A REPORT ON

Training Program on "Preparation of Digital Base Maps Using a Synergic Integration of Cadastral Maps and Satellite Imageries" held during 20th June, 2016 to 24th June, 2016

Principal Investigator & Coordinator

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Submitted to:

NRDMS Division, Department of Science and Technology (DST),

Government of India.

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CONTENT

1. <u>VIS Project Background</u>

Natural Resources Data Management System (NRDMS) division, and National Spatial Data Infrastructure (NSDI) of the Department of Science & Technology, New Delhi through a consultative working group meeting has conceptualized and initiated an innovative program on the development, validation and standardization of data structure and the optimum data requirements providing a subtle framework for spatial data development and management at village level. It needs to be realized at this stage, that the mechanisms and scope of the Govt. agencies and the associated systems are not being able to fill the gaps to address the national needs. It is time that innovative systems need to be developed, tested and standardized before being implemented. The scope for collection of required data on spatial and temporal scales does not seem to be viable with the current structure, mechanisms and resources of government and professional agencies. At the same time, the rapid developments taking place in almost all sectors, the information at village level has become highly critical and vital not only to propose and design new developmental programmes but also to develop and manage the resources in a sustainable way. Karnataka State Council for Science and Technology (KSCST) is a member of the consultative working group and the Council through its flagship programs i.e., NRDMS and KSSDI programs has been providing analyzed information to decision-making to district level line departments since 1992 and Karnataka is the only state to institutionalize NRDMS centres have been institutionalized in the state of Karnataka. Through NRDMS centres the Council is serving the State line departments with invaluable and informative spatial data. Now it is felt necessary that, the data collection and management at micro level like village level should be made available to the departments for better planning and decision making which will help in increasing the efficiency of the Government. In this context, the Council has proposed the Village Information System (VIS) on pilot scale and is totally supported by DST-GOI.

1.1 The training program concept and purpose

A National Network Programme has been launched with the support of NRDMS Division of Department of Science & Technology. This programme involves 11 investigating groups from 10 different states in the country. The programme is mainly envisaged to provide a digital spatial data approach in providing critical information as well as to form the base for the development of a base that a facilitate a data decision support information system at village level. As a part of this programme, with the main objective of providing standard methodology/ approaches for all the investigating groups, taking into account the data available in different parts of the country in respect of natural resources, human resources, agriculture practices, availability of minerals, water and other natural resources etc. It is, in this context, a training programme on preparation of digital base map utilizing cadastral maps and other high resolution satellite data is contemplated. Further, it is also proposed to train the research personnel on the principles and practices of cartography. The training also envisaged to provide enough knowledge and practice on the preparation of digital base line maps integrating the cadastral maps, cartosat / LISS-IV data in a synergic way. Apart from

the PIs who are also experts in the field, 3 to 4 outside experts are being invited to act as the resource persons.

In addition the participants will be given field training on the principles, operation and application and use of Total System along with DGPS to carry out precise topographic surveys and to use such data as ground control points in the processing and integration of Cadastral and RS satellite data products.

1.2 Participants

In all about 30 participants who are essential members of investigating group, research scholars (JRF, SRF and Field/Laboratory Personnel) and a few others attended the training programme.

1.3 Broad topics of training programme

- Village Information System- a Geospatial perception
- Basics of Geographic Information System
- NRDMS Program in India and their relevance to Village Information System
- Geospatial Technologies for Governance at local level –Example of Karnataka State
- Concepts and Characteristics of Cadastral Maps
- Synergic integration of Cadastral maps and Satellite Imageries
- Base Map Preparation based on NLRMP Guidelines
- Utilization of GPS, DGPS & ETS in Cadastral and Habitation mapping
- Hands on training for Base map preparation including habitation Mapping
- Preparation of thematic layers using satellite imageries

2. **About Karnataka State Council for Science and Technology**

Karnataka State Council for Science and Technology (KSCST) established in the year 1975 is one of the first State S&T Councils to be set up in the country. KSCST is an autonomous S&T organization under Department of Science & Technology, Government of Karnataka.

