No	Layers	Year of data	Scale/detail	India coverage	Details of coverage
157	Human Resources & Livestock Assets (2): Human Population, Livestock Population		Point layer	No	Even though Asset categories are made there are only few point found all over India
158	Natural Resources Assets (8): No of Rainy Days, Drainage & Hydrology, Groundwater, Flora, Fauna, Land Use/ Land Cover, Soil Fertility Level, Water Logging Conditions		Point layer	No	Even though Asset categories are made there are only few point found all over India
159	Productive Asset (9): Agriculture System, Dairy Unit, Fishery/Aquaculture, Other Farming Asset, Forest, Industry, Mine, Quarry, Other		Point layer	No	Even though Asset categories are made there are only few point found all over India

TABLE - 4.2: BHUVAN PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	**Seamless for whole Country-**Administrative Layers- Country, State, District, Taluk Infrastructure- Road, Rail Waterbodies-River, Reservoir, Tank(2015) Land Use Land Cover 50K (2005-2006 ,2011-2012), Land Use Land Cover 250K (2004 - 2014), Wasteland 50K (2008-2009), Geomorphology 50K (2005-2006), Lineament 50K, Waterbodies(2004-2015), NDVI (NOAA, MODIS), NDWI, Soil Moisture Index, Forest fire(Locations, Images), Biological Richness Map, Fragmentation Index Map, National Park, Air Pollution, Hydrological Unit- Basin , Sub Basin Boundary, Annual Rainfall, Monsoon Advance, Monsoon Retreat, Seasonal Rainfall, Forest Type, Wildlife Sanctuary, Relief, Glacial Lakes/Waterbodies(Himalayan Region),Parliament, Assembly, DEM Layer, HillShade, Settlement Location, Surface Waterbodies, Image Products-Cartosat-1:DEM - Version-1, Version 1.1R1, DEM - Version-2R1, IMS I - Hyperspectral Imager, Resourcesat-1: AWiFSortho, LISS III Ortho, Land Vegetation - OCM2: NDVI Global/Local 2014,NDVI Vegetation Fraction, Alebdo	Data is from different projects and for different time periods- thus decisions or applications that depend on changing parameters is not possible. Data can best be viewed- limiting the utility of the GI data Base Map on Bhuvan is in-consistently displayed in different modules- leading to non uniformity of portal and confusion to the user. Spatial data is not uniformly displayed across modules and some layers display in some modules and other layers in other modules, this poses confusion to the user and also shows poor design and testing.	Contains huge datasets. Need to be standarised.	

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
		Land & Terrain -OCM: Surface Water Layer Products 2day receptivity 1996, CartoDEM 2005, Albedo. Ocean Physical - Daily Ocean Heat Content of 700m Layer 2002-2015,Daily Ocean Mean Temperature & Heat Content of Different Layers 1998 - 2015, Daily Tropical Cyclone Heat Potential 1998 - 2015, CartoDEM - 1 arc Sec. National Information System for Climate &Environment Studies (NICES) - Atmospheric and Climate Science - Derived Tropospheric Ozone 2010-2014, Ocean Science - Daily Ocean Heat Content of 700m Layers 2002-2015, Daily Mean Temperature & Heat , Daily Tropical Cyclone Heat Potential, Model Derived Depth of 26 Degree Celsius ISOTHERM 2013-2015, Model Derived Tropical Cyclone Heat Potential 2013-2015, Ocean and Wind Curl 2012-2014, Ocean and Stress 2012-2014, Ocean and Velocity 2012-2014, Terrestrial Science - AWiFS: Snow Cover Fraction 2014-2015,AWiFS: Water Bodies Fraction 2004-201,Mesoscale compatible inputs for: MM5 2004-2013, Mesoscale compatible inputs for: WRF 2004-2013, OCM2: Albedo 2015-2013, Terrestrial Science - OCM2: Normalized Difference Vegetation Index - Global Coverage 2013-2014, OCM2: Normalized Difference Vegetation Index - Local Coverage 2011-2015, OCM2: Vegetation Fraction 2011-2015, Snow Melt and Freeze 2009-2011, Surface Soil Moisture - 2 Day 2012-2015			

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
		Not whole Country- Village(Bihar, Himachal Pradesh, Jammu and Kashmir- not available),Panchayat boundary, Erosion(2005-06), Salt affected(2005-06), Ground Water prospects, Flood Annual layer, Flood Hazard, Aggregated Flood, Landuse Landcover(10K), Urban Sprawl, Watershed boundary, minerals Forest Fire Alert, Urban Landuse (10k), Landslide hazard zones, Event based Landslide inventory, Early Warning, Potential Fishing Zones, Pest Surveillance, Plantation, Entry Point JFMC, GIM Plantation, GIR Eco Sensitive Zone, Wetland, Mangroves, Corel Reef, Botanical Garden, Bio Sphere Reserves, Mining, Conservation, Industrial Pollution, Ganga Action Plan- Drainage network, City Built up, Forest boundary(Circle, Division, Range, Section, Beat), SAT AIBP(Project boundary, Canal Network, Structures, CartoSat Satellite), Top Destination, Travel, Hotel, Important Monuments, Important Temple, Archeology sites, Zone, Block, Ward, Locality, House No, Urban Growth, Ground Water prospects, Structures, Rice, Wheat Growing Area, Coal Field & Mines, HVJ Natural GIS Pipeline, Major Natural Gas Reserves, Cotton, Iron Steel Plants, Silk, Software Tech Parks, Woolen, Bauxite, Iron Ore Export Ports, Iron Ore Fields & Mines, Manganese, Mica, Nuclear & Thermal, Soil Type, Airports, Sea ports, Stadium(cricket, badminton, Football, Golf, Hockey), Topography- Slope, Contour (m), High Resolution(1m) city images- 225 cities			
2	Non-Spatial	Limited Census data parameters of-2001 census available in main Bhuvan module Limited Census data parameters of-2011 census available in some state modules	There is no uniformity in non spatial data availability. Further limited parameter of census data is available AND complete census data is not linked.		

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
3	User-ingest	Volunteered Geographic Information (VGI)- Bhuvan allows for VGI of different categories Parks, Hospitals, Place of Workship, Café, Restaurant, Bar, Bank, Supermarket, Road, Rail, path, Water, Powerline, Lanuse(Residential, Industrial, Commercial, Retail, Farm, Farmyard, Forest, Measdow, Cemetery), Buildings, Water. Limited user ingest has been done till now which is unverified. Asset Categories: Civic Amenities (41), Governance Assets (7), Human Resources & Livestock Assets (2), Natural Resources Assets (8), Productive Asset (9) Public Layers (KML, shp, fly, WMS, WFS, Tiff, img, elevation layer)	Bhuvan has no mechanism for verifying user-ingest data, thereby making any unverified data unusable for any decisions.		
4	Geo-Linked Data	Rediff Maps as base maps, PFZ, CHL, SST from ICONS, Weather Information from MOSDAC, Cyclone data from IMD, Industrial Pollution from CPCB.			
B]	**VISUALISATION**				
5	Bhuvan 2D	Basic user Tool for Zoom to full extent, previous and next extent are not available. There is in-consistency of this tool as in some screen this facility is provided and in some screen the facility is missing. However, Help screen mentions this utility BUT it does not function as such in all screens.	A single click operation to display full India extent is not possible but has to be done in multiple clicks, steps and this becomes quite cumbersome and tedious. Not so user friendly and poor design.	Primary zoom tools are important capabilities in a GIS portal and must be included in all screens. A consistency audit needs to be done to maintain uniformity in user interface - user interface elements are different in different categories and “confuses” users. Considerable improvement in design and quality is required.	Figure -4.1

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
6		Geo Search using place names or lat, Long gives erroneous locations (Mysore search identifies location far way from Mysore; 77.56 and 12.36 gives location in a different co-ordinate).	Bhuvan provides mis leading geographic locations to users. Not at all a good geographic search tool in Bhuvan.	Consistency in spatial framework and Co-ordinate systems of different layer has not been maintained- Thus resulting in un systematic geographic database. Further the search algorithm and tool needs proper design and implementation.	Figure –4.2,4.3
7		Overview Map shows panning India frame which is not useful because inset box overview map should show full India extent with moving red box of display extent	User is unable to see moving red box extent with reference to full India frame- which is what user requires. Not a good design and not user-friendly.	Map extent consistency for inset box and display screen needs to be maintained.	Figure -4.4
8		WMS Manager- Search catalogue which is having options like “LULC50K” and “Wasteland50K” populates all the available data.	No filtration is happening according to the options given. Thus, the functionality is “confusing” or showing erroneous results.	Proper filtration of data to be done - once again showing poor design and poor QA/QC/ testing of Bhuvan functionality.	Figure -4.5
9	Bhuvan 3D	Always give an error message in “Skyline Globe” viewer	The constant error of Skyline is “confusing” and not expected on Portals. This reflects poor testing and design capability of Bhuvan. Also reflects poorly on use of commercial software - Skyline.		Figure -4.6

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
10		Most of the Sections have only 1 layer view at a time.	Can't overlay more than one layer. Ex: Administrative layer like Taluk and District layer. It is essential to be able to overlay other layers and more than one layer too.	It would be useful if we could overlay more than one layer at a time.	Figure -4.7
11		In "Add Layer "- WMS Services shows wrong location and data is not added	Cannot add WMS layers - that too when erroneous locations are shown. This shows poor design and testing of Bhuvan	Adding layer functionality is important - though at user end this becomes critical.	Figure -4.8
12		In "Add Layer"- Options like add KML, Shp, imagery are not working	It is strange that these functionalities are not working - thereby content in shape, KML etc cannot get added to Bhuvan. Such dummy functionality puts-off users and shown poor design and functionality of Bhuvan. Even Help content to know what kind of format it should be added like Shp file in Zip format etc.	Rectification of the error and help content to add data is critical. Also high-level intense design review and testing is called for.	
13		In "GIS Tool" - "Find Object" Layers doesn't contain any data to perform given operations	Can't perform any operation given in the "Find Object" tool - again providing a dummy tool does not make any sense. Atleast Help should mention how to go about this functionality - this is missing.	Proper design and testing of the Tool with data has to be done.	Figure -4.9
14		In "GIS Tool"- "Buffer" doesn't show proper buffer circles/ areas.	Difficult to find the exact boundary of buffer - user is confused whether Buffer has happened and what is the buffer area. This is a critical requirement.	Clear defined boundary of buffer must appear. Again a design and testing needs to be of rigor.	Figure -4.10

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
15		In "Add Photo" Tool- Photo is not displaying on the map.	Photos added are not getting displayed on map - if added images are not displayed then it "confuses" users what has happened. It is not clear whether database is updated with added image.	Rectification of the error is required to confirm database updation with images and also display on screen. Proper design and testing is required.	Figure -4.11
16		No Scale bar in the 3D viewer	User will not know in what scale data is displayed - this is really "confusing" as scale display is essential.	Scale Bar design must get added.	
17		Layer visibility information is not available.	User doesn't know at what scale layer is visible.	Tool tip for each layer showing information like Visible in 50000-35000 scale etc.	
18		Query symbol which is used for querying polygon doesn't show for all the polygons.	Difficulty in identifying polygons. Shows query mark for only few polygons.	Identify operations for all the polygons must be well-designed and tested.	
19		"Weather Service"- Few weather service Station data shows wrong temperature.	Wrong display of information. Ex: SSF EDATHURUTHI TRISSUR DIST shows -20.5/-24.4 Deg C dated on 4/15/2015. If wrong and mis-information is shown in Bhuvan it is really not good.	Proper validation of data and design of functionality needs to be done. Database consistency must be maintained at all levels and for all times with checks and balances for data-consistency. Such principles are missing in Bhuvan.	Figure -4.12

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
20		Zoom to Layer option is not available	Difficulty in finding the location of the layer and thus zooming is not possible.	Poorly designed and ir-rational functionality.	
C]	**SERVICES**				
21	Disaster Service (Cyclone)	This service is a display of information about cyclone NILOFFER, HUDHUD and PHAILIN which shows the cyclone track information from IMD department. Cyclone HUDHUD contains Mobile survey, crowd source data, Inundation, forecast, spatial overlay options	Crowed Sourced data which is available has not been categorised properly. (Ex: Damaged Feature-Building shows picture of crop) Legend for LULC layer throws an error. Help shows wrong information	Proper testing is needed.	Figure -4.13, 4.14, 4.15
22	Disaster Service (Drought)	This service contain NDVI, NDWI, Soil Moisture Index, SASI data for whole India "Analysis" part shows district wise intra seasonal graphs of selected years only. No current year information is available(Available till 2012) and No other GIS information is available	Apart from graphs, cannot find any analysed information like Percentage of loss etc. It is a misnomer to call this ANALYSIS - there is no analytics in this function.	This is really NOT A SERVICE but just a display.	
23	Disaster Service (Forest Fire)	Forest fire service shows current fire location on daily basis and burnt location (INFFRAS Rapid Response based on IRS P6 AWiFS Satellite data). It also contains Achieved forest fire locations form 2000-2012. There is no GIS based analysis available in this service.	Even with the maximum zoom of the village layer it is difficult to make out the village name from the map. "Burnt Area" doesn't show any of the information like "Area(ha)" etc.	Identify tool which can show details. This is really NOT A SERVICE but just a display.	Figure -4.16, 4.17

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
24	Disaster Service (Landslide)	Landslide disaster service contains Early Warning system, Landslide inventory, Landslide hazard zones. Information which is available is very limited and contains only for 3-4 places.	Difficult to view Landuse data over satellite image as it is coloured map.	Option set transparency Or polygon should be displayed with only outline and identity tool to query polygon. This is really NOT A SERVICE but just a display.	Figure -4.18
25	Disaster Service (Flood)	Flood related data can be found in this service like Recent floods, Historic floods, Flood hazard zone etc. Only few flood affected places can be found.	In "Historical flood"- Layer '2007 Bihar' area has map which is not matching with the legend. Legend is static display, doesn't change with the map. In "Aggregated flood" - Layers like 'Flood', 'Tsunami', 'Cyclone' doesn't contain any legends and there is no option to perform query operation on the layer. Difficult to understand display map and No other layer information is available, like "Area" etc.	Map or Legend correction required is missing and too "confusing" and identify tool to query information. This is really NOT A SERVICE but just a display.	Figure -4.19, 4.20

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
26	Disaster Service UI	Help- Help content is not relevant to this module Print- Print is just a Screen dump	Help content is not available for this module and shows some ir-relevant help. A screen-dump to be called a Print function is a misnomer. Print should allow User to cuztomise a map and print it (generally to printer or to pdf/Geopdf). A screen-dump print is no good at all. Further, customization is also not possible.	Relevant help content must be available. Professional help development needs to be taken up. Customizable option like setting of the scale and selection of the specific boundary for print. Further, scaled print against screen-dump is most essential. Bhuvan does not have good design for print functionality.	Figure -4.21, 4.22
27	Ocean Services	Ocean Services which contains potential fishing zones data which is only available for few coastal areas (AP, Orissa& West Bengal) Which doesn't give current date data. Other data which are available is CHL (Chlorophyll) and SST (Sea Surface Temperature). These information are linked from INCOIS	Ocean data available are very limited, not available for all the coastal area and not current date information	Data should be made available for all coastal area.	Figure -4.23
28	Open Data Archive Services	This Service facilitates the user to select, browse and download data from the portal. Available products are categorized into Satellite/Sensor, Theme/Products and Program/Projects. Selection of area to download has options like bounding box, Mapsheet, Tiles, Interactive drawing.	Download service works fine.		

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
29	Thematic Service	Thematic services are collection of thematic maps under different projects. Upto 10k thematic layers are available (not seamless). However recent/current thematic layers are not available. Following are the observations No option to overlay thematic layers with the satellite image Option to overlay doesn't have any significance as Query (identify) operation for the layer which is overlayed on the map is not possible. Shows result for only 1 layer and overlayed layer doesn't have swipe option to compare	Data with satellite images can't be viewed - this is a major gap in functionality. Thematic map overlay has no use. We cannot 'identify' the overlayed layer - Ex: Landuse 2012 and Landuse 2005	Option to see both satellite image and Landuse map. Identifying operation should show results for both the layers and swipe option to view both the layers.	Figure -4.24, 4.25
30	Weather Services	Weather service displays weather data like temperature, atmospheric pressure, wind speed and direction, relative humidity which is collected through ISRO's Automatic Weather Station (AWS), located across the country. This name of service is not displayed in Bhuvan main page.	In "Current weather information" layer, Temperature Information is displayed wrongly in some places. Ex: GS Yelburga Koppal shows -40/-40 Deg C dated 4/15/2015.	Erroneous results and in-proper data display happens in Bhuvan. Proper testing needs to be done and data validation is required.	Figure -4.26
31	Climate & Environment	This service says it delivers the products related to Terrestrial Sciences, Ocean Sciences, Atmospheric Sciences, Model Derived Products, Cryospheric products but only documentation and metadata information are available in this section and GIS maps are just a replica of data from "Open Data Archive Services".	Data which are present are very elementary and contains old (2013) data which cannot be considered as decision support application.	Serious climate and Environment related service which gives current date information can be made available.	Figure -4.27
32	Create a Map/GIS	Bhuvan Mapper is a service where only Registered users have the facility to map the places using point, line and polygon and can be put under well defined categories. User will be able to search for location and have options to edit (delete, move, change direction), undo, redo and save.	This service works fine		

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
33	State Portal Services	The layers present are extracts of the layers from main Bhuvan portal. However few state contains few additional layers like census data-2011, Polling Booths of Election 2014, Revenue boundary for few villages, Choropleth maps of district and village wise categorizing Population on (Age-06, Literacy & SC) of census 2011 data. No state specific information is made available apart from the replica of the data which is already present.	Print- Legend is static and shows wrong description. Layers when added shows data present outside concerned district. Potential Fishing Zone doesn't populate any information.	Large scale decision supporting system can be made available for each state.	Figure -4.28, 4.29, 4.30
D]	**APPLICATION SECTORS**				
34	Agriculture (Pest/Disease Surveillance)	This application displays point location of pest/disease affected area. This application just populates the online available data (source: newspaper, online reports) through filtering. No real time and authenticated GIS data is available.	GIS based information is not available as application - what is seen is listing of newspaper and online report items - this is not at all an APPLICATION	Relevant GIS based application with integrative capability of multiple layers and criterion analysis is essential. The present functionality is just a display AND NOT A GIS APPLICATION.	Figure -4.31
35	Agriculture (Plantations)	Agriculture plantation application shows location points of Tea plantation (only Assam and West Bengal) and Rubber plantation of Tripura, field photos which are present is of year 2011. The norm Agriculture plantation doesn't really include all kinds of agriculture plantations in India.	"Agricultural Plantation Rubber" - Query (identify) Shows no information other than the layer name. Relevant attribute information of the layer is not available. Very poor and no data at all and no GIS integrative application is possible. A message "Click within area of s1" is always displayed which is irrelevant to context	Attribute information like Area etc should be provided. Rectification of the message in the dialogue box. The present functionality is just a display AND NOT A GIS APPLICATION.	Figure -4.32

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
36	Irrigation	Irrigation Section contains implementation and monitoring of Accelerated Irrigation Benefit Program (AIBP) which is central govt sponsored project. As it is project based service, Only visualisation of patterns is available. Value added GIS information is not available.	In "AIBP Phase-II" attribute value of Canal Name is wrongly spelled.	Spell check in data and menu -items needs to be done exhaustively at many places.	Figure -4.33
37	Forestry (Karnataka)	This application displays Forestry information of Himachal Pradesh, Karnataka states where few headings like change monitoring contains forest cover monitoring of 2011-20012 data and some forest boundaries Boundaries which is generated from different projects shows different boundary. MOEFCC has layers which are replica of the data present in other modules of forestry and contains few additional data like National Parks, Sanctuaries and few industrial pollution points, Mining areas	In "Know your forest" section, Selection operation for Circle, Division, Range, Sector, Beat doesn't show filtered data. Ex: When certain 'Circle' is selected, following 'Division' list doesn't show data for that 'Circle' instead it shows all 'Division' names. Proper hierarchical administrative set-up in menu is not included - poor design. In "Greening India mission" Layer 'Waterbodies' is not matching with the satellite image. Mis-match of layers and geometric super-imposition errors. "In Greening India mission" Layer "landscapes" doesn't have any relevant information. Ex: Himachal Pradesh forestry's Landscape contains relevant data. Confusion for the user to find correct information	Layer wise filtration required for hierarchy representation. Layer specific information needed is not displayed. Proper data validation and testing required. Layer standarisation is required.	Figure -4.34, 4.35, 4.36, 4.37, 4.38

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
38	E- Governance (Decentralise Planning)	This Application is mainly based on NRSC- SISDP (Space based Information Support for Decentralized Planning) project, where 1:10K thematic layers are present. This application does following things i) SIS-DP project mapping status and other details like object, goal, reports etc project related details are present. ii) Area Selection- User has facility to select area for visualization based on Administrative unit, hydrological unit, Constituency and custom search based on place name. iii) Area Profile report- contains Dashboard of old available climate data(Rainfall & Temperature) data(1971- 2005), Both Interact active area report and print area report have same functionality where user can generate detail report on identification details, major issues, priorities, ongoing projects etc. by Administrative unit, hydrological unit, Constituency and custom search. However report generation will take too much of time (more than a 1hr). iv) Asset Mapping- This module contains asset mapping based on 2 types of login- PRI's and citizens. Assets are broadly classified into 5 categories where it even contains sub categories. However the user mapped assets are not available for next sessions and we cannot identify the available asset information v.)Activity Planning- Here citizen and PRI's can plan an activity based on Govt available schemes. User can create and view his plan and submit it for approval, consolidation activity can be done by only PRI's. This module is in very elementary level more improvement can be done on this application by using more GIS capabilities like zooming to school location to add the schemes etc. vi) Implementation & Monitoring- This module concentrates on viewing approved plans, Ongoing activities and Completed activities. However write now there is no data available. Only schemas can be found. Apart from this application has Navigation tools, Measure tools, identify, swipe etc and Linked view (with other WMS).	Portal hangs many times- Shows poor designing. Search in full extent view shows Jammu and Kashmir and Kerala Erroneous result. Tool Query present under personalisation is mis- leading norm as it doesn't display any operator based query or spatial query but does only string search in few layers.	Requires professional designer which can make product user friendly and stable. Wrong usage of terminologies can be avoided and professional testing need to be carried out in order to avoid errors.	Figure -4.39, 4.40

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
39	Urban (Municipal GIS)	Municipal GIS contains information about only Ludhiana, Punjab, Here we can search house by ward, locality name or House no. Municipal GIS doesn't contain any GIS related decision supporting app which could be implemented in Municipal boundary level.	"Search by House no" spelling of option 'Amenety' should be "Amenity". Sections mentioned under amenities contain incomplete information like Bank-it contains location information but name of the bank is not available.	Spell check need to be done. Complete information regarding amenity displayed can be made available	Figure -4.41, 4.42
40	Urban (Urban Information System)	This "Application" is just a reshow of the Thematic service	Value added GIS information can be made available.		Figure -4.43
41	Urban (Urban Growth Monitoring)	This Application shows the urban growth patterns of few cities over a period of 20-25 years using Multi temporal and multi spectral satellite data	Only visualisation of patterns is available. Value added GIS data are not found.	Analysis showing statistics, percentage over the pattern shown would give more technicalities to the urban sprawl information.	Figure -4.44
42	Rural(Ground Water)	"Bhuvan- Bhujal" application has 2 layers ground water prospects and structures out of which only ground water prospects layer is queryable and structure layer doesn't even has legend information.	Groundwater prospects classification contains inappropriate information - Rock Type and Landform attribute information	Relevant data display.	Figure -4.45
43	Tourism (Tourism-GIS)	"Tourism GIS" contains 5 tourist place information and functionalities are not standarised for all the places.	Get directions (option available for only 1 city) gives only the route map which is incomplete without any distance information or driving directions or time taken with different mode of transport. Nalanda, Bihar contains only map without any other tourism related information.	Better Tourism site which could give more user friendly options and information.	Figure -4.46

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
44	Tourism (Archeology)	"Archeology" contains only little archeological point in India, arranged state wise.	Most of the Information which are provided are from Wikipedia and doesn't give any other GIS related information.		Figure -4.47
45	Special Application	**International Disasters-** Contains scenes from satellite images of few countries (Asia specific regions) where disaster has occurred **IRS Pass Quick Looks-** contains satellite images from ResourceSat-1, ResourceSat-2, OceanSat-2, CartoSat-1 with different sensors and user can view satellite images with reference to the path of IRS pass date. **MANU (Mapping the Neighborhood in Uttarakhand) -** Is a quick link provider of existing services like Bhuvan Mapper, Bhuvan 3D viewer, Disaster Services, Discussion forum. Contains user added data which is not monitored and it contains junk database. **Sports in India-** Contains stadium location of various games and it shows outdated information. **School Bhuvan-** Information which is available is very elementary and doesn't cover proper information (Ex: Agriculture - doesn't cover all Rice growing area, wheat growing areas, Power plants etc.)	Most of the special application contains insufficient data.		Figure 4.48, 4.49, 4.50
E]	**GENERAL**				
46	Design gap	There is no systematic design consistency adopted - things are different in different functions and behave differently at different functions.	Ex: Add Layer i(identify tool) etc. serves different purpose in different modules, which is confusing. In few modules navigation tools Zoom-in, Zoom-out, PAN etc are provided in others it's not present.	Systematic design required - professional GIS Portal development metrics must be adopted. Proper testing is required.	

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
47	Spellings and Text	Full name of the fields not defined and many places spelling mistakes	Ex: RF , JFMC boundary User finds it difficult know the layer name	Proper names of the layer must be adopted to represent layers AND no acronyms for layer-names at all - that is bad practice for GIS Portal. Further, spelling check must be done at all places - there are lots of spelling mistakes.	
48	Others	Attribute Query with operators like 'AND', 'OR', etc is not possible	Advance query operations are missing - such absolute queries are fundamental to GIS Portals and if this basic functionality is not provided then it is really a poor design in modern times.	Options for advance query and multi-parameter query with operands is MUST.	
49		Legend for all the layers not available/possible	Layer readability is difficult without legend and thus the display of map becomes of no use. Legends are a must for MAP PORTALS and help users.	Legend for all the layers must be properly displayed.	

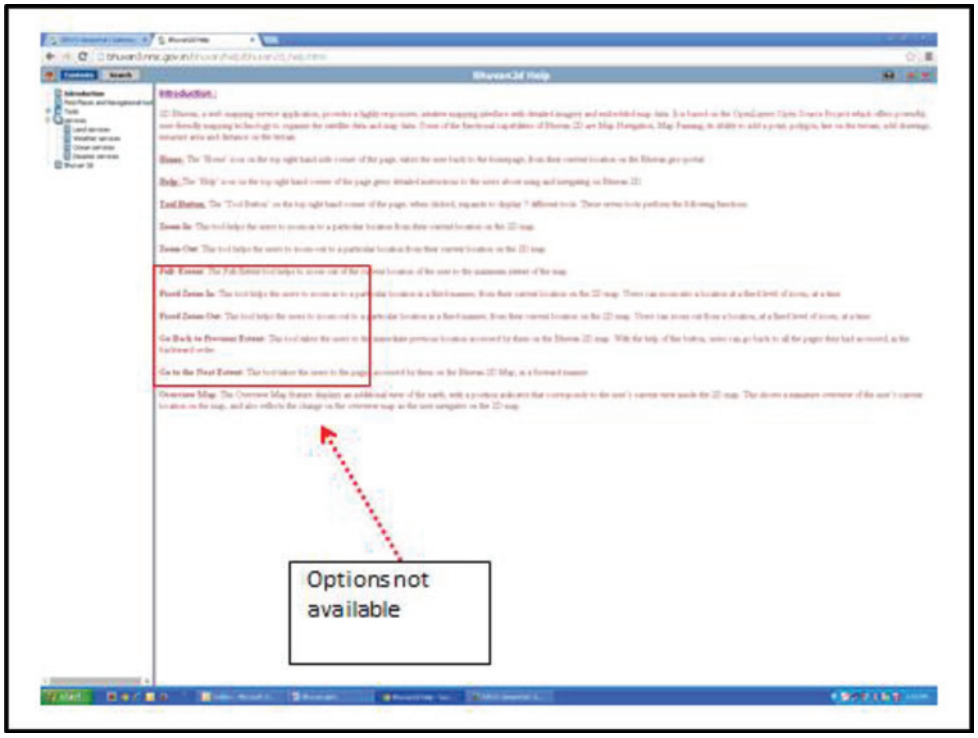


FIGURE-4.1-Help on utility which is not present in the portal

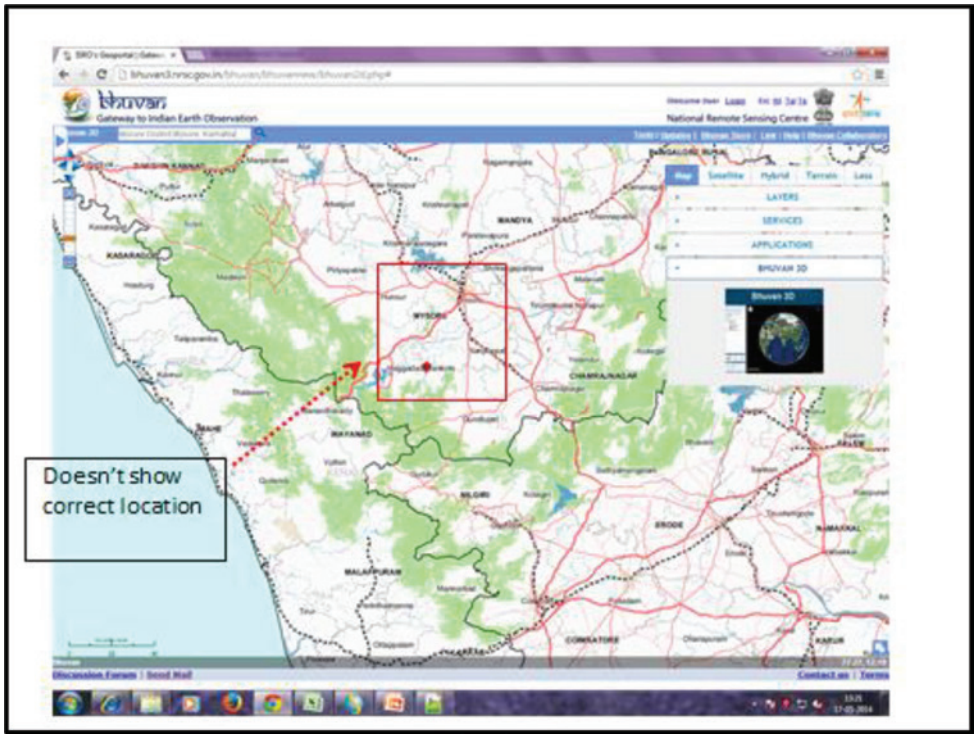


FIGURE-4.2- Wrong location of Mysore, Karnataka

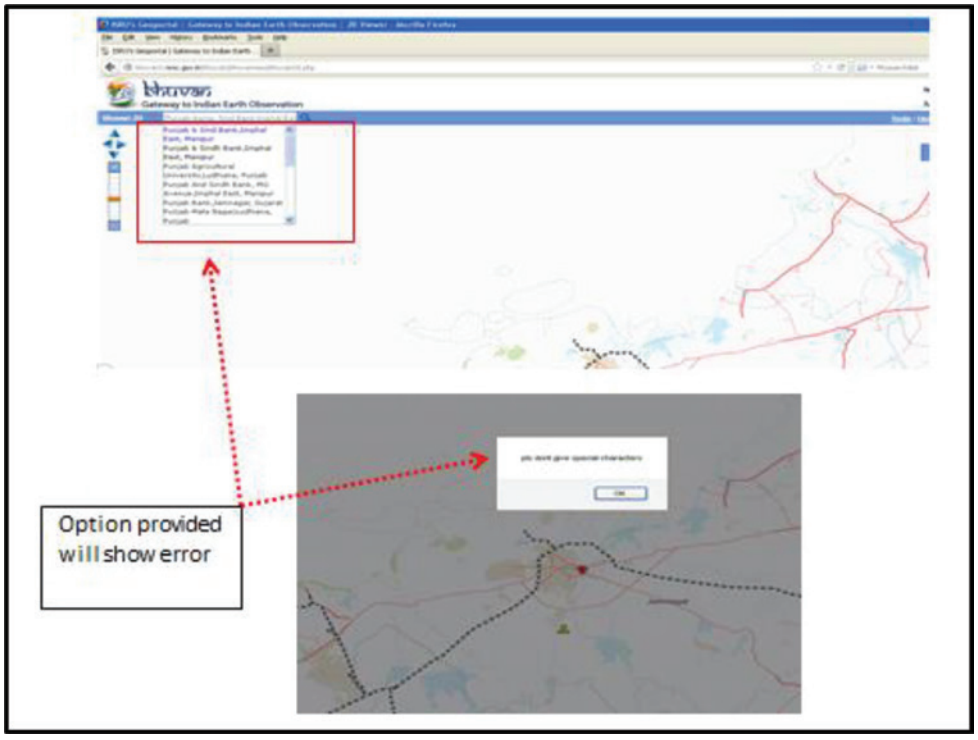


FIGURE-4.3- Erroneous result of search using Location name

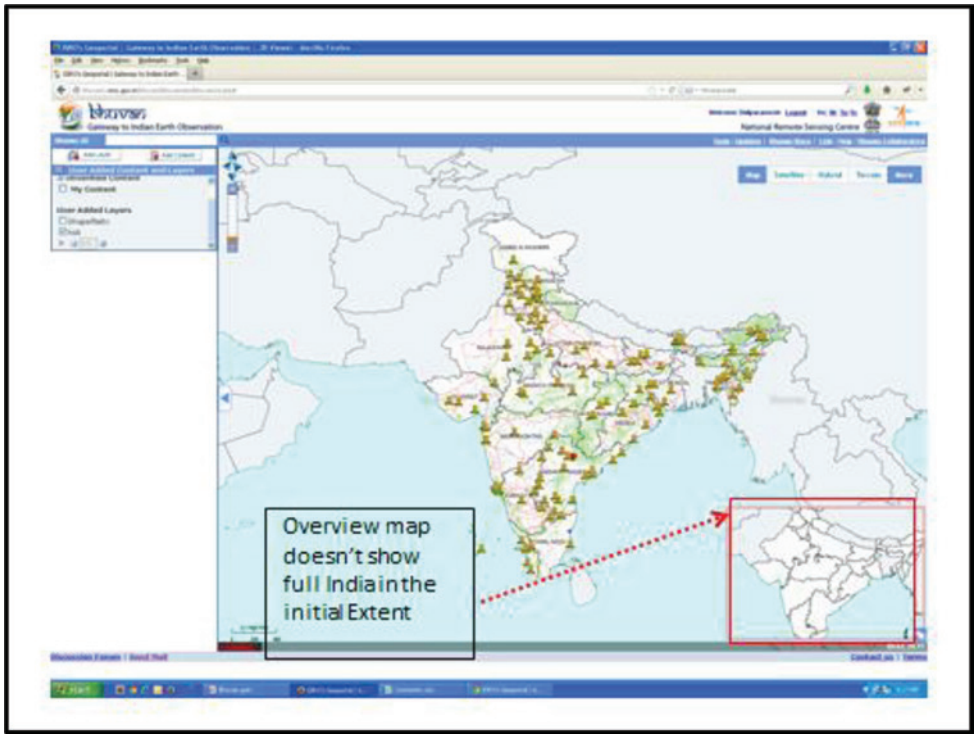


FIGURE-4.4- Malfunctioning of Overview Map

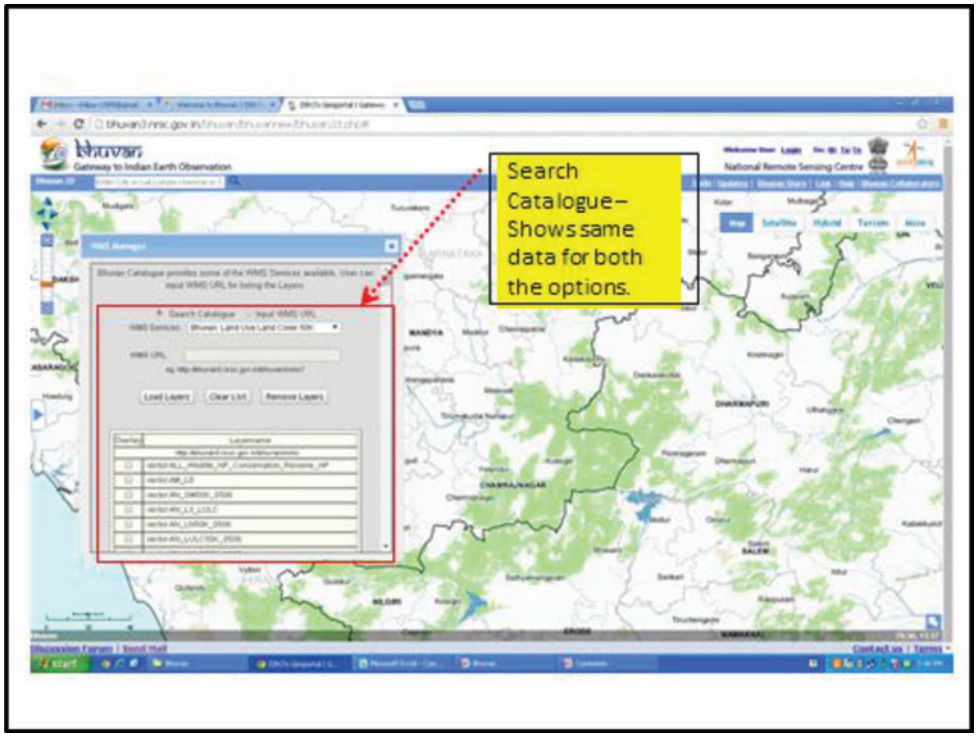


FIGURE-4.5- Erroneous result of WMS Manager tool

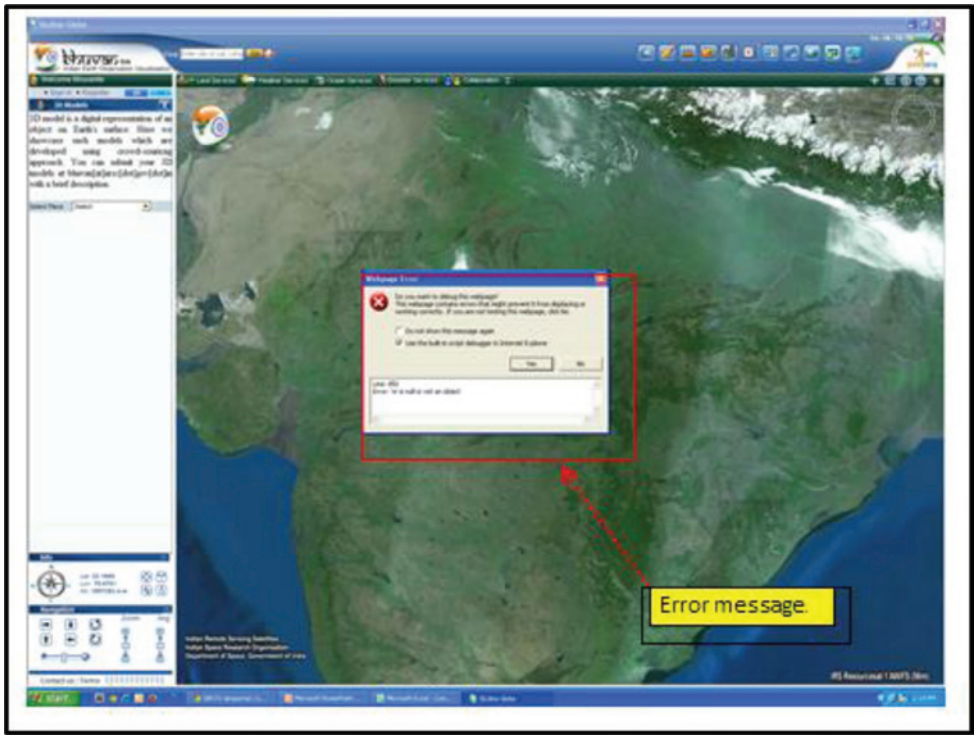


FIGURE-4.6- Error message while operating Bhuvan 3D plug-in

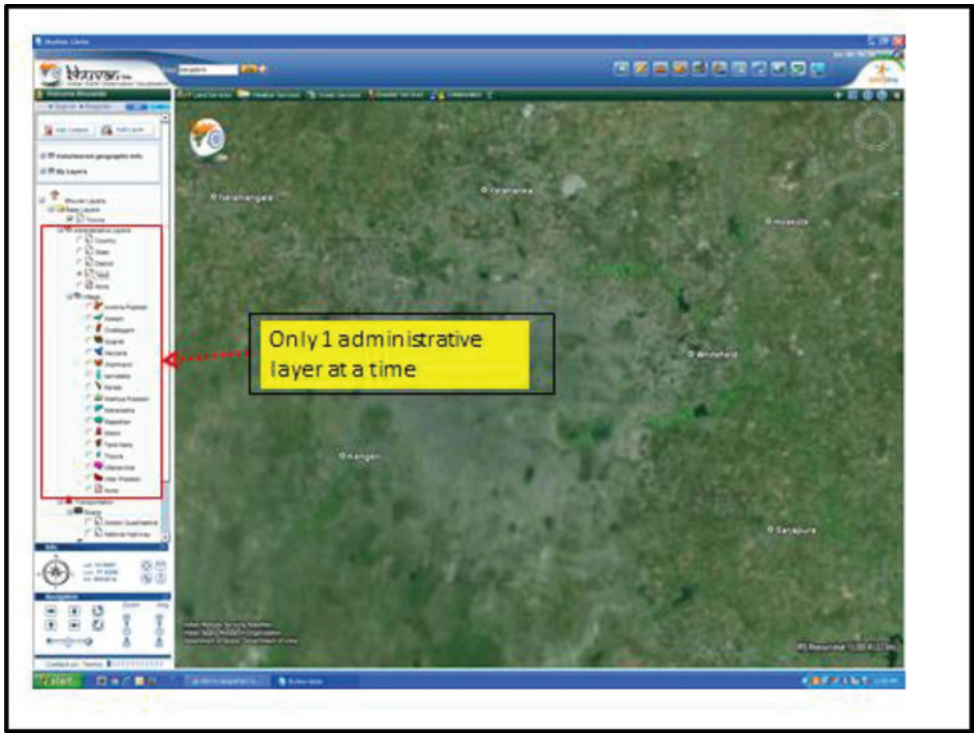


FIGURE-4.7-Limitations of Table of Content in Bhuvan 3D

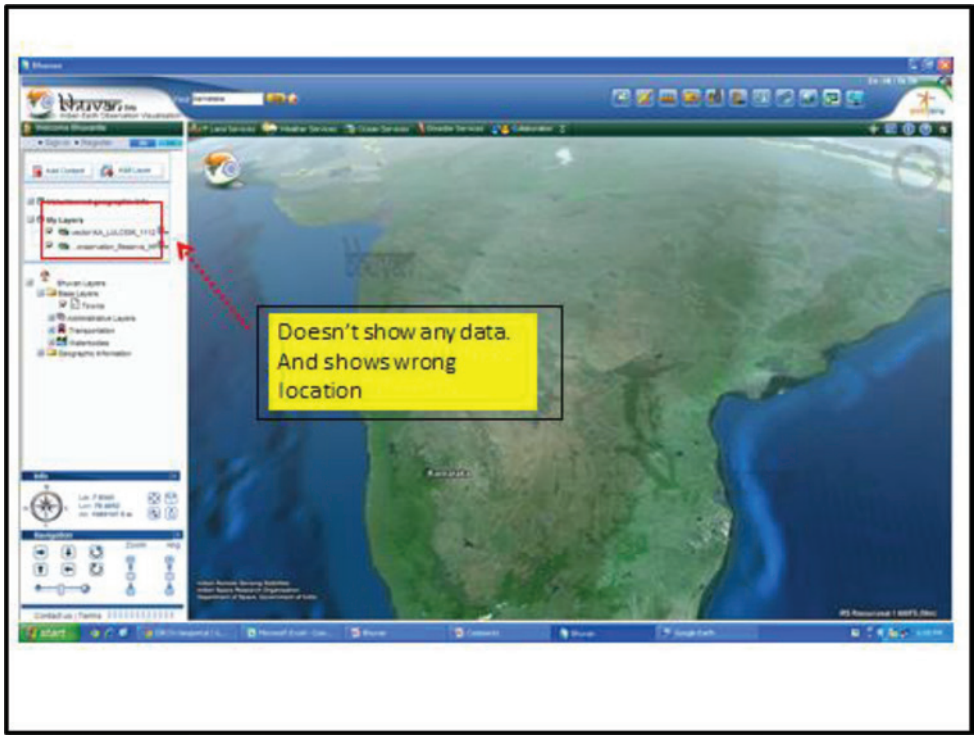


FIGURE-4.8- Malfunctioning of Add layer (WMS) in Bhuvan 3D

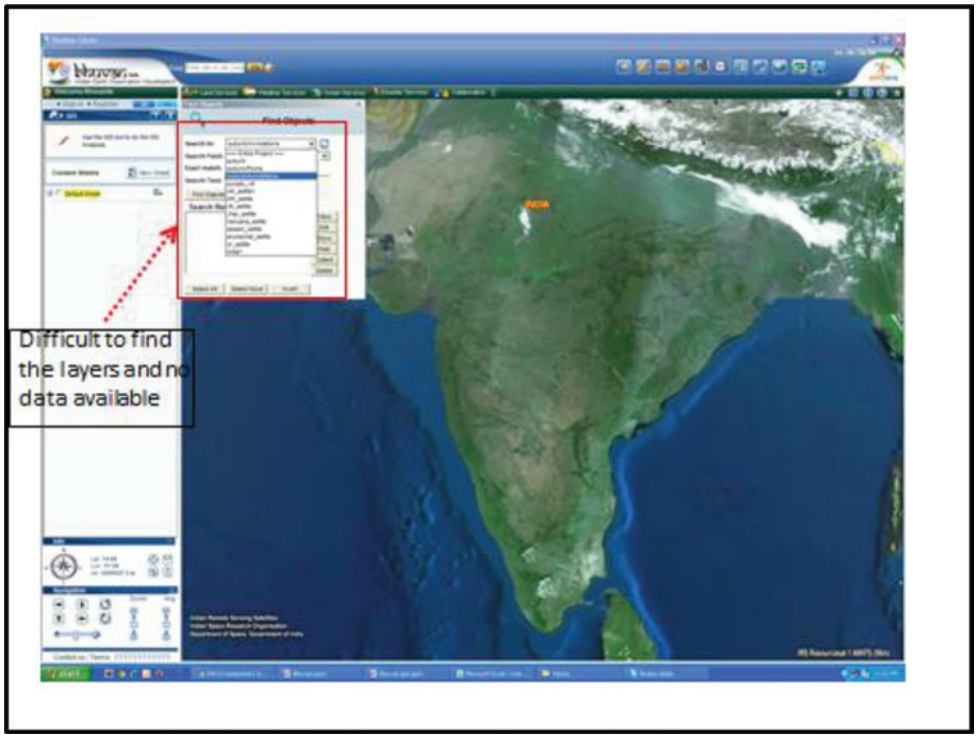


FIGURE-4.9- Difficulty in finding the layer name in GIS Tool of Bhuvan 3D

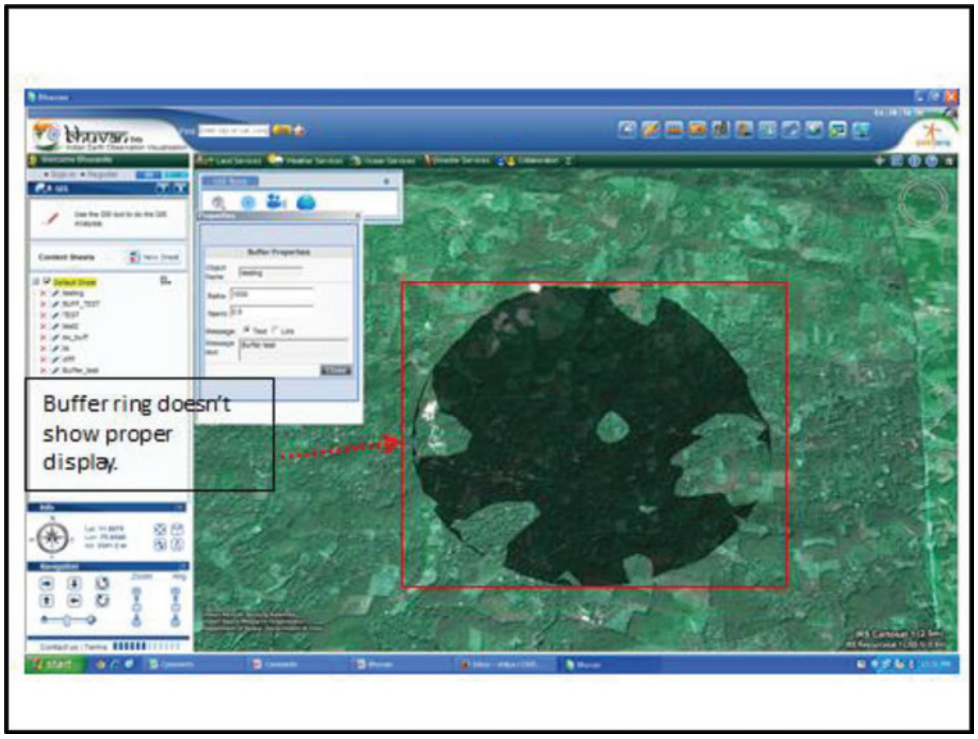


FIGURE-4.10- Wrong functioning of buffer in GIS Tool of Bhuvan 3D

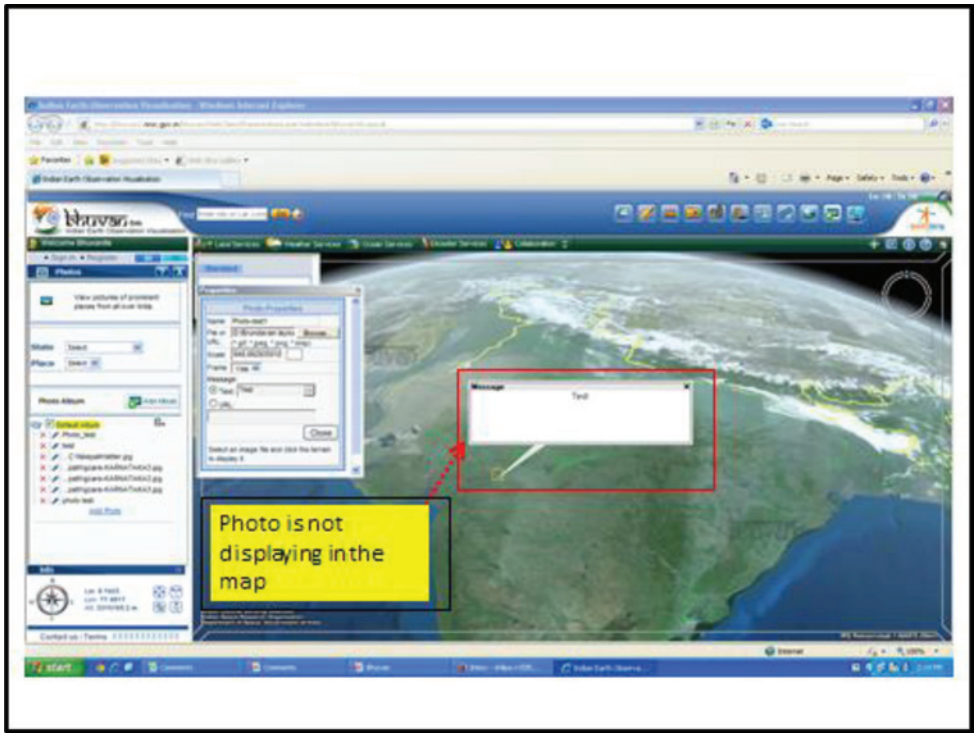


FIGURE-4.11-Non-functioning of Add photo tool in Bhuvan 3D

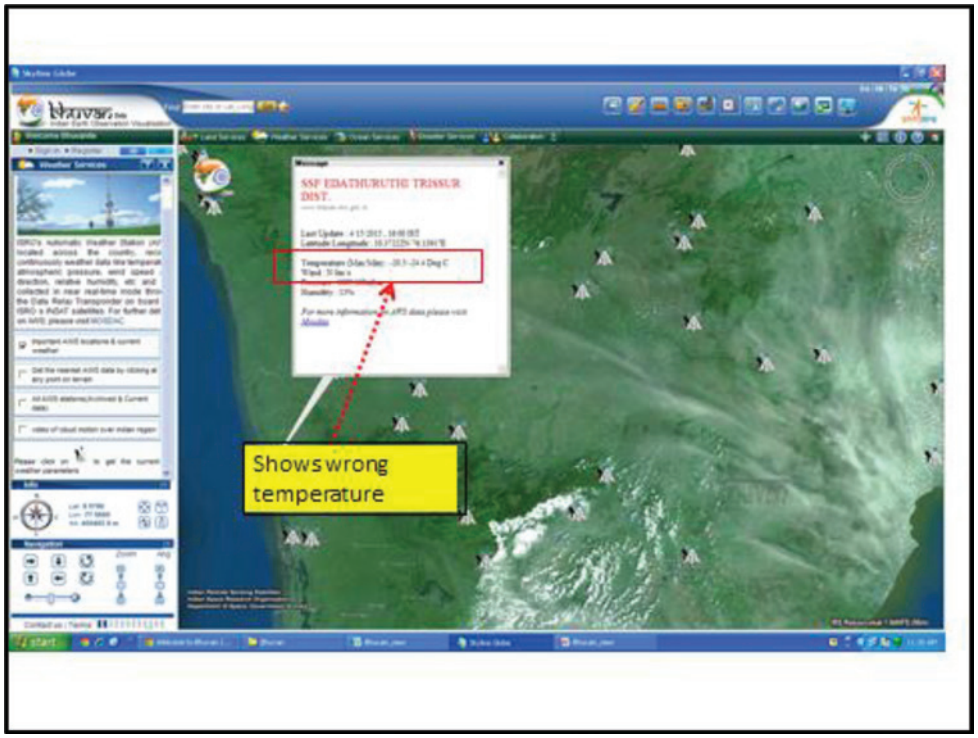


FIGURE-4.12- Erroneous display of temperature data in Bhuvan 3D

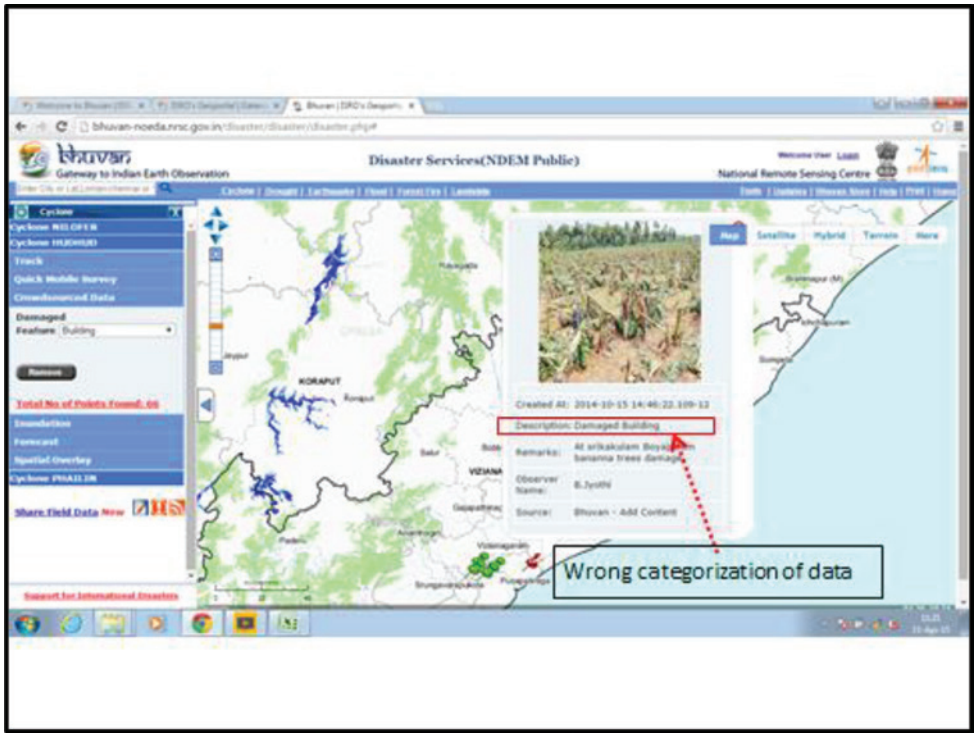


FIGURE-4.13-Wrong categorization of data in Disaster service (Cyclone)

