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ANNUAL REPORT 2016-17

ICAR-National Bureau of Soil Survey and Land Use Planning

Nagpur - 440 033, Maharashtra, India

www.nbsslup.in

Annual Report

2016-17

ICAR-National Bureau of Soil Survey and Land Use Planning
Nagpur-440 033, Maharashtra, India
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PREFACE

The year 2016-17 has certainly been one of the most productive years for the Bureau and it can look back with pride on what it has achieved in the year. Lack of site-specific data, particularly on soils, and of situation-specific recommendations have been the causes of failure of most of the agricultural development schemes that operated in the country in the past. The problem is being addressed by undertaking site-specific land resources inventory on 1:10000 scale. About 100 blocks including 12 blocks of Goa State have been completed; more than 600 micro watersheds of Karnataka state are also covered under Sujala III project. LRI database was made richer by developing and distributing more than 75000 soil health cards in the states of Maharashtra and Bihar. Apart from this fallow land of Goa is mapped and characterized and 1:10000 scale. A bulletin on **Land Resource Inventory on 1:10000 scale "Why and How"** has also been published. A new methodology for mapping soils on 1:10000 scale involving legacy data of 1:250000 scale, high resolution remote sensing data and Digital Elevation model has been developed and standardized.

Bureau developed, **Agro-Ecological Regions of India (Revised).** The AER, can effectively serve as a basic agricultural research unit for (a) the development of resource conservation diversified agro-techniques; and (b) for mounting farm level extension programs for the adoption of best practices by the stakeholders, so that they are able to harvest sustained high agricultural production from their land. In 1992, the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) first published the Atlas of AERs' in India. It was based on a limited set of soil, climate, and related geographical and biodiversity data. Its soils information was of a coarse scale. Since then, the Bureau has collected a large volume of soils and climatic data, has assembled LGP information for over 600 locations, and ecological, land use, and soils information has been refined at a better and finer mapping scale. Thus the revised Agro-ecological Regions Atlas, in my opinion, is an up-to-date reliable primer for drawing up integrated land use plans for sustained and increased ecologically sensitive, environmentally safe agricultural production systems with a low carbon footprint. The set of 20 well delineated and mapped AERs could also potentially provide a platform for the transfer and validation of improved natural resources conservative, region specific diversified agro- technologies for adoption of sustainable agriculture.

Land use planning programme in the country is one of the grey area; NBSS&LUP during the year, has taken a big initiative in this direction. In the process, 610 land management units have defined in the country based on soil regions, physiography regions, soil properties alternating management, AER and Land Use Land Management units are further evaluated for defining potential zones for 17 crops in the country; the information is well taken by Govt. of Telangana and Department of Agriculture and Cooperation for oil seeds. Land use plan of twenty one blocks representing different geographic setting have been developed based on 1:10000 scale database; LUP includes best available options of crop and cropping sequences both in winter and summer seasons with cost: benefits ratio. LMU wise soil and water conservation practices have also been recommended.

The impact of LUP has been demonstrated in Bali island of Sundarbans, West Bengal, H.D. Kote Taluk, Mysore District, Karnataka and Bhomoraguri, Upar Deurigaon villages in Jorhat district, Natun Chaporigaon village in Golaghat district of Assam, and rainfed ecosystem of Deccan plateau in Warud block of Amravati district, Maharashtra. The most notable in Bali island where cropping intensity has increased from 112 to 198-296%.

Human resource development through education and training continued to be a major activity. The Bureau organized a number of training programmes in its

mandated areas of work. One scientist visited The University of Sydney, Australia to attend research symposium organised by Faculty of Agriculture and Environment. Besides, a number of staff underwent national trainings in varied fields.

The Bureau brought out a total of 451 publications including 80 research papers (45 in national and 35 in international referred journals), 28 book Chapters, 30 reports/bulletins, 117 sujala LRI atlases, 23 popular articles, 158 seminar/symposia papers, 1 review article, 3 pamphlets. Apart from this, 11 lectures delivered by the scientists and 1 videography prepared. Revenue generated during the year through different activities of research touches the mark of Rs. 4,38,88,178/-.

I am thankful to the Chairman and members of Research Advisory Committee (RAC), the Chairman and members of Institute Management Committee (IMC) and the Member-Secretary of Institute Research Council (IRC) for the guidance and support provided in formulating and pursuing our RD&T programmes.

I am highly grateful to Dr. T. Mohapatra, esteemed Secretary, DARE and Director General, Dr. Alagusundaram, Deputy Director General (NRM) Acting and Dr. S.K. Chaudhari, Assistant Director General (S&WM), ICAR, New Delhi for the guidance and support provided and also for encouraging new research initiatives.

I appreciate the sincere and dedicated efforts put in by the scientists in the huge task of compiling and editing the report. I am more than contented in placing the **Annual Report (2016-17)** for public scrutiny. I welcome suggestions and feedback from the readers. The same will provide valuable inputs towards raising the bar in Annual Report writing in years to come.

(S.K. SINGH)
DIRECTOR

Place: Nagpur

Date: June 2017

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EXECUTIVE SUMMARY

Substantial progress has been made in Land Resource Inventory (LRI) on 1:10000 initiated in a phased manner during 2016-17 and land use planning using the database of LRI. Landscape Ecological Unit maps were developed for 52 blocks, 5 blocks from northern region, 8 blocks from eastern region, 6 blocks from north-eastern region, 5 blocks from central region, 13 from western region and 15 from southern region. LEU maps were developed for Lahul block of Lahul and Spiti district, Pangi block of Chamba district, Himachal Pradesh, Chamba block of Tehri Garhwal district, Uttarakhand, Baragaon block of Varanasi district, Uttar Pradesh and Odhan block of Sirsa district, Haryana representing northern region; Borio block of Sahibganj district, Katkamdag block of Hazaribagh district and Dumka block of Dumka district, Jharkhand, Piprakothi block of East Champaran district, Motihari block of Purba Champaran district, Chakia block of Purba Champaran district, Baisi block of Purnia district, Bihar, Tangi block of Khorda district, Odisha representing eastern region; Bishalgarh block of Sepahijala district, Tripura, Mangan block of North Sikkim district, Sikkim, Jirang, Umling, and Umsing blocks of Ri-Bhoi district, Meghalaya and Diyun block of Changlang district, Arunachal Pradesh representing north-eastern part of the country; Jagdalpur block of Jagdalpur district, Chhattisgarh, Parbhani block of Parbhani district, Maharashtra, Tikamgarh block of Tikamgarh district, Datia block of Datia district and Dhanora block of Seoni district, Madhya Pradesh representing central region; Netrang, Amod, Jambusar, Jhagadia tehsils of Bharuch district, Umarpada and Olpad tehsils of Surat district, Dharampur, Valsad, and Pardi talukas of Valsad district, Gujarat, Suratgarh and Anupgarh tehsils of Sriganganagar district, Rawatsar tehsil of Hanumangarh district, Fatehgarh tehsil of Jaisalmer district, Rajasthan.

The Agro-Ecological Region map published in the year 1992 was revised after 23 years using the soil and climate data acquired till 2015. The revised map provides a better management perspective with change in spatial and areal extent of different Agro-Ecological Regions (AEU). For instance, in 1992 AERs 4 to 8 were assigned to cover semiarid ecosystem, whereas AERs 4 to 9 represent semiarid ecosystem in the revised edition. AER 20 represents exclusively island agro-ecosystem in 1992, whereas in the revised edition, island agro-ecosystem is merged with the coastal agro-ecological units 19. Bio-climate component of AER is also revised. The area under Bio-climate type namely hyper arid and sub-humid moist is revised from 9.9 to 6.6 mha, and from 72.4 to 13.2 mha, respectively. The area under semi-arid moist and sub-humid dry is revised from 78.9 to 98.6 mha, and 42.8 to 78.9 mha, respectively. The area under humid and per-humid is revised from 32.9 and 52.6 mha to 16.5 and 39.5 mha, respectively. The semi-arid (dry) areas have been revised from 26.3 mha to 49.4 mha. Similarly, length of growing period (LGP) map is also revised. It shows that the area under <60 days is revised from 16.5 to 29.6 mha and the area under LGP class of 60-90 days belonging to the western Rajasthan, arid part of Gujarat and Ladakh region of Jammu and Kashmir is changed from 16.4 to 9.9 mha. Thus there are many changes.

Potential crop zone maps of the country for important crops were developed using legacy soil data (1:1 million scale) by grouping of soils/lands with the similar management needs, revised AER map, and LGP map. Relative spread of the crop and relative yield index were used the key parameters in delineation of crop zones. The crop zones were validated with representative trials. The maps with classes such as 'High Potential' 'Moderate Potential' and 'Low Potential' will aid the policy makers in understanding potential to grow a selected crop in the country/region and decision making. At larger scale, crop decisions could be assisted by LRI data on 1:10K scale. Based on these data land use plans of 21 blocks / mandal / taluka were prepared including available options of crops and cropping sequences for *kharif* and *rabi* season with benefit: cost ratio. Implementation of LUP was demonstrated in a cluster of villages (Gosaba Block). It reveals that the cropping intensity increased from existing 112 to 198–296 per cent, which is reflected in increased income and better livelihood. Similarly, customised recommended management practices were implemented and proved to be highly

rewarding in H D Kote villages. In another village level LUP executed in a cluster of villages in Warud block, desiltaion of drain lines, introduction of micro-irrigation, soil test based management practices involving integrated nutrient and water management in different land management units proved effective in enhancing crop yields and livelihood. In case of chickpea (Variety-Vishal), 92 and 137 per cent increase was found in LMU 2 and 3 over farmers' practice with B: C ratio of 2.9 and 3.4, respectively. In Bukkarayasamudrum block, field studies showed that deep soils (75-100 cm) have higher BC ratio of 2.05 than their counter parts on medium deep (50-75 cm) 2.0 and shallow (25-50 cm) soils 1.97. Higher B:C ratio of 2.42 was recorded in loamy soils as compared to other soils. Higher B:C Ratio of 2.02 was registered in Non calcareous soils than their calcareous counterparts (1.95).

LRI data are also very useful in estimating water harvesting potentials and planning soil conservation measures. In eight watersheds of Karnataka, water harvesting potential has been estimated using LRI database with existing and proposed water bodies. The estimated command area in each watershed is also calculated for 10, 15 and 20 cm irrigation. Another study was conducted in Darwha block of Yavatmal district, Maharashtra using LRI database for soil and water conservation measures and for projecting water harvesting potentials in three situations of rainfall. The soil, water and socio-economic data were overlaid to arrive at integrated LUP. The LUP suggests possible ways for execution of govt. sponsored land based activity keeping in view the practical feasibility in conjunction with socio-economic conditions of the farmers. Ground water potential zones delineated in the study are recommended for better water management in the block. The study claims that shallow soils generally owned by small and marginal farmers should be targeted for soil conservation plans, whereas medium farmer's owner of medium and deep soils should be chosen for diversification of agriculture. Non eroded deep soils owned by large farmers are the ideal family for targeting value added crops.

In a major step towards use online dissemination of information, a dedicated Geo-portal 'BHOOMI' is being developed. Soil maps of 1:1M, 1:250000, 1:50000 and 1:10000; various thematic maps on natural resources depicting type, spatial distribution and severity of degradation and desertification; degradation in crop land, prime agriculture land, soil nutrient status map depicting area of sufficiency, deficiency and toxicity of nutrients in the country; area vulnerability to drought (type and severity) and flood (extent and severity) are structured in a systematic manner. The bureau is also actively involved as key partner in conceptualization of theme and development of ICAR Research Data Repository for Knowledge Management (KRISHI). The bureau developed "Rubber Soil Information System" based on interpolated soil fertility data in collaboration with Indian Institute of Information Technology and Management - Kerala (IIITM-K) overlaying different soil fertility parameters and soil depth following the guidelines of discriminatory fertilizer recommendation and released for use. Development of Digital Library (DL) using Visual studio is another achievement. The DL user can access and visualize the information on the soils, current land use, existing hydrological structures, proposed conservation measures, fertility status and suitability to different crops.

Land Resource Inventory on 1:10,000 scale was the major activity of the Bureau during the reporting period. Soil maps of twenty blocks were finalized during the year and 230 soil series were identified and the soils were mapped into 530 phases of soil series. This included the whole state of Goa with 33 soil series mapped into 139 phases. Thus the overall progress of the LRI indicate that the base-maps were prepared for 96 talukas and field survey has been completed in 94 blocks and 2 blocks are on the verge of completion. Soil maps were finalized in 45 blocks.

Soil genesis studies indicated that Vertisols and the intergrades of Bemetara block of Chhattisgarh are formed from the alluvium-derived from Deccan basalt and not from the shale rock observed in the area. Soil-landform relationship was studied in major landforms of the country wherein land resource inventory was going on. Soil variability were interpreted using coefficient of variations and factor analysis for combined datasets of the landforms. Indexing for soil quality was another area of research carried out by the Bureau during the period. Minimum data sets for assessing soil quality were arrived through different methods. Studies indicated that expert opinion derived weighted index for soil quality were consistent in their correlation with crop yield indicating its better performance. A submodule to assess groundwater and surface water, quantity and quality has been developed during the development of a DSS for agricultural land use planning. Under carbon modelling SOC was simulated under different climate change scenarios and it was observed that

recommended dose of fertilizer alongwith FYM can sustain the organic carbon status of the soil in the future.

The information generated through the land resource inventory programme was used for mapping the fallow lands of Goa and *Jhum* lands in north-eastern region of the country. A geospatial approach was adopted for fallow land mapping in the state of Goa wherein, as the first step, the land use/land cover was delineated using the IRS-R2-LISS-IV P6 data of 5.8-meter resolution and high resolution google earth and was compared with the land use / land cover maps of the state generated at different time scales. The area under *Jhum* land (shifting cultivation) was mapped in Mokokchung district of Nagaland and in the Kolasib district of Mizoram. About 0.74 % of the total area was found to be under *Jhum* cultivation in Kolasib district and the *Jhum* area increased from 10183 in 2015 to 10841 in 2017 in Mokokchung district.

The methodology of land degradation mapping, using Revised Universal Soil Loss Equation (RUSLE), at 1: 10,000 scale was standardized and tested at ten sites representing different agro-ecosystems of the country. Degraded lands of Uttar Pradesh state were identified using time series Normalized Difference Vegetation Index (NDVI), based on the hypothesis that the degraded lands constantly have lower biomass productivity reflected in terms of continuous lower NDVI. Spatial-contextual information from high resolution Landsat data was combined with land degradation patterns identified with time series NDVI to get large scale maps of degraded lands. The main degradation types in the IGP are salt affected soils which have been estimated for twenty districts. Desertification mapping was carried out at 1:50000 scale using three seasons LISS-III data of 2011-13. The results showed that 40.5, 47.6, 34.1 and 27.7% of total geographical area of Bellary, Anantapur, Mahabubnagar and Chamarajanagar, respectively, were affected by land degradation / desertification processes. Desertification vulnerability index (DVI), a cumulative index of climate, soil, land utilization and socioeconomic, was developed to classify the intensity of desertification and delineate the priority areas that need immediate action to combat the desertification.

The village/survey number wise fertility data for all the 66 Micro Watersheds and 33 villages of Karnataka have been covered and the soil fertility maps were generated using interpolation technique in GIS. In another study of soil fertility, acidity and inadequate level of phosphorus, calcium, magnesium, sulphur, zinc and boron were found to be the major soil fertility problems of Elamdesom block in Todupuzha taluk (an area of 40,307 ha) of Idukki district, Kerala. The soils of coffee and rubber growing areas of Kerala, Tamil Nadu and Karnataka were characterized with respect to soil fertility by monitoring 121 sites. The status of exchangeable Al^{+3} and aluminium saturation percentage were also measured. The hyper-spectral characteristics of these soils were also studied and a very strong absorption feature was found around 1400, 1900 and 2200 nm wavelength indicating dominance of kaolinitic clay minerals in soils. The spectral data has been modelled for prediction of soil organic carbon (SOC).

Soil Health Cards were prepared for the farmers of the Piprakothi block of East Champaran district, Bihar, Nagpur rural taluka of Nagpur district and Kelapur taluka of Yavatmal district. The soil samples were collected at 325x325 meter grid interval. The soil samples were analyzed for soil reaction (pH), organic carbon and salinity (EC), available major nutrients (N, P, K), micronutrients (Fe, Mn, Zn, Cu) and sulphur. Based on the chemical analysis of the grid soil samples and critical limit of the nutrient, the soil health cards were prepared for all the farmers of three blocks/talukas and suggestions were also given for application of correct quantity of the fertilizers including farm yard manures or other organic manures to be applied to improve the soil health for increasing productivity and sustainability.

1 NBSS & LUP : A PROFILE

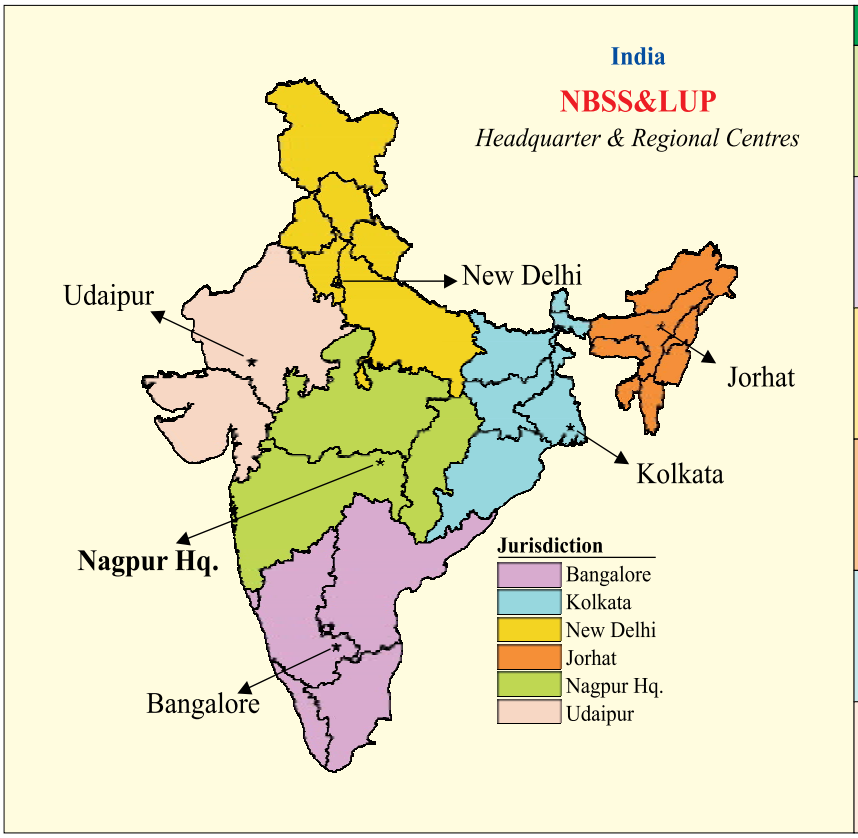
Genesis

Subsequent to the recognition of Soil Survey as a National Priority, a need was felt for creating a centralized information warehouse to assimilate, verify and disseminate information on nature, extent and distribution of soils in the country. Consequently, the Indian Council of Agricultural Research (ICAR) established National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) (to be hereafter referred to as Bureau) in 1976, with its Hqrs. at Nagpur. The Hqrs. houses 3 Research Divisions, namely, Division of Remote Sensing Applications, Division of Soil Resource Studies and Division of Land Use Planning. Subsequently, five regional centres came into existence that are located at Bangalore, Delhi, Jorhat, Kolkata and Udaipur and address regional specific issues in the mandated areas of work.

The Bureau is the country's only premier national institute mandated for research, development and training (RD&T) in the field of soil survey, land use planning and allied aspects. Over the years, the Bureau has excelled as a centre of RD&T in Soil Survey and Land Use Planning at national and international level.

Location

The Hqrs. is located on Amravati Road (Kolkata-Mumbai National Highway 6). It has in its close vicinity the ICAR-affiliated Central Citrus Research Institute (CCRI), Ginning Training Centre (GTC) a regional centre of Central Institute for Research on Cotton Technology (CIRCOT), and Regional Remote Sensing Centre (RRSC) ISRO. The campus of the Bureau is also quite close to Nagpur University. The Hqrs., therefore, has locational advantage which facilitates multidisciplinary studies, inter-institutional interactions and research linkages, etc. A map showing location of the Hqrs and the five regional centres is shown below.



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Mandate

- To conduct soil survey and mapping of the soils of the country to promote scientific and optimal land use programmes in collaboration with relevant institutions and agencies.
- To conduct and promote research in the National Agricultural Research System in the areas of Pedology, Soil survey, Remote sensing applications, Land degradation, Land evaluation and Land use planning.
- To impart training and education to create awareness on soil and land resources and their state of health.

The role of the ICAR-National Bureau of Soil Survey and Land Use Planning (ICAR-NBSS&LUP) becomes more important in view of the serious challenges the country faces in terms of shrinking soil and land resource base, soil/land degradation, depleting nutrient stock, deterioration in soil/land quality, changing climate, land use conversion and non-judicious planning of land use.

Major research themes

- Inventorying natural resources
- Remote sensing and GIS applications
- Pedological Research
- Soil Survey Data Interpretation and Applications
- Land Evaluation and Land Use Planning

Training Areas

- Soil Survey and Land Evaluation for Land Use Planning
- Remote Sensing and GIS Applications in Soil Resources Mapping

Management

A high powered Research Advisory Committee (RAC) comprising eminent professionals, mostly from outside the ICAR system guides the Bureau on formulating its research policies thrusts area and strategies.

The Institute Management Committee (IMC), constituted and mandated by the ICAR, supervises the functioning of the Bureau. Internal Committees, such as, Institute Research Council, Purchase Committee, Library and Publication Committee, Official Language Committee and a Grievance Cell, to name a few, are operating for decentralization of management. The Institute Joint Staff Council promotes healthy interaction and congenial work environment.

Infrastructural Facilities

Laboratories

The Bureau has various state-of-art laboratories. Some of the modern and sophisticated equipments are listed below.

- X-ray diffractogram
- Scanning Electron Microscope
- Inductively coupled Plasma Spectrometre
- Atomic Absorption Spectrophotometer
- Spectroradiometer
- Latest Remote Sensing and GIS softwares
- CN Analyzer

The facilities available in micromorphology and GIS laboratories are the best in the country that match international standards.

Library

The Bureau houses a fully computerized library located at the Hqrs. that has a comprehensive collection of books, reports and periodicals. The regional centres also have computerized libraries.

ICAR-NBSS&LUP website

The Bureau posts all important information about its activities, particularly about research projects, publications, linkages, educational trainings, staff and infrastructure on its Website (http://www.nbsslup.in).

Major Achievements

1976-2016

The Bureau, through its journey over last 4 decades, has every reason to feel proud for its tremendous accomplishments in the domains of research and development.

- Soil resource map of the country (1:1 million scale), states (1:250,000 scale) and 82 districts (1:50,000 scale),selected watersheds (267), blocks (60), villages (173) and research farms (106) on 1:10000 scale, Geo-referenced soil information system for black soil region (BSR) and Indo-Gangetic plain (IGP) monitoring soil quality
- Agro-Ecological Regions (AER) and Agro-ecological Sub-Region (AESR) maps of country,
- Land evaluation and land use planning of irrigated, rainfed, coastal, arid, and hill and mountain Agro-ecosystem and showcasing of agro-techniques at 56 operational units; Land Use Planning

in coconut based farming system of Kerala, strategies for natural resource management in backward district of India). strategies for arresting other forms of land degradation in India

- Spectral characteristics of benchmark soils of India, mineral composition of dominant soils of India, Organic carbon stock of Indian soils in general, cold arid and hot arid region of India in particular (Product) and Spectral Library (Technology).
- Automated Land Evaluation Software for Linking Socio-economic conditions of the farmers and natural resource information
- Soil erosion map of the country and the states on 1:250000 scale; extent and severity of degradation in the country and in the crop land using Remote sensing and GIS
- Methodology for Land Resource Mapping on 1:10000 scale in the different agro-ecological regions of the country using high resolution remote sensing data and GIS in conjunction with the cadastral map for site specific information and situation specific recommendation
- Soil nutrient maps on 1:50000 scale for the state of West Bengal, Kerala, Goa, Karnataka, Jharkhand, Assam, and Nagaland, Sikkim. Tripura, Andhra Pradesh and Telangana and mining the data for delineating area affected by low balance of multiple nutrients using GIS and GPS in the Eastern and North-Eastern Region
- Web and Mobile based Farmers' Advisory for Soil Nutrient Management and input based land use planning
- Methodology developed for Soil Health Cards for farmers of different regions using Geo-informatics
- Methodology for district, block and watershed/ village level land use planning on 1:10000 scale.

Salient achievements (2016-17)

- Methodology for Land Resource Inventory on 1:10000 scale, using high resolution remote sensing data and perfected application of land resource inventory data of 1:10000 scale for Fallow and Khajan land mapping of Goa, salt affected area of coastal region, extent of shifting cultivation in Nagaland and Meghalaya, delineation of degraded land in the different agro-ecological regions and assessment of water harvesting potential and soil-water conservation measures requirement in the watershed.
- **Site Soil-land use models** for enhancing productivity and improving livelihood for tribal farmers in Bali Island Sundarban (Rice-vegetable cropping system with farm pond technologies), Agro-silvicultural based land use models in the coastal ecosystem of A&N Island, Rice-wheat and Rice-maize cropping systems with conservation technology on coarse loamy soils of middle Gangetic plains; Cotton and wheat based cropping system in command area of desert; Alternate land-use systems for non-command area of the desert ecosystem; Pigeonpea-rice-pigeonpea-rice on uplands and Rice+sunhemp-fallow in on low lands, Jharkhand state, paddy-vegetable based cropping system in flood plains of Brahmputra, cotton-finger millet based cropping system on Mysore plateau of Karnataka.
- **Land use plans (options)** for enhancing productivity, improving livelihood and arresting land degradation in Bali Island of Sundarbans, West Bengal, H.D. KoteTaluk, Mysore District, Karnataka and Bhomoraguri, Jorhat district, Assam, UparDeurigaon, North West Jorhat Development Block, Jorhat district, Assam, Bahphalagaon, North West Jorhat Development Block, Jorhat district, Assam, Natun Chaporigaon, Kakadanga Block, Golaghat district, Assam, rainfed ecosystem of Deccan plateau (Case studies of three Mandals of Telangana) and delineation of potential areas for growing cotton, soybean, sesame, safflower medicinal plants in Karnataka, rubber, spices and coconut in Kerala.
- Scale Neutral Database (dedicated Geo-portal on soils, Bhumi), **Web and Mobile based Farmer's advisory for input based land use planning; MridaSangrahak** (Android based mobile apps for collecting Geo-referenced smart mobile phone aided soil samples **and automated land evaluation software. Protocols for delineating prime agriculture land in the country.**
- Developed a farmer's advisory service, hosted on www.wbagrisnet.gov.in of the NIC server and linked to mobile phones that guides farmers on soil fertility management of West Bengal for growing vegetables, rice, pulses and fruits.
- Potential area for growing onion has been identified in the selected villages of Aurangabad, Dhule and Gondia districts of Maharashtra and a number of soil based agro-technologies implemented for livelihood improvement of the farmers.
- Participatory diagnosis exercise was undertaken in selected hamlets of villages of Mysore district, Karnataka, 24 Paraganas (South) district, West

Bengal and Jorhat, Assam under the Tribal Sub Plan to identify the needs of the tribal community, prioritize and address them.

- Prepared Soil health cards and distributed 1.5 lakh farmers of Telangana State. Apart from this we prepared the base for issuing 70,000 soil health cards to the farmers of Maharashtra and 1045 cards to the other parts of the country.

New initiatives

- Land use planning for managing acid sulphate soils
- Application of geo-informatics in land use planning and land degradation studies
- Assessment and monitoring of impact of land use planning on soil system and environment
- Development of Soft Computing Techniques for Land Evaluation
- Updation of information on prime land of different states and the country
- Fallow land mapping of the country
- Updation of National Soil Geoportal.

Linkages

The Bureau maintains close linkages with many national organizations like ICAR institutes, State Agricultural Universities (SAUs), state Departments of Agriculture, Soil and Land Use Survey of India (SLUSI), National Remote Sensing Centre (NRSC), Hyderabad, Govt. of Telangana, Govt. of Meghalaya and Govt. of Goa.

It has also maintained close linkages in the past with a number of international organizations like ICRISAT, Hyderabad, CYMMIT, New Delhi, ISRIC, ITC, the Netherlands and APARI, Bangkok.

Thrust areas for 2017-2020

- **Flagship projects of the Institute**
  - To undertake work in Phase-II of the programme on Land Resource Inventory on 1:10000 scale.
  - To undertake work in the Phase-II of the programme on Agricultural Land Use Planning using Land Resource Inventory Database.
- **Develop demand driven soil and land resources inventory at different levels with special emphasis on village/farm level inventory**
  - Develop soil and land resource database and maps at different levels, particularly at village level to enable undertake precision agriculture.
  - Establish benchmark soil series in the National Register for transfer of technology
  - Develop 'Benchmark soil series Bank'
  - Develop soil degradation maps at different levels to evolve suitable soil and water conservation techniques/practices
- **Emerge as global leaders in basic and strategic research in soil resources**
  - Develop concepts and knowledge base on soil formation
  - Development of Indian soil taxonomy rationale
  - Development of user-friendly classification system for varied conditions
  - Explore applicability of remote sensing and GIS techniques and assess their effectiveness and efficiency in soil resource mapping
  - Agro-ecological regionalization
  - Understand relevance and importance of soil functions in eco-system services and generate soil quality indicators and quantify soil quality in different regions
  - Develop national soil resource information system
  - Develop soil carbon and other nutrients maps
  - Develop indicators of climate change impact (on soils and land use) and soil processes-based mitigation techniques
- **Generate contemporary land use plans at different levels specially at the level of village/ farm**
  - Delineate crop production zones and evaluate land for land use allocation based on land capability and land suitability classification
  - Optimum utilization of vacant (fallow) lands based on their capability and soil suitability
  - Prepare blue prints for efficient land use planning for varied purposes and at different levels
  - Develop Decision Support System for sustainable land resource management
- **Emerge as a Centre of Excellence for capacity building in soil survey, remote sensing and GIS applications in soil resource mapping, land evaluation and land use planning**
  - Teaching and training
- **Adapt RD&T programmes to address**

contemporary societal challenges

- To establish linkage with national and international organizations, stakeholders including farmers

- **Suggest perspective land use policies for varied situations**
  - To equip the policy makers with policy guidelines on various issues towards suggesting perspective land use policies.

Budget (2016-17)

Plan

Funds Received : 470.00 Lakhs

Funds Utilized : 470.00 Lakhs

Non-Plan

Funds Received : 6206.15 Lakhs

Funds Utilized : 5792.41 Lakhs

Revenue Generation (in Rs.)

Research Projects : 42737781

Sales of publications : 238747

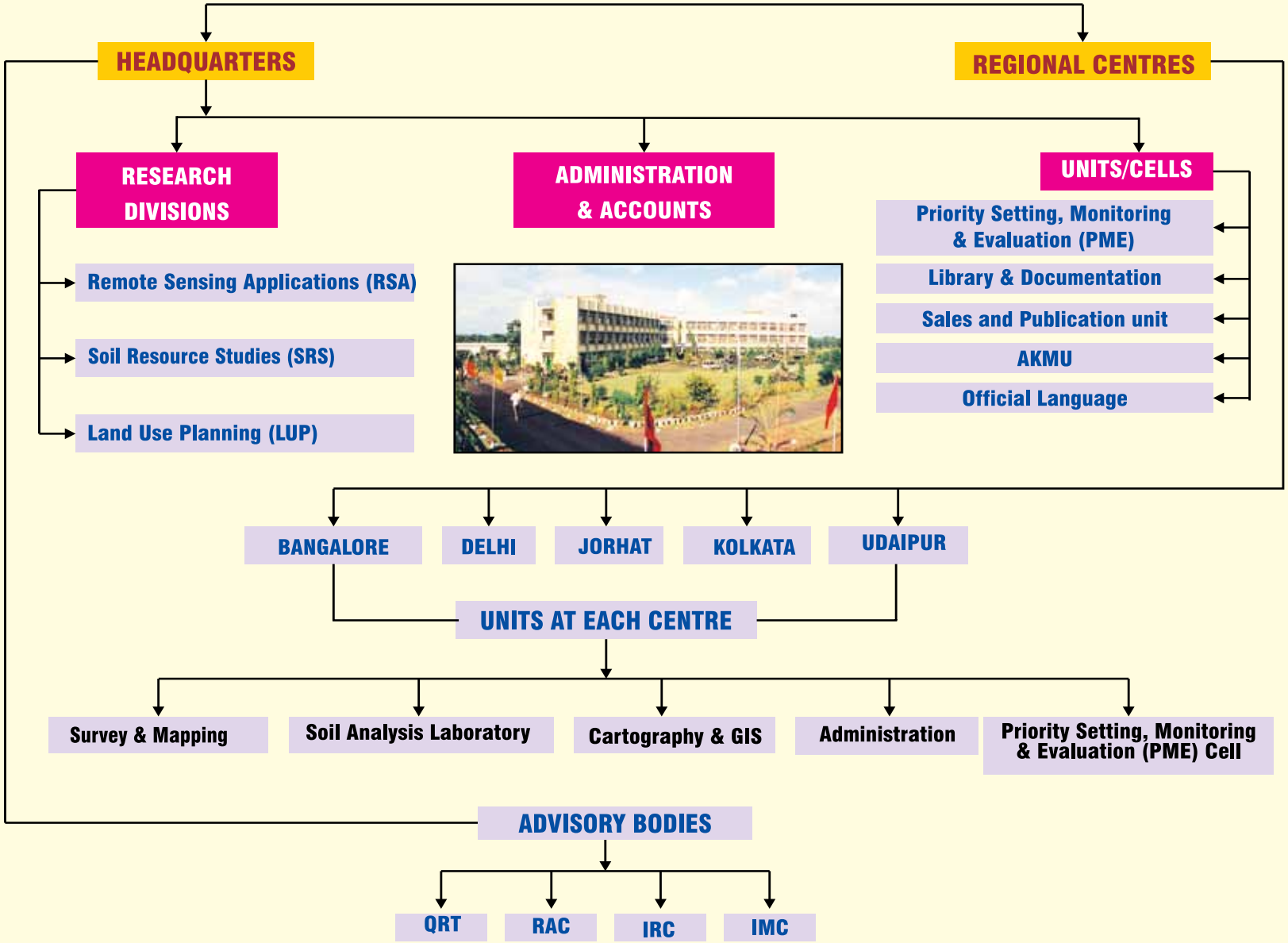
Soil analysis/testing : 911650

Total : 43888178

Staff strength (as on 31.03.2017)

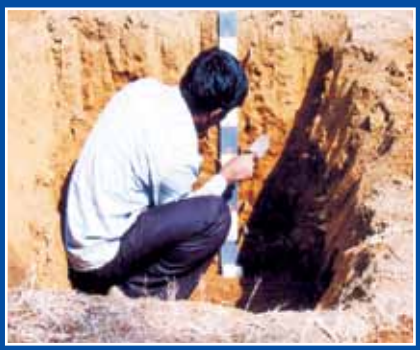
Category	Sanctioned	Filled	Vacant	% Vacant
Scientific	100	76	24	21
Technical	165	132	33	18
Administrative	67	44	23	28
Supporting	76	42	34	34
Total	408	294	114	23

ORGANOGRAM


HEADQUARTERS
REGIONAL CENTRES
RESEARCH DIVISIONS
ADMINISTRATION & ACCOUNTS
UNITS/CELLS
Remote Sensing Applications (RSA)
Soil Resource Studies (SRS)
Land Use Planning (LUP)
Priority Setting, Monitoring & Evaluation (PME)
Library & Documentation
Sales and Publication unit
AKMU
Official Language
BANGALORE
DELHI
JORHAT
KOLKATA
UDAIPUR
UNITS AT EACH CENTRE
Survey & Mapping
Soil Analysis Laboratory
Cartography & GIS
Administration
Priority Setting, Monitoring & Evaluation (PME) Cell
ADVISORY BODIES
QRT
RAC
IRC
IMC

2 RESEARCH ACHIEVEMENTS

- REMOTE SENSING AND GIS APPLICATIONS
- INVENTORYING NATURAL RESOURCES
- PEDOLOGICAL RESEARCH
- INTERPRETATION OF SOIL SURVEY DATA
- LAND EVALUATION AND LAND USE PLANNING
- EXTENSION PROGRAMME



2.1 REMOTE SENSING AND GIS APPLICATIONS

Delineation of Landscape Ecological Unit (LEU): A base map for Land Resource Inventory on 1:10000 scale

A. Northern region

Lahul block, Lahaul and Spiti district, Himachal Pradesh (32°07'50" to 33°15'39"N latitude and 76°21'59" to 77°47'00"E longitude, Area 201085 ha). Lahul block is a part of cold arid region of India belonging to Greater Himalayas (with or without cryic temperature regime) under the physiographic region of Himalayas and other mountain range. The block has been classified into 23 landscape ecological units (Fig. 2.1.1 and Table 2.1.1), associated with summits/ridge tops, side/ reposed slopes, mountain and valley glaciers and fluvial valley landforms.

Pangi block Chamba district Himachal Pradesh (32°48'30"to 33°13'00"N latitude and 76°13'45"to 76°47'20"E longitude, Area 160052 ha). Another block Pangi also represent a part of cold arid region of India belonging to Greater Himalayas with cryic temperature regime under the physiographic region of Himalayas and other mountain range. It is classified into 14 landscape ecological units (Fig. 2.1.2 and Table 2.1.2), associated with summits/ridge tops and side/ reposed slopes, side/reposed slopes and glacio-fluvial valley.

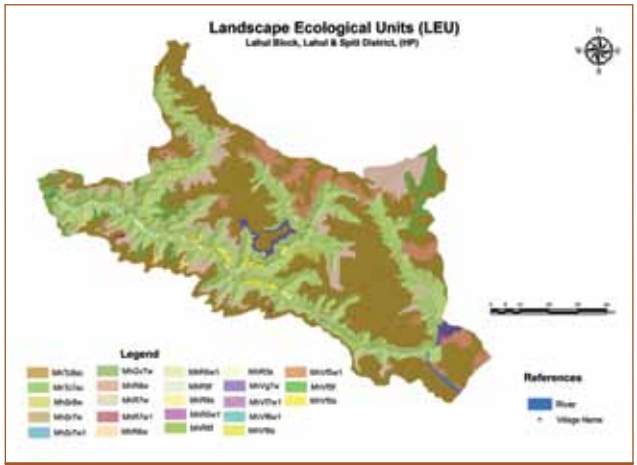


Fig. 2.1.1 Landscape Ecological Unit map of Lahul block

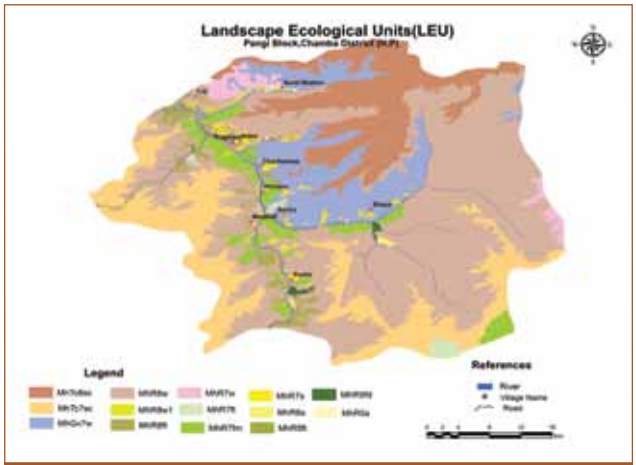


Fig. 2.1.2 Landscape Ecological Unit map of Pangi block

Table 2.1.1. Description of Landscape Ecological Unit Lahul block, Greater Himalayas (with or without cryic temperature regime), Himalayas and other mountain range

LEU	Description
MhTc8sc	Strongly sloping Greater Himalayan cryic temperature regime (snow cover/ ice caps)
MhTc7sc	Very steeply sloping Greater Himalayan cryic temperature regime (snow cover/ ice caps)
MhSr8w	Strongly sloping summits/ ridge tops (waste land)
MhSr7w	Very steeply sloping summits/ ridge tops (waste land)
MhSr7w1	Very steeply sloping summits / ridge tops (scrub land)
MhGv7w	Very steeply sloping mountain and valley glaciers (waste land)

LEU	Description
MhR8w	Strongly sloping side/reposed slopes (waste land)
MhR7w	Very steeply sloping side/ reposed slopes (waste land)
MhR7w1	Very steeply sloping side/reposed slopes (scrub land)
MhR6w	Steeply sloping side/ reposed slopes (waste land)
MhR6w1	Steeply sloping side/ reposed slopes (scrub land)
MhR5f	Steeply sloping side/ reposed slopes (forest)
MhR6s	Steeply sloping side/ reposed slopes (single crop)
MhR5w1	Moderately steeply sloping side/ reposed slopes (scrub land)
MhR6f	Moderately steeply sloping side/ reposed (forest)
MhR5s	Moderately steeply sloping side/ reposed slopes (single crop)
MhVg7w	Very steeply sloping glacio-fluvial valley (waste land)
MhVf7w1	Very steeply sloping fluvial valley (scrub land)
MhVf6w1	Steeply sloping fluvial valley (scrub land)
MhVf6s	Steeply sloping fluvial valley (single crop)
MhVf5w1	Moderately steeply sloping fluvial valley (scrub land)
MhVf5f	Moderately steeply sloping fluvial valley (forest)
MhVf5s	Moderately steeply sloping fluvial valley (single crop)

Table 2.1.2. Description of Landscape Ecological Units Pangi block, Greater Himalayas (Cryic temperature regime), Himalayas and other mountain range

LEU	Description
MhT8sc	Strongly sloping Greater Himalayan cryic temperature regime (snow cover/ ice caps)
MhT7sc	Very steeply sloping Greater Himalayan cryic temperature regime (snow cover/ ice caps)
MhR8w	Strongly sloping side/reposed slopes (waste land)
MhR8s1	Strongly sloping side/reposed slopes (scrub land)
MhR8ft	Strongly sloping side/reposed slopes (thin forest)
MhR7w	Very steeply sloping side/reposed slopes (wast land/pasture/grazing land).
MhR7ft	Very steeply sloping side/reposed slopes (thin forest).
MhR7fm	Very steeply sloping side/reposed slopes (medium dense forest).
MhR7s	Very steeply sloping side/reposed slopes (single crop)
MhR6s	Steeply sloping side/reposed slopes (single crop)
MhR5ft	Moderately steeply sloping side/reposed slopes (thin forest)
MhR5fd	Moderately steeply sloping side/reposed slopes (thick/dense forest).
MhR5s	Moderately steeply sloping side/reposed slopes (single crop)
MhGv7w	Very steeply sloping mountain and valley glaciers (waste land)

Chamba block Tehri Garhwal district Uttarakhand (30°08'52"N to 30° 24'32"N latitude and 78°15'22"E to 78°36'21"E longitude, Area 16256 ha). Chamba block represents Lesser Himalayas in the physiographic region of Himalayas and other mountain ranges and is classified into 31 landscape ecological units (Fig. 2.1.3 and Table 2.1.3) These are associated with summit and ridge top, side slopes and fluvial valley.

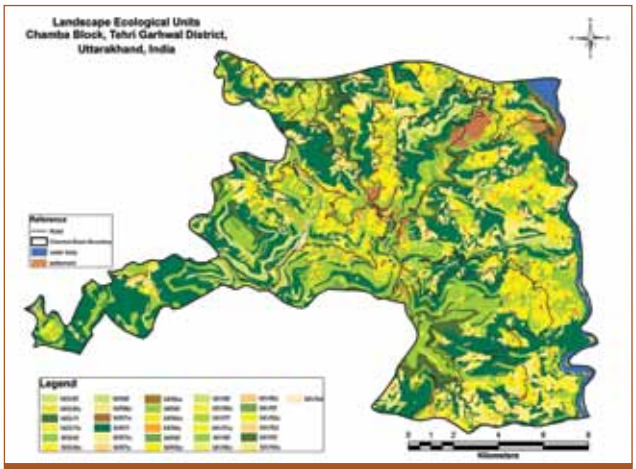


Fig. 2.1.3 Landscape Ecological Unit map of Chamba block

Baragaon block, Varanasi district, Uttar Pradesh (25°23'00"N to25°34'47"N latitude and 82°39'50"E to 82°50'15"E longitude, Area 17243 ha). Baragaon block represents alluvial plains under the Indo-Gangetic Alluvial Plains and is classified into 5 landscape ecological units (Fig. 2.1.4 and Table 2.1.4). These are associated with old alluvial plain, old alluvial plains with concave relief, old alluvial plains with low lying *Tal* lands and young alluvial plains.

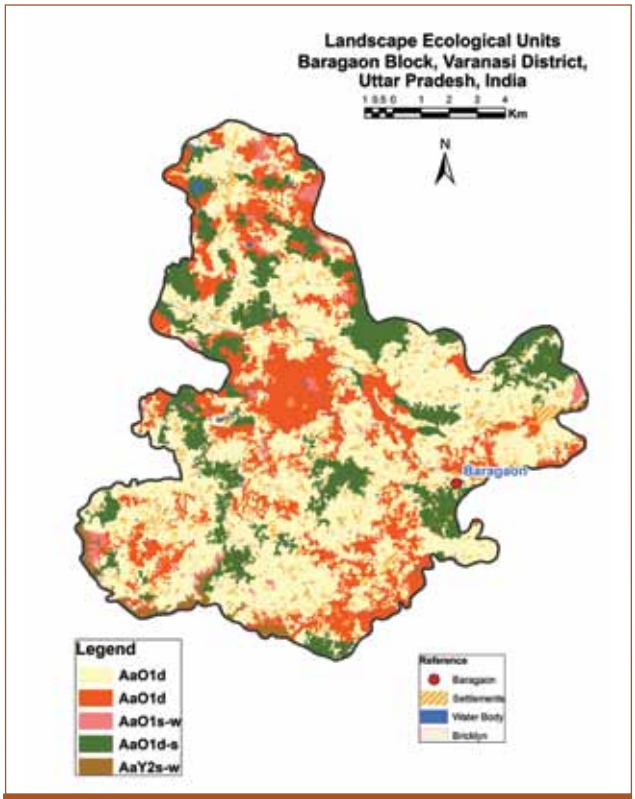


Fig. 2.1.4 Landscape Ecological Unit map of Baragaon block

Table 2.1.3. Description of Landscape Ecological Units Chamba block, Lesser Himalayas; Himalayas and other mountain range

LEU	Description
MIS_r8f	Strongly sloping summits/ridge tops (forest)
MIS_r8tc	Strongly sloping summits/ridge tops (terrace cultivation)
MIS_r7f	Very steeply sloping summits/ridge tops (forest)
MIS_r7tc	Very steeply sloping summits/ridge tops (terrace cultivation)
MIS_r6f	Steeply sloping summits/ridge tops (forest)
MIS_r6tc	Steeply sloping summits/ridge tops (terrace cultivation)
MIR8f	Strongly sloping side slopes (forest)
MIR8tc	Strongly sloping side slopes (terrace cultivation)
MIR7w	Very steeply sloping side slopes (culturable waste)
MIR7f	Very steeply sloping side slopes (forest)
MIR7tc	Very steeply sloping side slopes (terrace cultivation)
MIR7s	Very steeply sloping side slopes (single crop)
MIR6w	Steeply sloping side slopes (culturable waste)

LEU	Description
MIR6f	Steeply sloping side slopes (forest)
MIR6tc	Steeply sloping side slopes (terrace cultivation)
MIR6s	Steeply sloping side slopes (single crop)
MIR5f	Moderately steeply sloping side slopes (forest)
MIR5tc	Moderately steeply sloping side slopes (terrace cultivation)
MIV_f8f	Strongly sloping fluvial valley (forest)
MIV_f8tc	Strongly sloping fluvial valley (terrace cultivation)
MIV_f7f	Very steeply sloping fluvial valley (forest)
MIV_f7tc	Very steeply sloping fluvial valley (terrace cultivation)
MIV_f6f	Steeply sloping fluvial valley (forest)
MIV_f6tc	Steeply sloping fluvial valley (terrace cultivation)
MIV_f6d	Steeply sloping fluvial valley (double crop)
MIV_f5f	Moderately steeply sloping fluvial valley (forest)
MIV_f5tc	Moderately steeply sloping fluvial valley (terrace cultivation)
MIV_f5d	Moderately steeply sloping fluvial valley (double crop)
MIV_f4f	Gently sloping fluvial valley (forest)
MIV_f4tc	Gently sloping fluvial valley (terrace cultivation)
MIV_f4d	Gently sloping fluvial valley (double crop)

Table 2.1.4. Description of Landscape Ecological Units Baragaon block, Indo-Gangetic alluvial plains

LEU	Description
AaO1d	Level to nearly level old alluvial plain (double crop)
AaO1d	Nearly level old alluvial plain (double crop)
AaO1s-w	Nearly level old alluvial plain with salt affected soils (single crop and waste land)
AaO1d-s	Nearly level old alluvial plain with low lying salt affected soils (double crop and single crop).
AaY2s-w	Very gently sloping young alluvial plain with (single crop and waste land)

Odhan block, Sirsa district Haryana (29°42'00"N to 29°58'00"N latitude and 74°47'00"E to 75°07'00"E longitude, Area 49611ha). Odhan block represents alluvial plains in upper Indo-Gangetic Alluvial Plains and is classified into 8 landscape ecological units (Fig. 2.1.5 and Table 2.1.5), associated with alluvial plain, old alluvial plains with concave relief /low lying lands, aeofluvial plains, aeofluvial plains with reclaimed sand dune and aeolian plains with occasional sand dunes.