During the last 40 years, KSCST has been pro-actively engaging itself to identify, propose and implement S&T based solutions to locale specific needs / problems in the broad areas of Water, Education, Energy, Ecology and Environment, Waste management and Infrastructure. In co-operation with the Indian Institute of Science and several other premier R&D institutions, KSCST executes many projects and programmes aimed at improving socio-economic conditions of the people of the state.

Over the years, a number of technologies have been translated, from research and demonstration phase, to the implementation and operational phase. KSCST provides support to the Central and State Governments, in formulation of S&T based policies, scientific surveys, project implementation, evaluation, co-ordination & monitoring, organization of scientific meets and awareness campaigns. The Department of Science and Technology, Government of India advocated KSCST as a model to all the states.

Vision: Application of Science & Technology for the management of resources, improvement of environment, quality of life and socio-economic conditions of the people of Karnataka.

Mission: Co-ordinate R & D activities for generation of knowledge for scientifically based interventions, development and popularization of appropriate technologies for adaption by the civil society to overcome local-specific problems and, inspire and improve human resources of the S & T sectors in the state.

About Karnataka NRDMS program

The Karnataka State Council for Science & Technology (KSCST) recognizing the need for both spatial and non-spatial data to local level planning across Karnataka established Karnataka Natural Resources Data Management System (NRDMS) program in 1992 to develop a comprehensive spatial data management system for easy access of data and information. NRDMS is a joint project of Natural Resources Data Management System (NRDMS) of Department of Science & Technology, Government of India, and the Government of Karnataka. The State Council through its flagship program i.e., Natural Resources Data Management System (NRDMS) has been actively involved in providing geospatial data, information and services through district NRDMS centres to district and state line departments and administration since past 2.5 decades for developmental planning. The district NRDMS centres supported by State Spatial Data Centre and State NRDMS centre at KSCST, Bangalore now delivers analyzed spatial information and services to end users at districts to planners and administrators.

The State Council established a standards-based web-based Geoportal called Karnataka Geoportal, the first web Geoportal in the country a, implementing Open Geospatial

Consortium (OGC) and International Organization for Standardization (ISO) standards, and a clearinghouse for spatial data generated by various agencies of the government of Karnataka. The KSSDI project required a solution to catalog vast stores of distributed geospatial data, and make this data available via OGC compliant web services to other systems whose interfaces and encodings are compliant with the same OGC standards. The portal enables organizations to describe, catalog, search, discover and securely disseminate massive volumes of data. KSSDI implements Standard OGC services including comprehensive Web Mapping Service (WMS), Web Coverage Service (WCS), Catalog Service for the Web (CS-W), Web Feature Service (WFS), Web Map Context (WMC), Web Processing Service (WPS) and ISO 19115/19139 metadata standards.

The KSCST realizing the need for Web based GIS services and keeping in view of the expertise available and the need to introduce a synergic approach using multidisciplinary knowledge for addressing the present and future issues associated with geospatial technologies, has developed web based geospatial applications to provide integrated solutions to user departments specifically for Karnataka watershed Development Department. The Karnataka Geoportal now has the following standard based services.

- Map viewer - Web Map Service (WMS),
- Product catalogue/metadata - Catalogue Service on Web (CS-W),
- Services specific service/ feature data sets - Web Feature Service (WFS),
- Simple Applications (Query based decision support)
- Coverage services/images - Web Coverage Service (WCS)
- Web processing Service (WPS)
- Transactional Web Feature Service (WFS-T)
- Mobile Mapping
- Multi-spatial and multi-attribute query and analysis
- Multi-lingual
- Help/support

3. Programme Schedule

Preparation of Digital Base Maps using a Synergic integration of Cadastral Maps and satellite imageries