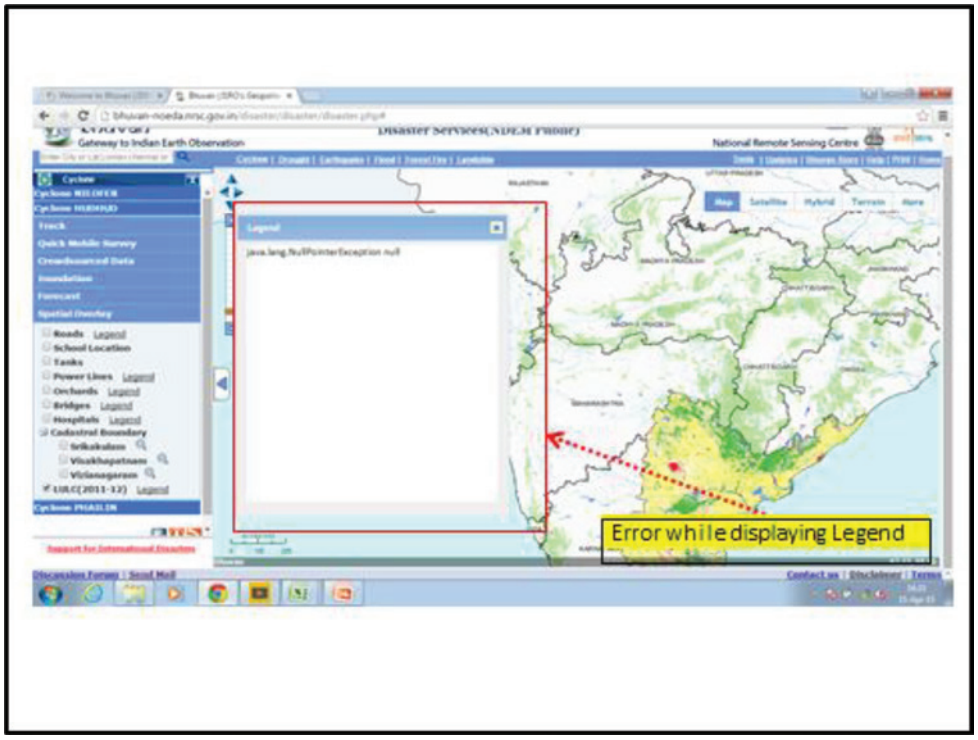


FIGURE-4.14- Error while displaying Legend (Cyclone)

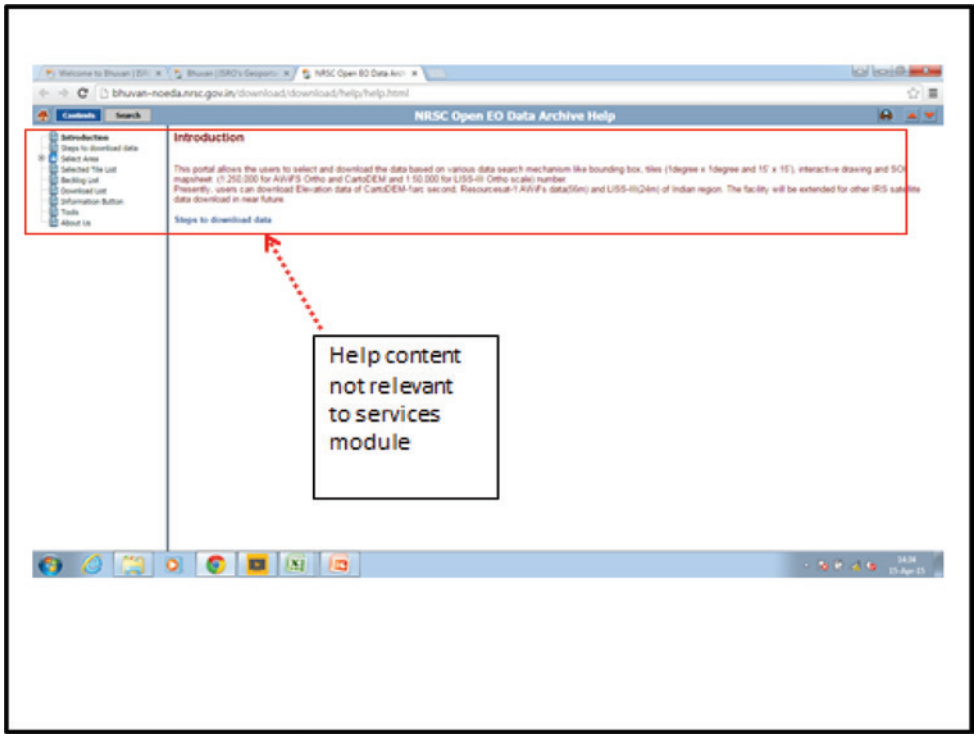


FIGURE-4.15- Help content which is not relevant to Disaster Service (Cyclone)

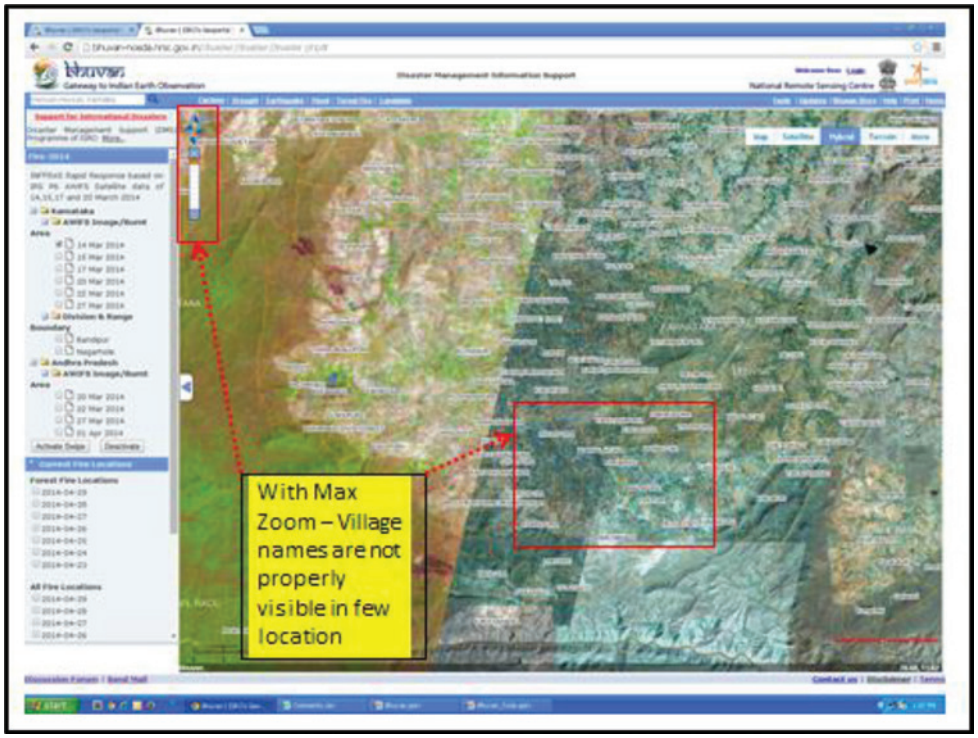


FIGURE-4.16- Difficulty in viewing the village names

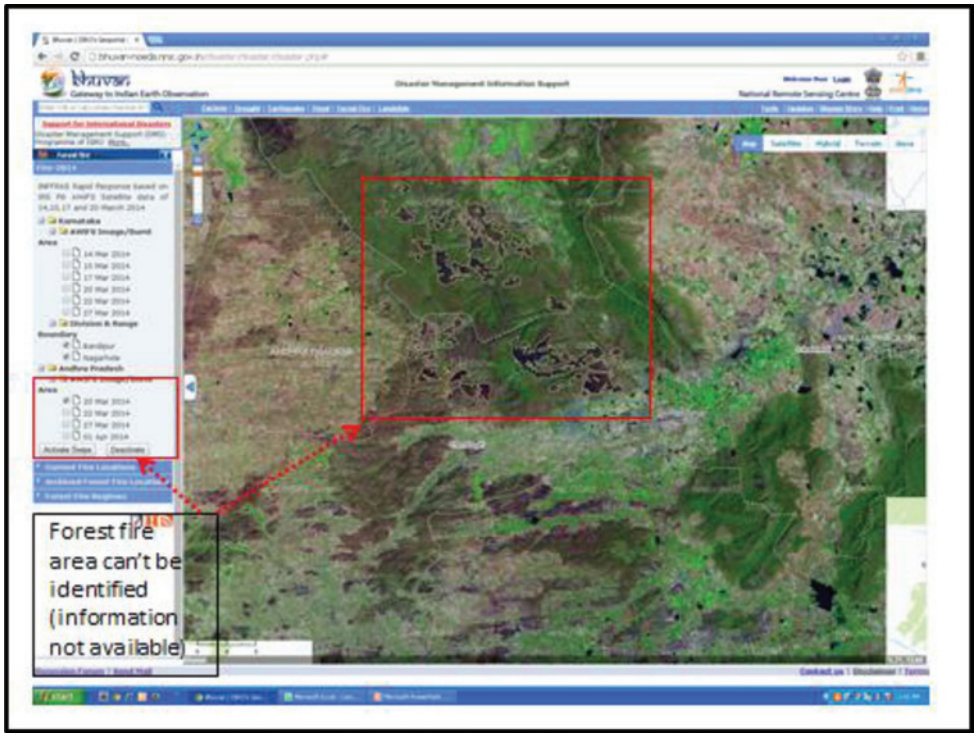


FIGURE-4.17- Burnt area boundary without containing any Area information

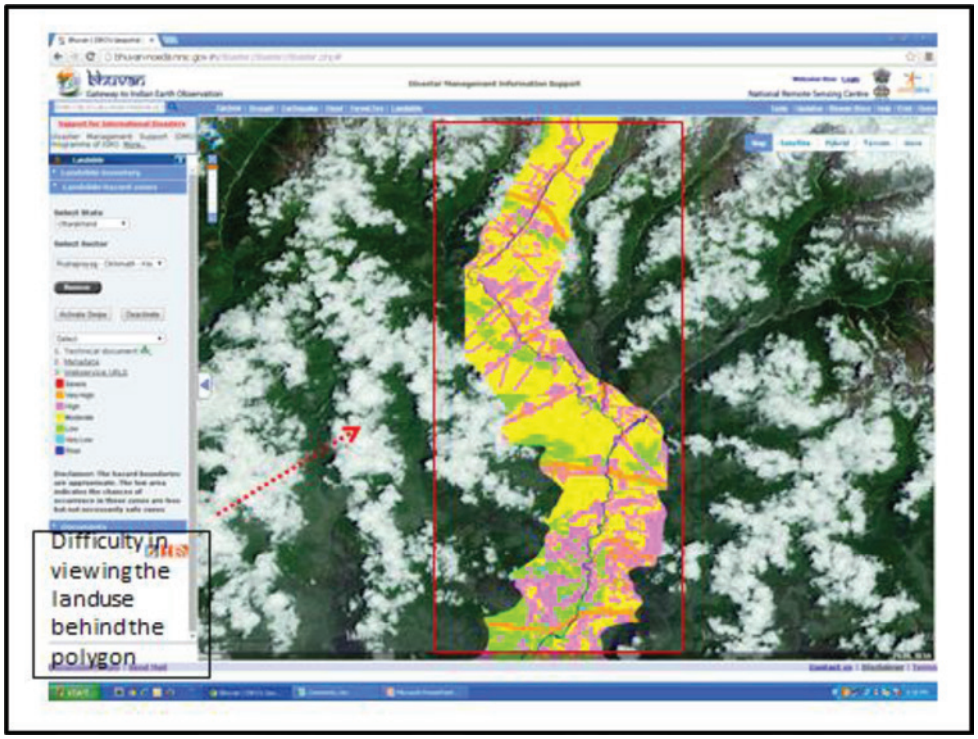


FIGURE-4.18- Difficulty in viewing landuse data with satellite image, with no transparency option in Disaster Service (Landslide)

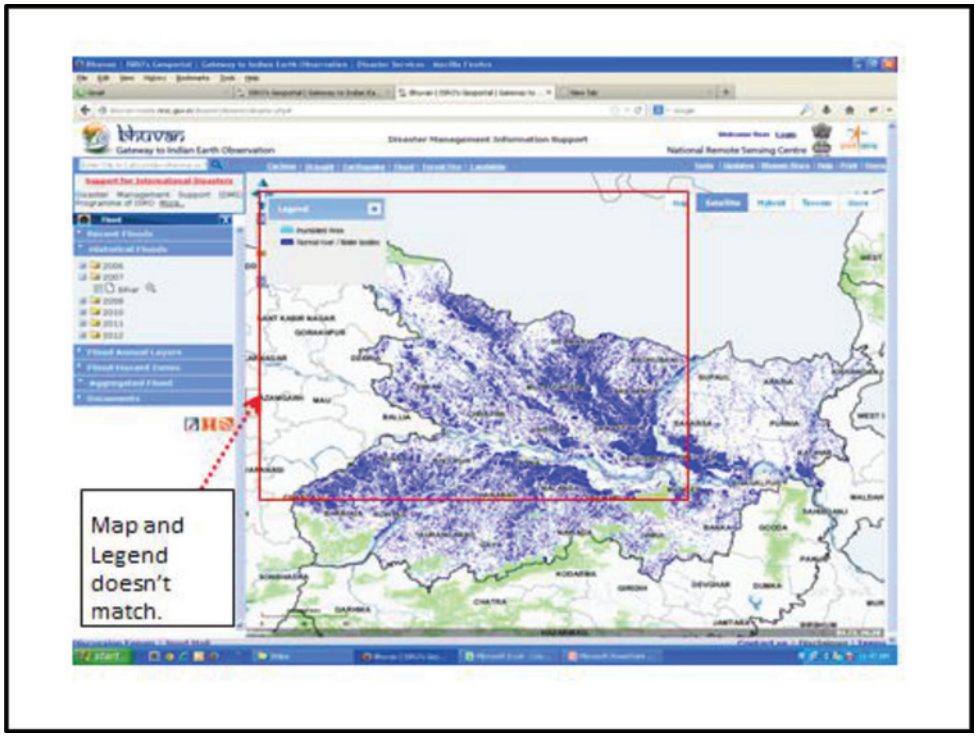


FIGURE-4.19- Error in viewing the legend which doesn't match with map in Disaster Service (Flood)

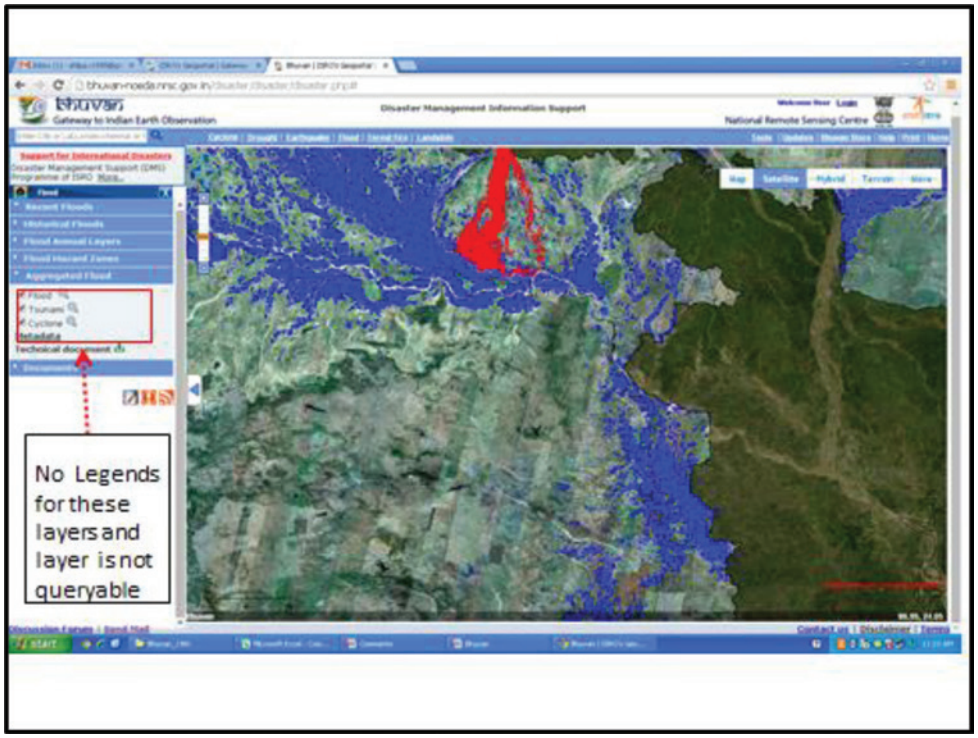


FIGURE-4.20- Map without any legend information in Disaster service (Flood)

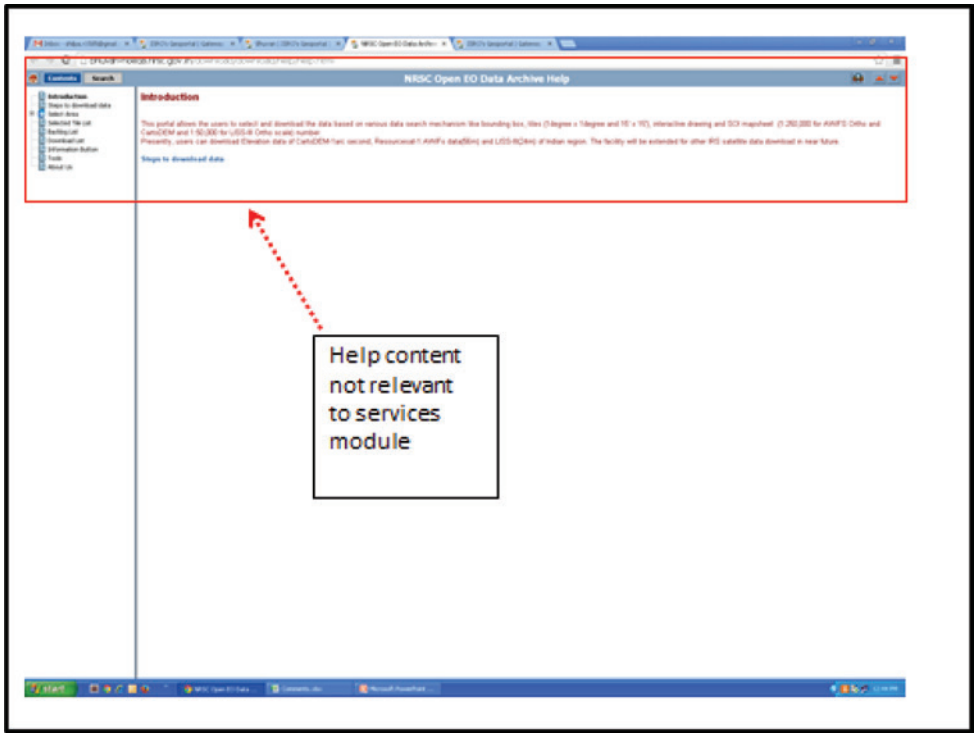


FIGURE-4.21- Help menu with is irrelevant to Disaster Service

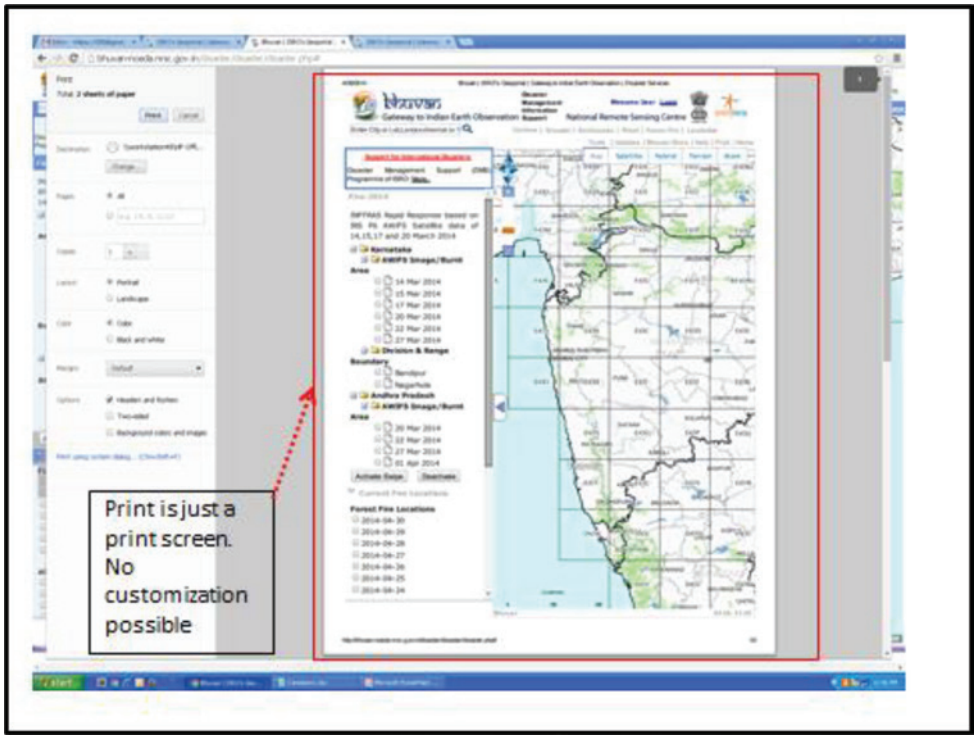


FIGURE-4.22- Print options of Disaster service which has limited functionalities

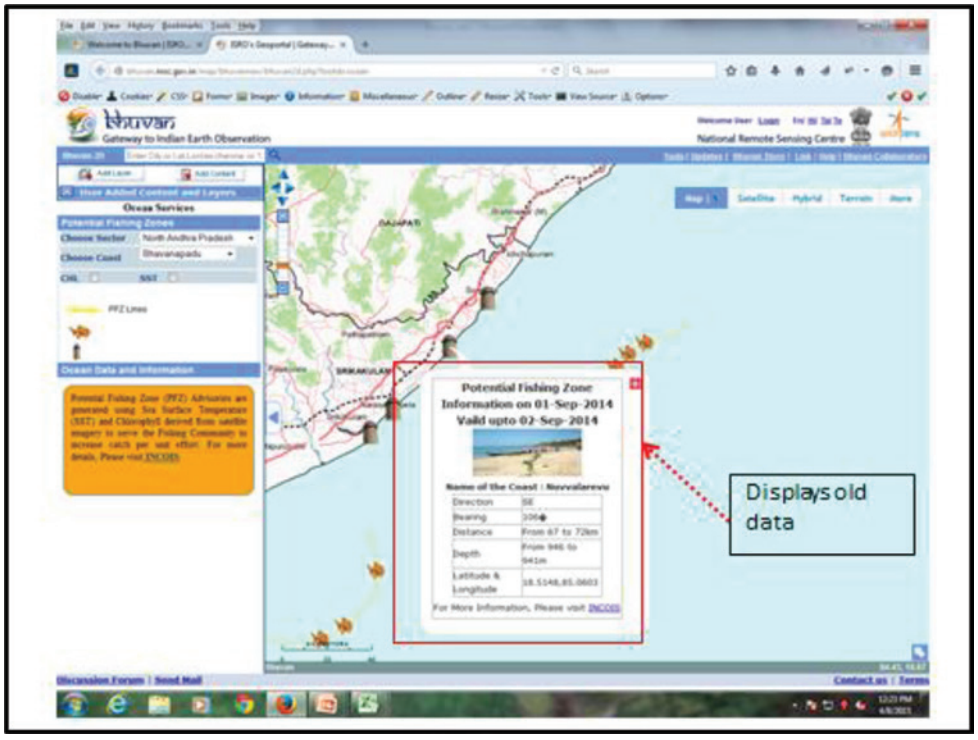


FIGURE-4.23- Old data (2014) in Ocean service

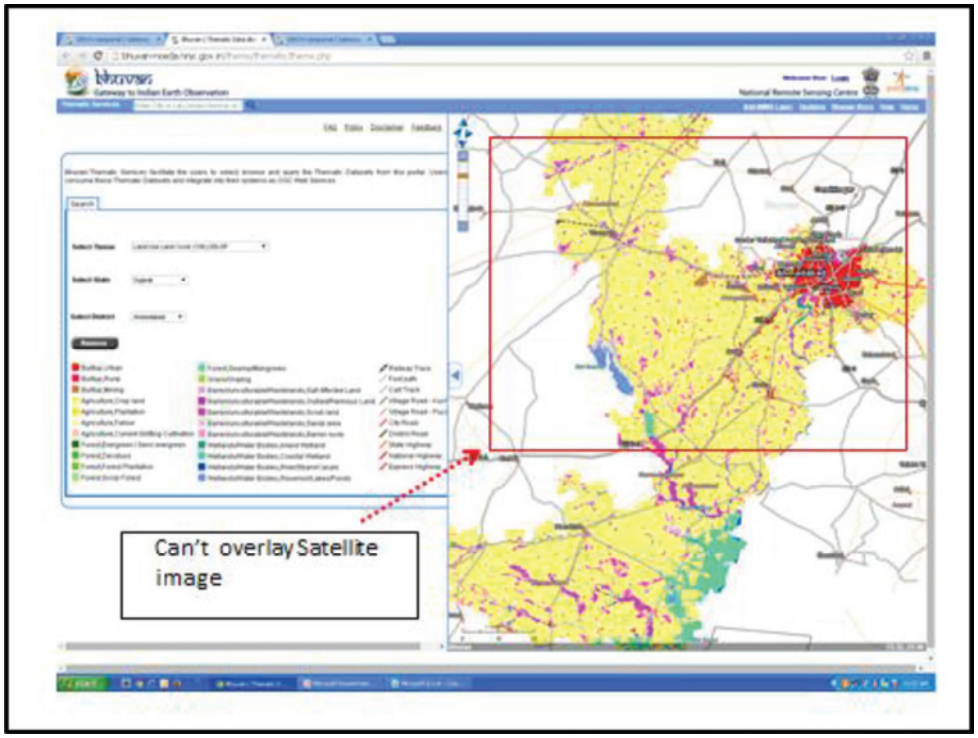


FIGURE-4.24- Short fall of functionality where we cannot overlay satellite image in Thematic Service

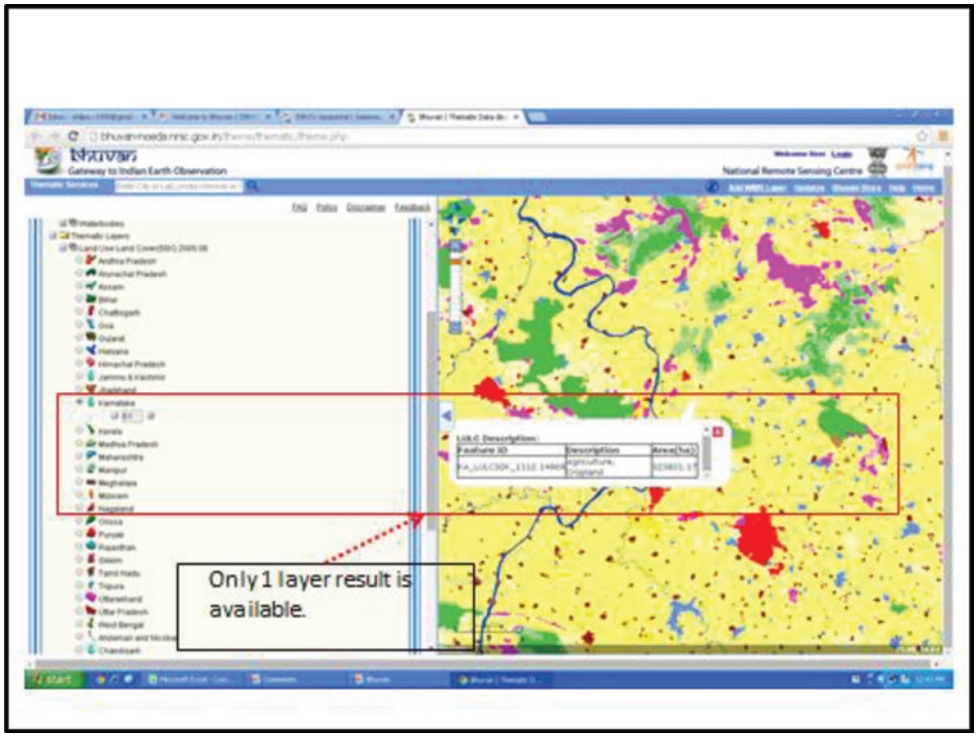


FIGURE-4.25- Limited functionality of identify tool in Thematic Service

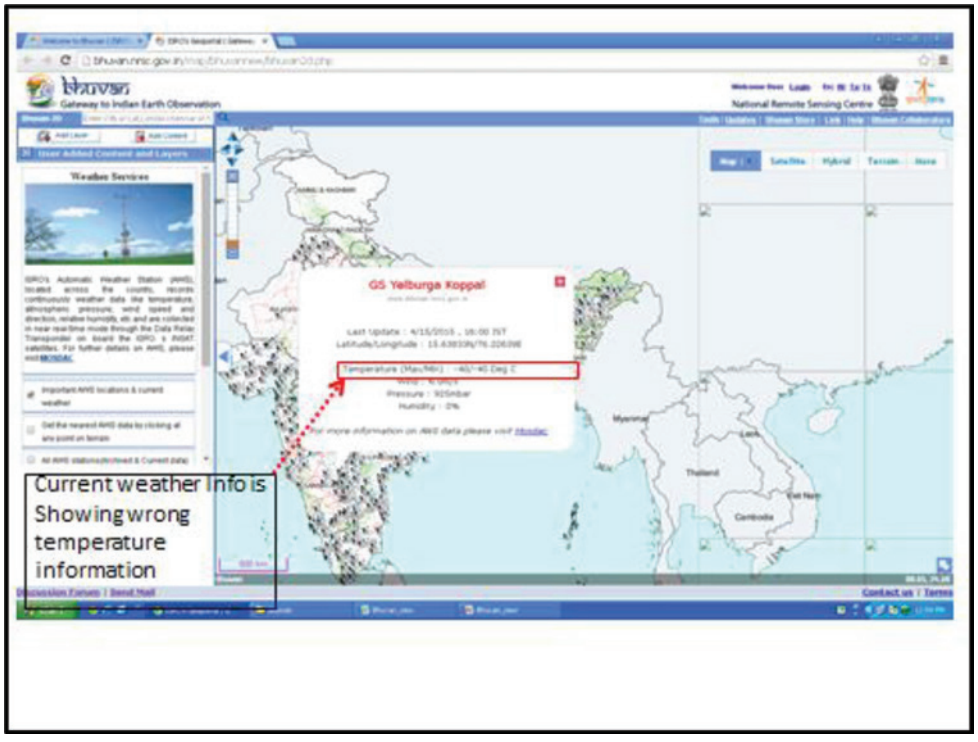


FIGURE-4.26- Wrong temperature information in Weather service

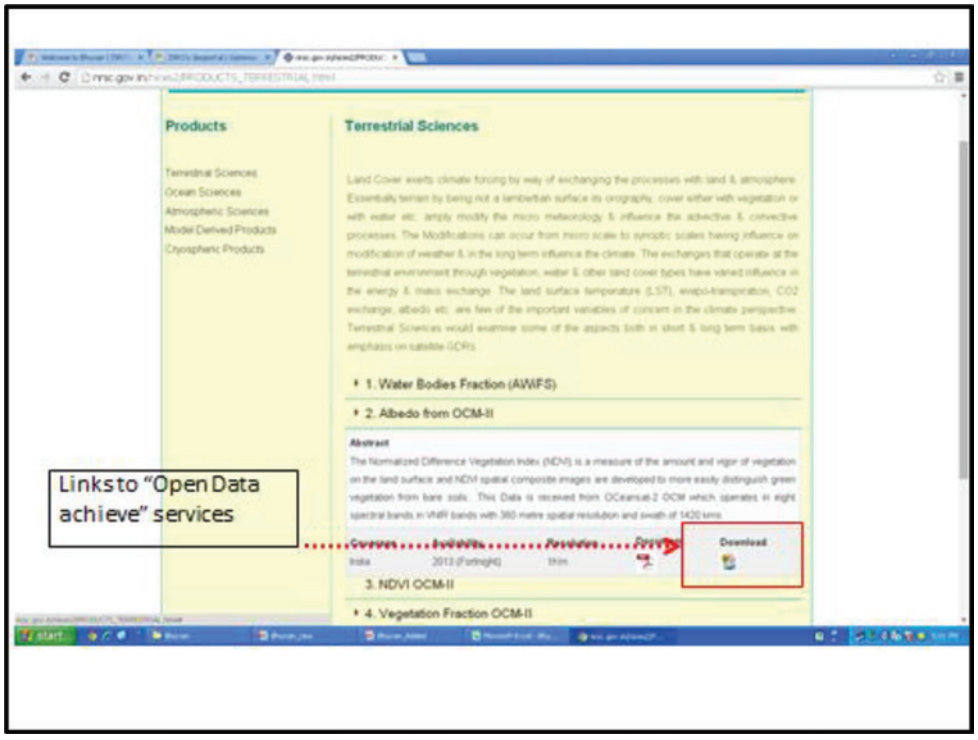


FIGURE-4.27- Limited data & repeating data service in Climate & environment service

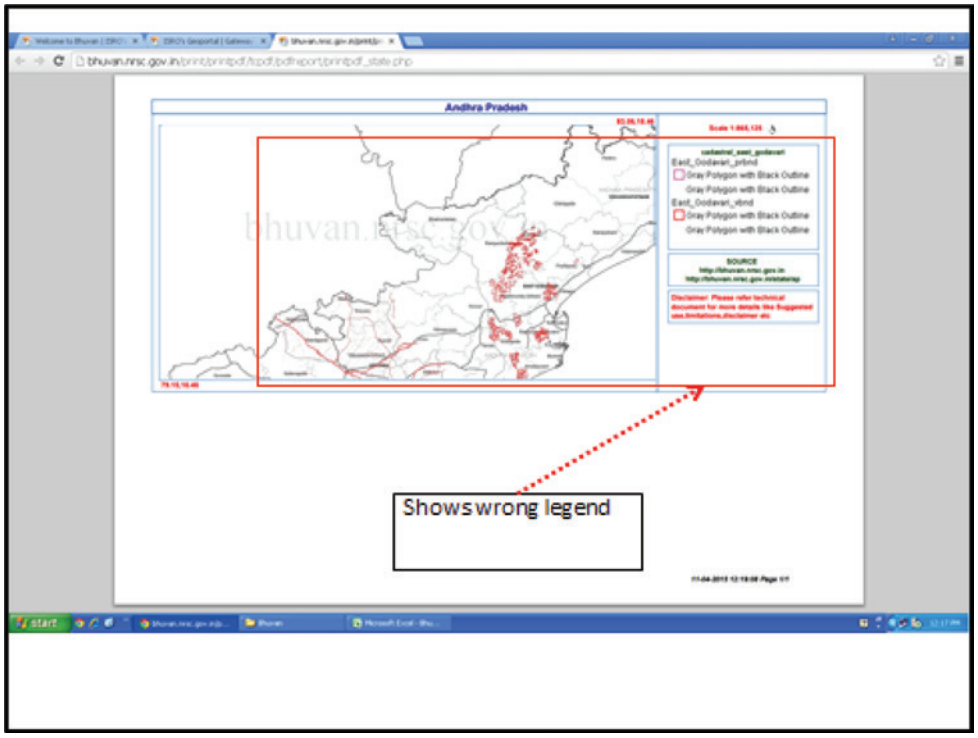


FIGURE-4.28- Wrong legend display of state portal service

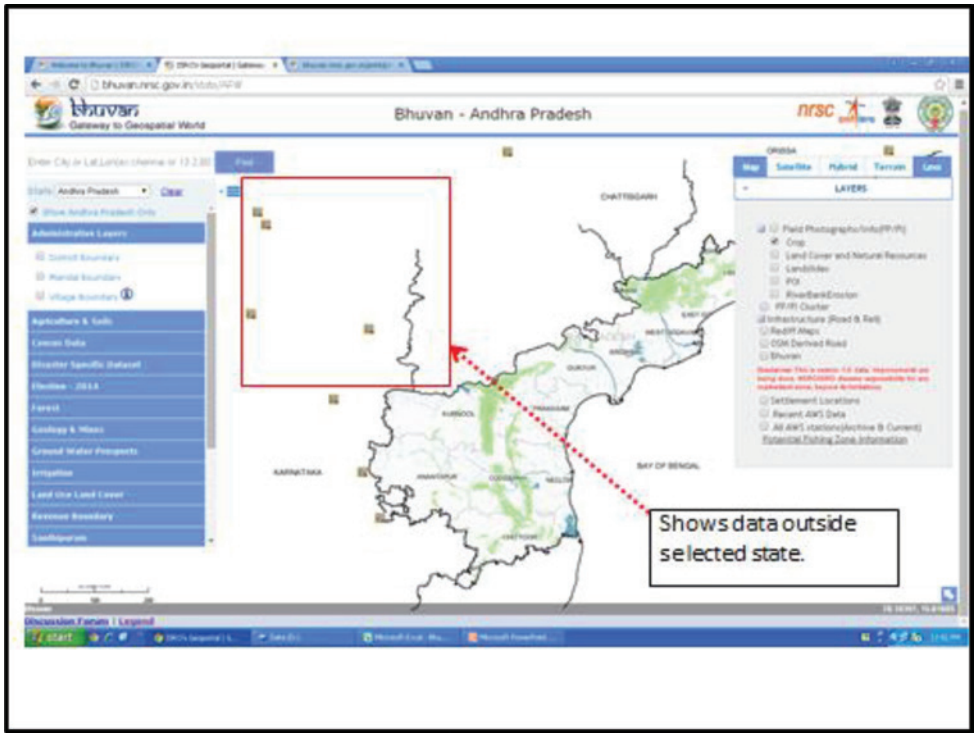


FIGURE-4.29- Data populated outside the state boundary in state portal service

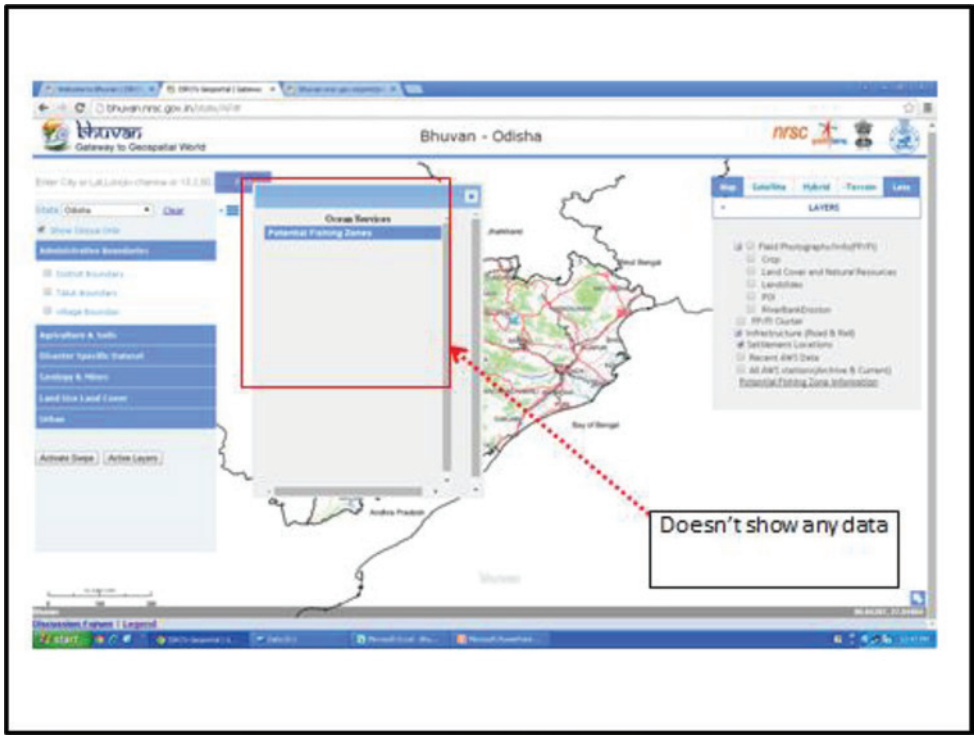


FIGURE-4.30- Empty dataset in ocean services of state portal service

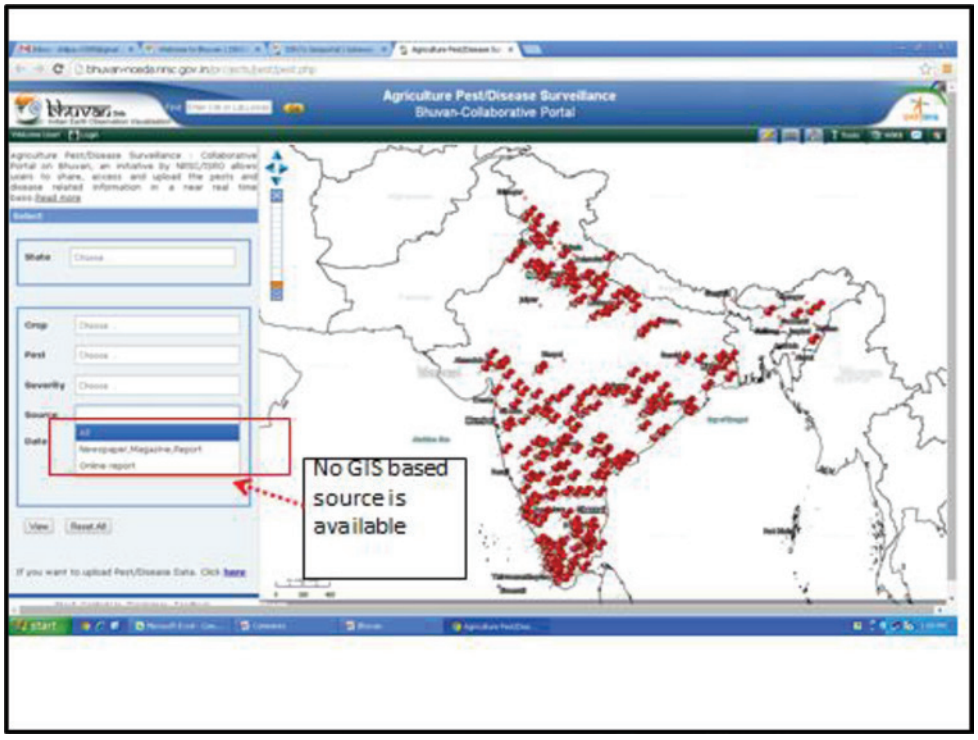


FIGURE-4.31- Limitation of Agriculture (Pest/Disease Surveillance) application

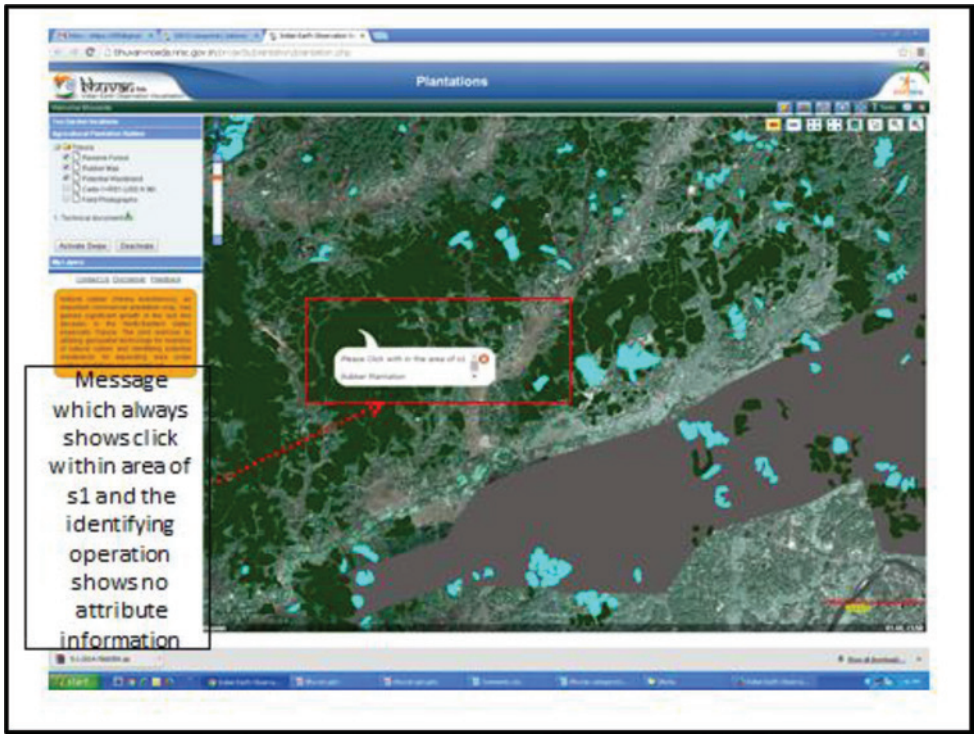


FIGURE-4.32- Malfunction of tool in Agriculture plantation application

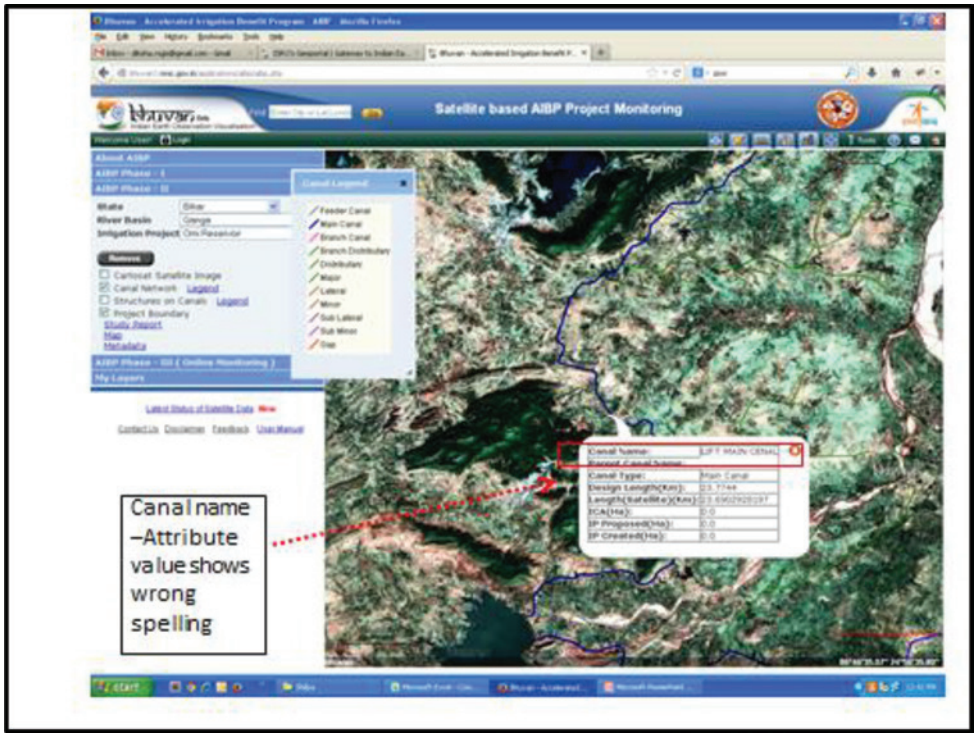


FIGURE-4.33- Spelling errors in Irrigation Application

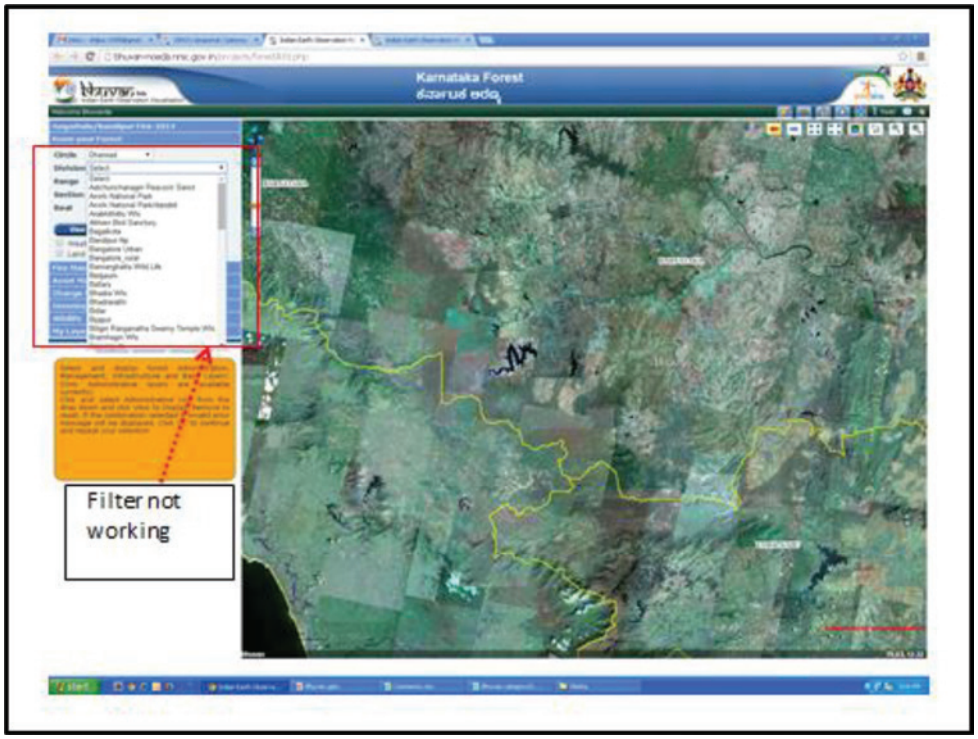


FIGURE-4.34- Malfunction of the dropdown list in Forest Application (Karnataka)