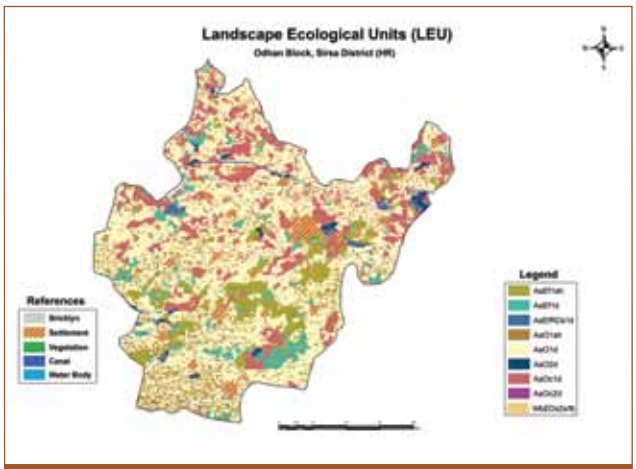


Fig. 2.1.5 Landscape Ecological Units map of Odhan Block

Table 2.1.5. Description of Landscape Ecological Unit Odhan block, Indo-Gangetic Alluvial plains

LEU	Description
AaO1d	Level to nearly level old alluvial plain (double crop)
AaO1ah	Level to nearly level old alluvial plain (agro-horticulture)
AaOc1d	Level to nearly level old alluvial plain with concave relief (double crop).
AaOc2d	Very gently sloping old alluvial plain with concave relief (double crop).
AaE_f1d	Level to nearly level aeofluvial Plains (double crop)
AaE_f1ah	Level to nearly level aeofluvial Plains (agro-horticulture)
AaE_fRD_s1d	Level to nearly level aeofluvial Plains with reclaimed sand dunes (double crop)
$WbED_s2s/fb$	Very gently sloping aeolian Plains with occasional sand dunes (single crop or fallow land other than current fallow)

B. Eastern region

Borio block Sahibganj district Jharkhand (24°57'18'' N to 25°16'48'' Nlatitude and 87°27'46''to 87°42' 27'' E longitude, Area 38590 ha). Borio block is chosen to represent the Chhotanagpur Plateau belonging to the eastern plateau and is classified into 29 landscape ecological units (Fig. 2.1.6 and Table 2.1.6), associated with Rajmahal hill, foot hill, undulating plain, old alluvial plain and flood plain

Katkamdag block Hazaribagh district, Jharkhand (29°42'00"N to 29°58'00"N latitude and 74°47'00"E to 75°07'00"E longitude, Area 12834 ha). Katkamdag block belongs to Hazaribagh plateau in the physiographic region of Chotanagpur plateau and is classified into 40 landscape ecological units (Fig.2.1.7 and Table 2.1.7), associated with gullied land, isolated hillock, plateaus, undulating uplands, undulating plains, and levelled plains.

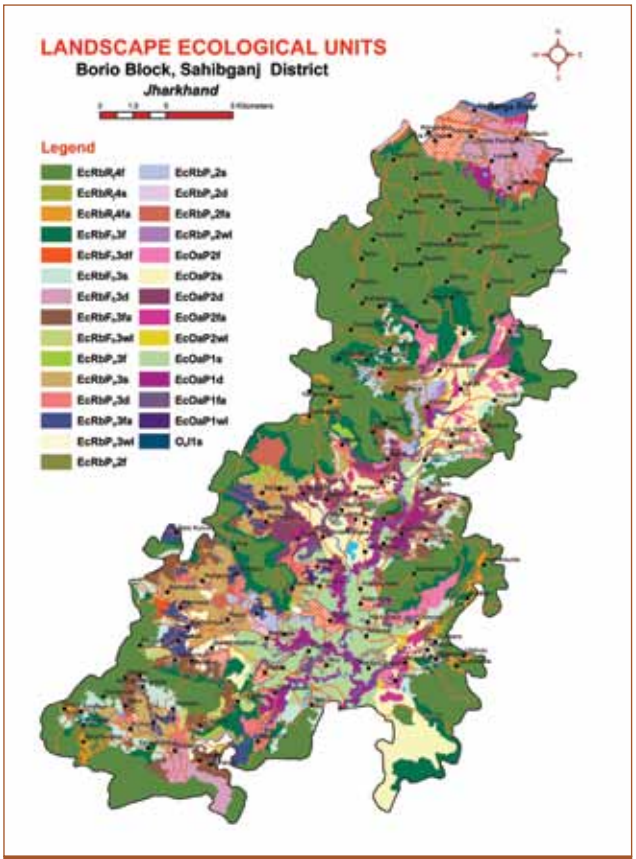


Fig. 2.1.6 Landscape Ecological Unit map of Borio block

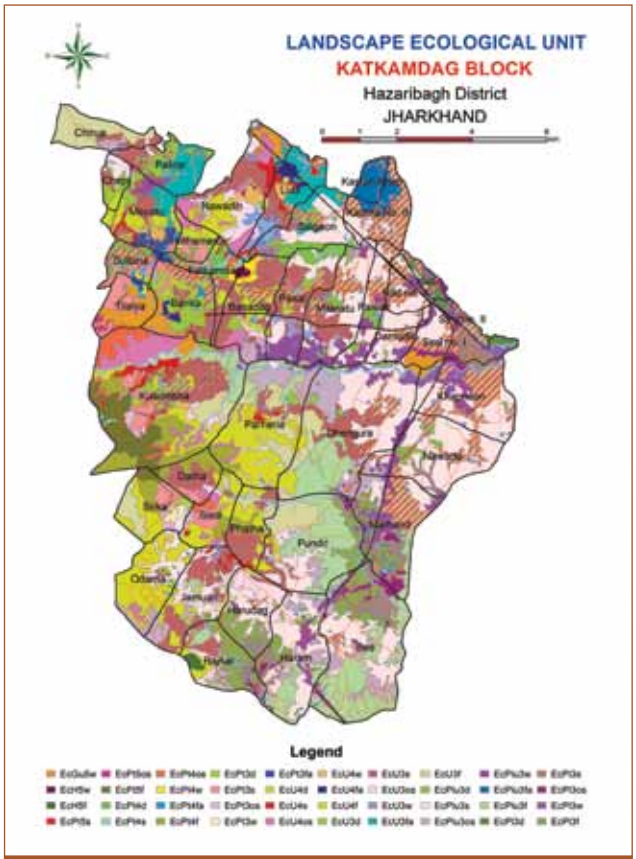


Fig. 2.1.7. Landscape ecological unit map of Katkamdag block

Table 2.1.6. Description of Landscape Ecological Unit Chotanagpur plateau, Eastern plateau

LEU	Description
$EcRbR_j4f$	Rajmahal hill (forest)
$EcRbR_j4s$	Rajmahal hill (single crop)
$EcRbR_j4fa$	Rajmahal hill (fallow land)
$EcRbF_h3f$	Foot hill (forest)
$EcRbF_h3df$	Foot hill (degraded forest)
$EcRbF_h3s$	Foot hill (single crop)
$EcRbF_h3d$	Foot hill (double crop)
$EcRbF_h3fa$	Foot hill (fallow land)
$EcRbF_h3wl$	Foot hill (waste land)
$EcRbP_u3f$	Gently sloping undulating plain (forest)
$EcRbP_u3s$	Gently sloping undulating plain (single crop)
$EcRbP_u3d$	Gently sloping undulating plain (double crop)
$EcRbP_u3fa$	Gently sloping undulating plain (fallow land)
$EcRbP_u3wl$	Gently sloping undulating plain (waste land)
$EcRbP_u2f$	Very gently sloping undulating plain (forest)
$EcRbP_u2s$	Very gently sloping undulating plain (single crop)
$EcRbP_u2d$	Very gently sloping undulating plain (double crop)
$EcRbP_u2fa$	Very gently sloping undulating plain (fallow land)
$EcRbP_u2wl$	Very gently sloping undulating plain (waste land)
EcOaP2f	Very gently sloping old alluvial plain (forest)
EcOaP2s	Very gently sloping old alluvial plain (single crop)
EcOaP2d	Very gently sloping old alluvial plain (double crop)
EcOaP2fa	Very gently sloping old alluvial plain (fallow land)
EcOaP2wl	Very gently sloping old alluvial plain (waste land)
EcOaP1s	Nearly level old alluvial plain (single crop)
EcOaP1d	Nearly level old alluvial plain (double crop)
EcOaP1fa	Nearly level old alluvial plain (fallow land)
EcOaP1wl	Nearly level old alluvial plain (waste land
AaYp1s	Nearly level flood plain (single crop)
AaYp1fa	Nearly level flood plain (fallow land)

Table 2.1.7. Descriptionof Landscape Ecological Units Katkamdag block, Hazaribagh plateau, Chotanagpur plateau

LEU	Legend description
EcGu5w	Strongly sloping gullied land (waste land)
EcH5f	Strongly sloping isolated hillocks (forest)
EcH5w	Strongly sloping isolated hillocks (waste land)
EcPt5s	Strongly sloping plateaus (single crop)
EcPt5os	Strongly sloping plateaus (open scrubs)
EcPt5f	Strongly sloping plateaus (forest)
EcPt4d	Moderately sloping plateaus (double crop)
EcPt4s	Moderately sloping plateaus (single crop)
EcPt4os	Moderately sloping plateaus (open scrubs)
EcPt4w	Moderately sloping plateaus (waste land)
EcPt4fa	Moderately sloping plateaus (fallow land)
EcPt4f	Moderately sloping plateaus (forest)
EcPt3d	Gently sloping plateaus (double crop)
EcPt3s	Gently sloping plateaus (single crop)
EcPt3os	Gently sloping plateau (open scrubs)
EcPt3w	Gently sloping plateau (waste land)

LEU	Legend description
EcPt3fa	Gently sloping plateau (fallow land)
EcU4d	Moderately sloping undulating uplands (double crop)
EcU4s	Moderately sloping undulating uplands (single crop)
EcU4os	Moderately sloping undulating uplands (open scrubs)
EcU4w	Moderately sloping undulating uplands (waste land)
EcU4fa	Moderately sloping undulating uplands (fallow land)
EcU4f	Moderately sloping undulating uplands (forest)
EcU3d	Gently sloping undulating uplands (double crop)
EcU3s	Gently sloping undulating uplands (single crop)
EcU3os	Gently sloping undulating uplands (open scrubs)
EcU3w	Gently sloping undulating uplands (waste land)
EcU3fa	Gently sloping undulating uplands (fallow land)
EcU3f	Gently sloping undulating uplands (forest)
EcPlu3d	Gently sloping undulating plains (double crop)
EcPlu3s	Gently sloping undulating plains (single crop)
EcPlu3os	Gently sloping undulating plains (open scrubs)
EcPlu3w	Gently sloping undulating plains (waste land)
EcPlu3fa	Gently sloping undulating plains (fallow land)
EcPlu3f	Gently sloping undulating plains (forest)
EcPl3d	Gently sloping plains (double crop)
EcPl3s	Gently sloping plains (single crop)
EcPl3os	Gently sloping plains (open scrubs)
EcPl3w	Gently sloping plains (waste land)
EcPl3f	Gently sloping plains (forest)

Piprakothi block, Purba Champaran district, Bihar (26^{0}31'40' to 26^{0}36'20' N latitude and 84^{0}51'49' to 85^{0}02'07' E longitude, Area 6613 ha). Piprakothi block is the part alluvial plains of middle Indo Gangetic plains and is classified into 21 landscape ecological units (Fig. 2.1.8 and Table 2.1.8), associated with young and active alluvial plain.

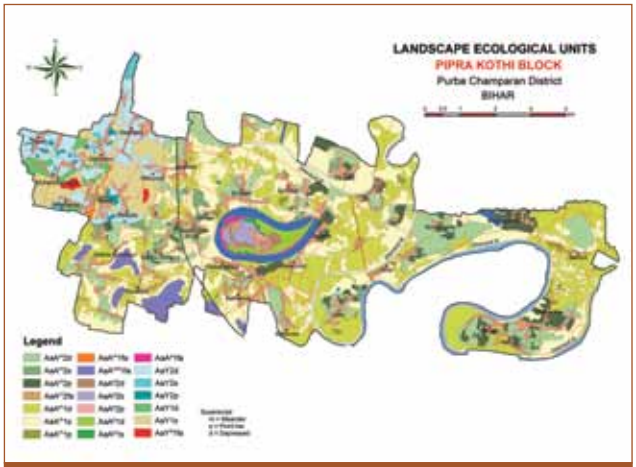


Fig. 2.1.8. Landscape Ecological Unit map of Piprakothi block

Motihari block, Purba Champaran district Bihar (26°32'04" to 26°48'37" N latitude and 84°52'40" to 85°03'32.5"E longitude, Area 23577 ha) belong to Indo-Gangetic plains and is classified into 17 landscape ecological units (Fig. 2.1.9 and Table 2.1.9). These are associated with young and active alluvial plain of river Ganga.

Fig. 2.1.9 Landscape ecological unit map of Motihari block

Table 2.1.8. Description of Landscape Ecological Unit Piprakothi block; Indo-Gangetic alluvial plains

LEU	Description
AaY2d	Very gently sloping young alluvial plain (double crop)
AaY2s	Very gently sloping young alluvial plain (single crop)
AaY2p	Very gently sloping young alluvial plain (plantation)
AaY1d	Nearly level young alluvial plain (double crop)
AaY1s	Nearly level young alluvial plain (single crop)
AaY^{d}1fa	Nearly level young alluvial plain (fallow land)
AaA^{m}2d	Very gently sloping active meander alluvial plain (double crop)
AaA^{m}2s	Very gently sloping active meander alluvial plain (single crop)
AaA^{m}2p	Very gently sloping active meander alluvial plain (plantation)
AaA^{m}2fa	Very gently sloping active meander alluvial plain (fallow)
AaA^{m}1d	Nearly level active meander alluvial plain (double crop)
AaA^{m}1s	Nearly level active meander alluvial plain (single crop)
AaA^{m}1p	Nearly level active meander alluvial plain (plantation)
AaA^{m}1fa	Nearly level active meander alluvial plain (fallow)
AaA^{md}1fa	Nearly level active meander depressed alluvial plain (fallow)
AaA^{p}2d	Nearly level active alluvial plain point bar(double crop)
AaA^{p}2s	Very gently sloping active alluvial plain point bar (single crop)
AaA^{p}2p	Very gently sloping active alluvial plain point bar (plantation)
AaA^{p}1d	Nearly level active alluvial plain point bar (double crop)
AaA^{p}1s	Nearly level active alluvial plain point bar (single crop)
AaA^{p}1fa	Nearly level active alluvial plain point bar (fallow)

Table 2.1.9. Description of Landscape ecological units Motihari block, Indo-Gangetic alluvial plains

LEU	Description
AaY2d	Very gently sloping young alluvial plain (double crop)
AaY2s	Very gently sloping young alluvial plain (single crop)
AaY2p	Very gently sloping young alluvial plain (plantation)
AaY1d	Nearly level Young alluvial plain (double crops)
AaY1s	Nearly level Young alluvial plain (single crop)
AaY1p	Nearly level Young alluvial plain (plantation)
AaA^{m}2d	Very gently sloping active alluvial plain (double crops)
AaA^{m}2s	Very gently sloping active alluvial plain (single crop)
AaA^{m}2p	Very gently sloping active alluvial plain (plantation)
AaA^{m}1d	Nearly level active alluvial plain (double crops)
AaA^{m}1s	Nearly level active alluvial plain (single crop)
AaA^{m}1p	Nearly level active alluvial plain (plantation)
AaA^{p}2d	Very gently sloping active alluvial plain (double crops)
AaA^{p}2p	Very gently sloping active alluvial plain (plantation)
AaA^{f}1d	Nearly level active alluvial plain (double crops)
AaA^{f}1s	Nearly level active alluvial plain (single crop)
AaA^{c}1fa	Nearly level active alluvial plain (fallow)

Chakia block Purba Champaran district Bihar (26°16'53" N to 26°30'16"N N latitude and 84°59'35" to 85°12'13"E longitude, Area 19220 ha). Chakia the other block classified into 22 landscape ecological units (Fig.2.1.10 andTable 2.1.10) associated with young and active alluvial plain of river Ganga. It also represents the alluvial land of middle Indo Gangetic Plain.

Baisi block Purnia district Bihar (25°44'41" to 25°56'03" N latitude and 87°40'18" E to 87°48'48" E longitude, Area 20460 ha). Baisi block is classified into 15 landscape ecological units (Fig. 2.1.11 and Table 2.1.11), associated with young and active alluvial plains of river Ganga, represents a part of middle Indo Gangetic Plains.

Fig. 2.1.10. Landscape ecological unit map of Chakia block

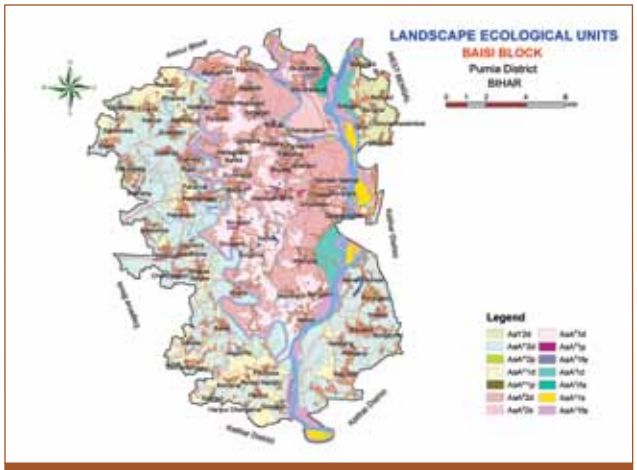


Fig. 2.1.11. Landscape ecological unit map of Baisi block

Table 2.1.10. Description of Landscape Ecological Units Chakia block, Indo-Gangetic alluvial plains

LEU	Legend description
AaY2d	Very gently sloping young alluvial plain (double crops)
AaY2s	Very gently sloping young alluvial plain (single crop)
AaY2p	Very gently sloping young alluvial plain (plantation)
AaY1d	Nearly level young alluvial plain (double crops)
AaY1s	Nearly level young alluvial plain (single crop)
AaY1p	Nearly level young alluvial plain (plantation)
AaY^{d}1fa	Nearly level young alluvial plain (fallow)
AaA2d	Very gently sloping active alluvial plain (double crops)
AaA2s	Very gently sloping active alluvial plain (single crop)
AaA2p	Very gently sloping active alluvial plain (plantation)
AaA2of	Very gently sloping active alluvial plain (open field)
AaA1d	Nearly level active alluvial plain (double crops)
AaA1s	Nearly level active alluvial plain (single crop)
AaA1p	Nearly level active alluvial plain (plantation)
AaA1of	Nearly level active alluvial plain (open field)
AaA1fa	Nearly level active alluvial plain (fallow)
AaA1s	Nearly level active alluvial plain (single crop)
AaA^{m}fa	Nearly level active alluvial plain (fallow)
AaA1d	Nearly level active alluvial plain (double crops)
AaA^{f}1s	Nearly level active alluvial plain (single crop)
AaA^{f}1fa	Nearly level active alluvial plain (fallow)
AaA^{c}1fa	Nearly level active alluvial plain (fallow)

Table 2.1.11. Description of Landscape Ecological Units Baisi block, Indo-Gangetic alluvial plains

LEU	Description
AaY2d	Very gently sloping young alluvial plain (double crops)
AaA2d	Very gently sloping active alluvial plain (double crops)
AaA2p	Very gently sloping active alluvial plain (plantation)
AaA1d	Nearly level active alluvial plain (double crops)
AaA1p	Nearly level active alluvial plain (plantation)
AaA^{f}2d	Very gently sloping active alluvial plain (double crops)
AaA2s	Very gently sloping active alluvial plain (single crop)
AaA^{i}2p	Very gently sloping active alluvial plain (plantation)
AaA1d	Nearly level active alluvial plain (double crops)
AaA1p	Nearly level active alluvial plain (plantation)
AaA1fa	Nearly level active alluvial plain (fallow)
AaA1d	Nearly level active alluvial plain (double crops)
AaA1fa	Nearly level active alluvial plain (fallow)
AaA1s	Nearly level active alluvial plain (single crop)
AaA1fa	Nearly level active alluvial plain (fallow)

Tangi block Khorda district Odisha (19°47'58" N to 20°06'40"N latitude and 85°17'10" E to 85°35'10"E longitude, Area 34374 ha). Tangi block is classified into 50 landscape ecological units (Fig. 2.1.12 and Table 2.1.12) which are associated with hills, upland, valley, alluvial plains, coastal plains, represents a part of east coast in the coastal plains of India.

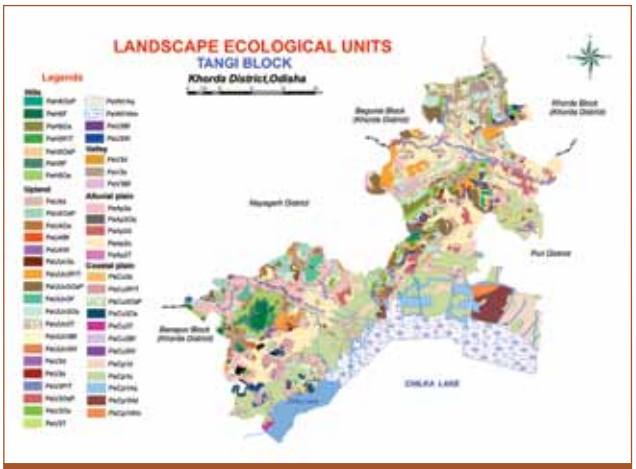


Fig. 2.1.12. Landscape ecological unit map of Tangi block

Dumka block, Dumka district, Jharkhand (24°03'55" N to 24°25'42" N latitude and 87°12'21" E to 87°24'38" E longitude, Area 37950 ha). Dumka block is classified into 50 landscape ecological units (Fig. 2.1.13 and Table 2.1.13), associated with depressed land, undulating alluvial plain, lower pediment, upper pediment, undulating upland, valley fill, undulating plateau, foot hill and residual hillock, represents a part, of Chhotanagpur plateau in the eastern plains of India.

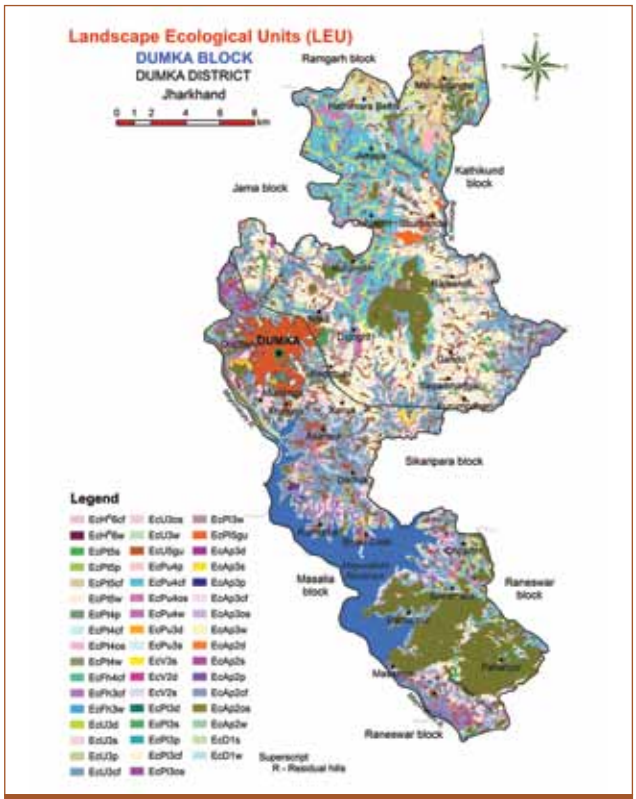


Fig. 2.1.13. Landscape ecological unit map of Dumka block,

Table 2.1.12. Description of Landscape ecological units Tangi block, East coast, Coastal plains

LEU	Description
PeH6OsP	Steeply sloping residual hill (open scrub/ plantation)
PeH6F	Steeply sloping residual hill (forest)
PeH6Os	Steeply sloping residual hill (open scrub/wasteland/degraded forest)
PeH5P/T	Moderately steeply sloping foot hill (plantation/Trees)
PeH5OsP	Moderately steeply sloping foot hill (open scrub/ plantation)
PeH5F	Moderately steeply sloping foot hill (forest)
PeH5Os	Moderately steeply sloping foot hill (open scrub/wasteland/degraded forest)
PeU4s	Gently-moderately sloping upland (single crop)
PeU4Osp	Gently-moderately sloping upland (open scrub/ plantation)
PeU4Os	Gently-moderately sloping upland (open scrub/wasteland/degraded forest)
PeU4Bf	Gently-moderately sloping upland (bare field)
PeU4W	Gently-moderately sloping upland (wasteland)
PeUUn3s	Gently sloping undulating upland (single crop)
PeUUn3P/T	Gently sloping undulating upland (plantation/trees)
PeUUn3OsP	Gently sloping undulating upland (open scrub/ plantation)
PeUUn3F	Gently sloping undulating upland (forest)
PeUUn3Os	Gently sloping undulating upland (open scrub/wasteland/degraded forest)
PeUUn3T	Gently sloping undulating upland (trees/plantation/cultivation)
PeUUn3Bf	Gently sloping undulating upland (bare field)
PeUUn3W	Gently sloping undulating upland (waste land)
PeU3d	Gently sloping upland (double crop)
PeU3s	Gently sloping upland (single crop)
PeU3P/T	Gently sloping upland (plantation/trees)
PeU3OsP	Gently sloping upland (open scrub/ plantation)
PeU3Os	Gently sloping upland (open scrub/wasteland/degraded forest)
PeU3T	Gently sloping upland (double crop)
PeU3Bf	Gently sloping upland (bare field)
PeU3W	Gently sloping upland (wasteland)
PeV3d	Gently sloping valley fill (double crop)
PeV3s	Gently sloping valley fill (single crop)
PeV3Bf	Gently sloping valley fill (bare field)
PeAp3s	Gently sloping alluvial plain (single crop)
PeAp3Os	Very gently sloping alluvial plain (open scrub/wastel and/degraded forest)
PeAp2d	Very gently sloping alluvial plain (double crop)
PeAp2s	Very gently sloping alluvial plain (single crop)
PeAp2T	Very gently sloping alluvial plain (trees/plantation/cultivation)
PeCu3s	Gently sloping coastal upland (single crop)
PeCu3P/T	Gently sloping coastal upland (plantation/trees)
PeCu3OsP	Gently sloping coastal upland (open scrub/ plantation)
PeCu3Os	Gently sloping coastal upland (open scrub/wasteland/degraded forest)

LEU	Description
PeCu3T	Gently sloping coastal upland (trees/plantation/cultivation)
PeCu3Bf	Gently sloping coastal upland (bare field)
PeCu3W	Gently sloping coastal upland (waste land)
PeCp1d	Nearly level coastal plain (double crop)
PeCp1s	Nearly level coastal plain (single crop)
PeCp1Aq	Nearly level coastal plain (aquaculture)
PeCp1Md	Nearly level coastal plain (mudflat)
PeCp1Wm	Nearly level coastal plain (wetland/marshy/mud flat)
PeWt1Aq	Nearly level wetlands (aquaculture)
PeWt1Wm	Nearly level wetlands (wet land/marshy/mud flat)

Table 2.1.13. Description of Landscape Ecological Units Dumka block, Chhotanagpur Plateau, Eastern Plateau

LEU	Description
EcD1s	Nearly level depressed land (single crop)
EcD1w	Nearly level depressed land (waste land)
EcAp2d	Very gently sloping undulating alluvial plain (double crop)
EcAp2s	Very gently sloping undulating alluvial plain (single crop)
EcAp2p	Very gently sloping undulating alluvial plain (plantation)
EcAp2cf	Very gently sloping undulating alluvial plain (current fallow)
EcAp2os	Very gently sloping undulating alluvial plain (open scrub)
EcAp2w	Very gently sloping undulating alluvial plain (waste land)
EcAp3d	Gently sloping undulating alluvial plain (double crop)
EcAp3s	Gently sloping undulating alluvial plain (single crop)
EcAp3p	Gently sloping undulating alluvial plain (plantation)
EcAp3cf	Gently sloping undulating alluvial plain (current fallow)
EcAp3os	Gently sloping undulating alluvial plain (open scrub)
EcAp3w	Gently sloping undulating alluvial plain (waste land)
EcPl3d	Gently sloping lower pediment (double crop)
EcPl3s	Gently sloping lower pediment (single crop)
EcPl3p	Gently sloping lower pediment (plantation)
EcPl3cf	Gently sloping lower pediment (current fallow)
EcPl3os	Gently sloping lower pediment (open scrub)
EcPl3w	Gently sloping lower pediment (waste land)
EcPl5gu	Moderately steeply sloping lower pediment (gulley)
EcPu3d	Gently sloping upper pediment (double crop)
EcPu3s	Gently sloping upper pediment (single crop)
EcPu4p	Moderately sloping upper pediment (plantation)
EcPu4cf	Moderately sloping upper pediment (current fallow)
EcPu4os	Moderately sloping upper pediment (open scrub)
EcPu4w	Moderately sloping upper pediment (waste land)
EcU3d	Gently sloping undulating upland (double crop)
EcU3s	Gently sloping undulating upland (single crop)

LEU	Description
EcU3p	Gently sloping undulating upland (plantation)
EcU3cf	Gently sloping undulating upland (current fallow)
EcU3os	Gently sloping undulating upland (open scrub)
EcU3w	Gently sloping undulating upland (waste land)
EcU5gu	Moderately steeply sloping undulating upland (gulley)
EcV2d	Very gently sloping valley fill (double crop)
EcV2s	Very gently sloping valley fill (single crop)
EcV3s	Gently sloping valley fill (single crop)
EcPt4p	Moderately sloping undulating plateau (plantation)
EcPt4cf	Moderately sloping undulating plateau (current fallow)
EcPt4os	Moderately sloping undulating plateau (open scrub)
EcPt4w	Moderately sloping undulating plateau (waste land)
EcPt5s	Moderately steeply sloping undulating plateau (single crop)
EcPt5p	Moderately steeply sloping undulating plateau (plantation)
EcPt5cf	Moderately steeply sloping undulating plateau (current fallow)
EcPt5w	Moderately steeply sloping undulating plateau (waste land)
EcFh3cf	Gently sloping foot hill (current fallow)
EcFh3w	Gently sloping foot hill (waste land)
EcFh4cf	Moderately sloping foot hill (current fallow)
$EcH^{R}6cf$	Steeply sloping residual hillock (current fallow)
$EcH^{R}6w$	Steeply sloping residual hillock (waste land)

C. North-Eastern region

Bishalgarh block Sepahijala district Tripura (23°36'51² to 23°45'02²N latitude and 91°08'58² to 91°23'00²E longitude, Area 17051 ha). Bishalgarh block of Tripura state is classified into 27 landscape ecological units (Fig. 2.1.14 and Table 2.1.14), associated with hills and narrow valley, undulating upland and alluvial plain in Purvanchal hills, represents north eastern ranges of eastern Himalayas.

Mangan block North Sikkim district Sikkim (27°24'34² to 27°32'45² N latitude and 88°31'29² to 88°38'31² E longitude, Area 9098 ha). Mangan block of north Sikkim is classified into 54 landscape ecological units (Fig. 2.1.15 and Table 2.1.15) and is associated with cliff, escarpments, ridge line, mountain top/ summits, mountain side slopes, mountain valley in eastern Himalayas belonging to Himalayas and other mountain ranges

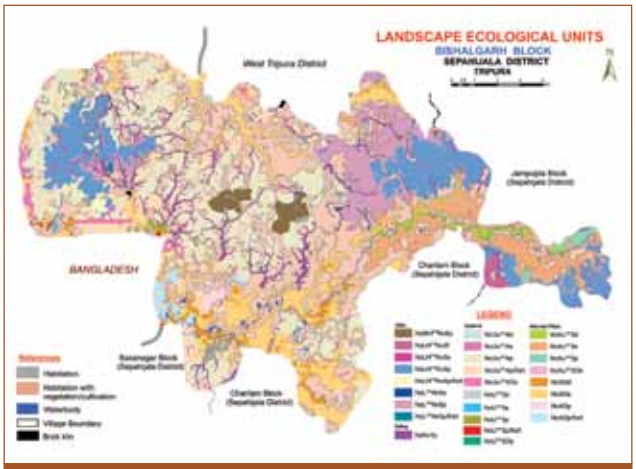


Fig. 2.1.14. Landscape ecological unit map of Bishalgarh block

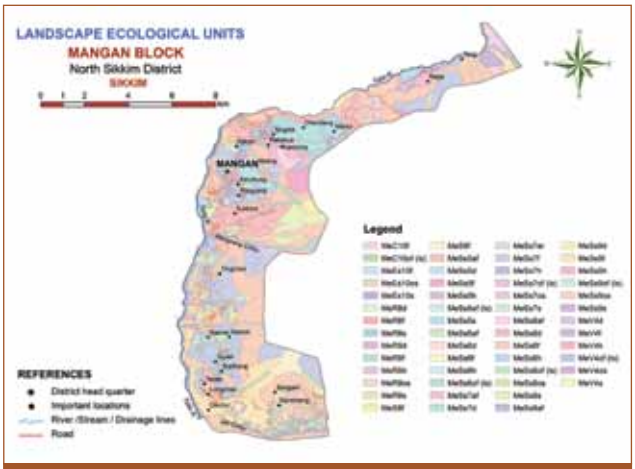


Fig. 2.1.15. Landscape ecological unit map of Mangan block

Table 2.1.14. Description of Landscape Ecological Units Bishalgarh block, Purvanchal Hills (Nagaland) in the physiographic region of north eastern ranges, eastern Himalaya

LEU	Description
NcMH^{Md}Nv6p	Moderately steeply sloping moderately Dissected medium Relief Hills & Narrow Valleys (plantation)
NcLH^{Md}Nv5s	Moderately steeply sloping moderately Dissected Low Relief Hills & Narrow Valleys (single crop)
NcLH^{Md}Nv5p	Moderately steeply sloping moderately Dissected Low Relief Hills & Narrow Valleys (plantation)
NcLH^{Md}Nv5p/f/s/t	Moderately steeply sloping moderately Dissected Low Relief Hills & Narrow Valleys (plantation/forest/ scrub/trees)
NcLH^{Md}Nv5f	Moderately steeply sloping moderately Dissected Low Relief Hills & Narrow Valleys (forest)
NcL^{mo}Nv5s	Moderately Steeply sloping Low mounds interspersed with narrow valleys (single crop)
NcL^{mo}Nv5p	Moderately Steeply sloping Low mounds interspersed with narrow valleys (plantation)
NcL^{mo}Nv5p/f/s/t	Moderately Steeply sloping Low mounds interspersed with narrow valleys (plantation/forest/scrub/ trees)
NcNv3s	Gently sloping Narrow Valleys (single crop)
NcUu^{mo}4d	Moderately Sloping Undulating Upland with mounds (double crop)
NcUu^{mo}4s	Moderately Sloping Undulating Upland with mounds (single crop)
NcUu^{mo}4p	Moderately Sloping Undulating Upland with mounds (plantation)
NcUu^{mo}4p/f/s/t	Moderately Sloping Undulating Upland with mounds (plantation/forest/scrub/trees)
NcUu^{mo}4os	Moderately Sloping Undulating Upland with mounds (open scrub)
NcU^{mo}3d	Gently Sloping Upland with mounds (double crop)
NcU^{mo}3s	Gently Sloping Upland with mounds (single crop)
NcU^{mo}3p	Gently Sloping Upland with mounds (plantation)
NcU^{mo}3p/f/s/t	Gently Sloping Upland with mounds (plantation/forest/scrub/trees)
NcU^{mo}3os	Gently Sloping Upland with mounds (open scrub)
NcAu^{mo}3d	Gently sloping Upper Alluvial Plain interspersed with low mounds (double crop)
NcAu^{mo}3p	Gently sloping Upper Alluvial Plain interspersed with low mounds (plantation)
NcAu^{mo}3s	Gently sloping Upper Alluvial Plain interspersed with low mounds (single crop)
NcAu^{mo}3os	Gently sloping Upper Alluvial Plain interspersed with low mounds (open scrub)
NcAl3d	Gently sloping Lower Alluvial Plain (double crop)
NcAl3s	Gently sloping Lower Alluvial Plain (single crop)
NcAl3p	Gently sloping Lower Alluvial Plain (plantation)
NcAl3p/f/s/t	Gently sloping Lower Alluvial Plain (plantation/forest/scrub/trees)

Table 2.1.15. Description of Landscape Ecological Units Mangan block, eastern Himalaya, Himalayas and other mountain

LEU	Description
MeC10f	Extremely sloping Cliff (forest)
MeC10of (ls)	Extremely sloping Cliff (open field)
MeEs10f	Extremely sloping Escarpments (forest)
MeEs10os	Extremely sloping Escarpments (open scrub)
MeEs10s	Extremely sloping Escarpments (single crop)
MeR8d	Strongly sloping Ridge line (double crops)
MeR8f	Strongly sloping Ridge line (forest)

LEU	Description
MeR8s	Strongly sloping Ridge line (single crop)
MeR9d	Very strongly sloping Ridge line (double crops)
MeR9f	Very strongly sloping Ridge line (forest)
MeR9os	Very strongly sloping Ridge line (open scrub)
MeR9s	Very strongly sloping Ridge line (single crop)
MeS8f	Strongly sloping Mountain top / Summits (forest)
MeS9f	Very strongly sloping Mountain top / Summits (forest)
MeSs5d	Moderately steeply sloping Mountain side slopes (double crops)
MeSs5f	Moderately steeply sloping Mountain side slopes (forest)
MeSs5of (ls)	Moderately steeply sloping Mountain side slopes (open field)
MeSs5s	Moderately steeply sloping Mountain side slopes (single crop)
MeSs6af	Steeply sloping Mountain side slopes (agro forestry)
MeSs6d	Steeply sloping Mountain side slopes (double crops)
MeSs6f	Steeply sloping Mountain side slopes (forest)
MeSs6of (ls)	Steeply sloping Mountain side slopes (open field)
MeSs7af	Very steeply sloping Mountain side slopes (agro forestry)
MeSs7d	Very steeply sloping Mountain side slopes (double crops)
MeSs7f	Very steeply sloping Mountain side slopes (forest)
MeSs7of (ls)	Very steeply sloping Mountain side slopes (open field)
MeSs7os	Very steeply sloping Mountain side slopes (open scrub)
MeSs7s	Very steeply sloping Mountain side slopes (single crop)
MeSs8af	Strongly sloping Mountain side slopes (agro forestry)
MeSs8d	Strongly sloping Mountain side slopes (double crops)
MeSs8f	Strongly sloping Mountain side slopes (forest)
MeSs8of (ls)	Strongly sloping Mountain side slopes (open field)
MeSs8os	Strongly sloping Mountain side slopes (open scrub)
MeSs8s	Strongly sloping Mountain side slopes (single crop)
MeSs9af	Very strongly sloping Mountain side slopes (agro forestry)
MeSs9d	Very strongly sloping Mountain side slopes (double crops)
MeSs9f	Very strongly sloping Mountain side slopes (forest)
MeSs9of (ls)	Very strongly sloping Mountain side slopes (open field)
MeSs9os	Very strongly sloping Mountain side slopes (open scrub)
MeSs9s	Very strongly sloping Mountain side slopes (single crop)
MeV4d	Moderately sloping Narrow mountain valley (double crops)
MeV4f	Moderately sloping Narrow mountain valley (forest)
MeV4of (ls)	Moderately sloping Narrow mountain valley (open field)
MeV4os	Moderately sloping Narrow mountain valley (open scrub)
MeV4s	Moderately sloping Narrow mountain valley (single crop)

Jirang block, Ri-Bhoi district, Meghalaya (25°48'54.36'' to 26°4' 40.08'' Nlatitude and 91°20'40.56'' to 92°16' 33.96'' E longitude, Area 71400 ha). Jirang block of Meghalaya state is classified into 32 landscape ecological units (Fig.2.1.16 and Table 2.1.16), associated with, upper plateau, hills of middle and lower plateau (sub montane), valley plain, represents Meghalaya plateau of north eastern ranges, eastern Himalayas.

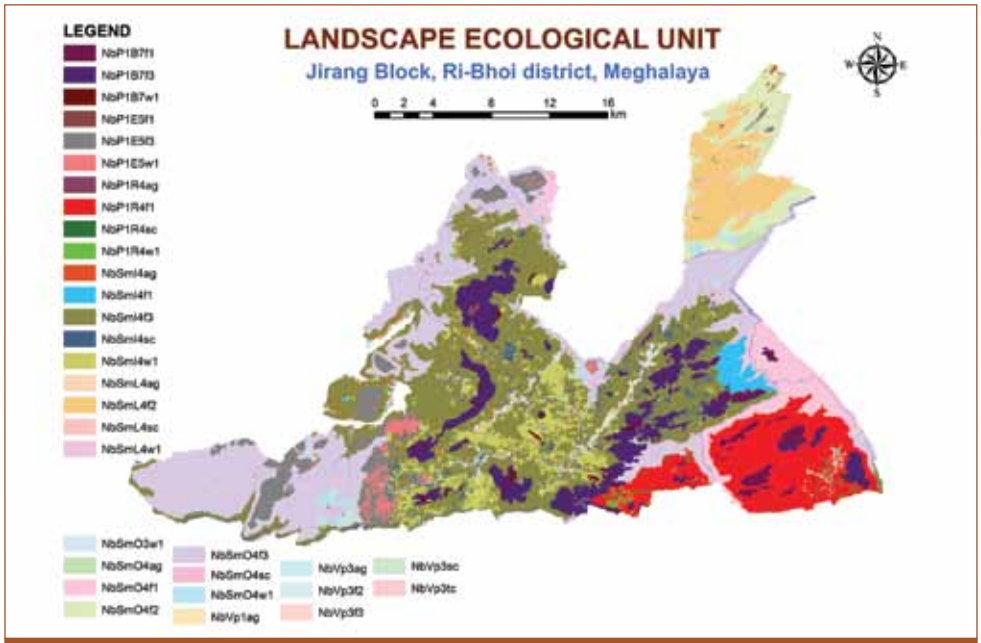


Fig. 2.1.16. Landscape ecological unit map Jirang block

Table 2.1.16. Description of Landscape Ecological Units Jirang block Meghalaya plateau, north eastern Himalayas

LEU	Description
NbP1B7f1	Steep to very steep denudational high hills (evergreen forest)
NbP1B7f3	Steep to very steep denudational high hills (deciduous forest)
NbP1B7w1	Steep to very steep denudational high hills (scrub land)
NbP1E5f1	Strongly sloping to moderately steep denudational low hills (evergreen forest)
NbP1E5f3	Strongly sloping to moderately steep denudational low hills (deciduous forest)
NbP1E5w1	Strongly sloping to moderately steep denudational low hills (scrub land)
NbP1R4ag	Moderately sloping moderately dissected upper plateau (agriculture)
NbP1R4f1	Moderately sloping moderately dissected upper plateau (evergreen forest)
NbP1R4sc	Moderately sloping moderately dissected upper plateau (shifting cultivation)
NbP1R4w1	Moderately sloping moderately dissected upper plateau (scrub land)
NbSmI4ag	Moderately sloping highly dissected lower plateau (agriculture)
NbSmI4f1	Moderately sloping highly dissected lower plateau (evergreen forest)
NbSmI4f3	Moderately sloping highly dissected lower plateau (deciduous forest)
NbSmI4sc	Moderately sloping highly dissected lower plateau (shifting cultivation)
NbSmI4w1	Moderately sloping highly dissected lower plateau (scrub land)
NbSmL4ag	Moderately sloping lowly dissected lower plateau (agriculture)
NbSmL4f2	Moderately sloping lowly dissected lower plateau (scrub forest)
NbSmL4sc	Moderately sloping lowly dissected lower plateau (shifting cultivation)
NbSmL4w1	Moderately sloping lowly dissected lower plateau (scrub land)

LEU	Description
NbSmO4ag	Moderately sloping moderately dissected lower plateau (agriculture)
NbSmO4f1	Moderately sloping moderately dissected lower plateau (evergreen forest)
NbSmO4f2	Moderately sloping moderately dissected lower plateau (scrub forest)
NbSmO4f3	Moderately sloping moderately dissected lower plateau (deciduous forest)
NbSmO4sc	Moderately sloping moderately dissected lower plateau (shifting cultivation)
NbSmO4w1	Moderately sloping moderately dissected lower plateau (scrub land)
NbSmO3w1	Gently sloping moderately dissected lower plateau (scrub land)
NbVp1ag	Nearly level valley plain (agriculture)
NbVp3ag	Very gently sloping to gently sloping valley plain (agriculture)
NbVp3f2	Very gently sloping to gently sloping valley plain (scrub forest)
NbVp3f3	Very gently sloping to gently sloping valley plain (deciduous forest)
NbVp3sc	Very gently sloping to gently sloping valley plain (shifting cultivation)
NbVp3tc	Very gently sloping to gently sloping valley plain (terrace cultivation)

Umling block, Ri-Bhoi district, Meghalaya (25°48'54.36'' to 26°4' 40.08'' N latitude and 91°20'40.56'' to 92°16' 33.96'' E longitude, Area 72200 ha). Umling block of Ribhoi district is classified into 27 landscape ecological units (Fig. 2.1.17 and Table 2.1.17), associated with upper plateau, hills of middle and lower plateau (sub montane), valley plain. Umling block represents Meghalaya plateau of north eastern ranges, eastern Himalayas.

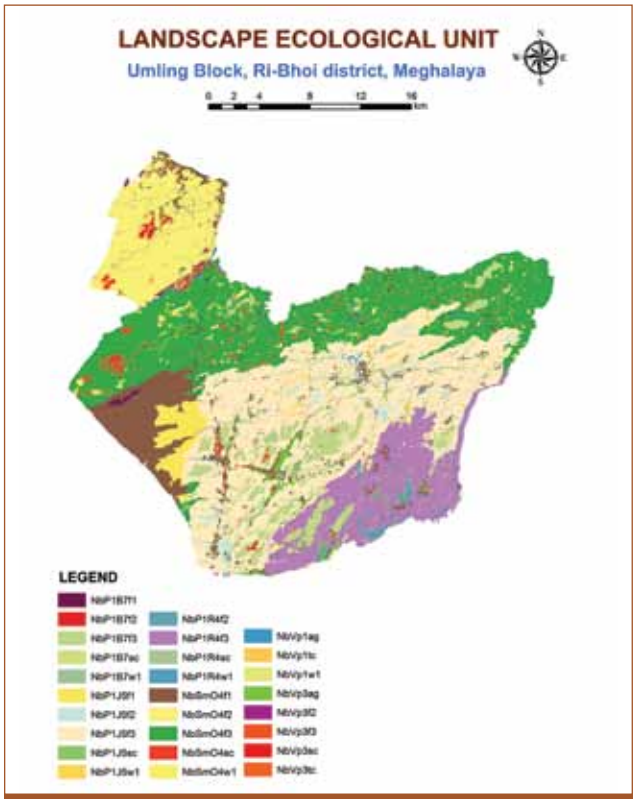


Fig. 2.1.17. Landscape ecological unit map Umling block

Umsing block, Ri-Bhoi district, Meghalaya (25°48'54.36'' to 26°4' 40.08'' N latitude and 91°20'40.56'' to 92°16' 33.96'' E longitude, Area 101200 ha). Umsing block of Ribhoi district of Meghalayais classified into 32 landscape ecological units (Fig. 2.1.18 and Table 2.1.18). These are associated with Upper plateau, hills of middle and lower plateau (sub montane), valley plain and represents Meghalaya Plateau of north eastern ranges, eastern Himalayas.