DATE & TIME		TOPICS	RESOURCE PERSONS
	9:30– 10:00	Registration	
	10:00–10:20	Inauguration	
		TOPICS	**RESOURCE PERSONS**
20/06/16	10:30-11:30	Introduction to the training	Mr. H Hemanth Kumar Fellow & PI-NRDMS, KSCST
		Basics of Geographic Information System and NRDMS Program in India and their relevance to Village Information System	
	11:30-15:00	Concepts and Characteristics of Cadastral Maps.	Mr V S Shivarudraiah Ex – Deputy Director, SSLR, Bangalore
	14:00-17:00	Data creation and sharing; create geographic data from scanned maps & from GPS units; Data management and Map Preparations.	Karnataka NRDMS centre (Mr. Mohan Kumar/ Mrs. Sharadhi/ Ms. Ramya)
21/06/16	09:30-11:15	Geospatial Technologies for Governance at local level –Example of Karnataka State.	Mr. H Hemanth Kumar Fellow & PI-NRDMS, KSCST
	11:30-13:00	Base Map Preparation based on NLRMP Guidelines	Mr V S Shivarudraiah Ex – Deputy Director, SSLR, Bangalore
	14:00-17:00	Hands on training for Base map preparation including habitation Mapping	Karnataka NRDMS centre (Mr. Mohan Kumar/ Mrs. Sharadhi/ Ms. Ramya)
22/06/16	09:30-11:15	Village Information System- a Geospatial perception	Prof Rajendra Prasad Sir Arthur Cotton Geospatial Chair Professor, Andhra University
	11:30-13:00	Utilization of GPS, DGPS & ETS in Cadastral and Habitation mapping	Chhattisgarh Council of Science & Technology And JNTU
	14:00-17:00	Demonstration of survey equipments including GPS, DGPS & ETS	Chhattisgarh Council of Science & Technology And JNTU
23/06/16	9:30-10.45	Cadastral Surveying Practices for VIS project	Dr.S.S.Ramakrishnan Director, IRS & Director,, Anna University
	10:45-11:30	Satellite Data Ordering, Pre-processing and Georeferencing	Dr K S Raju Associate Professor, Anna University
		Satellite Data Processing, Classification Methods, Mapping and Accuracy Assessment	Dr.M.Shanmugam Associate Professor, IRS, Anna University
	14:15-17:30	Demo and Hands on training on GIS for Base Map Preparation, Land use Mapping	Dr.M.Muneeswaran GIS Coordinator, ATREE,
24/06/16		Hands on training by participants	

4. <u>List of Participants</u>

SL.NO	NAME	DESIGNATION	ORGANIZATION
1.	Mr. Abdul Moid	JRF	Centre for Environment
2.	Mr. Abhilash	Project Associate	Institute of Science and Technology JNTU, Hyderabad, Telangana
3.	Mr. C H Raghu Ram	JRF	Andhra university, Vizag
4.	Mr. Harish Sinha	Research Associate	Chhattisgarh Council of Science & Technology, Raipur
5.	Mr P Amaladas	Research Scholar	Anna University
6.	Mr.Sunil Sheoran	JRF	Department of Geography, M D University, Rohtak
7.	Mr. Sunil Nehra	JRF	Punjab Remote Sensing Centre PAU Campus, Ludhiana 141004 Punjab
8.	Ms.Tisha	SRF	Chhattisgarh Council of Science & Technology, Raipur
9.	Ms.P. Sarita Hepsibha	JRF	Andhra University, Visakhapatnam
10.	Ms.Sanju Verma	JRF	Chhattisgarh Council of Science & Technology, Raipur
11.	Mrs.Tanu Kumari	JRF	CGRT, Himachal Pradesh
12.	Mr. B.S.S.V.Krishna	JRF	Andhra University, Visakhapatnam
13.	Mr. Sujoy Kanti Bhattacharjee	JRF	Department of Geography, DSB Campus, Kumaun University, Nainital, Uttarkhand
14.	Mr. Deepak Kumar	Project Fellow	
15.	Mr. Mohan Kumar S	Project Associate	KSCST, Bengaluru
16.	Mrs. Sharadhi S M	Project Associate	KSCST, Bengaluru
17.	Ms. Ramyashree M K	Project Associate	KSCST, Bengaluru

5. Technical Sessions

The training program scheduled for 5 days was meant to train project staff from 11 participating organisation in both theory and practice on Geospatial Technologies. The training program was purely dedicated to utilization of Geographic Information system (GIS) and Remote sensing (RS) techniques in preparation of Cadastral Maps.