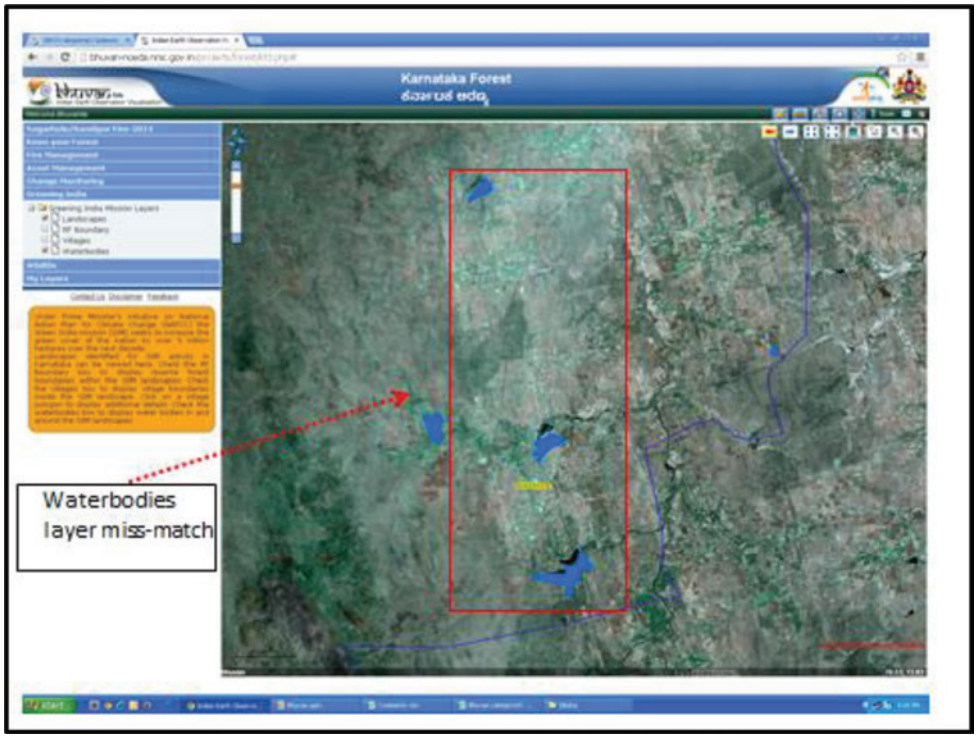


FIGURE-4.35- Mis match of vector data and satellite image in Forest application (Karnataka)

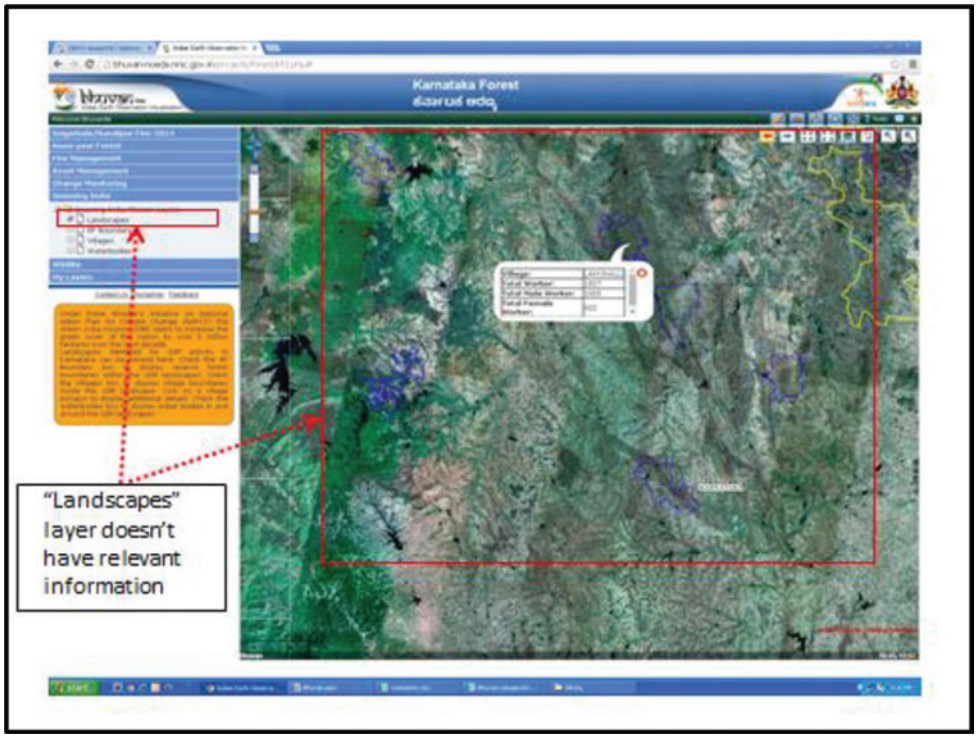


FIGURE-4.36- Irrelevant information in Landscape layer in Forest application (Karnataka)

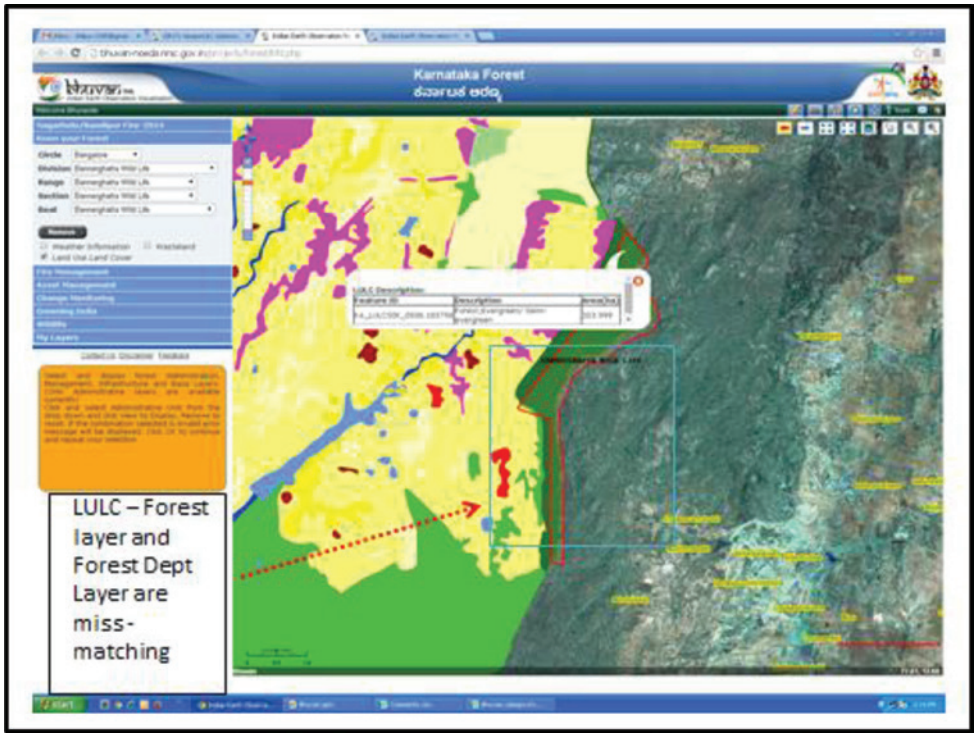


FIGURE-4.37- Layer mis match between LULC Forest boundary and Forest Dept Forest boundary in Forest application (Karnataka)

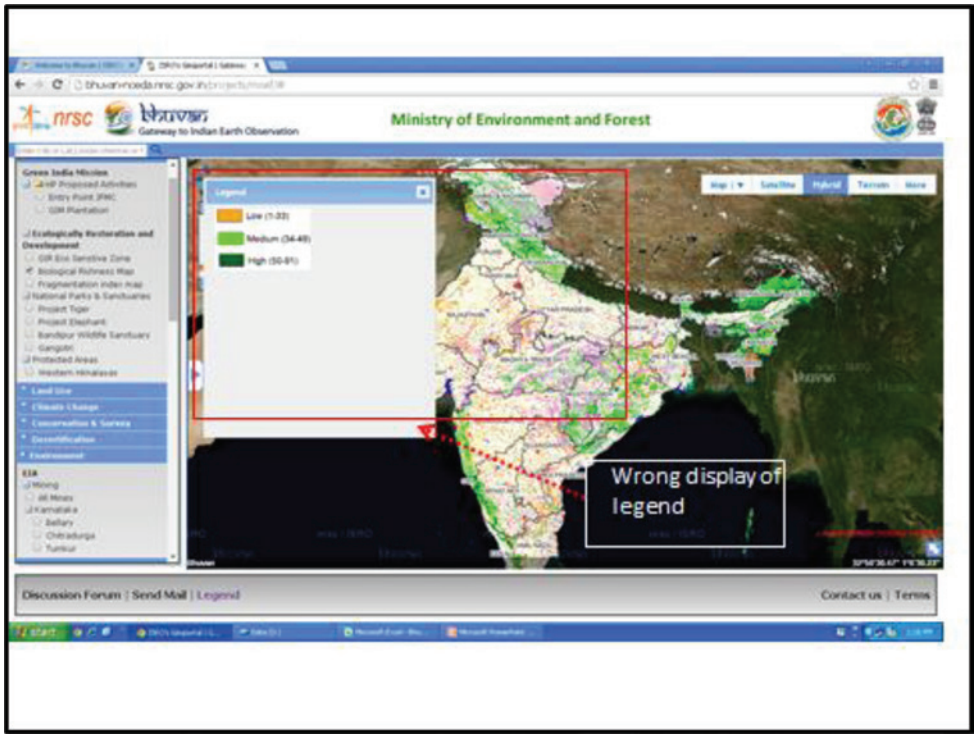


FIGURE-4.38- Wrong display of legend in Forest application (Ministry of Environment and Forest)

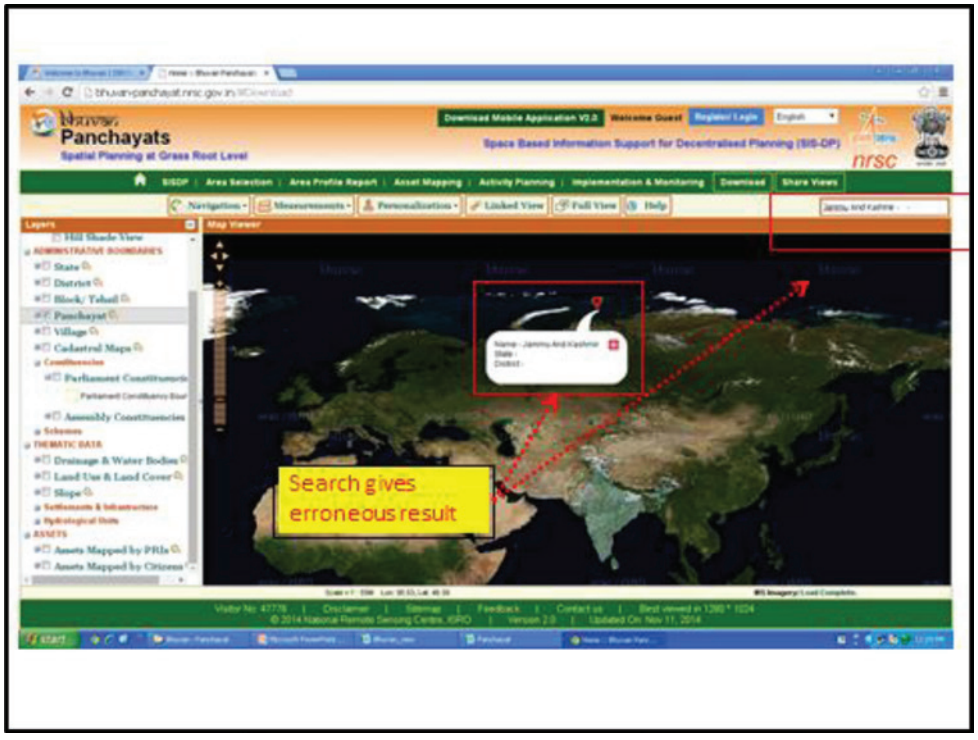


FIGURE-4.39- Erroneous result of search in E- Governance application (Decentralise Planning)

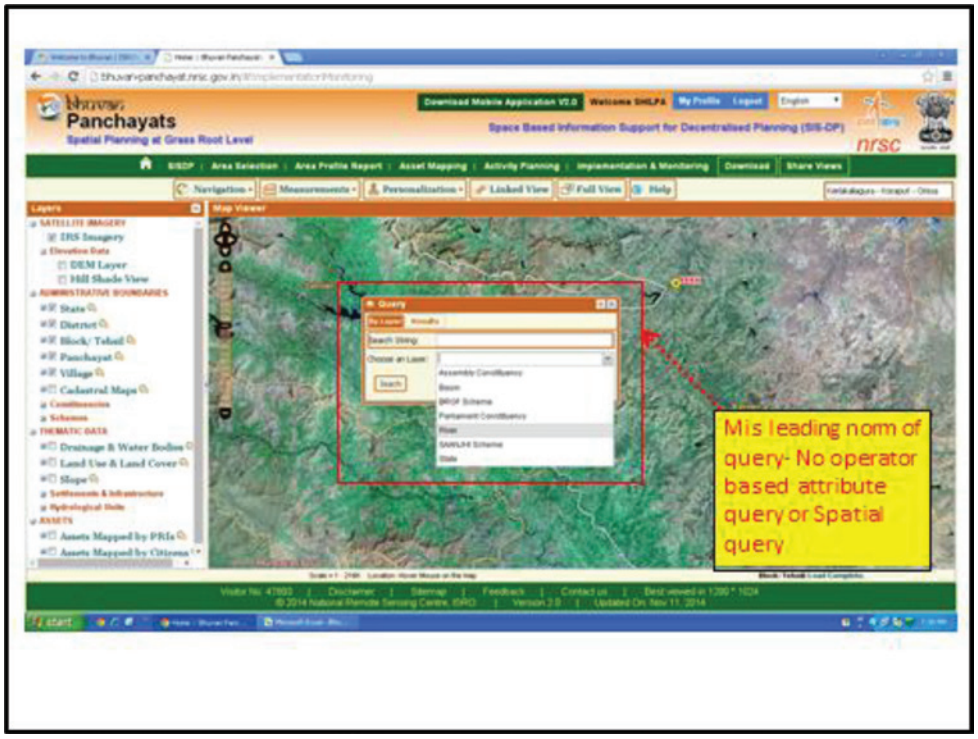


FIGURE-4.40- Limitation of Query tool in E- Governance application (Decentralise Planning)

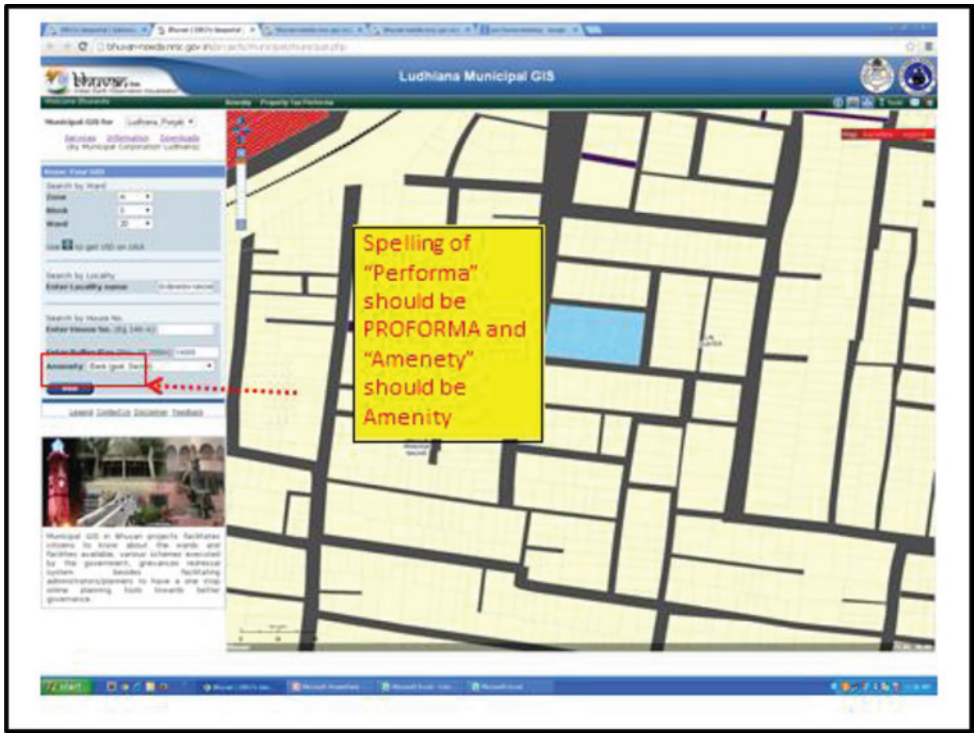


FIGURE-4.41-spelling mistake in Urban application (Municipal GIS)

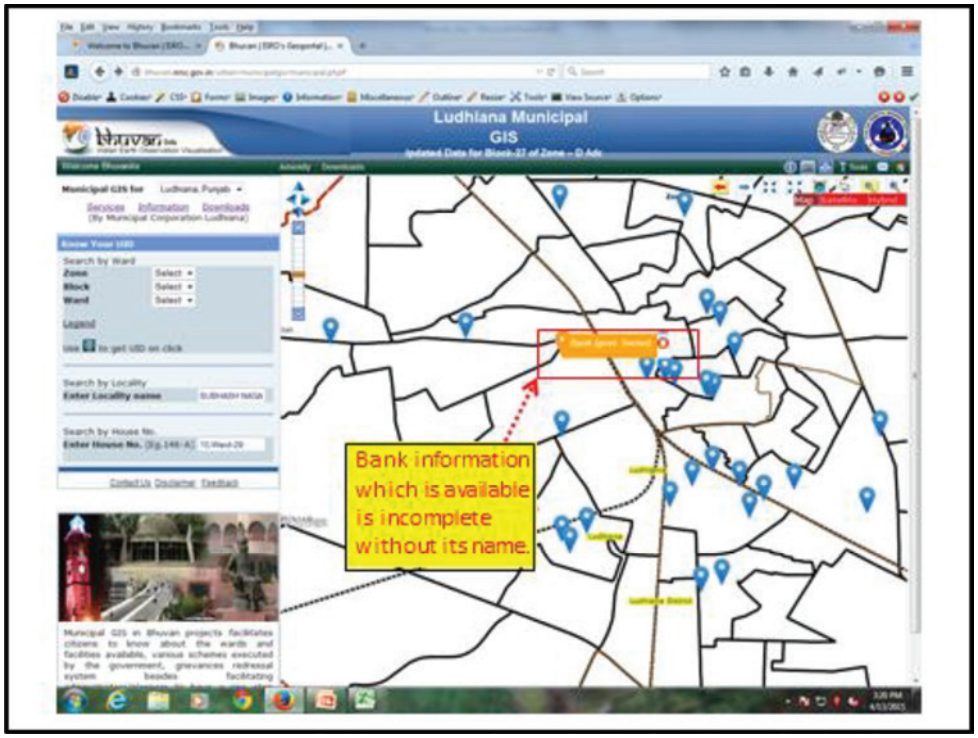


FIGURE-4.42- incomplete point information in Urban application (Municipal GIS)

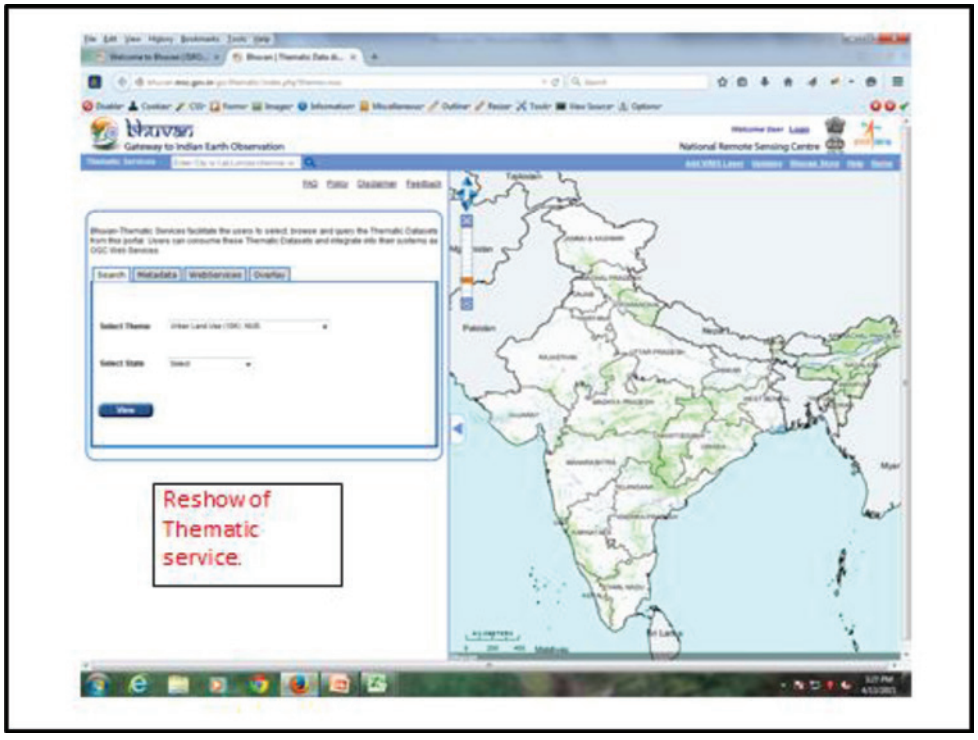


FIGURE-4.43- Repetition of service in Urban application (Urban Information System)

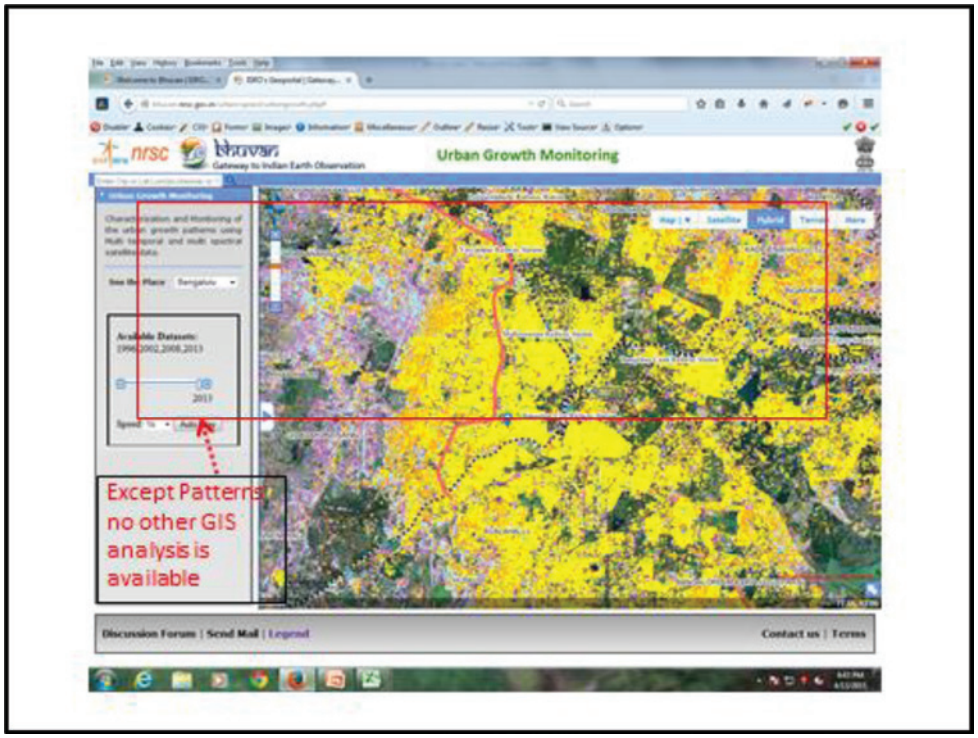


FIGURE-4.44- Limitation of Urban (Urban Growth Monitoring) application

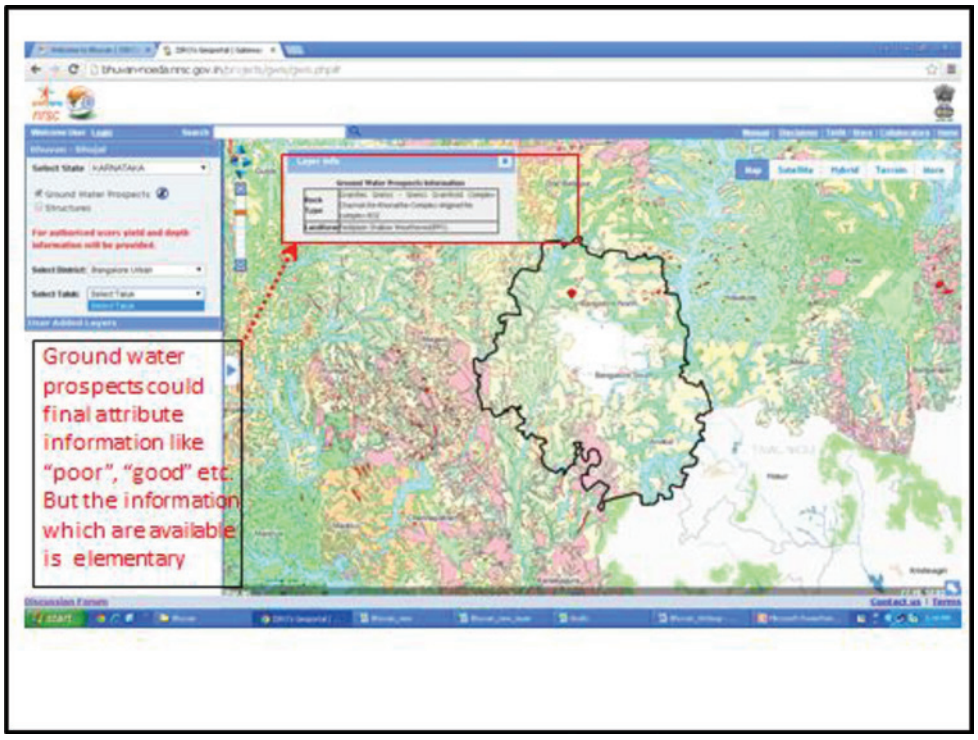


FIGURE-4.45- Disassociation of data with Rural (Ground Water) application

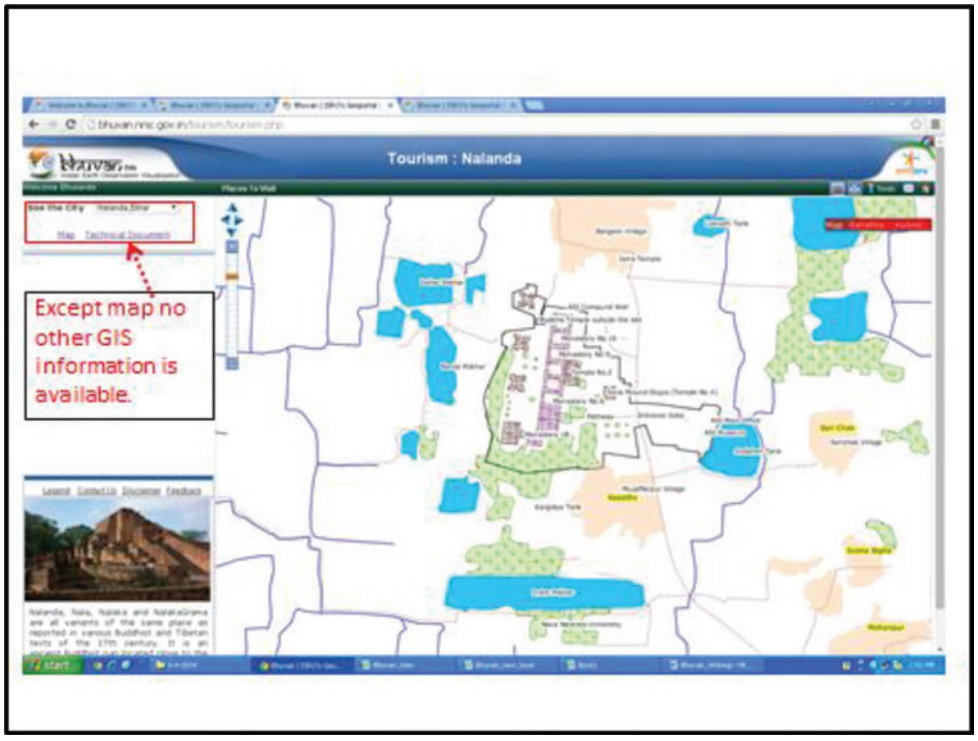


FIGURE-4.46- Limitation of data in Tourism (Tourism-GIS) application

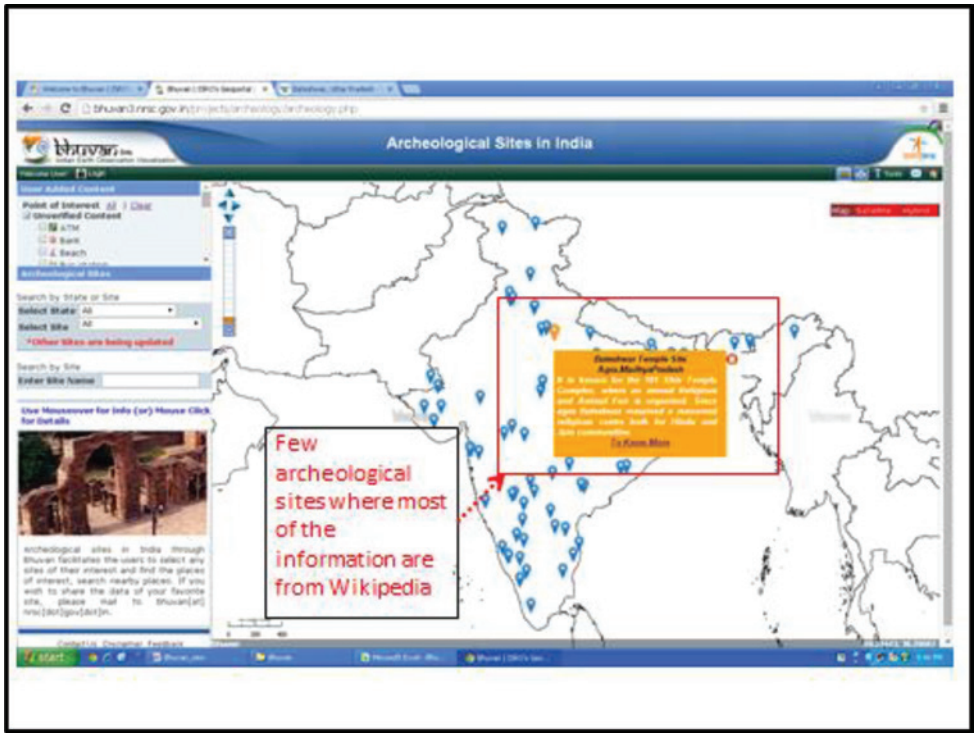


FIGURE-4.47- Information where most of them are from Wikipedia source in Tourism (Archeology) application

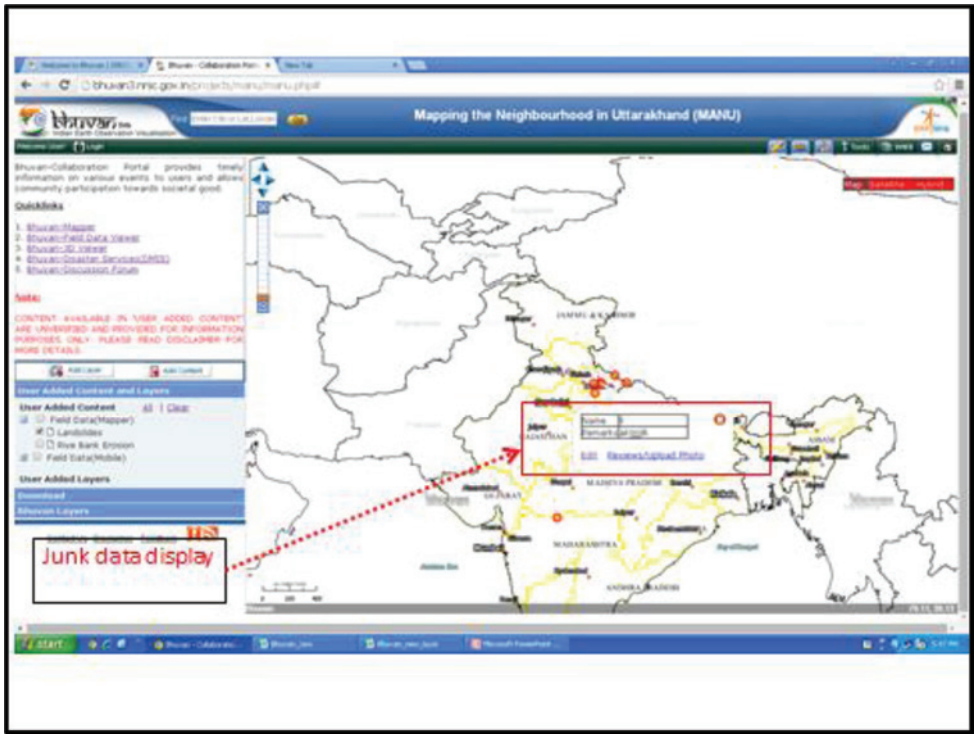


FIGURE-4.48- Un-verified data display in Special Application (MANU)

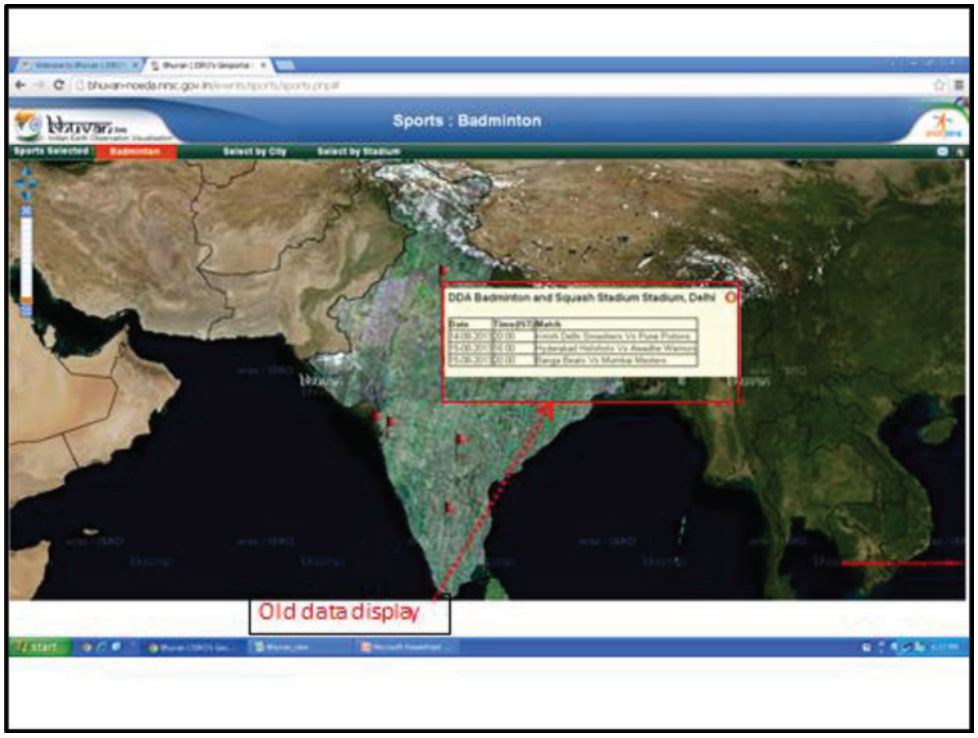


FIGURE-4.49- Old data display in Special Application (Sports in India)

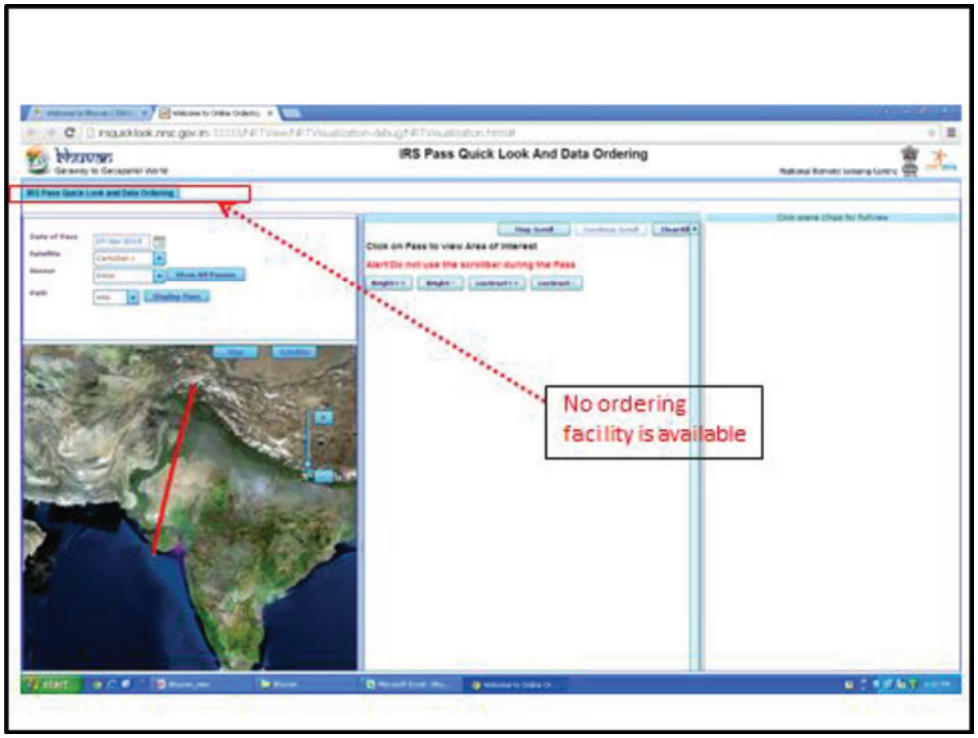


FIGURE-4.50- Non functioning Data ordering facility in Special Application (IRS Pass Quick Looks)

5. INDIA NSDI PORTAL

5.1. INTRODUCTION

50. NSDI is India's only Geoportal which facilitates search on metadata. It is a single window display of several organizations' metadata along with few GIS layers.

51. It is one of the portal which displays spatial information for citizens through maps in India.

52 NSDI data is available with the collaborations and partnership with SOI, DST, GSI, FSI, NBSSSLUP, MoD, MHA, MoES, Census of India etc.

53. This report includes an independent test and evaluation - technical evaluation report of design and functional characteristics of NSDI from http://www.nsdiindia.gov.in/nsdi/nsdiportal/index.jsp as of July, 2014 and again April, 2015.

53.1 In order to make a high-quality GIS Portal for India under National GIS, A study was carried out on various Indian GIS portals. NSDI Geoportal is one among them.

53.2 We want to evaluate the "bar" that needs to be set for excellence and quality that matches any other effort in the world, nay, not just matches but surpasses it to make a high-quality GIS Portal of India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

5.2. NSDI GEOPORTAL DATA

54 In **TABLE-5.1** a detailed assessment of NSDI has been provided. NSDI Geoportal has a following project Dataset.

54.1 Administrative Boundaries up to taluk level on 1:250000 scale and Topographic features like contour, habitation on 1:50000 scale of Survey of India top sheets.

54.2 Hydrology map of 1:50000 scale and Transport layer Road and Rail of 1:50000 scale.

54.3 Thematic layer like Land use data of 1:50000 of NNRMS project.

54.4 Non- Spatial data like metadata from different agencies are available.

54.5 IRS images from Bhuvan website.

54.6 The above listed layers are available only for few pockets of India. Seamless data is not available.

54.7 The data which are available is of old (around 15-20years) vintage. Current and updated data is not available.

55 In **TABLE-5.1** a detailed assessment of NSDI has been provided. The map and image data in NSDI has the following characteristics:

55.1 NSDI mainly concentrates on the Metadata. GIS layers are present, servers as a base layers.

55.2 Most of the spatial layers are derived from top sheets. Current database is not available.

55.3 Maps which are available are in non query able format; As a result we cannot query any layers.

55.4 NSDI has its own metadata standards and metadata which are available in respective format.

5.3. NSDI GEOPORTAL SERVICES/APPLICATIONS

56 In **TABLE- 5.1** a detailed assessment of NSDI has been provided. Below are some important observations/examples of NSDI Geoportal **services/applications**:

56.1 Basic visualization tools like pan, zoom, Lat long display, scale display are present.

56.2 Some of the layer specific tools like reordering, transparency, fit to layer are present.

57 Save (gml) and upload content operations can be done only on OGC complaint files. Other GIS formats are not supported.

58 Map query can be performed only on Map Index (Grids) other spatial layers don't have this facility.

59 Metadata services are available through spatial query and non-spatial query. Results appear as per metadata formats. User can only view these results but there is no facility to save the data.

60 NSDI provides WMS services from BHUVAN portal- Satellite images are available from Bhuvan. User can over layer vector data on that. However this feature is available for limited area.

61 There is no Print Service available in this portal.

62 There is NO GIS APPLICATIONS present in NSDI Geoportal.

63 In **TABLE- 5.1** a detailed assessment of NSDI Design and Architecture has been provided. Some of the notable observations are:

63.1 A good professional GIS Portal design needs to be adopted in order to improve outlook of the portal and also more emphasis should be given on GIS capabilities like advance query options, print, save data in different GIS formats etc.

63.2 Robustness of the portal can be improved.

63.3 Help content can be reviewed again and should be made more relevant and more users friendly.

63.4 Apart from Mozilla, Portal can be made compatible with other browsers also.

64 Performance- wise NSDI can focus on following areas.

64.1 Layer rendering is slow- many times portal hangs. Most of the time portal doesn't works.

64.2 Caching and Tiling techniques can be used to improve the performance.

64.3 Speed of services can be improvised with better Hardware capacity.

5.4. SUMMARY

65 NSDI Geoportal mainly focus on "Metadata" there are not much GIS capabilities.

66 GIS layers available are at base level and cannot address major decision support needs from different government needs.

TABLE –5.1: NSDI PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	Layers are publishes as Images, Query operation is not possible. Following are the available layers. **Boundaries**- State, District, Taluk **Contour, Habitation, Hydrography, Land cover, Railways, Roads, Utilities** Layers for states Maharashtra, Andhra Pradesh, Delhi, Karnataka only. **Country boundary with all state.** **Map Index(Grids)**	Grouping of the layers are not systematic. As Hierarchy is not present, user finds it difficult to search layers.	Layers can be arranged in Collapsible tree like structure. Seamless layer for whole India should be made available.	Figure –5.1
2	Non-Spatial	Metadata from different agencies. NSDI Metadata mainly concentrate on categories of Metadata like Data Identification Information, Abstract Describing the data, Citation, Contact Information, Dataset Topic Category, Image Data, Language, Metadata Date Stamp.	Clear representation of the information.		
3	User-Ingest	There is no option to add user ingest data.			
4	Others	NA			
B]	**VISUALIZATION**				
5	Login	User has to Register to access the portal. With the credential- Login and Password, one can login into the portal. Fax No, even though it is mentioned as non- mandatory field, User is prompted to enter the Fax-No	User finds difficult to register, as Fax no is asked as a mandatory field to be entered.	User Registration Form can be made simpler by asking minimum inputs from the user.	Figure –5.2

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
6	Map Viewer	Map viewer which displays 2D data has a Zoomslider; Status bar contains Lat/ Long information on cursor movement and Map Scale. Larger map area is visible by hiding the Table of Content. In Table of Content, Layers can be reordered. Fit to layer and Layer transparency options are available for each layer.	Map viewer operations are quite easy and user friendly.		
7	Navigation Tool	Navigation tools like Pan, Zoom-In, Zoom-out, Interactive Zoom, and Zoomto Previous extent and Next extent are present.	User can easily do the navigation operations with the available tools.		Figure –5.3
8	i-information	This tool is used to identify information about the selected layers in the Map. A result window appears with all the attributes. It is observed that this tool works only for 2 layers(Map Index & State boundary)	As maps are published only for viewing, user cannot make use of this tool.	Publishing of layers as Web Map services (Query able layer) would allow user to use this tool.	Figure – 5.4
9	Save Context	This Tool downloads an OGC complainant gml (xml) file which gives information about layer like type of services, its Source, Name, Title and Format similar to config file.	User can download only Xml file. Downloading option in other formats like image, vector (GIS ready) format is not possible.	Options for the user to select content and format to download	Figure –5.5
10	Upload Context	Users have an option to upload file or Url. Context file which is saved from the portal (gml) can be uploaded; this provision is not there for any other external files.	User doesn't have an option to upload any other kind of file. When users try to upload files like Shp, Jpg, Xml files etc, Portal throws an error. Upload context through URI's is not working	Further options for user-ingest data.	Figure –5.6
11	Long/Lat	User can view Lat/ Long in 2 different formats- Decimal degree and Degree Minutes and map scale is also displayed with this.	User doesn't have facility to navigate to particular location by entering lat/long.		