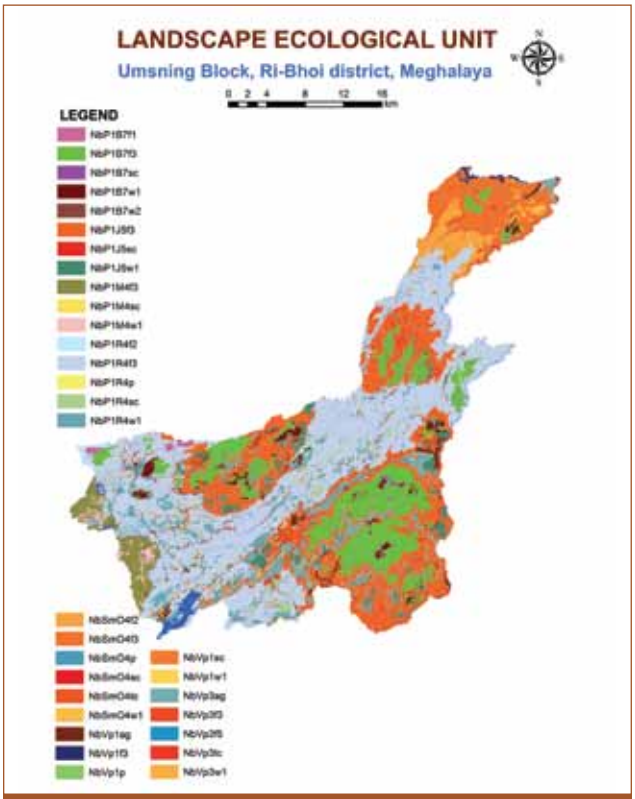


Fig. 2.1.18. Landscape ecological unit map Umsing block

Table 2.1.17. Description of Landscape Ecological Units, Umling block, Meghalaya plateau in the physiographic region of north eastern ranges, eastern Himalaya

LEU	Description
NbP1B7f1	Steep to very steep denudational high hills (evergreen forest)
NbP1B7f2	Steep to very steep denudational high hills (scrub forest)
NbP1B7f3	Steep to very steep denudational high hills (deciduous forest)
NbP1B7sc	Steep to very steep denudational high hills (shifting cultivation)
NbP1B7w1	Steep to very steep denudational high hills (scrub land)
NbP1J5f3	Strongly sloping to moderately steep highly dissected upper plateau (deciduous forest)
NbP1J5sc	Strongly sloping to moderately steep highly dissected upper plateau (shifting cultivation)
NbP1J5w1	Strongly sloping to moderately steep highly dissected upper plateau (scrub land)
NbP1J5f1	Strongly sloping to moderately steep highly dissected upper plateau (evergreen forest)
NbP1J5f2	Strongly sloping to moderately steep highly dissected upper plateau (scrub forest)
NbP1R4f3	Moderately sloping moderately dissected upper plateau (deciduous forest)
NbP1R4f2	Moderately sloping moderately dissected upper plateau (scrub forest)
NbP1R4sc	Moderately sloping moderately dissected upper plateau (shifting cultivation)
NbP1R4w1	Moderately sloping moderately dissected upper plateau (scrub land)
NbSmO4f1	Moderately sloping moderately dissected lower plateau (evergreen forest)
NbSmO4f2	Moderately sloping moderately dissected lower plateau (scrub forest)
NbSmO4f3	Moderately sloping moderately dissected lower plateau (deciduous forest)
NbSmO4sc	Moderately sloping moderately dissected lower plateau (shifting cultivation)
NbSmO4w1	Moderately sloping moderately dissected lower plateau (scrub land)
NbVp1ag	Nearly level valley plain (agriculture)
NbVp1w1	Nearly level valley plain (scrub land)
NbVp1tc	Nearly level valley plain (terrace cultivation)
NbVp3ag	Very gently sloping to gently sloping valley plain (agriculture)
NbVp3f2	Very gently sloping to gently sloping valley plain (scrub forest)
NbVp3f3	Very gently sloping to gently sloping valley plain (deciduous forest)
NbVp3sc	Very gently sloping to gently sloping valley plain (shifting cultivation)
NbVp3tc	Very gently sloping to gently sloping valley plain (terrace cultivation)

Table 2.1.18. Description of Landscape Ecological Units, Umsing block, Meghalaya plateau, north eastern ranges, eastern Himalayas

LEU	Description
NbP1B7f1	Steep to very steep denudational high hills (evergreen forest)
NbP1B7f3	Steep to very steep denudational high hills (deciduous forest)
NbP1B7sc	Steep to very steep denudational high hills (shifting cultivation)
NbP1B7w1	Steep to very steep denudational high hills (scrub land)
NbP1B7w2	Steep to very steep denudational high hills (land with open scrub)
NbP1J5f3	Strongly sloping to moderately steep highly dissected upper plateau (deciduous forest)
NbP1J5sc	Strongly sloping to moderately steep highly dissected upper plateau (shifting cultivation)
NbP1J5w1	Strongly sloping to moderately steep highly dissected upper plateau (scrub land)
NbP1R4f3	Moderately sloping moderately dissected upper plateau (deciduous forest)
NbP1R4f2	Moderately sloping moderately dissected upper plateau (scrub forest)
NbP1R4p	Moderately sloping moderately dissected upper plateau (plantation)

LEU	Description
NbP1R4sc	Moderately sloping moderately dissected upper plateau (shifting cultivation)
NbP1R4w1	Moderately sloping moderately dissected upper plateau (scrub land)
NbP1M4f3	Moderately sloping lowly dissected upper plateau (deciduous forest)
NbP1M4sc	Moderately sloping lowly dissected upper plateau (shifting cultivation)
NbP1M4w1	Moderately sloping lowly dissected upper plateau (scrub land)
NbSmO4f2	Moderately sloping moderately dissected lower plateau (scrub forest)
NbSmO4f3	Moderately sloping moderately dissected lower plateau (deciduous forest)
NbSmO4sc	Moderately sloping moderately dissected lower plateau (shifting cultivation)
NbSmO4w1	Moderately sloping moderately dissected lower plateau (scrub land)
NbSmO4p	Moderately sloping moderately dissected lower plateau (plantation)
NbSmO4tc	Moderately sloping moderately dissected lower plateau (terrace cultivation)
NbVp1ag	Nearly level valley plain (agriculture)
NbVp1f3	Nearly level valley plain (deciduous forest)
NbVp1p	Nearly level valley plain (plantation)
NbVp1sc	Nearly level valley plain (shifting cultivation)
NbVp1w1	Nearly level valley plain (scrub land)
NbVp3ag	Very gently sloping to gently sloping valley plain (agriculture)
NbVp3f3	Very gently sloping to gently sloping valley plain (deciduous forest)
NbVp3tc	Very gently sloping to gently sloping valley plain (terrace cultivation)
NbVp3f5	Very gently sloping to gently sloping valley plain (island forest)
NbVp3w1	Very gently sloping to gently sloping valley plain (scrub land)

Diyun block, Changlang district of Arunachal Pradesh (27°24'45'' to 27°41'08' N latitude and 95°48'45'' to 96°15'43'' E longitude, Area 21704 ha). Diyun block of Changlang district of Arunachal Pradesh is classified into 19 landscape ecological units (Fig.2.1.19 and Table 2.1.19). These are associated with, low amplitudinal hill, interhill valley, upper piedmont, lower piedmont, upland and flood plain and represents Purvanchal Hill of north eastern ranges, eastern Himalayas.

D Central region

Jagdalpur block, Jagdalpur district of Chhattisgarh state (18°48'00' to 19°16'21' N latitude and 81°51'05' to 82°15'00' Elongitude, Area 163350 ha), Jagdalpur block of Jagdalpur district is classified into 57 landscape ecological units (Fig. 2.1.20 and Table 2.1.20), associated with, granitic landform of Dandakaranya of eastern plateau.

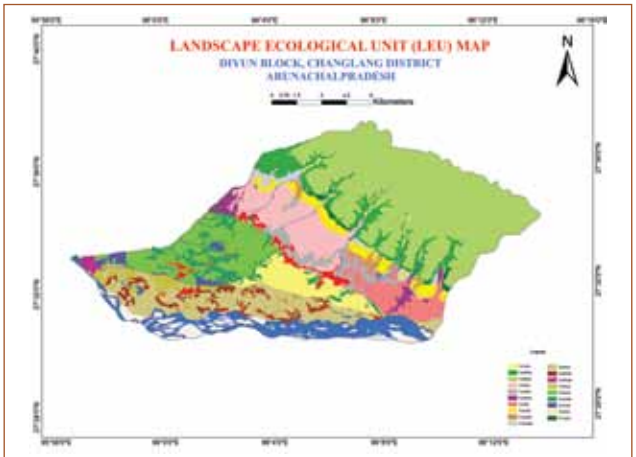


Fig. 2.1.19. Landscape ecological unit map of Diyun block

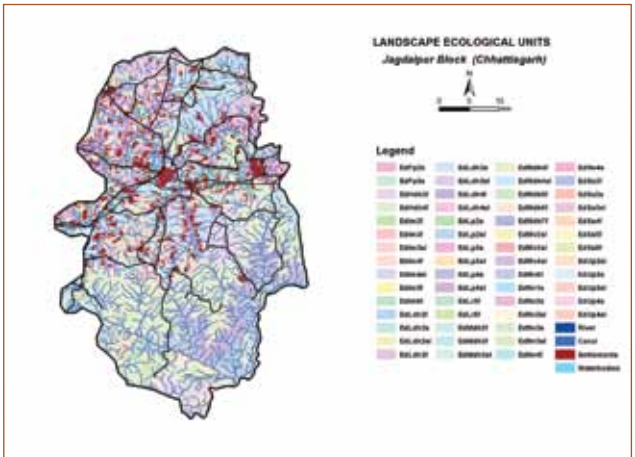


Fig. 2.1.20. Landscape ecological units map Jagdalpur block

Table 2.1.19. Description of Landscape Ecological Units, Diyun block, Purvanchal hill and Brahmaputra valley, north eastern Himalayas

LEU	Description
NcHl5fd	Strongly sloping low amplitudinal hill (fairly densed forest).
NcHl3fm	Gently sloping low amplitudinal hill (mixed forest).
NaVp3s	Gently sloping Narrow hill valley (single crop).
NaVp3d	Gently sloping narrow hill valley (double crop).
NcXu3d	Gently sloping Upper piedmont (double crop)
NcXu3fm	Gently sloping Upper piedmont (mixed forest)
NcXu3f6	Gently sloping Upper piedmont (home stead plantation)
NcXl3fm	Gently sloping Lower piedmont (mixed forest)
NcXl3d	Gently sloping Lower piedmont (double crop)
NcXl3s	Gently sloping Lower piedmont (single crop)
NcXl3f6	Gently sloping Lower piedmont (home stead plantation)
NaUd2f6	Very gently sloping upland (homestead plantation)
NaUd2s	Very gently sloping upland (single crop)
NaUd2d	Very gently sloping upland (double crop)
NaUd2p	Very gently sloping upland (tea plantation)
NaFP2d	Very gently sloping flood plain (double crop)
NaFP2fm	Very gently sloping flood plain (mixed forest)
NaFP2p	Very gently sloping upland (tea plantation)
NaFP2f6	Gently sloping flood plain (homestead plantation)

Table 2.1.20. Description of Landscape Ecological Units, Jagdalpur block, Granite/gneiss/ sedimentary landforms; Dandkaranya, eastern plateau

LEU	Description
EdFp2s	Very gently slopingflood plains (single crop)
EdFp3s	Gently sloping flood plains (single crop)
EdHdh3f	Gently slopinghighly dissected hills (forest)
EdHdh4f	Moderately sloping highly dissected hills (forest)
EdIm2f	Very gently sloping isolated mounds (forest)
EdIm3f	Gently sloping isolated mounds (forest)
EdIm3sl	Gently sloping isolated mounds (scrub lands)
EdIm4f	Moderately sloping isolated mounds (forest)
EdIm4sl	Moderately sloping isolated mounds (scrub lands)
EdIm5f	Moderately steep sloping isolated mounds (forest)
EdIm6f	Steeply sloping isolated mounds (forest)
EdLdh2f	Very gently slopinglow dissected hills (forest)
EdLdh2s	Very gently sloping low dissected hills (single crop)
EdLdh2sl	Very gently sloping low dissected hills (scrub lands)
EdLdh3f	Gently sloping low dissected hills (forest)
EdLdh3s	Gently sloping low dissected hills (single crop)
EdLdh3sl	Gently sloping low dissected hills (scrub lands)

LEU	Description
EdLdh4f	Moderately sloping low dissected hills (forest)
EdLdh4sl	Moderately sloping low dissected hills (scrub lands)
EdLp2s	Very gently slopinglower pediments(single crop)
EdLp2sl	Very gently sloping lower pediments (scrub lands)
EdLp3s	Gently sloping lower pediments(single crop)
EdLp3sl	Gently sloping lower pediments (scrub lands)
EdLp4s	Moderately sloping lower pediments(single crop)
EdLp4sl	Moderately sloping lower pediments (scrub lands)
EdLr5f	Moderately steep slopinglinear ridges (forest)
EdLr6f	Steeply sloping linear ridges (forest)
EdMdh2f	Very gently slopingmoderately dissected hills (forest)
EdMdh3f	Gently sloping moderately dissected hills (forest)
EdMdh3sl	Gently sloping moderately dissected hills (scrub lands)
EdMdh4f	Moderately sloping moderately dissected hills (forest)
EdMdh4sl	Moderately sloping moderately dissected hills (scrub lands)
EdMdh5f	Moderately steep sloping moderately dissected hills (forest)
EdMdh6f	Steeply sloping moderately dissected hills (forest)
EdMdh7f	Very steeply sloping moderately dissected hills (forest)
EdMv2sl	Very gently slopingmain valley (scrub lands)
EdMv3sl	Gently sloping main valley (scrub lands)
EdMv4sl	Moderately sloping main valley (scrub lands)
EdMv6f	Steeply sloping main valley (forest)
EdNv1s	Level to nearly levelnarrow valleys (single crop)
EdNv2s	Very gently sloping narrow valleys (single crop)
EdNv2sl	Very gently sloping narrow valleys (scrub lands)
EdNv3s	Gently sloping narrow valleys (single crop)
EdNv3sl	Gently sloping narrow valleys (scrub lands)
EdNv4f	Moderately sloping narrow valleys (forest)
EdNv4s	Moderately sloping narrow valleys (single crop)
EdSs3f	Gently slopingscrap slopes (forest)
EdSs3s	Gently sloping scrap slopes (single crop)
EdSs3sl	Gently sloping scrap slopes (scrub lands)
EdSs4f	Moderately sloping scrap slopes (forest)
EdSs5f	Moderately steep sloping scrap slopes (forest)
EdSs6f	Steeply sloping scrap slopes (forest)
EdUp2sl	Very gently slopingupper pediments (scrub lands)
EdUp3s	Gently sloping upper pediments (single crop)
EdUp3sl	Gently sloping upper pediments (scrub lands)
EdUp4s	Moderately sloping upper pediments (single crop)
EdUp4sl	Moderately sloping upper pediments (scrub lands)

Parbhani block, Parbhani district, Maharashtra state (19⁰01'21' to 19⁰27'49' N latitude and 76⁰36'12' to 76⁰56'58' E longitude, Area 111000 ha). Parbhani block of Maharashtra state is categorized into 29 landscape ecological units (Fig.2.1.21 and Table 2.1.21). It represents basaltic landform of lower Maharashtra plateau (Deccan) of Deccan plateau.

Tikamgarh block, Tikamgarh district, Madhya Pradesh (24⁰26'08' to 24⁰53'52' N latitude and; 78⁰45'05' to 79⁰10'55' E longitude, Area 87340 ha). 42 landscape ecological units associated with granite/ gneiss of Pathar and Bundelkhand upland of Central highlands (Fig. 2.1.22 and Table 2.1.22) define physiographic setup of Tikamgarh block in Madhya Pradesh.

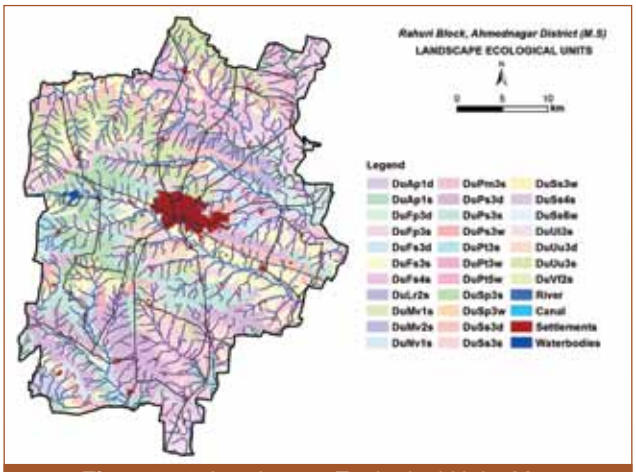


Fig. 2.1.21. Landscape Ecological Units Map of Parbhani block

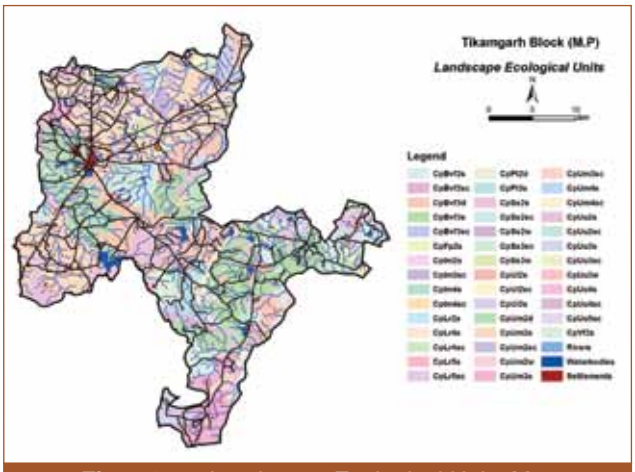


Fig. 2.1.22. Landscape Ecological Units Map of Tikamgarh block

Table 2.1.21. Description of Landscape Ecological Units on the basaltic landscape Parbhani block, Lower Maharashtra plateau, Deccan plateau

LEU	Description
DuAp1d	Level to nearly level alluvial Plains (double crops)
DuAp1s	Level to nearly level alluvial Plains(single crop)
DuFp3d	Gently sloping flood plains (double crops)
DuFp3s	Gently sloping flood plains (single crop)
DuFs3d	Gently sloping foot slopes (double crops)
DuFs3s	Gently sloping foot slopes(single crop)
DuFs4s	Moderately sloping foot slopes (single crop)
DuLr2s	Very gently sloping linear ridges (single crop)
DuMv1s	Level to nearly level main Valley (single crop)
DuMv2s	Very gently sloping main Valley (single crop)
DuNv1s	Level to nearly level narrow Valley (single crop)
DuPm3s	Gently sloping pediments (single crop)
DuPs3d	Gently sloping plateau spurs (double crops)
DuPs3s	Gently sloping plateau spurs (single crop)
DuPs3w	Gently sloping plateau spurs (wastelands)
DuPt3s	Gently sloping plateau top (single crop)
DuPt3w	Gently sloping plateau top (wastelands)
DuPt5w	Moderately steep sloping plateau top (waste lands)
DuSp3s	Gently sloping subdued plateau (single crop)
DuSp3w	Gently sloping subdued plateau (waste lands)

LEU	Description
DuSs3d	Gently sloping scarp slopes (double crops)
DuSs3s	Gently sloping scarp slopes (single crop)
DuSs3w	Gently sloping scarp slopes (waste lands)
DuSs4s	Moderately sloping scarp slopes (single crop)
DuSs6w	Steeply sloping scarp slopes (waste lands)
DuUl3s	Gently sloping undulating lowlands (single crop)
DuUu3d	Gently sloping undulating uplands (double crops)
DuUu3s	Gently sloping undulating uplands (single crop)
DuVf2s	Very gently sloping valley floors (single crop)

Table 2.1.22. Description of Landscape Ecological Units Tikamgarh block, Granite/Gneiss landscape; Pathar and Bundelkhand upland, Central Highlands

LEU	Description
CpBvf2s	Very gently sloping broad valley floor (single crop)
CpBvf2sc	Very gently sloping broad valley floor (scrub lands)
CpBvf3d	Gently sloping broad valley floor (double crops)
CpBvf3s	Gently sloping broad valley floor (single crop)
CpBvf3sc	Gently sloping broad valley floor (scrub lands)
CpFp2s	Very gently sloping flood plains (single crop)
CpIm2s	Very gently sloping isolated mounts (single crop)
CpIm3sc	Gently sloping isolated mounts (scrub lands)
CpIm4s	Moderately sloping isolated mounts (single crop)
CpIm4sc	Moderately sloping isolated mounts (scrub lands)
CpLr2s	Very gently sloping linear ridges (single crop)
CpLr4s	Moderately sloping linear ridges (single crop)
CpLr4sc	Moderately sloping linear ridges (scrub lands)
CpLr5s	Moderately steep sloping linear ridges (single crop)
CpLr5sc	Moderately steep sloping linear ridges (scrub lands)
CpPt2d	Very gently sloping plateau top (double crops)
CpPt3s	Gently sloping plateau top (single crop)
CpSs2s	Very gently sloping scarp slopes (single crop)
CpSs2sc	Very gently sloping scarp slopes (scrub lands)
CpSs2w	Very gently sloping scarp slopes (waste lands)
CpSs3sc	Gently sloping scarp slopes (scrub lands)
CpSs3w	Gently sloping scarp slopes (waste lands)
CpUl2s	Very gently sloping undulating lowlands (single crop)
CpUl2sc	Very gently sloping undulating lowlands (scrub lands)
CpUl3s	Gently sloping undulating lowlands (single crop)
CpUm2d	Very gently sloping undulating midlands (double crops)
CpUm2s	Very gently sloping undulating midlands (single crop)
CpUm2sc	Very gently sloping undulating midlands (scrub lands)

LEU	Description
CpUm2w	Very gently sloping undulating midlands (waste lands)
CpUm3s	Gently sloping undulating midlands (single crop)
CpUm3sc	Gently sloping undulating midlands (scrub lands)
CpUm4s	Moderately sloping undulating midlands (single crop)
CpUm4sc	Moderately sloping undulating midlands (scrub lands)
CpUu2s	Very gently sloping undulating uplands (single crop)
CpUu2sc	Very gently sloping undulating uplands (scrub lands)
CpUu3s	Gently sloping undulating uplands(single crop)
CpUu3sc	Gently sloping undulating uplands (scrub lands)
CpUu3w	Gently sloping undulating uplands (waste lands)
CpUu4s	Moderately sloping undulating uplands (single crop)
CpUu4sc	Moderately sloping undulating uplands (scrub lands)
CpUu5sc	Moderately steep sloping undulating uplands (scrub lands)
CpVf2s	Very gently sloping valley floor (single crop)

Datia block, Datia district of Madhya Pradesh (25^{0}32'48' to 25^{0}50'12' N latitude and 78^{0}12'50' to 78^{0}48'06'Elongitude, Area 90820 ha). 32 landscape ecological units (Fig. 2.1.23 and Table 2.1.23) associated with the alluvial landform of Pathar and Bundelkhand upland of Central highlands describes geo-graphic setting of Datia block.

Dhanora block, Seoni district, Madhya Pradesh (22021'52' to 22036'24' N Latitudes and 79038'15' to 79059'31' E Longitudes, Area 55470 ha). 63 landscape ecological units (Fig. 2.1.24 and Table 2.1.24) associated with the Satpura Ranges (Basalt) landform of north Deccan plateau describe geo-graphic setting of Dhanora block.

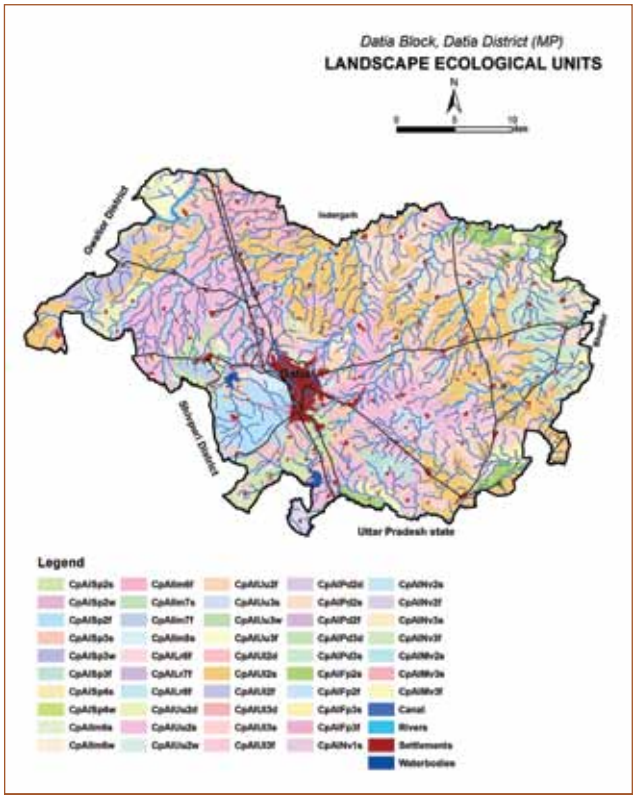


Fig. 2.1.23. Landscape ecological units map of Datia block

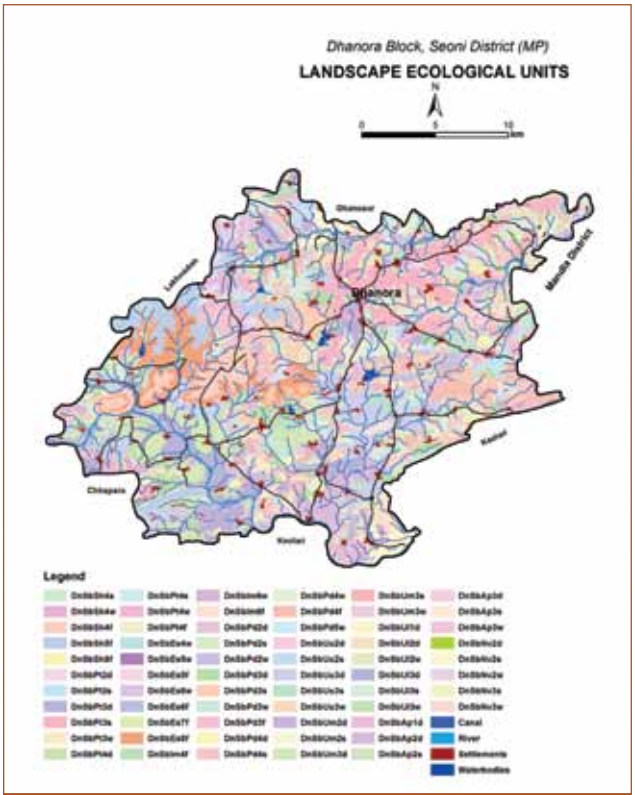


Fig. 2.1.24. Landscape ecological units maps of Dhanora block

Table 2.1.23. Description of Landscape Ecological Units, Datia block, Pathar and Bundelkhand upland, Central highlands

LEU	Description
CpAlSp2s	Very gently sloping subdued plateau (Single crop)
CpAlSp2w	Very gently sloping subdued plateau (Wastelands)
CpAlSp2f	Very gently sloping subdued plateau (Forest)
CpAlSp3s	Gently sloping subdued plateau (Single crop)
CpAlSp3w	Gently sloping subdued plateau (Wastelands)
CpAlSp3f	Gently sloping subdued plateau (Forest)
CpAlSp4s	Moderately sloping subdued plateau (Single crop)
CpAlSp4w	Moderately sloping subdued plateau (Wastelands)
CpAlIm6s	Steeply sloping isolated mounds (Single crop)
CpAlIm6w	Steeply sloping isolated mounds (Wastelands)
CpAlIm6f	Steeply sloping isolated mounds (Forest)
CpAlIm7s	Very steeply sloping isolated mounds (Single crop)
CpAlIm7f	Very steeply sloping isolated mounds (Forest)
CpAlIm8s	Strongly sloping isolated mounds (Single crop)
CpAlLr6f	Steeply sloping linear ridges (Forest)
CpAlLr7f	Very steeply sloping linear ridges (Forest)
CpAlLr8f	Strongly sloping linear ridges (Forest)
CpAlUu2d	Very gently sloping undulating uplands (Double crop)
CpAlUu2s	Very gently sloping undulating uplands (Single crop)
CpAlUu2w	Very gently sloping undulating uplands (Wastelands)
CpAlUu2f	Very gently sloping undulating uplands (Forest)
CpAlUu3s	Gently sloping undulating uplands (Single crop)
CpAlUu3w	Gently sloping undulating uplands (Wastelands)
CpAlUu3f	Gently sloping undulating uplands (Forest)
CpAlUl2d	Very gently sloping undulating lowlands (Double crop)
CpAlUl2s	Very gently sloping undulating lowlands (Single crop)
CpAlUl2f	Very gently sloping undulating lowlands (Forest)
CpAlUl3d	Gently sloping undulating lowlands (Double crop)
CpAlUl3s	Gently sloping undulating lowlands (Single crop)
CpAlUl3f	Gently sloping undulating lowlands (Forest)
CpAlPm2d	Very gently sloping pediments (Double crop)
CpAlPm2s	Very gently sloping pediments (Single crop)
CpAlPm2f	Very gently sloping pediments (Forest)
CpAlPm3d	Gently sloping pediments (Double crop)
CpAlPm3s	Gently sloping pediments (Single crop)
CpAlFp2s	Very gently sloping flood plains (Single crop)
CpAlFp2f	Very gently sloping flood plains (Forest)
CpAlFp3s	Gently sloping flood plains (Single crop)
CpAlFp3f	Gently sloping flood plains (Forest)
CpAlNv1s	Level to nearly level narrow valleys (Single crop)
CpAlNv2s	Very gently sloping narrow valleys (Single crop)
CpAlNv2f	Very gently sloping narrow valleys (Forest)
CpAlNv3s	Gently sloping narrow valleys (Single crop)
CpAlNv3f	Gently sloping narrow valleys (Forest)
CpAlMv2s	Very gently sloping main valley (Single crop)
CpAlMv3s	Gently sloping main valley (Single crop)
CpAlMv3f	Gently sloping main valley (Forest)

Table 2.1.24. Description of Landscape Ecological Units, Dhanora block, north Deccan plateau

LEU	Description
DnSbSh4s	Moderately sloping subdued hills (single crop)
DnSbSh4w	Moderately sloping subdued hills (Wastelands)
DnSbSh4f	Moderately sloping subdued hills (Forest)
DnSbSh5f	Moderately steep sloping subdued hills (Forest)
DnSbSh8f	Strongly sloping subdued hills (Forest)
DnSbPt2d	Very gently sloping plateau top (Double crop)
DnSbPt2s	Very gently sloping plateau top (single crop)
DnSbPt3d	Gently sloping plateau top (Double crop)
DnSbPt3s	Gently sloping plateau top (single crop)
DnSbPt3w	Gently sloping plateau top (Wastelands)
DnSbPt4d	Moderately sloping plateau top (Double crop)
DnSbPt4s	Moderately sloping plateau top (single crop)
DnSbPt4w	Moderately sloping plateau top (Wastelands)
DnSbPt4f	Moderately sloping plateau top (Forest)
DnSbEs4w	Moderately sloping escarpments (Wastelands)
DnSbEs5w	Moderately steep sloping escarpments (Wastelands)
DnSbEs5f	Moderately steep sloping escarpments (Forest)
DnSbEs6w	Steeply sloping escarpments (Wastelands)
DnSbEs6f	Steeply sloping escarpments (Forest)
DnSbEs7f	Very steeply sloping escarpments (Forest)
DnSbEs8f	Strongly sloping escarpments (Forest)
DnSbIm4f	Moderately sloping isolated mounds (Forest)
DnSbIm6w	Steeply sloping isolated mounds (Wastelands)
DnSbIm6f	Steeply sloping isolated mounds (Forest)
DnSbPd2d	Very gently sloping pediments (Double crop)
DnSbPd2s	Very gently sloping pediments (single crop)
DnSbPd2w	Very gently sloping pediments (Wastelands)
DnSbPd3d	Gently sloping pediments (Double crop)
DnSbPd3s	Gently sloping pediments (single crop)
DnSbPd3w	Gently sloping pediments (Wastelands)
DnSbPd3f	Gently sloping pediments (Forest)
DnSbPd4d	Moderately sloping pediments (Double crop)
DnSbPd4s	Moderately sloping pediments (single crop)
DnSbPd4w	Moderately sloping pediments (Wastelands)
DnSbPd4f	Moderately sloping pediments (Forest)
DnSbPd5w	Moderately steep sloping pediments (Wastelands)
DnSbUu2d	Very gently sloping undulating uplands (Double crop)
DnSbUu2s	Very gently sloping undulating uplands (single crop)
DnSbUu3d	Gently sloping undulating uplands (Double crop)
DnSbUu3s	Gently sloping undulating uplands (single crop)
DnSbUu3w	Gently sloping undulating uplands (Wastelands)
DnSbUm2d	Very gently sloping undulating midlands (Double crop)
DnSbUm2s	Very gently sloping undulating midlands (single crop)
DnSbUm3d	Gently sloping undulating midlands (Double crop)
DnSbUm3s	Gently sloping undulating midlands (single crop)

LEU	Description
DnSbUm3w	Gently sloping undulating midlands (Wastelands)
DnSbUl1d	Level to nearly level undulating lowlands (Double crop)
DnSbUl2d	Very gently sloping undulating lowlands (Double crop)
DnSbUl2w	Very gently sloping undulating lowlands (Wastelands)
DnSbUl3d	Gently sloping undulating lowlands (Double crop)
DnSbUl3s	Gently sloping undulating lowlands (single crop)
DnSbUl3w	Gently sloping undulating lowlands (Wastelands)
DnSbAp1d	Level to nearly level alluvial plain (Double crop)
DnSbAp2d	Very gently sloping alluvial plain (Double crop)
DnSbAp2s	Very gently sloping alluvial plain (single crop)
DnSbAp3d	Gently sloping alluvial plain (Double crop)
DnSbAp3s	Gently sloping alluvial plain (single crop)
DnSbAp3w	Gently sloping alluvial plain (Wastelands)
DnSbNv2d	Very gently sloping narrow valleys (Double crop)
DnSbNv2s	Very gently sloping narrow valleys (single crop)
DnSbNv2w	Very gently sloping narrow valleys (Wastelands)
DnSbNv3s	Gently sloping narrow valleys (single crop)
DnSbNv3w	Gently sloping narrow valleys (Wastelands)

Western region

Netrang block of Bharuch district, Gujarat (21º30'20.123" N to 21º45'41.831"N latitude and 73º16'45.722" E to 73º29'58.939" E longitude, Area, 38044 ha). 8 landscape ecological units (Fig. 2.1.25 and Table 2.1.25) associated with the Hills & valley and plateau in Gujarat plain of West coast describes geographic setting in Netrang block of Bharuch district.

Table 2.1.25. Description of Landscape Ecological UnitsNetrang block, Gujarat Plains, West Coast

LEU	Descriptions
GpHV5g	Steeply sloping hills (grazing/open scrub)
GpHV4g	Moderately sloping (grazing/open scrub)
GpPL1d	Nearly level plateau (double crop)
GpPL2d	Very gently sloping plateau (double crop)
GpPL2f	Very gently sloping plateau (forest)
GpPL2s	Very gently sloping plateau (single crop)
GpPL3f	Gently sloping plateau (forest)
GpPL2s	Gently sloping plateau (single crop)

Suratgarh block, Sri-Ganganagar district, Rajasthan (28º53'45.788" to 29º33'33.298"N latitude and 73º27'16.333" to 74º15'4.575" E longitude, Area 282289 ha). 9 landscape ecological units of sandy arid plains in Suratgarh tehsil (Fig. 2.1.26 and Table 2.1.26), associated with alluvial plain, flood plain, sand dune and inter dunal plain in semi arid transitional Ghaggar plain of Western plain label the geo-graphic setting of Suratgarh block of Sri- Ganganagar district, Rajasthan .

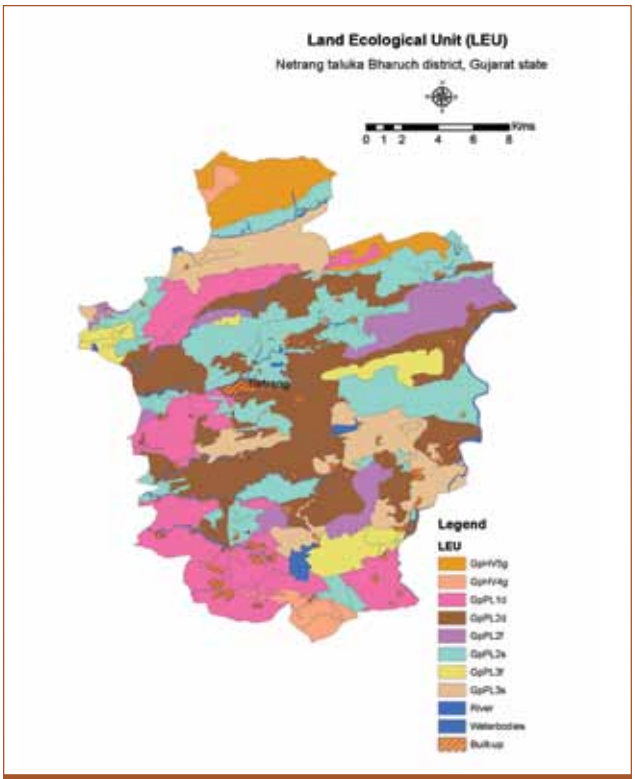


Fig. 2.1.25. Landscape Ecological Units map of Netrang block

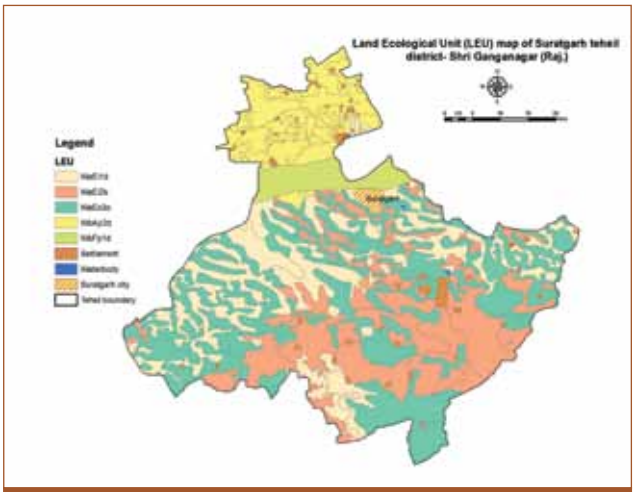


Fig. 2.1.26 Landscape Ecological Units map of Suratgarh tehsil

Table 2.1.26. Description of Landscape Ecological Units Suratgarh tehsil; Semi Arid transitional Ghaggar Plain and Sandy Arid plain (Marusthali) , Western Plains

LEU	Descriptions
WbAp2d	Very gently sloping alluvial plain (double crop)
WbFp2d	Very gently sloping flood l plain (double crop)
WbFp1d	Nearly level flood l plain (double crop)
WaEo3o	Gently sloping sand dune (open scrub)
WaEo2k	Very gently sloping undulating sand dune (single crop-kharif only)
WaEo2r	Very gently sloping undulating sand dune (single crop-rabi only)
WaEo3k	Gently sloping sand dune (single crop-kharif only)
WaEi1d	Nearly level interdunal plain (double crop)
WaEi1w	Nearly level interdunal plain (waste land)

Anupgarh Tehsil, Sri Ganga Nagar district, Rajasthan (28º54'27.059" to 29º15'15.091"N latitude and 72º47'48.718" to 73º25'39.726" E longitude, Area 1,14,935 ha). 7 landscape ecological units in Anupgarh block (LEUs) representing sandy arid plain (Marusthali) have been identified and mapped (Fig.2.1.27 and Table 2.1.27). These are associated with alluvial plain, flood plain and sand dune of semi arid transitional Ghaggar Plain of western plain.

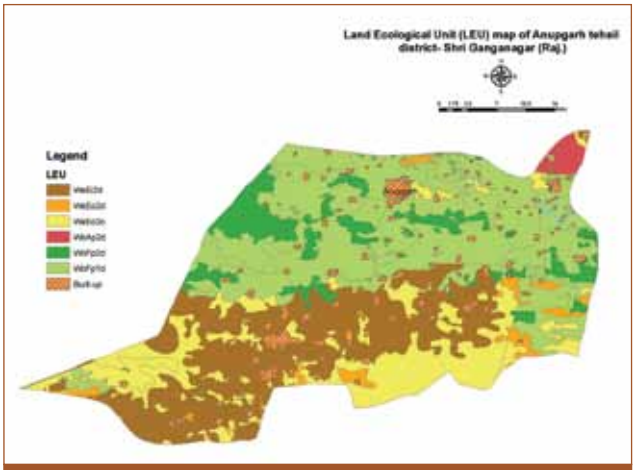


Fig. 2.1.27. Landscape Ecological Units map of Anupgarh tehsil

Table 2.1.27. Description of Landscape Ecological Units Anupgarh block, Semi Arid transitional Ghaggar Plain and Sandy Arid plain (Marusthali), Western plain

LEU	Descriptions
WbAp2d	Very gently sloping alluvial plain (double cropped)
WbFp2d	Very gently sloping flood l plain (double cropped)
WbFp1d	Nearly level flood plain (double cropped)
WaEo4o	Moderately sloping sand dune (open scrub)
WaEo3k	Gently sloping sand dune (single crop-kharif only)
WaEo1d	Nearly level interdunal plain (double cropped)
WaEo2d	Very gently sloping interdunal plain (double cropped)

Rawatsar tehsil, Hanumangarh district, Rajasthan (74° 03' 31" to 74° 24' 29" N latitude and 28° 46' 41" to 29° 20' 34" E longitude, Area 187608 ha). 30 landscape ecological units of Rawatsar tehsil (LEUs) represent sandy arid (Marusthali) Western plain (Fig. 2.1.28 and Table 2.1.28) are associated with sandy arid plain and Ghaggar aeofluvial plain.

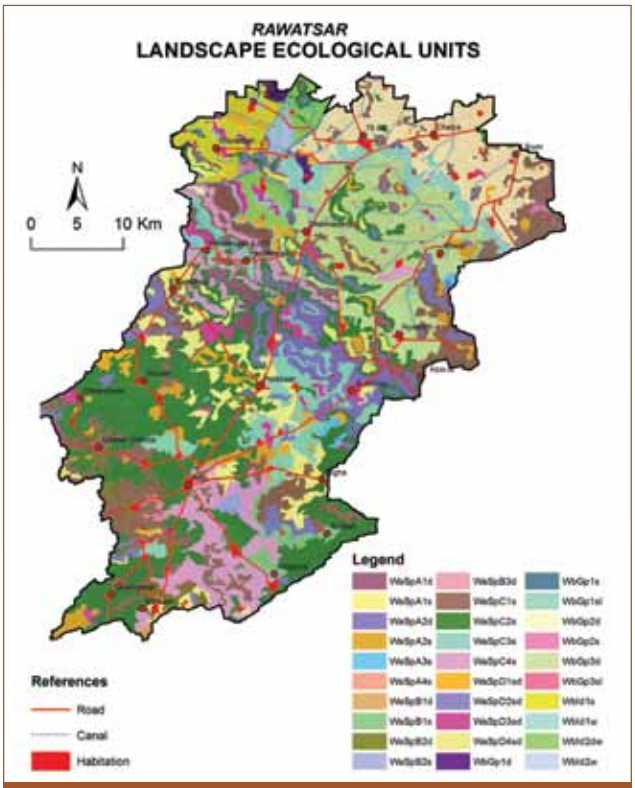


Fig. 2.1.28 Landscape Ecological Units map of Rawatsar tehsil

Table 2.1.28. Description of Landscape Ecological Units Rawatsar block, Sandy arid plain/ Marusthali and Semi-arid transitional plain, Western plain

LEU	Descriptions
WaSpA1d	Level to nearly level sandy arid plain with interspersed sand dunes (<25% area affected) (double crop)
WaSpA1s	Level to nearly level sandy arid plain with interspersed sand dunes (<25% area affected) (single crop)
WaSpA2d	Very gently sloping sandy arid plain with interspersed sand dunes (<25% area affected) (double crop)
WaSpA2s	Very gently sloping sandy arid plain with interspersed sand dunes (<25% area affected) (single crop)
WaSpA3s	Gently sloping sandy arid plain with interspersed sand dunes (<25% area affected) (single crop)
WaSpA4s	Moderately sloping sandy arid plain with interspersed sand dunes (<25% area affected) (single crop)
WaSpB1d	Level to nearly level sandy arid plain with interspersed sand dunes (25-50% area affected) (double crop)
WaSpB1s	Level to nearly level sandy arid plain with interspersed sand dunes (25-50% area affected) (single crop)
WaSpB2d	Very gently sloping sandy arid plain with interspersed sand dunes (25-50% area affected) (double crop)
WaSpB2s	Very gently sloping sandy arid plain with interspersed sand dunes (25-50% area affected) (single crop)
WaSpB3d	Gently sloping sandy arid plain with interspersed sand dunes (25-50% area affected) (double crop)
WaSpC1s	Level to nearly level sandy arid plain with interspersed sand dunes (50-75% area affected) (single crop)
WaSpC2s	Very gently sloping sandy arid plain with interspersed sand dunes (50-75% area affected) (single crop)
WaSpC3s	Gently sloping sandy arid plain with interspersed sand dunes (50-75% area affected) (single crop)
WaSpC4s	Moderately sloping sandy arid plain with interspersed sand dunes (50-75% area affected) (single crop)
WaSpD1sd	Level to nearly level sandy arid plain with interspersed sand dunes (>75% area affected) (sand dunes)
WaSpD2sd	Very gently sloping sandy arid plain with interspersed sand dunes (>75% area affected) (sand dunes)
WaSpD3sd	Gently sloping sandy arid plain with interspersed sand dunes (>75% areaaffected) (sand dunes)
WaSpD4sd	Moderately sloping sandy arid plain with interspersed sand dunes (>75% area affected) (sand dunes)
WbGp1d	Level to nearly level Ghaggar aeofluvial plain (double crop)
WbGp1s	Level to nearly level Ghaggar aeofluvial plain (single crop)
WbGp1sl	Level to nearly level Ghaggar aeofluvial plain (salt affected)
WbGp2d	Very gently sloping Ghaggar aeofluvial plain (double crop)
WbGp2s	Very gently sloping Ghaggar aeofluvial plain (single crop)
WbGp3d	Gently sloping Ghaggar aeofluvial plain (double crop)
WbGp3sl	Gently sloping Ghaggar aeofluvial plain (salt affected)
WbId1s	Level to nearly level Interior drainage (single crop with water spread)
WbId1w	Level to nearly level Interior drainage (waterlogged area)
WbId2dw	Very gently sloping Interior drainage (double crop with water spread)
WbId2w	Very gently sloping Interior drainage (waterlogged area)

Fatehgarh block, Jaisalmer district, Rajasthan lies between 26⁰01'12' to 26⁰57'07' N Latitudes and 70⁰24'36' to 71⁰27'22' E Longitudes with an area 44628 ha. 31 landscape ecological units of Fatehgarh block (LEUs) represent sandy arid plain of Western plain (Fig. 2.1.29 and Table 2.1.28).

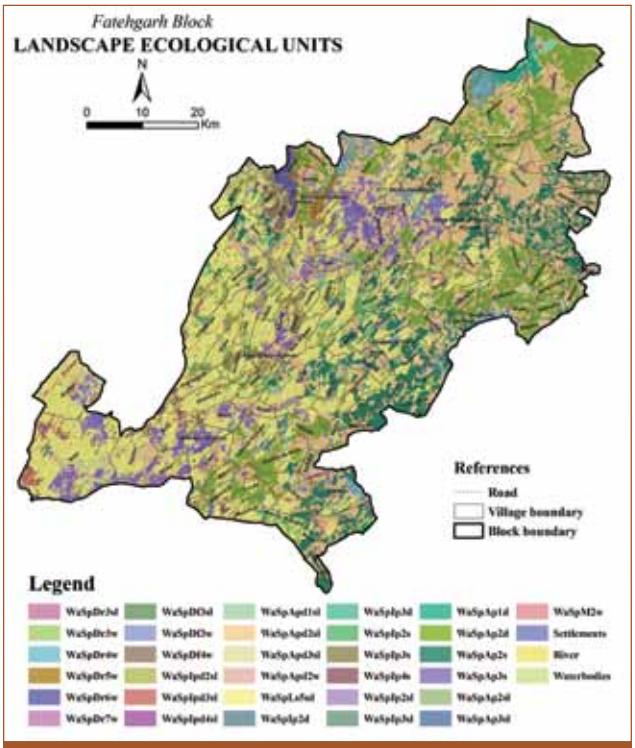


Fig. 2.1.29. Landscape ecological units maps of Fatehgarh block

Table 2.1.28. Description of landscape ecological units Fatehgarh block, Sandy Arid Plains, Western Plain

LEU	Description
WaSpDr3sl	Gently sloping denudational ridges (scrub land)
WaSpDr3w	Gently sloping denudational ridges (waste lands)
WaSpDr4w	Moderately sloping denudational ridges (forest)
WaSpDr5w	Moderately steep sloping denudational ridges (waste lands)
WaSpDr6w	Steeply sloping denudational ridges (waste lands)
WaSpDr7w	Very steeply sloping denudational ridges (waste lands)
WaSpDf3sl	Gently sloping denudational foot slopes (scrub land)
WaSpDf3w	Gently sloping denudational foot slopes (waste lands)
WaSpDf4w	Moderately sloping denudational foot slopes (waste lands)
WaSpIpd2sl	Very gently sloping interdunal pediments (scrub land)
WaSpIpd3sl	Gently sloping interdunal pediments (scrub land)
WaSpIpd4sl	Moderately sloping interdunal pediments (scrub land)
WaSpApd1sl	Level to nearly level aeolian pediments (scrub land)
WaSpApd2sl	Very gently sloping aeolian pediments (scrub land)
WaSpApd3sl	Gently sloping aeolian pediments (scrub land)
WaSpApd2w	Very gently sloping aeolian pediments (waste lands)
WaSpLs5sd	Moderately steep sloping longitudinal sand dunes (sand dunes)
WaSpIp2d	Very gently sloping sloping interdunal plains (double crop)
WaSpIp3d	Gently sloping interdunal plains (double crop)

LEU	Description
WaSpIp2s	Very steeply sloping interdunal plains (single crop)
WaSpIp3s	Gently sloping interdunal plains (single crop)
WaSpIp4s	Moderately sloping interdunal plains (single crop)
WaSpIp2sl	Very gently sloping interdunal plains (scrub land)
WaSpIp3sl	Gently sloping interdunal plains (scrub land)
WaSpAp1d	Level to nearly level aeolian plains (double crop)
WaSpAp2d	Very gently sloping aeolian plains (double crop)
WaSpAp2s	Very gently sloping aeolian plains (single crop)
WaSpAp3s	Gently sloping aeolian plains (single crop)
WaSpAp2sl	Very gently sloping aeolian plains (scrub land)
WaSpAp3sl	Gently sloping aeolian plains (scrub land)
WaSpM2w	Very gently sloping mining (waste lands)

Southern region

Goa state (14° 53' 47" to 15° 47' 59" N latitude and 73° 40' 54" -74°20' 11" E longitude, Area 3702 km^2) comprises of two districts and twelve talukas. In the Goa state, 97 landscape ecological units (LEUs) have been identified and mapped in five broad landform units namely, basalt, granite and granite-gneiss, quartzite/ schistose, fluvio-littoral and dissected laterite hill in Western Ghats and West Coast sub-physiography of hill ranges-Ghats, Central Sahyadri and Coastal plain (Konkan Coast). The Landscape ecological unit map of all the taluka of the state are presented in figures 2.1.30 to 2.1.41 and describe in table 2.1.29.