Mr. Hemanth Kumar H (Co –Ordinator of the training program and Fellow & PI-NRDMS/, KSCST) gave an introduction about the training program.

Session1: Mr. Hemanth Kumar H handled the session on *Fundamental of GIS and Karnataka NRDMS program.* The topics included from fundamentals of GIS to applications using geospatial technologies. The fundamentals include historical background of GIS, GIS components, GIS system Architect, Contribution disciplines of GIS, Basic function of GIS, Query and analysis, GIS data model, concept of Vector model and Raster model, data structure, GIS enterprise etc. He explained in detail the GIS applications developed under NRDMS program based on user requirements and also gave an overview of Karnataka Geoportal.

Session 2 and 5: Mr. Shivarudraiah Handled the session on *Concepts and characteristics of cadastral data and information*. He started with the basic concepts in cadastral mapping i.e., survey carried out in colonial era, devices used and the mapping aspects; Data management such as tippans; scale and dimension of maps and more specifically the importance of Cadastral Land Records and its components. The sessions also dealt with the updation of land records and some of the concerns of data compared to new age geospatial technologies. In session 5, he explained the process of base map Preparation based on NLRMP guidelines using modern technique and advanced instruments such as Total Station, DGPS/GPS, High Resolution Satellite imageries and aerial, photography.

Session3: **Mr. Mohan Kumar S,** *Mrs. Sharadhi S M and Ms. Ramya* handled the session on hands on training on *Geospatial software i.e ArcGIS.* Mr Mohan Kumar S and Ms Ramya started with introduction on ArcGIS, Coordinate systems, UTM Projection systems, Georeferencing of toposheet using ArcGIS, generation of database, creation of shape files & attributes using ArcGIS and other functionalities including extraction of features from raster data using vector layers; Import and export of shape files using ArcGIS. The next session was about *Maps, Datum and Projections by Ms Sharadhi S M from* NRDMS, Bengaluru. She explained about basics of mapping, datum and projections such as components of maps, source and types of thematic maps, topographic map and their features, types of projection systems and their importance.

Session 4: Mr. Hemanth Kumar H handled the session on *Geospatial Technologies for Governance (Informed decision-making),* in which he gave detailed presentation of NRDMS programme. Further he presented on the shift made from NRDMS to Karnataka

Geoportal in providing seamless standards based database for public on internet. He started with genesis of NRDMS program and its objectives. He explained different governance projects implemented under NRDMS:- Planning atlas of Karnataka; transport sector; Demographic indicators for planning developmental activities; management of watersheds using Geo-ICT; crime mapping; Prioritization of minor irrigation tanks for fund allocation; Relocation of stone crusher based on government guidelines; Education; GPS in managing agriculture department scheme i.e., Suvarna Bhoomi Yojane; Zoning ATLAS for sighting of industries; quality/quantity of drinking water; support to elections up to Gram Panchayaths; Beat mapping in forest for enforcement; Solid waste management of Tumakuru city etc. During the presentation he demonstrated automated DSS for health sector to plan health facilities. He took time to show the impact of GIS in managing telecommunication issues like connectivity, identifying better the service provider and existing & proposed tower location. He highlighted the importance of crowd sourcing in managing the data gaps at micro level which is essential requirement for planning.

He highlighted the activities carried out under Karnataka Geoportal including Geoportal Services i.e., Map viewer- web map services, Production catalogue/ metadata- catalogue service on web, Service specific service/ feature data, Simple applications (Query based/ decision support), Coverage specific / image (web coverage service), Search & Discovery, Help, Requirement for geospatial governance – Multilingual, Policy & coordination among department, Mobile compatibility, Perform multi-spatial attribute query, Crowd sourcing, Viewing information over publically available portals – Google, Bing, OSM, Bhuvan, Online data editing- authorised department, Integration of existing MIS.