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
12	Measure distance	Measure distance gives correct measurements. User can measure distance between two points, in different units like Km/m, Miles/Feet, and nautical miles.	Even though user can measure distance between two points, distance measurement of different location at a time is not possible.	Options for Area measurement can be provided. A clear button to clear the graphic drawn and do new operation or Automatic end vertices when user double clicks at a point would allow user to measure distance in different location	Figure –5.7
13	Help	Help Menu shows information about the portal, Profile and Map viewer. However this content doesn't match with the portal design and its functionality.	As help content doesn't match with the portal design, user finds it difficult to view details of the tools.	Relevant help menu could be provided	Figure –5.8
C]	**SERVICES**				
14	Search Metadata	User has two options to view metadata -"Administrative" and "Spatial" **Administrative**- In this option user can view metadata either by selecting State & district or Place name or by selecting the agency & product. **Spatial**-User has an option to view metadata according to the spatial query he does. In this user can select Lat/long by an option called Drag on map, As user Clicks it on map lat, long will be added automatically into Lat, Long box. There is a dropdown which displays Map code in the selected area to view metadata information. In Spatial search - Lat/Long labels are not properly arranged	User can view metadata easily either through administrative layer or by Spatial operation. However user cannot download the information.	Option to download Metadata can be made available.	Figure –5.9, 5.10
15	Toggle Bhuvan WMS	User can view Satellite imagery and Thematic maps as a service from Bhuvan. Polygon layer can be overlaid on the satellite images.	We can view only Andhra Pradesh and part of Maharashtra vector layer overlaid on Bhuvan data. For other state layers it is not possible	This service can be made available for all states data.	Figure –5.11

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
D]	**APPLICATION SECTORS**	NA			
E]	**GENERAL**				
16	Design/Architecture	Portal is best viewed in Mozilla Firefox	Few contents in Help menu is not visible in Google chrome and IE		
		User-Interface could be more elegant and attractive.	Recent technologies can be used to build the website		
17	Text				
18	Others				

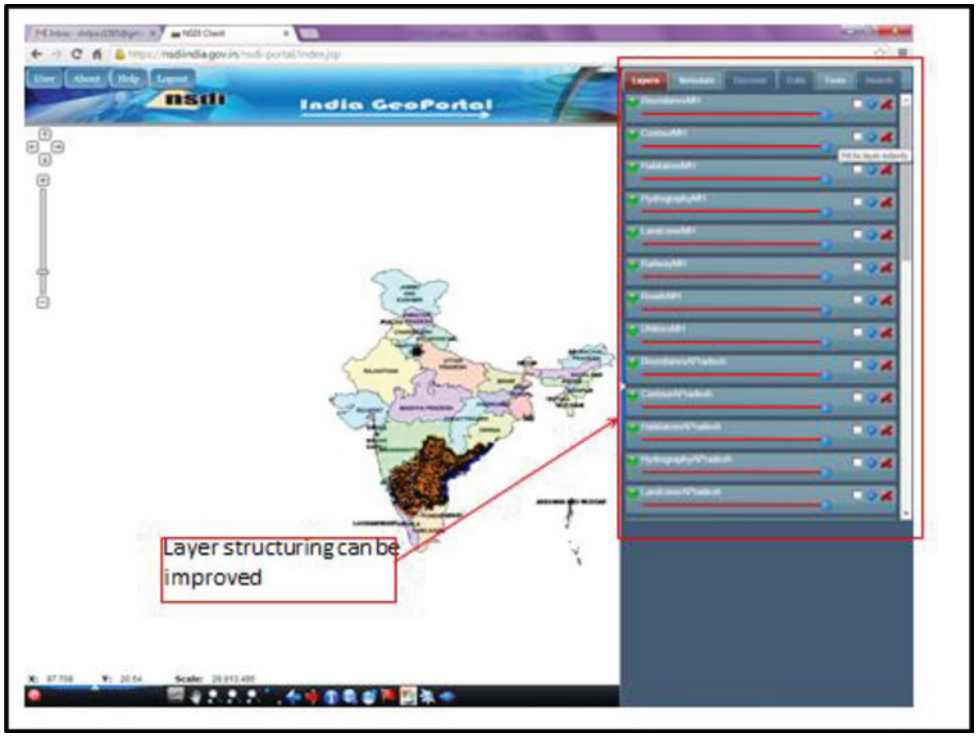


FIGURE-5.1- Table of content

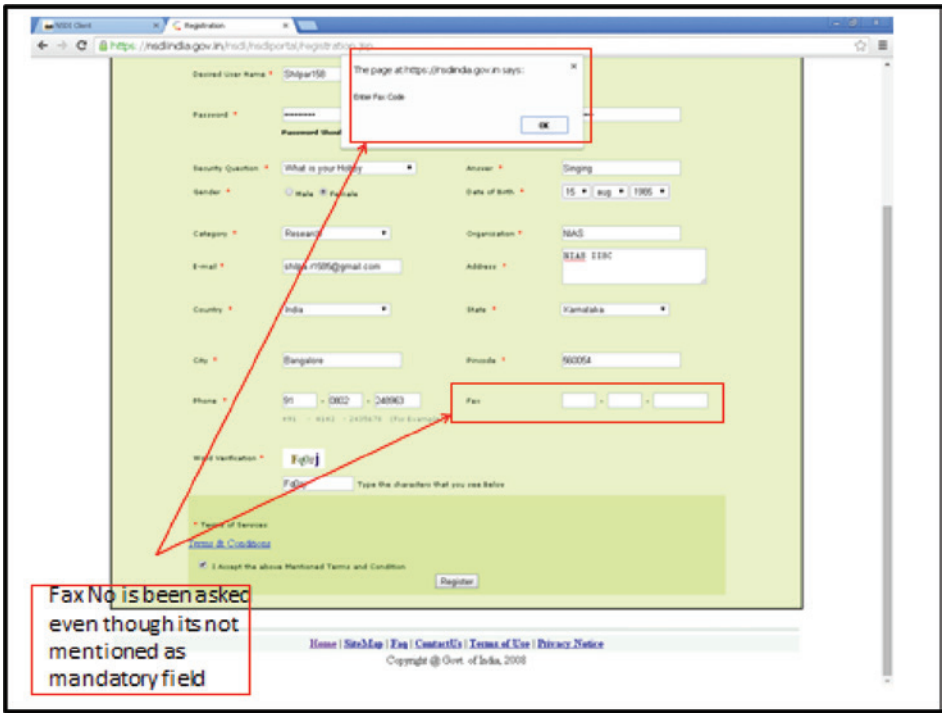


FIGURE-5.2- Error while registering to the website

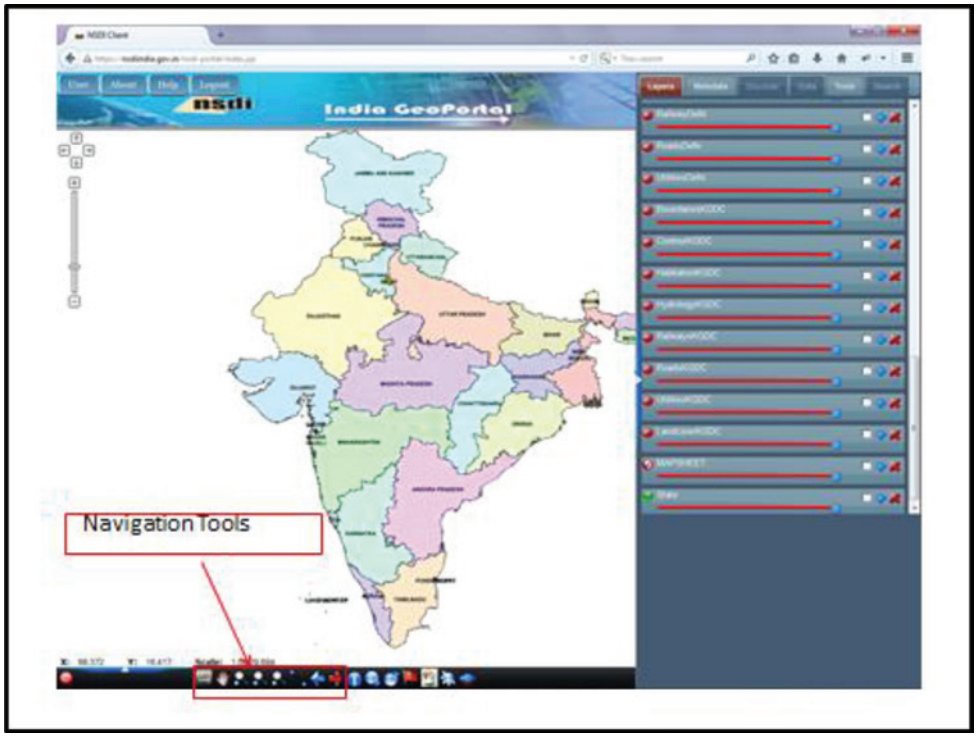


FIGURE-5.3- Navigation Tool

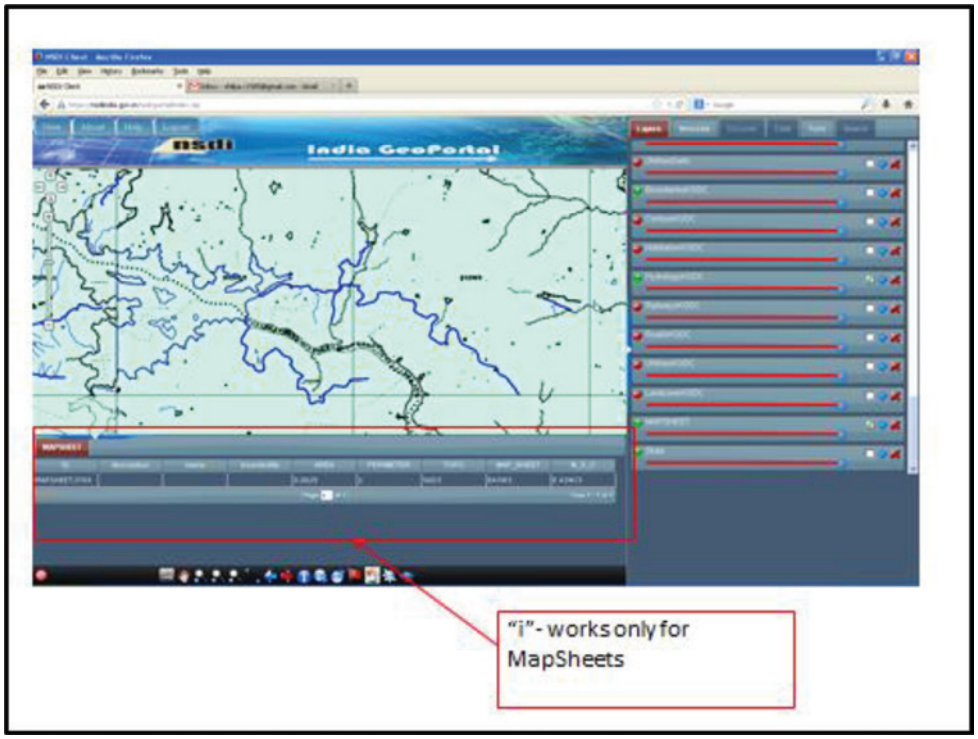


FIGURE-5.4- Limited layer availability for using identify tool

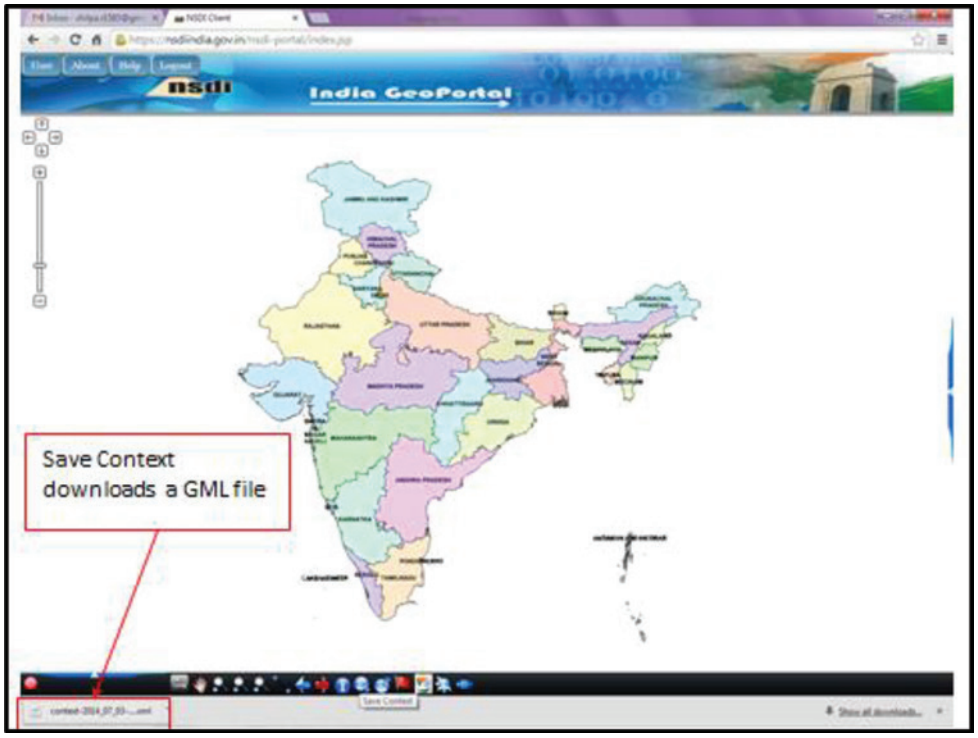


FIGURE-5.5- Non-GIS Ready format through Save context tool

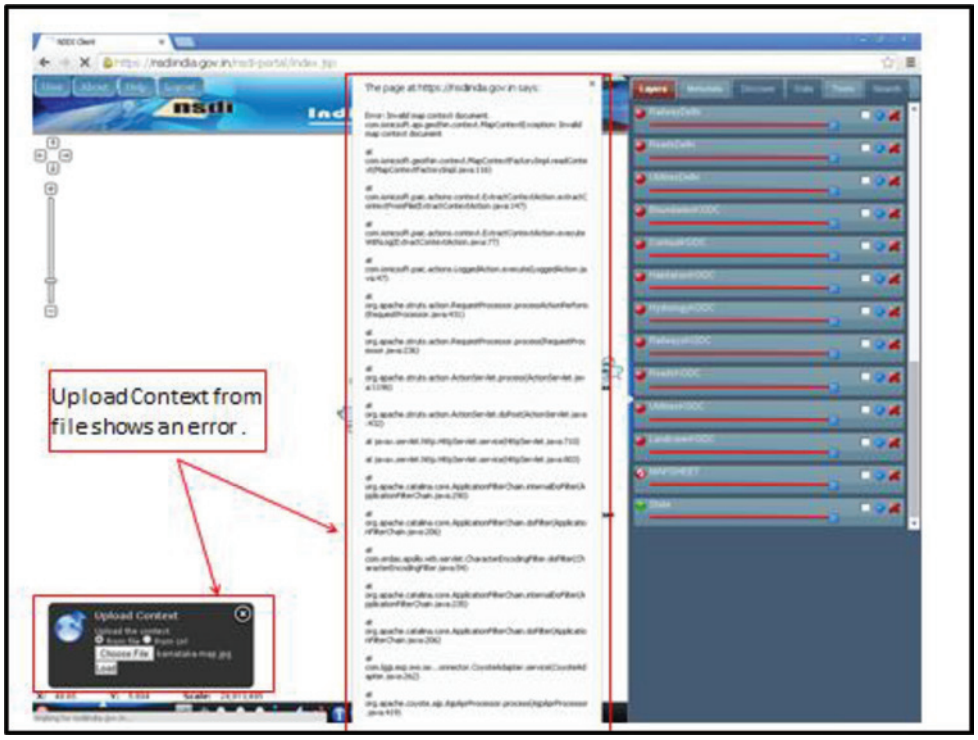


FIGURE-5.6- Error display while using Upload context tool

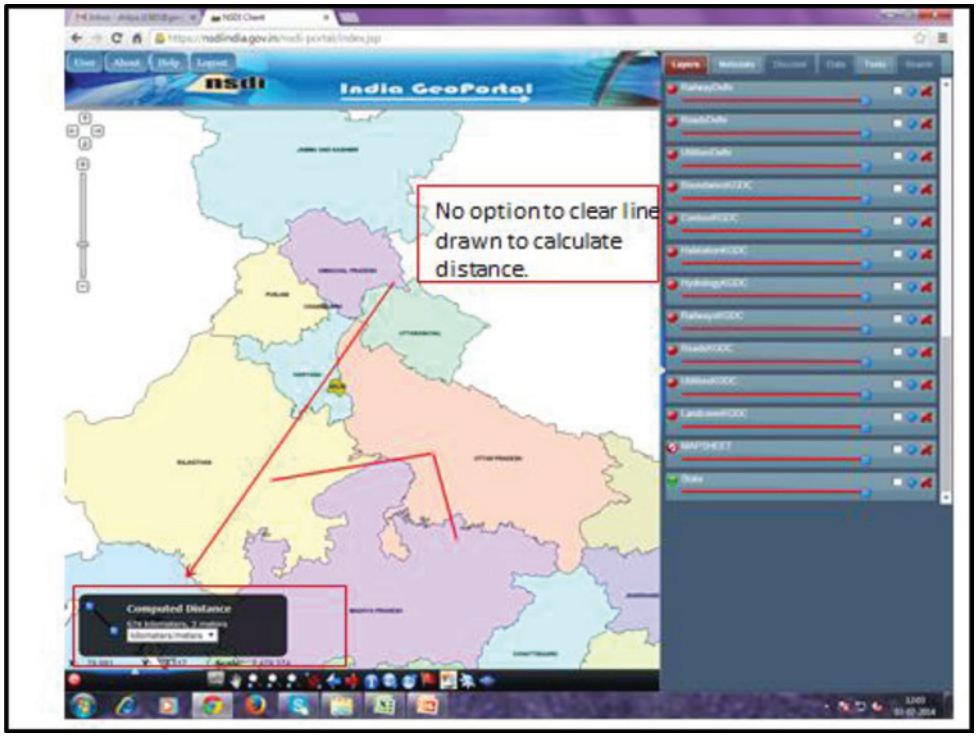


FIGURE-5.7- Limited function-ality of measure tool

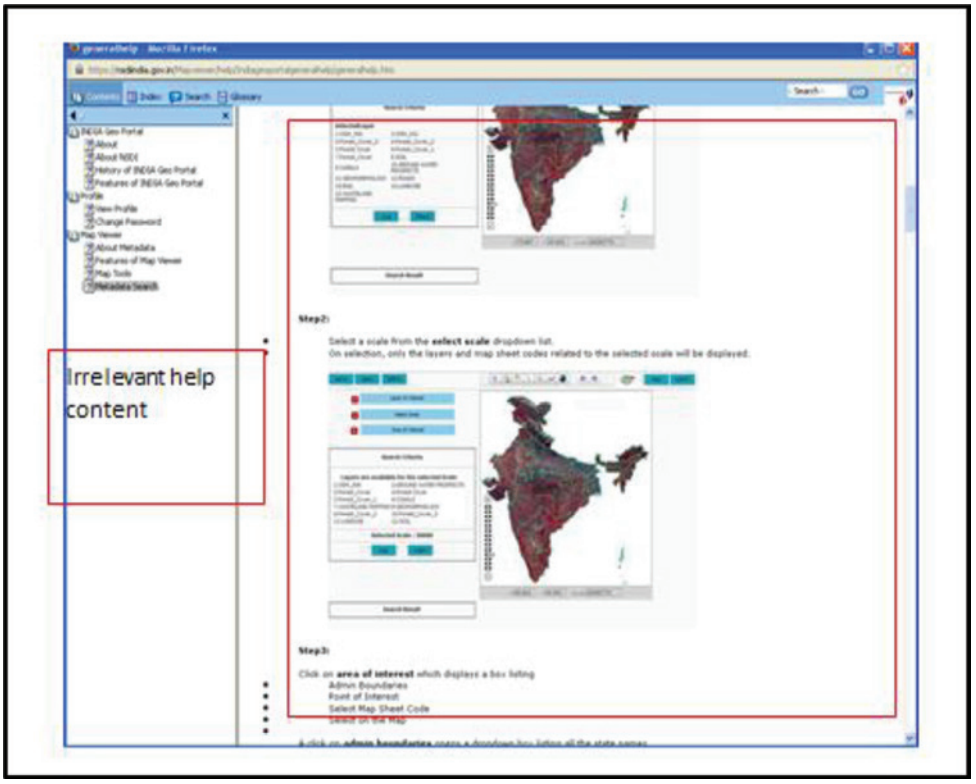


FIGURE-5.8- Irrelevant Help menu content

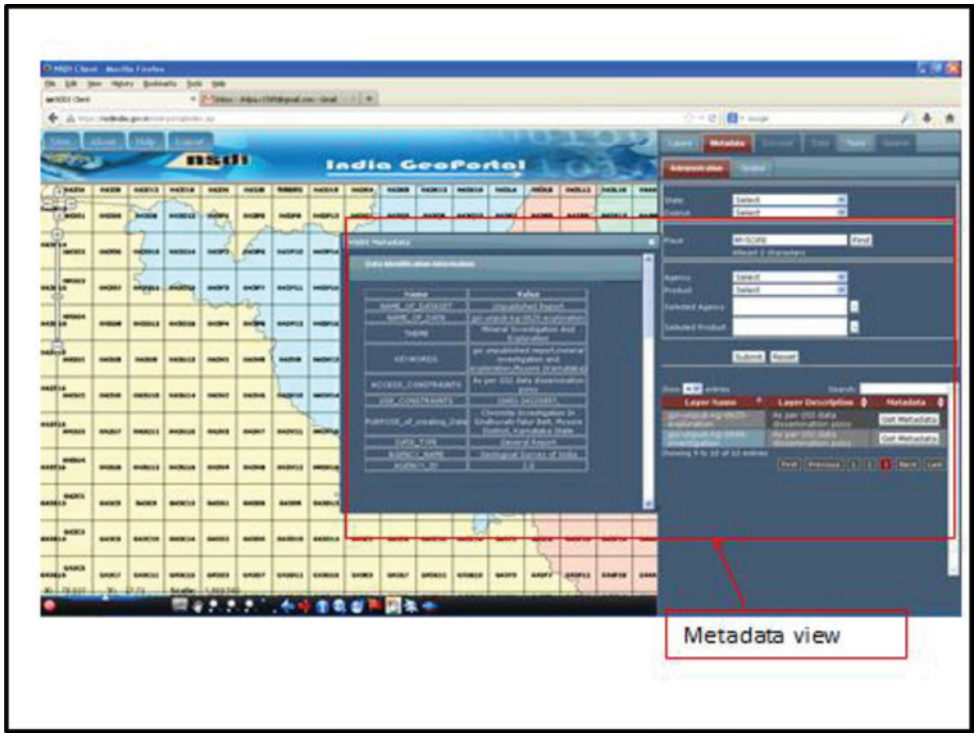


FIGURE-5.9- Metadata tool

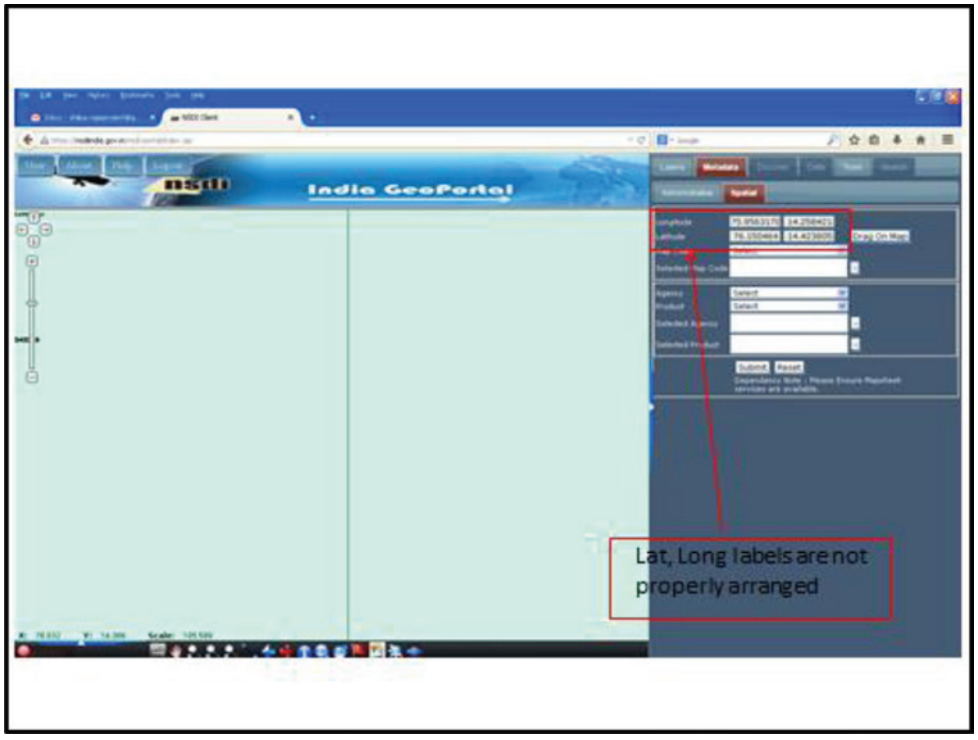


FIGURE-5.10- Repetition of Lat, Long box in spatial metadata tool

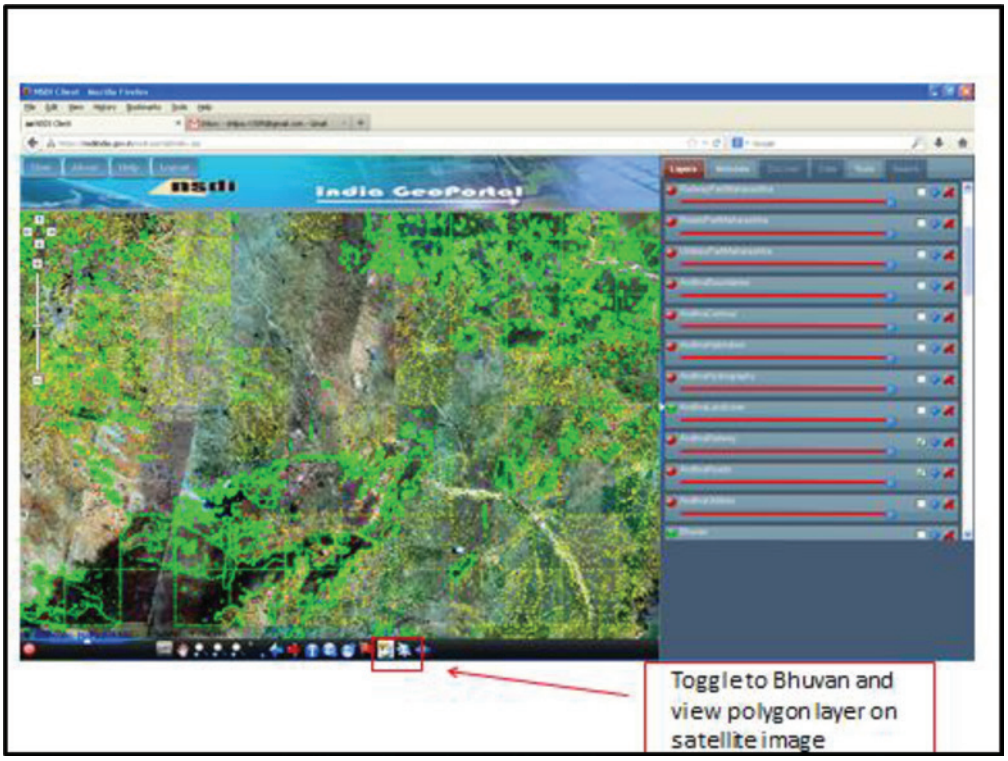


FIGURE-5.11- Usage of Bhuvan service

6. MapmyIndia Portal

6.1. INTRODUCTION

67. MapmyIndia has their own "portal" with same name as "MapmyIndia.com" through which it provides "visual window" of their collected information.

68. Although MapmyIndia does not contain GIS relevant data. Portal mainly concentrates on providing information service about the locations than allowing doing any sort of GIS analysis.

69. Portal provides "window" about information about the specific/desired location. This information is mainly related "may I help you".

70. This report includes an independent test and evaluation-technical evaluation report of design and functional characteristics of MapmyIndia at http://maps.MapmyIndia.com/ - as of July, 2014 and again April, 2015.

    70.1 This is not a "loud critic" of MapmyIndia- is a just analysis of capabilities of MapmyIndia- the study give insights into the standing level of Indian Portal and help us to get a more standards and high quality progression for National GIS.

    70.2 We appreciate to MapmyIndia –in kind in India and that has made a good service for geographical search we can search some specific category with specific features along with routes.

71. In coming days, we hope to also bring out such evaluation of other GIS Portal Services in India and ultimately make a impacting design statement adoption for National GIS.

6.2. MAPMYINDIA DATA

72. MapmyIndia has the following project dataset.

Note: *Portal claims following dataset is available but in reality the statement varies. In other words, Portal claims that they have huge dataset available for services but not much data is available or cannot see on the portal.*

    72.1 All India State Boundary is available (including 28 states and 7 Union Territories Reported by portal).

72.2 District Boundaries are available (640 in number Reported by portal) – Cannot see any District Boundary

72.3 Sub-district Boundaries are available (5924 in number Reported by portal) – Cannot see any Sub District (Taluk) Boundary.

72.4 Town Boundaries defining municipal limits (7933 is available Reported by portal).– Cannot see any Town Boundary

72.5 Ward Boundary for towns, Villages, both as points and boundaries is available. – Cannot see any Ward boundary Villages are available as point but village boundary cannot be seen.

72.6 7000 cities with boundaries by MapmyIndia considering urban agglomerates (Reported) – Cannot see any city boundary.

72.7 Some Specific Sub-localities within localities are available. This information is available in points.

72.8 House numbers for over 50 large cities are available (Reported)- Can search by house no but doesn't display in the map.

72.9 Road network data covering over 2 million road kilometers connecting every village and town. (Reported)

72.10 Railway network (~70,000 kms) is available (Reported).

72.11 Traffic layer only for Bangalore, Delhi, Pune, Mumbai, Hyderabad, and Chennai is available.

72.12 Restaurants, Hotels, Recreation Places, Travel & tourism, Commercial and Shopping places, Community Services, Religious places, Medical Facilities, Transportation services, Residential Apartments etc. - point of interest are available.

73. MapmyIndia data has following characteristics

73.1 MapmyIndia have no separate layers; they have single display of all data on that user can't do any operation since no GIS layers available.

73.2 MapmyIndia have good point of interest data that is from specific category to specific features such so user can get good information with MapmyIndia. These points are available only in point shape with information about it.

74. MapmyIndia is more informative oriented portal. This cannot be considered as a GIS portal. MapmyIndia is far away from being called GIS portal.

6.3. MAPMYINDIA SERVICES

75. In **TABLE- 6.1** a detailed assessment of MapmyIndia Portal has been provided. However, here are some summary of observations/examples of the limited nature of MapmyIndia portal:

75.1 Portal has good display as a map. Map pans fast and smooth. Available "Search" option is limited since it cannot be searched by co-ordinates. It can be search by name. Co-ordinates should be search if it would have been GIS Portal.

75.2 Geographical search service is limited. Multiple utility cannot be searched in single route.

75.3 Direction route is well defined, 5 destination points can add at a time. It shows good direction from start to end. Also it shows duration & distance in linear unit. Since it is limited service again, it shows only road direction, not pathways or any other mode of travelling.

75.4 Portal has added service "Add Address/Location", this service allow user to add their location on portal. Portal assigns a unique code to the location and that location can be searched by other user with same location name. It is not sure whether portal verifies user added location.

75.5 Portal provides geographical location widget service which can convert into code and can be use that directly in development application.

75.6 Portal provides print menu with limited services. It does not allow user to modify description, no scale bar, map scale and so on. Map can be zoom in/out in the print menu before to take a print.

76. THUS, MapmyIndia SERVICES ARE MAP-DISPLAYS AND HAVE NO GIS INTEGRATION; GIS APPLICATIONS OR GIS DECISION SUPPORT CAPABILITY. SUCH PORTAL CAPABILITIES CAN ONLY SERVE DISPLAY AND PREVIEW PURPOSES AND NOT FOR SERIOUS GIS DECISION-SUPPORT REQUIREMENTS.

77. Portal lacks in design/architecture level.

77.1 Portal need to adopt high-end technology to portray MapmyIndia as a GIS Portal. Currently portal can be defined as display purpose, not for any analysis.

77.2 Map available on the portal is indefinable since it cannot be recognized as base map or GIS layers. Map pans fast and smooth with zoom in/out facility, that's good feature about it.

77.3 Since there are no GIS layer available so it is tough to comment on robustness & categorized or group of layers. There is no option available to access single layer or attribute of it.

77.4 There is no “Help menu is available on the portal. Portal is very easy to use but having help menu would have been added advantage.

78. Text size varies at different zoom levels. And text font size is proper and readable.

79. The performance of portal is very good. Map moves fast and can with no jerk. The available text is easy to read while map is being panned, zoomed in/out.

80. Portal does not contain lot of data or any other application or services. The architecture of the portal seems very low and need to develop the standards in terms of providing good GIS services and application.

6.4. SUMMARY

81. In summary, it is clear from above analysis that:

81.1 MapmyIndia is just a display purpose and not for GIS analysis.

81.2 MapmyIndia have Limited GIS functions.

81.3 MapmyIndia Portal design, architecture and infrastructure are user friendly but very basic, nothing great or attractive about it.

TABLE –6.1: MapmyIndia PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	**Base layers** **Administrative Boundaries (Polygon):** All India State Boundary including, District Boundaries – (Reported 640 in number), Sub-district Boundaries – (Reported 5924 in number), Town Boundaries defining municipal limits - (Reported 7933), Ward Boundary for towns, Villages, both as points and boundaries reported. **Address database / Postal Boundaries (Point):** Urban cities, Localities for every city, Sub-localities within localities, House numbers for specific cities. **Transportation network (Line):** road network data covering over 2 million road kilometers connecting every village and town, railway network (Reported ~70,000 kms). Traffic layer only for Bangalore, Delhi, Pune, Mumbai. **Point Of Interest(Point):** Restaurants, Hotels, Recreation Places, Travel & tourism, Commercial and Shopping places, Community Services, Religious places, Medical Facilities, Transportation services, Residential Apartments etc.	User cannot control on layers. And all layers are only as a display layer we can't do any operation with single layer.	All content layer should have option to control and manage it	
2	Non-Spatial	**NA**			
3	User-ingest	MapmyIndia contains User-Ingest data. It is possible by Add place tool.	Add place possible by point only we can't add as a polygon and line. It is easy to get Clear information with full address and code.		
4	Others	**NA**			
B]	**VISUALIZATION**				

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
5	Map viewer	It has Zoom bar that can be zoom till ward no. There is scale bar and one checking box of Traffic layer that can be used by click and its shows traffic area by green and red lines. There is some option to link with Apps, Explore, Add a place directly.	It is easy and fast because there is no separate layers its only group of all layers.	Map viewer has no option to get previous search and next search it is useful to user at easy handling.	Figure –6.1
6	Navigation tool	Zoom slider is present apart from this we can pan, zoom in, zoom out the map using mouse scroll button.	This tool is quick and smooth user can easily move cursor and zoom in zoom out also very quick because of there is very limited data.		Figure –6.2
C]	**SERVICES**				
7	String Search	It is possible to search map features by entering string of characters. The corresponding map features are displayed. We can search by using full address or business type, locality name, pin code. We can also take print of our area of interest in pdf formate.	It has very good speed to search when we give the instruction it will show location very quickly. We can't search places by using coordinates.		Figure –6.3
8	Driving Direction	It allow to user get traveling routes by five points. User can see some category (Hotel, Restaurant, petrol pumps, Attractions, coffee shops, ATMs) along with routes. Print can be possible for getting driving direction.	User can see each and every turning point starting to destination point time and distance of traveling routes also can be seen.		Figure –6.4

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
9	Geographical search	It allows locating Specific category with specific features such as **Eat & Drink:** Fast food, pubs & bar, coffee shops, Indian Restaurants, continental restaurants, oriental restaurants, Ice cream & desserts, road side dhaba, juice shop, other restaurants **Utilities:** ATMs, petrol pumps, banks, post office, parking, library, auto repair, Money chargers/forex, photo studio, public convenience, banquet and marriage hall, crematorium, burial grounds. **Shopping:** malls, liquor and wines, flowers, books, customer electronics, grocery, furniture **Entertainment:** cinemas & multiplex, art & theatre, Auditorium/convention centers, water park, Indoor game **Health and Wellness:** chemist & medical store blood bank, hospitals, pathological labs, clinics/Dispensaries, Health centers, Gym, Spa, Beauty parlors, Veterinary hospital **Accommodation:** Budget hotel, premium hotels **Religious:** Hindu temple, church, Gurudwara, Islamic, jain temple, buddhist sites **Emergency:** Police station, Ambulance Services, Fire station **Education:** School, Colleges Universities, Couching Centers, play school, Vocational college **Tourism:** Attraction, Museums, historical places, lakes & beaches, Sanctuaries and parks as in the map display area identified by geographic location.	This option is very good in this portal. User can Search distance in km, Address and contact details of specific features along with routs and user can not able to search two or more features in one time.		Figure – 6.5
10	Use Interface (Add place)	It allows user to add place by some specific user detail (Place name, Building house no, city, state, locality, pin code, phone no, website, email address, category, small description, add photo) after adding place user get code of add feed and user can search by that code also.	It is easy to get clear information with address and code this information user can be search as a code also and everyone can see whole information about user details and it can't be changeable by other user id.		Figure -6. 6

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
11	Map widgets	It allows user to get script of map that can be used in other application. Script for map widgets, direction widgets (by two point from and to), local search widgets (by what and where), full search widgets (by Location, map direction, local search) are available.	This is good tool in MapmyIndia From widget tool. It is easy to get script of map, direction; local search and full search wise that can be useful for directly reach on other application.		Figure –6.7
12	Traffic Service	There is an option to know traffic information we can also switch on\off this layer.	User can get Real time information of traffic layer by red and green line		Figure –6.8
D]	**APPLICATION SECTORS**	**NA**			
E]	**GENERAL**				
13	Design/Architecture	It has good design easy to workable and very fast in performance.			
14	Text	Text size varies at different zoom levels. And text font sizes are proper and readable.			
15	Others	NA			

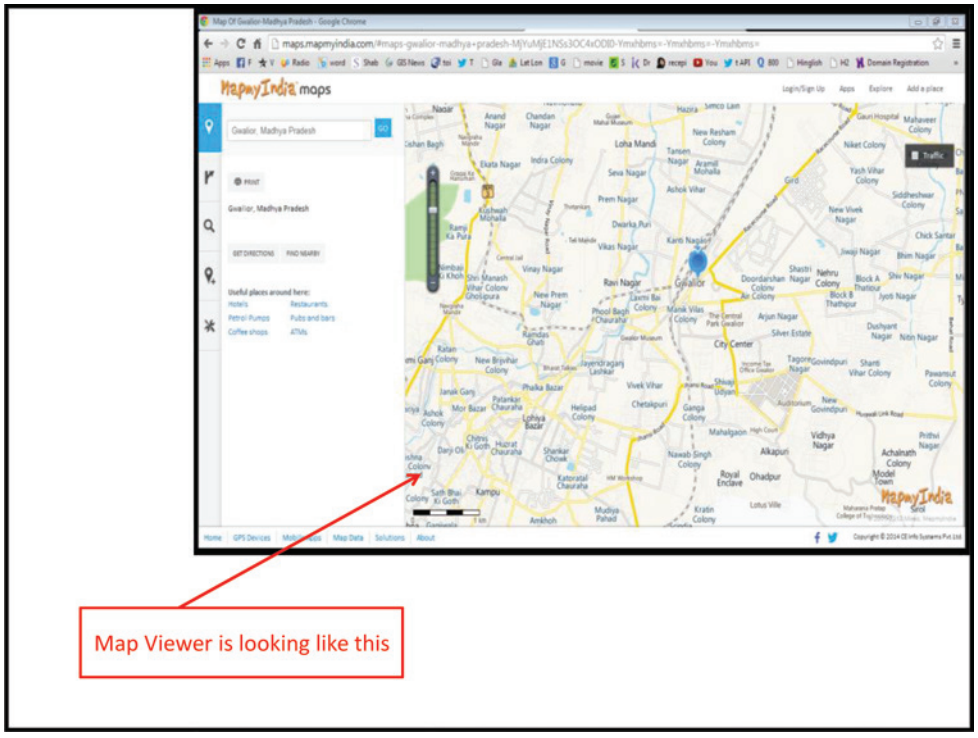


Figure – 6.1- Map Viewer

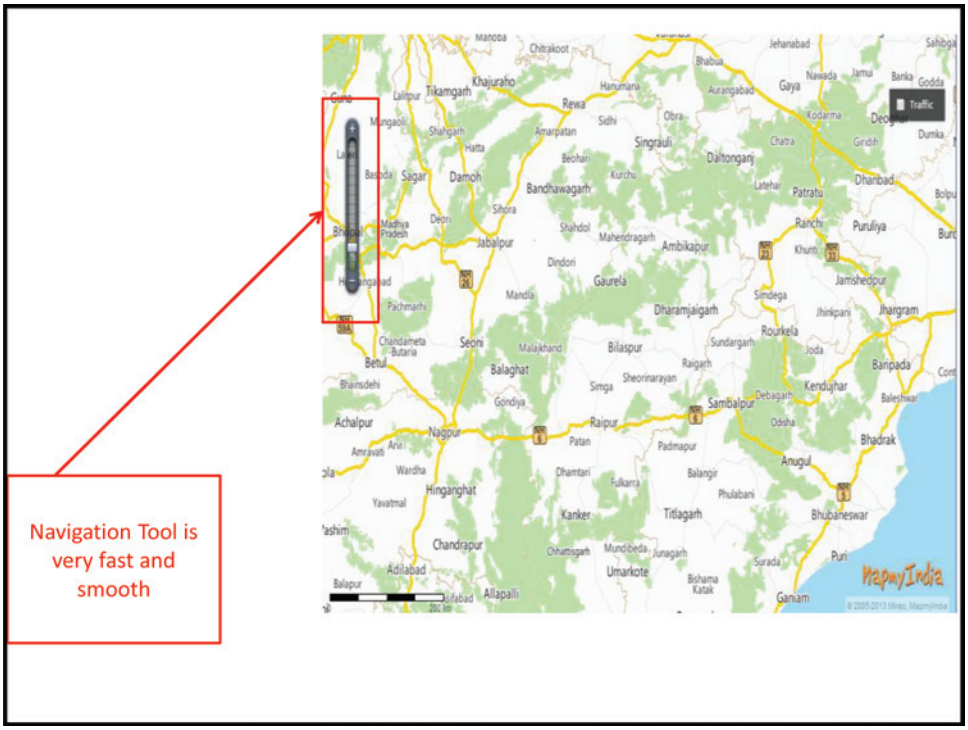


Figure –6.2- Navigation Tool

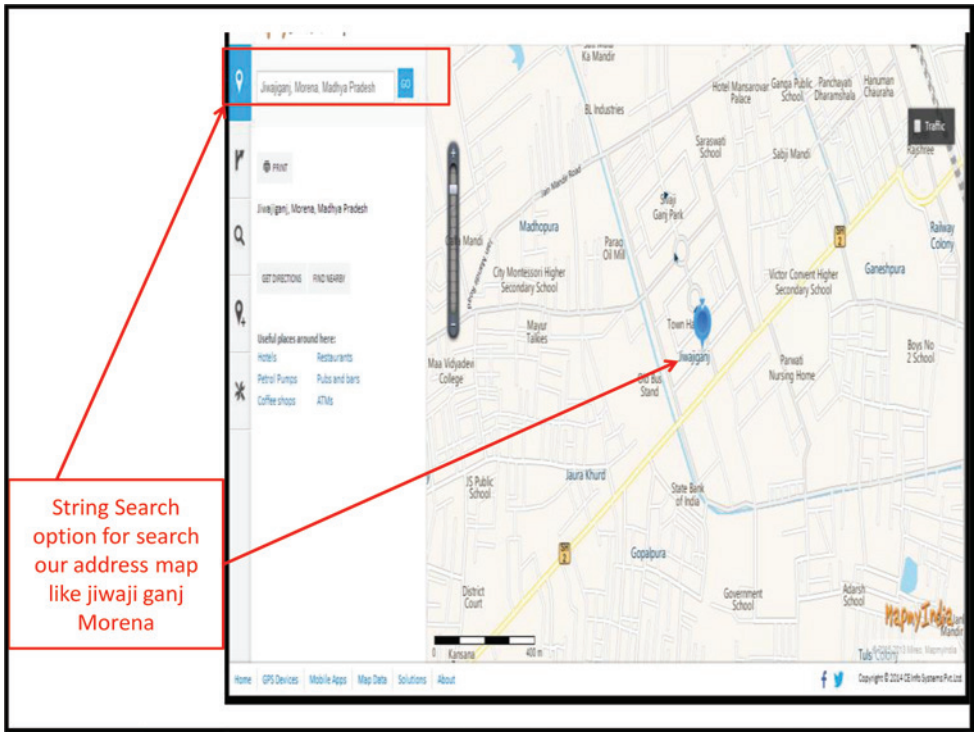
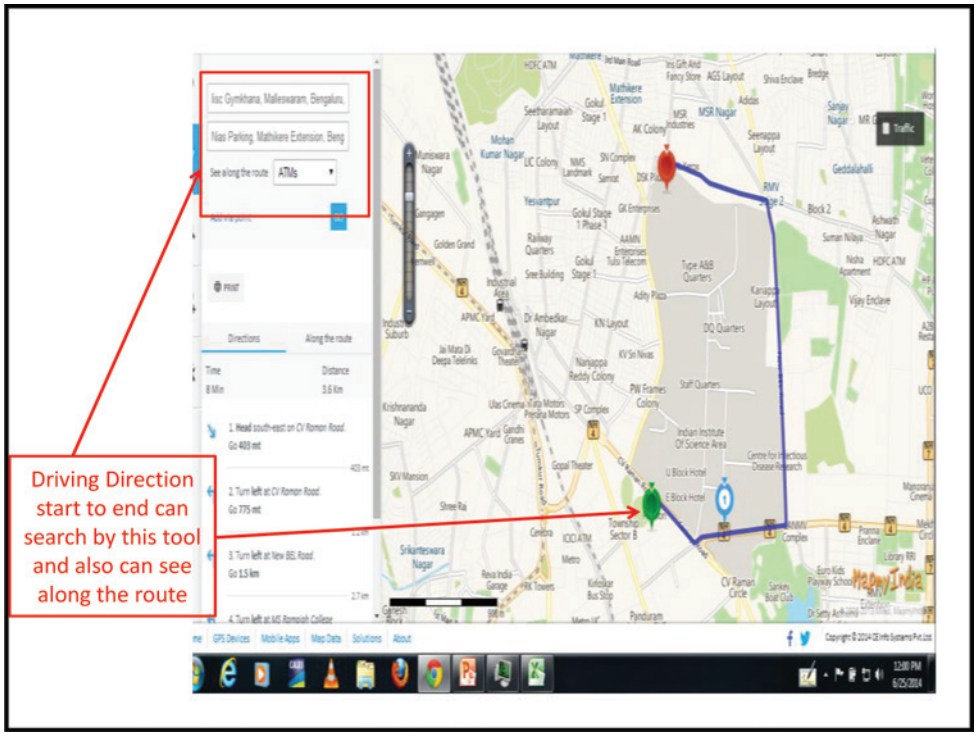


Figure – 6.3- String Search



Figure– 6.4- Driving Direction Tool

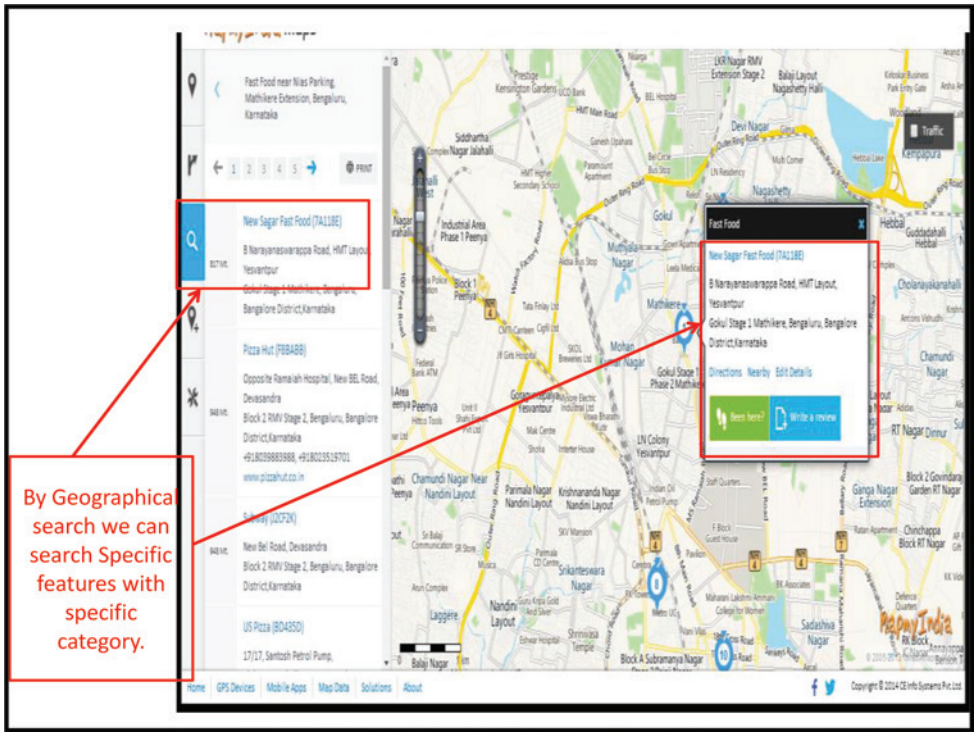
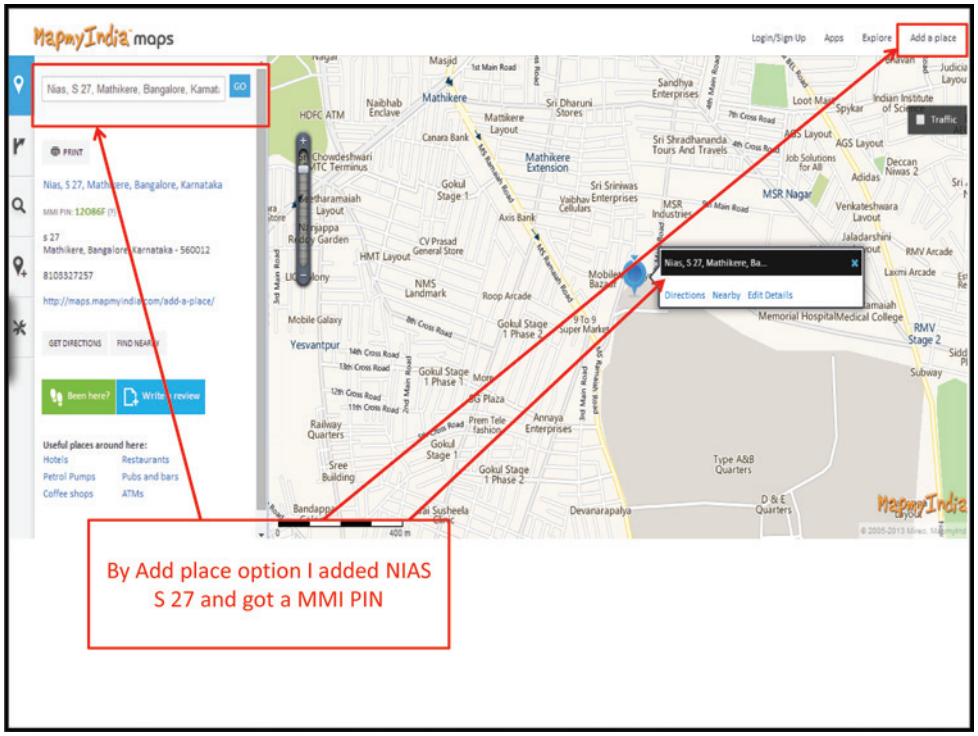


Figure – 6.5- Geographical Search



Figure– 6.6- User Interface (add place) tool

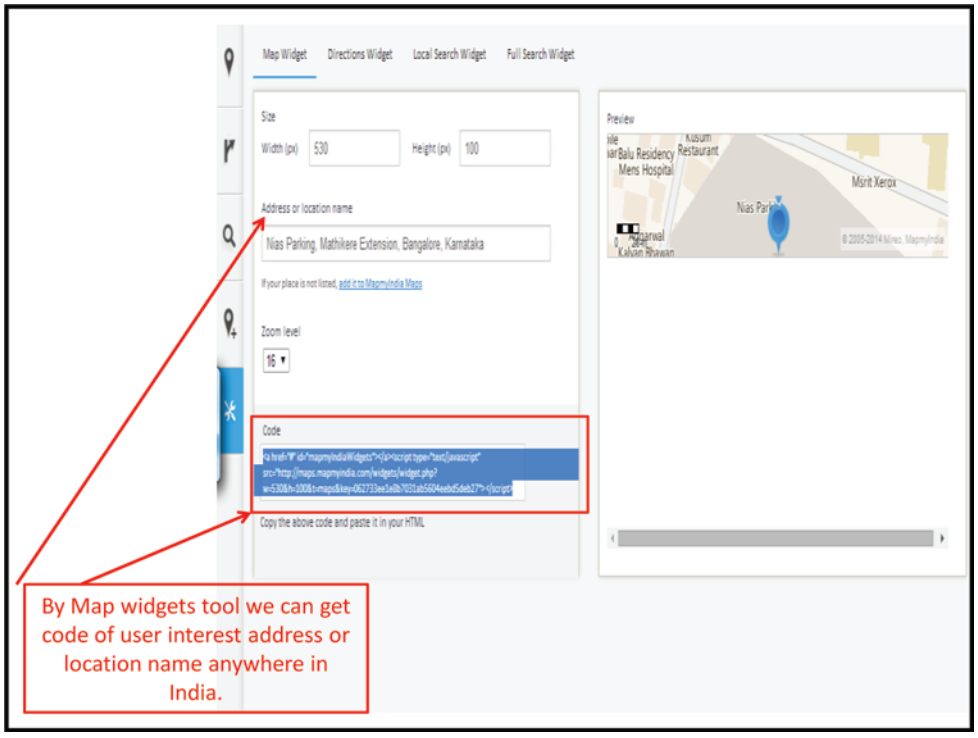


Figure – 6.7- Map Widgets Tool

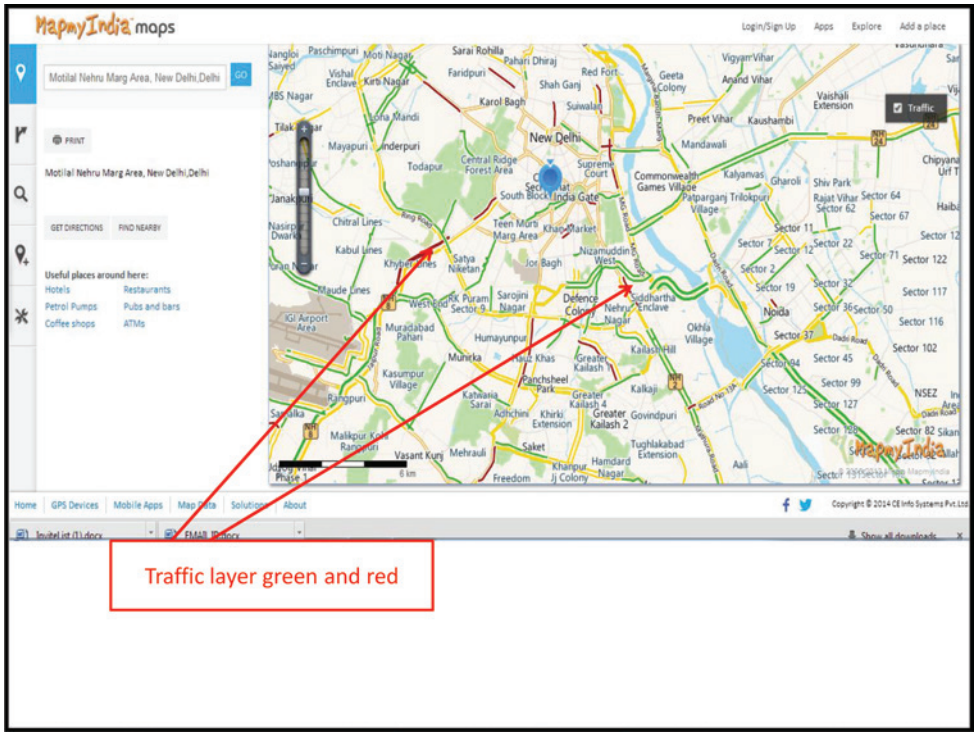


Figure – 6.8- Traffic Layer by Green & Red Line

7. Prototype K-GIS Portal

7.1. INTRODUCTION

82. Prototype K-GIS is a portal of Karnataka State Remote Sensing Application Centre (KSRSAC) through which provides "visual displays" of organization own data.