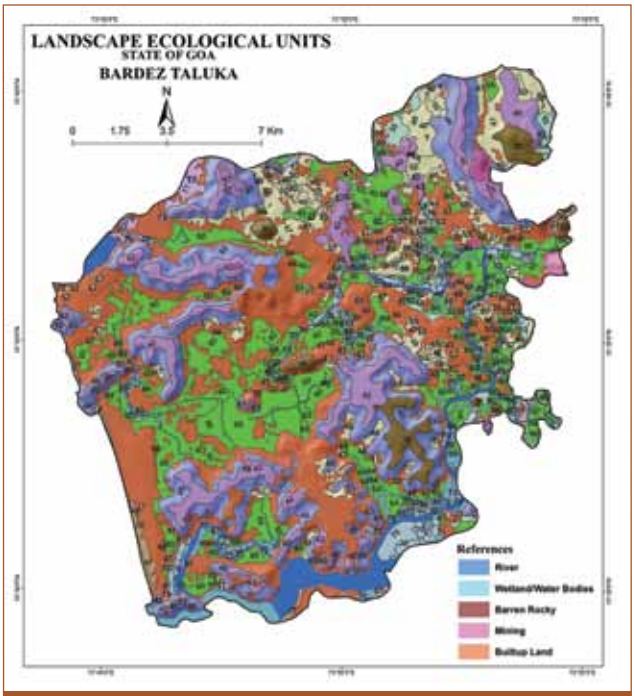


Fig. 2.1.30. Landscape Ecological Unit map of Bardez Taluka, Goa

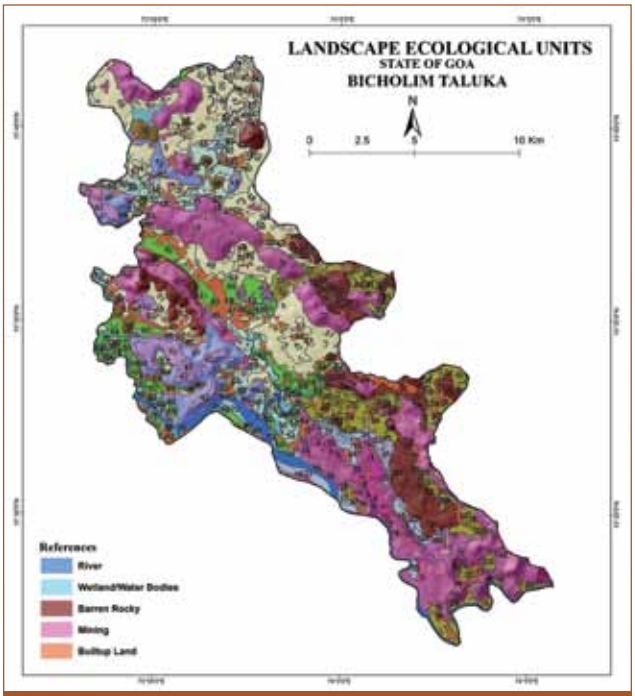


Fig. 2.1.31. Landscape Ecological Unit map of Bicholim Taluka, Goa

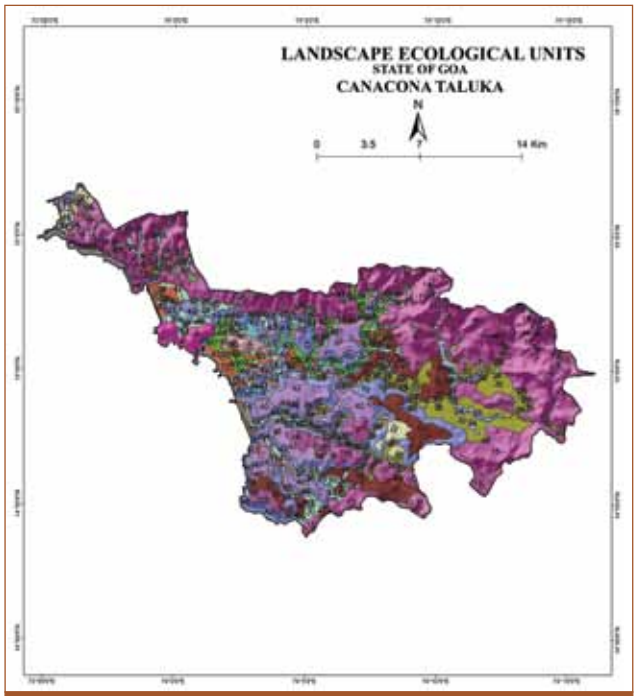


Fig. 2.1.32. Landscape Ecological Unit map of Canacona Taluka, Goa

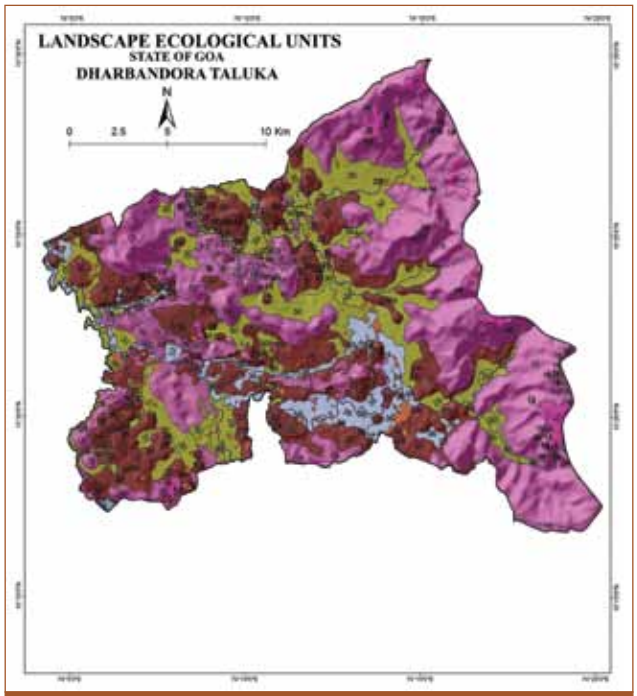


Fig. 2.1.33. Landscape Ecological Unit map of Dharbondhara Taluka, Goa

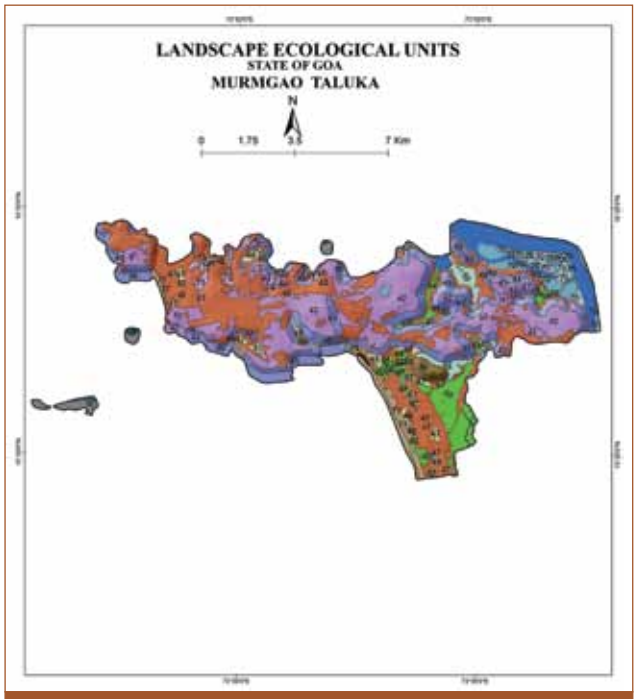


Fig. 2.1.34. Landscape Ecological Unit map of Murmgao Taluka, Goa

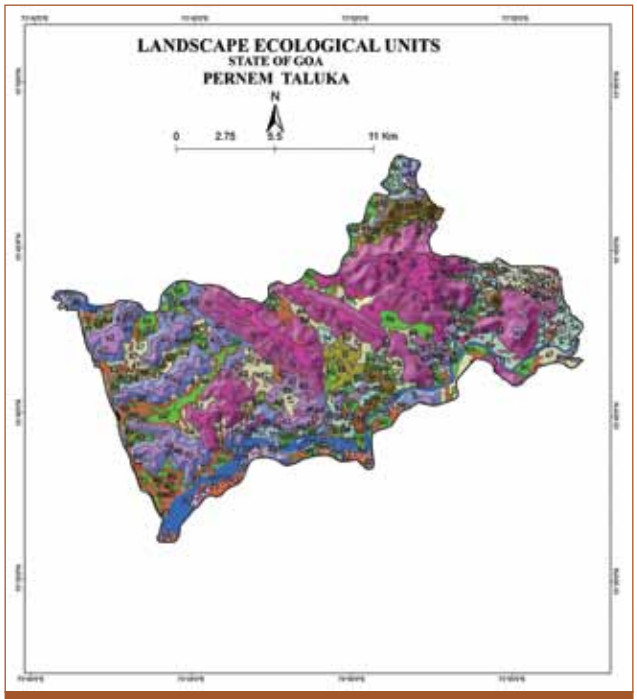


Fig. 2.1.35. Landscape Ecological Unit map of Pernem Taluka, Goa

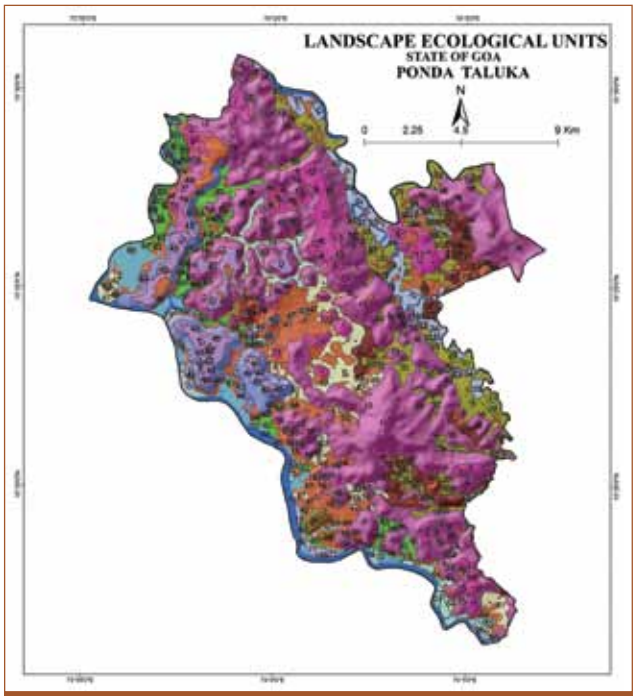


Fig. 2.1.36. Landscape Ecological Unit map of Ponda Taluka, Goa

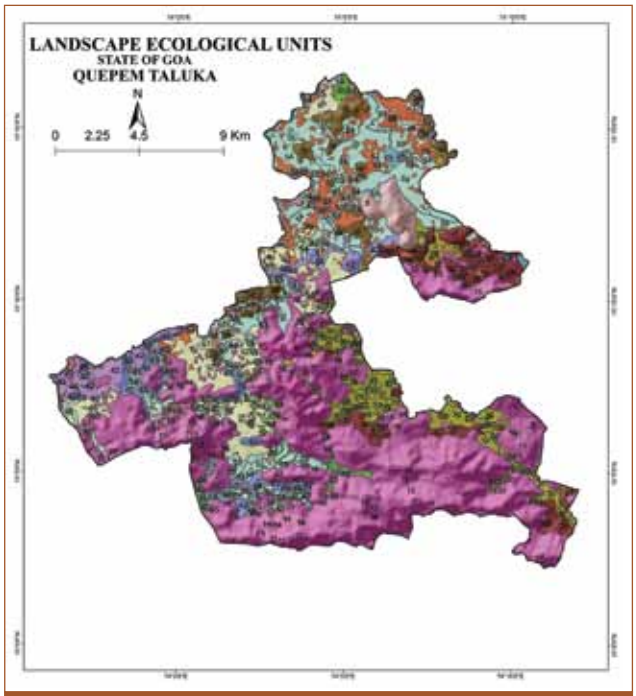


Fig. 2.1.37. Landscape Ecological Unit map of Quepem Taluka, Goa

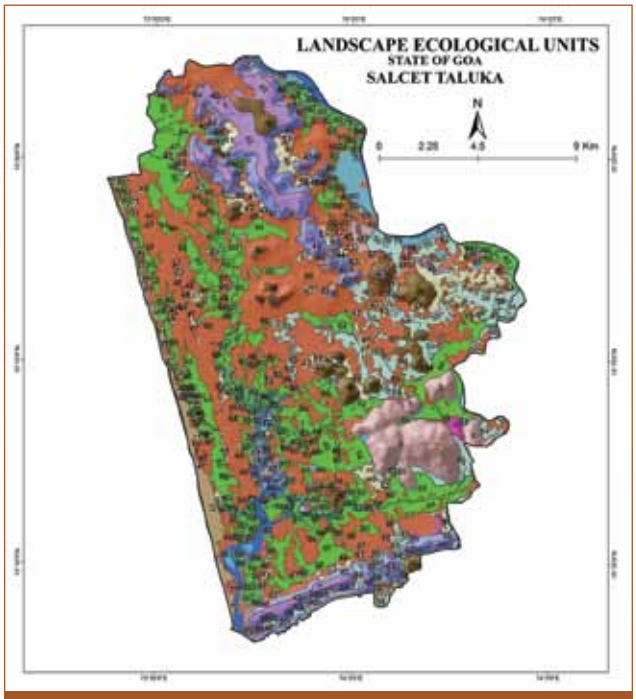


Fig. 2.1.38. Landscape Ecological Unit map of Salcet Taluka, Goa

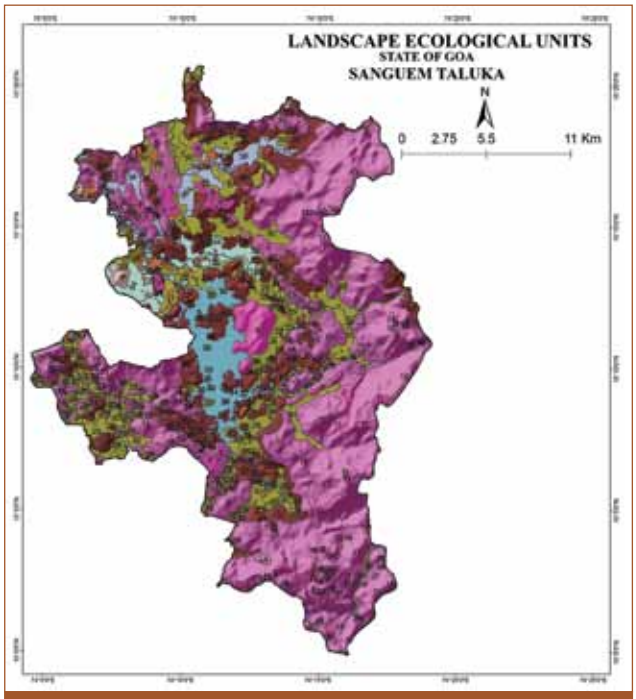


Fig. 2.1.39. Landscape Ecological Unit map of Sanguem Taluka, Goa

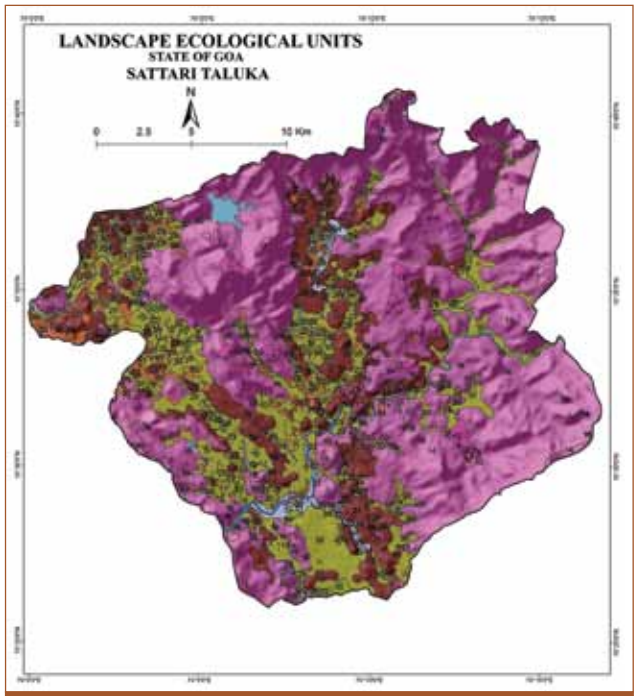


Fig. 2.1.40. Landscape Ecological Unit map of Sattari Taluka, Goa

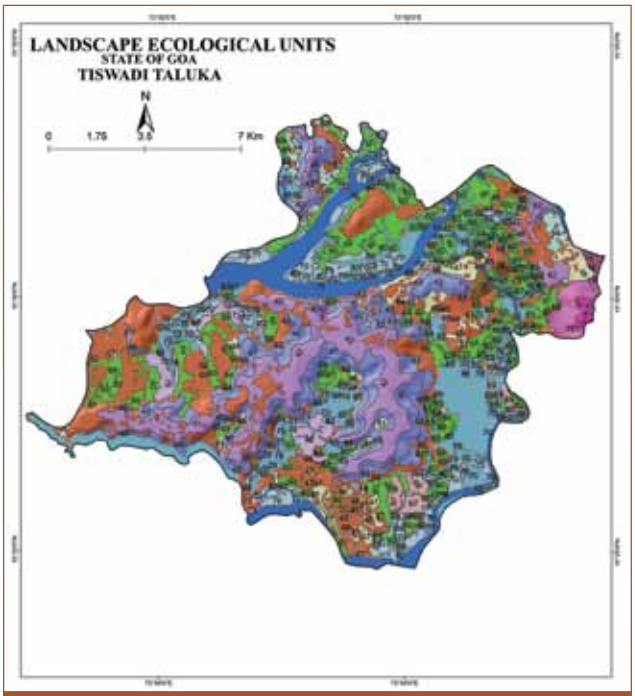


Fig. 2.1.41. Landscape Ecological Unit map of Tiswadi Taluka, Goa

Table. 2.1.29. Description of Landscape Ecological Units

LEU code	LEU	Description of LEU characteristics
1	HwBaHH6f	Steeply sloping, high hills basalt, western ranges-ghats (forest/forest plantation)
2	HwBaRS3f	Gently sloping, restricted summits basalt, western hill ranges-ghats (forest/forest plantation)
3	HwGnRS4f	Moderately sloping, restricted summits, granite and granite-gneiss western hill ranges-ghats (forest/forest plantation)
4	HwGnRS5f	Moderately steeply sloping, restricted summits, granite and granite-gneiss western hill ranges-ghats (forest/forest plantation)
5	HwGnRS6f	Steeply sloping, restricted summits, granite and granite-gneiss western hill ranges-ghats (forest/forest plantation)
6	HwGnHS6f	Steeply sloping, hill side slopes, granite and granite-gneiss western hill ranges-ghats (forest/forest plantation)
7	HwQsHH4w1	Moderately sloping, high hills quartzite/schistose, western hill ranges-ghats (barren/ unculturable/scrub land/wasteland)
8	HwQsHH5f	Moderately steeply sloping, high hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
9	HwQsHH5w3	Moderately steeply sloping, high hills quartzite/schistose, western hill ranges-ghats (barren rocky)
10	HwQsHH6f	Steeply sloping, high hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
11	HwQsHH7w1	Very steeply sloping, high hills quartzite/schistose, western hill ranges-ghats (barren/ unculturable/scrub land/wasteland)
12	HwQsHH7w3	Very steeply sloping, high hills quartzite/schistose, western hill ranges-ghats (barren rocky)
13	HwQsLH1ag	Level to nearly level, low hills quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)

LEU code	LEU	Description of LEU characteristics
14	HwQsLH1w1	Level to nearly level, low hills quartzite/schistose, western hill ranges-ghats (barren/ unculturable/scrub land/wasteland)
15	HwQsLH2ag	Very gently sloping, low hills quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
16	HwQsLH2f	Very gently sloping, low hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
17	HwQsLH2w1	Very gently sloping, low hills quartzite/schistose, western hill ranges-ghats (barren/ unculturable/scrub land/wasteland)
18	HwQsLH3f	Gently sloping, low hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
19	HwQsLH4ag	Moderately sloping, low hills quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
20	HwQsLH4f	Moderately sloping, low hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
21	HwQsLH4w1	Moderately sloping, low hills quartzite/schistose, western hill ranges-ghats (barren/ unculturable/scrub land/wasteland)
22	HwQsLH5f	Moderately steeply sloping, low hills quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
23	HwQsLH5w1	Moderately steeply sloping, low hills quartzite/schistose, western hill ranges-ghats (barren/unculturable/scrub land/wasteland)
24	HwQsLH6f	Steeply sloping, low hills quartzite/schistose ,western hill ranges-ghats (forest/forest plantation)
25	HwQsRS3ag	Gently sloping, restricted summits quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
26	HwQsRS4ag	Moderately sloping, restricted summits quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
27	HwQsRS4f	Moderately sloping, restricted summits quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
28	HwQsRS4w1	Moderately sloping, restricted summits quartzite/schistose, western hill ranges-ghats (barren/unculturable/scrub land/wasteland)
29	HwQsRS5f	Moderately steeply, sloping restricted summits quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
30	HwQsRS5w1	Moderately steeply sloping, restricted summits quartzite/schistose, western hill ranges-ghats (barren/unculturable/scrub land/wasteland)
31	HwQsRS6f	Steeply sloping, restricted summits quartzite/schistose, western hill ranges-ghats (forest/ forest plantation)
32	HwQsIHV2ag	Very gently sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
33	HwQsIHV2f	Very gently sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (forest/forest plantation)
34	HwQsIHV2w1	Very gently sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (barren/unculturable/scrub land/wasteland)
35	HwQsIHV3ag	Gently sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
36	HwQsIHV3f	Gently sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (forest/ forest plantation)

LEU code	LEU	Description of LEU characteristics
37	HwQsIHV4ag	Moderately sloping, inter-hill valleys quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
38	HwQsNV2ag	Very gently sloping, narrow valleys quartzite/schistose, western hill ranges-ghats (agriculture crop land/agriculture plantation)
39	HwQsNV2f	Very gently sloping, narrow valleys quartzite/schistose, western hill ranges-ghats (forest/ forest plantation)
40	PwLeCH3w1	Gently sloping, conical hills dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
41	PwLeCH4w1	Moderately sloping, conical hills dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
42	PwLeFTH2ag	Very gently sloping, flat topped hills dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
43	PwLeFTH2w1	Very gently sloping, flat topped hills dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
44	PwLeFTH3w1	Gently sloping, flat topped hills dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
45	PwLeE3w1	Gently sloping, escarpments dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
46	PwLeE4w1	Moderately sloping, escarpments dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
47	PwLeE5ag	Moderately steeply, sloping escarpments dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
48	PwLeE5f	Moderately steeply, sloping escarpments dissected laterite hills, west coastal plains (forest/forest plantation)
49	PwLeE5w1	Moderately steeply, sloping escarpments dissected laterite hills, west coastal plains (barren/unculturable/scrub land/wasteland)
50	PwLeE6f	Steeply sloping, escarpments dissected laterite hills, west coastal plains (forest/forest plantation)
51	PwLeE6w1	Steeply sloping, escarpments dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
52	PwLeUL2ag	Very gently sloping, undulating lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
53	PwLeUL2f	Very gently sloping, undulating lands dissected laterite hills, west coastal plains (forest/ forest plantation)
54	PwLeUL3ag	Gently sloping, undulating lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
55	PwLeUL3f	Gently sloping, undulating lands dissected laterite hills, west coastal plains (forest/forest plantation)
56	PwLeUL3w1	Gently sloping, undulating lands dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
57	PwLeUL4ag	Moderately sloping, undulating lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
58	PwLeUL4f	Moderately sloping, undulating lands dissected laterite hills, west coastal plains (forest/ forest plantation)
59	PwLeUL4w1	Moderately sloping, undulating lands dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
60	PwLeCL1ag	Level to nearly level, colluvial low lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)

LEU code	LEU	Description of LEU characteristics
61	PwLeCL2ag	Very gently sloping, colluvial low lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
62	PwLeCL2w1	Very gently sloping, colluvial low lands dissected laterite hills, west coastal plains (barren/ unculturable/scrub land/wasteland)
63	PwLeCL3ag	Gently sloping, colluvial low lands dissected laterite hills, west coastal plains (agriculture crop land/agriculture plantation)
64	PwLeIL4f	Moderately sloping, islands dissected laterite hills, west coastal plains (forest/forest plantation)
65	PwLeIL5f	Moderately steeply sloping, islands dissected laterite hills, west coastal plains (forest/ forest plantation)
66	PwFlPL1ag	Level to nearly level, plain lands, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
67	PwFlPL1sl	Level to nearly level, plain lands, fluvio-littoral west coastal plains (salt affected land)
68	PwFlPL1w1	Level to nearly level, plain lands, fluvio-littoral west coastal plains (barren/unculturable/ scrub land/wasteland)
69	PwFlPL2ag	Very gently sloping, plain lands, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
70	PwFlPL2f	Very gently sloping, plain lands, fluvio-littoral west coastal plains (forest/forest plantation)
71	PwFlPL3ag	Gently sloping, plain lands, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
72	PwFlPL3f	Gently sloping, plain lands, fluvio-littoral west coastal plains (forest/forest plantation)
73	PwFlPL3w1	Gently sloping, plain lands, fluvio-littoral west coastal plains (barren/unculturable/scrub land/wasteland)
74	PwFlSP1ag	Level to nearly level, salt pans, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
75	PwFlSP1sl	Level to nearly level, salt pans, fluvio-littoral west coastal plains (salt affected land)
76	PwFlSP1w1	Level to nearly level, salt pans, fluvio-littoral west coastal plains (barren/unculturable/ scrub land/wasteland)
77	PwFlSP2w1	Very gently sloping, salt pans, fluvio-littoral west coastal plains (barren/unculturable/ scrub land/wasteland)
78	PwFlMF1ag	Level to nearly level, mudflats, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
79	PwFlMF1w1	Level to nearly level, mudflats, fluvio-littoral west coastal plains (barren/unculturable/ scrub land/wasteland)
80	PwFlMF1w2	Level to nearly level, mudflats, fluvio-littoral west coastal plains (sandy area)
81	PwFlMF2ag	Very gently sloping, mudflats, fluvio-littoral west coastal plains (agriculture crop land/ agriculture plantation)
82	PwFlMF2sl	Very gently sloping, mudflats, fluvio-littoral west coastal plains (salt affected land)
83	PwFlMF2w1	Very gently sloping, mudflats, fluvio-littoral west coastal plains (barren/unculturable/ scrub land/wasteland)
84	PwFlSM1m	Level to nearly level, swamps and marshes, fluvio-littoral west coastal plains (mangroves)
85	PwFlSM2m	Very gently sloping, swamps and marshes, fluvio-littoral west coastal plains (mangroves)
86	PwFlBR1w2	Level to nearly level, beach and beach ridges, fluvio-littoral west coastal plains (sandy area)

Bukkarayasamudram Mandal

Bukkarayasamudram Mandal, Anantapur district, Andhra Pradesh (13°37› 51›› to 14°48› 09›› N latitude and 77°33' 47" E and 77°47'45" E longitude, Area 24,808 ha). 15 landscape ecological units of Bukkarayasamudram mandal (LEUs) represent south Deccan plateau (Fig. 2.1.42 and Table 2.1.30) and are associated with granite and gneissic complex..

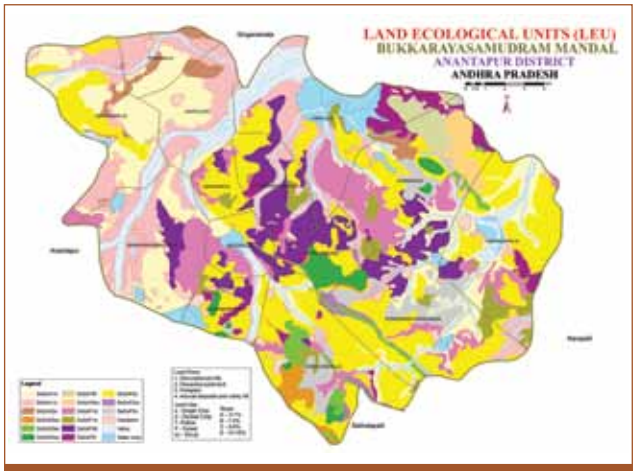


Fig. 2.1.42. Land ecological unit (LEU) Bukkarayasamudrum mandal

Kangayam block, Tiruppur District, Tamil Nadu

Kangayam block, Tiruppur District, Tamil Nadu (10°54'55" to 11°7'39" N latitude and 77°43›19›› to 77°27› 6›› E longitude, Area 33805 ha). 15 landscape ecological units of **Kangayam** mandal (LEUs) represent south Deccan plateau (Fig. 2.1.43 and Table 2.1.31) and are associated with granite and gneissic complex.

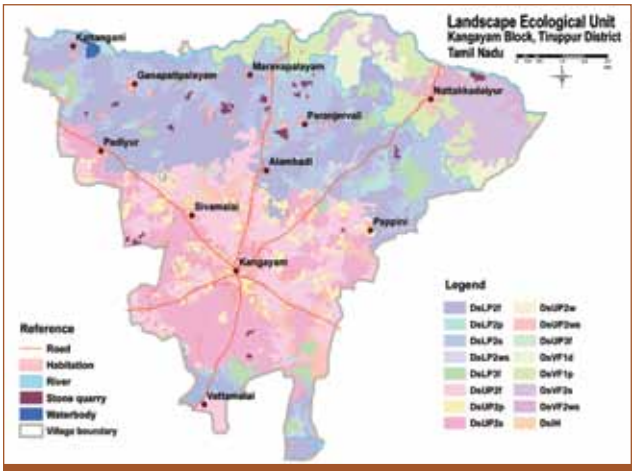


Fig. 2.1.43. Landscape ecological unit map of Kangayam block

Table 2.1.30. Description of Landscape Ecological Units Bukkarayasamudrum mandal, Granite and gneissic complex landscape, south Deccan plateau

LEU	Description
DsGnH5f	Strongly sloping denudational hills and ridges (forest)
DsGnH5sc	Strongly sloping denudational hills and ridges (scrub)
DsGnD2sc	Very gently sloping dissected pediment (scrub)
DsGnD3sc	Gently sloping dissected pediment (scrub)
DsGnD5sc	Steeply sloping dissected pediment (scrub)
DsGnP1d	Nearly level pediplain (double crop)
DsGnP1s	Nearly level pediplain (single crop)
DsGnP2d	Very gently sloping pediplain (double crop)
DsGnP2f	Very gently sloping pediplain (fallow)
DsGnP2s	Very gently sloping pediplain (single crop)
DsGnP3s	Gently sloping pediplain (single crop)
DsGnP2sc	Very gently sloping pediplain (scrub)
DsGnA1d	Nearly level alluvial deposits and valley fills (double crop)
DsGnA1s	Nearly level alluvial deposits and valley fills (single crop)
DsGnA2s	Very gently sloping alluvial deposits and valley fills (single crop)

Table 2.1.31. Description of Landscape Ecological Units on Granite and gneissic complex Landscape; South Deccan plateau

LEU	Description
DsUP2f	Very gently sloping upper pediplain (fallow land)
DsUP2p	Very gently sloping upper pediplain (plantation)
DsUP2s	Very gently sloping upper pediplain (single crop)
DsUP2ws	Very gently sloping upper pediplain (waste land with scrub)
DsUP3f	Gently sloping upper pediplain (fallow land)
DsLP2f	Very gently sloping lower pediplain (fallow land)
DsLP2p	Very gently sloping lower pediplain (plantation)
DsLP2s	Very gently sloping lower pediplain (single crop)
DsLP2ws	Very gently sloping lower pediplain (waste land with scrub)
DsLP3f	Gently sloping lower pediplain (fallow land)
DsVF1d	Nearly level valley floor (double crop)
DsVF1p	Nearly level valley floor (plantation)
DsVF2d	Very gently sloping valley floor (double crop)
DsVF2ws	Very gently sloping valley floor (waste land with scrub)
DsIH	Isolated hills

Landscape Ecological Unit

Sujala-III project

LRI work was completed in 66 microwatersheds under the original programme and 33 villages under the new expansion programme covering about 64206 ha area during the current year. Hosur-1 microwatershed in Gadag district covering an area of 408 ha is given as an example. Five landscape ecological units of **the watershed** represent south Deccan plateau (Fig. 21.44 and Table 2.1.32) and are associated with Metamorphic-Schist landform.

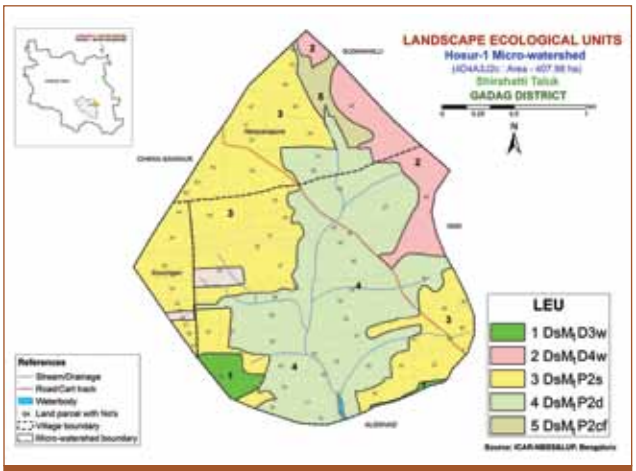


Fig. 2.1.44 Landscape Ecological Units map of Hosur-1 Microwatershed

Bilalgodu micro-watershed (4D4D3S2d), Mudigere sub-watershed of Chikmagalur district, Karnataka

Nine Landscape ecological units were identified in Bilalgodu micro-watershed (4D4D3S2d), Mudigere sub-watershed of Chikmagalur district, Karnataka, which represents quartzite schist complex of western ghats – Central Sahyadri (Table 2.1.33).

Landscape Ecological Unit

The adopted villages under this project are Hosadurga and Heramgere under Kodihalli block, and Uyamballi

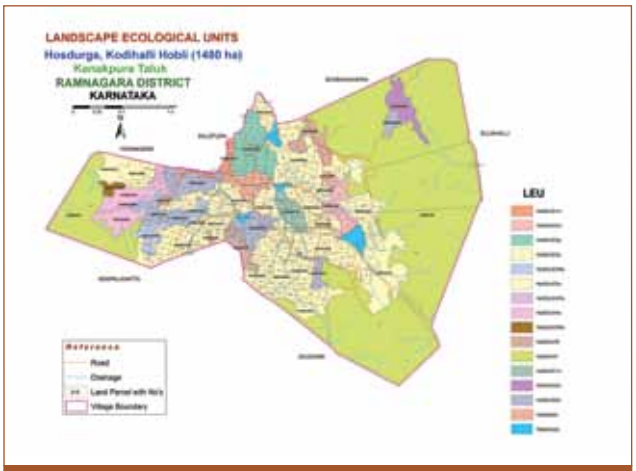


Fig. 2.1.45. Landscape ecological units map of Hosadurga Village Kanakapura taluk, Ramanagara district, Karnataka

Doddahalli Alahalli villages under Uyamballi block, Kanakapura taluk, Ramanagara district, Karnataka (12° 26' 27" to 12° 23' 19" N and 77° 31' 36" to 77° 34' 53" E, Area 1986 ha). 15 landscape ecological units of the area represent south Deccan plateau (Fig. 2.1.45 and Table 2.1.34) and are associated with Granite and gneissic complex.

Table 2.1.32. Description of Landscape Ecological Units (LEU's) of Hosur-1 Microwatershed, Shirahatti taluk, Gadag district, Karnataka

LEU	Description
DsM_tD3w	Gently sloping dissected pediments (Rocky waste lands)
DsM_tD4w	Moderately sloping dissected pediments (Rocky waste lands)
DsM_tP2s	Very gently sloping pediplains (single cropped)
DsM_tP2d	Very gently sloping pediplains (double cropped)
DsM_tP2cf	Very gently sloping (1-3% slopes) pediplains (current fallow)

Table 2.1.33. Description of landscape ecological units, Bilalgodu (4D4D3S2d) watershed, Chikmagalur, Karnataka

Physiographic region	Physiographic sub-region	Broad landform	LEU	Description
Hill ranges	Western ghats	Western ghats-Central Sahyadri	HwS_cS^r2p	Very gently sloping summit and ridge top (plantations with natural vegetation)
			HwS_cS^r3p	Gently sloping Summit and ridge top (plantations with natural vegetation)
			HwS_cS^r4p	Moderately sloping Summit and ridge top (plantations with natural vegetation)
			HwS_cS^r5p	Strongly sloping Summit and ridge top (plantations with natural vegetation)
			HwS_cR3p	Gently sloping side slopes of hills (plantations with natural vegetation)
			HwS_cR4p	Moderately sloping side slopes of hills (plantations with natural vegetation)
			HwS_cR5p	Strongly sloping side slopes of hills (plantations with natural vegetation)
			HwS_cV_c2d	Very gently sloping colluvial valley (double crop)
			HwS_cV_c3d	Gently sloping colluvial valley (double crop)

Table 2.1.34.. Description of landscape ecological units (LEU'S) of Hosadurga village Kanakapura taluk, Ramanagara district Karnataka

LEU	Description
HeSGnHf	Strongly sloping (10-15%) denudation hills (forest)
HeSGnHR	Strongly sloping (10-15%) denudation hills (Rock out crops)
HeSGnS2s	Very gently sloping (1-3%) summits (single crop)
HeSGnS3s	Gently sloping (3-5%) summits (single crop)
HeSGnD5Rs	Strongly sloping (5-10%) Dissected pediments with rockyland (single crop)
HeSGnD4Rs	Moderately sloping (5-10%) Dissected pediments with rockyland (single crop)
HeSGnD4s	Moderately sloping (5-10%) Dissected pediments (single crop)
HeSGnD3Rs	Gently sloping (1-3%) Dissected pediments with rockyland (single crop)
HeSGnD3s	Gently sloping (1-3%) Dissected pediments (single crop)
HeSGnD2	Very gently sloping (1-3%) Dissected pediments. (single crops)
HeSGnD2p	Very gently sloping (1-3%) Dissected pediments. (perennial crops)
HeSGnP1d	Nearly level land (0-1%) (Double crop)

2.2 INVENTORYING NATURAL RESOURCES

Land Resource Inventory on 1:10000 scales using geo-spatial technique

Mapping of land resource inventory on 1:10000 scales has been intiated in the country. The progress of the programme is reported herein (Table 2.2.1).

Table 2.2.1. Status of Land Resource Inventory on 1:10000 scale

Sl. No	Region	Physiography	Sub Physigraphy	Block	District	State	Monitorable indicators			
							No.	Soil survey completed	Soil Survey partly completed	Soil map
1.	Southern	Deccan plateau	South Deccan plateau	Bukkarayasa-mudram	Anantpur	Andhra Pradesh	√	√		√
2.		Deccan plateau	South Deccan plateau	Indervalle	Adilabad	Telangana	√	√		√
3.		Deccan plateau	South Deccan plateau	Thimajipet	Mehbubnagar	Telangana	√	√		√
4.		Deccan plateau	South Deccan Plateau	Gajwel	Medak	Telangana	√	√		√
5.		Hill Ranges (Ghat)	Western Ghats	Kangayam	Tiruppur	Tamil Nadu	√	√		√
6.		Coastal Plains	West Coast	Tiswadi	North Goa	Goa	√	√		√
7.		Coastal Plains	West Coast	Bardez	North Goa	Goa	√	√		√
8.		Hill Ranges (Ghats)	Western Ghat	Pernem	North Goa	Goa	√	√		√
9.		Hill Ranges (Ghats)	Western Ghat	Bicholim	North Goa	Goa	√	√		√
10.		Hill Ranges (Ghats)	Western Ghat	Sattari	North Goa	Goa	√	√		√
11.		Coastal Plains	West Coast	Ponda	North Goa	Goa	√	√		√
12.		Hill Ranges (Ghats)	Western Ghat	Sanguem	South Goa	Goa	√	√		√
13.		Hill Ranges (Ghats)	Western Ghat	Dharbandora	South Goa	Goa	√	√		√
14.		Hill Ranges (Ghats)	Western Ghat	Canacona	South Goa	Goa	√	√		√
15.		Hill Ranges (Ghats)	Western Ghat	Quepem	South Goa	Goa	√	√		√
16.		Hill Ranges (Ghats)	Western Ghat	Salcete	South Goa	Goa	√	√		√
17.		Hill Ranges (Ghats)	Western Ghat	Murmgoa	South Goa	Goa	√	√		√
18.		Gujarat coastal plain	West coast plain	Ankaleswar	Bharuch	Gujarat	√	√		√
19.		Gujarat coastal plain	West coast plain	Dholka	Ahmedabad	Gujarat	√	√		√

Sl. No	Region	Physiography	Sub Physigraphy	Block	District	State	Monitorable indicators			
							No.	Soil survey completed	Soil Survey partly completed	Soil map
20.		Central highlands	Aravalli landscape	Khedbrahma	Sabarkantha	Gujarat	√	√		√
21.		Gujarat coastal plain	West coast plain	Deesa	Banaskantha	Gujarat	√	√		√
22.		Gujarat coastal plain	Kathiawar peninsula	Porbandar	Porbandar	Gujarat	√	√		√
23.		Gujarat coastal plain	Kutch peninsula	Rapar	Kutch	Gujarat	√	√		
24.		Gujarat coastal plain	West Coast Plain	Jhadadia	Bharuch	Gujarat	√	√		
25.		Gujarat coastal plain	West Coast Plain	Amod	Bharuch	Gujarat	√	√		
26.		Gujarat coastal plain	West Coast Plain	Vagva	Bharuch	Gujarat	√	√		
27.		Gujarat coastal plain	West Coast Plain	Jamusar	Bharuch	Gujarat	√	√		
28.		Gujarat coastal plain	West Coast Plain	Valia	Bharuch	Gujarat	√	√		
29.		Gujarat coastal plain	West Coast Plain	Bharuch	Bharuch	Gujarat	√	√		
30.		Gujarat coastal plain	West Coast Plain	Hansat	Bharuch	Gujarat	√	√		
31.		Gujarat coastal plain	West Coast Plain	Netrang	Bharuch	Gujarat	√	√		
32.		Gujarat coastal plain	West Coast Plain	Mandvi	Surat	Gujarat	√	√		
33.		Gujarat coastal plain	West Coast Plain	Mangrol	Surat	Gujarat	√	√		
34.		Gujarat coastal plain	West Coast Plain	Umarpada	Surat	Gujarat	√	√		
35.		Gujarat coastal plain	West Coast Plain	Olpad	Surat	Gujarat	√	√		
36.		Gujarat coastal plain	West Coast Plain	Kamrej	Surat	Gujarat	√	√		
37.		Gujarat coastal plain	West Coast Plain	Palsana	Surat	Gujarat	√	√		
38.		Gujarat coastal plain	West Coast Plain	Bardoli	Surat	Gujarat	√	√		
39.		Gujarat coastal plain	West Coast Plain	Surat City	Surat	Gujarat	√	√		
40.		Gujarat coastal plain	West Coast Plain	Chorasi	Surat	Gujarat	√	√		
41.		Gujarat coastal plain	West Coast Plain	Mahuva	Surat	Gujarat	√	√		
42.		Gujarat coastal plain	West Coast Plain	Dharampur	Valsad	Gujarat	√	√		
43.		Gujarat coastal plain	West Coast Plain	Valsad	Valsad	Gujarat	√	√		
44.		Gujarat coastal plain	West Coast Plain	Pardi	Valsad	Gujarat	√	√		

Sl. No	Region	Physiography	Sub Physigraphy	Block	District	State	Monitorable indicators			
							No.	Soil survey completed	Soil Survey partly completed	Soil map
45.		Gujarat coastal plain	West Coast Plain	Vapi	Valsad	Gujarat	√	√		
46.		Gujarat coastal plain	West Coast Plain	Umargaon	Valsad	Gujarat	√	√		
47.		Gujarat coastal plain	West Coast Plain	Kaparda	Valsad	Gujarat	√	√		
48.		Gujarat coastal plain	West Coast Plain	Gandevi	Navsari	Gujarat	√	√		
49.		Gujarat coastal plain	West Coast Plain	Chikhil	Navsari	Gujarat	√	√		
50.		Gujarat coastal plain	West Coast Plain	Jalalpur	Navsari	Gujarat	√	√		
51.		Gujarat coastal plain	West Coast Plain	Navsari	Navsari	Gujarat	√	√		
52.		Gujarat coastal plain	West Coast Plain	Bansda	Navsari	Gujarat	√	√		
53.		Gujarat coastal plain	West Coast Plain	Khergaon	Navsari	Gujarat	√	√		
54.		Western Plains	Sandy arid plains	Rawatsar	Hanumangarh	Rajasthan	√	√		
55.		Western Plains	Sandy arid plains	Sriganga nagar	Sriganganagar	Rajasthan	√	√		
56.		Western Plains	Sandy arid plains	Anupgarh	Sriganganagar	Rajasthan	√	√		
57.		Western Plains	Sandy arid plains	Suratgarh	Sriganganagar	Rajasthan	√	√		
58.		Western Plains	Sandy arid plains	Fatehgarh	Jaisalmer	Rajasthan	√	√		
59.	Eastern	Eastern plateau	Mahanadi basin	Titlagarh	Koraput	Odisha	√	√		√
60.		Coastal plain	East coast	Basudevpur	Bhadrak	Odisha	√	√		√
61.		Coastal plain	East coast	Ganjam	Ganjam	Odisha	√	√		√
62.		Indo-Gangetic plain	Alluvial plain	Kadwa	Katihar	Bihar	√	√		√
63.		Indo-Gangetic plain	Alluvial plain	Mushahari	Samastipur	Bihar	√	√		√
64.		Eastern plateau	Chhotanagpur plateau	Dumka	Dumka	Jharkhand	√	√		√
65.		Eastern plateau	Chhotanagpur plateau	Borio	Sahibganj	Jharkhand	√	√		√
66.		Eastern plateau	Chhotanagpur plateau	Rajnagar	Birbhum	West Bengal	√	√		√
67.		Bengal basin	Coastal Plains	Deshapran	Purba Medinipur	West Bengal	√	√		√
68.		Bengal basin	Delta plain	Kultali	South 24 Parganas	West Bengal	√	√		√
69.		Bengal basin	Coastal Plains	Canning II	South 24 Pargana	West Bengal	√	√		√
70.		Bengal basin	Coastal Plains	Namkhana	South 24 Parganas	West Bengal	√	√		√

Sl. No	Region	Physiography	Sub Physigraphy	Block	District	State	Monitorable indicators			
							No.	Soil survey completed	Soil Survey partly completed	Soil map
71.		Bengal basin	Delta plain	Gosaba	South 24 Parganas	West Bengal	√	√		√
72.		Bengal basin	Coastal Plains	Ramnagar-I	Purba Medinipur	West Bengal	√	√		√
73.		Bengal basin	Delta plain	Hasnabad	North 24 Parganas	West Bengal	√	√		√
74.		Eastern plateau	Chotanagpur plateau	Rajnagar	Birbhum	West Bengal	√	√		√
75.		Indo-Gangetic plain	Alluvial plain	Chakia	East Champaran	Bihar	√	√		
76.		Indo-Gangetic plain	Alluvial plain	Piprakothi	East Champaran	Bihar	√	√		
77.		Indo-Gangetic plain	Alluvial plain	Maynaguri	Jalpaiguri	West Bengal	√	√		
78.		Indo-Gangetic plain	Alluvial plain	Baisi	Purnea	Bihar	√	√		
79.		Eastern plateau	Chhotanagpur plateau	Katkamdag	Hazaribagh	Jharkhand	√	√		
80.		Northeastern ranges, eastern Himalayas	Eastern Himalayas	Diyun	Changlang	Arunachal Pradesh	√	√		
81.		Northeastern ranges, eastern Himalayas	Meghalaya Plateau	Umling	Ri-Bhoi	Meghalaya	√	√		
82.		Northeastern ranges, eastern Himalayas	Meghalaya Plateau	Umsning	Ri-Bhoi	Meghalaya	√	√		
83.		Northeastern ranges, eastern Himalayas	Meghalaya Plateau	Jirang	Ri-Bhoi	Meghalaya	√	√		
84.		North Eastern ranges, eastern Himalayas	Brahmaputra valley	North West Jorhat	Jorhat	Assam	√	√		
85.		Northeastern ranges, eastern Himalayas	Purvanchal hills	Medziphema	Dimapur	Nagaland				
86.		Northeastern ranges, eastern Himalayas	Purvanchal Hills	Bishalgarh	Sipahijala	Tripura	√	√		
87.		Northeastern ranges, eastern Himalayas	Purvanchal Hills	Charigram	Sipahijala	Tripura	√	√		
88.	Northern	Central highlands	Aravalli plains	Jagner	Agra	Uttar Pradesh	√	√		√
89.		Himalayas and other mountain ranges	Siwalik hills/outer Himalayas	Nagrota Bagwan	Kangra	Himachal Pradesh	√	√		√
90.		Indo-Gangetic plain	Alluvial plain	Odhan	Sirsa	Haryana	√	√		√
91.		Indo-Gangetic plains	Alluvial plain	Rajpura	Patiala	Punjab	√	√		√

Sl. No	Region	Physiography	Sub Physigraphy	Block	District	State	Monitorable indicators			
							No.	Soil survey completed	Soil Survey partly completed	Soil map
92.		Indo-Gangetic plain	Alluvial plain	Baragaon	Varanasi	Uttar Pradesh	√	√		√
93.		Himalayas and other mountain ranges	Lesser Himalayas	Chamba	Chamba	Uttarakhand	√	√		√
94.		Deccan plateau	Deccan plateau (Lower Maharashtra)	Darwha	Yavatmal	Maharashtra	√		√	
95.		Deccan plateau	North Deccan plateau	Dhanora	Seoni	Madhya Pradesh	√	√		√
96.		Central highlands	Pathar and Bundelkhand upland	Bemetara	Bemetara	Chattisgarh	√		√	
97.		Deccan plateau	Deccan plateau (upper Maharashtra)	Rahuri	Ahmednagar	Maharashtra	√			

Eastern Region

Borio block, Sahibganj district, Jharkhand

Borio block represents Chhotanagpur Plateau of Eastern plateau and the soils of the block are mapped into 31 phases of 13 soil series (Fig. 2.2.1 and Table 2.2.4)

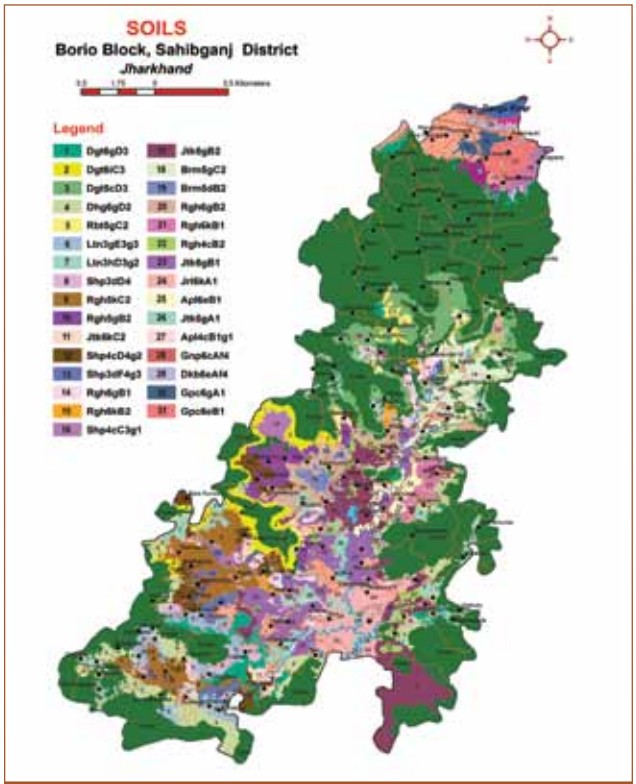


Fig. 2.2.1. Soils of Borio block, Sahibganj district, Bihar

Dumka block, Dumka district, Jharkhand

Dumka block of Dumka district, Jharkhand covers an area of 37950 ha in the region of Chhotanagpur plateau. The soils of the block are mapped into 34 phases of 14 soil series (Fig. 2.2.2 and Table 2.2.5).