Session6: Mr. Mohan Kumar S handled the session *on Downloading and analysis of Open Source Data sets for Geospatial analysis.* He gave an overview of the freely available datasets for geospatial analysis, how to download and extract the information from open source datasets and showed the step by step procedure to use these datasets.

Session7: Prof. Rajendra Prasad handled the session on *Village information system- a geospatial perception*. He gave the participants a detailed background of Village information system and the major role Cadastral Land records and its components including soil and water data content. In his talk he briefed the participants the use of advanced instruments and technologies for generating database for preparing base map for villages at micro level and informed the gathering how important is this project in the future of cadastral land records system in India.

Session 8 and 9: Dr. M K Baig handled the session on *Utilization of GPS, DGPS and ETS in cadastral and habitation mapping.* He explained the fundamentals of GPS, GPS satellites, Accuracy between different GPS instruments, Theoretical background of DGPS, and ETS instruments. On the same day demonstration of survey equipments was conducted in IISC campus wherein the participants from Chhattisgarh State council showed the operation of DGPS in extracting location information. During the demo different smart phones values were also used to ascertain the location accuracy provided by different equipments. Later

DGPS survey readings and values from different devices were imported to GIS platform and evaluated.

Session 10, 11 and 12:Dr. S.S. Ramakrishnan handled the session on *Cadastral surveying practices for VIS project*. He discussed on cadastral survey, explained historical way of cadastral survey, instruments used for survey, how to numbering the cadastral parcels, present techniques for cadastral mapping.

Dr. K S Raju and Dr. M Shanmugam handled the session on Satellite *data ordering, Pre – processing and georeferencing, satellite data processing classification methods, mapping and accuracy assessment.* The faculty from Anna University presented step by step process of ordering satellite data products through NRSC website and explained availability of different satellite images and their resolutions including quality of data. The techniques involved in pre-processing, post processing and georeferencing techniques was also expalined.

Session 13. Dr. M. Shanmugam handled the session on Demo and Hands on Training on GIS for base map preparation and land use mapping. During the training he explained the procedure for importing satellite images to ArcGIS, discussion on band combination in Satellite images and how to import Google earth plug-in into GIS software's.

Session13: Mr. Mohan Kumar S, Mrs. Sharadhi S M and Ms. Ramya handled the session on *Demo and hands on training on GIS for base map Preparation, land use mapping*. Participants were made to explore proprietary software (ArcGIS) and open source software (QGIS) including the usage of high resolution image for data extraction. The hands on training delved on topics like data creation and sharing; GIS database management; spatial data models and operations; data management etc. The trainees were exposed to the usage of satellite imageries to extract cadastral information.
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(a) Dr. Rajendra Prasad and (b) Mr. H Hemanth Kumar discussing about the VIS Base Map Preparation

(C) Demonstration of DGPS at IISc campus

(D) Group Photo

6. MINUTES OF THE 2ND EVALUATION MEETING OF NATIONAL NETWORKING PROGRAMME

On

"Village Information System (VIS)" under NRDMS, DST, New Delhi, held on 24th June, 2016 at 09:30 AM at Karnataka State Council for Science and Technology (KSCST), Bengaluru

MEMBERS PRESENT

1. Prof. P. Rajendra Prasad, Technical Coordinator, VIS Programme, Dept. of Geophysics, A.U.
2. Dr. S G S Swamy, Executive Secretary, KSCST, IISc Campus, Bengaluru.
3. Dr. H. Hemanth Kumar, KSCST., IISc., Bangalore
4. Prof. Sharda Singh, Himachal Pradesh Agricultural University, Palampur, H.P.
5. Dr S S Ramakrishnan, Director, IRS, Anna University, Chennai
6. Dr. K. Srinivasa Raju, IRS, Anna University, Chennai
7. Dr M Shanmugam, Associate Professor, Anna University, Chennai
8. Prof. Mehtab Singh, Maharshi Dayanand University, Rohtak, Haryana.
9. Prof. P. Rama Rao, Director, Center for Studies on Bay of Bengal, A.U.
10. Prof. V. Valli Kumari, Dept. of Computer Science & Systems Engineering, A.U.
11. Shri M.K. Baig, CGCST, Raipur, Chhattisgarh
12. Dr. T. Vijaya Lakshmi, JNTU, Hyderabad
13. Dr. V.K. Verma, Punjab Remote Sensing Centre, PAU Campus, Ludhina.
14. Dr. Sanjay Sharma, Himachal Pradesh Agricultural University, Palampur, H.P.
15. Sri B. Ananda Gajapathi Raju, Dept. of Geophysics, A.U.