83. Prototype K-GIS has successfully managed to display IRS images and thematic maps – providing "window" into the spatial data holding of KSRSAC. The initiated efforts of displaying the IRS image & spatial data on web are appreciable. The content, quality and service are good with the advance state of web-mapping and GIS services technology in the world.

84. It not wise to compare Prototype K-GIS portal with other GIS portal available on web but the portal is well sufficient in its services to serve the analysis with available dataset on the portal. At the moment portal has accommodated Karnataka state data but it is possible to incorporate other state and can be done for entire country.

85. This reports includes an independent test and evaluation – technical evaluation report of design and functional characteristics of Prototype K-GIS –http://164.100.133.66/g2g/#/Views/LoginPage.xaml as of July, 2014 and again April, 2015.

85.1 This is not critic on Prototype K-GIS – but is a just analysis of the capabilities of Prototype K-GIS – the study has been taken up by NIAS Research team to give insight into the standing-level of Indian GIS Portal and help us to get a more standards and high-quality progression for National GIS.

85.2 We salute the efforts of Prototype K-GIS – that has made a telling impact in the satellite images scenario.

85.3 Since the this study has taken to evaluate the 'bar' that need to be set for excellence and quality that matched any other efforts in the world, nay, not just matched but surpasses it to make a high-level GIS Portal on India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

86. In coming days, we hope to also bring out such evaluation for other GIS portal services in India and ultimately make an impacting design statement adoption for National GIS.

7.2. Prototype K-GIS DATA

87. Prototype K-GIS has the following project dataset. Dataset can be dividing in two parts, State data & project data, state data covers complete state and project data cover pockets of state, as area of interest.

87.1 State Data are with 1:50,000 scale mainly year 2000 onward. Admin layers available updated and keep on updating as any changes takes place. Thematic layer are update data as well, as they have completed project of pockets of Karnataka state. Although year of those layers varies and scale.

87.2 List of State as follows- 10 Admin Layer, 42 Thematic Layer and two group of project with 32 layers. Also three satellite images have been incorporated with from 0.6 meter to 56 meter resolution.

88. In **Table-7.1** a detailed assessment of Prototype K-GIS has been provided. The map and image data in Prototype K-GIS has following characteristics

88.1 Admin layer of Prototype K-GIS is derived from raster images provided from authorized agencies. As data has been geo-processed and made it more accurate to use as a benchmark of state admin layers to user. Project has been gone through same procedure to make accurate but there are possible edge matching issues since they are derived at different scale as compare to admin layer.

88.2 Most of the data are of year 2000 onwards and generated at different time-period. Admin data doesn't change often but thematic layers are updated and keep on updating as project demands. As a result, the current situation analysis is quite reliable with available dataset.

88.3 Most of thematic layers including admin layer are available on 1:50,000 scale. They have been created as project demanded. There are no large scale data available for state. Project which cover small pockets of state has been created on 1:10,000 scale but they might have cover all required thematic layers.

88.4 Prototype K-GIS data covers whole state of Karnataka. The thematic layers are seamless and quite consistent. The attributes of each layer consisted and well checked.

88.5 Most of the attributes of the layer cover basic but important information. There are no any ministry/department/user related data except Village layer. Demographic & occupation data has been integrated with village layer. Along with this census code data is available with all admin layers which maintain the census code of years 2001 & 2011.

88.6 There are no real time services available at the moment, like weather reports, warning & alerts but portal is compatible for such services to be available. Thus, linkage to

e-services and citizen services can be undertaken. Portal has facility to give feedback in order to improve the user services

88.7 Prototype K-GIS can be claimed GIS-Ready portal can be ready to integrate little other GIS functionality in future. Prototype K-GIS does not contain data for rest of country. Integrating rest of country data would be challenging to Prototype K-GIS administrator but having that portal would be most advance GIS portal in India.

89 From a technical perspective, Prototype K-GIS is a good collection of Dataset with huge count of layer with three high resolution satellite images. These layers are not update till 2014 but they are latest layers. Portal is compatible to append new layer easily. The analysis done on available layers are reliable.

7.3. PROTOTYPE K-GIS SERVICES/APPLICATION

90. In **Table-7.1** a detailed assessment of Prototype K-GIS Portal has been provided. Below are important observation/examples of Prototype K-GIS Portal Services/Application

90.1 Prototype K-GIS has tools that can help to display/query – display maps, distance query, measure query overlay data etc. – all are basic but still useful to do analysis.

90.2 Prototype K-GIS has seamless data which covers entire state data that increases analysis power for user.

90.3 Query can be obtained on Spatial and Attribute basis on seamlessly available data which enriches the analysis power. Also having available buffer tool gives analytical liberty to user. Added print tool on portal is allowing user to add their description. Different annotations can be added to the portal which can be shared with other user. This is one of remarkable utility of Prototype K-GIS.

90.4 Since data contain on portal is seamless, the queries shows good result. Data might not be latest but services available on the portal plays vital role.

91. Application- There isn't any dedicated applications available on the portal. Small projects have been integrated to achieve desired analysis which could be converted in application in future. In future such application can be developed by understanding real requirement in terms of weather, agriculture and so on.

92. Few Portal design perspectives are as follows

92.1 Prototype K-GIS Portal has good professional design. Portal has managed to provide good display and visualization capability.

92.2 Portal has good combination of dashboard design, functional consistency, and help design.

92.3 Layers have grouped well and testing and robustness has done professionally.

92.4 Help function is quite comprehensive and contains every help user needed.

93. Few insight on Performance of the portal are as follows

93.1 The performance of portal is good. At times certain query takes long time to perform but portal is stable, it does not crash or hangs while performing 'long-waited' queries.

93.2 Since robustness of data has done well the performance of manage to improve at good level.

7.4. SUMMARY

94. In summary, it is clear from above analysis that:

94.1 Prototype K-GIS portal contain not only huge dataset but also different resolution satellite images. Data is quite systematic, seamless and layers are available at state-wide. Data might not be update till 2014 but the analyses are reliable since data is available on for whole state.

94.2 Prototype K-GIS does not have any dedicated application towards any government department or ministry. Although census code data has been integrated with admin layers and demographic and occupation data has been incorporated with village layer. But layer are definitely ready to be compatible with any other MIS data from any source.

TABLE –7.1: Prototype K-GIS PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	There are total 51 state layer are available and 33 Projects layer (Pockets of State) and 3 Asset layers which will be keep on updating through GPS. Portal contains layers which are group as follows **Admin Layers** Cadastral, Ward, Village, Grampanchayat, City, Assembly, Parliament, District, State, Taluk	The Admin & State layers are available for entire state but Project layer are specifically for selected area. Each group can be collapse and layer can be individually selected.		Figure –7.1
		State Layer Oil Palm Suitability, Land Degradation, Wasteland 2009, Slope, Soil Irrigability, Runoff Potential, Land Capability, Soil, Ground Water Prospectus, Lithology, Geomorphology, Landuse 2006, ForestDensity, ForestType, Tanks, Waterbodies, Settlements Area, Structures, Canal Network, Drainage, Road, Railway, Power Stations, Power Networks, Wells, Minerals, Settlement Location, Micro watershed, MiniWatershed, SubWatershed, Watershed, Subcatchment, Catchment, Basin, Region, Forest Status, Forest Range, Forest Division, Forest Circle, Asset GPS Dharwad, Asset Phone Dharwad, Water Quality Satellite Images- AWiFS 56 Meters Resolution & Cart Sat Merge LISS IV 2.5 Meters Resolution			Figure –7.2
		Project layers IRDP (Bellary) IRDPLanduse, IRDPLithology, IRDPHydrology, IRDPGeomorphology, , IRDPRoad, IRDPRoadPath, IRDPRailway, IRDPCanal, IRDPWaterbodies, IRDPSettlement, IRDPTransportationNetwork IRDPLineament, IRDPDrainage, IRDPCulvert IRDP Bore well, IRDP - Satellite Image			Figure –7.3

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
		Urban BaseMap For Cities 2K Urban BaseMapWaterbody, Urban BaseMapVacantLand Urban BaseMapSettlement Urban BaseMapRoad Urban BaseMapMetro Urban BaseMapRailwaysTrack Urban BaseMapCanal Urban BaseMapBridge Urban BaseMapBridgeLine Urban BaseMapRoadCenterline Urban BaseMap Metro line Urban BaseMapMetroline Urban BaseMapRailwayCenterline Urban BaseMapDrainage Urban BaseMapLandmarks Urban BaseMapSlumBoundaries Urban BaseMapLocalBodyBoundary			Figure –7.4
		Asset Layers AssetPolygon AssetLine AssetPoint			Figure –7.5
2	Non Spatial	Village Demographic & Occupation data	These tables are connected with village level layers. Census code, Demographic & Occupation data be useful while performing basic quarries		
3	User-ingest	Markup tool	It is easy to use Markup on the portal. Markups can be accessed from Standard tool.		Figure – 7.6

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
B]	**VISUALISATION**				
4	Map Viewer	Map Viewer opens with full screen by default. It has TOC which can be open with drop down button available on it. Different basemaps are made available on portal which is integrated in map viewer. There are two drop down tabs are available where tools are categorized in as standard and advanced. Map navigation tools are with transparency bar. Map Viewer contains, progress bas, index window, cursor location, scale bar, map scale. At the bottom of the map viewer window, result panel resides.	Functionalities & tools are designed on map viewer are easy to use and understand. Most of the functions are available on minimal clicks. Functions are easy to access and conformable to view.		Figure –7.7
5	TOC	Layers has arranged well organized. They have grouped in Admin layers & geological layers. Also small pockets of project layers have been arrange in different group. Layers can be seen by collapsing the group and can be visible by switching on. Layers can be reordered and zoom to their respective scale level. Also information of respective layer is available.	TOC is easy to access and understand in order to view the layers. The functions of the TOC are available with minimal clicks. It's easy to minimize TOC in order to have full screen window.		Figure –7.8, 7.9
6	Navigation Tools	Portal has incorporated basic navigation tools which can help to move map at ease. Map can be panned easily to all four directions. Also it can be zoomed in/out and previous & next can be saved till session is on. Anytime map can be viewed at full extent.	Map can be easily panned with available navigation tools. The navigation map tool is symbolic, by looking at it, it is easy to understand the role of the tool.		Figure - 7.10

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
7	Location of coordinates, Scale Bar, Map Scale & Progress Bar	The latitude & longitude of mouse cursor can be seen at the left bottom of the portal. Also portal has map scale and scale bar. Progress bar appears at the middle top part of the portal while any movements taking place on the portal.	As the mouse moves over portal the relevant information appears at the bottom of the portal. It is easy to view and understand the location of the mouse, map scale & information about scale bar. Progress bar helps to understand the map is busy. It prevents user from doing any other activity till map is ready completely.		Figure – 7.11
8	Measure	Shapes can measured with available tool on the portal. The shape can be line or polygon.	The result of measure tool will appear where tool box is. This tool can be easily accessed from standard tools.		Figure – 7.12, 7.13
9	Buffer	Drawn line or polygon can be easily buffered with available tool on the portal. Also it gives option to buffer existing shapes of the layers from TOC	Buffer tool is easy to access since it opens with an option where required parameters can be filled and buffered result can be seen in map viewer window.		Figure-7.14, 7.15, 7.26
10	Search	Search tool box is located at the top of the portal which helps to search the names of places. Search tool works as a GIS data engine. As the name type in it, the available list of the place will appear below search box.	The name place need to type in search box rest everything will do the search box. It is very user friendly tool to find the admin place on the portal.		Figure- 7.17

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
11	Tools	The set of tools appears on portals which are further divided in Standard & Advanced. This tool allow user to increase the analytical power of user. Active tool information or parameter need to be filled can be seen in tool box which shares with TOC. The results, attribute/selected query can be seen in Result Panel which is at bottom of the portal. Standard tools contain Markup, Identity, Buffer, Measure, Bookmark & Area of Interest. Advanced tools contains Quarry Spatial/Attribute, Clip, Search Coordinates, Print & Asset identify.	The tools of toolbox are easy to access. The selected layers/attributes can be clear from 'Clear menu' available on the portal. Tools are quite advance and also easy to use.		Figure-7.18, 7.19
12	Basemap	Basemaps are available on the tabs. The basemaps are created with existing data of admin layer. The topobasemap opens with portal and other basemap can be accessed by clicking on the tabs. Also ESRI & Bing basemap can added to the portal.	Basemap can be added to the portal by clicking on the tab. They are easy to access and helps user to analyze data with it.		Figure-7.20, 7.21, 7.22, 7.23
C]	**SERVICES**				
13	Spatial Query	Spatial Query tool is available on Advanced tab. User can opt query by choosing available layer from the TOC. The tool box which shares with TOC will be active once the query is in use. The result can be seen in Result Panel with relevant attribute.	Spatial query is easy to execute. Switched on layer can be seen in the query box and can be selected to execute the query.		Figure-7.24

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
14	Attribute Query	Attribute query resides in Advanced tool tab. The box appears where attribute query can take place. This box is designed well to execute the query. This query involved only attributes of the layer and results can be seen in Result Panel.	The attribute query box is self-container which has all tools available to execute the query. This is easy to access.		Figure-7.25
15	Print	User can print their work in map viewer window. User can define their extent or can have map extent to print.	Print is easy to access with minimal clicks.		Figure-7.26
16	Markup	User can add own markups and make it available to public. Markup can be in point, line & polygon shape and also can change the color of it.	Markup tool can easily operate. The option available on the tool can be easily read and understand.		Figure-7.27
D]	**APPLICATION SECTORS**	NA			
E]	**GENERAL**				
17	Design	The name of the login user can be seen on the portal Portal allows to change pass work and to give feedback to portal admin. Light colors have been used to design the portal.	These functionalities are easily accessible and useful to user.		
	Architecture	Portal allow user to update personal details.	Allowing user login to portal, it gives operate		
18	Text	Portal has used different type's fonts, size & color to define the layers or landmarks available on it.			
19	Others	Prototype K-GIS portal is not fast as expected but it is stable. Multiple layers take time to load.	Performance can be improved by introducing lightweight programming language or by having more advance hardware configure.		