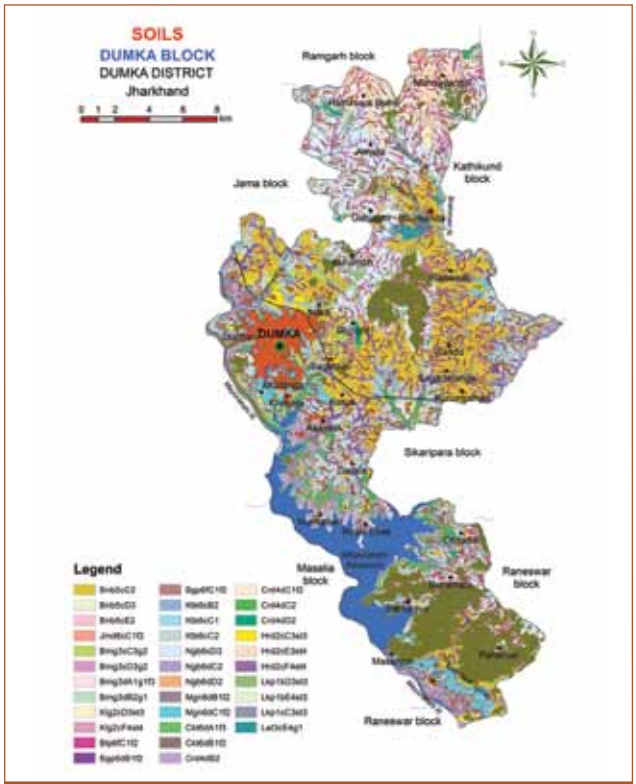


Fig. 2.2.2. Soils of Dumka block, Dumka district, Jharkhand

Table 2.2.4. Soils of Borio Block, Sahibganj District, Jharkhand

Soil phases (soil series)	Brief description
Apl4cB1g1 (Aprol)	Moderately deep, somewhat poorly drained, dark brown to dark yellowish brown, fine loamy soils on very gently sloping old alluvial plain, sandy loam surface and slight erosion.
Apl6eB1 (Aprol)	Very deep, somewhat poorly drained, dark brown to dark yellowish brown, fine loamy soils on very gently sloping old alluvial plain, silt loam surface and slight erosion
Brm5dB2 (Baramosia)	Deep, moderately well drained, strong brown to yellowish red on very gently sloping old alluvial plain with loam surface and moderate erosion.
Brm5gC2 (Baramosia)	Deep, moderately well drained, strong brown to yellowish red on gently sloping old alluvial plain, silty clay loam surface and moderate erosion
Dgt5cD3 (Durgatola)	Deep, somewhat excessively drained, reddish brown to yellowish red, fine loamy soils on moderately sloping undulating plain, sandy loam surface and moderate to severe erosion.
Dgt6gD3 (Durgatola)	Very deep, somewhat excessively drained, reddish brown to yellowish red, fine loamy soils on moderately sloping undulating plain, silty clay loam surface and severe erosion
Dgt6iC3 (Durgatola)	Very deep, somewhat excessively drained, reddish brown to yellowish red, fine loamy soils on gently sloping undulating plain, sandy clay loam surface and severe erosion.
Dhg6gD2 (Dhogre)	Very deep, somewhat excessively drained, dark reddish brown to reddish brown, fine soils on moderately sloping undulating plain, silty clay loam surface and moderate erosion.
Dkb6eAf4 (Dakshin Balua)	Very deep, imperfectly drained, dark grayish brown to dark gray, fine silty soils on nearly level flood plain, silt loam surface and very frequent flooding
Gnp6cAf4 (Gangaprasad)	Very deep, well drained, dark brown, coarse loamy soils on nearly level flood plain with sandy loam surface and very frequent flooding
Gpc6eB1 (Gopalchauki)	Very deep, moderately well drained, dark brown to brown, fine loamy soils on very gently sloping recent alluvial plain, silt loam surface and slight erosion.
Gpc6gA1 (Gopalchauki)	Very deep, moderately well drained, dark brown to brown, fine loamy soils on nearly level sloping recent alluvial plain, silt loam surface and slight erosion
Jrl6kA1 (Jirul)	Very deep, well drained, very dark grayish to very dark gray, fine soils on nearly level sloping old alluvial plain, silty clay surface and slight erosion
Jtk6gA1 (Jetkumarjari)	Very deep, somewhat poorly drained, very dark brown to dark yellowish brown, fine soils on nearly level old alluvial plain, silty clay loam surface and slight erosion.
Jtk6gB1 (Jetkumarjari)	Very deep, somewhat poorly drained, very dark brown to dark yellowish brown, fine soils on very gently sloping old alluvial plain, silty clay loam surface and slight erosion.
Jtk6gB2 (Jetkumarjari)	Very deep, somewhat poorly drained, very dark brown to dark yellowish brown, fine soils on very gently sloping old alluvial plain, silty clay loam surface and moderate erosion.
Jtk6kC2 (Jetkumarjari)	Very deep, somewhat poorly drained, very dark brown to dark yellowish brown, fine soils on gently sloping undulating plain, silty clay surface and moderate erosion.
Ltn3gE3g3 (Lilatanr)	Moderately shallow, somewhat excessively drained, dark brown, gravelly fine soils on moderately steeply sloping foot hills, silty clay loam surface and severe erosion
Ltn3hD3g2 (Lilatanr)	Moderately shallow, somewhat excessively drained, dark brown, gravelly fine soils on moderately sloping foot hills, sandy clay loam surface and severe erosion
Rbt5gC2 (Rani Bathan)	Deep, well drained, dark reddish brown to red, fine soils on gently sloping undulating plain, silty clay loam surface and moderate erosion
Rgh4cB2 (Rangahatia)	Moderately deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, sandy loam surface and moderate erosion.
Rgh5gB2 (Rangahatia)	Deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, silty clay loam surface and moderate erosion.
Rgh5kC2 (Rangahatia)	Deep, moderately well drained, dark brown to yellowish brown, fine soils on gently sloping undulating plain, silty clay surface and moderate erosion

Soil phases (soil series)	Brief description
Rgh6gB1 (Rangahatia)	Very deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, silty clay loam surface and slight erosion
Rgh6gB2 (Rangahatia)	Very deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, silty clay loam surface and moderate erosion.
Rgh6kB1 (Rangahatia)	Very deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, silty clay surface and moderate erosion.
Rgh6kB2 (Rangahatia)	Very deep, moderately well drained, dark brown to yellowish brown, fine soils on very gently sloping undulating plain, silty clay surface and moderate erosion.
Shp3dD4 (Saharpur)	Moderately shallow, well drained, red, gravelly fine soils on moderately sloping foot hills, loam surface and very severe erosion
Shp3dF4g3 (Saharpur)	Moderately shallow, well drained, red, gravelly fine soils on moderately sloping undulating plain, sandy loam surface and very severe erosion.
Shp4cC3g1 (Saharpur)	Moderately deep, well drained, red, gravelly fine soils on gently sloping undulating plain, sandy loam surface and very severe erosion.
Shp4cD4g2 (Saharpur)	Moderately deep, well drained, red, gravelly fine soils on moderately sloping undulating plain, sandy loam surface and very severe erosion.

Table 2.2.5. Soils of Dumka block, Dumka district, Jharkhand

Soil phases (Soil series)	Brief description
Bgp6dBlf2 (Baghapathar)	Very deep, moderately well to imperfectly drained, yellowish brown to brown, sandy clay loam to clay loam soils on very gently sloping valley fill, loamy surface and moderate flooding
Bgp6fC1f2 (Baghapathar)	Very deep, moderately well to imperfectly drained, yellowish brown to brown, sandy clay loam to clay loam soils on gently sloping upper and lower pediments, clay loam surface and moderate flooding
Blp6fC1f2 (Bhalpahari)	Very deep, moderately well to imperfectly drained, dark yellowish brown to strong brown, clay loam to clay soils on gently sloping lower pediment, clay loam surface and moderate flooding
Bmg3cC3g2 (Bajarrahamatganj)	Moderately shallow, well drained, dark reddish brown, gravelly sandy clay loam soils, on lower pediment, sandy loam surface, and severe erosion
Bmg3cD3g2 (Bajarrahamatganj)	Moderately shallow, well drained, dark reddish brown, gravelly sandy clay loam soils, on moderately sloping plateau sandy loam surface, very gravelly and severe erosion
Bmg3dA1g1f3 (Bajarrahamatganj)	Moderately shallow, well drained, dark reddish brown, gravelly sandy clay loam soils, on nearly level depressed land, loamy surface, and severe flooding
Bmg3dB2g1 (Bajarrahamatganj)	Moderately shallow, well drained, dark reddish brown, gravelly sandy clay loam soils, on very gently sloping alluvial plain, loamy surface and moderate erosion
Bnb5cC2 (Bansberwa)	Deep, well drained, dark reddish brown to reddish brown, sandy clay loam soils on gently sloping lower pediment and undulating upland, sandy loam surface and moderate erosion
Bnb5cD3 (Bansberwa)	Deep, well drained, dark reddish brown to reddish brown, sandy loam to sandy clay loam soils on moderately sloping plateau, sandy loam surface and severe erosion
Bnb5cE2 (Bansberwa)	Deep, well drained, dark reddish brown to reddish brown, sandy loam to sandy clay loam soils on moderately steeply sloping plateau, sandy loam surface and moderate erosion
Ckt6dA1f3 (Chorkata)	Very deep, moderate to imperfectly drained, brown to grayish brown, silty clay loam to silty clay soils on nearly level depressed land, loamy surface, severe flooding and slight erosion
Ckt6dB1f2 (Chorkata)	Very deep, moderately well to imperfectly drained, brown to grayish brown, silty clay loam to silty clay soils on very gently sloping alluvial plain, loamy surface and moderate flooding

Soil phases (Soil series)	Brief description
Crd4dB2 (Chirudih)	Moderately deep, moderately well drained, strong brown, sandy loam soils on very gently sloping alluvial plain, loamy surface and moderate erosion
Crd4dC1f2 (Chirudih)	Moderately deep, moderately well drained, strong brown, sandy loam soils on gently sloping alluvial plain, loamy surface and moderate flooding
Crd4dC2 (Chirudih)	Moderately deep, moderately well drained, strong brown, sandy loam soils on gently sloping alluvial plain, loamy surface and moderate erosion
Crd4dD2 (Chirudih)	Moderately deep, moderately well drained, strong brown, sandy loam soils on moderately sloping upper pediment, loamy surface and moderate erosion.
Hrd2cC3st3 (Harwadih)	Shallow, well drained, dark reddish brown, gravelly sandy loam soils on gently sloping undulating upland, sandy loam surface, rubbly and severe erosion
Hrd2cE3st4 (Harwadih)	Shallow, well drained, very dark gray to dark reddish brown, gravelly sandy loam soils on moderately steeply sloping plateau sandy loam surface, very rubbly and severe erosion
Hrd2cF4st4 (Harwadih)	Shallow, well drained, very dark gray to dark reddish brown, gravelly sandy loam soils on steeply sloping residual hillocks, sandy loam surface, very rubbly stoniness and very severe erosion
Jmd6cC1f2 (Jamdali)	Very deep, well drained, dark brown to reddish brown, loam to sandy loam soils on gently sloping alluvial plain, sandy loam surface and moderate flooding
Klg2cD3st3 (Kulungu)	Shallow, well drained, reddish black to very dusky red, gravelly sandy loam to sandy clay loam soils on moderately sloping plateaus, sandy loam surface, rubbly stoniness and severe erosion
Klg2cF4st4 (Kulungu)	Shallow, well drained, reddish black to very dusky red, gravelly sandy loam to sandy clay loam soils on steeply sloping residual hillocks, sandy loam surface, very rubbly stoniness and very severe erosion
Ktb6cB2 (Khutabandh)	Very deep, well drained, brown to reddish brown, loam to clay loam soils on very gently sloping alluvial plain, sandy loam surface and moderate erosion
Ktb6cC1 (Khutabandh)	Very deep, well drained, brown to reddish brown, loam to clay loam soils on gently sloping upland, sandy loam surface and slight erosion
Ktb6cC2 (Khutabandh)	Very deep, well drained, brown to reddish brown, loam to clay loam soils on gently sloping alluvial plain, sandy loam surface and moderate erosion
Let3cE4g1 (Leto)	Moderately shallow, well drained, yellowish brown to pale brown, sandy loam soils on moderately steeply sloping gullies lower pediment and undulating uplands, sandy loam surface, gravelly and very severe erosion
Lkp1bD3st3 (Lakrapahari)	Very shallow, well drained, reddish brown to dark reddish brown, gravelly loamy sand soils on moderately sloping upper pediment, loamy sand surface, rubbly stoniness and severe erosion.
Lkp1bE4st3 (Lakrapahari)	Very shallow, somewhat excessive to well drained, dark reddish brown, gravelly loamy sand soils on moderately steeply sloping undulating plateau, loamy sand surface, rubbly stoniness and very severe erosion
Lkp1cC3st3 (Lakrapahari)	Very shallow, well to somewhat excessively drained, reddish brown, gravelly sandy loam to loamy sand soils on gently sloping alluvial plain and lower pediment, sandy loam surface, rubbly stoniness and severe erosion
Mgn6dB1f2 (Murgabani)	Very deep, imperfectly drained, brown to dark brown, sandy clay loam to clay loam soils on very gently sloping alluvial plain, loamy surface, moderate flooding and slight erosion
Mgn6dC1f2 (Murgabani)	Very deep, moderately well to imperfectly drained, brown to dark brown, sandy clay loam to clay loam soils on gently sloping upland, loamy surface, moderate flooding and slight erosion
Ngb6cD3 (Nagbil)	Very deep, well drained, dark reddish brown to dark red, clay loam to clay soils on moderately sloping upper pediment sandy loam surface and severe erosion
Ngb6dC2 (Nagbil)	Very deep, well drained, dark reddish brown to dark red, clay loam to clay soils on gently sloping alluvial plain and lower pediment, loamy surface and moderate erosion
Ngb6dD2 (Nagbil)	Very deep, well drained, dark reddish brown to dark red, clay loam to clay soils on moderately sloping upper pediment and undulating plateau, loamy surface and moderate erosion

Piprakothi block, Purba Champaran district, Bihar

Young and old alluvial plains of Piprakothi block of Purba Champaran district in north Bihar represents middle Indo- Gangetic plains and developed from the deposition of alluvium from the Nepal Himalayas. Soils of the block are mapped into 13 phases of seven soil series (Fig. 2.2.3 and Table 2.2.6).

Titlagarh block, Bolangir district, Odisha

Titlagarh block represents Mahanadi basin of Eastern plateu and the soils of the block are mapped into 18 phases of 9 soil series (Fig. 2.2.4 and Table 2.2.7).

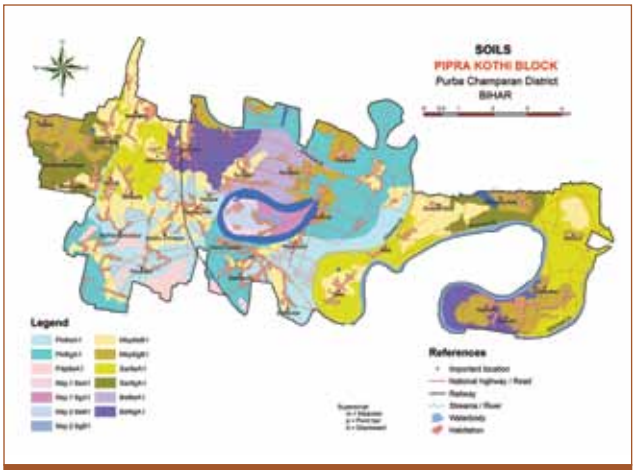


Fig. 2.2.3. Soil map of Piprakothi block

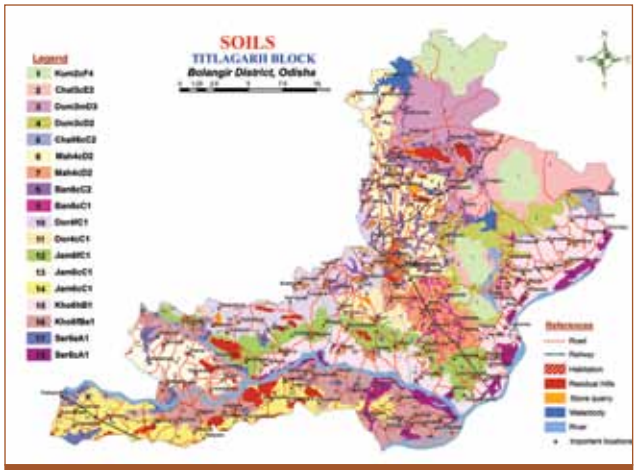


Fig. 2.2.4. Soils of Titlagarh block

Table 2.2.6. Soils of Piprakothi block, Purba Champaran district, Bihar

Soil phases (Soil series)	Brief description
Bel6eA1 (Belwatia)	Very deep, moderately well drained, silty soils on nearly level alluvial plains, silt loam surface and slight erosion.
Bel6gA1 (Belwatia)	Very deep, moderately well drained, silty soils on nearly level alluvial plains, silty clay loam surface and slight erosion.
Maj-16eA1 (Majharia-1)	Very deep, moderately well drained, fine silty soils on nearly level point bar, silt loam surface and slight erosion.
Maj-16gA1 (Majharia-1)	Very deep, moderately well drained silty soils on nearly level alluvial plain, silty clay loam surface and slight erosion.
Maj-26eB1 (Majharia-2)	Very deep, somewhat poorly drained, fine silty soils on very gently sloping point bar, silt loam surface and slight erosion.
Maj-26gB1 (Majharia-2)	Very deep, somewhat poorly drained, fine silty soils on very gently sloping point bar, silty clay loam surface and slight erosion.
Mbp-6eB1 (Mathiya Bariyapur)	Very deep, moderately well drained, fine silty soils on very gently sloping active alluvial plain, silt loam surface and slight erosion.
Mbp-6gB1 (Mathiya Bariyapur)	Very deep, moderately well drained, fine silty soils on very gently active alluvial plain, silty clay loam surface with slight erosion.
Pdp6eA1 (Panditpur)	Very deep, somewhat poorly drained, fine silty soils on nearly level depressed meander plain, silt loam surface and slight erosion
Pkt6eA1 (Piprakothi)	Very deep, somewhat poorly drained, fine silty soils on nearly level meander plain, silt loam surface and slight erosion.
Pkt6gA1 (Piprakothi)	Very deep, somewhat poorly drained, fine silty soils on nearly level meander plains, silty clay loam surface and slight erosion
Sar6eA1 (Saraya)	Very deep, somewhat poorly drained, fine silty soils on nearly level active alluvial plain, silt loam surface and slight erosion
Sar6gA1 (Saraya)	Very deep, somewhat poorly drained, fine silty soils on nearly level active alluvial plains, silty clay loam surface and slight erosion

Table 2.2.7. Soils of Titlagarh block, Bolangir district, Odisha

Soil phases Soil series)	Brief description
Ban6cC1 (Banjihal)	Very deep, moderately well drained, dark yellowish brown sandy clay loam soils on gently sloping valley fill, sandy loam surface and slight erosion
Ban6cC2 (Banjihal)	Very deep, moderately well drained, dark yellowish brown sandy clay loam soils on gently sloping valley fill, sandy loam surface and moderate erosion.
ChaI6cE2	Moderately shallow, well drained, brown to strong brown, sandy clay loam to sandy clay soils on moderately steeply sloping hills, gravelly sandy loam surface and severe erosion.
ChaII6cC2	Very deep, well drained, dark reddish brown to red loam to sandy clay loam soils on gently sloping pediment, sandy loam surface and moderate erosion.
Dor4cC1 (Dorla)	Moderately deep, moderately well drained, dark brown to dark yellowish brown sandy clay loam soils on gently sloping old alluvial plain, sandy loam surface and slight erosion.
Dor4fC1 (Dorla)	Moderately deep, moderately well drained, dark brown to dark yellowish brown sandy clay loam soils on gently sloping old alluvial plain, clay loam surface and slight erosion
Dum3cD2	Moderately shallow, well drained, dark yellowish brown to yellowish brown gravelly (60-70%) sandy loam soils on moderately sloping pediment, sandy loam surface and severe erosion.
Dum3mD3	Moderately shallow, well drained, dark yellowish brown to yellowish brown gravelly (40-60%) clayey soils on moderately sloping pediment, loam surface and severe erosion.
Jam6cC1 (Jampara)	Very deep, moderately well drained, very dark grayish brown to dark brown clay loam to clayey cracking soil on gently sloping young alluvial plain, sandy loam surface and slight erosion.
Jam6cC1 (Jampara)	Very deep, moderately well drained, very dark grayish brown to dark brown gravelly (30-40 %) clay loam to clayey soils on gently sloping young alluvial plain, gravelly sandy loam surface and slight erosion.
Jam6fC1 (Jampara)	Very deep, moderately well drained, very dark grayish brown to dark brown clay loam to clayey cracking soil on gently sloping young alluvial plain, clay loam surface and slight erosion.
Kho6fBe1 (Kholan)	Very deep, imperfectly drained, yellowish brown to dark yellowish sandy clay loam to sandy clay soils on very gently sloping young alluvial plain, clay loam surface and slight erosion.
Kho6hB1 (Kholan)	Very deep, imperfectly drained, yellowish brown to dark yellowish sandy clay loam to sandy clay soils on very gently sloping young alluvial plain, sandy clay loam surface and slight erosion.
Kum2cF4	Shallow, excessively well drained, brown to strong brown gravelly (40-60%) sandy clay loam soils on steeply sloping hills, sandy loam surface and very severe erosion.
Mah4cD2	Moderately deep, well drained, yellowish red to red gravelly (50-60%) sandy loam soils on moderately sloping upland, gravelly sandy loam surface and moderate erosion
Mah4cD2	Moderately deep, well drained, yellowish red to red gravelly (50-60%) sandy loam soils on moderately sloping upland, sandy loam surface and moderate erosion.
Ser6cA1 (Sirekala)	Very deep, imperfectly drained, dark grayish brown to very dark grayish brown clay loam to clayey soils on nearly level young alluvial plain, sandy loam surface and slight erosion.
Ser6eA1 (Sirekala)	Very deep, imperfectly drained, dark grayish brown to very dark grayish brown clay loam to soils on nearly level young alluvial plain, silt loam surface and slight erosion

Baisi Block of Purnea district, Bihar

Baisi block of Purnea district, Bihar represents active alluvial plain of Indo-Gangetic Plain. The soils associated with meander plain, interfluvial plain, flood /plain and young alluvial plain are mapped into ten phases of six soil series (Fig. 2.2.5 and Table 2.2.9). Flooding and light texture soil are the problems associated with the block.

Rajnagar block, Birbhum district, West Bengal

Rajnagar block represents Chotanagpur Plateau belonging to the eastern plateau. Soils of the block are mapped into13 phases of 12 soil series (Fig. 2.2.6 and Table 2.2.10).

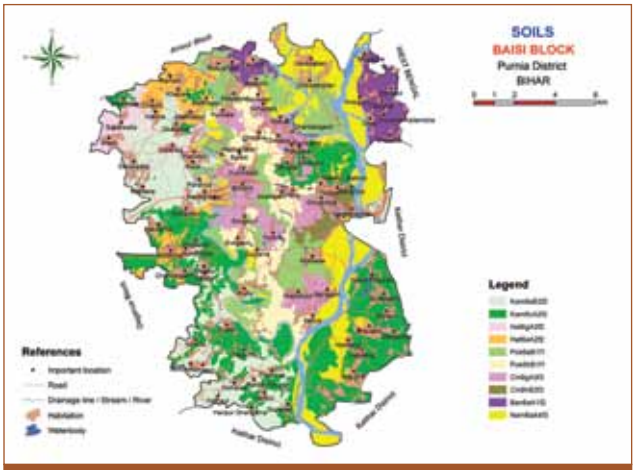


Fig. 2.2.5. Soil map of Baisi block, Purnea district, Bihar

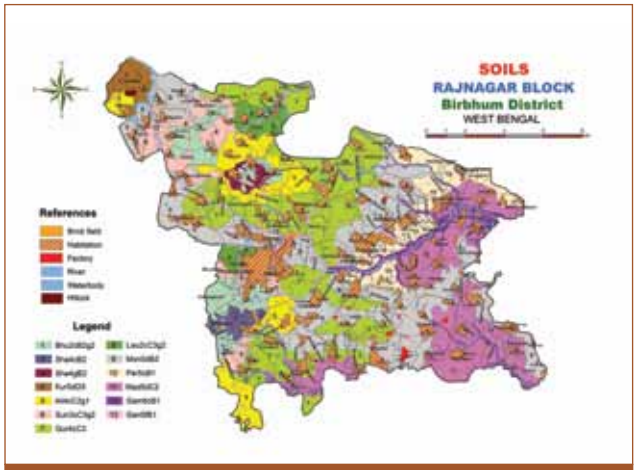


Fig. 2.2.6. Soil map of Rajnagar Block, Birbhum district, West Bengal

Table 2.2.9. Soils of Baisi block, Purnea district, Bihar

Soil series phases	Brief description of Soil Series
Kam6eB_2f_2 (Kamargaon)	Soils are very deep, somewhat excessive drained, light brownish gray, sandy loam to silt loam soils on very gently sloping meander plain having silt loam surface texture, slight erosion and moderate flooding.
Kam6cA_2f_2 (Kamargaon)	Soils are very deep, somewhat excessive drained, light brownish gray, sandy loam to silt loam soils on very gently sloping meander plain having sandy loam surface texture, slight erosion and moderate flooding.
Hat6cA_2f_2 (Hatgachi)	Soils are very deep, well drained, light gray, silt loam to silty clay loam soils on nearly level meander plain having sandy loam surface texture, moderate erosion and moderate flooding.
Hat6eA_2f_2 (Hatgachi)	Soils are very deep, well drained, light gray, silt loam to silty clay loam soils on nearly level meander plain having silt loam surface texture, moderate erosion and moderate flooding.
Pok6cB_1f_1 (Pokharia)	Soils are very deep, well drained, light olive brown, sandy loam to silt loam soils on very gently sloping interfluvial plain having sandy loam surface texture, slight erosion and slight flooding.
Pok6eB_1f_1 (Pokharia)	Soils are very deep, well drained, light olive brown, sandy loam to silt loam soils on very gently sloping interfluvial plain having silt loam surface texture, slight erosion and slight flooding.
Chi6eA_3f_3 (Chirraiya)	Soils are very deep, well drained, pale yellow, sandy loam to silt loam soils on nearly level interfluvial plain having silt loam surface texture, moderate erosion and moderate flooding.
Chi6cB_2f_2 (Chirraiya)	Soils are very deep, well drained, pale yellow, sandy loam to silt loam soils on nearly level interfluvial plain having sandy loam surface texture, moderate erosion and moderate flooding.
Ban6eA_1f_2 (Bansdol)	Soils are very deep, well drained, pale yellow, sand to silt loam soils on nearly level young alluvial plain having silt loam surface texture, slight erosion and slight flooding.
Nem6bA_4f_3 (Neamatpur)	Soils are very deep, somewhat excessive drained, light olive brown, sand to loamy sand soils on nearly level flood plain having loamy sand surface texture, moderate erosion and moderate flooding.

Table 2.2.10. Soils of Rajnagar block, Birbhum district, West Bengal

Soil phases (Soil series)	Brief description
Ali4cC2g1 (Aligarh)	Moderately deep, moderately well drained, yellowish to dark yellowish brown moderately acidic, loamy skeletal gravelly soils on depositional phase of plateau fringe region, sandy loam surface and moderate erosion
Bhu2cB2g2 (Bhurabali)	Shallow, excessively well drained, strong to reddish brown, moderately acidic, loamy skeletal gravelly soils on plateau top region with sandy loam surface and moderate to severe erosion
Gam5cB1 (Gamarkunda)	Deep, somewhat poorly drained, neutral, fine loamy soils on very gently sloping valley, sandy loam surface with slight erosion
Gan5fB1 (Gangmuri)	Deep, well drained, yellowish brown to dark yellowish brown, neutral, coarse loamy soils on gently sloping valley, clay loam surface and slight erosion

Soil phases (Soil series)	Brief description
Gur4cC3 (Gurkata)	Moderately deep, well drained, yellowish brown to brown, moderately acidic, coarse loamy gravelly soils, on undulating upland region with sandy loam surface and severe erosion
Kur5dD3 (Kuralmatia)	Deep, moderately well drained, dark yellowish brown to brown, neutral, fine loamy soils on gently sloping undulating dissected plateau, loam surface and moderate erosion
Lau2cC3g2 (Lauberia)	Shallow, well drained, brownish yellow to yellowish brown, strongly acidic, loamy skeletal gravelly soils on undulating upland, sandy loam surface with severe erosion
Mad5dC2 (Madhaipur)	Deep, moderately well drained, dark grayish brown to dark yellowish brown, moderately acidic, coarse loamy soils on gently sloping undulating plains, loam surface and slight erosion
Mon5dB2 (Monaharpur)	Deep, somewhat poorly drained, light yellowish brown to dark yellowish brown, neutral, fine loamy soils on very gently sloping alluvial plains, sandy loam surface and slight erosion
Per5cB1 (Perul)	Deep, somewhat poorly drained, light olive brown to grayish brown, neutral, fine loamy soils on gently sloping undulating plains, sandy loam surface with slight erosion
Sha4cB2 (Shankarpur)	Moderately deep, well drained, yellowish to dark yellowish brown moderately acidic, fine loamy soils on plateau top, sandy loam surface and moderate erosion
Sha4gB2 (Shankarpur)	Moderately deep, well drained, yellowish to dark yellowish brown moderately acidic, fine loamy soils on plateau top, sandy clay loam surface and moderate erosion
Sun3cC3g2 (Sundarkhela)	Moderately shallow, moderately well drained, yellowish brown to brown, moderately acidic, loamy skeletal gravelly soils on erosional phase of plateau fringe region, sandy loam surface and severe erosion

North Eastern Region

Bishalgarh Block, Sepahijala District, Tripura

Bishalgarh block represents north eastern ranges of eastern Himalayas. Soils of the block associated with hills, valley, upland and plains are mapped into 11 phases of seven series. (Fig. 2.2.7 and Table 2.2.12).

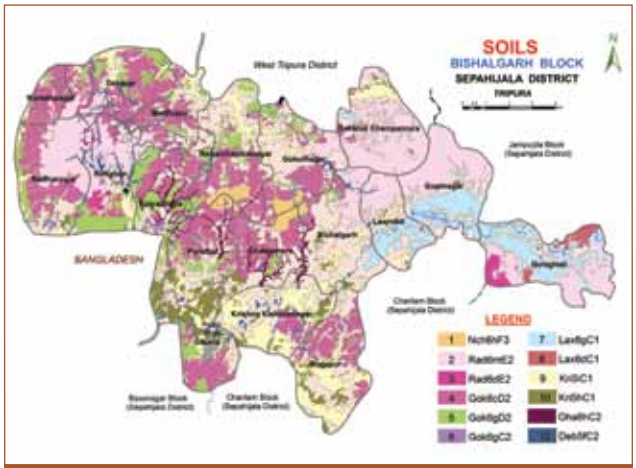
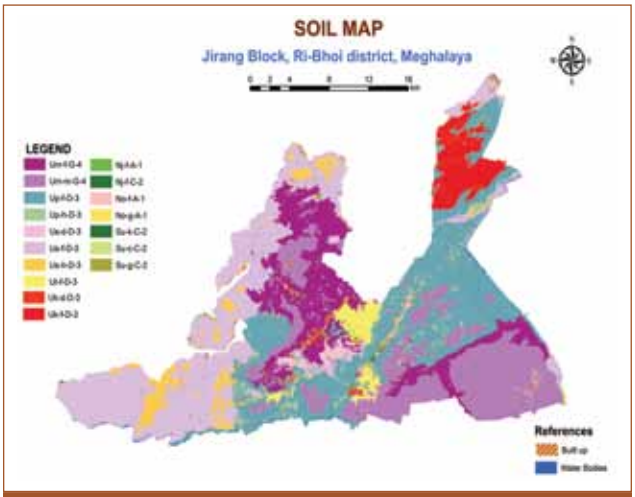


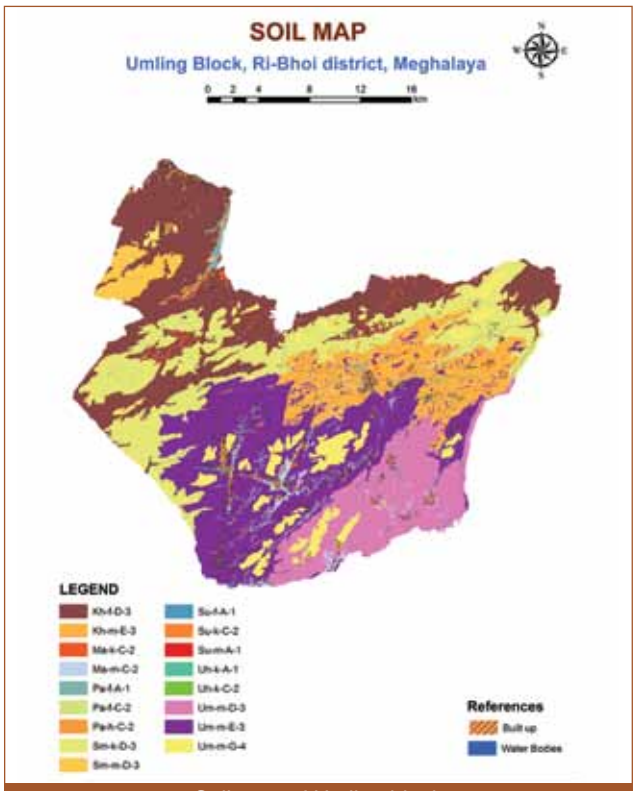
Fig. 2.2.7. Soil map of Bishalgarh block of Sepahijala district of Tripura

Jirang, Umling and Umsning block, Ri bhoi district

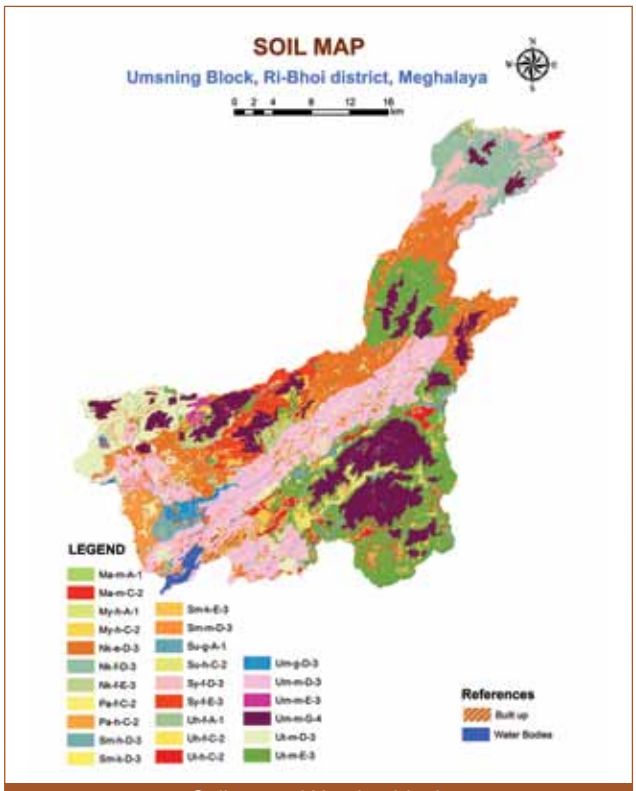
Jirang, Umling and Umsning blocks in Ri Bhoi district of Meghalay state belong to Meghalya Plateau and the soils of these three blocks are mapped into 49 phases of seventeen soil series (Table 2.2.13 and Fig. 2.2.8 (a to c)).



Soil map of Jirang block



Soil map of Umling block



Soil map of Umsing block

Fig. 2.2.8. Soil map of (a) Jirang block, (b) Umling block, (c) Umsning block of Ri-Bhoi district, Meghalaya

Table 2.2.12. Soils of Bishalgarh block, Sepahijala district, Tripura

Soil phases (Soil series)	Brief description
Deb5fC2 (Debipur)	Deep, somewhat poorly drained, dark gray to very dark gray, clay soils on gently sloping narrow valleys, clay loam surface and moderate erosion
Gha6hC2 (Ghaniamara)	Very deep, somewhat poorly drained, yellowish brown to very dark gray, clay soils on gently sloping narrow valleys, sandy clay loam surface and moderate erosion
Gok6cD2 (Gokulnagar)	Very deep, well drained, yellowish brown to reddish yellow, clay soils on moderately sloping undulating upland with mounds, sandy loam surface and moderate erosion
Gok6gC2 (Gokulnagar)	Very deep, well drained, yellowish brown to reddish yellow, clay soils on gently sloping undulating upland with mounds, silty clay loam surface and moderate erosion
Gok6gD2 (Gokulnagar)	Very deep, well drained, yellowish brown to reddish yellow, clay soils on moderately sloping undulating upland with mounds, silty clay loam surface and moderate erosion
Kri5hC1 (Krishnakishorenagar)	Deep, poorly drained, dark yellowish brown to gray, clay soils on gently sloping lower alluvial plain with sandy clay loam surface and slight erosion
Kri5iC1 (Krishnakishorenagar)	Deep, poorly drained, dark yellowish brown to gray, clay soils on gently sloping lower alluvial plain, sandy clay surface texture and slight erosion
Lax6dC1 (Laxmibil)	Very deep, somewhat poorly drained, light olive brown to grayish brown, clay soils on gently sloping upper alluvial plain interspersed with low mounds, loam surface and slight erosion
Lax6gC1 (Laxmibil)	Very deep, somewhat poorly drained, light olive brown to grayish brown, clay soils on gently sloping upper alluvial plain interspersed with low mounds, silty clay loam surface and slight erosion
Nch6hF3 (Nehalchandranagar)	Very deep, well drained, yellowish brown to strong brown, clay soils on moderately steeply sloping moderately dissected medium relief hills and narrow valleys, sandy clay loam surface and severe erosion
Rad6mE2 (Radhanagar)	Very deep, moderately well drained, strong brown to dark strong brown, clay soils on moderately steeply sloping moderately dissected low relief hills and narrow valleys and moderately steeply sloping low mounds interspersed with narrow valleys, clay surface and moderate erosion

Table 2.2.13. Soils of Ri-Bhoi district, Meghalaya

Soil phases (Soil series)	Soil description
Kh-f-D-3 (Kharpati)	Deep to Very deep, moderately well drained, clay soils on moderately sloping moderately dissected lower plateau, clay loam surface and severe erosion hazards.
Kh-m-E-3 (Kharpati)	Deep to Very deep, moderately well drained, very strongly acidic, clay soils on strongly sloping highly dissected upper plateau, clay surface and severe erosion hazards.
Ma-k-C-2 (Mawlyng)	Deep, somewhat poorly drained, clay soils on gently sloping lower valleys, clay surface and moderate erosion.
Ma-m-A-1 (Mawlyng)	Deep, somewhat poorly drained, clay soils on nearly level lower valleys, clay surface and slight erosion.
Ma-m-C-2 (Mawlyng)	Deep, somewhat poorly drained, clay soils on gently sloping lower valleys, clay surface and moderate erosion.
My-h-A-1 (Myrdon)	Very deep, well drained, fine loamy soils on nearly level upper valleys, sandy clay loam surface and slight erosion.
My-h-C-2 (Myrdon)	Very deep, well drained, fine loamy soils on gently sloping upper valleys, sandy clay loam surface and moderate erosion.
Nj-f-A-1 (New Jirang)	Deep to very deep, well drained, fine loamy soils on nearly level upper valleys, clay loam surface and slight erosion.
Nj-f-C-2 (New Jirang)	Deep to very deep, well drained, fine loamy soils on gently sloping upper valleys, clay loam surface and moderate erosion.
Nk-e-D-3 (Nanjiri Kuti)	Very deep, moderately well drained, fine loamy soils on moderately sloping moderately dissected upper plateau, silt loam surface and severe erosion.
Nk-f-D-3 (Nanjiri Kuti)	Very deep, moderately well drained, fine loamy soils on moderately sloping moderately dissected upper and lower plateau, clay loam surface and severe erosion
Nk-f-E-3 (Nanjiri Kuti)	Very deep, moderately well drained, fine loamy soils on strongly sloping highly dissected upper plateau, clay loam surface and severe erosion.
No-f-A-1 (Nongladew)	Very deep, somewhat poorly drained, fine clay soils on nearly level to gently sloping upper valleys, clay loam surface and slight erosion.
No-g-A-1 (Nongladew)	Very deep, somewhat poorly drained, fine soils on nearly level upper valleys and moderately dissected lower plateaus, silty clay loam surface and slight erosion.
Pa-f-A-1 (Paitklong)	Deep to Very deep, moderately well drained, fine loamy soils on nearly level upper valleys, clay loam surface and slight erosion.
Pa-f-C-2 (Paitklong)	Deep to Very deep, moderately well drained, fine loamy soils on gently sloping upper valleys, clay loam surface and moderate erosion.
Pa-h-C-2 (Paitklong)	Deep to Very deep, moderately well drained, fine loamy soils on gently sloping upper valleys, sandy clay loam surface and moderate erosion.
Sm-h-D-3 (Sumer)	Deep to very deep, moderately well drained, fine soils on moderately sloping moderately dissected upper plateau, loam surface and severe erosion.
Sm-k-D-3 (Sumer)	Deep to very deep, moderately well drained, fine soils on moderately sloping lowly dissected upper plateau and moderately dissected lower plateau, silty clay surface and severe erosion.
Sm-k-E-3 (Sumer)	Deep to very deep, moderately well drained, fine soils on strongly sloping highly dissected upper plateau, silty clay surface and severe erosion.
Sm-m-D-3 (Sumer)	Deep to very deep, moderately well drained, fine soils on moderately sloping moderately dissected plateau, clay surface and severe erosion.
Su-c-C-2 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on gently sloping lower valley regions, sandy loam surface and moderate erosion.
Su-f-A-1 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on nearly level lower valleys, clay loam surface and slight erosion.
Su-g-A-1 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on nearly level lower valleys, silty clay loam surface and slight erosion.

Soil phases (Soil series)	Soil description
Su-g-C-2 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on gently sloping lower valleys, clay loam surface and moderate erosion.
Su-h-C-2 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on gently sloping lower valleys, sandy clay loam surface and moderate erosion.
Su-k-C-2 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on gently sloping lower valleys, silty clay surface and moderate erosion.
Su-m-A-1 (Sukurbaria)	Deep to very deep, imperfectly drained, fine loamy soils on nearly level lower valleys, clay surface and slight erosion.
Sy-f-D-3 (Syngku)	Deep to very deep, moderately well drained, fine soils on moderately sloping moderately dissected lower plateau, clay loam surface and severe erosion.
Sy-f-E-3 (Syngku)	Deep to very deep, moderately well drained, fine soils on strongly sloping highly dissected upper plateau, clay loam surface and severe erosion.
Uh-f-A-1 (Umshaki)	Deep to very deep, imperfectly drained, fine soils on nearly level lower valleys, clay loam surface and slight erosion.
Uh-f-C-2 (Umshaki)	Deep to very deep, imperfectly drained, fine soils on gently sloping lower valleys, clay loam surface and moderate erosion.
Uh-k-A-1 (Umshaki)	Deep to very deep, imperfectly drained, fine soils on nearly level lower valleys, silty clay surface and slight erosion.
Uh-k-C-2 (Umshaki)	Deep to very deep, imperfectly drained, fine soils on gently sloping lower valleys, silty clay surface and moderate erosion.
Uk-d-D-3 (Umkynsier)	Very deep, well drained, fine loamy soils on moderately sloping denudational low hills, highly, to moderately dissected lower plateau, loam surface and severe erosion.
Uk-f-D-3 (Umkynsier)	Very deep, well drained, fine loamy soils on moderately sloping highly, moderately and lowly dissected lower plateau, clay loam surface and severe erosion.
Ul-h-C-2 (Umlaitang)	Very deep, well drained, fine loamy soils on gently sloping upper valleys, sandy clay loam surface and moderate erosion.
Um-g-D-3 (Umtyngar)	Very deep, moderately well drained, fine soils on moderately sloping denudational high hills, silty clay loam surface and very severe erosion.
Um-m-D-3 (Umtyngar)	Very deep, moderately well drained, fine soils on moderately sloping denudational high hills, clay surface and very severe erosion.
Um-m-E-3 (Umtyngar)	Very deep, moderately well drained, fine soils on strongly sloping denudational high hills, clay surface and very severe erosion.
Um-m-G-4 (Umtyngar)	Very deep, moderately well drained, fine soils on steeply sloping denudational high hills, clay surface and very severe erosion.
Up-f-D-3 (Umsophanon)	Deep to very deep, moderately well drained, fine loamy soils on strongly to moderately sloping denudational low hills, highly and moderately dissected lower plateau, clay loam surface and severe erosion.
Up-h-D-3 (Umsophanon)	Deep to very deep, moderately well drained, fine loamy soils on moderately sloping highly and moderately dissected lower plateau, sandy clay loam surface and severe erosion.
Us-d-D-3 (Umsong)	Very deep, moderately well drained, fine soils on moderately sloping highly dissected lower plateau, loam surface and severe erosion.
Us-f-D-3 (Umsong)	Very deep, moderately well drained, fine soils on moderately sloping highly and moderately dissected lower plateau, clay loam surface and severe erosion.
Us-h-D-3 (Umsong)	Very deep, moderately well drained, fine soils on moderately sloping highly and moderately dissected lower plateau, sandy clay loam surface and severe erosion.
Ut-f-D-3 (Umtang)	Deep to very deep, moderately well drained, fine soils on moderately sloping denudational low hills and moderately dissected upper plateau, clay loam surface and severe erosion.
Ut-m-D-3 (Umtang)	Very deep, moderately well drained, fine soils on moderately sloping moderately dissected upper plateau, clay surface and severe erosion.
Ut-m-E-3 (Umtang)	Very deep, moderately well drained, fine soils on strongly sloping highly dissected upper plateau, clay surface and severe erosion.

Diyun block, Changlang district, Arunachal Pradesh

Soils associated with Purvanchal hills, uplands and flood plains of Brahmaputra river are mapped into eighteen phases of eight soil series (Fig. 2.2.9 and Table 2.2.14).

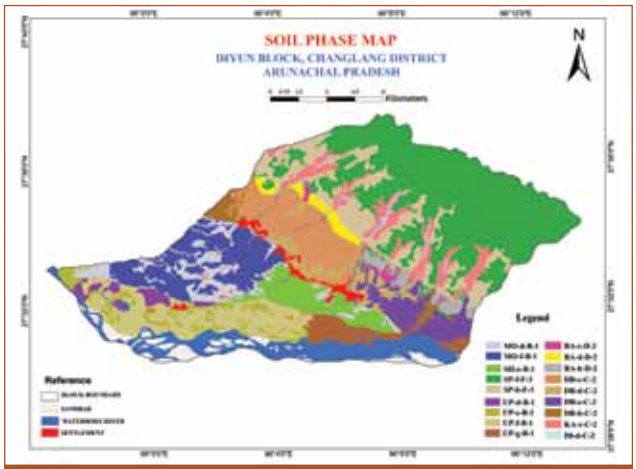


Fig. 2.2.9. Soil map of Diyun block of Changlang district, Arunachal Pradesh

Western Region

Netrang Taluka, Bharuch district, Gujarat

The Netrang Taluk represent Gujarat plain of West Coast and the soils of the block are mapped into sixteen phases of fifteen soils series (Fig. 2.2.10 and Table 2.2.15).

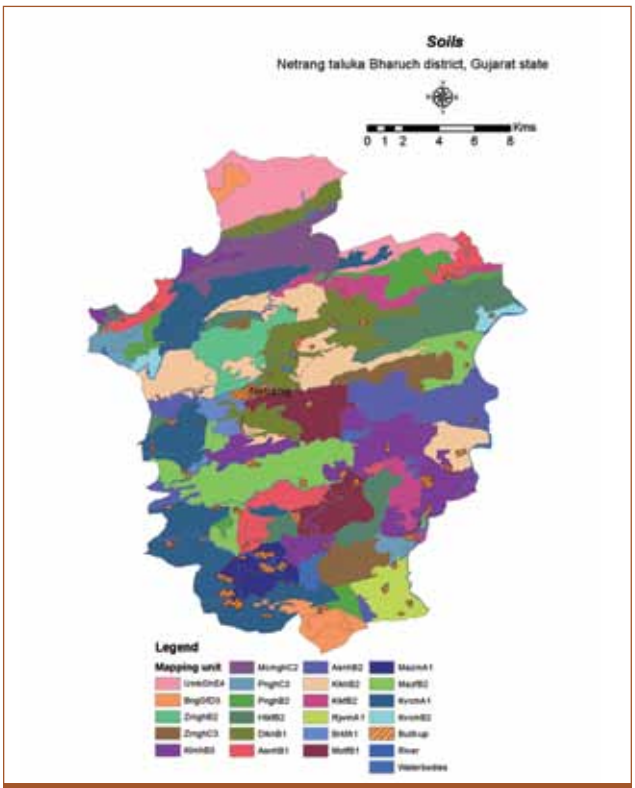


Fig. 2.2.10 Soil map of Netrang taluka of Bharuch District, Gujarat.