I.   *General*

a. Dr. Swamy, Executive Secretary, KSCST, has welcomed the experts and the principal investigators for the 2nd Evaluation Meeting on Village Information System (VIS). He also thanked the DST for giving KSCST a unique opportunity not only to participate in the VIS programme but also to organise the 2nd evaluation meeting preceded by a weeklong training programme on "Preparation of Digital Base maps using a synergic integration of cadastral maps and remote sensing imageries". He also reiterated the importance and role of this programme in the development and management of all resources at village level and its impact on national development. He also appreciated the efforts put in by Dr. H Hemanth Kumar in organising the training programme.

b. Prof. P. Rajendra Prasad, Technical Coordinator, VIS Programme reiterated the concept and importance of VIS in local and national development. He lamented the critical role and involvement of Hemanth Kumar in the design, development and execution of the Training programme on "Preparation of Digital Base maps using a synergic integration of cadastral maps and remote sensing imageries". He also explained the importance and need of an integrated digital map in the context of VIS. He also expressed his appreciation to all the Investigators, and the invited experts for participating in the review meeting.

c. He also briefed the Principal Investigators that their presentations may be focussed on various activities listed in the Kick off meeting and the status of their implementation. He also mentioned about the details of the training programme being organised concurrently from 20th to 24th June, 2016 on "Preparation of Soil and Water Characterization and Conservation" and also appreciated the efforts made by Dr. Hemanth Kumar. He also provided the detailed schedule of the training programme (Annexure). He also mentioned that enough field exposure is also inbuilt in the training programme.

II.   The Status of progress

a. All the project investigators have already procured the necessary cadastral maps and Survey of India toposheets on 1:50000 or better scales. In almost all the cases cadastral maps were procured as hard copies or scanned images. They need to be digitalized properly. However, the principal investigators from Himachal Pradesh, Chhattisgarh, Punjab, Telangana, Tamil Nadu have also procured Cartosat – I data. At the same time, Tamil Nadu, Telangana, Punjab, Chhatisgarh, Haryana have also procured LISS-III/LISS-IV data.

b. The recruitment of project personnel and identification and selection of student forces to carry out the field work has also been completed by all the projects. It is also reported that all the investigators have completed the formation of local committees and hence it is requested that all the principal investigators may send the details of the Committees being formed both for internal evaluation and monitoring.

c. The progress made by the individual investigators in their project area has been presented except in the case of Nainital, Uttarakhand, as Prof. R.C. Joshi could not attend the meeting. However, the progress report sent by him has been considered.

d. All the project investigators have also completed one field work collecting water and soil samples.

e. The investigators are also in the process of collecting and collating the census data. However, investigators from Karnataka, Tamilnadu and Punjab have also completed a detailed door-to-door survey in one or two villages.

f. It is also discussed in detail the procedures to be adopted in the preparation of digital base maps, collection and collation of data both from census and other available sources including the field observations.

g. Having revisited the data model presented and finalized in the previous meetings, the members suggested that information on health with a focus on the commonly prevailing diseases with the identification of causative factors and also a unique ID following the Government of India norms need to be incorporated. It is suggested that the information on health status may be collected from a PHC close to Clusters 1 & 2.

h. While reviewing the progress made by the project entitled "VIS Data Model (VISDM) based Decision Support Information System" by Prof. V. Valli Kumari, it is suggested that the principal investigator may focus initially on the development of a portal and then focus on the development of Android based apps for use in the field through handheld mobile units.

i. The members have appreciated the efforts made by Dr. Hemanth Kumar supported by the Secretary and Members of KSCST along with Prof. K.S. Raju, IIT-Chennai in the design and development of a training programme on "Preparation of digital base maps using a synergic integration of cadastral maps and remote sensing imageries". It is also acknowledged that all the participants have gained valuable knowledge and optimum hands on experience in the training programme.