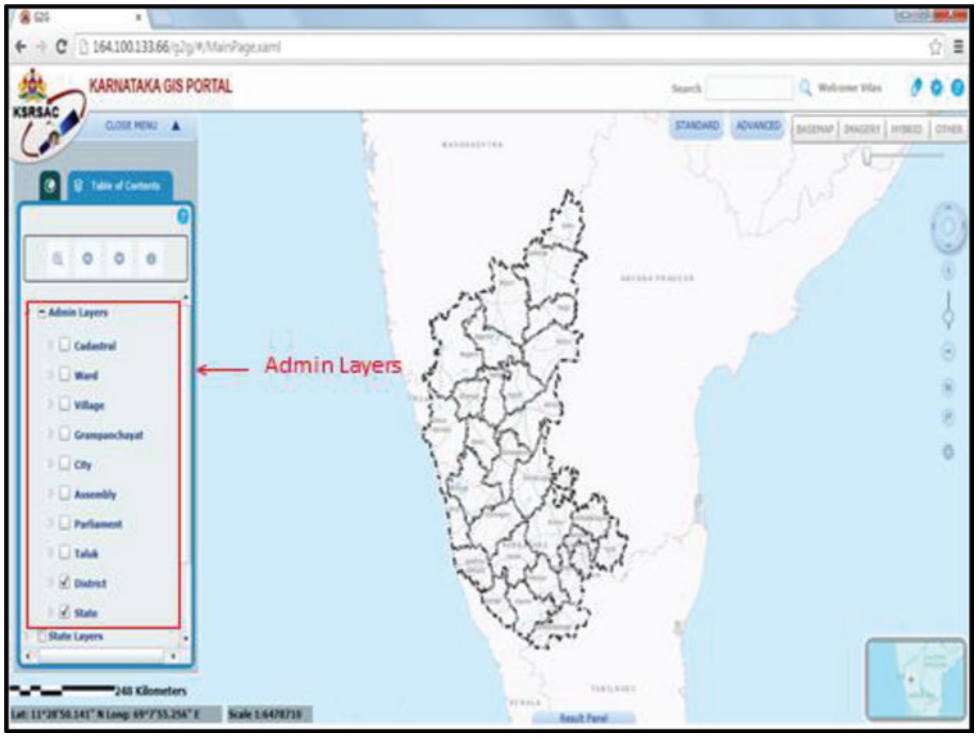


FIGURE-7.1- Admin layers in Table of Content

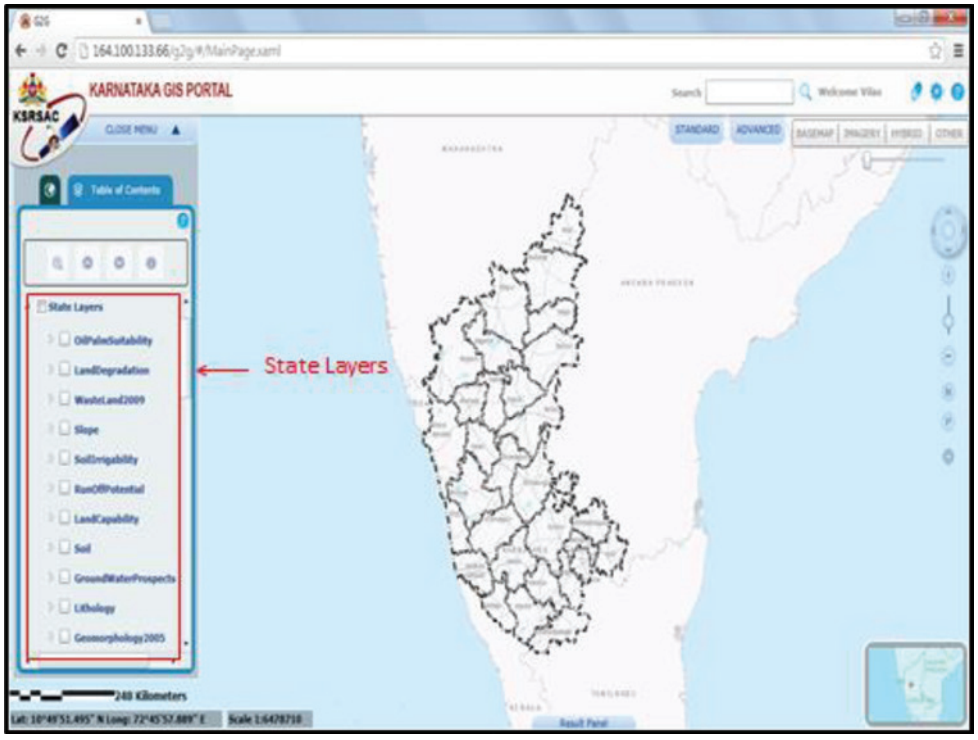


FIGURE-7.2- State layers in Table of Content

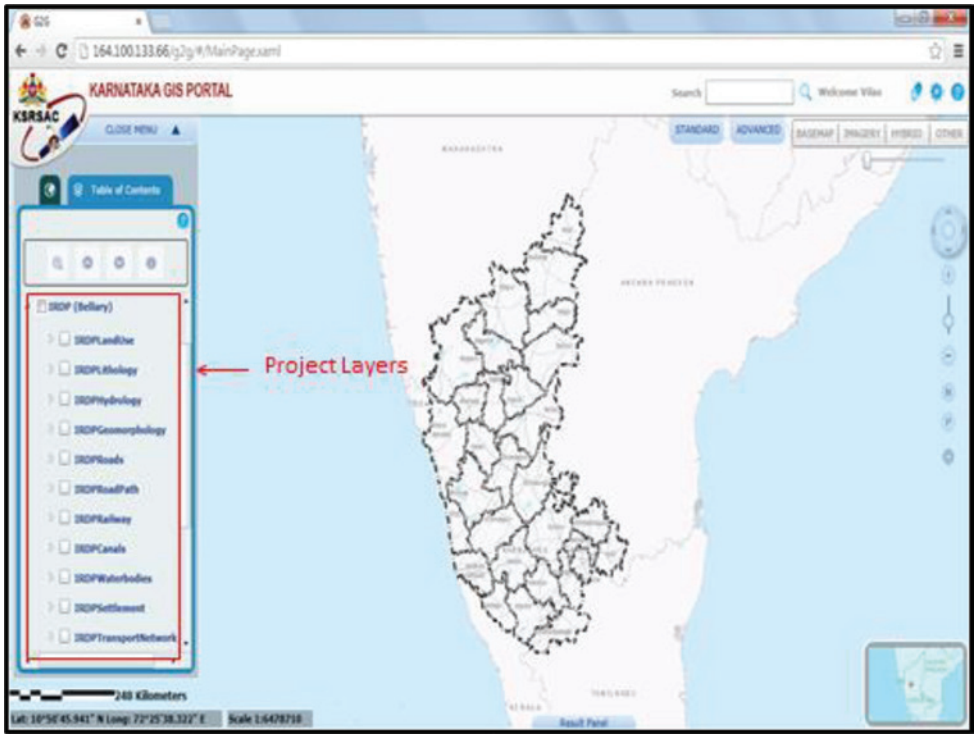


FIGURE-7.3- IRDP Project layers in Table of Content

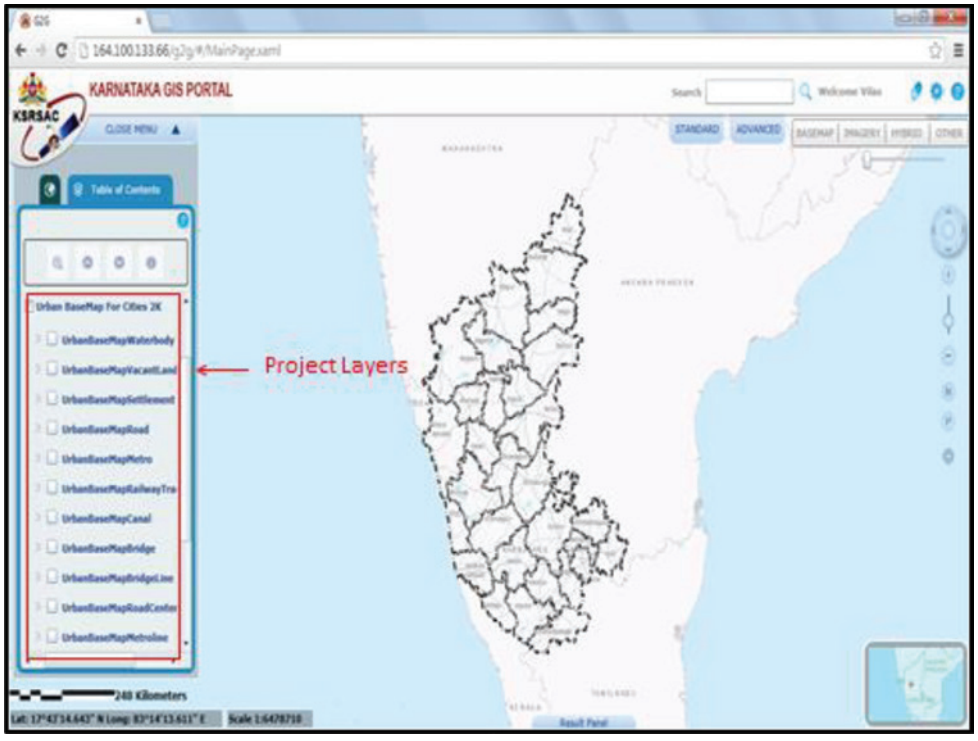


FIGURE-7.4- NUIS Project layers in Table of Content

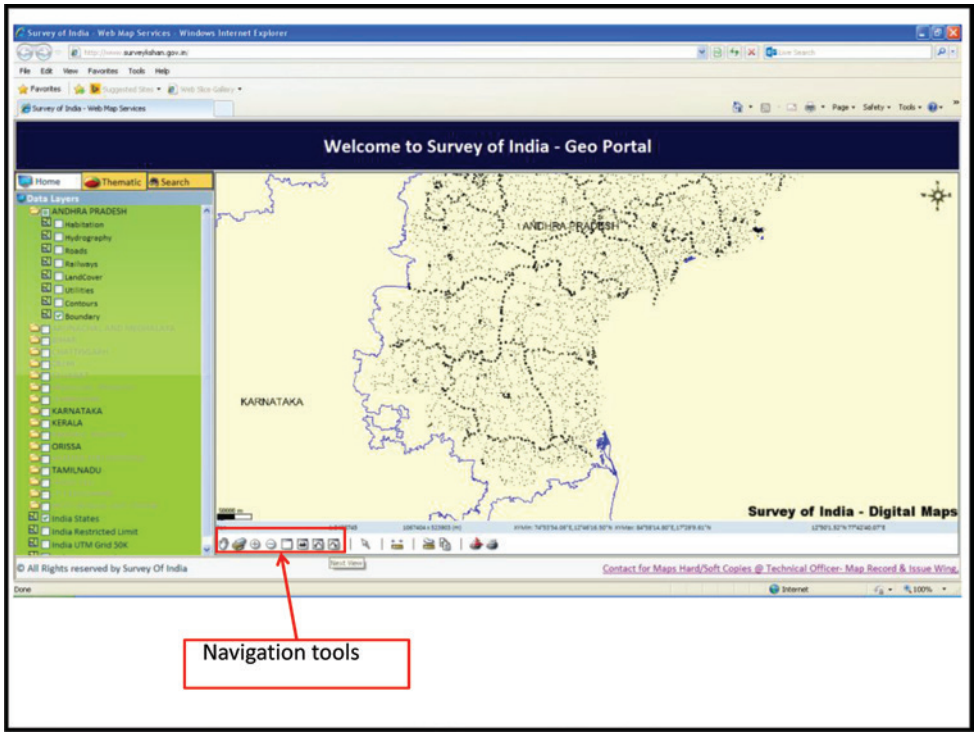


FIGURE-7.5- Asset layers in Table of Content

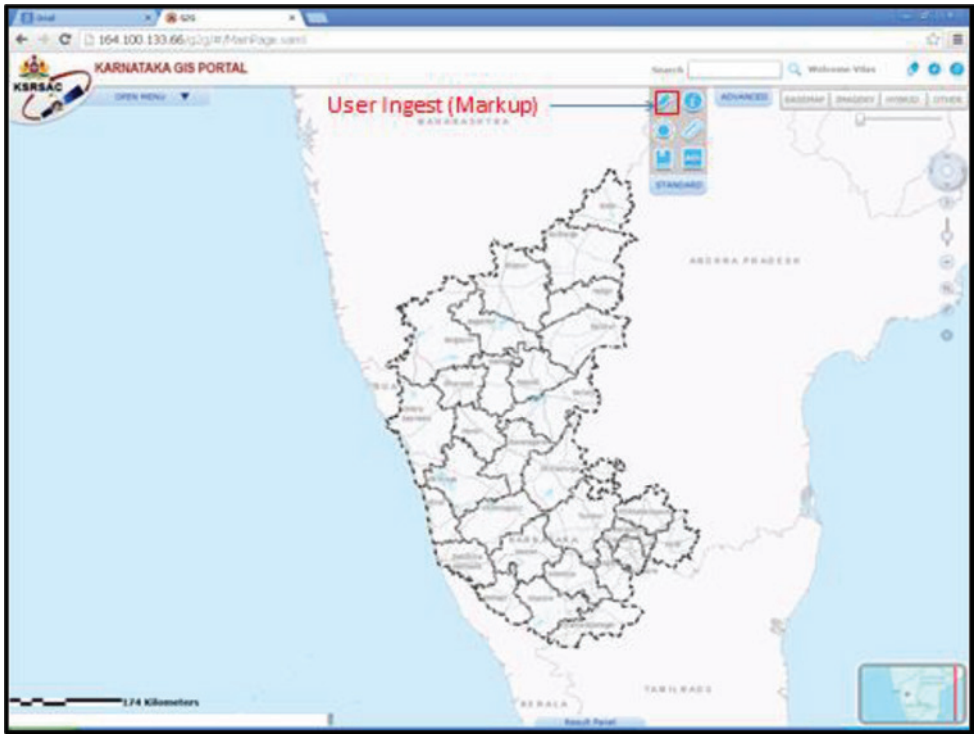


FIGURE-7.6- User- Ingest (Markup) tool

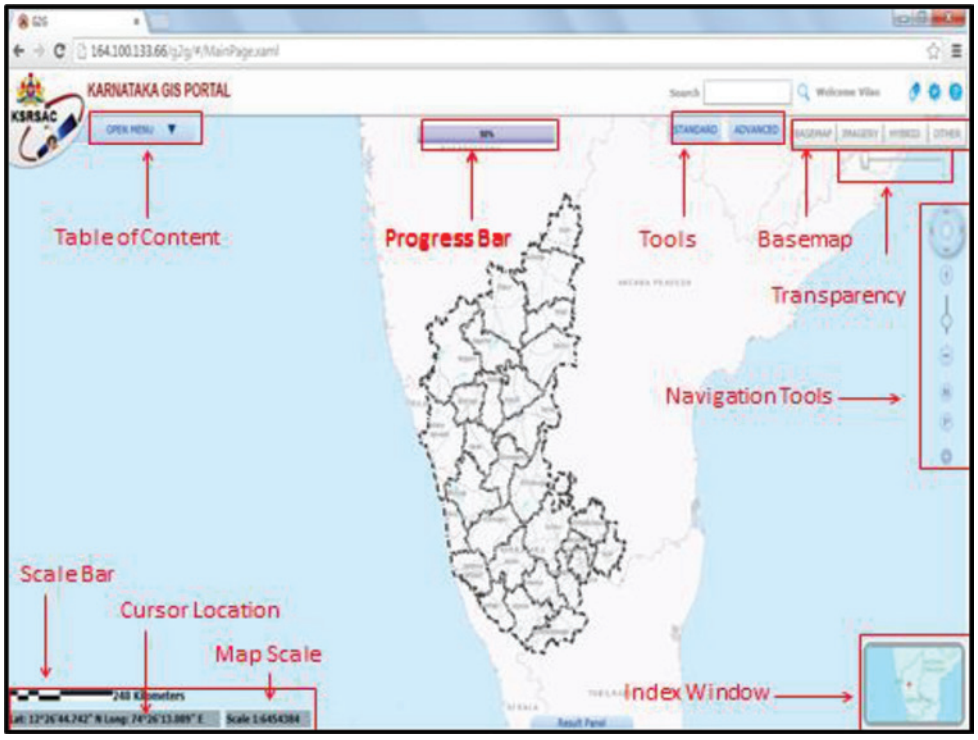


FIGURE-7.7- Map viewer with the view of available functionalities

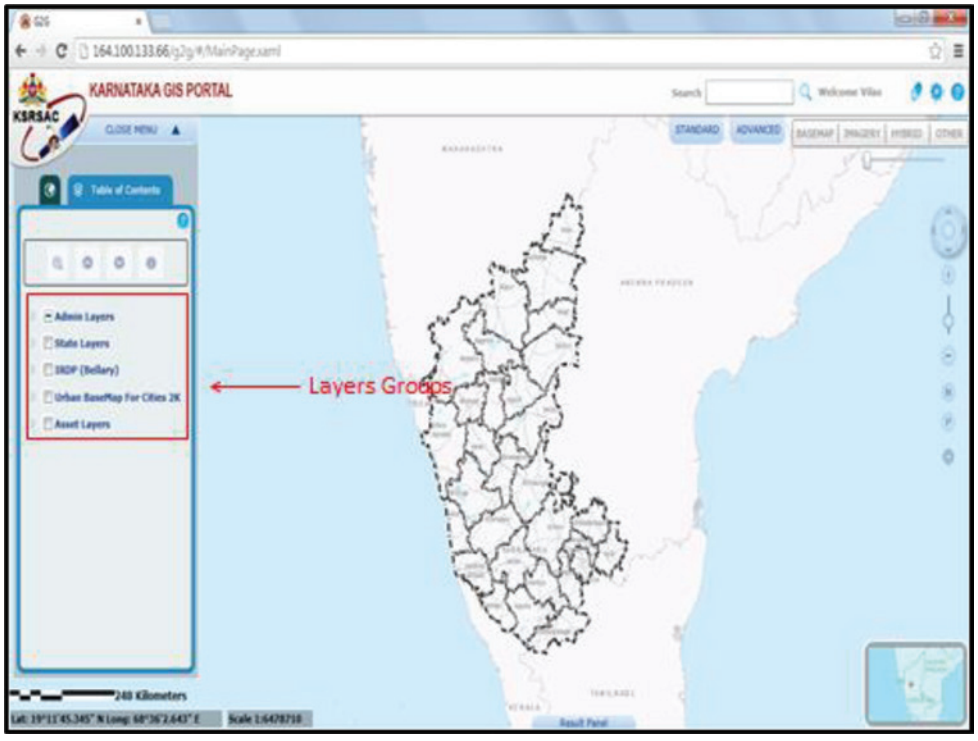


FIGURE-7.8- Organised arrangement of Table of content

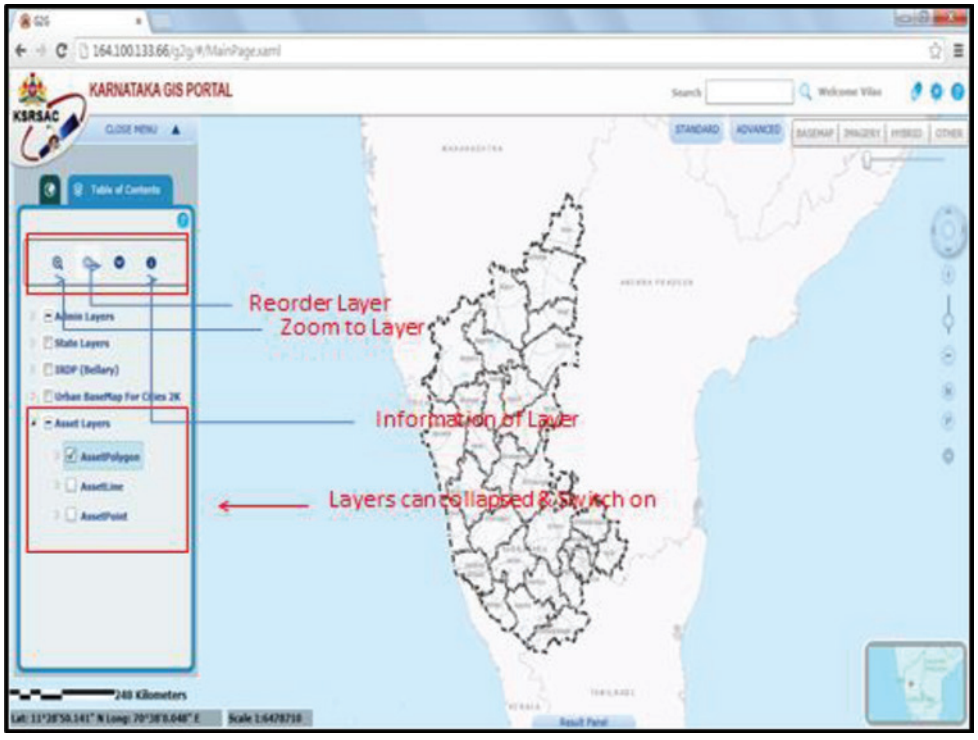


FIGURE-7.9- Other functionalities available in Table of content

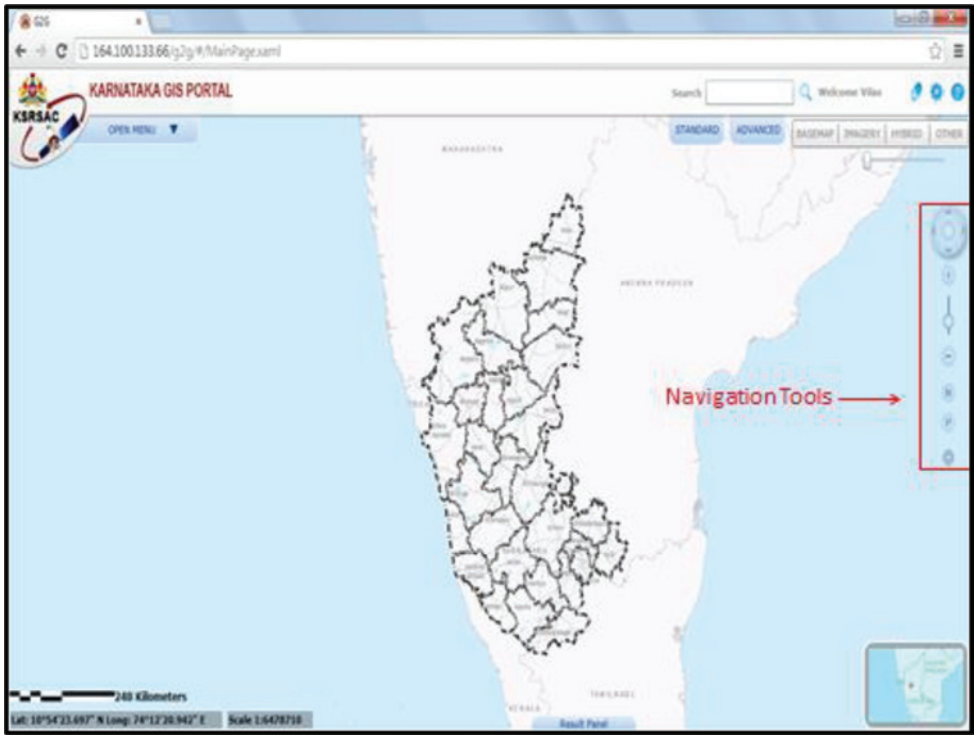


FIGURE-7.10- Navigation tools

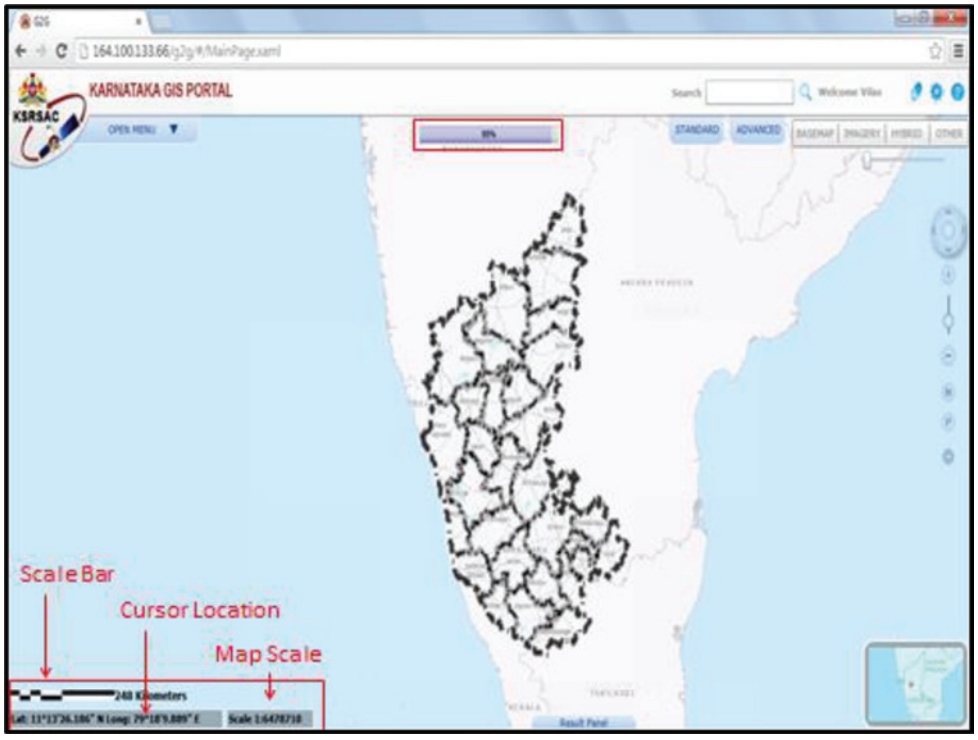


FIGURE-7.11- Location of coordinates, Scale Bar, Map Scale & Progress Bar

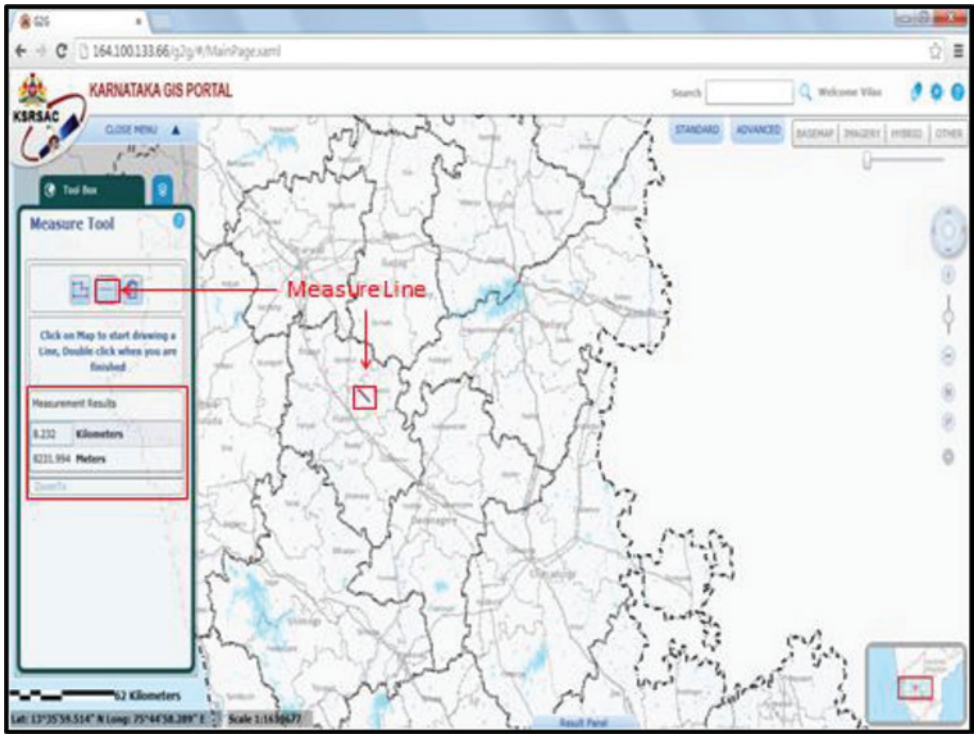


FIGURE-7.12- Length measurement using Measure tool

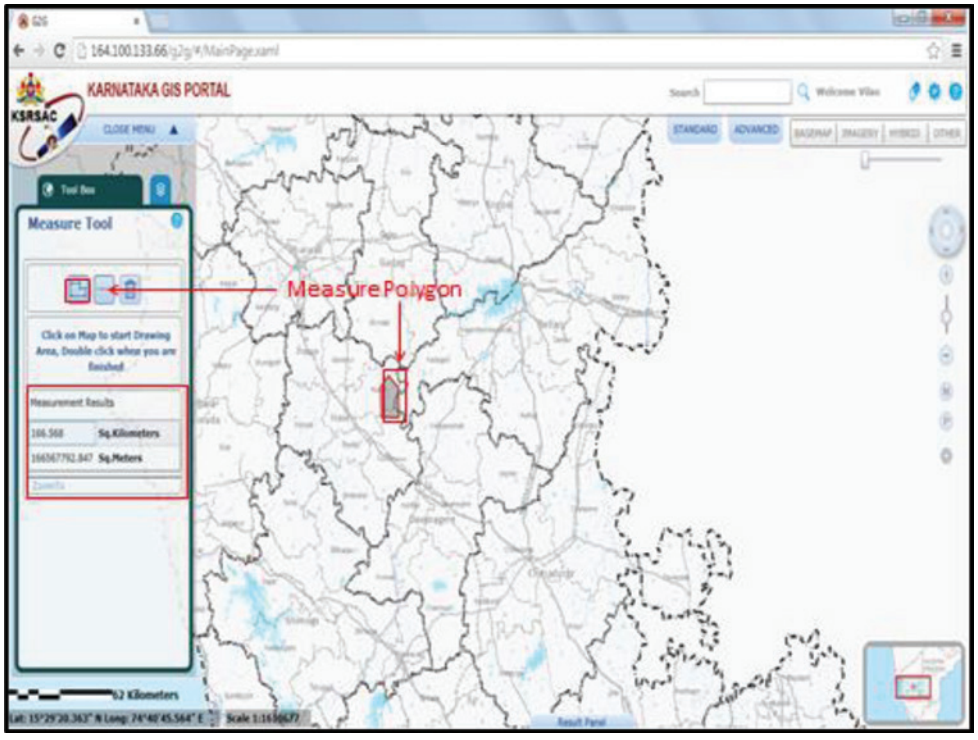


FIGURE-7.13- Area measurement using Measure tool

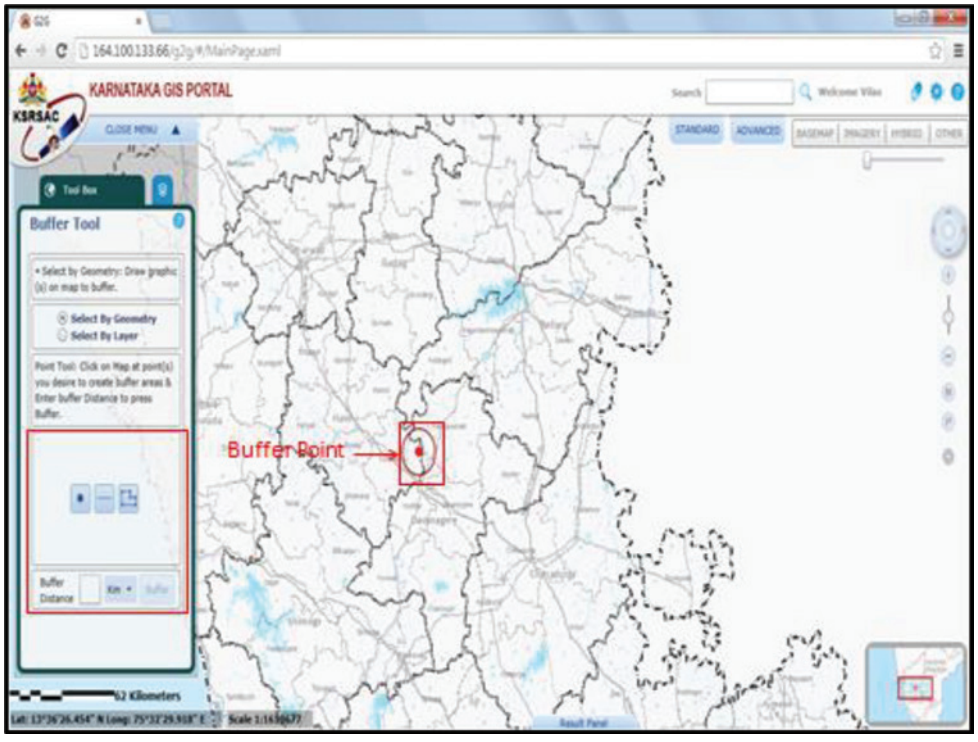


FIGURE-7.14- Buffer tool using Point

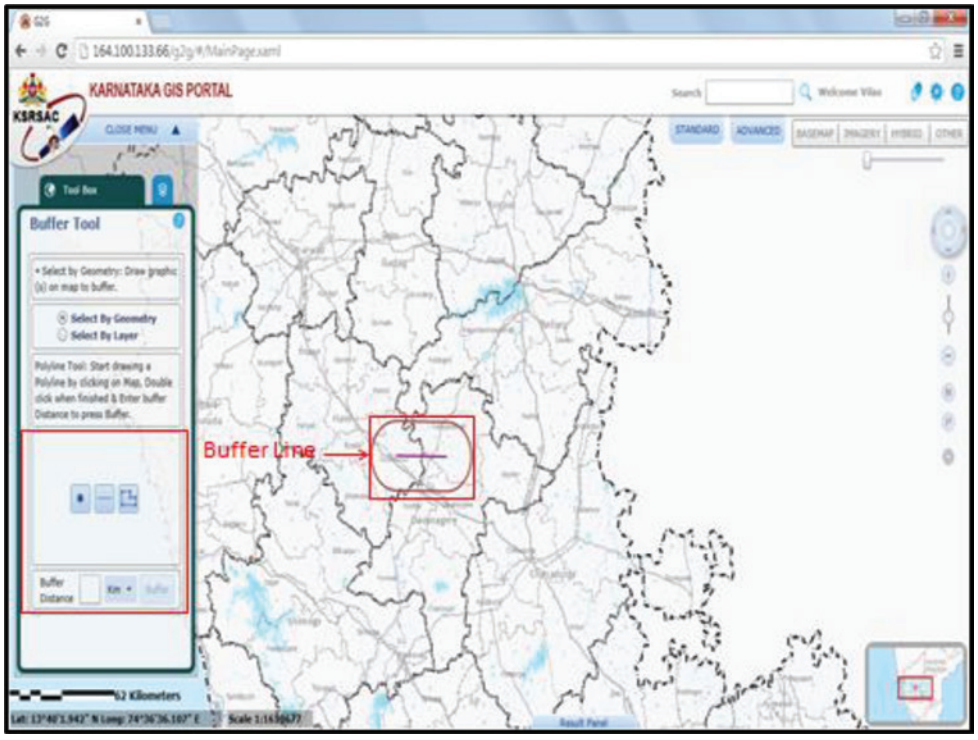


FIGURE-7.15- Buffer tool using Line

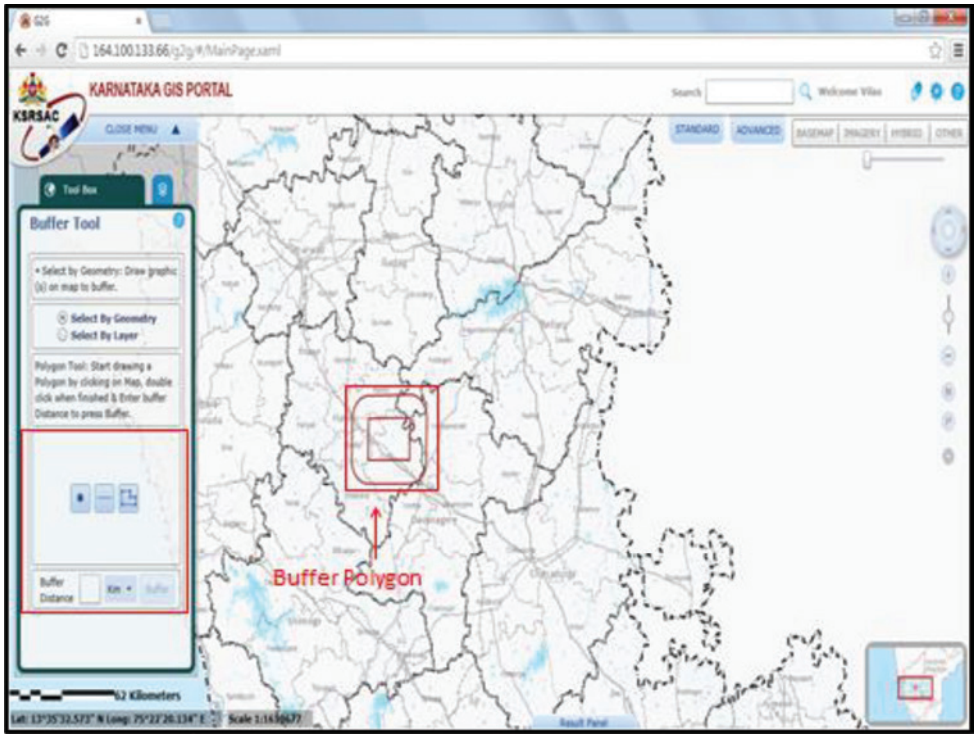


FIGURE-7.16- Buffer tool using Polygon

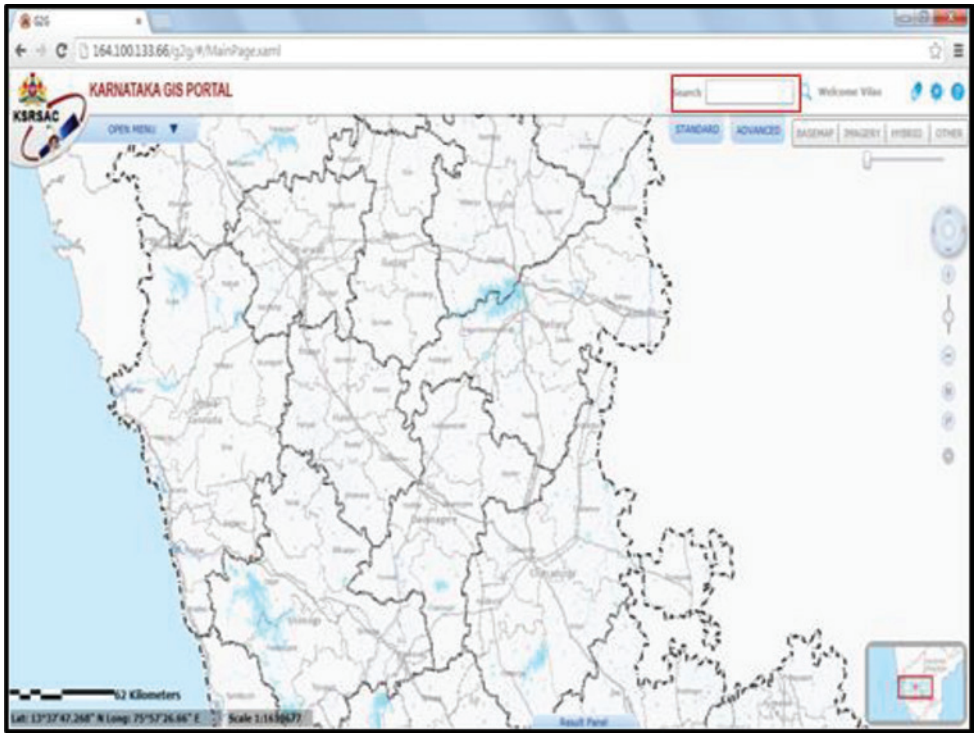


FIGURE-7.17- Search Tool

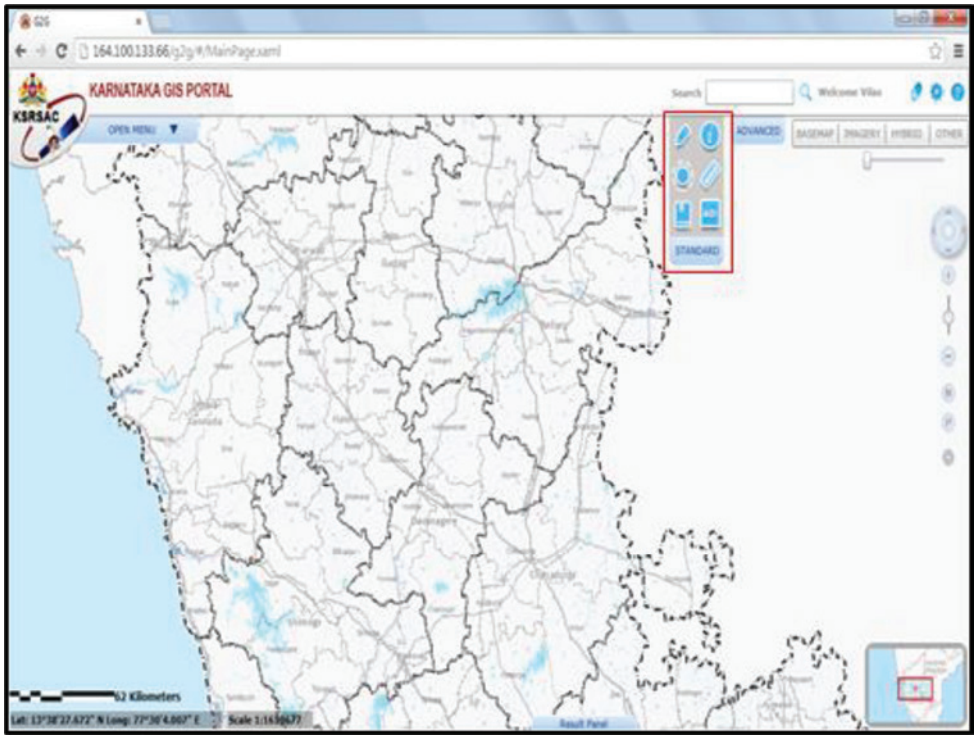


FIGURE-7.18- Standard tools

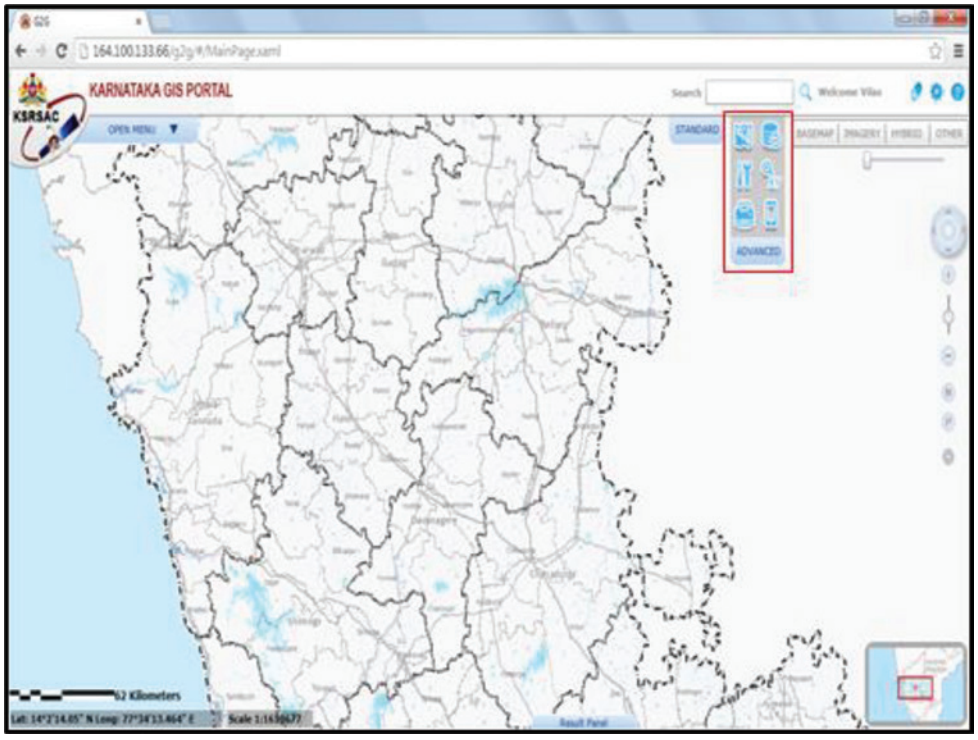


FIGURE-7.19- Advance tools

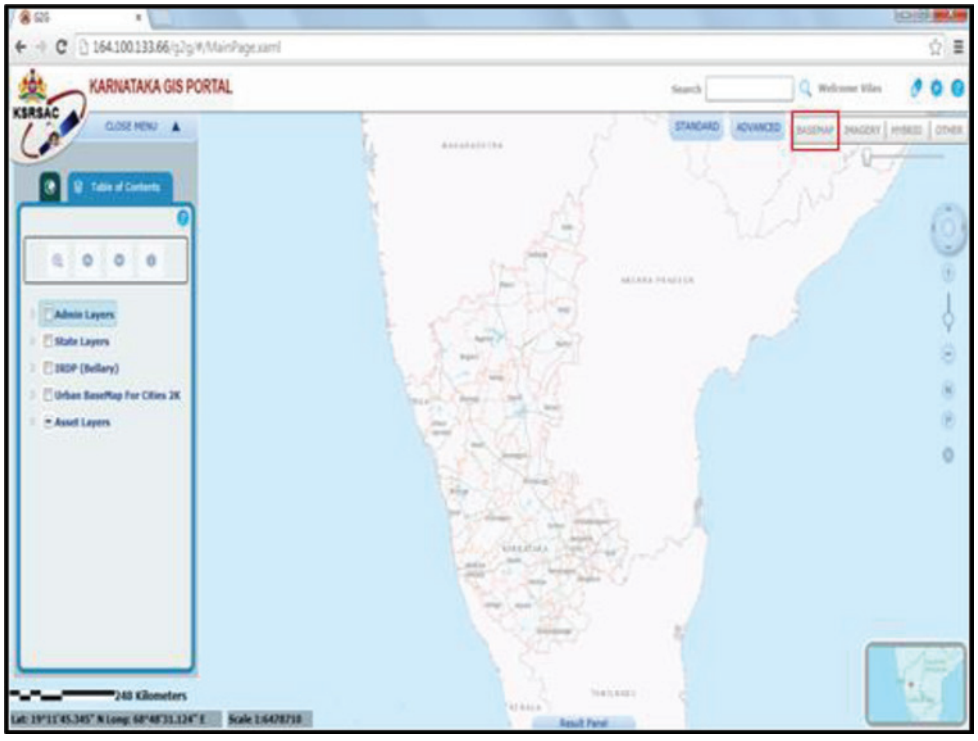


FIGURE-7.20- KSRAC BaseMap option

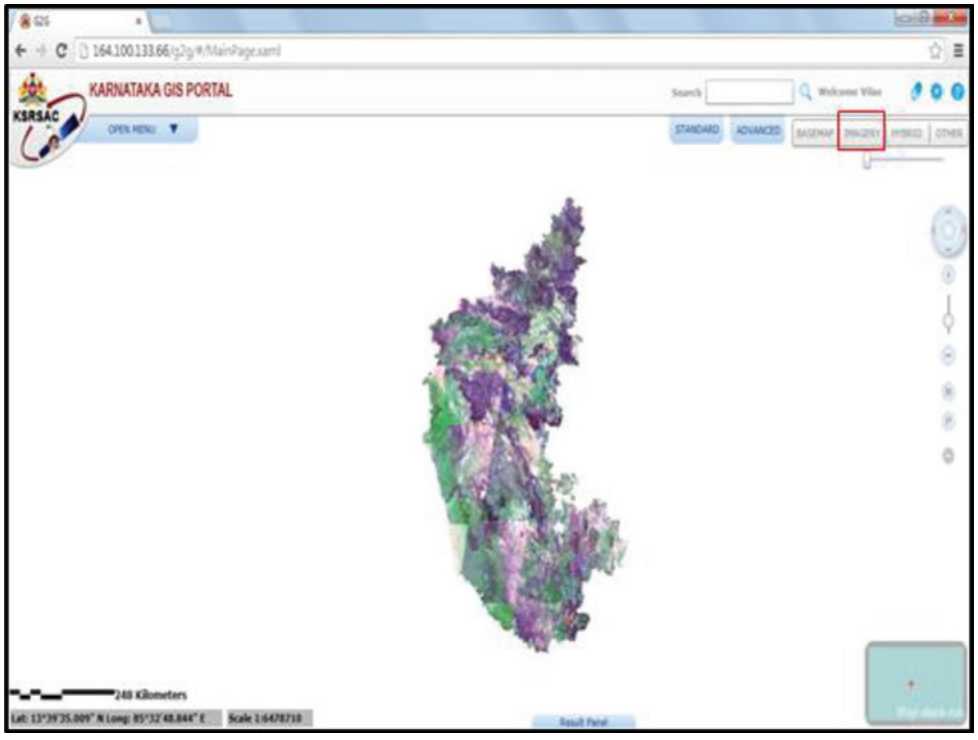


FIGURE-7.21- Imagery option

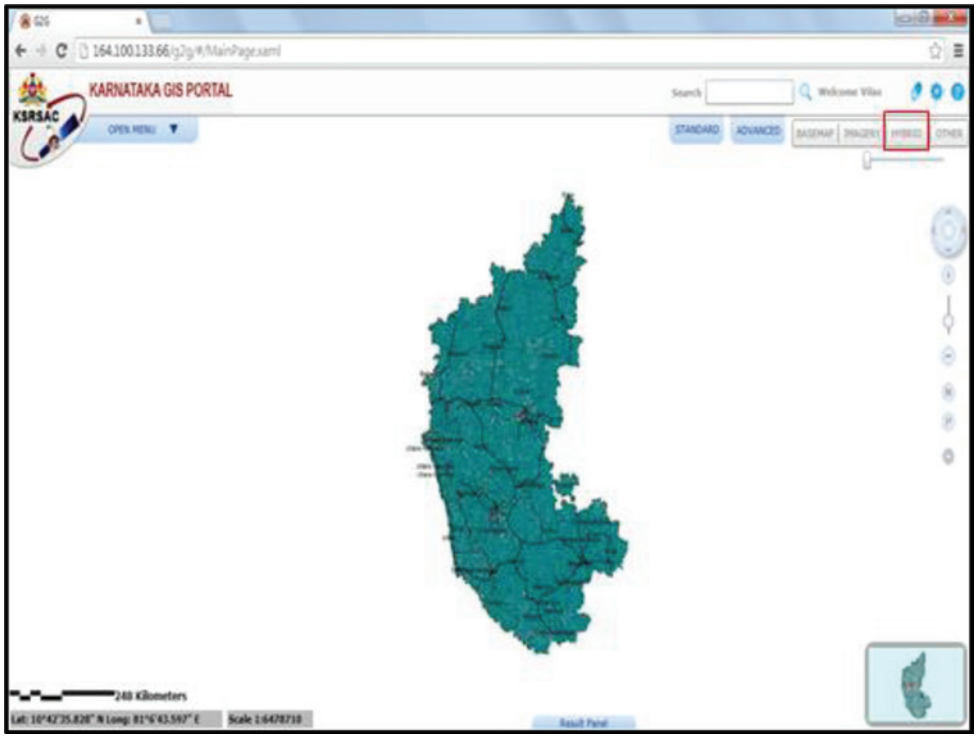


FIGURE-7.22- Hybrid option

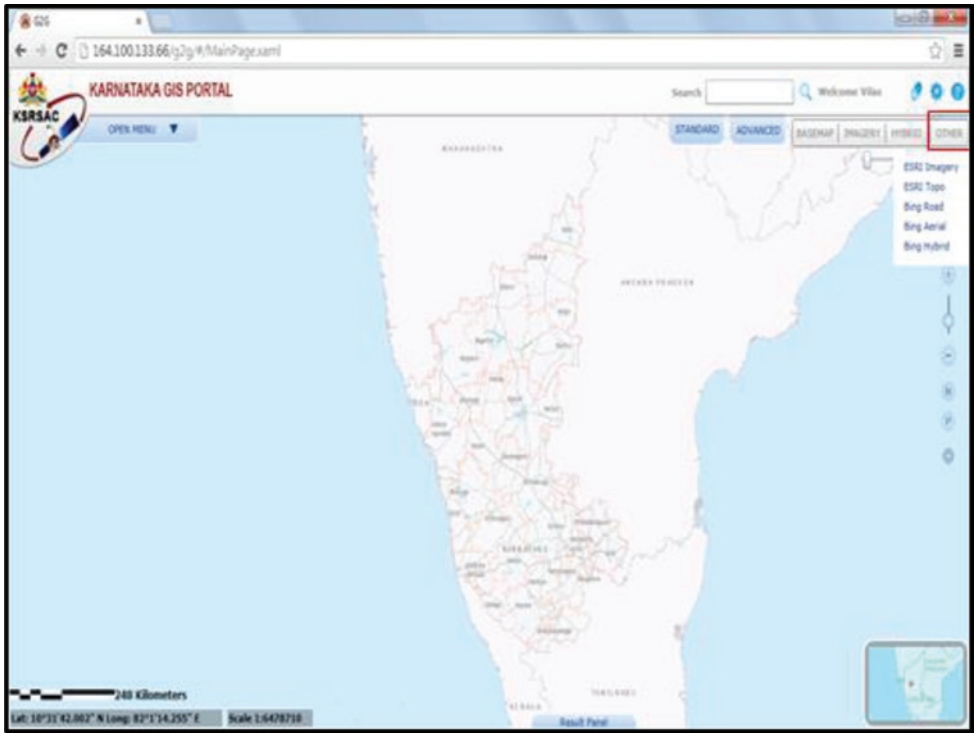


FIGURE-7.23- Other available BaseMap options

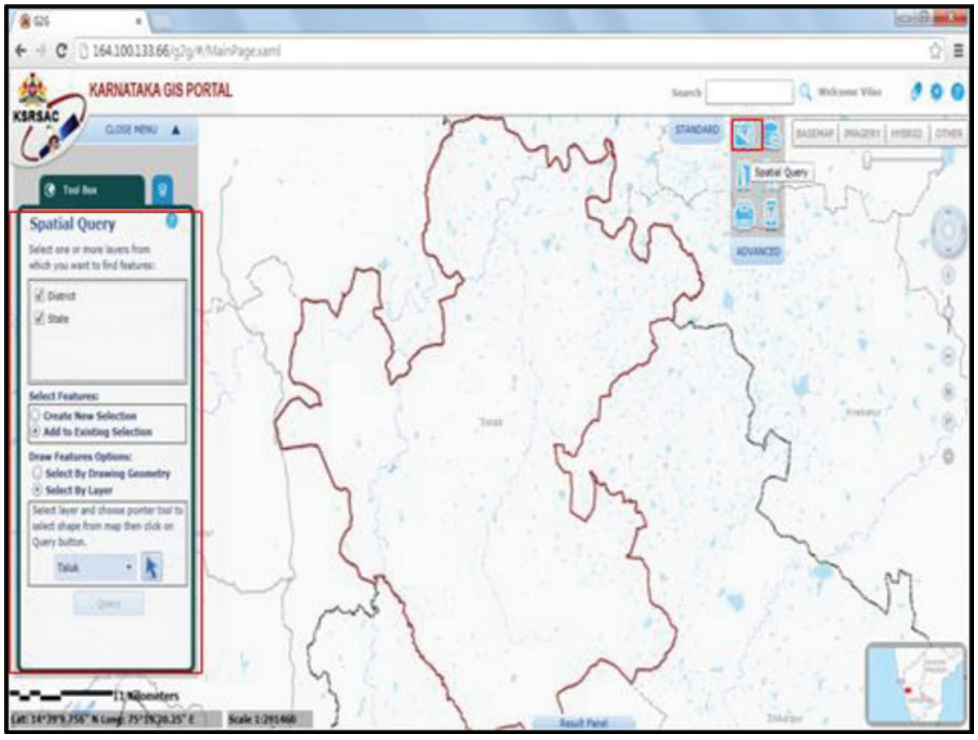


FIGURE-7.24- Spatial Query tool

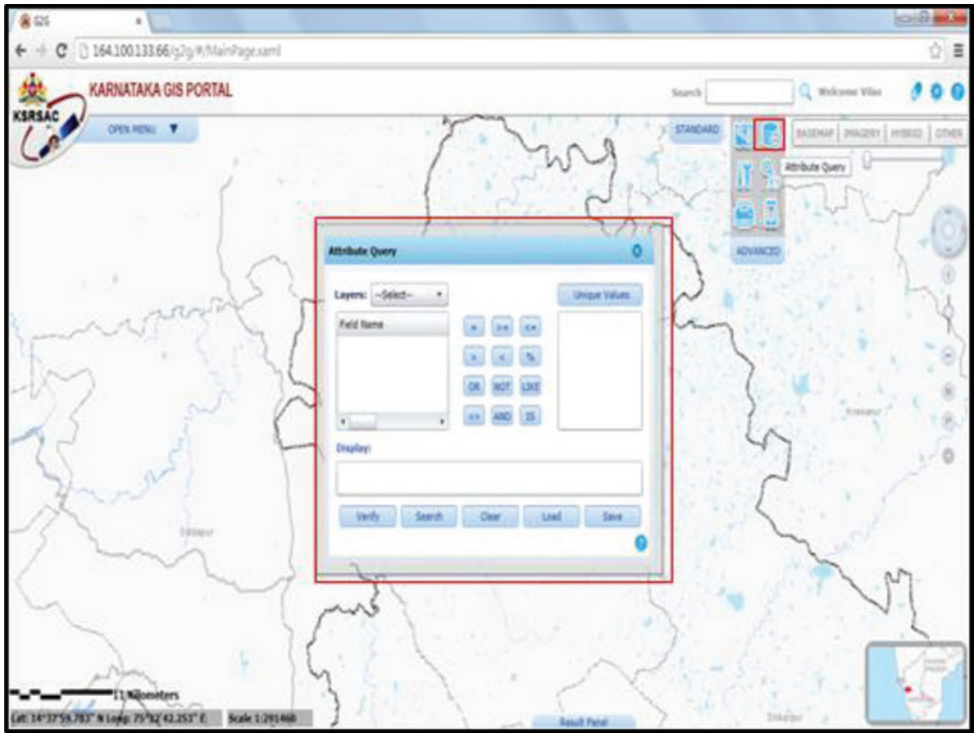


FIGURE-7.25- Attribute Query tool

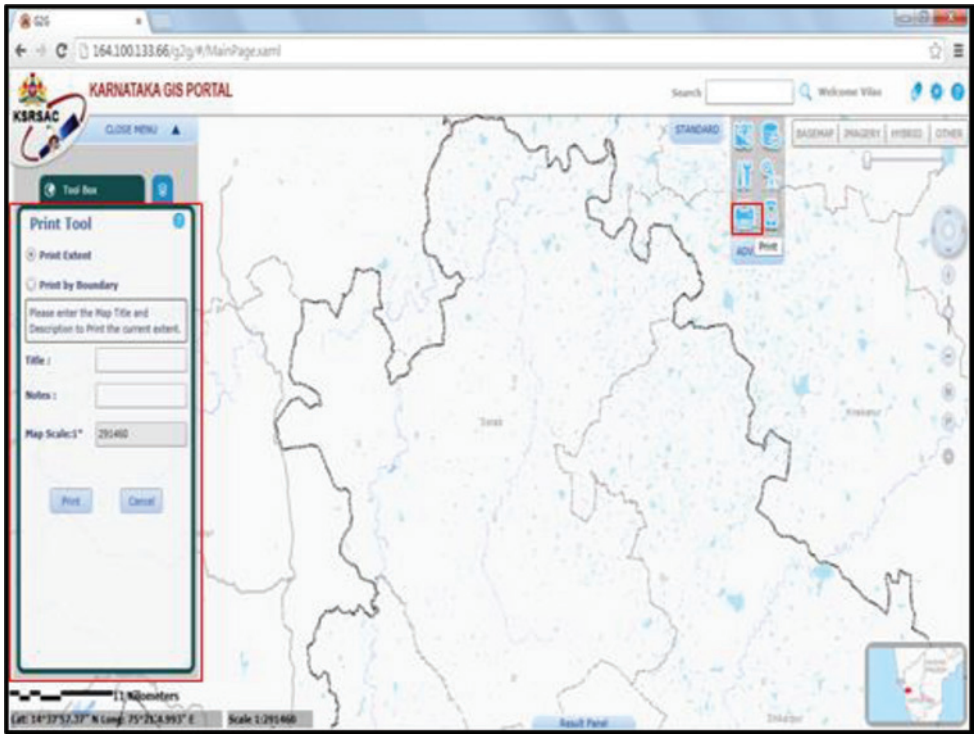


FIGURE-7.26- Options available in Print tool

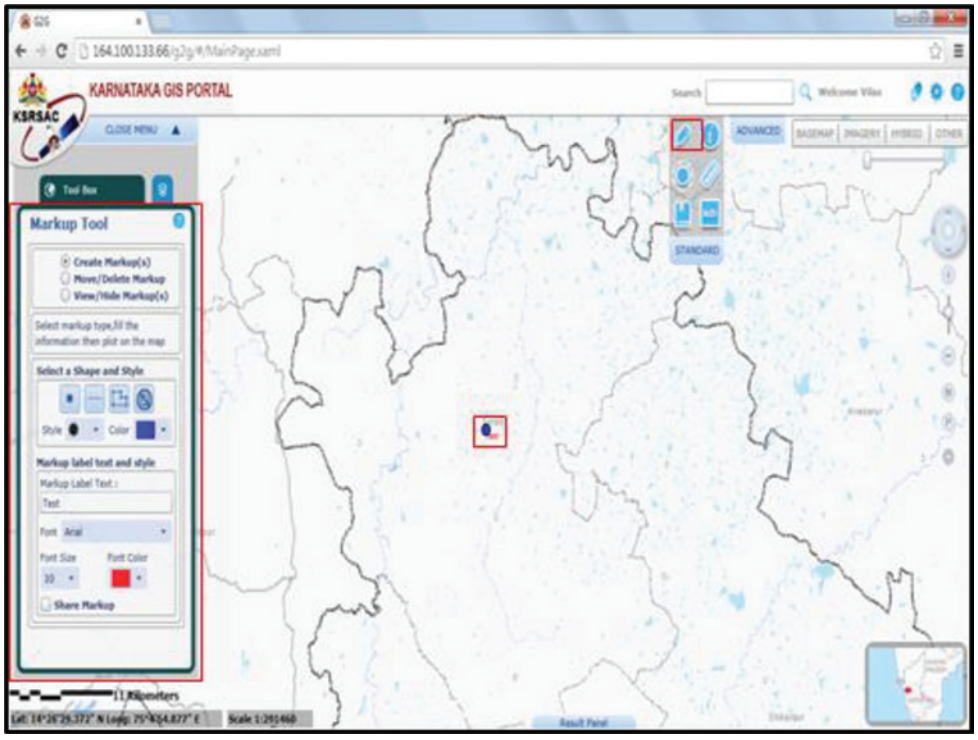


FIGURE-7.27- Options available in Markup tool

8. Surveykshan Portal of SOI

8.1. INTRODUCTION

95. Surveykshan is a Geoportal of, Survey of India which is responsible for all geodetic, geophysical and topographical surveys and maps within India, including those of government forests, cantonments, and town guide maps; and for any special surveys and maps that the Government of India may authorize, such as those for international boundaries etc.

96. Surveykshan displays Survey of India's Digital OSM maps in WMS format, which is at present available for 22 states of India.

97. This report includes an independent test and evaluation - technical evaluation report of design and functional characteristics of Surveykshan portal from http://www.surveykshan.gov.in/ viewed as of July, 2014 and again April, 2015. .

97.1 In order to make a high-quality GIS Portal for India under National GIS, A study was carried out on various Indian GIS portals. NSDI Geoportal is one among them.

97.2 We want to evaluate the "bar" that needs to be set for excellence and quality that matches any other effort in the world, nay, not just matches but surpasses it to make a high-quality GIS Portal of India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

8.2. SURVEYKSHAN GEOPORTAL DATA

98. In **TABLE-8.1** a detailed assessment of Surveykshan has been provided. SOI Geoportal has a following project Dataset.

98.1 Administrative Boundaries upto like India boundary, State boundary, District & Taluk.

98.2 Other topographic map like Contours, Road, Rail, Habitation, Utilities, and Hydrography are present.

98.3 Thematic layer like Landcover data exists. Grid data, India UTM Grid with Grid number of 50k are available.

98.4 There is no non- Spatial data available in this portal. Image services are also not available.

98.5 The above listed layers are available only for about 22 states.

99. In **TABLE-8.1** a detailed assessment of Surveykshan has been provided. The map data has the following characteristics:

99.1 Spatial Layers which are present in Surveykshan portal is a digital map display of toposheets.

99.2 Current Thematic maps or more GIS layers are not available in the portal.

8.3. SURVEYKSHAN GEOPORTAL SERVICES/APPLICATIONS

100. In **TABLE- 8.1** a detailed assessment has been provided. Below are some important observations/ examples of Surveykshan Geoportal **services/applications**:

100.1 Basic visualization tools like pan zoom in, zoom out, previous extent, next extent, Fit to extent window are present.

100.2 Few other information which are showed in status bar include Map scale, Map display area in meters, Box bound value XY Min & XY Max in DMS format, cursor movement shows Lat & Long values in DMS format.

101. Measure Tool- Measure tool is available for measuring distance between two points. There is a separate tool for measuring area.

102. Map query can be performed only on MapIndex (Grids) other spatial layers don't have this facility.

103. Print Service are available in two options one is normal print where we can take print according to the software we use and other is Advance printing facility, Where user can take customized print.

104. There is NO GIS APPLICATIONS present in Surveykshan Geoportal.

105. In **TABLE- 8.1** a detailed assessment of Design and Architecture has been provided. Some of the notable observations are:

105.1 Portal design is pretty good. However some of the GIS tool like query, search, Download Buffer etc can be made available in the portal.

105.2 Help tool can be made available for the portal user. It would be helpful for most of the Non- GIS users.

105.3 Apart from Mozilla & IE Portal can be made compatible with other browsers also.

106. Performance- wise Surveykshan can focus on following areas

106.1 Layer rendering is slow.

106.2 Caching and Tiling techniques can be used to improve the performance.

106.3 Speed of services can be improvised with better hardware capacity.

8.4. SUMMARY

107. Surveykshan portal focuses on displaying digital maps of toposheets.

108. GIS layers available are at base level and cannot address major decision support needs from different government sectors. However if SOI portal provides download option, one can use authoritative boundary for other GIS activities.

TABLE –8.1: SURVEYKSHAN PORTAL: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	**India-**International boundary, State boundary, India UTM grids 50K with grid numbers and India restricted limit boundary **Boundary Layer-** District, Taluk. Other Layer- Habitation, Hydrography, Roads, Railways, Landcover, Utilities, contours. The above layers are present for states like Andhra Pradesh, Arunachal and Meghalaya, Bihar, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab and Haryana, Tamil Nadu, Uttarakhand, Tripura, Manipura, Mizoram, West Bengal and Sikkim.	Layers are well classified in collapsible tree structure. Switch On/Off of the layers is easy.	Symbol of the layer with color can displayed along with the data layer.	Figure- 8.1
2	Non-Spatial	NA			
3	User-Ingest	There is no option to add user ingest data.			
4	Others	NA			
B]	**VISUALIZATION**				
6	Map Viewer	Map viewer is capable of displaying 2D information. TOC is fixed and has 3 tabs in it; Home, Thematic, Search. Home tab is the container of the entire data layer. Other two tabs don't show any of the capabilities. Layers are bounded with the bound box value; User can operate only on those layers which has activated at that bound box value.	Displays of layers are not precise to particular state boundary; Layers display feature outside the boundary also.	Feature of particular state should be made to appear within that boundary.	Figure- 8.2, 8.3, 8.4

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
		Status bar shows the name of the tool which is highlighted, a progress bar appears when layer is rendering and also displays other information like Map scale, Map display area in meters, Box bound value XY Min & XY Max in DMS format, cursor movement shows Lat & Long values in DMS format. Map area displays scale bar and North Arrow along with the Map layers. An external link to contact for maps Hard/Soft copies is present			
7	Navigation Tool	Navigation tools like Pan, Zoom-In, Zoom-Out, (Zoom to) Window area, Fit (initial extent), Previous view, Next view are present.	Easy and smooth to navigate.		Figure- 8.5
8	Layer Book Tool	This tool opens a new window with the Header description as “Legend”. But there is only information of the layers present in the portal with its scale info. Other Legend component like symbol and colour of the layer are not present.	Legend information of the map is incomplete. User finds it difficult to read the map.	Legend information should be displayed properly with all the components.	Figure- 8.6
9	Select Map Element Tool	This is used to select map element. Ctrl key can be used to select multiple map elements. The significance of this tool in the portal is unknown as the portal provides only WMS service, Query operations cannot be performed.	The use of this tool in the portal is unknown.	This tool could be used if the user has an option to select map element and download it or to edit any user ingest data.	Figure- 8.7
C]	**SERVICES**				
10	Measure distance & Measure Area Tool	These tools shows distance between two point and multiple points. Results are represented in meters and square meters respectively.		User can be given options to read distance in different format	Figure- 8.8

No	Category	Major Observations	User Friendliness/ Difficulty	Important Suggestion	Screen Shots
11	Copy to Clip board, Print & Advance Print Tools	Copy to clip board tool gives a screen shot of the Map area. Print tool facilitates user to customize the print properties of that Map area. We can save file in different format. Advance Print tool provides additional facility to select the area to print and also option to include border and comments. Print can be saved in Pdf format. However doesn't show legend and space to enter comment is very less.	More advance options in printing gives user privilege to customize the print. User finds it difficult to read a printed map without legend		Figure-8.9, 8.10, 8.11
D]	**APPLICATION SECTORS**	NA			
E]	**GENERAL**				
16	Design/Architecture	There is no Help tool	New GIS user finds it difficult to understand the tools without user manual.		
17	Text				
18	Others				