Table 2.2.14. Soils of Diyun block, Changlang district, Arunachal Pradesh

Soil phases (Soil series)	Brief description
BA-c-D-2 (Balu pather)	Very deep, well drained, sandy loam soils on moderate sloping upper piedmont, moderate erosion
BA-d-D-2 (Balu pather)	Very deep, well drained, loam soils on moderate sloping upper piedmont, moderate erosion
BA-h-D-2 (Balu pather)	Deep, well drained, sandy clay loam soils on moderate sloping upper piedmont, moderate erosion
DB-c-C-2 (Deba block)	Very deep well drained sandy loam soils on gently sloping lower piedmont, moderate erosion
DB-d-C-2 (Deba block)	Very deep well drained, loam soils on gently sloping lower piedmont, moderate erosion
DB-e-C-2 (Deba block)	Very deep, well drained silt loam soils on gently sloping lower piedmont, moderate erosion
DB-h-C-2 (Deba block)	Very deep, well drained sandy clay loam soils on gently sloping lower piedmont, moderate erosion
DI-d-B-1 (Dimapur)	Moderate, shallow,poorly drained, loamyto sandy loam soils on very gently sloping narrow valley, slight erosion
KA-c-B-1 (Kamayakapur)	Very deep, imperfectly drained, sandy loam soils on very gently sloping narrow valley, slight erosion
MO-d-B-1 (Modai)	Very deep, imperfectly drained loam soils on very gently sloping upland, slight erosion

Soil phases (Soil series)	Brief description
MO-f-B-1 (Modai)	Very deep, imperfectly drained clay loam soils on very gently sloping upland, slight erosion
SH-c-B-1 (Shyambasti)	Very deep, well drained sandy loam soils on very gently sloping upland, slight erosion
SH-c-B-1 (Shyambasti)	Very deep, well drained sandy loam soils on very gently sloping upland, slight erosion
SP-f-F-3 (Shillong Phar)	Very deep, well drained, soils on strongly sloping upland, severe erosion
SP-h-F-3 (Shillong Phar)	Very deep, well drained, sandy clay loam soils on strongly sloping upland, severe erosion
UP-d-B-1 (Udaipur)	Very deep, well drained loam soils on very gently sloping flood plain, slight erosion
UP-e-B-1 (Udaipur)	Very deep, imperfectly drained silt loam soils on very gently sloping flood plain, slight erosion
UP-f-B-1 (Udaipur)	Very deep imperfectly drained clay loam soils on very gently sloping flood plain, slight erosion
UP-g-B-1 (Udaipur)	Very deep imperfectly drained silty clay loam soils on very gently sloping flood plain, slight erosion

Table 2.2.15. Soils of Netrang Taluka, Bharuch district, Gujarat

Soil phases (Soil series)	Soil description
Asn-hB1 (Ashnavi)	Deep, well drained, dark brown to brown, sandy loam to sandy clay loam soils on very gently sloping plateau, sandy loam surface having of slight erosion.
Asn-hB2 (Ashnavi)	Deep, well drained, dark brown to brown, sandy loam to sandy clay loam soils on very gently sloping plateau, sandy loam surface having of moderate erosion.
Bng-GfD3 (Bhangariya)	Shallow, well drained, brown to dark reddish brown, gravelly clay loam to clay loam soils on moderately sloping hills, gravelly clay loam surface and severe erosion.
Brk-fA1 (Borkhadi)	Moderately deep, well drained, dark brown to dark yellowish brown, clay loam soils on nearly level plateau, clay loam surface and slight erosion.
Dlk-hB1 (Dholekham)	Moderately deep, well drained, dark brown to brown, sandy loam to sandy clay loam soils on very gently sloping plateau, sandy loam surface and slight erosion.
Htk-fB2 (Hathakundi)	Moderately shallow, well drained, dark brown, clay loam to clay soils on very gently sloping plateau, clay loam surface and moderate erosion.
Klk-fB2 (Kelvikua)	Deep, well drained, dark brown, clay loam to clay soils on very gently sloping plateau, clay loam surface and moderate erosion.
Klk-hB2 (Kelvikua)	Deep, well drained, dark brown, sandy clay loam to clay soils on very gently sloping plateau, clay loam surface and moderate erosion.
Klm-hB3 (Koyali Madvi)	Shallow, well drained, brown, sandy clay loam soils on gently sloping undulating plateau, sandy clay loam surface and severe erosion.
Kvc-mA1 (Kavachia)	Deep, well drained, very dark brown to very dark greyish brown, clay soils on nearly level plateau, clay surface and slight erosion.
Kvc-mB2 (Kavachia)	Deep, well drained, very dark brown to very dark greyish brown, clay soils on very gently sloping plateau, clay surface and moderate erosion.
Maz-fB2 (Mauza)	Deep, well drained, dark brown to brown, clay loam to clay soils on very gently sloping plateau, clay loam surface and moderate erosion.
Maz-mA1 (Mauza)	Deep, well drained, dark brown to brown, clay soils on nearly level plateau, clay loam surface and slight erosion.
Mcm-ghC2 (Machamadi)	Moderately shallow, well drained, dark brown to brown, sandy clay loam soils on gently sloping undulating plateau, sandy loam surface and moderate erosion and surface stoniness.

Soil phases (Soil series)	Soil description
Mot-fB1 (Motia)	Moderately deep, well drained, dark brown, clay loam to clay soils on very gently sloping plateau, clay loam surface and slight erosion.
Png-hB2 (Pingot)	Moderately shallow, well drained, brown to dark brown, sandy clay loam to clay loam soils on very gently sloping undulating plateau, sandy clay loam surface and moderate erosion.
Png-hC3 (Pingot)	Moderately shallow,well drained, brown to dark brown, sandy clay loam to clay loam soils on gently sloping undulating plateau, sandy clay loam surface and severe erosion.
Rjw-mA1 (Rajwadi)	Moderately shallow, well drained, dark brown to very dark greyish brown, clay soils on nearly level plateau, clay surface and slight erosion.
Umk-GhE4 (Umarkhada)	Shallow, well drained, brown, sandy clay loam soils on steeply sloping hills, gravelly sandy clay loam surface and very severe erosion.
Zrn-ghB2 (Zarna)	Shallow, well drained, dark brown, sandy clay loam soils on very gently sloping undulating plateau, gravelly sandy clay loam surface and moderate erosion.
Zrn-ghC3 (Zarna)	Shallow, well drained, dark brown, sandy clay loam soils on gentle sloping undulating plateau, gravelly sandy clay loam surface and severe erosion.

Southern Region

Soils of Goa State

Goa represents physiographic western Ghats, West coast of Coastal plain and South Deccan Plateau. Total 33 soil series were identified in the state and mapped in 129 phases of soil series Taluk-wise soil maps are given in figures 2.2.11 to 2.2.22 and are described in table 2.2.20. The soil orders observed in the state are Inceptiols, Alfisols, Ultisols, Entisols and Oxisols.

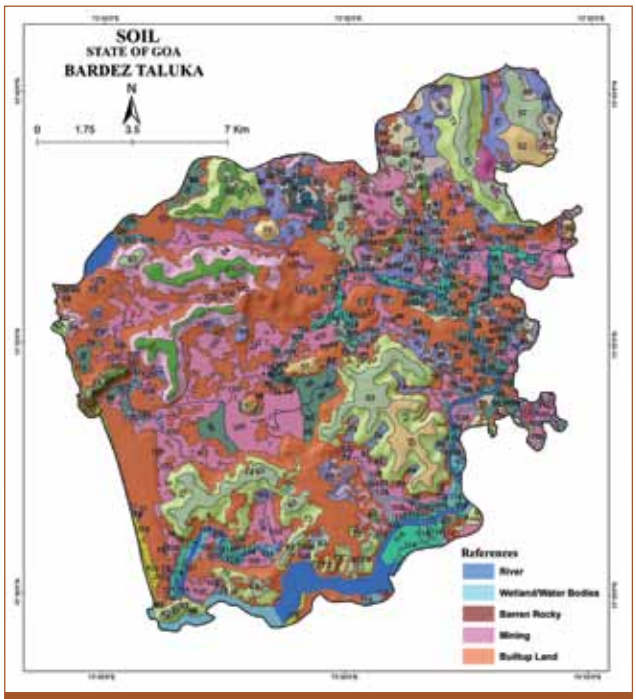


Fig. 2.2.11 Soil map of Bardez Taluka, Goa

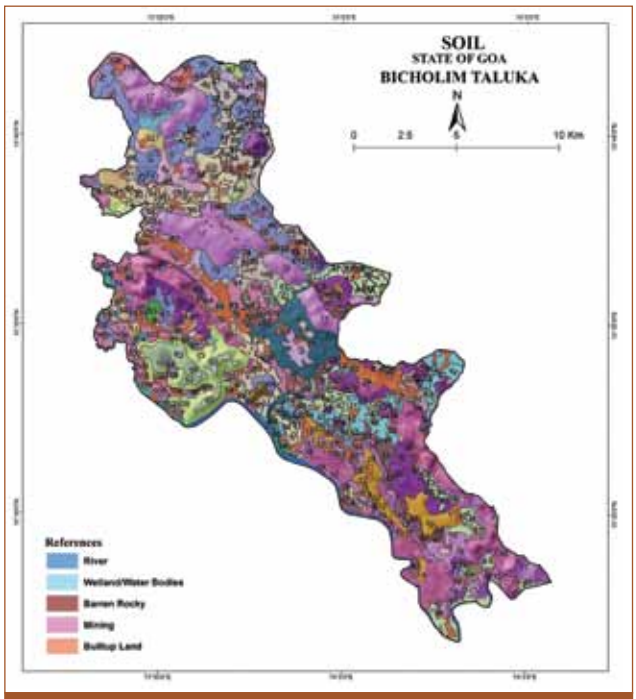


Fig. 2.2.12. Soil map of Bicholim Taluka, Goa

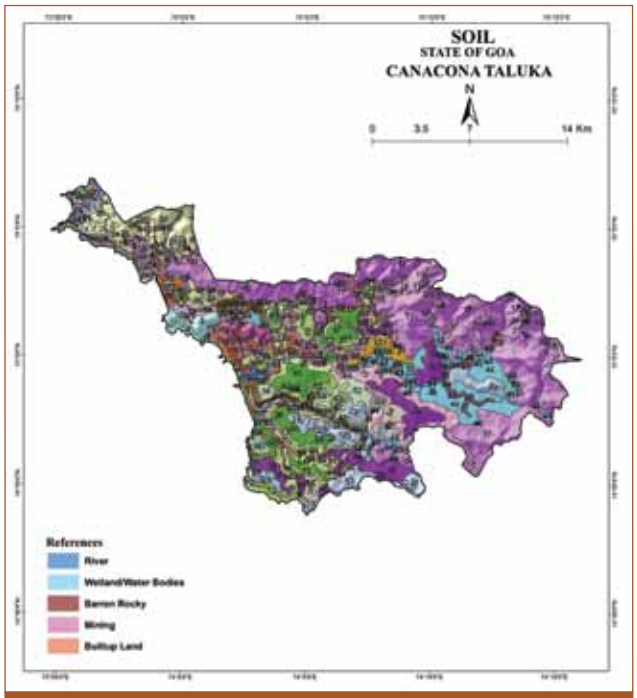


Fig. 2.2.13. Soil map of Canacona Taluka, Goa

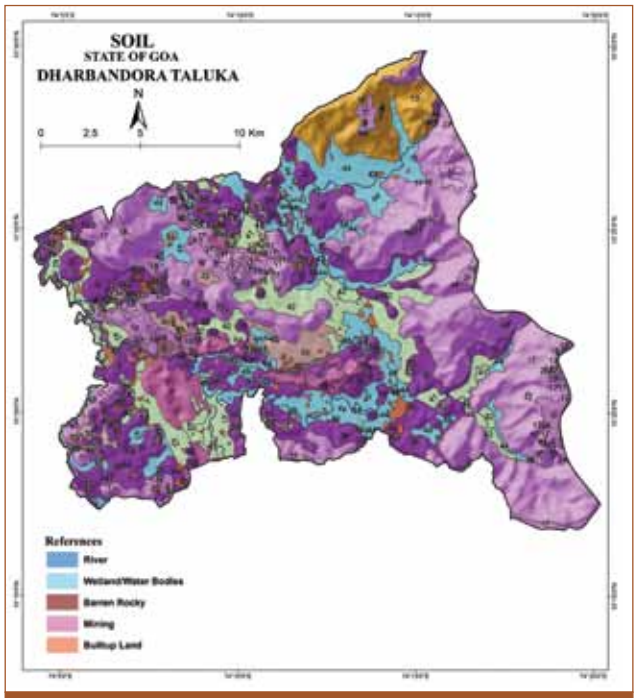


Fig. 2.2.14. Soil map of Dharbandora Taluka, Goa

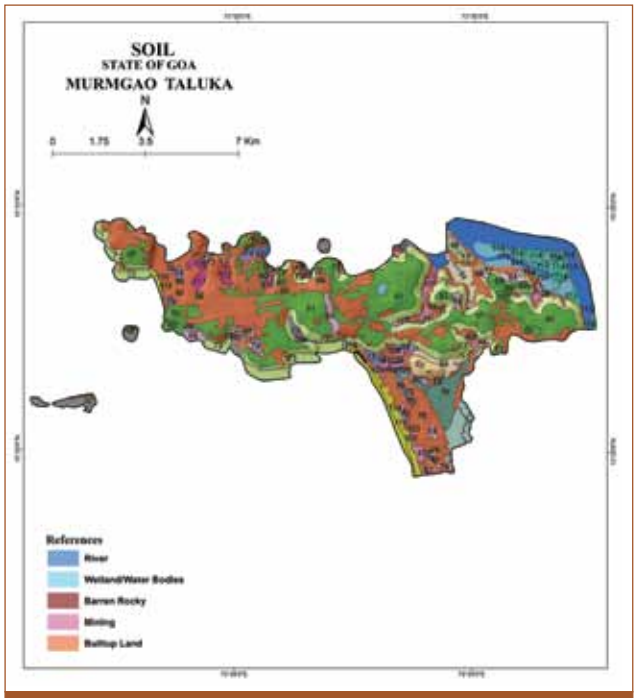


Fig. 2.2.15. Soil map of Murmgao Taluka, Goa

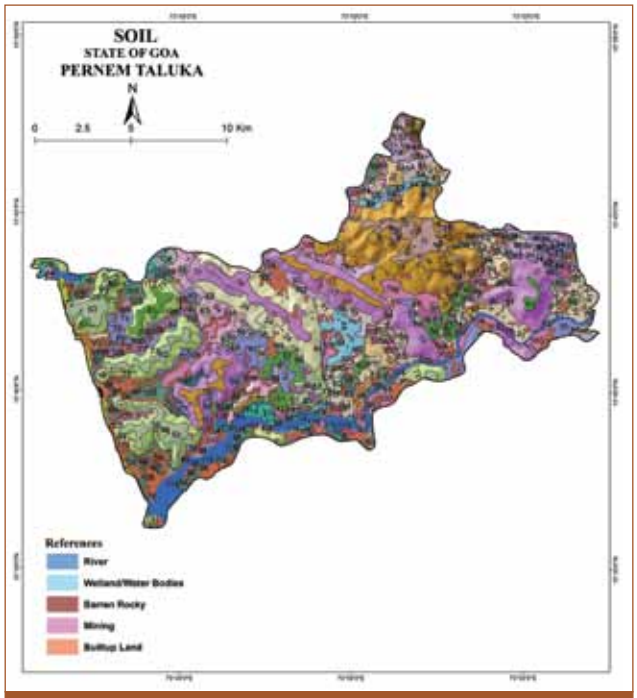


Fig. 2.2.16. Soil map of Pernem Taluka, Goa

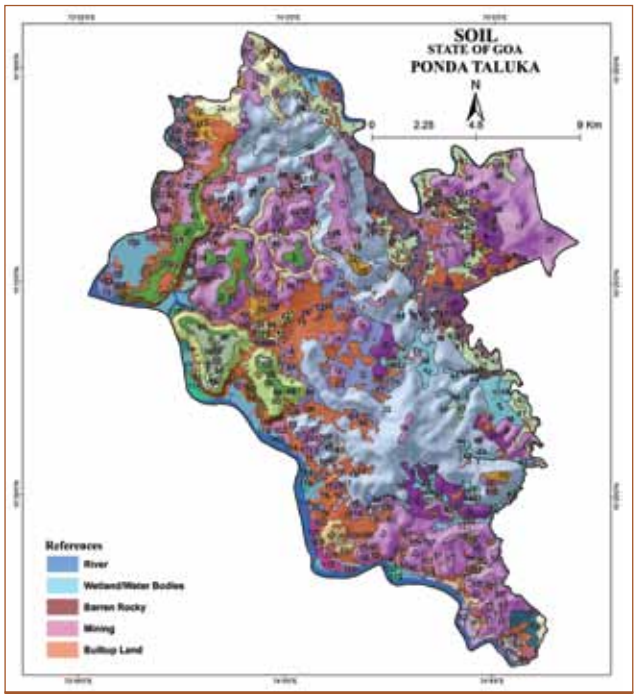


Fig. 2.2.17. Soil map of Ponda Taluka, Goa

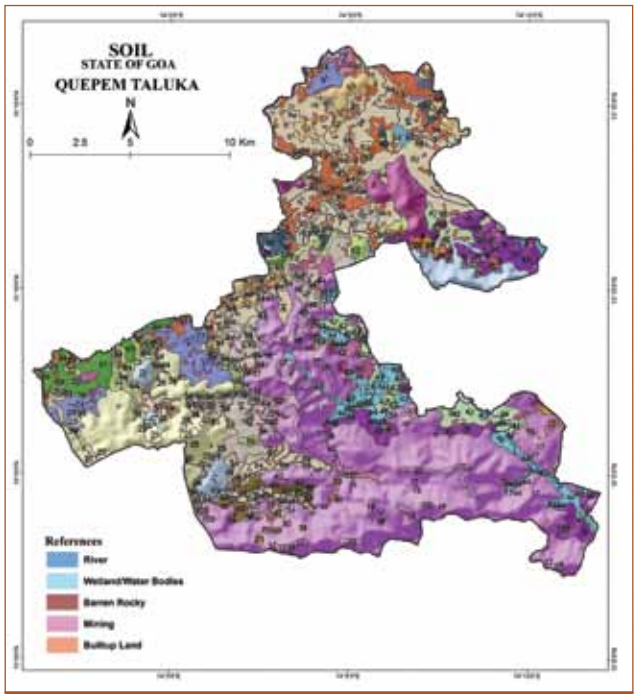


Fig. 2.2.18. Soil map of Quepem Taluka, Goa

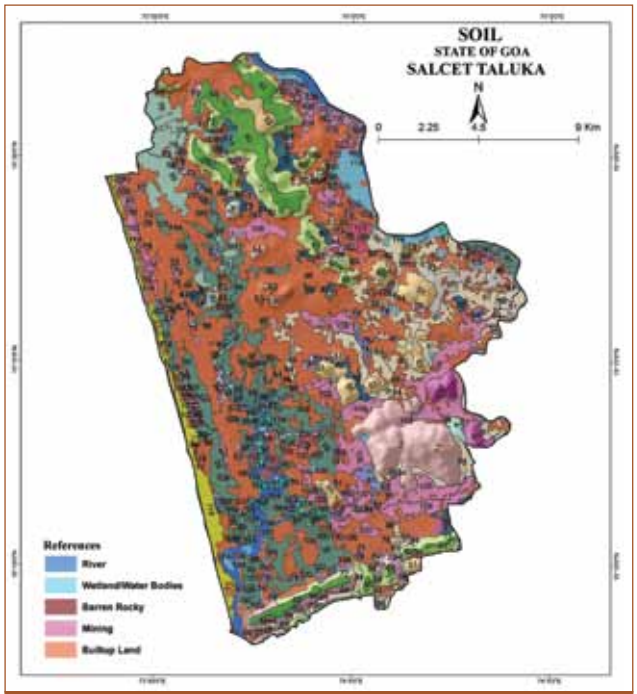


Fig. 2.2.19. Soil map of Salcet Taluka, Goa

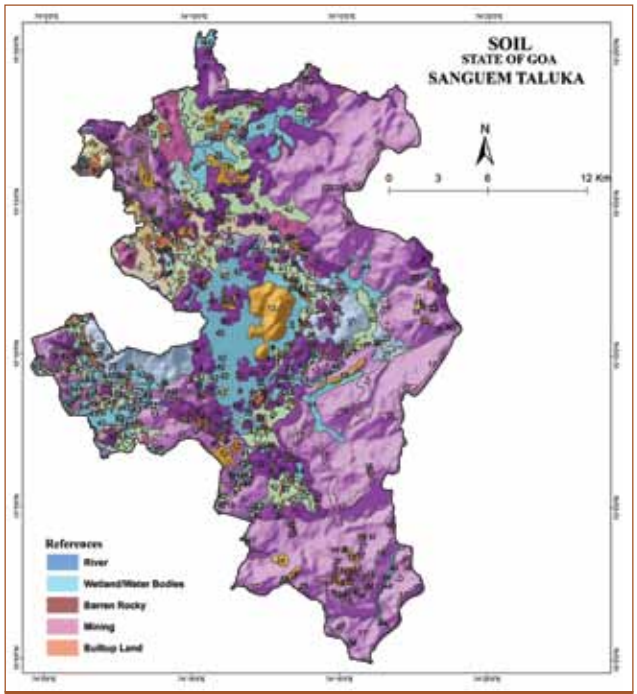


Fig. 2.2.20. Soil map of Sanguem Taluka, Goa

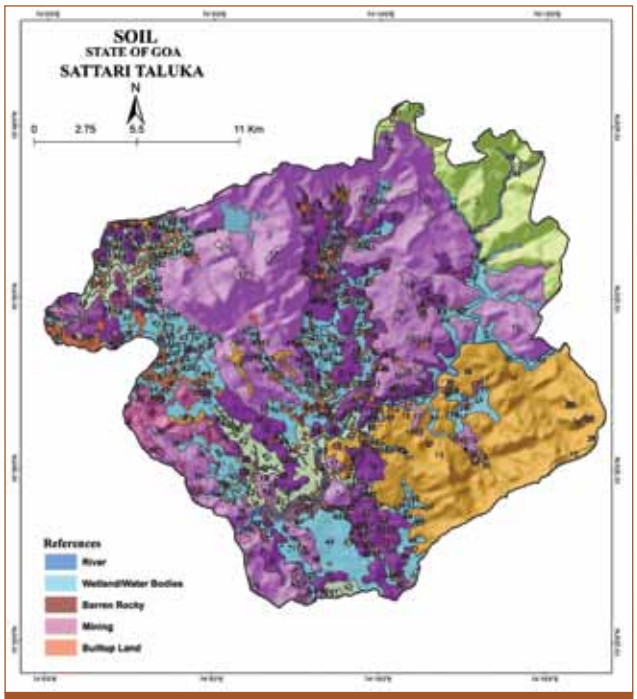


Fig. 2.2.21. Soil map of Sattari Taluka, Goa

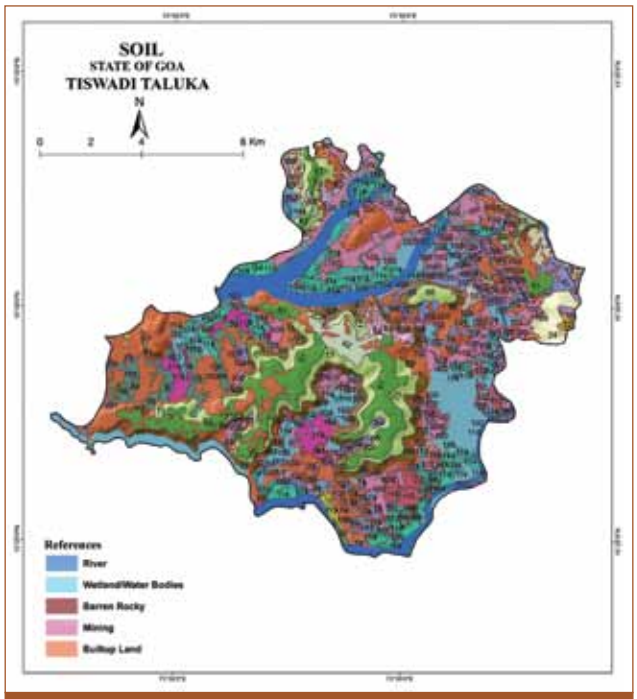


Fig. 2.2.22. Soil map of Tiswadi Taluka, Goa

Table 2.2.20. Description of soils of Goa state

Soil Phases (Series)	Mapping unit	Brief Description
Sur4mD3 (Surla)	1	Moderately deep, well drained, brown to dark brown, soils on moderately sloping restricted summits of basalt with clay surface and severe erosion.
Sur4fE3 (Surla)	2	Moderately deep, well drained, brown to dark brown, clay soils on moderately steeply sloping high hills of basalt with clay loam surface and severe erosion.
Dev2fE3g1 (Devabag)	3	Shallow, somewhat excessively drained, dark red, clay soils on moderately steeply sloping restricted summits of granite and granite-gneiss with clay loam surface, severe erosion and gravelly.
Dev2fE3g2 (Devabag)	4	Shallow, somewhat excessively drained, dark red, clay soils on moderately steeply sloping restricted summits of granite and granite-gneiss with clay loam surface, severe erosion and very gravelly.
Dev2hF3g2 (Devabag)	5	Shallow, somewhat excessively drained, dark red, clay soils on steeply sloping restricted summits of granite and granite-gneiss with sandy clay loam surface, severe erosion and very gravelly.
Dan4hF3 (Dande)	6	Moderately deep, well drained, dark reddish brown, clay soils on steeply sloping hill side slopes of granite and granite gneiss with sandy clay loam surface and severe erosion.
Gud5hF3 (Gudi)	7	Deep, well drained, light yellowish brown to dark yellowish brown, sandy clay loam to loam soils on steeply sloping hill side slopes of granite and granite-gneiss with sandy clay loam surface and severe erosion.
Ntv3fD3g1 (Netravli)	8	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping low hills of quartzite/schistose with clay loam surface, severe erosion and gravelly.
Ntv3hD2 (Netravli)	9	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping restricted summits of quartzite/schistose with sandy clay loam surface and moderate erosion.
Ntv3mD2g2 (Netravli)	10	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping restricted summits of quartzite/schistose with clay surface, moderate erosion and very gravelly.
Vlg1dD2g1 (Velge)	11	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately sloping restricted summits of quartzite/schistose with loam surface, moderate erosion and gravelly.

Soil Phases (Series)	Mapping unit	Brief Description
Ntv3hD2g2 (Netravli)	12	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping high hills of quartzite/schistose with sandy clay loam surface, moderate erosion and very vgravelly.
Ntv3fE3g2 (Netravli)	13	Moderately shallow, well drained, dark reddish brown, clay soils on moderately steeply sloping high hills of quartzite/schistose with clay loam surface, severe erosion and very gravelly.
Ntv3hE3g1 (Netravli)	14	Moderately shallow, well drained, dark reddish brown, clay soils on moderately steeply sloping high hills of quartzite/schistose with sandy clay loam surface, very severe erosion and gravelly.
Ntv3mE3g2 (Netravli)	15	Moderately shallow, well drained, dark reddish brown, clay soils on moderately steeply sloping restricted summits of quartzite/schistose with clay surface, severe erosion and very gravelly.
Tor2fF3g1 (Torse)	16	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with clay loam surface, severe erosion and gravelly.
Tor2hF3g1 (Torse)	17	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with sandy clay loam surface, severe erosion and gravelly.
Tor2hF3g2 (Torse)	18	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with sandy clay loam surface, severe erosion and very gravelly.
Ntv3fD2g2 (Netravli)	19	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping high hills of quartzite/schistose with clay loam surface, moderate erosion and very gravelly.
Ntv3fE3 (Netravli)	20	Moderately shallow, well drained, dark reddish brown, clay soils on moderately steeply sloping high hills of quartzite/schistose with clay loam surface and severe erosion.
Drb4fF3g2 (Darbandora)	21	Moderately deep, somewhat excessively drained, brown to dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with clay loam surface, severe erosion and very gravelly.
Drb4hF3 (Darbandora)	22	Moderately deep, somewhat excessively drained, brown to dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with sandy clay loam surface and severe erosion.
Drb4hF3g2 (Darbandora)	23	Moderately deep, somewhat excessively drained, brown to dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with sandy clay loam surface, severe erosion and very gravelly.
Gav4fF3g1 (Gavane)	24	Moderately deep, somewhat excessively drained, dark brown to dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with clay loam surface, severe erosion and gravelly.
Gav4hF3g1 (Gavane)	25	Moderately deep, somewhat excessively drained, dark brown to dark reddish brown, clay soils on steeply sloping high hills of quartzite/schistose with sandy clay loam surface, severe erosion and gravelly.
Gav4iG4g1 (Gavane)	26	Moderately deep, somewhat excessively drained, dark brown to dark reddish brown, clay soils on very steeply sloping high hills of quartzite/schistose with sandy clay surface, very severe erosion and gravelly.
Tor2hG4g1 (Torse)	27	Shallow, somewhat excessively drained, dark reddish brown, clay soils on very steeply sloping high hills of quartzite/schistose with sandy clay loam surface, very severe erosion and gravelly.
Drb4hG4g2 (Darbandora)	28	Moderately deep, somewhat excessively drained, brown to dark reddish brown, clay soils on very steeply sloping high hills of quartzite/schistose with sandy clay loam surface, very severe erosion and very gravelly.
Ntv3mD3g2 (Netravli)	29	Moderately shallow, well drained, dark reddish brown, clay soils on moderately sloping low hills of quartzite/schistose with clay surface, severe erosion and very gravelly.
Vlg1hD3g1 (Velge)	30	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately sloping low hills of quartzite/schistose with sandy clay loam surface, severe erosion and gravelly.
Vlg1iD3g1 (Velge)	31	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately sloping low hills of quartzite/schistose with sandy clay surface, severe erosion and gravelly.
Vlg1dE3g1 (Velge)	32	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately steeply sloping low hills of quartzite/schistose with loam surface, severe erosion and gravelly.

Soil Phases (Series)	Mapping unit	Brief Description
Vlg1dE3g2 (Velge)	33	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately steeply sloping low hills of quartzite/schistose with loam surface, severe erosion and very gravelly.
Vlg1hE3g2 (Velge)	34	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately steeply sloping low hills of quartzite/schistose with sandy clay loam surface, severe erosion and very gravelly.
Mtv2iF3g2 (Metavada)	35	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with sandy clay surface, severe erosion and very gravelly.
Mtv2mF3 (Metavada)	36	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with clay surface and severe erosion.
Mtv2mF3g2 (Metavada)	37	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with clay surface, severe erosion and very gravelly.
Mtv2fF3g1 (Metavada)	38	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with clay loam surface, severe erosion and gravelly.
Mtv2fF3g2 (Metavada)	39	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with clay loam surface, severe erosion and very gravelly.
Mtv2iF3g1 (Metavada)	40	Shallow, somewhat excessively drained, dark reddish brown, clay soils on steeply sloping low hills of quartzite/schistose with sandy clay surface, severe erosion and gravelly.
Ark5hC2 (Arukot)	41	Deep, well drained, dark reddish brown to dark brown, clay soils on gently sloping inter-hill valleys of quartzite/schistose with sandy clay loam surface and moderate erosion.
Ark5mC2 (Arukot)	42	Deep, well drained, dark reddish brown to dark brown, clay soils on gently sloping inter-hill valleys of quartzite/schistose with clay surface and moderate erosion.
Bnd5hC2 (Bandoli)	43	Deep, well drained, yellowish brown to dark reddish brown, clay soils on gently sloping inter-hill valleys of quartzite/schistose with sandy clay loam surface and moderate erosion.
Bnd5iC2 (Bandoli)	44	Deep, well drained, yellowish brown to dark reddish brown, clay soils on gently sloping inter-hill valleys of quartzite/schistose with sandy clay surface, moderate erosion.
Ark5iD2 (Arukot)	45	Deep, well drained, dark reddish brown to dark brown, clay soils on moderately sloping inter-hill valleys of quartzite/schistose with sandy clay surface and moderate erosion.
Bnd5hD2 (Bandoli)	46	Deep, well drained, yellowish brown to dark reddish brown, clay soils on moderately sloping inter-hill valleys of quartzite/schistose with sandy clay loam surface and moderate erosion.
Pal4hB2 (Pali)	47	Moderately deep, moderately well drained, brown to dark yellowish brown, sandy clay soils on very gently sloping narrow valleys of quartzite/schistose with sandy clay loam surface and moderate erosion.
Bnd5hC2g2 (Bandoli)	48	Deep, well drained, yellowish brown to dark reddish brown, clay soils on gently sloping narrow valleys of quartzite/schistose with sandy clay loam surface, moderate erosion and very gravelly.
Bnd5iC2g1 (Bandoli)	49	Deep, well drained, yellowish brown to dark reddish brown, clay soils on gently sloping narrow valleys of quartzite/schistose with sandy clay surface, moderate erosion and gravelly.
Pad3iC2g1 (Padi)	50	Moderately shallow, well drained, brown to yellowish brown, clay soils on gently sloping conical hills of dissected laterite hills with sandy clay surface, moderate erosion and gravelly.
Pad3cD2g1 (Padi)	51	Moderately shallow, well drained, brown to yellowish brown, clay soils on moderately sloping conical hills of dissected laterite hills with sandy loam surface, moderate erosion and gravelly.
Pad3fD2g1 (Padi)	52	Moderately shallow, well drained, brown to yellowish brown, clay soils on moderately sloping conical hills of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Pad3hD2g2 (Padi)	53	Moderately shallow, well drained, brown to yellowish brown, clay soils on moderately sloping conical hills of dissected laterite hills with sandy clay loam surface, moderate erosion and very gravelly.
Ngw5fD2g1 (Nagowa)	54	Deep, well drained, dark reddish brown to yellowish red, sandy clay soils on moderately sloping undulating lands of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Ngw5fE2g1 (Nagowa)	55	Deep, well drained, dark reddish brown to yellowish red, sandy clay soils on moderately steeply sloping conical hills of dissected laterite hills with clay loam surface, moderate erosion and gravelly.

Soil Phases (Series)	Mapping unit	Brief Description
Krm2fB2g1 (Karmali)	56	Shallow, well drained, dark brown, clay soils on very gently sloping flat topped hills of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Ray1iB2g1 (Raya)	57	Very shallow, well drained, dark brown, clay loam soils on very gently sloping flat topped hills of dissected laterite hills with sandy clay surface, moderate erosion and gravelly.
Dbl1cB2 (Dabolim)	58	Very shallow, well drained, brown to dark brown, sandy clay loam soils on very gently sloping flat topped hills of dissected laterite hills with sandy loam surface and moderate eosion.
Dbl1hB2 (Dabolim)	59	Very shallow, well drained, brown to dark brown, sandy clay loam soils on very gently sloping flat topped hills of dissected laterite hills with sandy clay loam surface and moderate eosion.
Dbl1cC2 (Dabolim)	60	Very shallow, well drained, brown to dark brown, sandy clay loam soils on gently sloping flat topped hills of dissected laterite hills with sandy loam surface and moderate eosion.
Dbl1hC2 (Dabolim)	61	Very shallow, well drained, brown to dark brown, sandy clay loam soils on gently sloping flat topped hills of dissected laterite hills with sandy clay loam surface and moderate eosion.
Krm2fC2g1 (Karmali)	62	Shallow, well drained, dark brown, clay soils on gently sloping flat topped hills of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Ray1hC2g1 (Raya)	63	Very shallow, well drained, dark brown, clay loam soils on gently sloping flat topped hills of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Krv5hD2g3 (Karven)	64	Deep, well drained, dark reddish brown to red, clay soils on moderately sloping escarpments of dissected laterite hills with sandy clay loam surface, moderate erosion and extremely gravelly.
Mdg5bD2g2 (Madgaon)	65	Deep, well drained, reddish brown, clay loam soils on moderately sloping escarpments of dissected laterite hills with loamy sand surface, mderate erosion and very gravelly.
Vrn2hD2g2 (Verna)	66	Shallow, well drained, dark red, clay soils on moderately sloping escarpments of dissected laterite hills with sandy clay loam surface, moderate erosion and very gravelly.
Vrn2hD2g3 (Verna)	67	Shallow, well drained, dark red, clay soils on moderately sloping escarpments of dissected laterite hills with sandy clay loam surface, moderate erosion and extremely gravelly.
Krv5mE3g1 (Karven)	68	Deep, well drained, dark reddish brown to red, clay soils on moderately steeply sloping escarpments of dissected laterite hills with clay surface, severe erosion nd gravelly.
Krv5fE2g1 (Karven)	69	Deep, well drained, dark reddish brown to red, clay soils on moderately steeply sloping escarpments of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Krv5fE3g2 (Karven)	70	Deep, well drained, dark reddish brown to red, clay soils on moderately steeply sloping escarpments of dissected laterite hills with clay loam surface, severe erosion and very gravelly.
Mdg5cE3g1 (Madgaon)	71	Deep, well drained, reddish brown, clay loam soils on moderately steeply sloping escarpments of dissected laterite hills with sandy loam surface, severe erosion and gravelly.
Vrn2hE2g1 (Verna)	72	Shallow, well drained, dark red, clay soils on moderately steeply sloping escarpments of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Vrn2hE3g2 (Verna)	73	Shallow, well drained, dark red, clay soils on moderately steeply sloping escarpments of dissected laterite hills with sandy clay loam surface, severe erosion and very gravelly.
Chp5cC2 (Chapora)	74	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on gently sloping undulating lands of dissected laterite hills with sandy loam surface and moderate erosion.
Chp5cC2g1 (Chapora)	75	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on gently sloping undulating lands of dissected laterite hills with sandy loam surface, moderate erosion and gravelly.
Chp5hC2 (Chapora)	76	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on gently sloping undulating lands of dissected laterite hills with sandy clay loam surface and moderate erosion.
Chp5hC2g1 (Chapora)	77	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on gently sloping undulating lands of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Sli5iC2 (Saligao)	78	Deep, well drained, brown to strong brown, clay soils on gently sloping undulating lands of dissected laterite hills with sandy clay surface and moderate erosion.

Soil Phases (Series)	Mapping unit	Brief Description
Zmo5hC2g1 (Zaimolo)	79	Deep, well drained, dark reddish brown to dark brown, clay soils on gently sloping colluvial low lands of dissected laterite hills with sandy clay loam surface and moderate erosion.
Zmo5hC2g2 (Zaimolo)	80	Deep, well drained, dark reddish brown to dark brown, clay soils on gently sloping colluvial low of dissected laterite hills with sandy clay loam surface, moderate erosion and very gravelly.
Chp5bC2 (Chapora)	81	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on gently sloping undulating lands of dissected laterite hills with loamy sand surface and moderate erosion.
Zmo5fC2g1 (Zaimolo)	82	Deep, well drained, dark reddish brown to dark brown, clay soils on gently sloping colluvial low lands of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Sli5hC2g1 (Saligao)	83	Deep, well drained, brown to strong brown, clay soils on gently sloping undulating lands of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Chp5cD2 (Chapora)	84	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on moderately sloping undulating lands of dissected laterite hills with sandy loam surface and moderate erosion.
Ngw5hD2 (Nagowa)	85	Deep, well drained, dark reddish brown to yellowish red, sandy clay soils on moderately sloping undulating lands of dissected laterite hills with sandy clay loam surface and moderate erosion.
Ngw5hD2g2 (Nagowa)	86	Deep, well drained, dark reddish brown to yellowish red, sandy clay soils on moderately sloping undulating lands of dissected laterite hills with sandy clay loam surface, moderate erosion and very gravelly.
Sli5hD2g1 (Saligao)	87	Deep, well drained, brown to strong brown, clay soils on moderately sloping undulating lands of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Zmo5hD2g2 (Zaimolo)	88	Deep, well drained, dark reddish brown to dark brown, clay soils on moderately sloping undulating lands of dissected laterite hills with sandy clay loam surface, moderate erosion and very gravelly.
Chp5bD2g2 (Chapora)	89	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils on moderately sloping undulating lands of dissected laterite hills with loamy sand surface, moderate erosion and very gravelly.
Bat6fA1 (Batim)	90	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on level to nearly level colluvial low lands of dissected laterite hills with clay loam surface and none to slight erosion.
Bat6fB2g1 (Batim)	91	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on very gently sloping colluvial low lands of dissected laterite hills with clay loam surface, moderate erosion and gravelly.
Bat6hB1g1 (Batim)	92	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on very gently sloping colluvial low lands of dissected laterite hills with sandy clay loam surface, none to slight erosion and gravelly.
Bat6cB2 (Batim)	93	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on very gently sloping colluvial low lands of dissected laterite hills with sandy loam surface and moderate erosion.
Bat6hB2 (Batim)	94	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on very gently sloping colluvial low lands of dissected laterite hills with sandy clay loam surface and moderate erosion.
Bat6hB2g1 (Batim)	95	Very deep, moderately well drained, strong brown to yellowish brown, clay soils on very gently sloping colluvial low lands of dissected laterite hills with sandy clay loam surface, moderate erosion and gravelly.
Ass5cA1 (Acid sulfate soil)	96	Deep, poorly drained, very dark grayish brown to yellowish brown, sandy clay loam to sandy clay soils on level to nearly level plain lands of fluvio-littorals with sandy loam surface, none to slight erosion and organic substrates formed under waterlogged
Kal5bA1 (Kalangut)	97	Deep, imperfectly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils on level to nearly level fluvio-littoral plains with loamy sand surface and none to slight erosion.
Kal5cA1 (Kalangut)	98	Deep, imperfectly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils on level to nearly level mudflats of fluvio-littoral with sandy loam surface and non to slight erosion.

Soil Phases (Series)	Mapping unit	Brief Description
Ugm5mA1 (Uguem)	99	Deep, imperfectly drained, dark brown to very dark grayish brown, clay soils on level to nearly level fluvio-littoral plains with clay surface and none to slight erosion.
Zuv5mA1 (Zuvari)	100	Deep, imperfectly drained, light brown gray, clay soils on level to nearly level fluvio-littoral plains with clay surface and none to slight erosion.
Zuv5fA1 (Zuvari)	101	Deep, imperfectly drained, light brown gray, clay soils on level to nearly level fluvio-littoral plains with clay loam surface and none to slight erosion.
Zuv5mA1s1 (Zuvari)	102	Deep, imperfectly drained, light brown gray, clay soils on level to nearly level fluvio-littoral plains with clay surface, none to slight erosion and slight salinity.
Kal5bB2 (Kalangut)	103	Deep, imperfectly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils on very gently sloping fluvio-littoral plains with loamy sand surface and moderate erosion.
Kal5cB1 (Kalangut)	104	Deep, imperfectly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils on very gently sloping fluvio-littoral plains with sandy loam surface and none to slight erosion.
Kal5cB2 (Kalangut)	105	Deep, imperfectly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils on very gently sloping mudflats of fluvio-littoral with sandy loam surface and moderate erosion.
Ugm5fB2 (Uguem)	106	Deep, imperfectly drained, dark brown to very dark grayish brown, clay soils on very gently sloping fluvio-littoral plains with clay loam surface and moderate erosion.
Zuv5fB1 (Zuvari)	107	Deep, imperfectly drained, light brown gray, clay soils on very gently sloping fluvio-littoral plains with clay loam surface and none to slight erosion.
Zuv5mB2 (Zuvari)	108	Deep, imperfectly drained, light brown gray, clay soils on very gently sloping fluvio-littoral plains with clay surface and moderate erosion.
Zuv5fB2 (Zuvari)	109	Deep, imperfectly drained, light brown gray, clay soils on very gently sloping fluvio-littoral plains with clay loam surface and moderate erosion.
Pnj3cA1 (Panaji)	110	Moderately shallow, imperfectly drained, gray, sandy soils on level to nearly level salt pans of fluvio-littoral with sandy loam surface, none to slight erosion and surface salt encrustations.
Pnj3bA1s1 (Panaji)	111	Moderately shallow, imperfectly drained, gray, sandy soils on level to nearly level salt pans of fluvio-littoral with loamy sand surface, none to slight erosion and slight salinity.
Pnj3cA1s1 (Panaji)	112	Moderately shallow, imperfectly drained, gray, sandy soils on level to nearly level salt pans of fluvio-littoral with sandy loam surface, none to slight erosion and slight salinity.
Kol5cA1 (Kolva)	113	Deep, poorly drained, dark gray to grayish brown, sandy loam to sandy clay loam soils on level to nearly level swamps and marshes of fluvio-littoral with sandy loam surface and none to slight erosion.
Kol5hA1 (Kolva)	114	Deep, poorly drained, dark gray to grayish brown, sandy loam to sandy clay loam soils on level to nearly level swamps and marshes of fluvio-littoral with sandy clay loam surface and none to slight erosion.
Mnd5bA1 (Mandavi)	115	Deep, poorly drained, brown to dark gray, loamy sand soils on level to nearly level mudflats of fluvio-littoral with loamy sand surface and none to slight erosion.
Mnd5cA1 (Mandavi)	116	Deep, poorly drained, brown to dark gray, loamy sand soils on level to nearly level mudflats of fluvio-littoral with sandy loam surface and none to slight erosion.
Mnd5cB2 (Mandavi)	117	Deep, poorly drained, brown to dark gray, loamy sand soils on very gently sloping mudflats of fluvio-littoral with sandy loam surface and moderate erosion.
Mnd5bB2s1 (Mandavi)	118	Deep, poorly drained, brown to dark gray, loamy sand soils on very gently sloping mudflats of fluvio-littoral with sandy loam surface, moderate erosion and slight salinity.
Hrm6aB2 (Harmal)	119	Very deep, somewhat excessively drained, bownish yellow to light yellowish brown, sandy soils on very gently sloping beach and beach ridges of fluvio-littoral with sandy surface and moderate eosion.

Kangayam Block, Tiruppur Distrcit, Tamil Nadu

The soils of Kangayam block represent granite and gneissic complex of south Deccan plateau in Tamil Nadu Uplands and the soils are mapped into 51 phases of twelve series (Table.2.2.21 and Fig. 2.2.23).

Bukkarayasamudrum Mandal, Anantapur District, Andhra Pradesh

The soils of Bukkarayasamudrum mandal represents granite and gneissic complex of south Deccan plateau and are mapped into 52 phases of eight soil series (Fig. 2.2.24 and Table. 2.2.22).

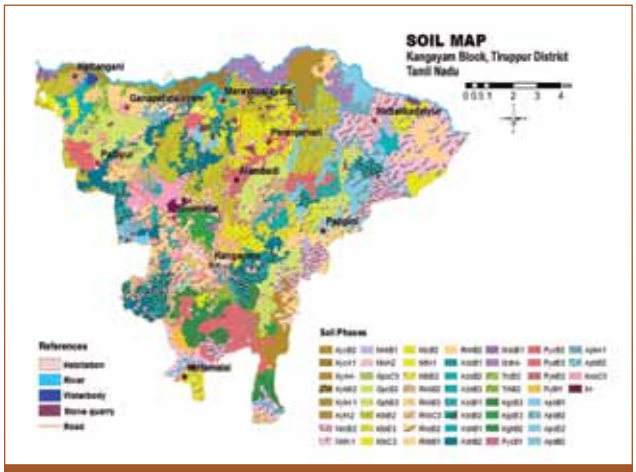


Fig. 2.2.23. Soil map of Kangayam block, Tiruppur District, Tamil Nadu

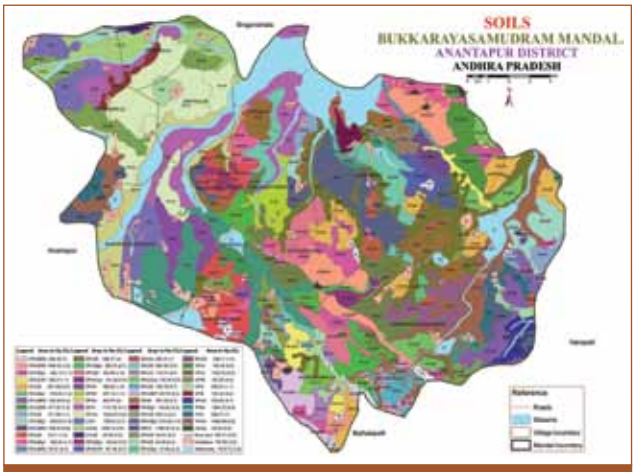


Fig. 2.2.24. Soil map of Bukkarayasamudrum mandal, Anantapur district

Table 2.2.21. Soils of Kangayam block, Tiruppur district, Tamil Nadu

Soil phases (Soil series)	Brief description
AbbB2 (Alambadi)	Moderately deep, moderately well drained, loamy soils on very gently sloping uplands, loamy sand surface and moderate erosion
AbbB3 (Alambadi)	Moderately deep, moderately well drained, loamy soils on very gently sloping uplands, loamy sand surface and severe erosion
AbcB1 (Alambadi)	Moderately deep, moderately well drained, loamy soils on very gently sloping uplands, sandy loam surface and slight erosion.
AbcB1 (Alambadi)	Moderately deep, moderately well drained loamy soils on nearly level to very gently sloping uplands, sandy loam surface and slight erosion.
AbcB1 (Alambadi)	Moderately deep, moderately well drained, loamy soils on nearly level to very gently sloping lands, sandy loam surface and slight erosion
AbcB2 (Alambadi)	Moderately deep, moderately well drained, loamy soils on very gently sloping uplands, sandy loam surface and moderate erosion.
AphB2 (Arasam-palayam)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy clay loam surface and moderate erosion
GpbC3 (Ganapathy-palayam)	Shallow, well drained, loamy soils, developed from granite gneiss, occurring on gently sloping lands, loamy sand surface and severe erosion
GpcB2 (Ganapathy-palayam)	Shallow, well drained, loamy soils on very gently sloping uplands, sandy loam surface and moderate erosion.
GpcB2 (Ganapathy-palayam)	Shallow, well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
GpcB2 (Ganapathy-palayam)	Shallow, well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
KghB2 (Kangayam)	Very shallow, well drained, loamy soils on very gently sloping upland, sandy clay loam surface and moderate erosion.