III. *Recommendations*

1. *Preparation of Digital Base Maps*

a. It is proposed to use high resolution open source data that is available for free and utilise the same in conjunction with Cartosat – I/II, LISS-III/IV data along with cadastral maps, as practice, before the Cartosat-II / World view data products are supplied by NRSC. It is also suggested that while downloading the freely available data, the resolution of the data and its compatibility needs to be considered. It is also recommended that the common procedure demonstrated in the training programme needs to be adopted in the preparation of the base maps. A document listing the procedure may kindly be prepared by Dr. Hemanth Kumar for circulation among the

PI's. In this connection, it is suggested that priority may be given to fix the village boundaries by augmenting additional GPS stations at least at the critical points of the village boundary polygon.

b. It is also suggested that the benchmarks that are available in Survey of India toposheets needs to be transferred to the base map along with other useful information to the extent possible.

c. It is further proposed that enough precaution to be taken in minimising the RMS error in connecting the GCPs during pre and post data processing and integrating products of different scales.

d. The investigators are requested to prepare a shape file with the longitude and latitude marked for each of the clusters and the nos. of SoI toposheets marked on it may be submitted to NRSC with a copy to Technical Coordinator for follow up. However, requite procedure may be followed to place the order for high resolution products on line with NRSC.

e. It is suggested that while procuring the RS products, it is recommended that products which are geo referenced/ortho rectified may be purchased and as many as possible GCPs be used in the process of rectification.

f. Further, based on the experience and recommendations of Anna University, it is suggested that all the principal investigators should obtain enumeration block maps from the local census office and the information available in the maps need to be embedded into the digital base maps being prepared.

g. It is also requested that Prof. K.S. Raju may prepare a 'symbol library' and circulate the same to everyone so that the same symbols may be used by all the PIs.

h. It is further suggested that Dr. Hemanth Kumar may prepare a document providing protocols/procedure to be commonly adopted by all the investigating groups in merging the data from cadastral, cartosat, high resolution imageries and LISS-III/IV, Survey of India toposheets etc.

2. *Soil and Water Samples*

a. It is suggested that the depth to water table and the piezometric levels may be mapped for all the existing wells along with in situ measurements like EC, pH, DO, temperature, etc., while the determination of major elements and variations in EC and other physical chemical composition, samples with anomalous properties may be collected in 100 ml bottles during post monsoon for trace elemental analyses at Center for Studies on Bay of Bengal (CSBOB). Nutrients composition of the selected samples may be determined in the laboratory. Such samples not exceeding 2 from each village and 10 in all may be sent to Visakhapatnam for analyses using ICP-MS.

b. It is also expected that the variations in soil properties would be less and hence a maximum of two samples may be analysed for granulometry, chemical and nutrient characteristics of soils in their region. It is further suggested that principal investigators may approach the Agriculture Department in their region to get the soil characteristics determinate at free of cost.

3. *Progress report and UC & SE*

It is proposed that a brief progress report in around 2 to 3 pages may be prepared and sent to DST along with a copy of UC & SE under copy to the Technical Coordinator as soon as possible.

4. *Publications*

a. It is suggested that a concept paper may be developed and published jointly by the entire investigating group and DST on Village Information System in which the Technical Coordinator is requested to take the lead.

b. Further, the principal investigators are strongly encouraged to publish the results as research articles in a good geospatial journal.

5. *Web portal*

It is suggested that Prof. Valli Kumari may collaborate with Dr. Hemanth Kumar in the design of the web portal for which the principal investigator along with research personnel may visit KSCST for a week from 18th July, 2016.

6. *Next review meeting*

The next Review Meeting will be held at Raipur on 20th October, 2016, and Dr. M.K. Beg, CCST, Raipur is requested to coordinate the same.