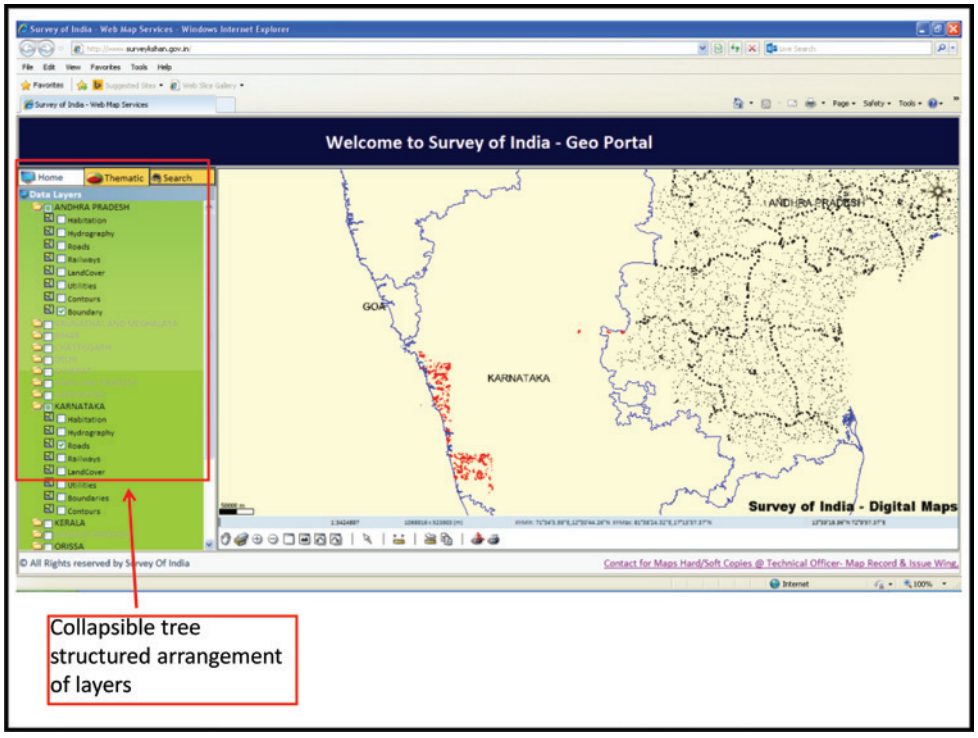


FIGURE-8.1- Structured arrangement of Table of Content

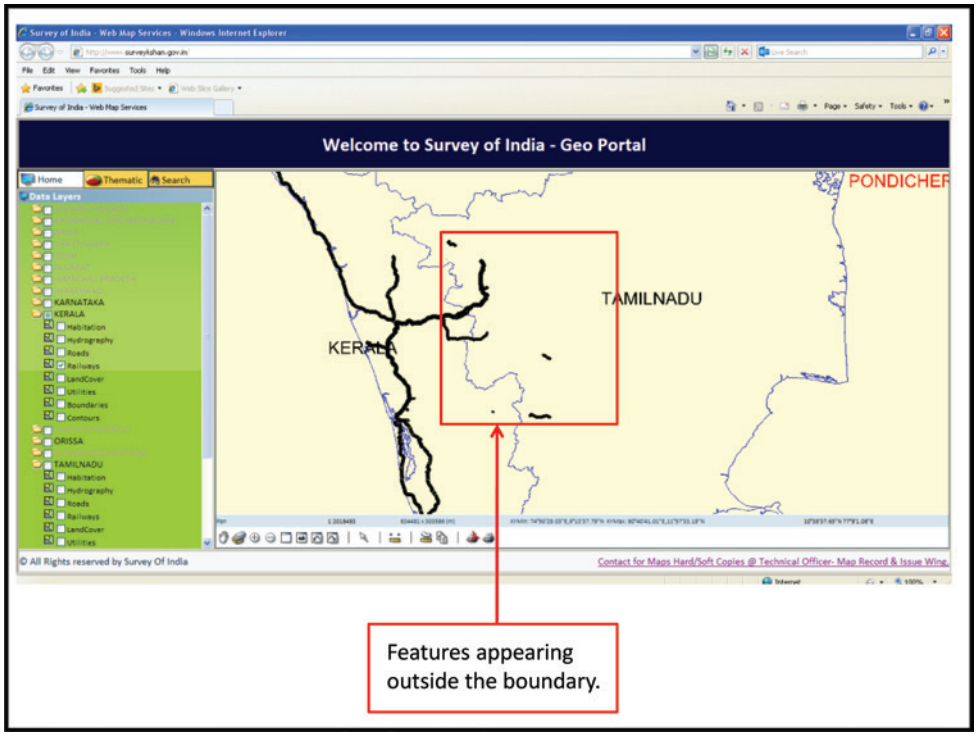


FIGURE-8.2- Error in displaying the data outside the state boundary

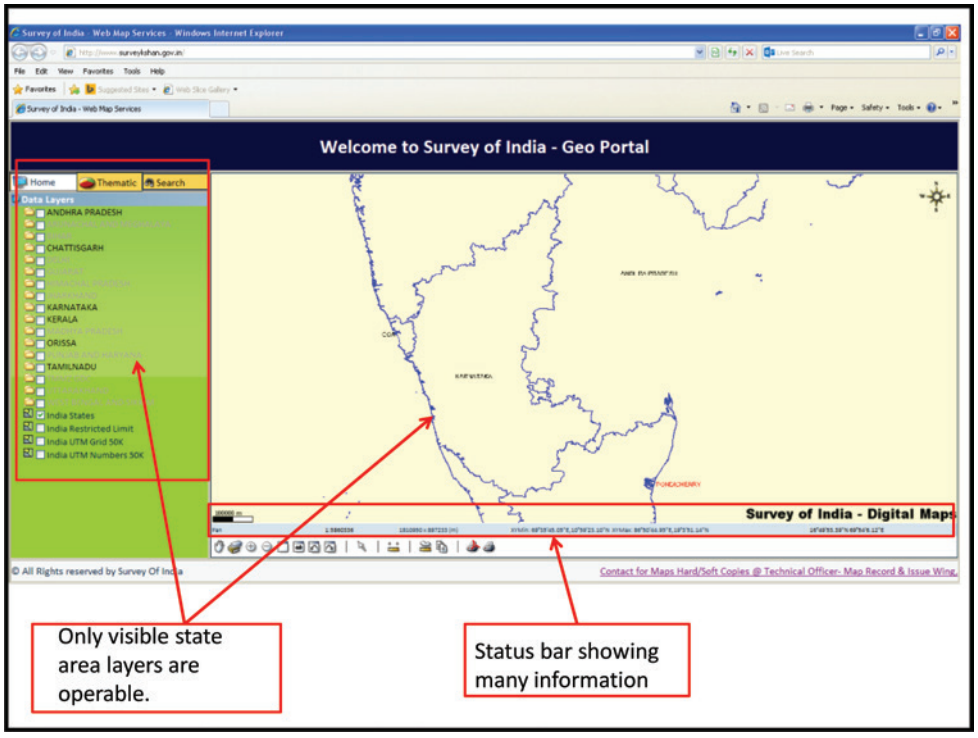


FIGURE-8.3- Display of map layers according to the scale

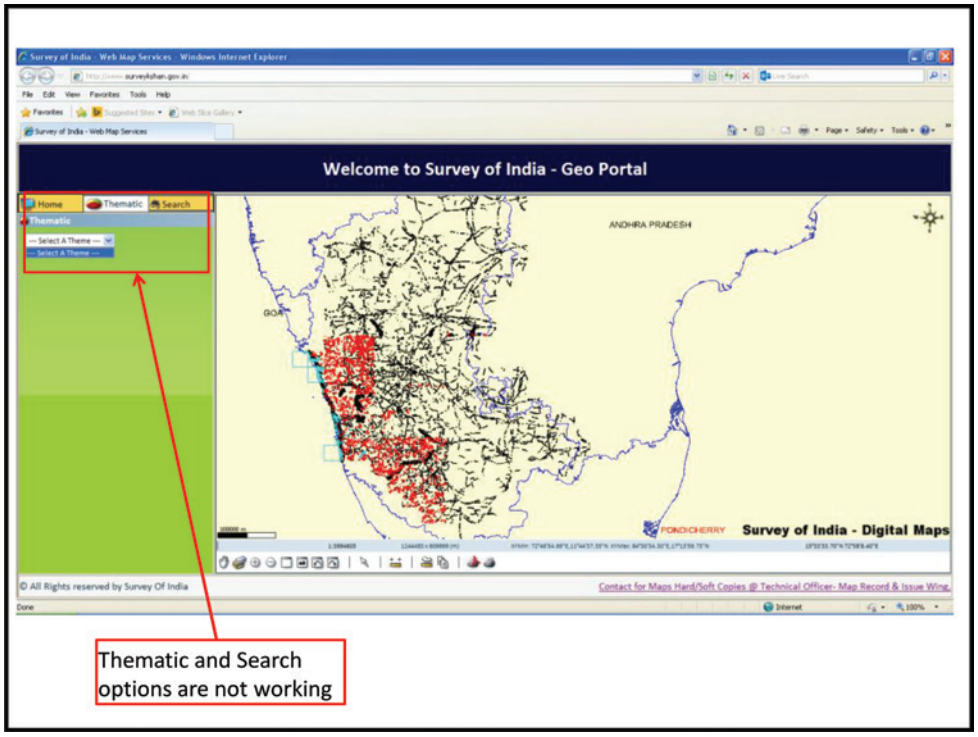


FIGURE-8.4- Non-functioning of the Thematic and Search tools

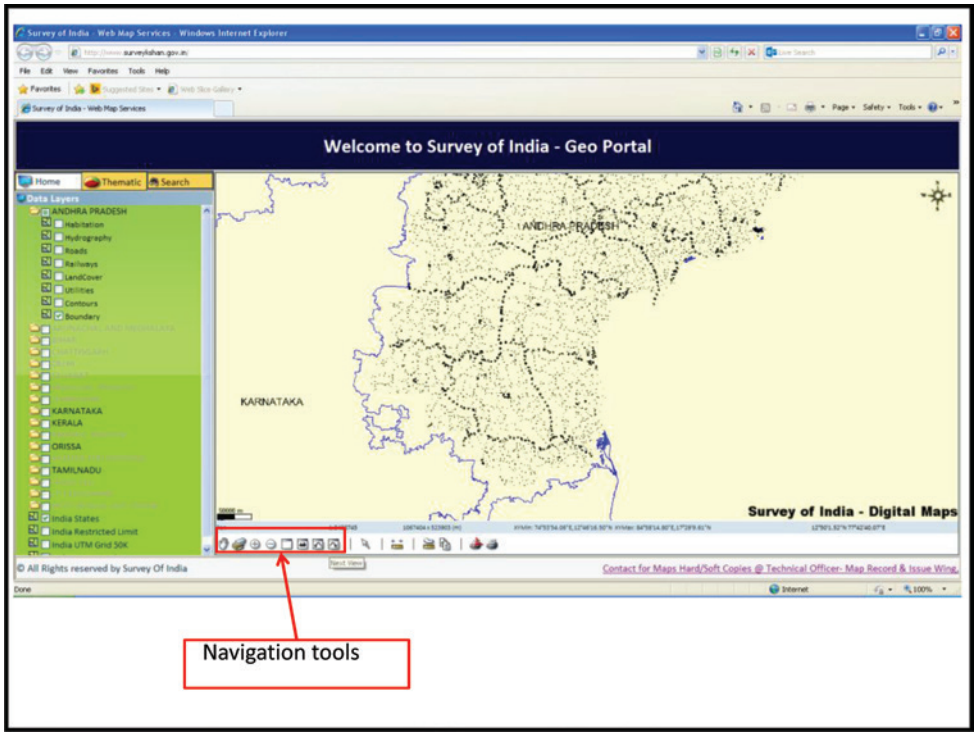


FIGURE-8.5- Navigation tool

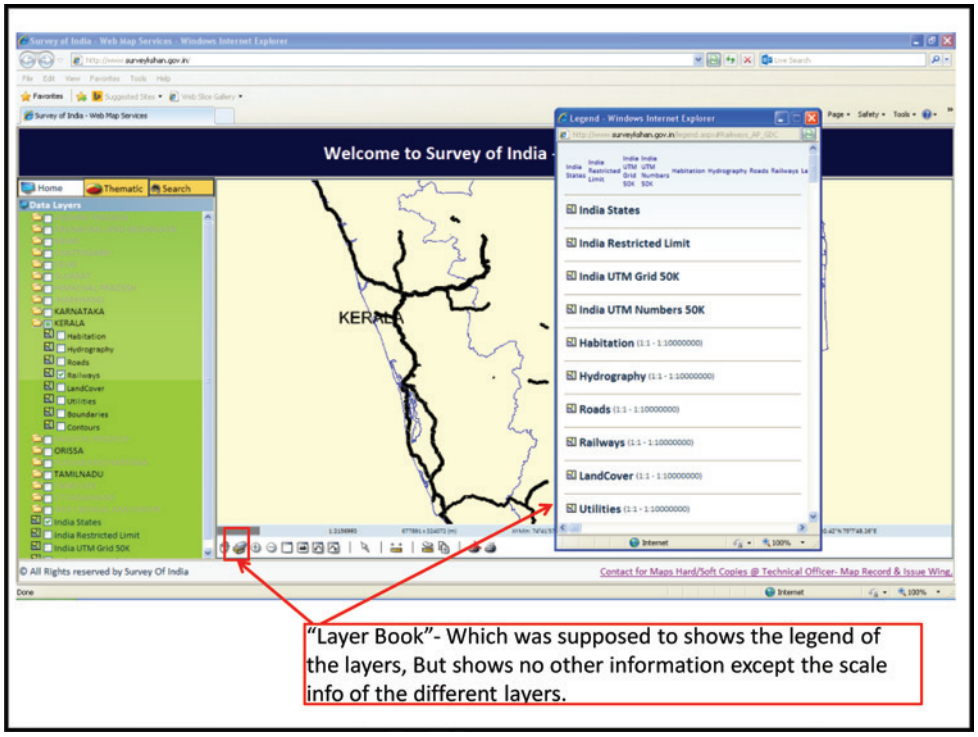


FIGURE-8.6- Limited functionality of Layer book tool

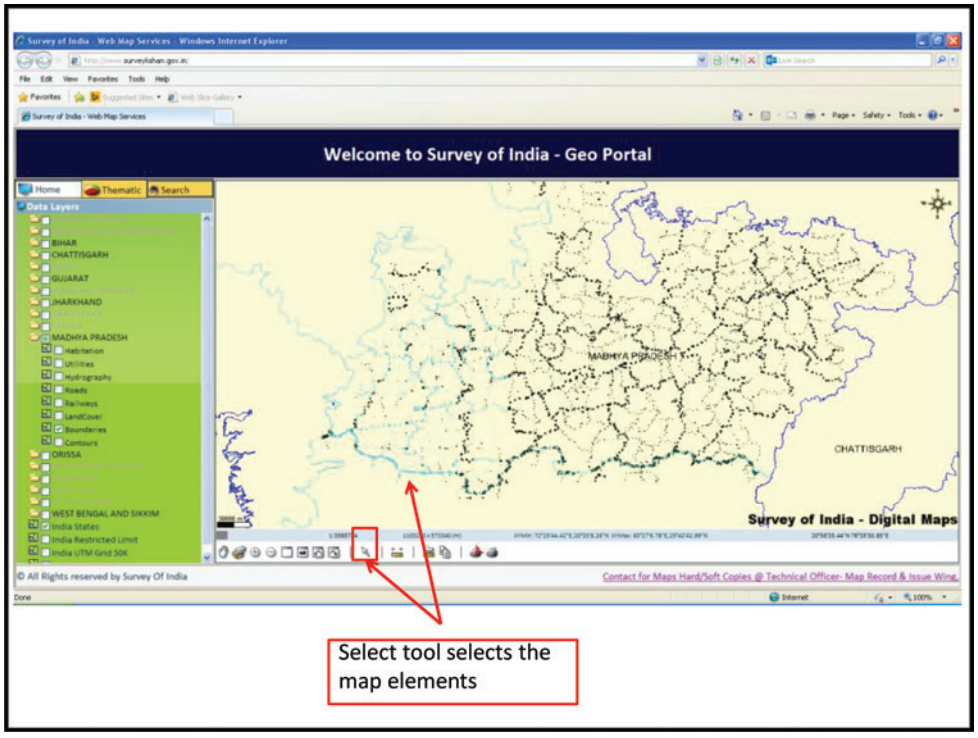


FIGURE-8.7- Select tool

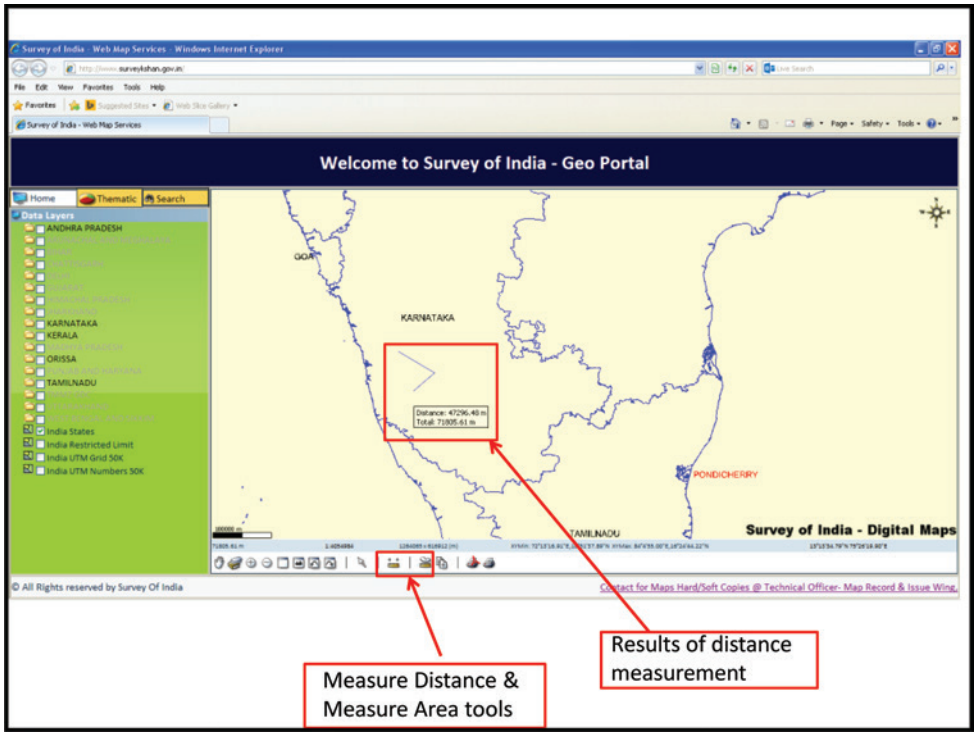


FIGURE-8.8- Measure tool

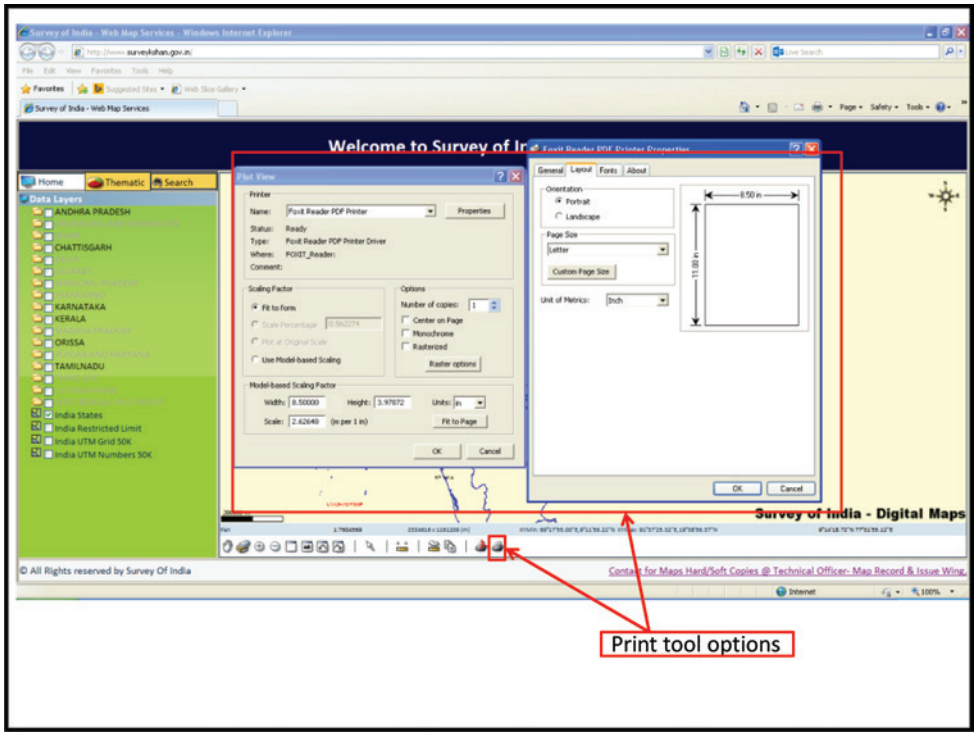


FIGURE-8.9- Options available in print tool

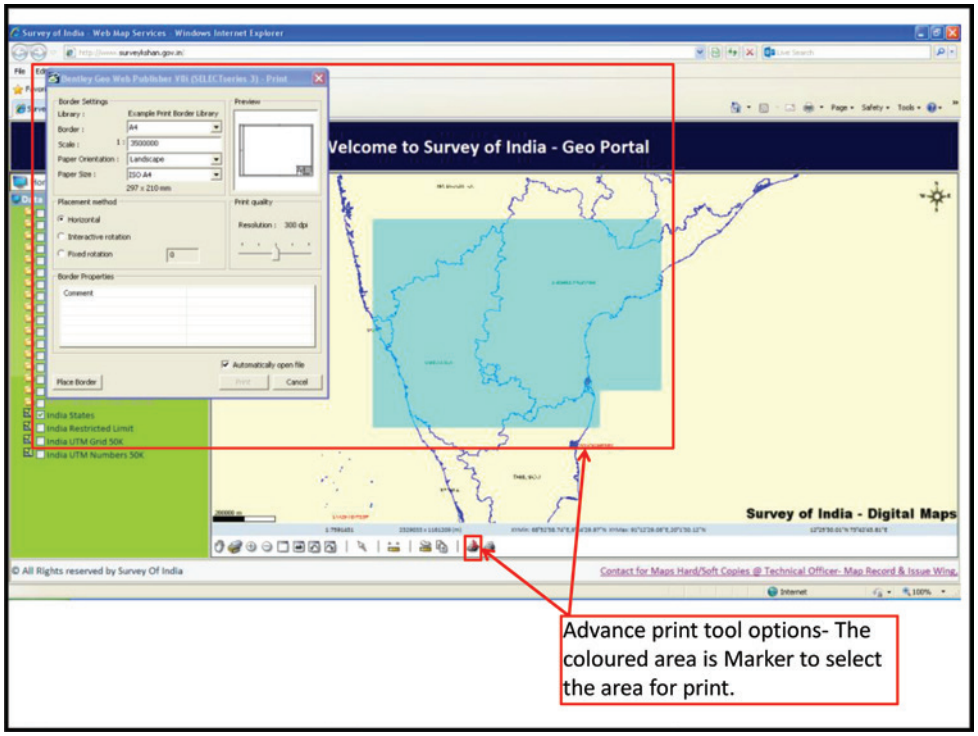


FIGURE-8.10- Advance printing tool options

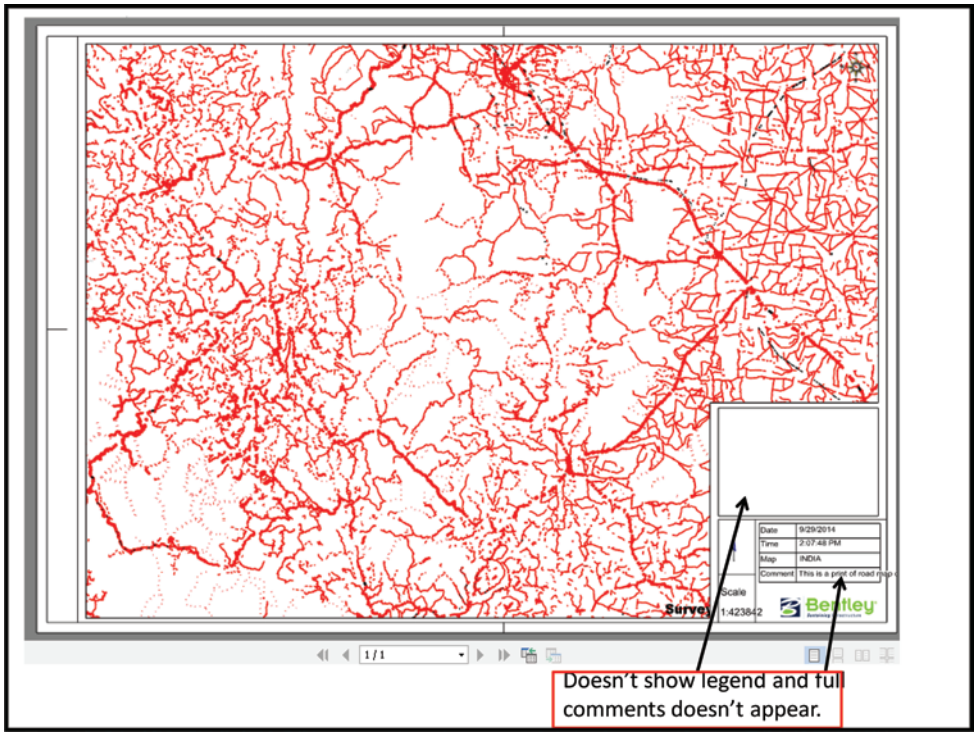


FIGURE-8.11- Pdf which doesn't contain legend and full display of comments

9. NICMAPS Portal of NIC

9.1. INTRODUCTION

109. NICMAPS is a "portal" of National Information Centre (NIC) through which it provides "visual display" of MIS data from NIC and Spatial data from Survey of India (SOI).

110. NICMAPS has managed to display the IRS images and thematic maps – providing "window" into the spatial data holding Survey of India (SOI) and non-spatial data holding of National Information Centre (NIC). NIC has managed to provide good content, quality and services through portal to GIS community.

111. NICMAPS is that provides a "window" to Indian spatial data along with satellite images. However it can be compared with few other map services provider like Google in terms of location findings and routes between locations. BUS NIC portal is pure GIS web portal service which provides MIS dataset with respect to spatial data (Admin Boundaries). In other words, the services provided by NIC portal are much different than services provided by other map viewer.

112. This report includes an independent test and evaluation – technical report of design and functional characteristics of NIC – The URL resides at following address http://nicpmaps.rsgis.nic.in of mid of October 2014.

112.1 This is not a critic but an evaluation and observations of the portal. The analysis of the capabilities of NICMAPS, the study has been taking up by NIAS Research team to give insight into the standing-level of GIS Portal and help us to get a more standards and high-quality progression for National GIS.

112.2 The efforts of NICMAPS are noticeable since NIC have administered spatial data in "portal" format.

112.3 The concept of evaluating the "bar" that needs to be set for excellence and quality that matches any other efforts in the world, nay, not just matched but surpasses it to make a high-quality GIS Portal of India. In doing so, we hope to learn and make best technical knowledge available for us for the future.

9.2. NICMAP DATA

113. NICMAPS has the following project dataset:

113.1 Administrative Maps: (5 Layers) state_hq2011 (Point), District_hq2011 (Point), subdt_hq2011 (Point), state2011 (Polygon), district2011 (Polygon), subdt_bnd_2011.

113.2 Villages: (3 Layers) Villages (Polygon), Census Villages (Point), Habitations (Point)

113.3 Administrative Places: (8 Layers) National Capital (Point), State Capitals (Point), District Headquarters (Point), Sub District Headquarters (Point), Census Towns (Point), Panchayat Headquarters (Point), Census Villages (Point), Habitations (Point)

113.4 Administrative Boundaries: (4 Layers) State Boundaries (Polygon), District Boundaries (Polygon), Sub-District Boundaries (Polygon), Block Boundaries (Polygon)

113.5 Bhuvan: Satellite Imagery

113.6 NIC: Terrain, Satellite Imagery [AWiFS (56M), LISS (23.5), PAN (5.8M)], 3 Base Maps (Scale Range 1:40 to 1:40000)

113.7 ESRI(External map has incorporated):TopoMap, Hybrid (World Boundaries & Places), Hybrid (World Transportation), Hybrid (World Imagery 15cm-60cm), StreetMaps, Aerial (World Imagery 15cm-60cm)

114. In **Table-9.1** a detailed assessment of NICMAPS has been provided. The map and images data in NICMAPS has the following characteristics:

114.1 NIC (National Information Centre) concentrates on maintaining non-spatial data for entire nation and organization has collected spatial data (Admin Boundaries) from Survey of India (SOI) to build NICMAPS.

114.2 The spatial boundaries have been categorized in three groups. Data resides at each category cannot be collapse or it does not have option to switch on/off individually. The group of layers has been integrated in single category where shape of layer has no bar. Since all layers appears at time since they resides in single category, NICMAPS has set the scale for those layer to avoid being clumsy. The visibility of data begins at 1:36,978,595 till 1:4,514.

114.3 The layers (Spatial Data) available the portal has been updated as per OG standards. Portal claims around 1000 layers have been updated as per OGC standards.

114.4 NICMAPS has incorporated three satellite images with different resolutions such AWiFS (56m), LISS (23.5 M) & PAN (5.80M) to produce good resolution base map. These base maps are cashed at scale from 1:40 Million to 1:40000.

114.5 NICMAPS has also integrated ready to use base maps from BHUVAN & ESRI to analyze their spatial data.

114.6 Data available on the portal seems latest but it's unable to find the last updated date & year on the portal.

114.7 There are no live updates, warnings & crowd sourcing information available on the portal.

114.8 Downloading data is partially possible. The spatial layers cannot be downloaded but the attribute (tabular format) data can. Attribute data can be download in text or CSV format.

115. From technical perspective, NICMAPS is quite close to GIS portal with voluminous spatial inventories. From technical stand-point, NICMAPS pleases user for making available spatial data and helps them in their decision making.

9.3. NICMAPS SERVICES/APPLICATIONS

116. In **Table-9.1** a detailed assessment of NICMAPS Portal has been provided. Below is some important observation/example of the portal.

116.1 NICMAPS does not support any application on the portal but it does provide services which are useful to user.

116.2 NICMAPS might not be offering data downloading & mathematical/logical queries but they have little advance services like Locators, Swipe & Spotlight, Elevation profile and so on. Locator is certainly one of innovative service NICMAPS has introduces which work as a GIS search engine and can find location not only by names but also by pin code of location. It has also integrated ESRI's locator search which helps to find out single line address. Swipe & Spotlight is another good service portal has included which separates spatial layers from base map temporarily with user area of interest. Elevation profile gives elevation information about desired location. It's a quick tool which is very user friendly and gives results of Height/Depth (Meter) Vs. Distance (Kilometer).

116.3 Portal does carry strong GIS characteristics with services like, Identity, Search, fixing AOI as per user's perspective.

116.4 Portal does not allow making bookmarks but it does have ready to use bookmarks which can directly zooms to location when it's been clicked.

116.5 Legend doesn't appear with layers in TOC but portal still offers separate list of layers with relevant legends.

116.6 Portal offers couple of option to take print. One is traditional option which allow user to define the title and will contain legends of layers and so on. On other hand portal offers

to take simple snapshot of portal by allowing user simply drawing on the portal and it can be saved as .jpg.

117. NICMAPS does offer any application relevant to any theme or subject.

118. NICMAPS does carry GIS web portals characteristics and helps user to do analysis on their required parameter with available data. Portal has made available various innovative services to improve analysis abilities. Portal has successfully manage provide large number MIS data to user to do their analysis.

119. NICMAPS has designed portal completely from user point of view.

119.1 User needs to create an account to log in on portal. The look of portal is good and easy to understand for user. The services available on the portal are very user friendly though some of them are very innovative but still easy to understand and to operate. Spatial data may not a large in quantity but non spatial data is huge and that increases analytical power of portal.

119.2 The portal is quite stable and data available on it is quite robust. Portal has only three categories of layer but layers have categorized very well. They are easy to view and they have set scales.

119.3 The panning of map is very smooth, map or base map does not jerk hard. The color used for designing is simple &eye pleasing. Base map can be change with single click and also each base map explains on the appearing on the tab which also make easy for user.

119.4 The text available on portal is very simple but still quite differentiable with respect to admin hierarchy. The labels aren't part of layers, they are maintain separately as point data or at time appears as annotations.

120. Performance

120.1 The performance of portal is definitely appreciable. The design, data robust, services, architecture of portal and all other factor make portal quite stable product. None of the activities got stuck, crashed or failed to work during using it. Portal works very stable and robust.

9.4. SUMMARY

121. In summary, it is clear from above analysis that:

121.1 NICMAPS sets benchmark as GIS portal with good combination of base map, satellite images spatial data with relevant attributes.

121.2 The technical design and architecture of portal is well done which make portal quite stable, robust & user friendly.

TABLE –9.1: NICMAPS: FUNCTIONAL, DESIGN AND USER EVALUATION

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
A]	**CONTENT**				
1	Spatial	**Administrative Maps:** (5 Layers) state_hq2011 (Point), District_hq2011 (Point), subdt_hq2011 (Point), state2011 (Polygon), district2011 (Polygon), subdt_bnd_2011 **Villages:** (3 Layers) Villages (Polygon), Census Villages (Point), Habitations (Point) **Administrative Places:** (8 Layers) National Capital (Point), State Capitals (Point), District Hqrs (Point), Sub District Hqrs (Point), Census Towns (Point), Panchayat Hqrs (Point), Census Villages (Point), Habitations (Point) **Administrative Boundaries:** (4 Layers) State Boundaries (Polygon), District Boundaries (Polygon), Sub-District Boundaries (Polygon), Block Boundaries (Polygon) **ESRI:** TopoMap, Hybrid (World Boundaries & Places), Hybrid (World Transportation), Hybrid (World Imagery 15cm-60cm), StreetMaps, Aerial (World Imagery 15cm-60cm)	Bunch of layers resides in designated category. Layer's visibility is scale dependency. Individual layer cannon be switch on/ off. Various Base Maps has integrated on the portal. Similarly it can be seen in 'Map Contents' box. Transportation layer is part of Base Map but it does appear in any layer's category.	Allowing individual layer to operate or to perform analysis would have been advantage.	FIGURE –9.1, 9.2, 9.3, 9.4, 9.5,9.6

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
		Bhuvan: Satellite Imagery **NIC:** Terrain, Satellite Imagery [AWiFS (56M), LISS (23.5), PAN (5.8M)], 3 Base Maps (Scale Range 1:40 to 1:40000) India: Administrative Boundaries			
2	Non-Spatial	Census Data (2001)			
3	User-ingest	NA			
4	Others	NA			
B]	**VISUALISATION**				

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
5	Map Viewer	Map Viewer has basic map navigation tools like Zoom Slider, Scale Bar, and Map Scale. Map always appears in full screen. Portal opens with Indian boundary with state boundaries and union territory and the capital of each state. Active tool can be recognized by seeing the underline beneath the tool. Map Viewer contains tools and Base Maps. Base Maps can be selected by clicking the tabs. External Base Maps has also integrated with NIC portal such ESRI, Bhuvan. Appearance of Map Viewer is simple and elegant. It does not appear complex. Help menu, Change Password & Logout option appears at the right hand side top corner. Portal's tools and services are well symbolised.	The application is very smooth and robust. It is very user friendly. It is easy to change/switch base map as per user convenience There is overview window but does not appear anything in it.	Map viewer should have mouse/ pointer co-ordinates location.	FIGURE –9.7

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
6	Table of Content	Clicking 'Map Content' Table of Content' appears. Layers are well integrated in table of content in defined category. Categories can be collapse. Also Base Maps has integrated in Table of Content. Table of Content has option to view the legend of respective layer. Transparent option is available along with each layer. Small tool appears with table of content which allow the map content box minimize/maximize and hide.	Map content is user friendly. Name appears in box is not well defined but understandable.	Individual layer should be operable. Option should have given to individual layer to switch on/off to single layer.	FIGURE –9.8
7	Navigation Tool	There are basic but useful navigation tools appears on the portal such as full extent, moving map right, left, up, down, last/previous extent, zoom slider, pan and zoom in/out. Panning is very smooth and it does not jerk.	These tools integral part of map viewing. They are very easy to understand and to operate.	Zoom slider should have more scales.	FIGURE –9.9
C]	**SERVICES**				
8	Identify	This tool helps user to identify the layer of map. The results of identify tool appears in same box. Points identify entire layers of the map and result can be seen in the box.	This tool is user friendly. The integration of 'zoom to' with every result helps user to access his area of interest. It has option to clear the point appearing on the map.		FIGURE –9.10

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
		Through result window, identified location can be zoomed in. Separate identify box appears along with point			
9	Search	Any location can be searched by name. The admin layers need to define before to enter the name of the location. Location of map can be also searched by various shapes which user can draw.	This is very easy operation. Search box gives two options to searched user desired location. The result of searched location can be seen in same box as searched The result can be exported to excel/ text format.		FIGURE –9.11, 9.12
10	Measure	Measure & Draw tools appear in same box. Line and predefined polygon with customised polygon can be used to measure the length/area. Unit can be measure in Meter kilometer, feet & mile Point, line & polygon can be drawn. Color of shape can be defined as well as width of the boundary. Text can be added and font and the style of text can be defined.	This is user friendly tool. It gives user to analyse their own measuring query.		FIGURE –9.13 & 9.14
11	AOI	AOI is gives adoption to user to define their area of interest. AOI can be defined on the basis of district and block. In map viewer, only area of interest map will appear. This makes map viewer window lighter and little fast panning.	This is definitely good tool portal has provide. This gives user to work on their desired location. The effect of AOI disappears as the window is closed.		FIGURE –9.15

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
12	Locator	Portal offers to locate user desired location three ways. User can locate their location by simply entering the name of the location. Also it allows locating the place by entering pin code. Portal has integrated ESRI geolocator where user can single line address. Map automatically zoomed to defined point.	Latitude & Longitude can be seen for each location. Also location can be searched by adding latitude & longitude of place.		FIGURE –9.16
13	Elevation	This tool gives information of particular location's elevation information. There are three ways lines can be drawn on the map in order to see the elevation. Separate elevation box appears with graphical interpretation of elevation.	This is very easy and simple operation to obtain the information of elevation of land. This operation is possible with minimum clicks.		FIGURE –9.17
14	Snapshot	This operation helps user to save map in on their local system. Tool gives option to choose area of interest with square box. Map can be saved in JPEG and PNG format. Portal has option to zip the file while saving it.	This is most common option would like to have any GIS user. Portal has simplified the option for user.		FIGURE –9.18

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
15	Print	Layers appearing in the map can print directly with print tool. User can define the title of the print. Map can be saved in PDF and can be print later or can be print directly if the printer is connected to the system	This is user friendly tool. User has option to print the map or save as PDF format with them with easy option.		FIGURE –9.19
16	Bookmark	There are predefined bookmarks available with portal. The list of cities available in the bookmark, by clicking on the name map zoomed to that location.	This is very basic bookmark and user friendly tool.	Portal should allow user to create their bookmark.	FIGURE –9.20
17	Legend	This gives the symbolic information of layer. Portal has maintained separate box to view the symbology of the layer.	Clicking on the option legend, legend box appear where user can view the symbology of layer	This also appears in Map of Content but it is not clear enough to understand.	FIGURE –9.21
18	Swipe Spotlight	This tool helps to differentiate vector data and topographic images. Layers can be separated by two ways: **Spotlight:** The topographic image beneath vector data can be seen in circular shape. **Swipe:** The tool available on the portal helps to separate the topographic image from vector data by simply holding and dragging the mouse.	This is very useful tool portal has. The radius of spotlight can be customised as required. Swipe and Spotlight can be switched easily with only one click.		FIGURE –9.22, 9.23, 9.24, 9.25
D]	**APPLICATION SECTORS**	NA			
E]	**GENERAL**				

No	Category	Major Observations	User Friendliness/Difficulty	Important Suggestion	Screen Shots
19	Design/Architecture	Design of portal is definitely user friendly and not complex. Services available on portal are easy to understand & operate. They are symbolic in appearance. The Map Viewer Window is full screen by default so it enhances the viewing area. All layers have assigned scale and it appear/disappears as it zoom in/out.	Portal does not have co-ordinates information of mouse location. No progress bar available. Index window available but cannot view anything in it.		
20	Text	The text format designed as admin hierarchy. Most of them are same font and size but with different color	Text format is simple but understandable.		
21	Others	Portal has good Help Menu.	Help Menu can be accessed by simply clicking on it. It explains everything appearing on portal.		
		Basemap: Portal has developed their very own base maps. Portal has integrated external basemap to increase analysis skill of user	Basemap are very easy to access as they are available on single click.		