Soil phases (Soil series)	Brief description
KnbC3 (Keeranur)	Shallow, well drained, loamy soils on gently sloping uplands, loamy sand surface, and severe erosion
KtcB2 (Kuttarai)	Moderately shallow, well drained, loamy soils on very gently sloping uplands, sandy loam sand surface, and moderate erosion.
KtcB2 (Kuttarai)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
KtcB2 (Kuttarai)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
KtfA1 (Kuttarai)	Moderately shallow, well drained, loamy soils on nearly level lowlands, clay loam surface and slight erosion
KthB2 (Kuttarai)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy clay loam surface and moderate erosion
KycA1 (Kadaiyur)	Deep, moderately well drained, loamy soils on nearly level lowlands, sandy loam surface and slight erosion
KycB1 (Kadaiyur)	Deep, moderately well drained, loamy soils on very gently sloping lowlands, sandy loam surface and slight erosion
KycB2 (Kadaiyur)	Deep, moderately well drained, loamy soils on very gently sloping low lands, sandy loam surface and moderate erosion
KycB2 (Kadaiyur)	Deep, moderately well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
KyhA1 (Kadaiyur)	Deep, moderately well drained, loamy soils on nearly level lowlands, sandy clay loam surface and slight erosion
KyhB2 (Kadaiyur)	Deep, moderately well drained, loamy soils on nearly level to very gently sloping lowlands, sandy clay loam surface and moderate erosion
MdhA (Marudurai)	Deep, well drained, loamy soils on nearly level lowlands, sandy clay loam surface and slight erosion
MdhB2 (Marudurai)	Deep, well drained, loamy soils on nearly level to very gently sloping lands, sandy clay loam surface and moderate erosion
NkcB2 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level to very gently sloping lowlands, sandy loam surface and moderate erosion
NkfA1 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level lands, clay loam surface and slight erosion
NkfA1 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level lowlands, clay loam surface and slight erosion
NkfA1 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level lowlands, clay loam surface and slight erosion
NkfA2 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level lowlands, clay loam surface and moderate erosion
NkhA1 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level lands, sandy clay loam surface and slight erosion
NkhB1 (Nathaka-daiyur)	Deep, well drained, loamy soils on nearly level to very gently sloping lowlands, sandy clay loam surface and slight erosion
PycB2 (Padiyur)	Shallow, well drained, loamy soils on very gently sloping upland, sandy loam surface and moderate erosion.
PydB2 (Padiyur)	Shallow, well drained, loamy soils on nearly level to very gently sloping lands, loamy surface and moderate erosion

Soil phases (Soil series)	Brief description
RkbC2 (Ramakara-palayam)	Moderately shallow, well drained, loamy soils on gently sloping uplands, loamy sand surface and moderate erosion
RkcB1 (Ramakara-palayam)	Moderately shallow, well drained, loamy soils on very gently sloping uplands, sandy loam surface and slight erosion.
RkcB2 (Ramakara-palayam)	Moderately shallow, well drained, loamy soils on very gently sloping uplands, sandy loam surface and moderate erosion
RkcB2 (Ramakara-palayam)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy loam surface and moderate erosion
RkhB1 (Ramakara-palayam)	Moderately shallow, well drained, loamy soils on very gently sloping lands, sandy clay loam surface and slight erosion
TrhB2 (Thammareddi-palayam)	Deep, moderately well drained, loamy soils on nearly level uplands, sandy clay loam surface and moderate erosion.

Table 2.2.22. Soils of Bukkarayasamudrum mandal, Anantapur district, Andhra Pradesh

Soil phases (Soil Series)	Brief description
CPb2BR4 (Chennampalle)	Shallow, well drained, gravelly, clay soils on very gently sloping uplands, loamy sand surface and moderate erosion.
CPb2ER4 (Chennampalle)	Shallow, well drained, gravelly, clay soils on strongly sloping hills and side, loamy sand surface and moderate erosion.
CPb2ER4 (Chennampalle)	Shallow, well drained, gravelly, clay soils on strongly sloping pediment slopes, loamy sand surface and moderate erosion.
CPb3B1 (Chennampalle)	Shallow, well drained, gravelly, slight gravelliness clay soils on very gently sloping pediplain, loamy sand surface and severe erosion.
CPb3CR1 (Chennampalle)	Shallow, well drained gravelly, clay soils on gently sloping, loamy sand surface and severe erosion.
CPc2B (Chennampalle)	Shallow, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and moderate erosion.
CPc2B1 (Chennampalle)	Shallow, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and slight erosion
CPc2BR2 (Chennampalle)	Shallow, well drained gravelly, clay soils on very gently sloping pediplain, sandy loam surface and moderate erosion.
CPc2ER4 (Chennampalle)	Shallow, well drained, gravelly, clay soils on strongly sloping side slopes of hills, sandy loam surface and moderate erosion.
CPh2B (Chennampalle)	Shallow, well drained, gravelly, clay soils on very gently sloping pediplain, sandy clay loam surface and moderate erosion.
CPh2B1 (Chennampalle)	Shallow, well drained, gravelly, clay soils on very gently sloping pediplain, sandy clay loam surface and moderate erosion
CPh2BR3 (Chennampalle)	Shallow, well drained, gravelly, clay soil on very gently uplands, sandy clay loam surface and moderate erosion.
DPb2B (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on very gently sloping pediplain, loamy sand surface and moderate erosion.
DPb2B1 (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, slight gravelliness loam soils on very gently sloping pediplain, loamy sand surface and moderate erosion
DPb2BR2 (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on very gently sloping pediplain, loamy sand surface and.moderate erosion

DPc2B (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on very gently sloping pediplain, sandy loam surface and moderate erosion
DPc2B1 (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, slight gravelly loam soils on very gently sloping pediplain, sandy loam surface and moderate erosion
DPh2B (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on very gently sloping pediplain, sandy clay loam surface and moderate erosion
DPh2C1 (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam on gently sloping pediplain, sandy clay loam surface and moderate erosion
DPhA (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on nearly level pediplain, sandy clay loam surface and very slight erosion
DPiB1 (Dayyadakuntapalle)	Moderately shallow, well drained, gravelly, loam soils on very gently sloping pediplain, sandy clay surface
GphA (Govindapalle)	Deep, moderately well drained calcareous clayey soils on nearly level alluvial deposits and valley fills, sandy clay loam surface and very slight erosion
GpiA (Govindapalle)	Deep, moderately well drained, calcareous clayey soils on nearly level alluvial deposits and valley fills, sandy clay surface and very slight erosion
GPmA (Govindapalle)	Deep, moderately well drained, calcareous clayey soils on nearly level alluvial deposits and valley fills, sandy clay surface and very slight erosion
LOiA (Lolluru)	Moderately deep, well drained, calcareous clayey soils on nearly level alluvial deposits, sandy clay surface and very slight erosion
LomA (Lolluru)	Moderately deep, well drained, calcareous clayey soils on nearly level alluvial deposits, clay surface and very slight erosion
LOmB (Lolluru)	Moderately deep, well drained, calcareous clayey soils on very gently sloping alluvial, clay surface and very slight erosion
NPb2B1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping pediplain, loamy sand surface and moderate erosion
NPb2CR1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on gently sloping uplands, loamy sand surface and moderate erosion.
NPc2A (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on nearly level pediplain, sandy loam surface and moderate erosion.
NPc2B (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and moderate erosion.
NPc2C (Nilampalle)	Moderately deep, well drained, gravelly, clay soil on gently sloping pediplain, sandy loam surface and moderate erosion.
NPc2C1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on gently sloping pediplain, sandy loam surface and moderate erosion.
NPc3B (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and severe erosion.
NPc3BR1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and severe erosion
NPcB (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping uplands, sandy loam surface and very slight erosion
NPcB1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping uplands and sandy loam surface and slight erosion.
NPh2B (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on very gently sloping pediplain and sandy clay loam surface and moderate erosion.
NPh2B1 (Nilampalle)	Moderately deep, well drained, gravelly, clay soils, on very gently sloping pediplain, sandy clay loam surface and moderate erosion

NPhA (Nilampalle)	Moderately deep, well drained, gravelly, clay soils on nearly level pediplain, sandy clay loam surface and very slight erosion.
RPb2B (Rekulakuntapalle)	Deep, well drained, gravelly, clay soils on very gently sloping pediplain, loamy sand surface and moderate erosion.
RPc2B (Rekulakuntapalle)	Deep, well drained, gravelly, clay soils on very gently sloping pediplain, sandy loam surface and moderate erosion.
RPc2B1 (Rekulakuntapalle)	Deep, well drained, gravelly, slight gravelly clay soils on very gently sloping pediplain, sandy loam surface and moderate erosion
RPc2C (Rekulakuntapalle)	Deep, well drained gravelly, clay soils on gently sloping pediplain, sandy loam surface and moderate erosion.
VpcA (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils, on nearly level valley fills, sandy loam surface and very slight erosion
VPhA (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils on valley fills, sandy clay loam surface and very slight erosion
VpiA (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils on nearly level valley fills, sandy clay surface and very slight erosion
VPiB (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils on very gently valley fills, sandy clay surface and very slight erosion
VPmA (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils on nearly level valley fills, clay surface and very slight erosion
YPhA (Yadavalaparti)	Moderately shallow, well drained, calcareous loamy soil, on nearly level alluvial deposits, sandy clay loam surface and very slight erosion
YpiA (Venkatapuram)	Moderately shallow, well drained, calcareous gravelly, clay soils on nearly level valley fills, sandy clay surface and very slight erosion
YPmA (Yadavalaparti)	Moderately shallow, well drained, calcareous loamy soil on nearly level alluvial deposits, clay surface and very slight erosion

Hosur-1 Microwatershed, Shirahatti taluk, Gadag district, Karnataka

Hosur-1 microwatershed in Gadag district covers an area of 408 ha. Ten soil series were identified in the watershed and mapped in 18 phases of soil series (Fig. 2.2.25, Table 2.2.23).

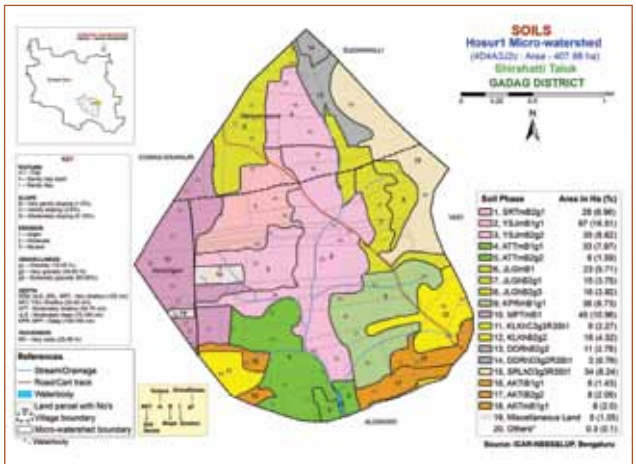


Fig. 2.2.25. Soil Phase map of Hosur-1 Microwatershed

Bilalgodu micro-watershed (4D4D3S2d), Mudigere sub-watershed of Chikmagalur district, Karnataka

Bilalgodu micro-watershed (4D4D3S2d), Mudigere sub-watershed of Chikmagalur district, Karnataka represents quartzite schist complex of western ghats – Central Sahyadri. Total 5 soil series are identified and mapped in 30 mapping units as phases of soil series.

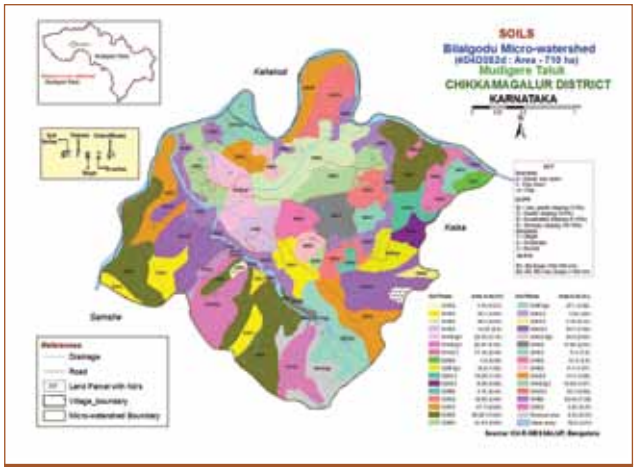


Fig. 2.2.26. Soil Map of Bilalgodu (4D4D3S2d) watershed, Mudigere, Chikmagalur, Karnataka

Table 2.2.23. Soil of Hosur-1 Microwatershed, Shirahatti taluk, Gadag district, Karnataka

Soil Phases (Soil series)	Brief description
AKTiB1g1 (Attikatti)	Shallow (25-50 cm), well drained, sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35%)
AKTiB2g2 (Attikatti)	Shallow (25-50 cm), well drained, sandy clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)
AKTmB1g1 (Attikatti)	Shallow (25-50 cm), well drained, clay surface, slope 1-3%, slight erosion, gravelly (15-35%)
ATTmB1g1 (Attikatti Tanda)	Moderately shallow (50-75 cm), well drained, clay surface, slope 1-3%, slight erosion, gravelly (15-35%)
ATTmB2g2 (Attikatti Tanda)	Moderately shallow (50-75 cm), well drained, clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)
DDRhB2g2 (Dindur)	Very shallow (<25 cm), well drained, Sandy clay loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)
DDRhD3g2R3St1 (Dindur)	Very shallow (<25 cm), well drained, sandy clay loam surface, slope 5-10%, severe erosion, very gravelly (35-60%), very rocky (25-50%), stony (0.01-0.1%)
JLGhB2g1 (Jelligere)	Moderately deep (75-100 cm), moderately well drained, sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)
JLGhB2g3 (Jelligere)	Moderately deep (75-100 cm), moderately well drained, sandy clay loam surface, slope 1-3%, moderate erosion, extremely gravelly (60-80%)
JLGmB1 (Jelligere)	Moderately deep (75-100 cm), moderately well drained, clay surface, slope 1-3%, slight erosion
KLKhB2g2 (Kabulayathkatti)	Very shallow (<25 cm), well drained, sandy clay loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)
KLKhC3g3R3St1 (Kabulayathkatti)	Very shallow (<25 cm), well drained, sandy clay loam surface, slope 3-5%, severe erosion, extremely gravelly (60-80%), very rocky (25-50%), stony (0.01-0.1%)
KPRmB1g1 (Kalasapur)	Deep (100-150 cm), moderately well drained, clay surface, slope 1-3%, slight erosion, gravelly (15-35%)
MPTmB1 (Mahalingapur Tanda)	Deep (100-150 cm), moderately well drained, clay surface, slope 1-3%, slight erosion
SRLhD3g3R3St1 (Shirol)	Very shallow (<25 cm), well drained, sandy clay loam surface, slope 5-10%, severe erosion, extremely gravelly (60-80%), very rocky (25-50%), stony (0.01-0.1%)
SRTmB2g1 (Soratur)	Very shallow (<25 cm), well drained, clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)
YSJmB1g1 (Yelisirunja)	Shallow (25-50 cm), well drained, clay surface, slope 1-3%, slight erosion, gravelly (15-35%)
YSJmB2g2 (Yelisirunja)	Shallow (25-50 cm), well drained, clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)

Table. 2.2.24. Soils of Bilalgodu (4D4D3S2d) watershed, Mudigere, Chikmagalur, Karnataka

Soil phases	Brief description
S1fC2	Deep, well drained, reddish brown, clay loam soil on gently sloping hill slopes, moderate erosion
S1fC3	Deep, well drained, reddish brown, clay loam soil on gently sloping hill slopes, severe erosion
S1fD2	Deep, well drained, reddish brown, clay loam soil on moderately sloping hill slopes, moderate erosion
S1fD3	Deep, well drained, reddish brown, clay loam soil on moderately sloping hill slopes, severe erosion
S1hD2g1	Deep, well drained, reddish brown, gravelly sandy clay loam soil on moderately sloping hill slopes, moderate erosion

Soil phases	Brief description
S1hE2g1	Deep, well drained, reddish brown, gravelly sandy clay loam soil on strongly sloping hill slopes, moderate erosion
S1mD3	Deep, well drained, reddish brown, clay soil on moderately sloping hill slopes, severe erosion
S2fD2	Deep, well drained, yellowish red, clay loam soil on moderately sloping hill slopes, moderate erosion
S2fE3g1	Deep, well drained, yellowish red, gravelly clay loam soil on strongly sloping hill slopes, severe erosion
S2hC3	Deep, well drained, yellowish red, sandy clay loam soil on gently sloping hill slopes, severe erosion
S2hD3	Deep, well drained, yellowish red, sandy clay loam on moderately sloping hill slopes, severe erosion
S3fB2	Very deep, well drained, reddish brown, clay loam soil on very gently sloping hill slopes, moderate erosion
S3fC2	Very deep, well drained, reddish brown, clay loam soil on gently sloping hill slopes, moderate erosion
S3fC3	Very deep, well drained, reddish brown, clay loam soil on gently sloping hill slopes, severe erosion
S3fD2	Very deep, well drained, reddish brown, clay loam soil on moderately sloping hill slopes, moderate erosion
S3fD3	Very deep, well drained, reddish brown, clay loam soil on moderately sloping hill slopes, severe erosion
S3fE3g2	Very deep, well drained, reddish brown, very gravelly clay loam soil on strongly sloping hill slopes, severe erosion
S3hC2	Very deep, well drained, reddish brown, sandy clay loam soil on moderately sloping hill slopes, moderate erosion
S3hD3	Very deep, well drained, reddish brown, sandy clay loam soil on moderately sloping hill slopes, severe erosion
S3mD3	Very deep, well drained, reddish brown, clay soil on moderately sloping hill slopes, severe erosion
S3mD3g2	Very deep, well drained, reddish brown, very gravelly clay soil on moderately sloping hill slopes, severe erosion
S4fC2	Very deep, well drained, reddish brown, clay loam soil on gently sloping hill slopes, moderate erosion
S4fC3	Very deep, well drained, brown, clay loam soil on gently sloping hill slopes, severe erosion
S4fD2	Very deep, well drained, brown, clay loam soil on moderately sloping hill slopes, moderate erosion
S4fD3	Very deep, well drained, brown, clay loam soil on moderately sloping hill slopes, severe erosion
S4hD2	Very deep, well drained, brown, sandy clay loam soil on moderately sloping hill slopes, moderate erosion
S4hD2g1	Very deep, well drained, brown, gravelly sandy clay loam soil on moderately sloping hill slopes, moderate erosion
S4mD3	Very deep, well drained, brown, clay soil on moderately sloping hill slopes, severe erosion
S5fB2	Very deep, well drained, grayish brown, clay loam soil on very gently sloping foot slopes, moderate erosion
S5fC2	Very deep, well drained, grayish brown, clay loam soil on gently sloping foot slopes, moderate erosion

2.3 PEDOLOGICAL RESEARCH

Characterization of clay minerals

Four typifying pedon associated in a toposequence have been studied in Benetara block, Chhatisgarh to discuss the presence of Vertisol/Vertic intergrade developed on the basement of shale. Clay and silt specimens were analysed for mineralogical composition. The silt fractions (50-2 µm) contains dominantly low charge dioctahedral smectite, together with mica, kaolin, quartz and the fine clay fractions are rich in dioctahedral smectite (Figs. 2.3.1 to 2.3.3).

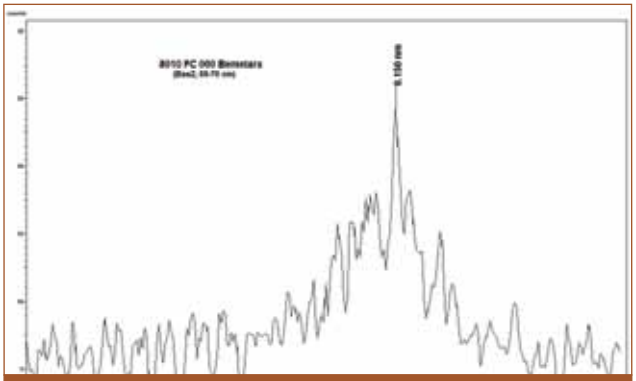


Fig. 2.3.1. 060 reflection of the soils of Bemetara

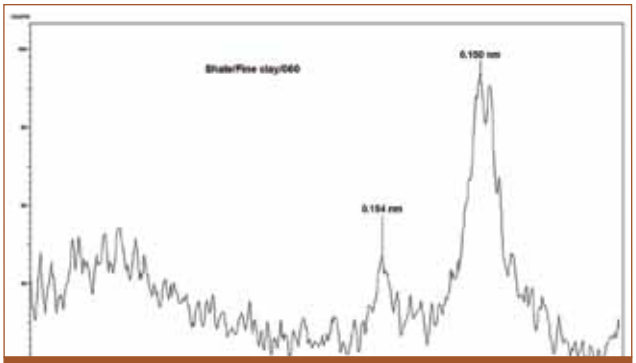


Fig. 2.3.2. The XRD graph shows the 060 reflection of the soils

Soil – landform relationship at 1:10000 scale

Thimmajipet mandal in Mahabubnagar district of Telangana state has been characterized into three major landforms viz., piedmont (474 – 550 m), alluvial plain (451 – 474 m) and valley (434 – 451 m) and covers an area of 9,899 (46% of the mandal), 5,021

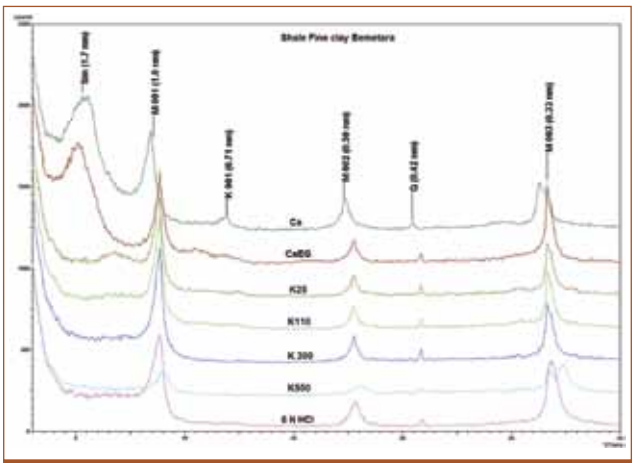
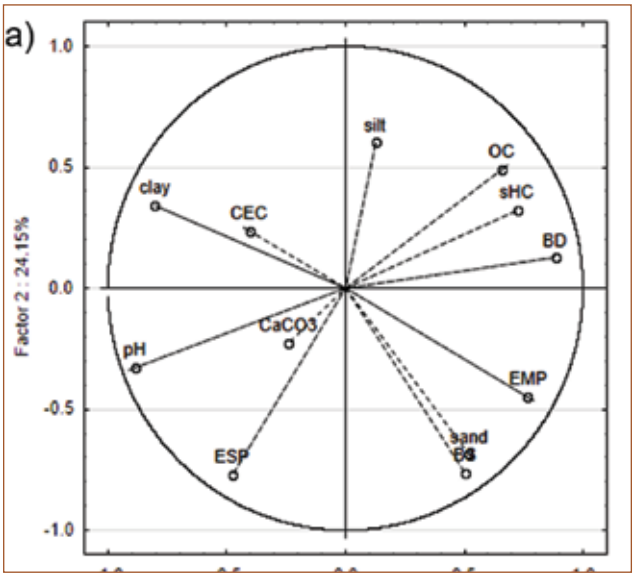


Fig. 2.3.3.Representative XRD patterns of the, fine clay fractions of soil of Bemetara block. Ca=Ca-saturated, Ca-EG=Ca-saturated plus glycol vapour,K25/110/300/300Eg/550°C = K–saturated and heated to 25°, 110°, 300° and 550°C, Sm= smectite, M=mica, K=kaolin, Q=quartz

(23% mandal) and 4,262 ha (20% of the mandal), respectively. The intermittently occurring hillocks (551 – 662 m) occupied an area of 1,840 ha (8.5% of the mandal). The soil variability of the study area was interpreted using coefficient of variation (CV) for combined data set of all landforms. Silt, clay, sHC, $CaCO_3$, OC, CEC, ESP and EMP were the most variable properties (Fig.2.3.4a)



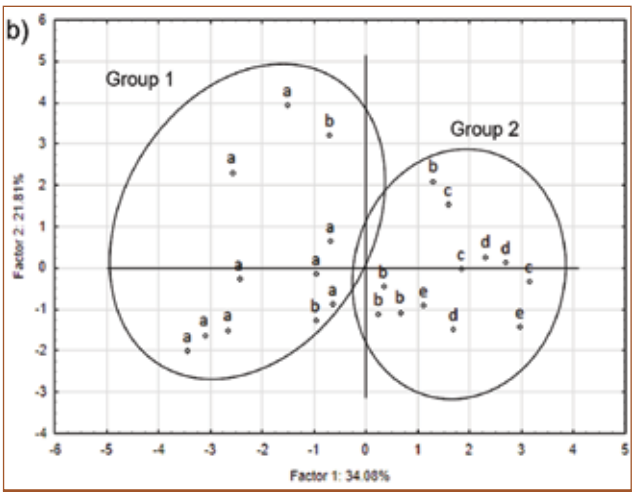


Fig 2.3.4. Results of factor analysis for valley landform showing a) relationship between soil properties; b) distribution of surface and subsurface soil sample values

The correlation study and factor analysis (Fig. 2.3.4b) results showed that silt, clay, OC and sHC varied significantly among the studied landforms (Table 2.3.1). However, the variability within the land forms are not significant. The study concludes that soil-landform relationship is good enough for soil mapping at large scale using high resolution remote sensing data, and digital elevation model.

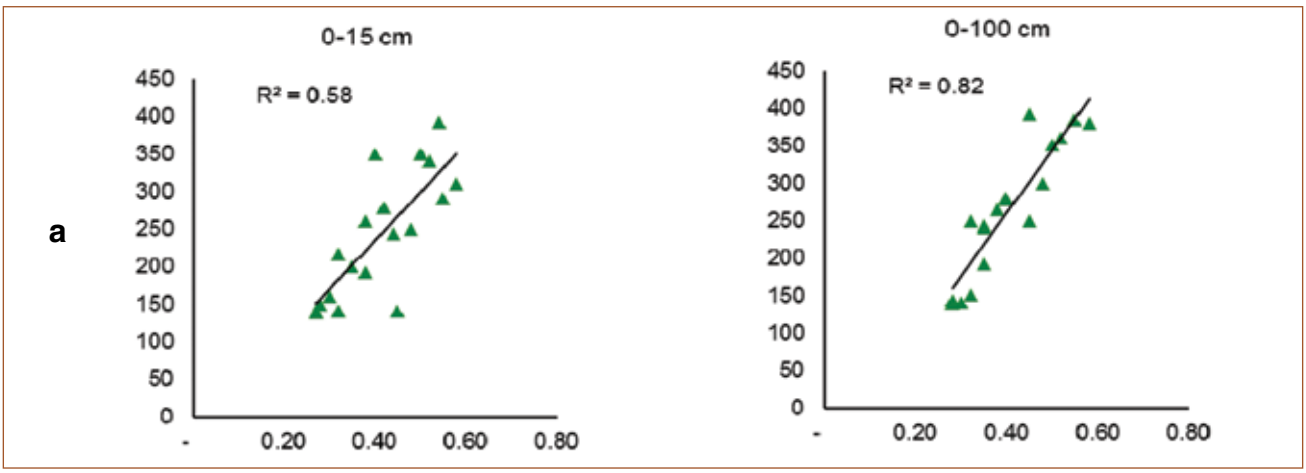
Soil quality index as a tool to evaluate crop productivity and land use planning in Deccan plateau region

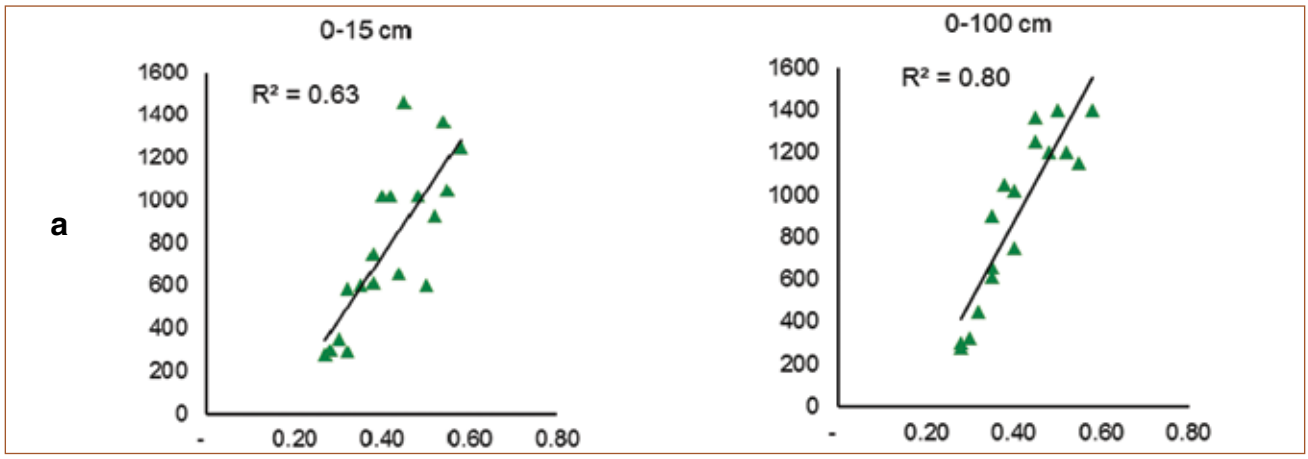
Two different SQIs were estimated for soil surface (0-15 cm) and control section (0-100 cm) using soil profile data of six identified soil series of Thimmajipet mandal, Mahabubnagar district and correlated with crop yield. Principal component analysis additive and weight index and expert opinion additive and weight index (EO) methods were used for selecting minimum soil data set (MDS). In PCA method, additive index of both surface and control section had poor correlation with yield of crops except with pigeon pea yield (R^2=0.68).

EO derived weighted index for SQI had good correlation with the crop yield significant by for maize, cotton and pigeon pea (Fig. 2.3.5), indicating its better performance.

Table 2.3.1. Soil quality index (SQI) values for six identified soil series by different methods

SQI Method	Gummagonda		Pullagiri		Chegunta		Nerelapally		Avancha		Koduparthy	
Depth (cm)	0-15	0-100	0-15	0-50	0-15	0-100	0-15	0-100	0-15	0-100	0-15	0-100
PCA Additive index	1.67	-	1.84	1.89	2.37	2.45	2.64	2.36	2.61	2.39	2.07	1.67
PCA Weighted index	0.39	-	0.50	0.64	0.58	0.78	0.28	0.38	0.30	0.28	0.27	0.22
EO additive index	1.81	-	2.34	2.19	2.59	2.55	2.10	1.79	2.35	2.33	1.77	1.62
EO weighted index	0.32	-	0.42	0.40	0.54	0.45	0.44	0.35	0.38	0.35	0.27	0.28





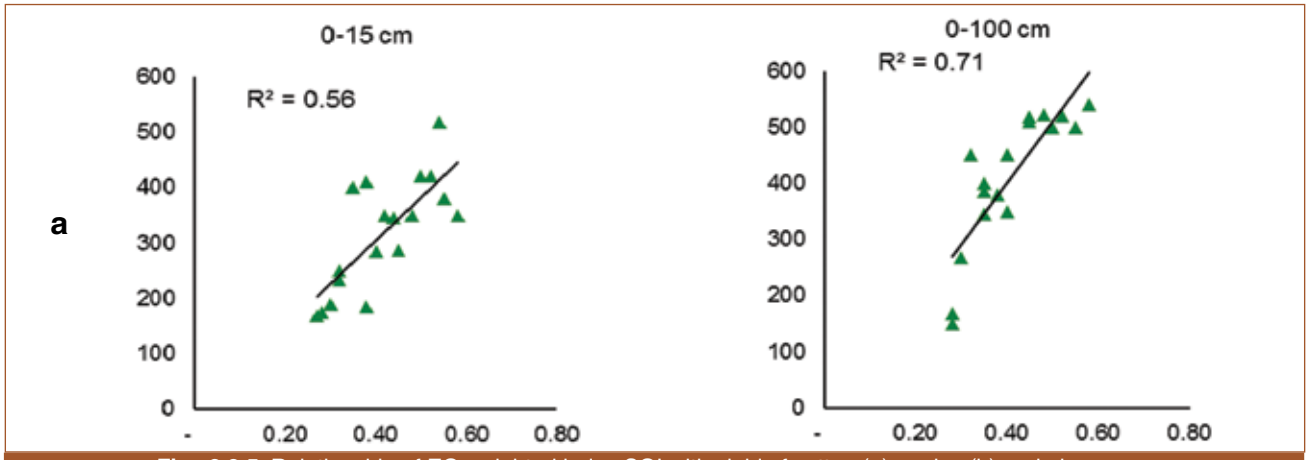


Fig. 2.3.5. Relationship of EO weighted index SQI with yield of cotton (a); maize (b) and pigeon pea (c); X axis = SQI; Y axis = crop yield (kg/ha-1)

Soil- Landform Relationship

a) Greater Himalayas - Lahul Block, Lahul & Spiti district, H.P.

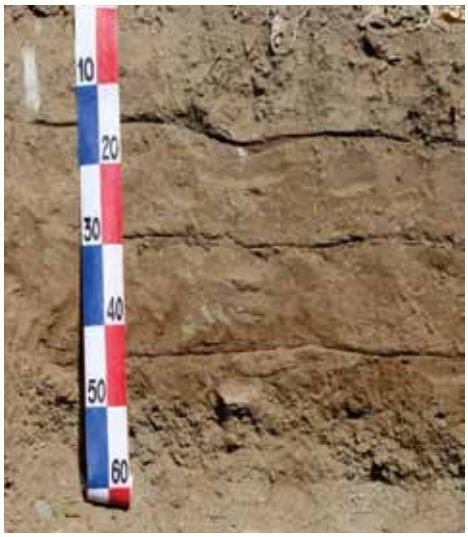
Loamy skeletal Lithic Cryorthents **Loamy skeletal Lithic Cryorthents**

Steeply Sloping side/reposed slopes

Moderately deep fine loamy Typic Haplucryepts

Moderately deep coarse loamy Typic Haplucryepts

Moderately Sloping Glacio-fluvial valleys



Deep fine loamy Typic Haplucryepts

Moderately deep fine loamy Typic Haplucryepts

Gently sloping Glacio-fluvial valleys

Fig. 2.3.6. Landform-soils relationship in Lahul Block, Lahul & Spiti district, H.P.

b) Upper Indo-Gangetic plains - Rajpura block, Patiala district, Punjab

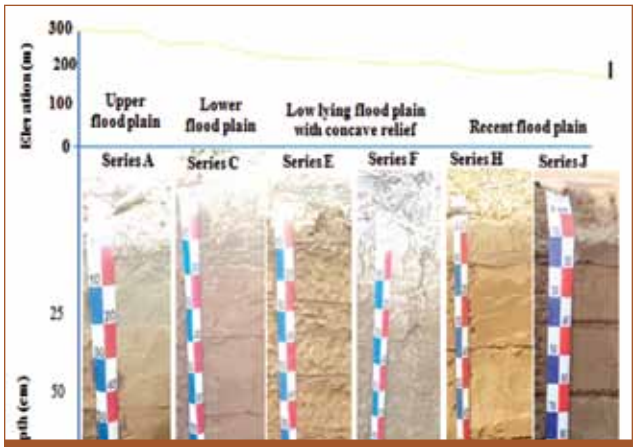


Fig 2.3.7. Landform-soils relationship in in Rajpura block, Patiala district, Punjab

c) Siwalik hills/outer Himalayas - Pangi block, Chamba district, Himachal Pradesh

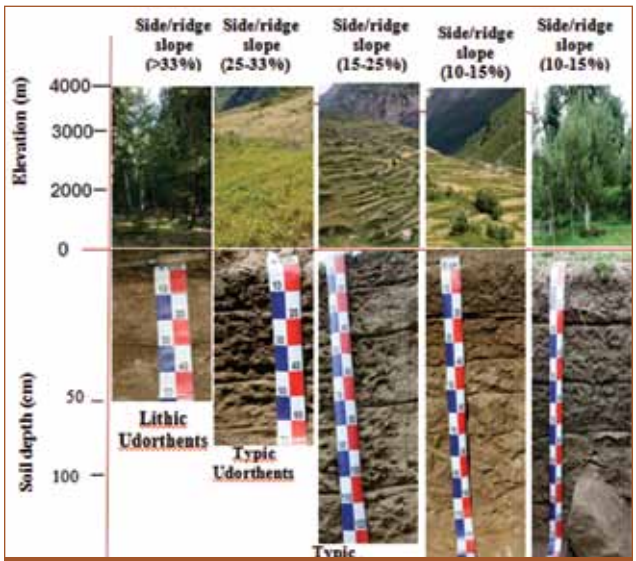


Fig. 2.3.8: Landform-soils relationship in Pangi block, Chamba district, Himachal Pradesh

d) Sandy Arid Western Plains - Suratgarh tehsil, Sri Ganganagar district, Rajasthan

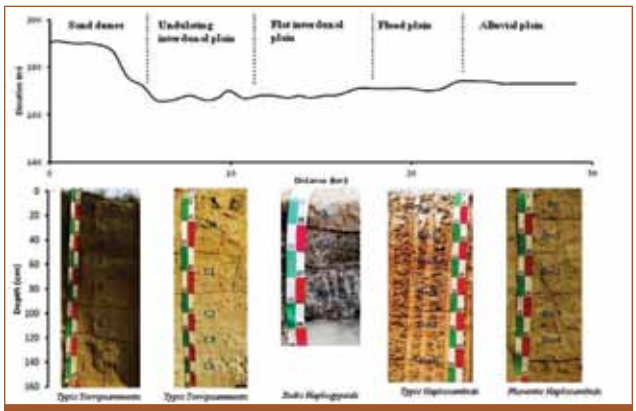


Fig. 2.3.9 Landform-soils relationship in Suratgarh taluk, Sri Ganganagar district, Rajasthan.

e) Sandy Arid Western Plains - Anupgarh tehsil, Sri Ganganagar district, Rajasthan –

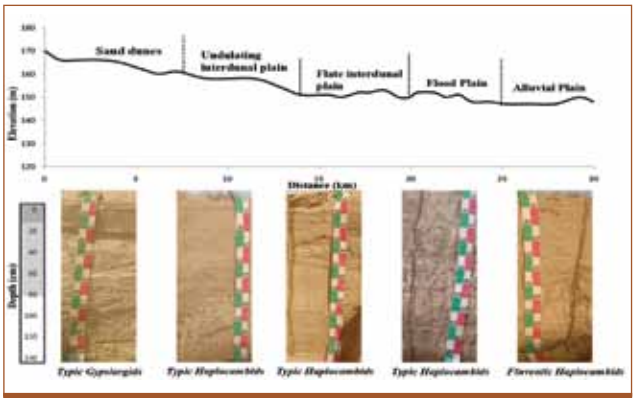


Fig.2.3.10 Landform-soils relationship in Anupgarh tehsil, Sri Ganganagar district, Rajasthan.

Assessment of Impact of Canal Irrigation on the Arid Agro-ecosystem – Case Study in five blocks of IGNP Command Area

During the year Rawatsar, Sri Ganganagar, Anupgarh and Suratgarh tehsil in Rajasthan Odhan block in Haryana and Faridkot block in Punjab have been selected for the study. Further land use/ land cover and landform map of Rawatsar and Sri Ganganagar have been prepared (Figs. 2.3.11 and 2.3.12).

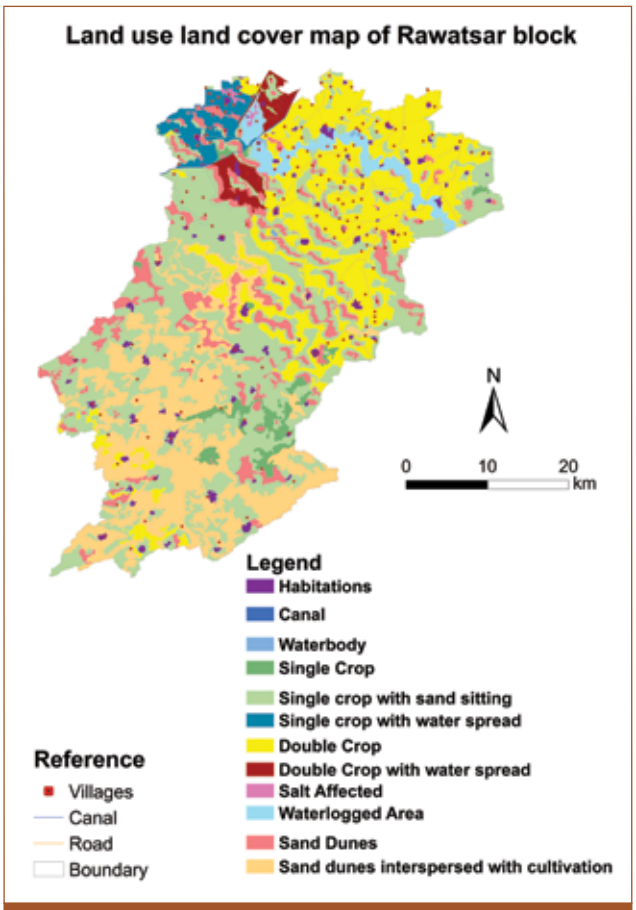


Fig. 2.3.11. Land use / land cover map of Rawatsar block

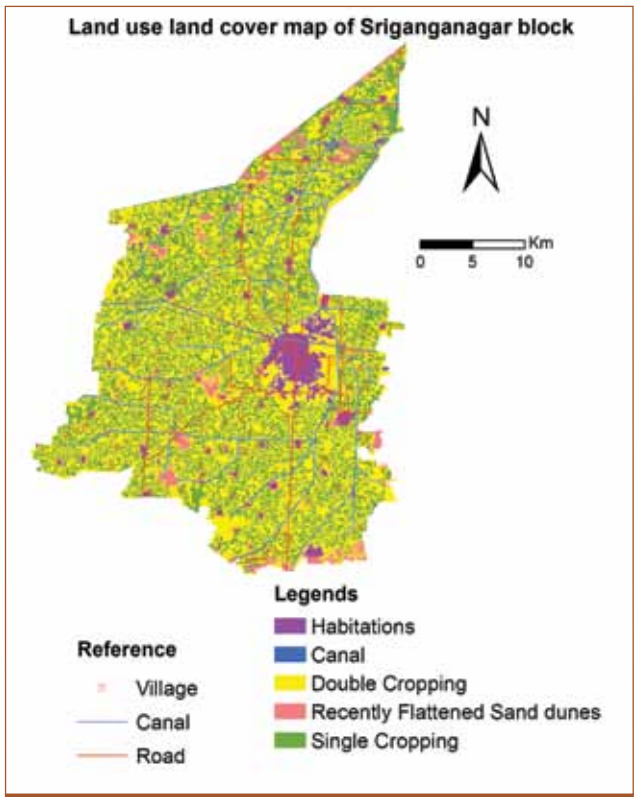


Fig. 2.3.12. Land use / land cover map of Sriganganagar block

Development of decision support system for agricultural land use planning

During the reporting period, a sub-module has been developed for the assessment of water resources from surface water and groundwater sources. The module considers not only quantity of water resources, but also the water quality. For surface water assessment, three methods have been used in the DSS: (1) SCS curve number for estimating excess rainfall or direct runoff volume (Fig. 2.3.13), (2) Muskingum Method for streamflow routing and stream storage and (3) Water balance method for storage estimation for the catchment/river basin, reservoirs and ponds. For the estimation of groundwater resources, the methods for estimating static and dynamic groundwater reserves have been used.

The input parameters required for estimating the static groundwater reserve are: (i) depth to the aquifer base, (ii) depth to water table in the pre-monsoon season, (iii) areal extent of the aquifer, and (iv) specific yield of the aquifer. For dynamic groundwater reserve, the required inputs parameters are: (i) depth to water table in the post-monsoon season of the current year, (ii) depth to water table in the pre-monsoon season of the next year, (iii) areal extent of the aquifer, and (iv) specific yield of the aquifer.

The major water quality parameters, considered for the assessment are: (i) total dissolved solids (TDS), (ii) pH, (iii) electrical conductivity (EC), (iv) sodium adsorption ratio (SAR), (v) dissolved oxygen (DO), (vi) chloride (Cl-), (vii) boron (B), and (viii) bicarbonate (HCO_3-) (Fig. 2.3.14).

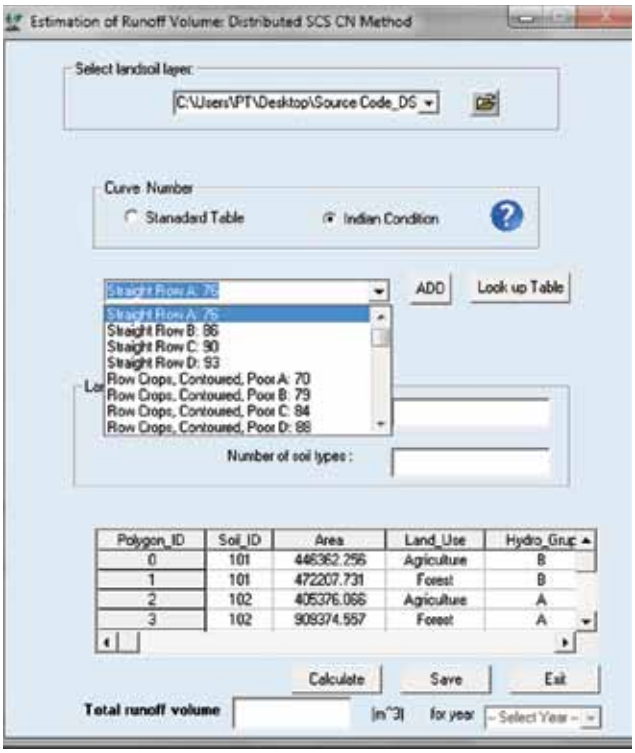


Fig. 2.3.13. A snapshot of sub-module for estimation of direct runoff

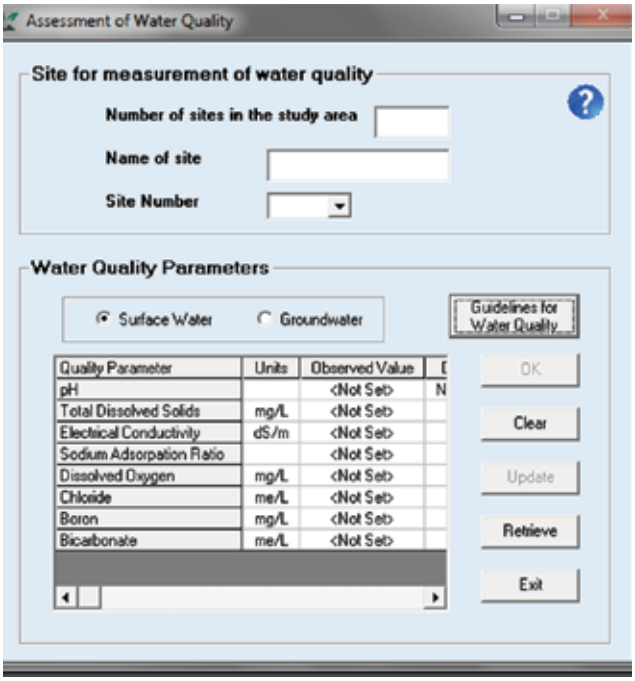


Fig. 2.3.14. A snapshot of sub-module for assessment of water quality

Generation and modelling of carbon datasets in different agro-ecosystems for climate resilient agricultural planning (NICRA)

The carbon stock (organic, inorganic and total carbon 0-100 cm soil depth) was estimated for 36 benchmark soils representing various agro-ecological regions that

cover arid to per-humid bio-climates of the country. The soil organic carbon (SOC) stock varied from a maximum of 10.9 kg/m^2 in semi-arid (moist) bio-clime to a minimum of 7.1 kg/m^2 in sub-humid (moist) bio-climate in the black soil region (BSR). For the soils of the Indo-Gangetic Plains (IGP), the SOC stock varied from a maximum of 7.8 kg/m^2 in per humid bio-climate to a minimum of 2.9 kg/m^2 in sub-humid dry bio-climate (Fig. 2.3.15).

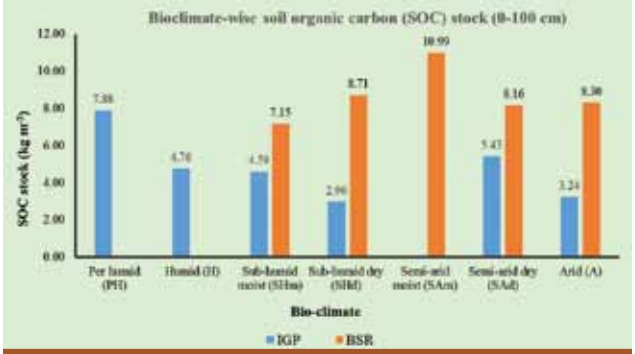


Fig. 2.3.15. Bioclimate-wise soil organic carbon (SOC) stock

In the BSR, the soil inorganic carbon (SIC) stock varied from a maximum of 29 kg/m^2 in sub-humid (dry) bio-clime to a minimum of 9.7 kg/m^2 in sub-humid (moist) bio-climate. The SIC stock varied from a maximum of 23 kg/m^2 in sub-humid (moist) bio-climate to a minimum of 1.2 kg/m^2 in sub-humid (dry) bio-climate of the IGP (Fig. 2.3.16).