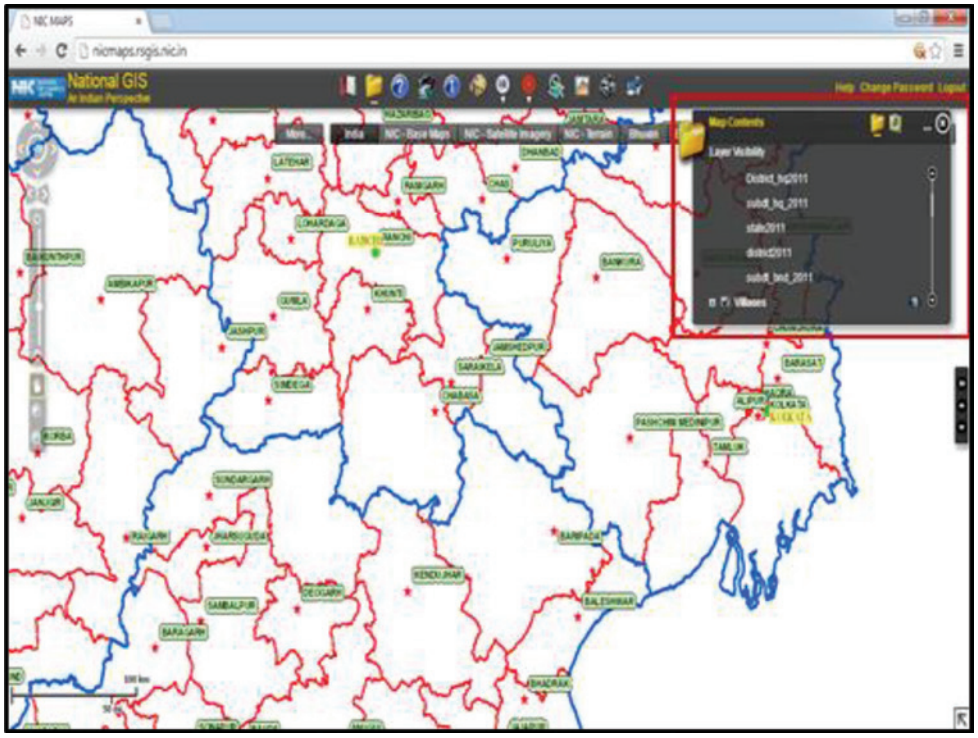


FIGURE-9.1- Administrative Map content list

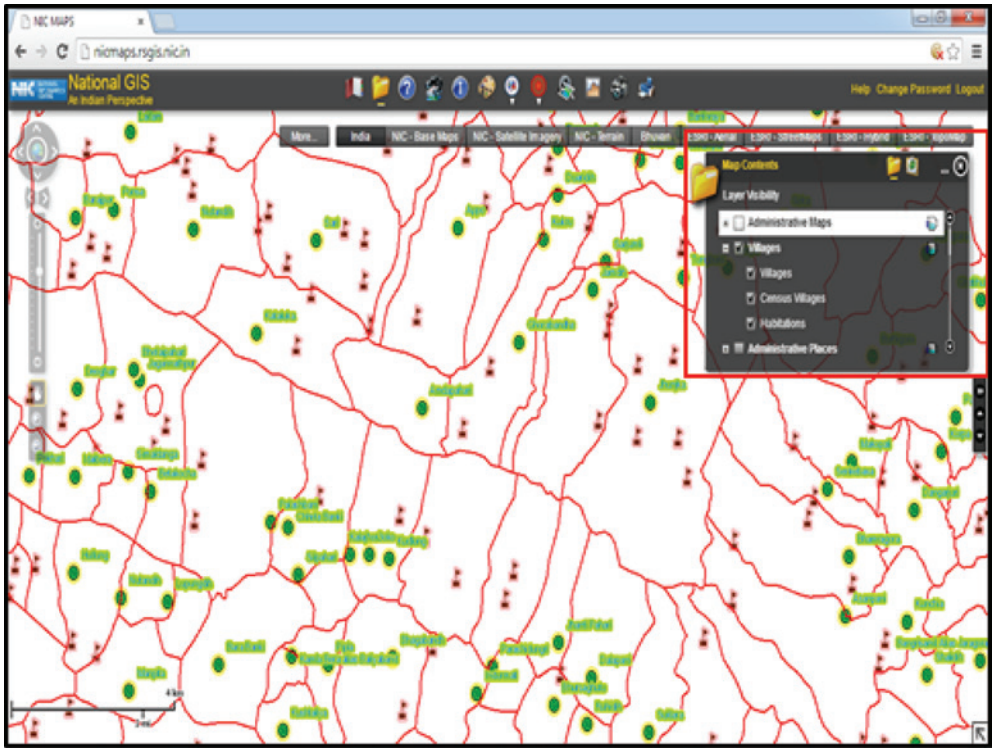


FIGURE-9.2- Administrative Maps

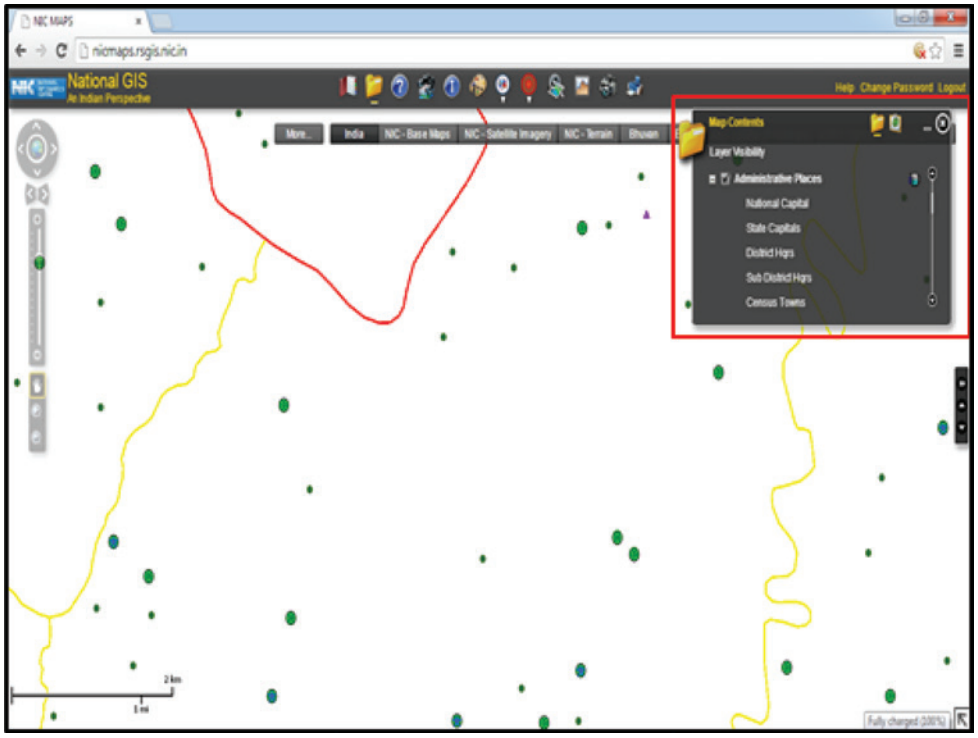


FIGURE-9.3- Administrative Places

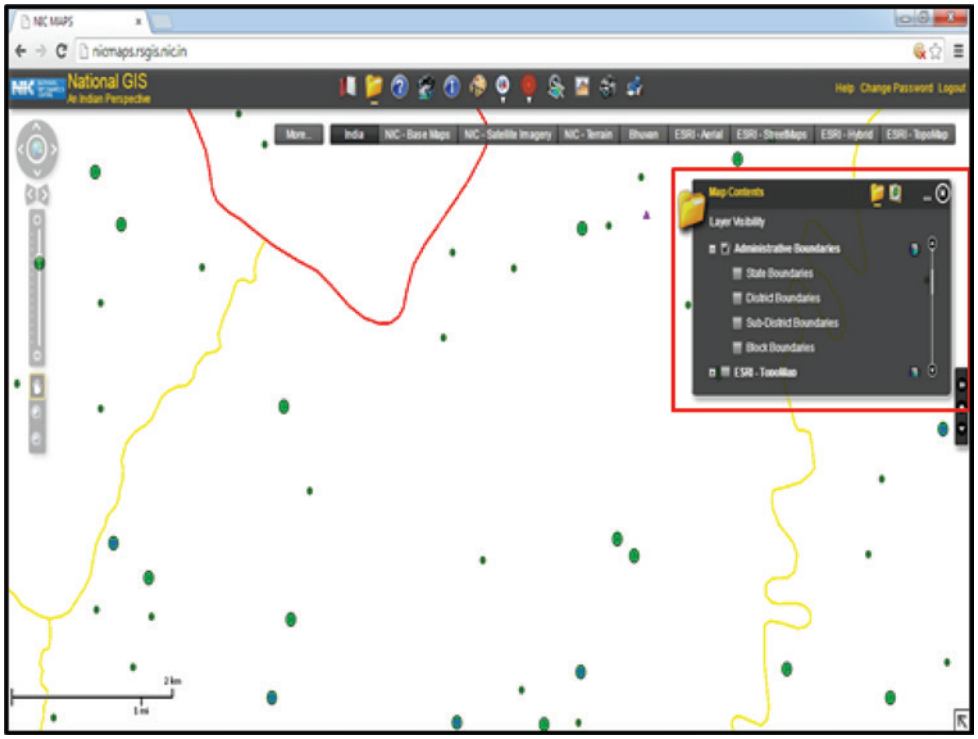


FIGURE-9.4- Administrative Boundaries

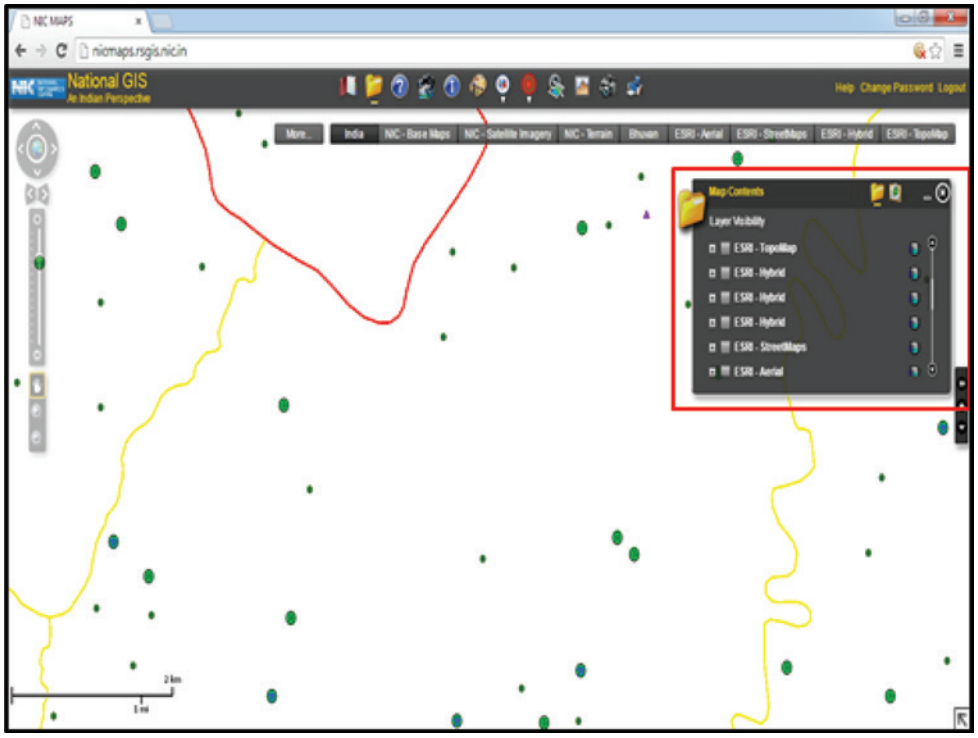


FIGURE-9.5- ESRI: TopoMaps

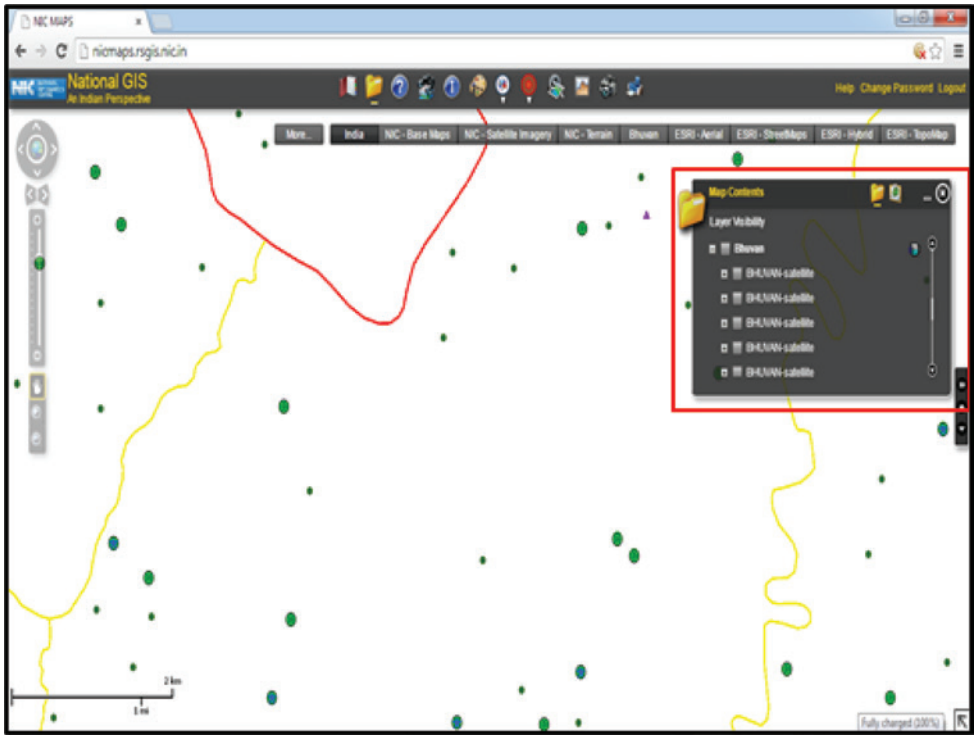


FIGURE-9.6- Bhuvan Satellite Imagery list

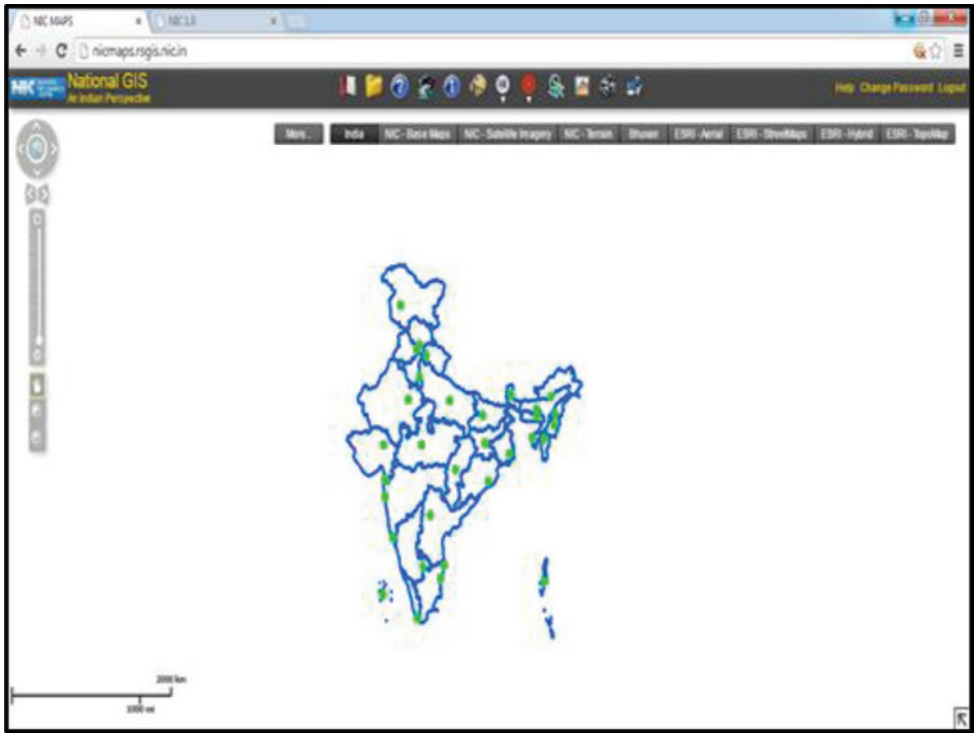


FIGURE-9.7- Map Viewer Window

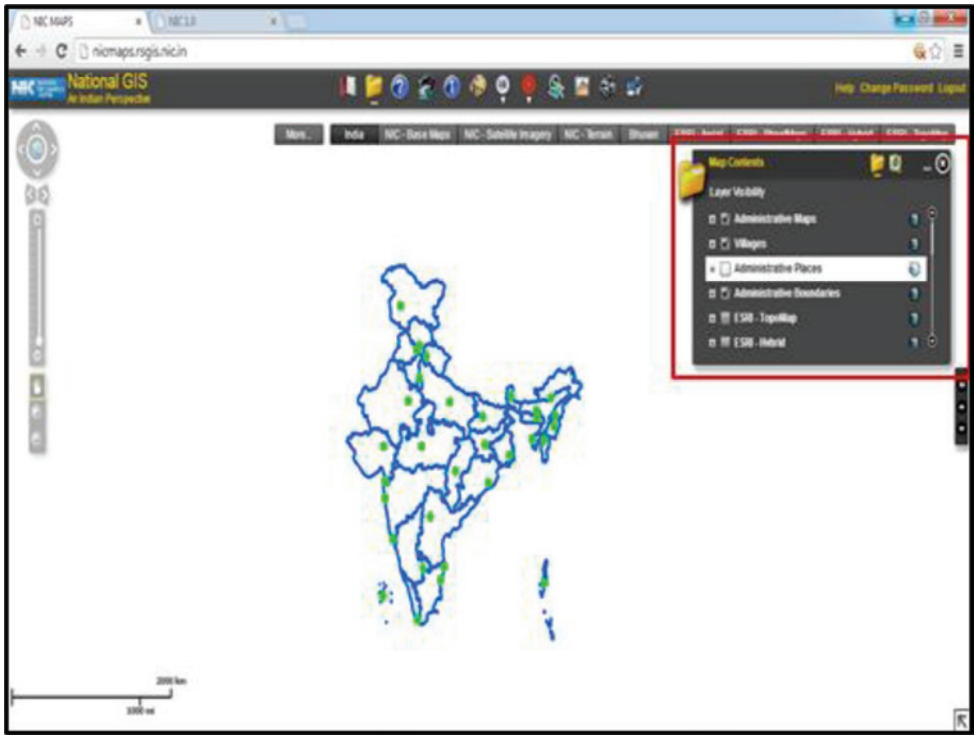


FIGURE-9.8- Table of Content

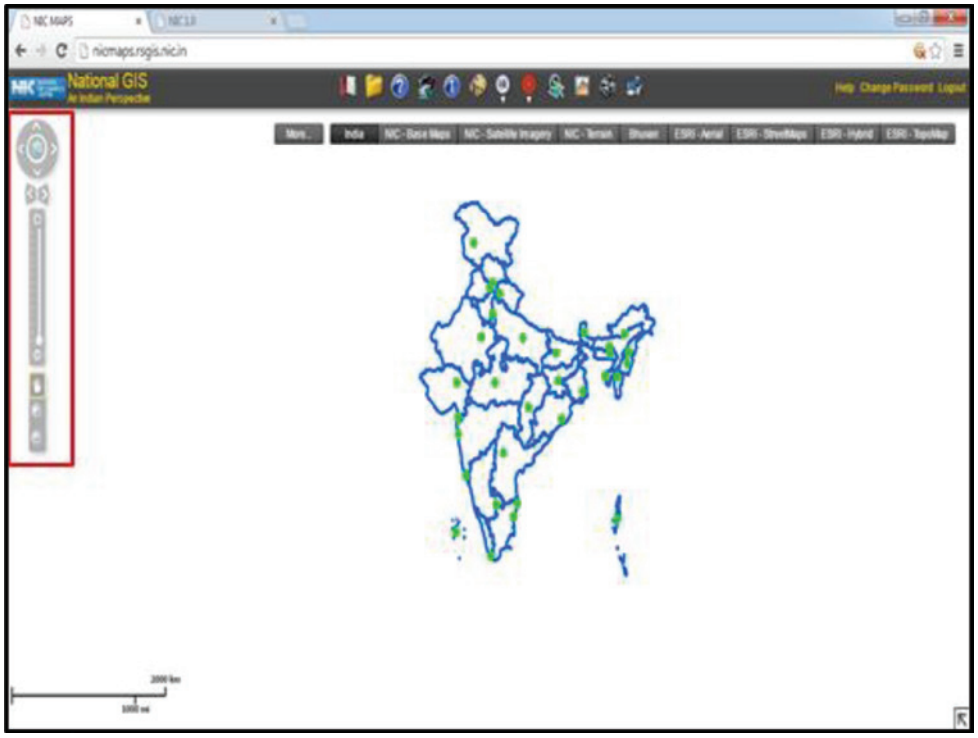


FIGURE-9.9- Navigation Tool

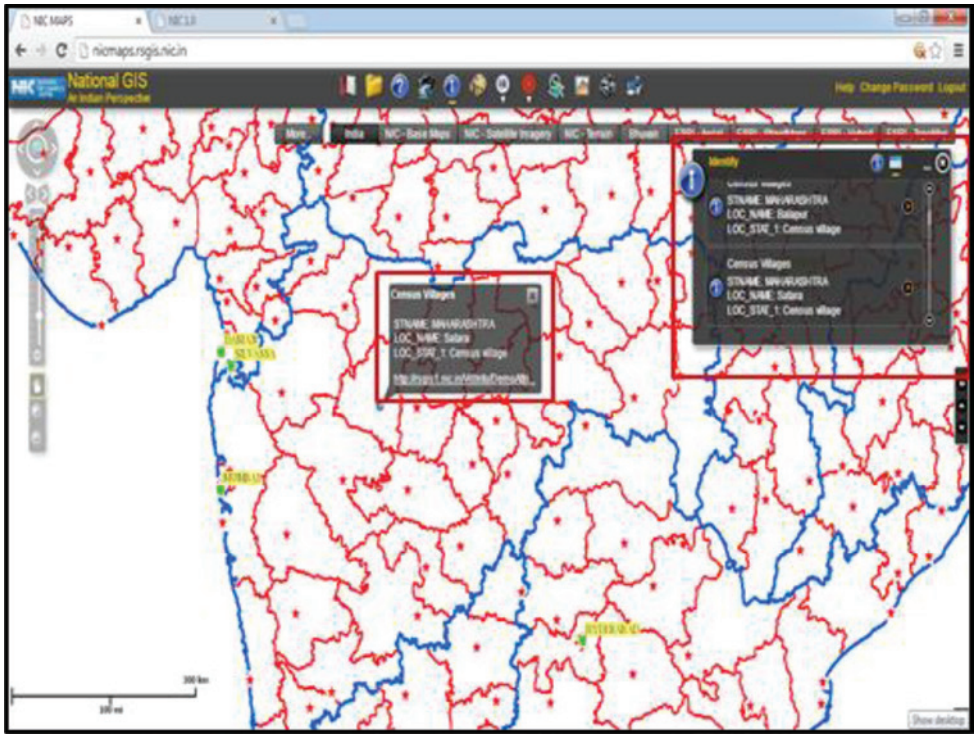


FIGURE-9.10- Identify Tool

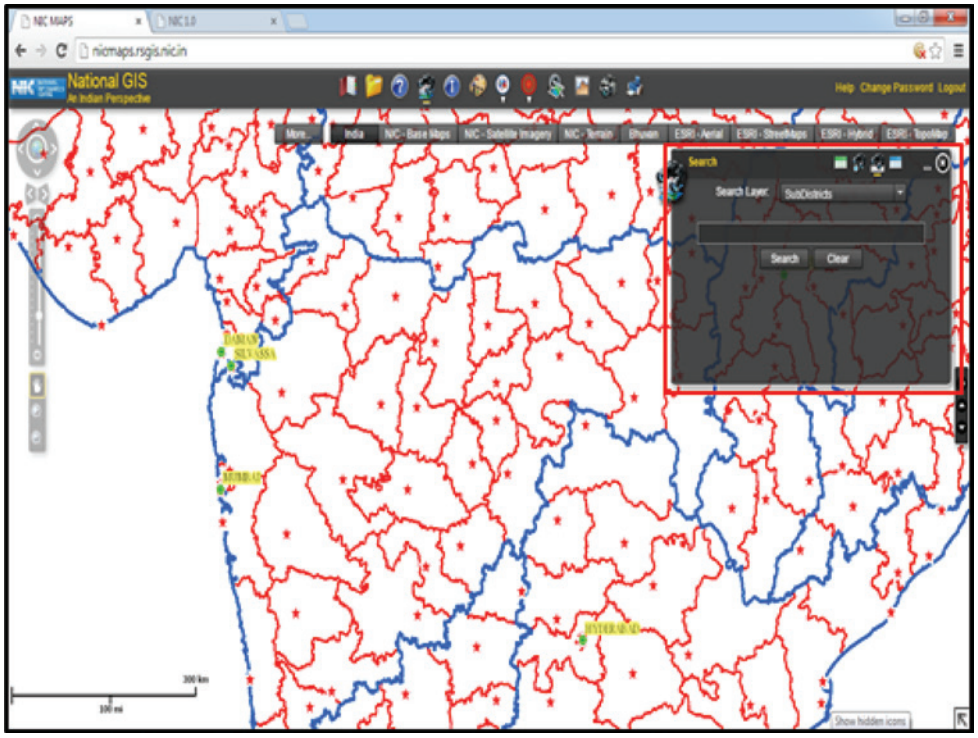


FIGURE-9.11- Search using Name of the Location

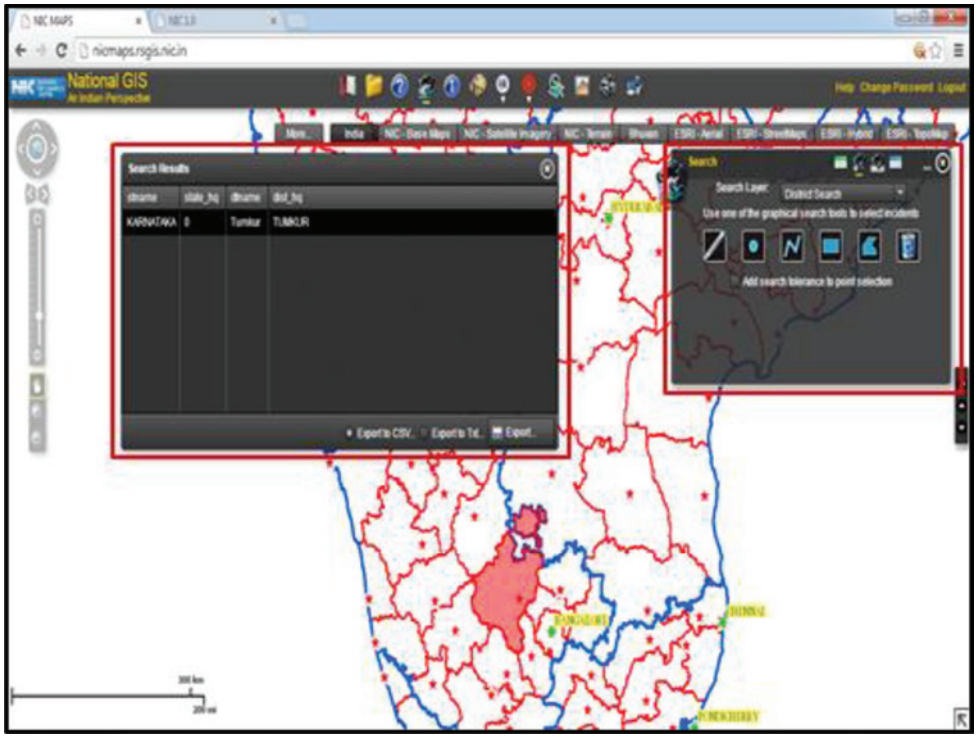


FIGURE-9.12- Search using draw from defined shape

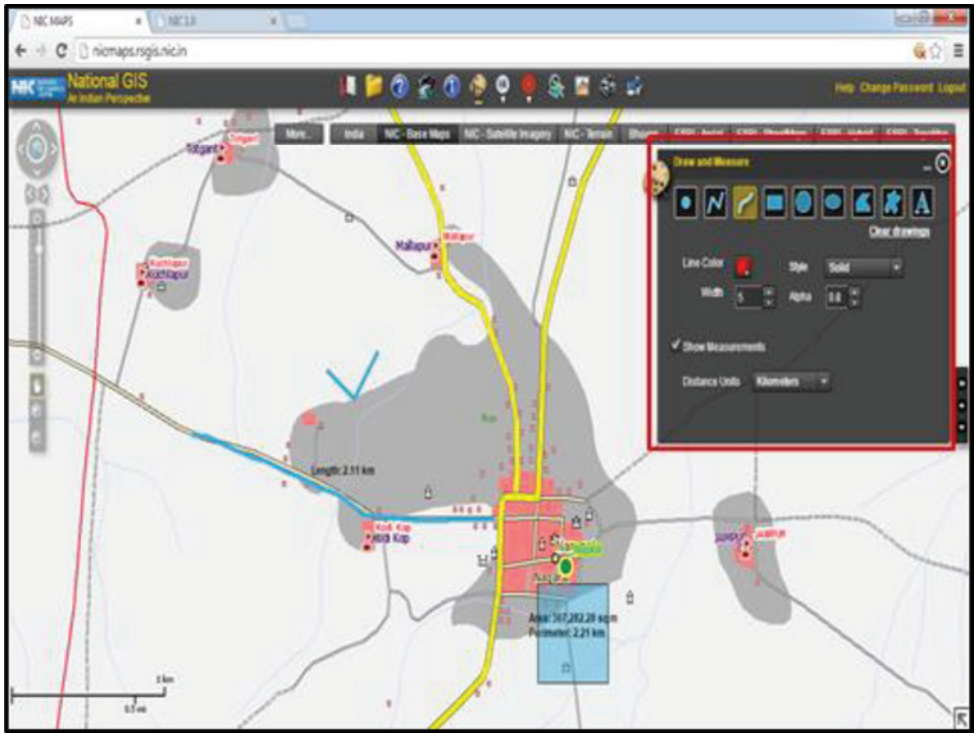


FIGURE-9.13- Measurement tool Using Draw line

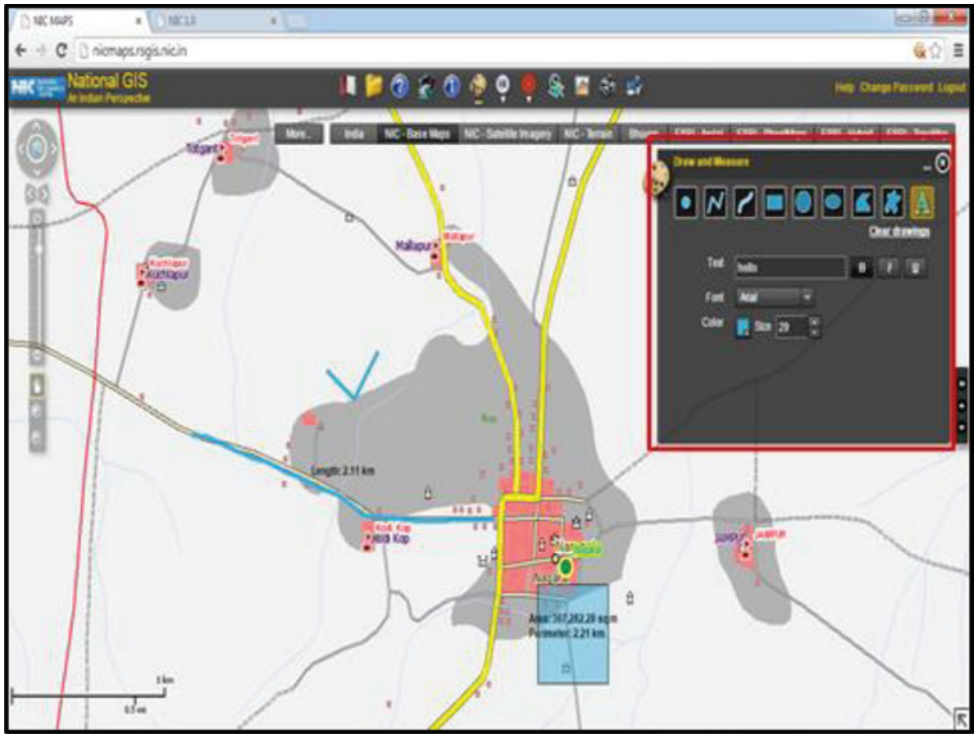


FIGURE-9.14- Measured Area's text, font & Color Can be define

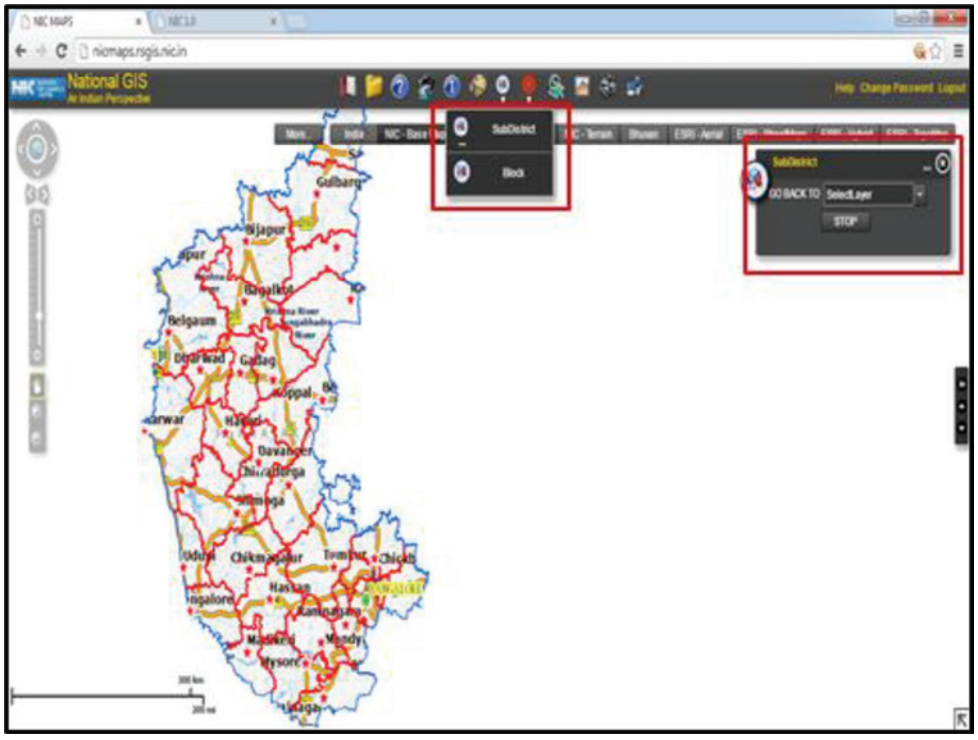


FIGURE-9.15- AOI Tool

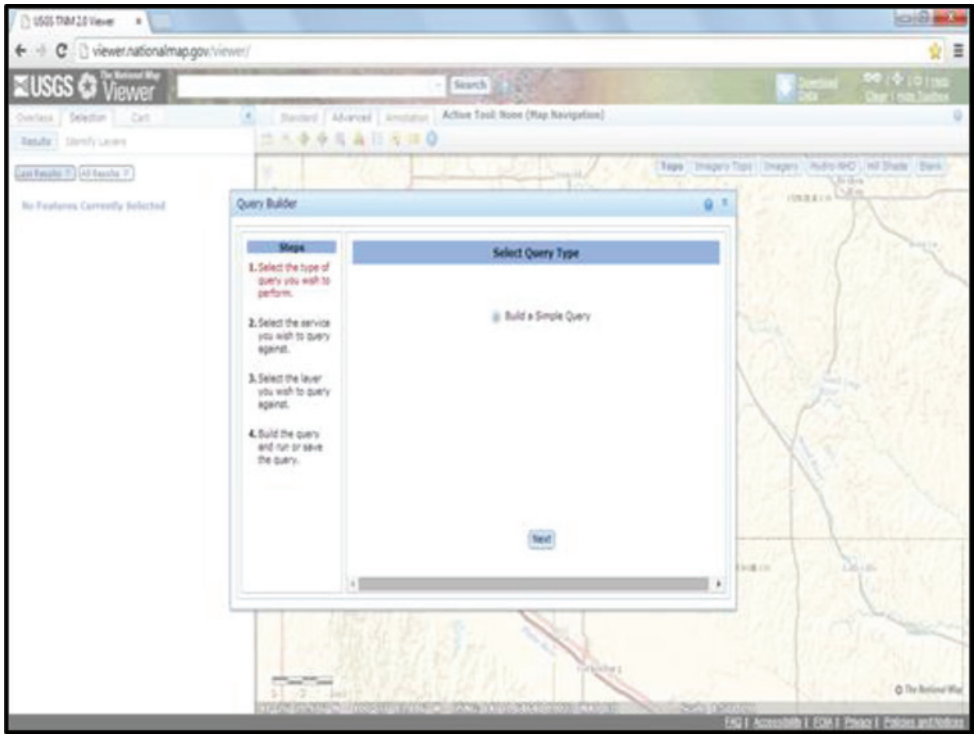


FIGURE-9.16- Locator Tool

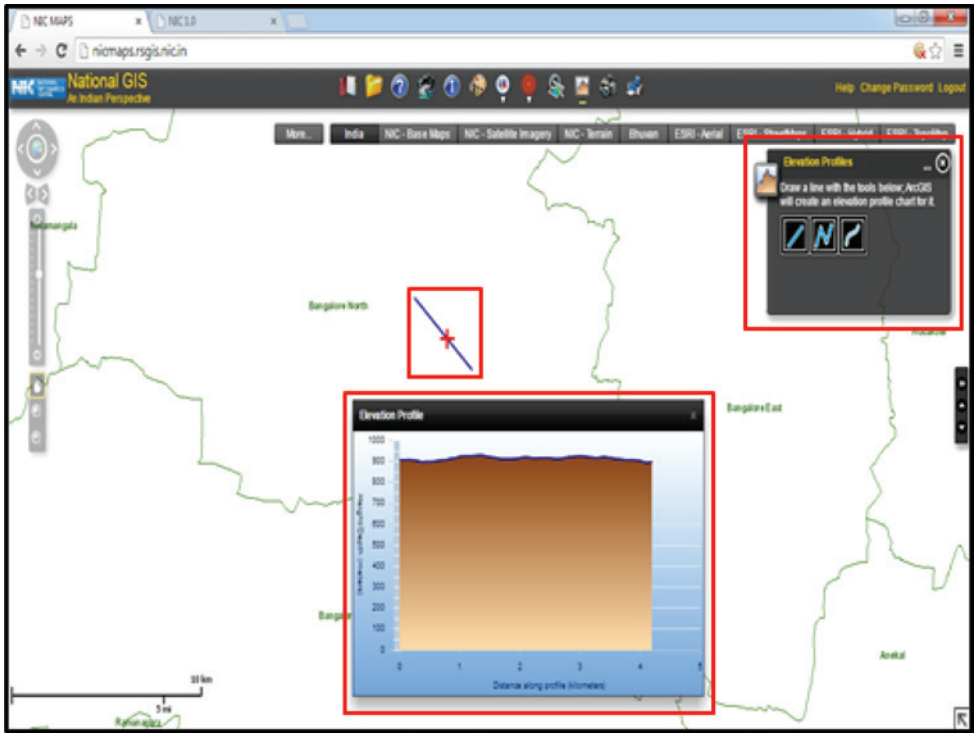


FIGURE-9.17- Elevation Tool

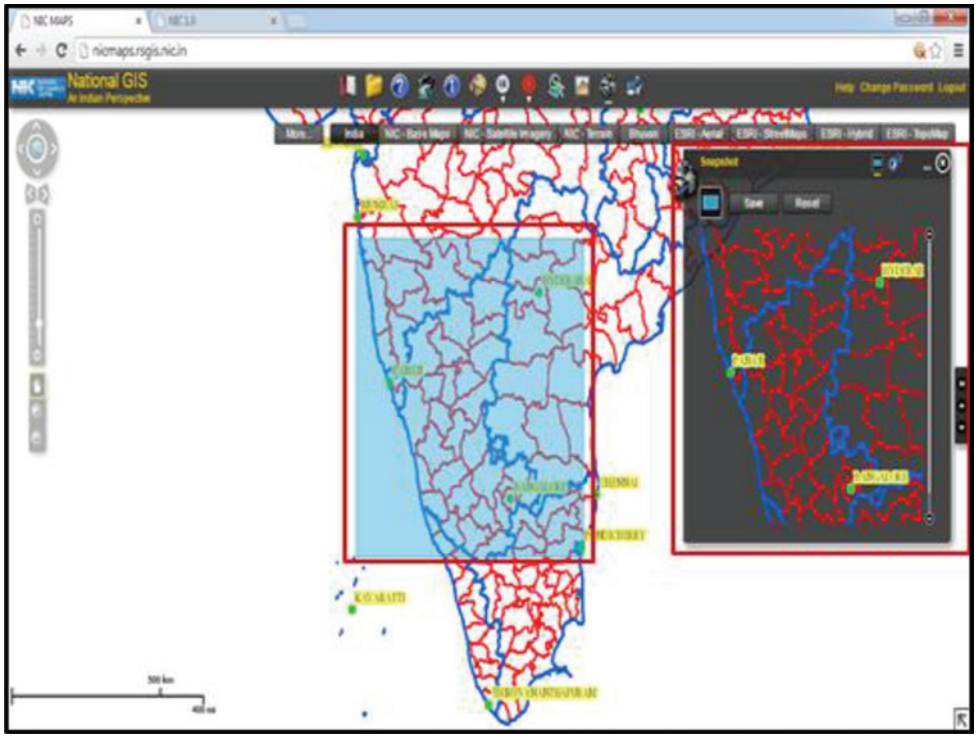


FIGURE-9.18- Snapshot Operation

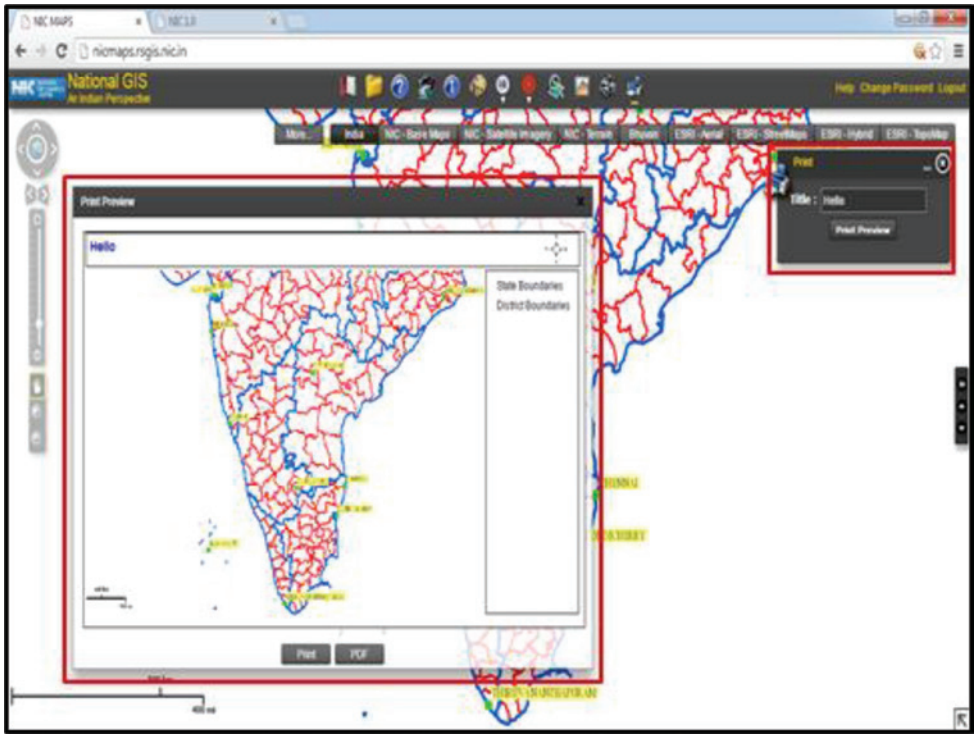


FIGURE-9.19 Print Option

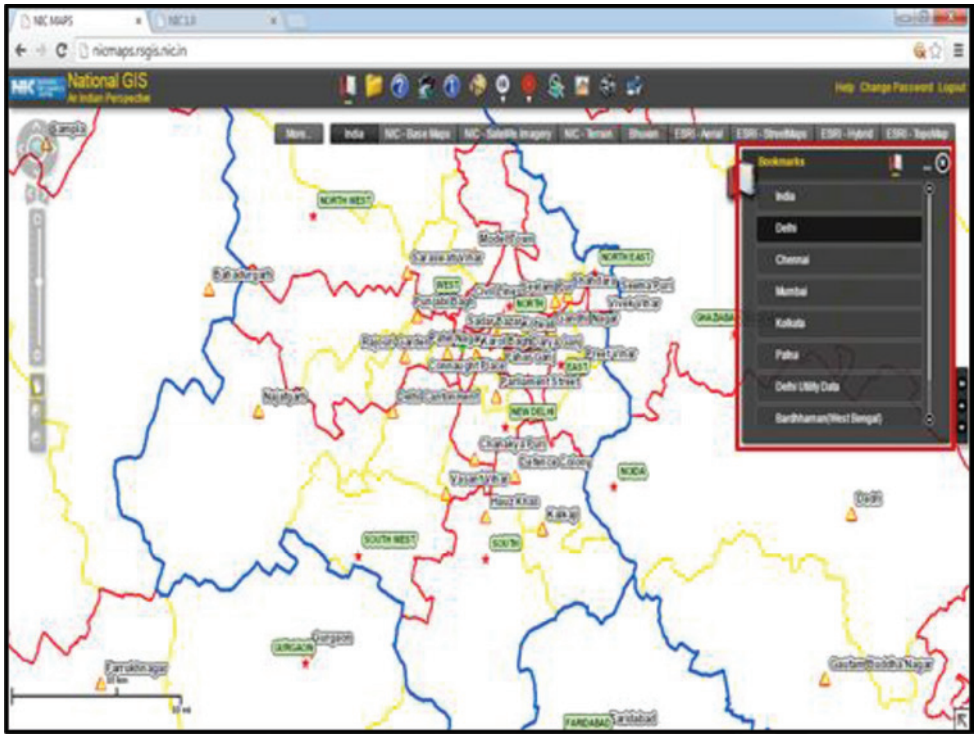


FIGURE-9.20- Bookmark Tool

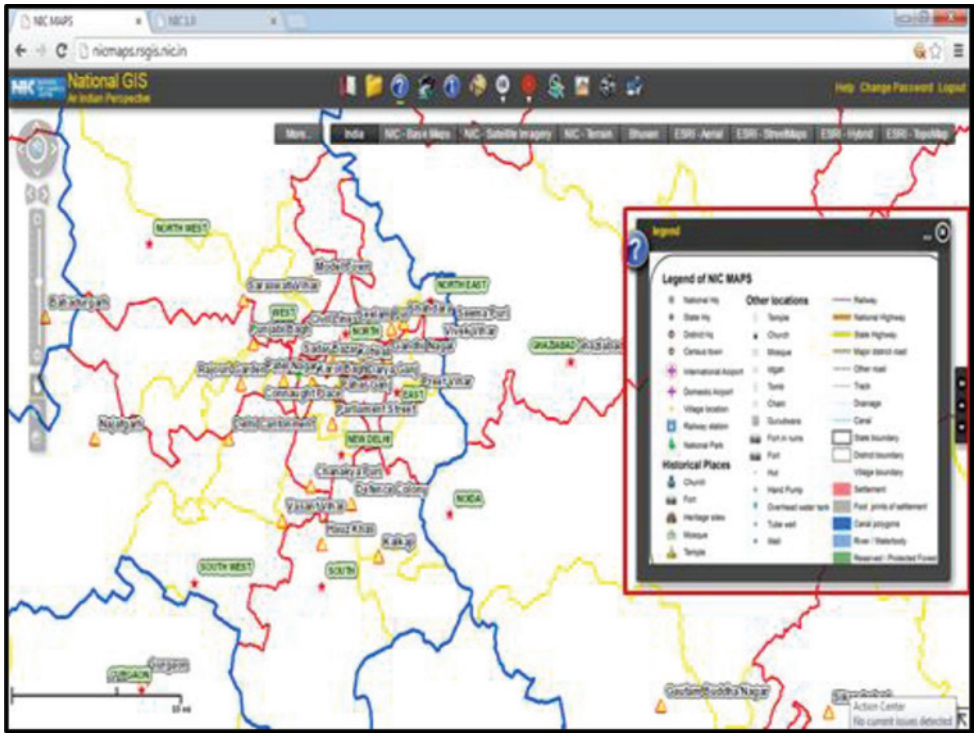


FIGURE-9.21- Legends of Layers

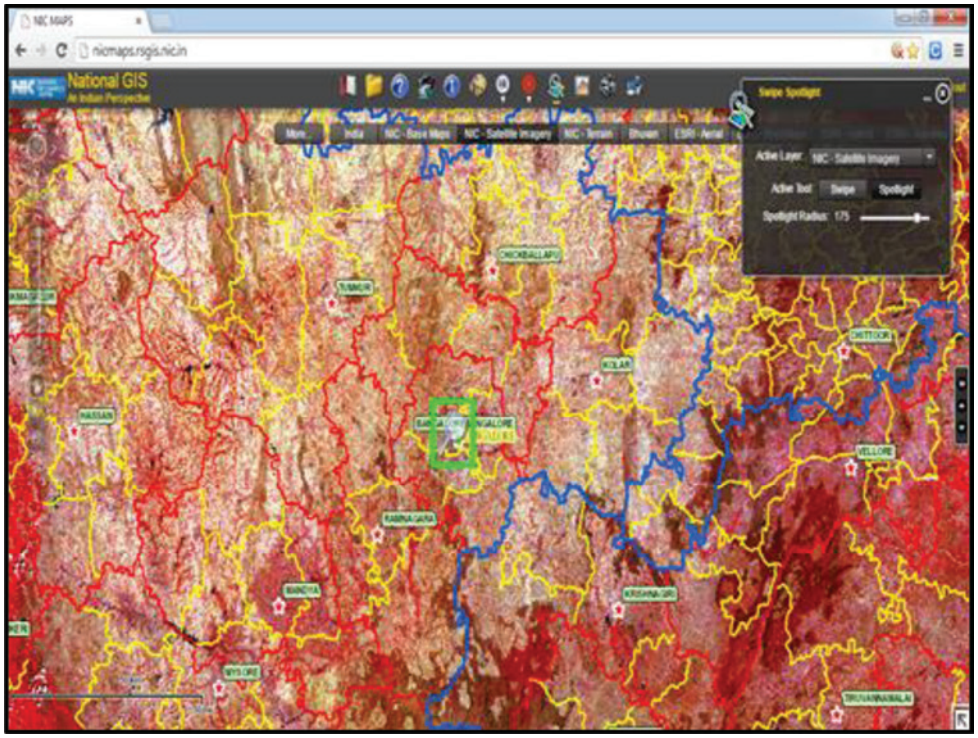


FIGURE-9.22- Vector layer in Swipe Tool

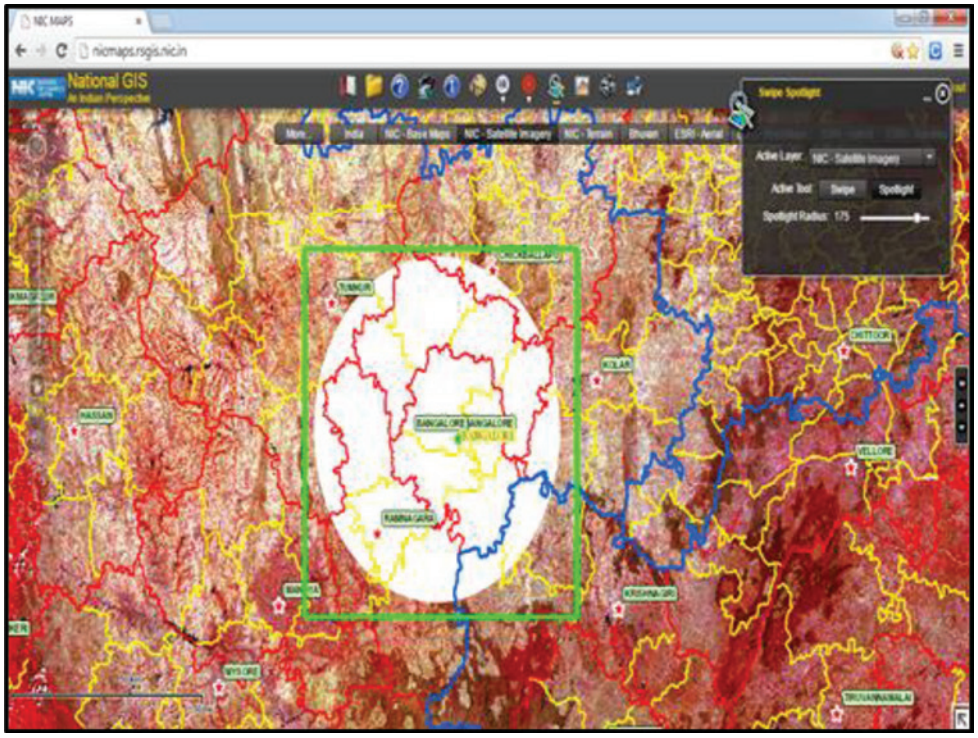


FIGURE-9.23- Customizable radius of Swipe tool

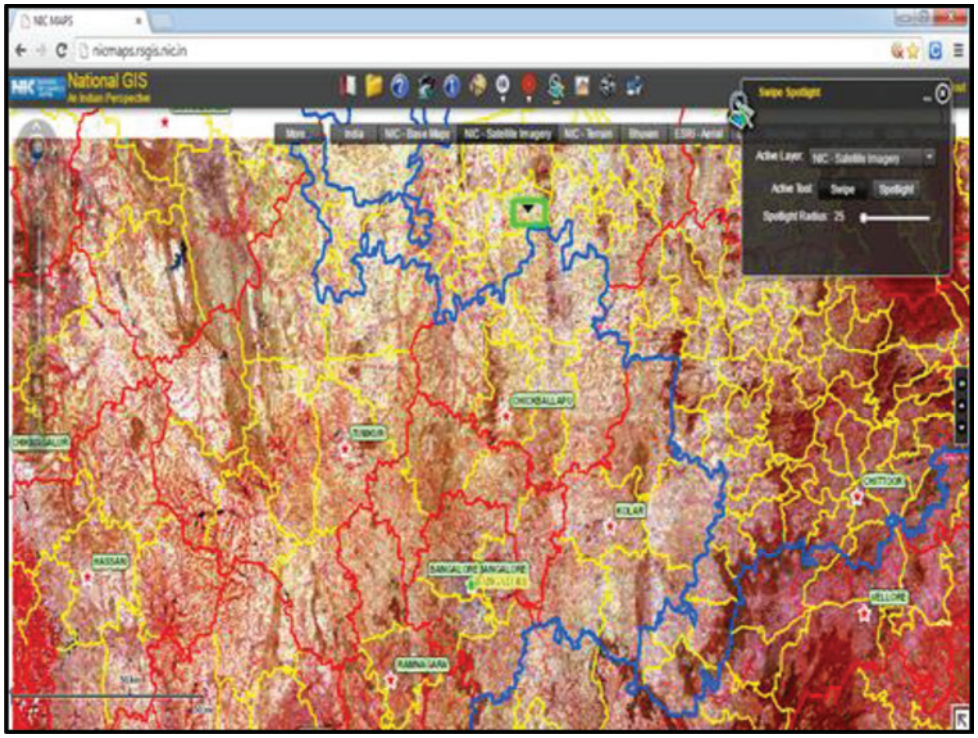


FIGURE-9.24- Spotlight tool

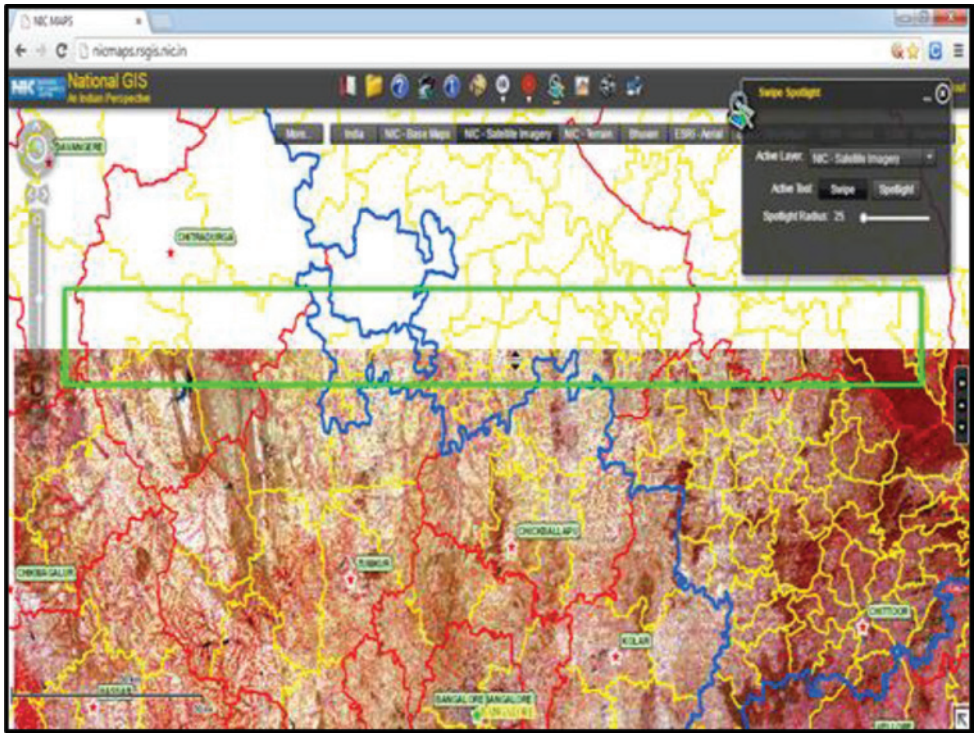


FIGURE-9.25- Customizable radius in rectangle shape in Spotlight tool

10. Conclusions

122. **USGS- National Map viewer**

122.1 USGS National Map Portal has seamless, well organised and standardized GIS Content.

122.2 Robust map viewer and can do querying operations in easy ways.

122.3 Portal is very robust with high performance.

122.4 Portal doesn't contain any GIS application

123. **Google Earth**

123.1 Google Earth has seamless, well referenced high resolution images; most content is 2012+ vintage with lots of Point of Interest.

123.2 The Portal is extremely efficient and high-performing – with robust and reliable viewing services.

123.3 The design and development templates are of high quality with good testing and roll-out processes.

123.4 Not really a GIS with GIS-ready and GIS analysis capability. But widely used by citizens for their day - to- day activity

124. **Bhuvan Portal**

124.1 Bhuvan is "one-period" seamless visualization of IRS images for India.

124.2 Bhuvan content is merely a "data bank" or REPOSITORY of NNRMS projects datasets that have been generated at different times, using different RS images and based on different map/GIS standards.

124.3 Bhuvan service are just a visualization and display tool for the IRS images and data-bank/repository data and does not offer integrative/analytical GIS Applications as Decision Support for users – governance, academia, industries or citizens.

124.4 Bhuvan design needs to considerably improve and reliability/robustness has to enhance with good testing and use of standards**.**

125. **India NSDI Portal**

125.1 NSDI Portal conforms to NSDI Metadata.

125.2 Limited GIS Layers which is not a GIS-ready format; mainly metadata population.

125.3 Performance, maintenance, updation and testing needs substantial improvement.

125.4 No GIS decision support application is available.

126. **MapmyIndia Portal**

126.1 MapmyIndia is first Indian private map portal which has nation-wide good-quality content.

126.2 MapmyIndia have Limited GIS Layers which is not in GIS-Ready format.

126.3 MapmyIndia Portal design, architecture and infrastructure are user friendly but has elementary functionalities.

126.4 It has no GIS decision support application.

127. **Prototype K-GIS portal**

127.1 Content is seamless for state and standardized.

127.2 It has good visualization and querying capabilities- both spatial and attribute query; user-interface is quite easy and navigable and performance is quite good.

127.3 It has GIS-Ready data. Fairly good design, quite robust and quite reliable.

127.4 Does not have integrative/analytical GIS Applications Decision Support capabilities.

128. **Surveykshan portal of SOI**

128.1 Authoritative administrative frame comes from SOI. However, WMS datasets makes the use of this data very limited.

128.2 Surveykshan has SOI OSM sheets data but not in GIS-Ready format.

129.3 It has only display functions. Poor design and reliability.

128.4 No GIS decision support capability.

129. **NICMAPS portal**

129.1 Data content is limited but a good spatial reference frame seems to have been generated by seaming the SOI OSM maps (this is a duplication of what Surveykshan has also done).

129.2 NICMAPS has good portal design and robustness – making it quite different from other portals that we have evaluated.

129.3 NICMAPS querying capability is good. It seems to show more professionalism from an IT-perspective.

129.4 No GIS decision support application.

Acknowledgement

The NIAS research team is grateful to Dr. Mukund Rao, Dr. V.S Rammamurthy and Dr. Baldev Raj for their valuable inputs and guidance. We are thankful to Dr Mukund Rao, PI of the DST Sponsored Project at NIAS for having given us an opportunity to work on this project. We are also thankful to Dr DK Prabhuraj, Director, KSRSAC for having permitted us to work in the NIAS project and also for allowing us to continue to use KSRSAC facilities.

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About NIAS Research Team and Guidance

Ms Shilpa Ramesh is member of staff at KSRSAC (Karnataka State Remote Sensing Application Center), Bangalore since last 7 years. As a Project Scientist at organisation she got involved in multiple GIS projects where she developed GIS skills. KSRSAC has undertaken state as well national wide project such as Land Suitability for Sericulture, Integrated Rural Development Program, and Quality Analysis for Bangalore Municipal, Change Analysis for National Wasteland, Land Resource Information System and many more. She was part of data creation and customization team where she was also doing QA/QC for same.

While working on GIS technologies she has developed the knowledge theoretical parameter of project theme to develop the spatial & non spatial database. She was also a team member of GIS portal development at the organisation. She was actively involved in developing most of the modules of GIS portal from designing the database to testing the portal thoroughly.

Organisation has shown confidence in her by allowing her to present paper on relevant projects in various parts of countries. She attended the sessions at NESAC (Meghalaya) while working on land suitability for sericulture and understood the importance of developing GIS portal for same from user perspective.

Since November 2013 she is associated with Dr. Mukund Rao for National GIS project as Research Associate where she is leading team for defining Standards, Spatial Framework and Technologies for National GIS. She has researched worldwide GIS standards and GIS web portal in order to define GIS standards for India.

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Mr Vilas H Chavan is working as Sr. GIS Analyst at KSRSAC (Karnataka State Remote Sensing Application Center), Bangalore. He has extensive experience in GIS Technology and Database technology and application. He has been working in IT industries over 15 years including 7 years in GIS technology.

He began his GIS profession at NGO where he was part of various projects. While working at socio-environmental NGO, where he gathered knowledge of ecological restoration, rural development, women empowerment and micro-finance etc. and thereby developed linkage with GIS technology.

Also he had an opportunity to work in Industry where he acquired knowledge of commercialization of GIS. He had chance to be a part of different upcoming urban development GIS projects in India such as Property Tax, e-Governance for Municipality and so on. He did not only get involved into GIS technology but also learned designing the architecture of database.

Currently he is working with Government organisation and involved in a mixture of projects where he is designing database for MUDA and Asset Mapping which has helped him to get his good hands on GIS technology. Such multicultural work practice has leaded him to be team member of NIAS (National Institute of Advanced Studies) where he was part of defining the Standards, Spatial Framework and Technologies for National GIS.

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Ms Diksha Bandil holds post graduate degree in Remote Sensing & GIS from Jiwaji University, Gwalior (MP). University recommended her to attend ISRO (Nagpur) to finish dissertation thesis as a part of course work where she got chance to enter in real time scenario of GIS industry and she took positive advantage of by working on project Land Use/Land Cover Mapping Using Temporal IRS Resource SAT2 AWiFS Data of Nagpur. Manual data creation from satellite image is just right thing happened with her as a student and she worked thoroughly on project and achieved practical vision about GIS technology. She got good hands on operating GIS software as well as Satellite Image Processing.

She joined MPCST (Madhya Pradesh Council of Science & Technology), Bhopal as a GIS Assistant and begins her career in GIS industry. She worked on project Space Based Information Support for Decentralized Planning where she was team member of data creation from satellite image. Since it was large scale data creation, data accuracy was priority and this work nature helped her to understand the importance of data creation. She earned good amount of knowledge in data creation and that helped her to move to Birla Institute of Technology, Jaipur, as a Junior Research Fellow.

She joined NIAS (National Institute of Advance Studies) end of November 2013 to October 2014 as a Junior Research Fellow. She worked as a team member for Standards, Spatial Framework and Technologies for National GIS under guidance of Dr. Mukund Rao as a Principal Investigator. In spite of intermediate amount of career period, her efforts in researching has help project to give good shape.

She joined KSRSAC (Karnataka State Remote Sensing Center) end of November 2014 as a Project Scientist. She is a team member of data creation from satellite image. Since it is large scale data creation like building mapping and land use / land cover mapping from LISS IV images for slum free city mapping.

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Dr Mukund Kadursrinivas Rao is an Information technology professional with >34 years of experience in EO, GIS and Space Systems. With a post-graduation in Geology, he has a MPhil in RS and GIS and a PhD in RS and GIS – his thesis is on automatic feature extraction using spatial and spectral information from high-res images. Presently, he works as an independent Consultant in the national and international scene and is also Adjunct Faculty in National Institute of Advanced Studies (NIAS).

Dr Rao is a well-known EO/GIS and Space technology expert and has been furthering EO, GIS and Space in India for more than34 years. He has the unique distinction of vast experience in government and industry. He has served in ISRO for 24 years – where he worked in shaping the Indian Remote Sensing (IRS) programme and its applications and establishment of India's National Natural Resources Management System (NNRMS). He has worked for India's first GIS programme on Natural Resources Information System (NRIS); conceptualized India's National Spatial Data Infrastructure (NSDI) Strategy and Action Plan; architectured India's National Urban Information System design etc. Dr Rao led GIS Standards in India and is key person for NRIS Standards in 1990s; NSDI Metadata Standards in 2002; NNRMS Standards in 2005 and NUIS Standards. Under his coordination, the demonstrative NSDI Portal was developed in 2003 and he was instrumental for NNRMS Portal in 2004.

He has played a lead role in EO programme coordination for India and was involved in the EO-2025 strategy formulation and architecting/definition of a range of national level RS applications for various user ministries, including conceptualizing the NR Census programme. He has actively worked on defining policies for EO and GIS. He has been active in the international EO and GIS circuit with extensive involvement in CEOS, IAF, IAA, ISPRS, GSDI, UN-COPUOS, UN-CSSTEAP, IISL and many other fora.

Later for 6 years he has been with GIS industry – where he was CEO of GIS business initiatives. He brought in his technical expertise to development and implementation of GIS business in Indian environment – Power-GIS applications in India, Municipal-GIS for Indian cities, OneMap of Singapore, enterprise GIS for Ras-Al Khaimah and Ajman emirates in ME, Delhi state SDI initial design, India's NSDI metadata portal and others. He also led ESRI distribution activities in India. He was also involved in a unique integrated project design by combined usage of GIS/GPS with direct satellite communication terminals.

For the past 5 years, he is in consulting domain of EO/GIS and Space and advises many entities in government, industry and academia. He has consulted for Indian Planning Commission as Expert on National GIS and was key person in conceptualization and definition of India's National GIS programme. He has steered the state-level enterprise of Karnataka-GIS. He also consults with geospatial industries on important technical and design aspects. He has vast experience in EO, GIS and Space Policy

and regulatory aspects at national and international level. In 2012, he successfully led a DST project in NIAS for defining National GI Policy– a report has been published by NIAS.

Presently, at NIAS, he is working on definition of a renewed Space Policy for India. He has published key paper on renewing Indian Space Policy and also for privatization of Indian space. He is germinating a focused "UAS technology and policy" development study.

Dr Rao also serves as Member-Secretary of Karnataka Knowledge Commission and steers various knowledge activities in education technology, biodiversity, arts management, sports policy, Karnataka GIS and many other activities of relevance to state of Karnataka.

Dr Rao is well-recgnised in India and also in the world – he has contributed to many national and international initiatives – he was the founding and first President of the international Global Spatial Data Infrastructure Association (GSDI); Vice-President of the International Astronautical Federation (IAF); elected Member of International Academy of Astronautics (IAA) and International institute of Space Law (IISL); has been active in the international Committee on Earth Observations Satellites (CEOS) and other forum like International Society for Photogrammetry and Remote Sensing (ISPRS) and UN-Office for Outer Space Affairs and supported UN-ESCAP for GIS.

Dr Rao has been honored with many awards - GIS Professional of 2009 at the Map India, 2010 Conference; National Geospatial Award for Excellence of the Indian Society of Remote Sensing (ISRS) in 2009; Exemplary Service Medal from international Global Spatial Data Infrastructure (GSDI) association in 2009 and Hari Om Ashram's Vikram Sarabhai Young Scientist Award in the area of "Systems Analysis and Management" in 2002.

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Prof Ramamurthy is a well-known Indian nuclear scientist with a broad range of contributions from basic research to science administration. Prof Ramamurthy started his career in Bhabha Atomic Research Centre, Mumbai in the year 1963. He has made important research contributions, both experimental and theoretical, in many areas of nuclear fission and heavy ion reaction mechanisms, statistical and thermodynamic properties of nuclei, physics of atomic and molecular clusters and low energy accelerator applications. During the period 1995-2006, Prof Ramamurthy was fully involved in science promotion in India as Secretary to the Government of India, Department of Science & Technology (DST) New Delhi.

For more than a decade, Prof Ramamurthy has steered national level programmes of mapping and GIS and has been closely associated with the SOI mapping programmes, NRDMS programmes, NSDI conceptualization and also in National GIS and Karnataka-GIS framework. He continues to guide and support various GIS activities in the countries – especially through NIAS research projects.

He was also the Chairman of the IAEA Standing Advisory Group on Nuclear Applications for nearly a decade. After retirement from government service, Prof Ramamurthy, in addition to continuing research in Nuclear Physics in the Inter-University Accelerator Centre, New Delhi has also been actively involved in human resource development in all aspects of nuclear research and applications. Prof Ramamurthy is also a Chairman, Recruitment and Assessment Board, Council of Scientific and Industrial Research and Member, National Security Advisory Board. In recognition of his services to the growth of Science and Technology in the country, Prof Ramamurthy was awarded one of the top civilian awards of the country, the Padma Bhushan, by the Government of India in 2005.

He was a director of NIAS from September 2009 - 31 August 2014 and now he is an Emeritus Professor of NIAS from September 2014.

Contact: Prof V S Ramamurthy (**Email**: vsramamurthy@nias.iisc.ernet.in)

Dr Baldev Raj has assumed responsibilities as the Director of the National Institute of Advanced Studies, Bangalore, one of India's leading multi-disciplinary institutions. A distinguished scientist and former Director of the Indira Gandhi Centre for Atomic Research in Kalapakkam, Dr Baldev Raj has helped advance several challenging technologies, especially those related to the Fast Breeder Test Reactor (FBTR) and the Prototype Fast Breeder Reactor (PFBR). He has also nurtured and grown excellent schools of global stature in nuclear materials and mechanics, non-destructive evaluation, nano science and technology, and robotics & automation. He is pursued his work in interdisciplinary domains of energy, cultural heritage, medical technologies, nano science and technology and education.

The author of more than 970 academic papers in peer reviewed journals along with 70 books and special journal volumes; Dr Baldev Raj has been recognized by way of more than 100 awards, 380 honors, keynote, invited lectures and assignments in more than 30 countries. A recipient of the Padma Shri; the other awards include Life Time Achievement Award of the Indian Nuclear Society, the Homi Bhabha Gold Medal, Distinguished Materials Science Award, Materials Research Society of India, etc. He is a distinguished alumni of Indian Institute of Science, Bangalore.

A member of the Circle of Advisors, Cambridge University, UK, and a member of the Search Group for the Queen Elizabeth prize in engineering, Dr Baldev Raj is also a Fellow of all the Science and Engineering academies in India, German Academy of Sciences and the World Academy of Sciences. He is the Chairman of the Board of Governors of IIT Gandhinagar, a member of the Court of Jawaharlal Nehru University, Delhi, and President-Elect of the International Council of Academies of Engineering and Technology Sources. He is Honorary Member, International Medical Sciences Academy.

Dr Baldev Raj is known to have mentored hundreds of children, students, scientists and technologists, inspiring them to pursue high levels of professionalism in the pursuit of science and technology without losing sight of the need for exemplary ethical practices.

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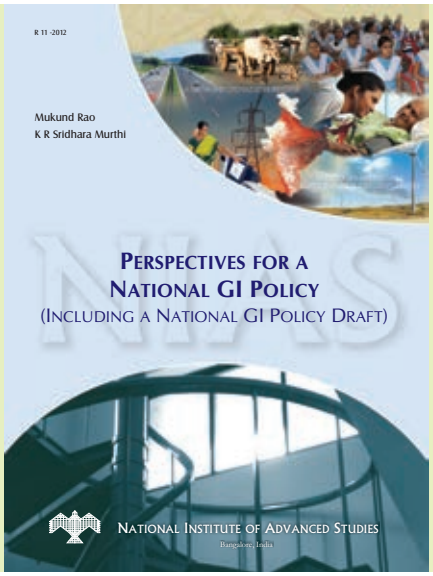

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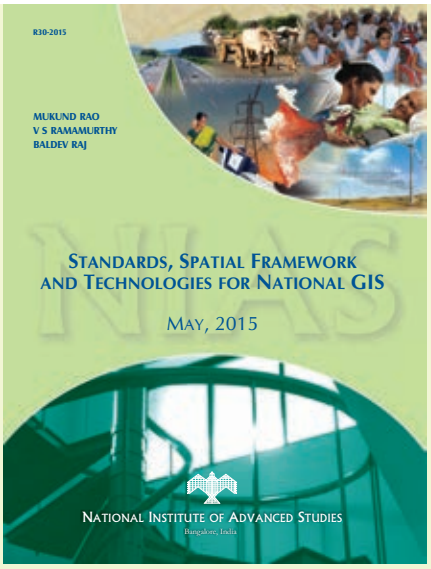

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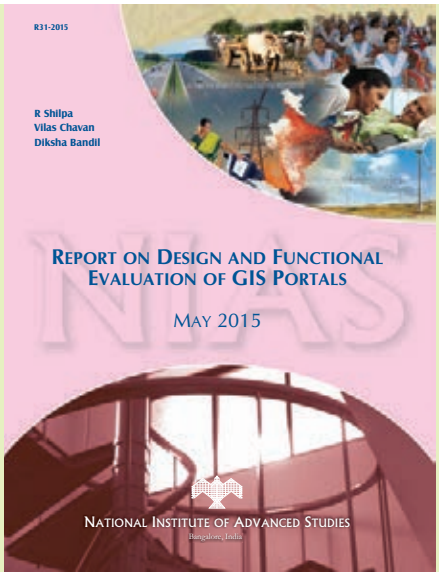

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