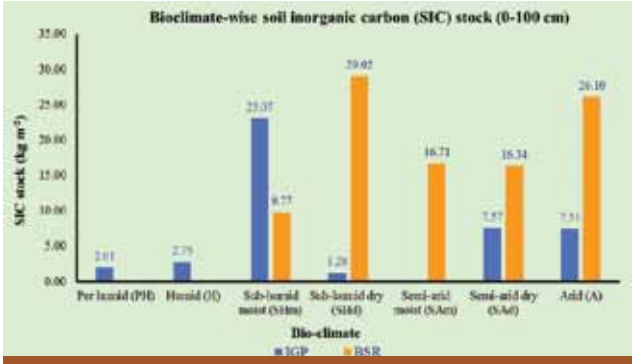


Fig. 2.3.16. Bioclimate-wise soil organic carbon (SOC) stock.

Thus, the status of soil carbon stock will help in prioritizing the areas for carbon management or in identifying potential areas for carbon sequestration and to further our understanding of the soil health, that helps in assessing the responses of terrestrial ecosystems to climate change and to aid policy makers in making land use/management decisions.

Simulation of soil organic carbon under climate change scenarios

The soil organic carbon was simulated for four representative concentration pathways (RCPs) using Century carbon model and datasets of long term fertilizer experiments (LTFE) carried out in the university farm of Bidhanchandra Krishi Vishwavidyalaya, Mohanpur, West Bengal, India. The LTFE site is represented by the Mohanpur *soil* series (fine, mixed, hyperthermic Vertic Endoaqualfs). These soils are formed by Gangetic alluvium on nearly level old flood plain at an elevation of about 210 m above the mean sea level. The surface soil (0-20 cm) of the experimental site for all treatments had oxidisable organic carbon of 8.8 g/kg, calcium carbonate equivalent 1.0 %, bulk density of 1.2 Mg/m^3 and cation exchange capacity of 22 cmol (p$^+$)/kg. Rice and wheat crops were grown annually using power tiller for land preparation and other management techniques including addition of fertilizers, farm yard manures, weeding, irrigation and plant protection measures. The climate of the area is humid subtropical with mean annual air temperature of 26.6 ^{0}C (mean annual maximum 31.6 ^{0}C, and mean annual minimum 21.7 ^{0}C) and mean annual rainfall of 1619 mm. The experiment was laid out with four replications showing various treatments. The 100% NPK dose was calculated on the basis of soil test value before start of the experiment. This dose (kg ha) was 120:60:60 (N:P:K) for rice and 100:60:40 (N:P:K) for wheat.

The RCPs focus on the 'concentrations' of green house gases that lead directly to a changed climate, and include a 'pathway'– the trajectory of green house gas concentrations over time to reach a particular radiative forcing (a measure of the energy absorbed and retained in the lower atmosphere in Watts per metre squared) in 2100. The carbon dioxide concentrations and the temperature increases under different RCPs and corresponding special report on emission scenarios (SRES) are presented in table 2.3.2.

The climatic data, viz., rainfall, maximum temperature (T_{max}) and minimum temperature (T_{min}) of four RCPs was used to simulate the soil organic carbon (0-23 cm soil depth) for paddy-wheat cropping systems under three nutrient management treatments- (i) Control, (ii)100% NPK (120:60:60 for paddy and 100:60:40 for wheat) and (iii) 100% NPK and 7.5 ton farm yard manure (FYM). The simulation was carried for three time periods, viz., 2020, 2050 and 2080. The simulation results are illustrated in figure 2.3.17.

From figure 2.3.17, it is observed that in 2020, there was significant increase soil organic carbon under

Table 2.3.2. Carbon dioxide concentrations and temperature increased under four RCPs

Name	Radiative forcing	CO_2 equiv (ppm.)	Temp increased (°C)	Pathway	SRES equiv
RCP8.5	8.5 Wm^2 in 2100	1370	4.9	Rising	SRES A1F1
RCP6.0	6 Wm^2 post 2100	850	3.0	Stabilization without overshoot	SRES B2
RCP4.5	4.5 Wm^2 post 2100	650	2.4	Stabilization without overshoot	SRES B1
RCP 2.6 (RCP3PD)	3 Wm^2 before 2100, declining to 2.6 Wm^2 by 2100	490	1.5	Peak and decline (PD)	None
Source: Moss et.al. 2010 and Rogelj et.al. 2012. SRES: Special Report on Emission Scenarios (IPCC, 2007)					

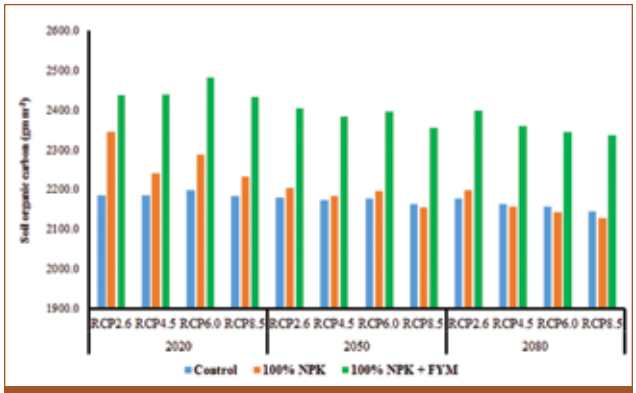


Fig. 2.3.17. Simulated soil organic carbon under different RCPs at BCKV LTFE site, Mohanpur

treatment of 100% NPK plus FYM for RCP 2.6, RCP 4.5 and RCP 6.0. However, under RCP 8.5, there is decrease in soil organic carbon. For other periods of 2050 and 2080, there is significant decrease in soil organic carbon in all the treatments under four RCPs, though this decrease was significantly less in treatment of 100% NPK plus FYM. Therefore, addition of inorganic fertilizer in combination with FYM could an important strategy in maintaining the soil organic carbon and thus, the soil quality under climate change scenarios.

Soil quality assessment and developing indices of major soils and production regions of India

In the project sampling scheme consisting of collection of samples at 20 km grid interval for AESR 6.1 and 18.4 has been prepared (Figs. 2.3.18 and 2.3.19). 192 soil samples are analysed and results are given in fig. 2.3.20.

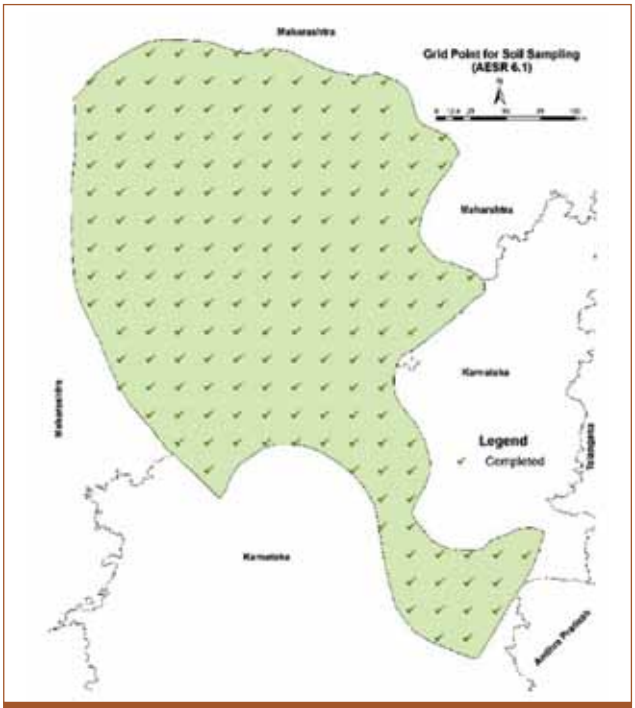


Fig. 2.3.18. AESR 6.1 South-western Maharashtra and North Karnataka, Plateau, hot, dry semi-arid eco-subregion.

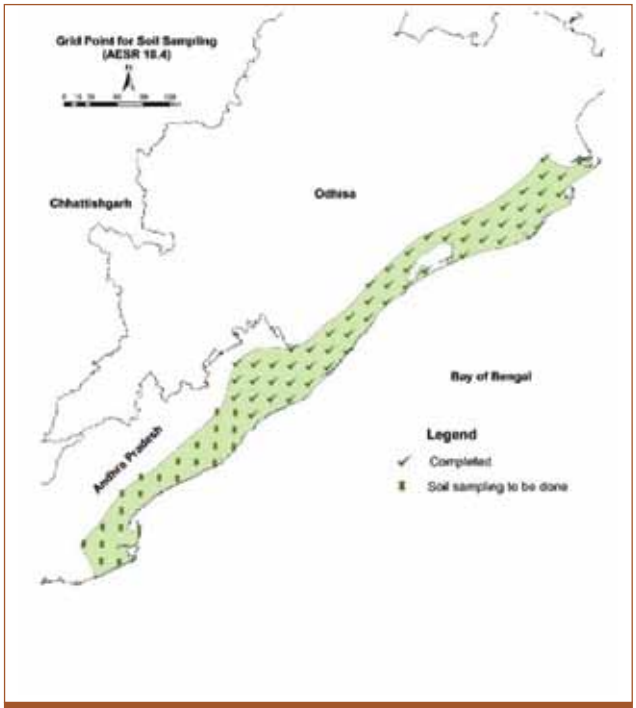


Fig. 2.3.19. AESR 18.4 Utkal Plain and East Godavari delta, hot dry subhumid eco-subregion

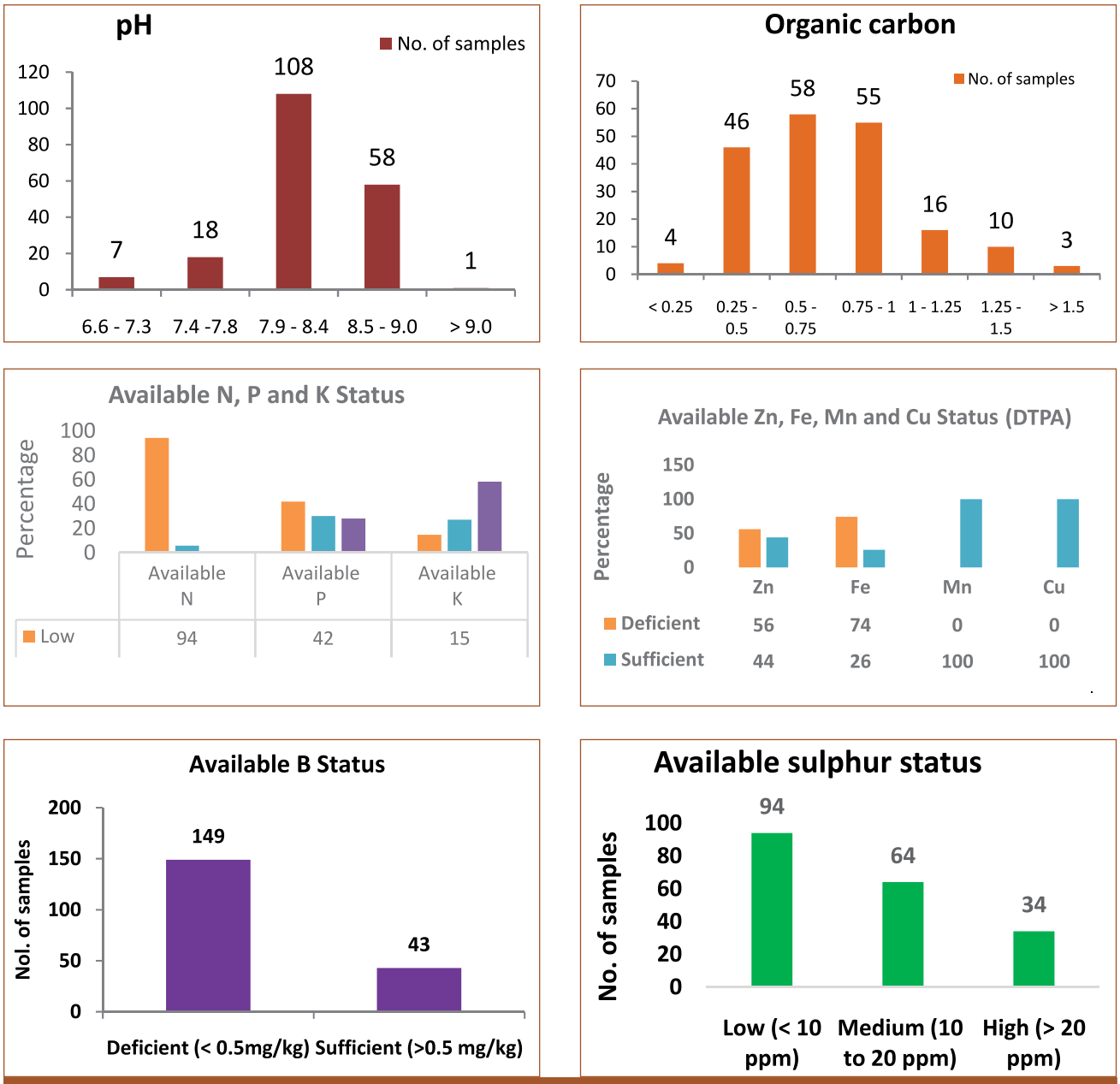


Fig. 2.3.20. General soil properties and nutrient status of soils of AESR 6.1.

2.4 INTERPRETATION OF SOIL SURVEY DATA

Fallow and *Jhum* land mapping

Fallow Land Mapping in Goa

The flow chart (Fig.2.4.1) explains the overall methodology for fallow land mapping in the state of Goa. In the first step, IRS-R2-LISS-IV P6 data of 5.8 meter resolution of 2014-15 and high resolution google earth imagery of 0.5 meter resolution available in public domain are interpreted visually to derive the land use/land cover of the Goa state on 1:10000 scales

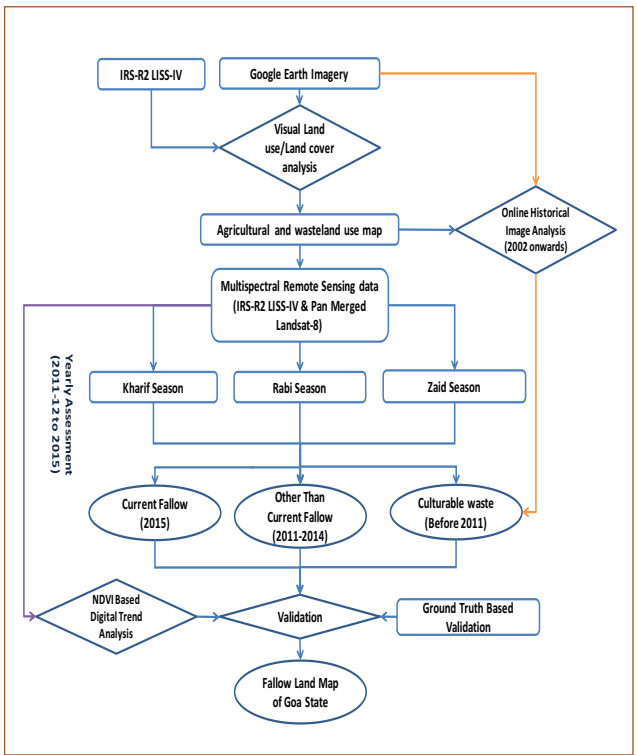


Fig. 2.4.1 Methodology flowchart of Fallow land mapping

Results revealed that fallow lands cover 13193 hectare area in Goa, constituting 3.6% area of the state. The current fallow lands (CFL) covers 4639 ha (35% of the total fallows in the state and 1.25% of total area of the state); culturable waste lands (CWL) are 4621 ha (35% of the total fallows in Goa and 1.24% of the total area of the state) and fallow lands other than current fallow (FLOCFL) cover 3933 ha (30% of the total fallows in Goa and 1.1% of the total area of the state) (Table 2.4.1, Fig. 2.4.2).

Fallow lands in north Goa cover an area of 9683 ha (73.4% area of total fallows of the state and is comparable to10.3% of the total net cropped area of north Goa) and 3510 ha area in south Goa (24.6% area of the total fallows of the state, corresponding to 5.5% of the total cropped area of south Goa) (Fig 2.4.3 and 2.4.4). Taluk wise distribution indicated that fallows are the highest, on 3669 ha area in Tiswadi and the lowest in Satari on 77 ha area. CFL is the highest, covering 1459 ha area (31.4% of CFL of the state) in Bardez and the lowest in 9 ha area (0.2% of CFL of the state) each in Marmgao and Satari. CWL is the highest in Tiswadi covering1453 ha area (31.4%

Fig. 2.4.2. Spatial distribution of fallow lands in Goa state

Fig. 2.4.3. Spatial distribution of fallow lands in North Goa district

of CWL of the state) and the lowest in Sanguem on 37 ha area (0.8% of the CWL of the state). FLOCFL occupies the highest area of 977 ha (24.8% of FLOCFL) in Salcet and the lowest on 7 ha area (0.7% of FLOCFL in the state) in Sattari.

Fallow land in Goa is equal to its 10.1% area used for food crops, 8.4% of total area sown for other field crops, 31.4% of the gross area under rice, 122% of the area under other cereals, pulses and other oilseed crops, 22.1% of the total area under different cash crops of the state including cashewnut, aracanut, pepper, tree species, kokum, sweet potato and sugarcane, 115.2% area of the garden crops, 183.5% of the area of the vegetable crops,and 49.5% area of the non-food crops. Extent and distribution of fallow land is also presented for each Panchayat of the state with the cadastral boundary (Fig. 2.4.5).

Fig. 2.4.4. Spatial distribution of fallow lands in South Goa district

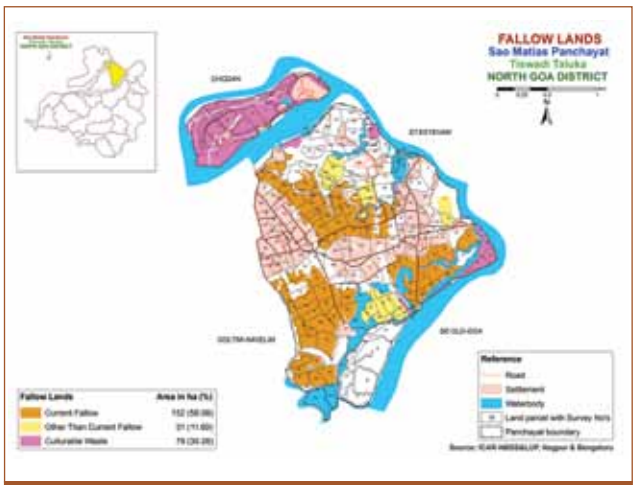


Fig. 2.4.5. Spatial distribution of fallow lands in Sao Matias panchayat, Tiswadi taluka

Table 2.4.1. Taluka wise distribution of fallow lands in Goa (Area in ha)

Taluka	CFL	FLOCFL	CWL	Total
Tiswadi	1352 (29.2)	864 (22.0)	1453 (31.4)	3669 (27.8)
Bardez	1459 (31.4)	860 (21.9)	765 (16.6)	3084 (23.4)
Bicholim	279 (6.0)	330 (8.4)	287 (6.2)	896 (6.8)
Pernem	651 (14.0)	258 (6.6)	591 (12.8)	1500 (11.4)
Satari	9 (0.2)	7 (0.2)	61 (1.4)	77 (0.6)
Ponda	74 (1.6)	195 (4.9)	188 (4.1)	457 (3.5)
Canacona	97 (2.1)	235 (6.0)	71 (1.5)	403 (3.0)
Dharbandora	28 (0.6)	19 (0.5)	58 (1.2)	105 (0.8)
Marmgao	9 (0.2)	135 (3.4)	157 (3.4)	301 (2.2)
Salcet	492 (10.6)	977 (24.8)	872 (18.9)	2341 (17.7)
Sanguem	124 (2.7)	29 (0.7)	37 (0.8)	190 (1.5)
Quepem	**65 (1.4)**	**24 (0.6)**	**81 (1.7)**	**170 (1.3)**
Total	4639	3933	4621	13193

Note: Figures in parenthesis are percent to total fallow land

Jhum Land Mapping in North Eastern Region

During the year, area under *Jhum* land (shifting cultivation) is mapped in Nagaland state and in the Kolasib district of Mizoram using high resolution remote sensing data (0.5 meter resolution). Out of the total 203274 ha area mapped as *Jhum* land, 74,656 ha is current fallow and 1, 28,618 ha is 3-5 years old *Jhum* land (Table 2.4.2 and Fig. 2.4.6). In the district Kolasib 0.74 % of the total area is under *Jhum* cultivation (Fig.2.4.7). In the year 2015, *Jhum* land mapping was done for Mokokchung district in Nagaland. The statistics indicates that *Jhum* area for Mokokchung increased from 10183 in 2015 to 10841 in 2017.

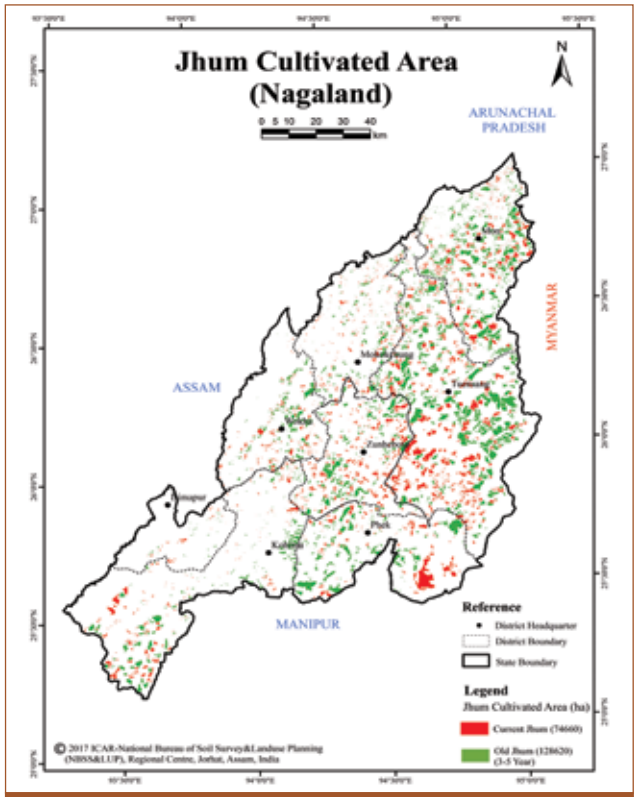


Fig. 2.4.6. Spatial distribution of Jhum land in Nagaland state

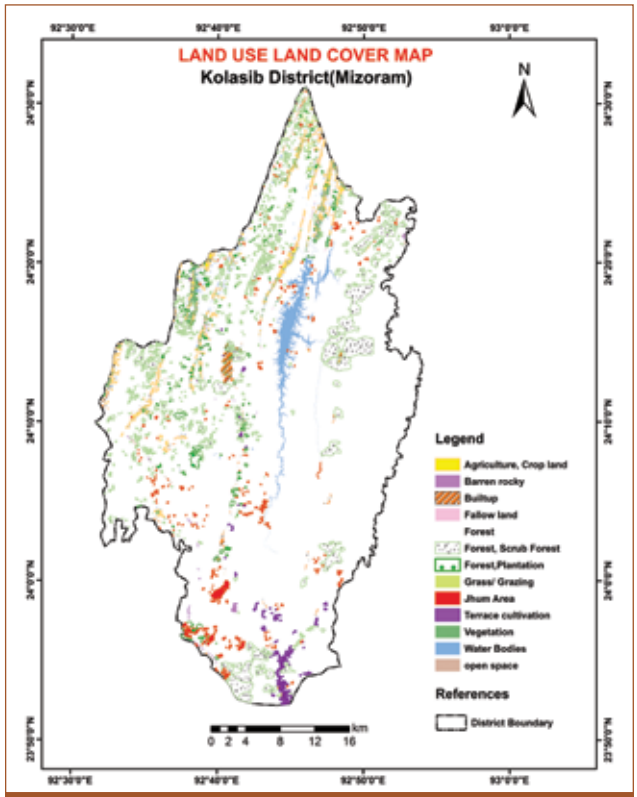


Fig. 2.4.7. Spatial distribution of Jhum land in Kolasib district of Mizoram

Table 2.4.2. Districtwise distribution of fallow land in Nagaland

District	Current Jhum (ha)	Old (3-5 yr) Jhum (ha)	Total Jhum land (ha) (% TGA of district)
Dimapur	564	350	914 (0.99)*
Mokokchung 3300		7541	10841 (6.71)
Wokha	3477	7175	10652 (6.54)
Kohima	7352	12561	19913 (6.39)
Zunheboto	7684	10206	17890 (14.3)
Phek	10294	15930	26224 (13.0)
Mon	10266	21145	31411 (17.6)
Tuensang	31719	53710	85429 (20.2)
Total Jhum area (ha)	74,656	1,28,618	2,03,274

Land degradation mapping

Methodology of land degradation mapping at 10K has been standardized using Revised Universal Soil Loss Equation (RUSLE) and tested at ten sites representing different agro-ecosystems of the country. Multi-seasonal high resolution temporal satellite data and legacy data of soils have been used. Slope, hill shade, flow accumulation, flow direction and drainage pattern have been developed using high resolution remote sensing satellite data. R-factor is computed using thirty years rainfall data; K- factor obtained

through the soil survey data; LS- factor is computed using SRTM DEM (30 meter) data. C & P factors are derived using the land use systems information (Landsat-8 (OLI) 2015-16), slope and conservation practices. In order to assign the C and P values, the monograph has been used in the study. During the year soil loss equations have been generated for Bukkarayasamudram (Anantapur), Ganjam (Ganjam), Jagner (Agra), Kangayam (Tirupur), NagrotaBagwan (Kangra) and Umsing (Ri-bhoi) blocks. R-Factor, K-factor, LS-factor, C-factor, and soil loss maps of Umsing block (Ri-bhoi) representing per-humid

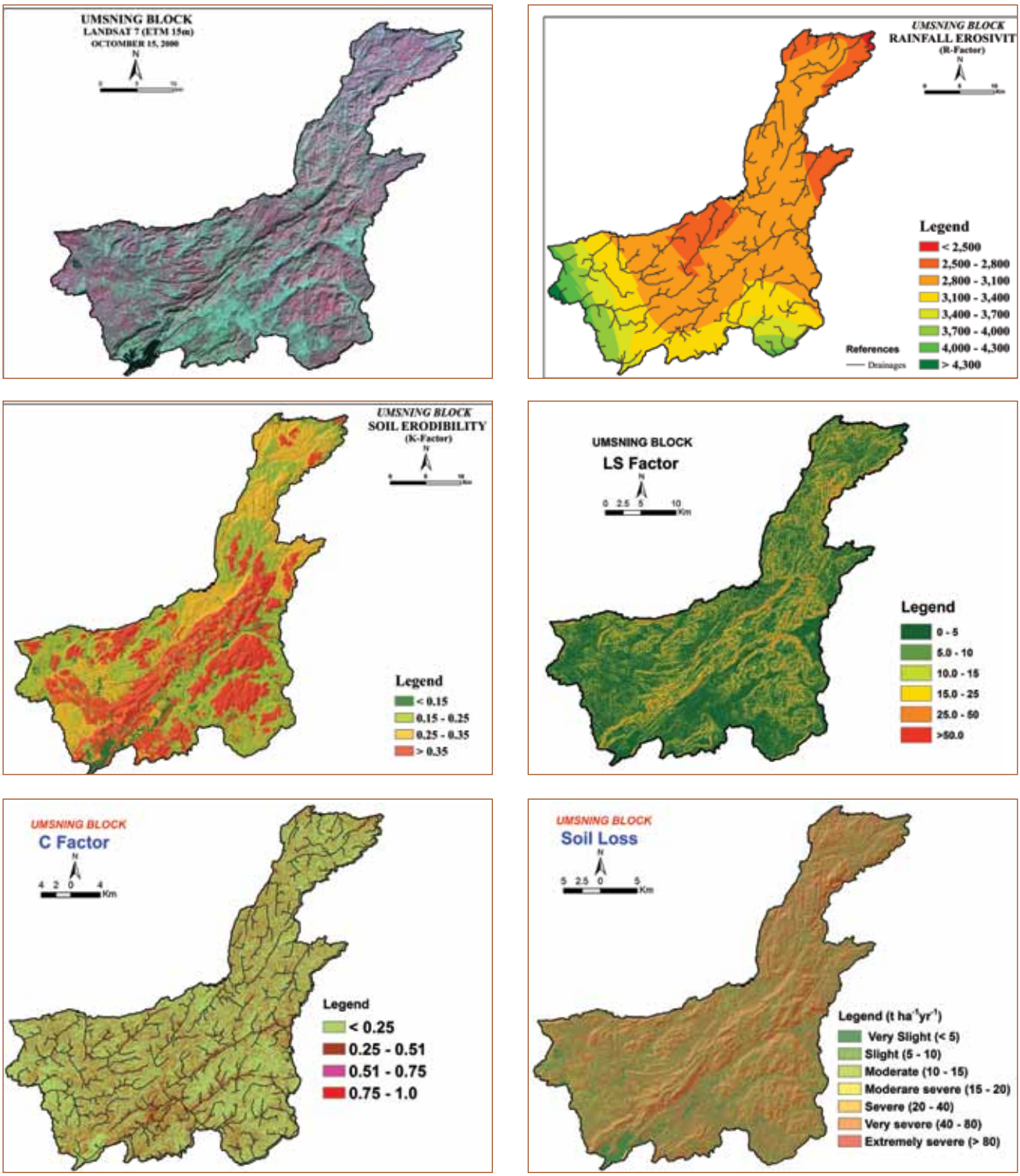


Fig. 2.4.8. Landsat ETM+ PAN fused 15m data, R-Factor, K-factor, LS-factor, C-factor, and soil loss maps of Umsining block (Ri-bhoi) in per-humid ecosystem of Meghalaya state

ecosystem of Meghalaya state are shown as an example (Fig. 2.4.8)

Desertification Status Mapping (2nd Cycle)

Desertification Mapping is carried out at 1:50000 scale using three seasons LISS-III data of 2011-13. The results showed that 40.5, 47.6, 34.1 and 27.7% of total geographical area of the districts namely Bellary, Anantapur, Mahabubnagar and Chamarajanagar are affected by land degradation / desertification processes. Vegetal degradation is the major desertification process in Bellary, Anantapur and Chamarajanagar, whereas water erosion is dominant in Mahabubnagar district. The spatial distribution of affected area is shown in Fig. 2.4.9.

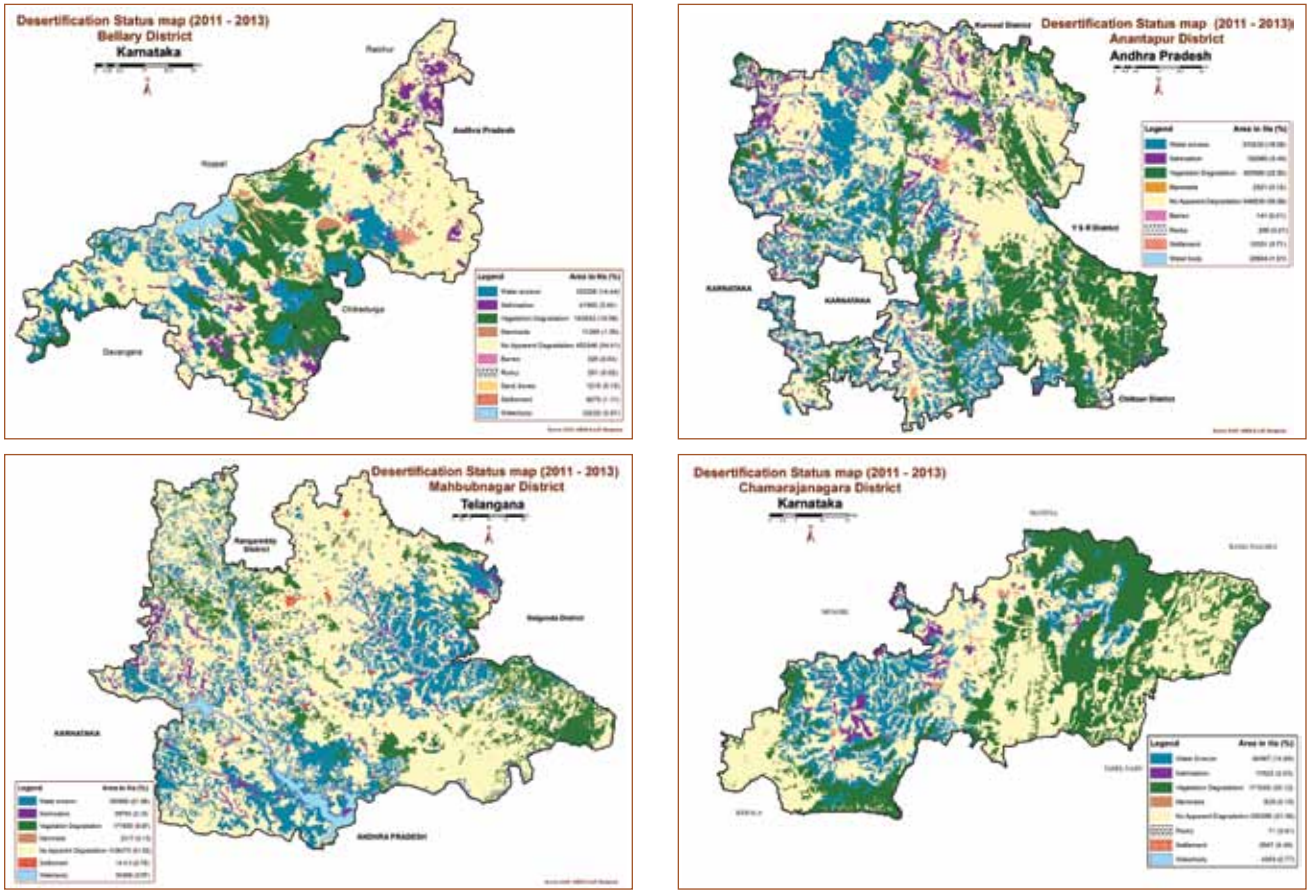


Fig. 2.4.9. Desertification status in Bellary, Anantapur, Mahabubnagar and Chamarajanagar districts, Karnataka

Desertification vulnerability index (DVI)

Desertification vulnerability index (DVI), which is cumulative index of climate, soil, land utilization and socioeconomic is developed. The results indicated that Anantapur district needs immediate action to combat the desertification which affected 18.7 % area of the district severely and 34.4% area of the district is affected by moderate intensity of desertification (Fig. 2.4.10).

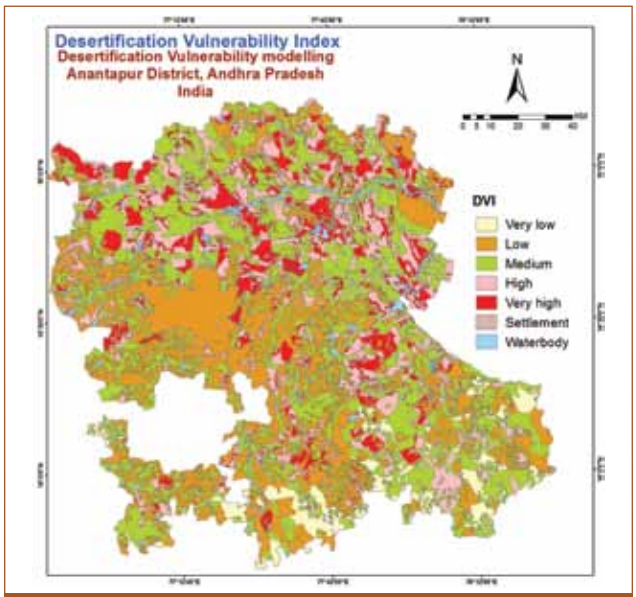


Fig. 2.4.10. Desertification vulnerability index of Anantapur district

Degradation status mapping, Uttar Pradesh

Degraded lands are identified using time series Normalized Difference Vegetation Index (NDVI) data as a proxy indicator. This is a quantitative method based on the hypothesis that the degraded lands constantly have lower biomass productivity reflected in terms of continuous lower NDVI. Sixteen days composite MODIS NDVI data (250 m) for 16 years (2000-2015) are utilized and the areas with constantly lower NDVI are identified. These areas also include permanent features like water bodies and settlements, which are masked out to get distribution of degraded lands. Spatial-contextual information from high resolution Landsat data is combined with land degradation patterns identified with time series NDVI to get large scale maps of degraded lands. The main degradation types in the IGP are salt affected soils which have been estimated for twenty districts (Fig.2.4.11) and the district wise distribution is presented in table 2.4.3.

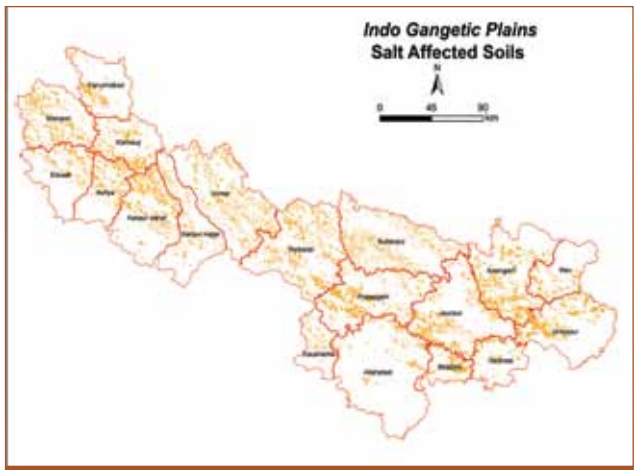


Fig. 2.4.11 Spatial distribution of salt affected soils of Uttar Pradesh

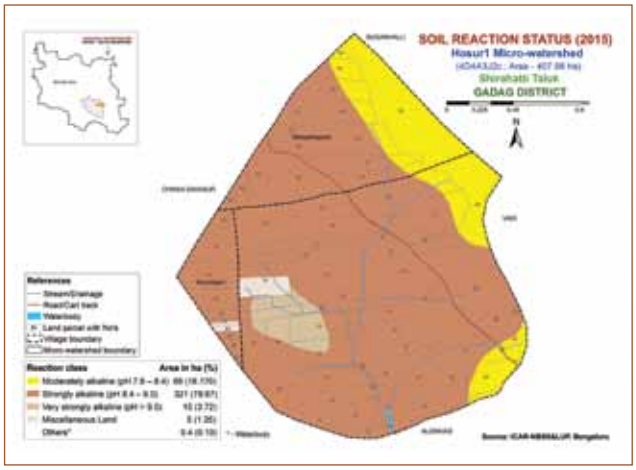
Table 2.4.3. Districtwise distribution of salt affected area, Uttar pradesh

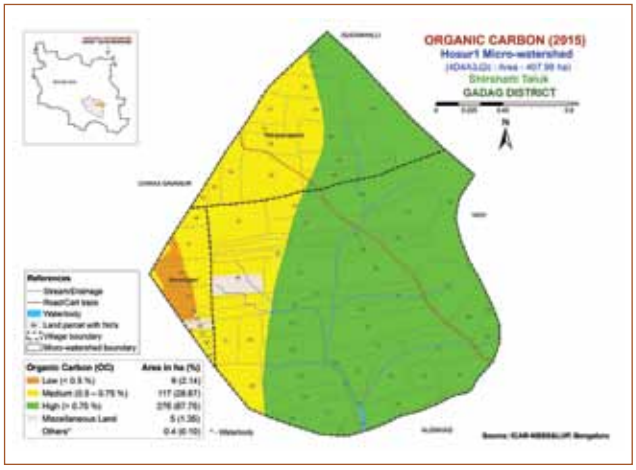
District	Area (ha)	% Salt affected area of state
Allahabad	22747.3	3.3
Auraiya	28271	4.1
Azamgarh	65875.7	9.7
Bhadohi	15421.8	2.3
Etawah	22487.9	3.3
Farrukhabad	18374.1	2.7
Gazipur	44674.2	6.5
Jaunpur	55248	8.1
Kannauj	30274.6	4.4
Kanpur Dehat	49253	7.2
Kanpur Nagar	18633.5	2.7
Kaushambi	10327.1	1.5
Mainpuri	42657.7	6.3
Mau	16562.4	2.4
Pratapgarh	54087.3	7.9
RaiBareli	66415.1	9.7
Sultanpur	48232.6	7.1
Unnao	58474.1	8.6
Varanasi	14103.5	2.1
Total	682120.9	100

Soil Fertility mapping

Karnataka

The Village/Survey number wise fertility data of 66 Micro Watersheds and 33 villages have been completed during the year. Grid wise surface soil samples are collected at 250 m interval and analyzed for pH, electrical conductivity (EC), macro and micro nutrients. Soil fertility maps are generated using interpolation technique in GIS.The fertility maps of Hosur-1 Micro Watershed for all the nutrients are presented in Fig. 2.4.12 as an example.





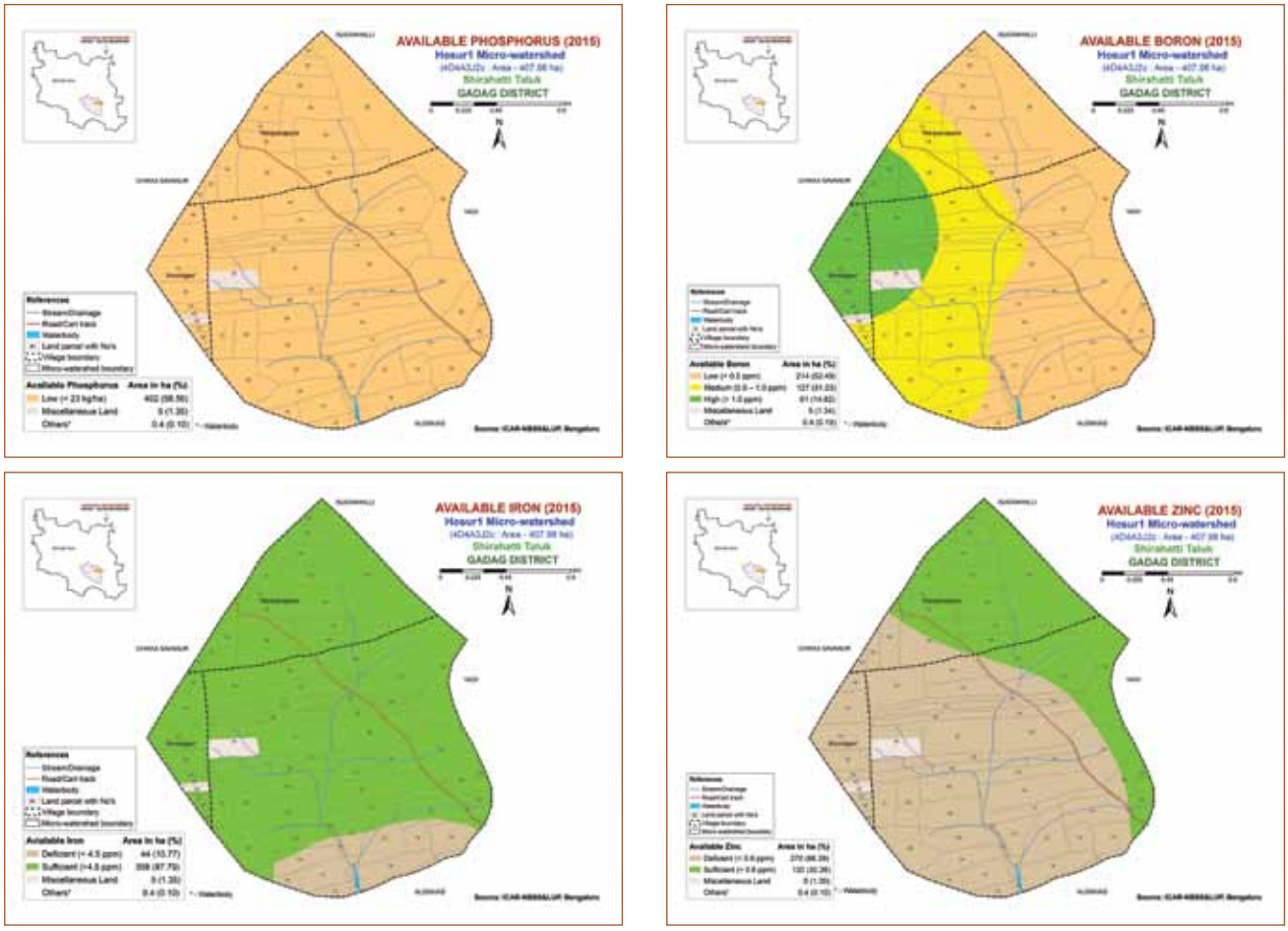


Fig. 2.4.12. Fertility maps of Hosur-1 microwatershed

Elamdesom block, Idukki district, Kerala

Elamdesom block in Todupuzha taluk, Idukki district, Kerala covering total geographical area of 40,307 ha (403.07 km^2) is investigated for understanding the soil fertility problems.

The status of macro and micro nutrients and pH is given in table 2.4.4. Acidity and inadequate level of phosphorus, calcium, magnesium, sulphur, zinc and boron are the major soil fertility problems

Table 2.4.4 Status of soil reaction, macro and micro nutrients

Paramers	Extremely acid	Very strongly acid	Strongly acid	Moderately acid	Slightly acid
pH	18.06	57.42	18.06	3.87	2.58
Organic Carbon	Medium	High	Very high		
	6.45	56.77	36.77		

Nutrients	Very low	Low	Medium	High	Veryhigh	Extremely high
Available P	10.97	27.74	23.23	9.68	18.06	10.32
Avialable K	30.32	30.32	33.55	4.52	1.29	-

Nutrients	Very low	Low	Adequate	High
Calcium	67.10	12.26	20.65	-
Magnesium	86.45	12.26	1.29	-
Sulphur	22.58	49.03	27.74	0.65

Nutrients	Deficient	Adequate	High
Copper	5.81	93.55	0.65
Zinc	72.26	27.74	-
Boron	92.90	7.10	-

Figures represents percentage of soil samples

Exchangeable Aluminium rich soils in Rubber and Coffee Growing areas of Kerala, Tamilnadu and Karnataka

Soils of coffee and rubber growing areas of Kerala, Tamil Nadu and Karnataka are characterized in 121 soil fertility monitoring sites (Fig. 2.4.13). The status of exchangeable Al^{+3}, aluminium saturation percentage from five representative sites are given in table 2.4.5.

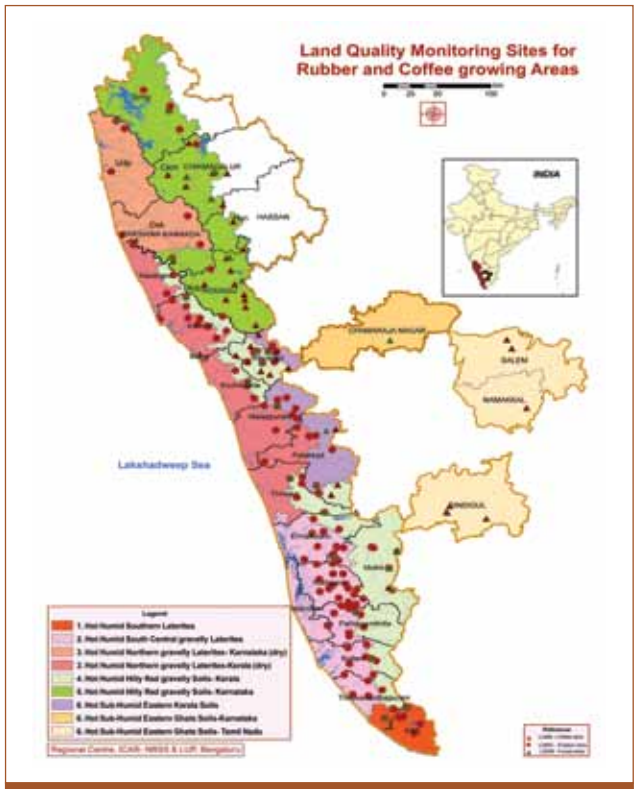


Fig. 2.4.13. Soil fertility status monitoring sites

Table 2.4.5. Status of exchangeable Al^{+3}, aluminium saturation percentage

Depth (cm)	pH (Water)	Exch. Al (cmol (p+) kg^{-1}	Aluminium saturation (%)
Kalluvathilkal Rubber Estate, Kollam district, Kerala			
0-15	5.30	0.00	0.00
15-34	4.92	1.08	36.30
34-66	4.76	1.59	53.58
66-89	4.78	1.86	63.30
89-128	4.85	1.89	62.48
128-155	4.84	2.08	66.15
ShanthanPara RF of Kumily Hills, Idikki district, Kerala			
0-26	4.94	0.83	13.90
26-56	4.72	2.55	86.47
56-73	4.58	3.03	78.47
73-92	5.04	2.35	72.77
92-123	5.13	1.50	69.09
123-140	5.14	1.95	74.71
IringoleKavu Sacred grove, Perumbavoor, Eranakulam			
0-15	4.59	0.80	28.14
15-33	4.63	1.43	58.81
33-61	4.55	1.10	59.24
61-93	4.70	0.55	38.36
93-128	4.87	0.38	29.68
128-151	4.90	0.40	33.25
Attikkan Coffee Estate, Kollegal, Chamaraj Nagar, Karnataka			
0-20	5.5	0.10	1.15
20-36	5.5	0.65	12.14
36-62	5.0	2.15	58.16
62-82	5.0	2.48	57.97
82-120	5.0	1.48	50.23
Padinjarethara Coffee Estate, Kalpetta, Wayand, Kerala			
0-23	5.54	0.44	7.53
23-44	4.83	2.11	65.36
44-67	4.90	1.67	62.55
67-96	4.88	1.13	57.40
96-139	4.83	0.29	30.42
139-157	4.85	0.54	39.37

Nutrient status mapping and development of Soil Health Cards for the farmers of Piprakothi block, Purba Champaran District, Bihar

Soil Health Card is prepared for the farmers of the Piprakothi block. Soil samples are collected at 325x325 meter grid interval. Sampling scheme for a part of Piprakothi is given in fig. 2.4.14. The results revealed that soils of the block are neutral to strongly alkaline (pH – 7.0 to 9.4), salinity in patches and dominantly rich in phosphorus and potassium, deficient in Zn and B (Table 2.4.6). Based on the chemical analysis of the grid soil samples and critical limit of the nutrient, the soil health cards are prepared for all the farmers of the block as per standard format (Fig. 2.4.15) and also suggests the quality and quantity of the fertilizers including farm yard manures and organic manures to be applied to improve the soil health for increasing productivity and sustainability.

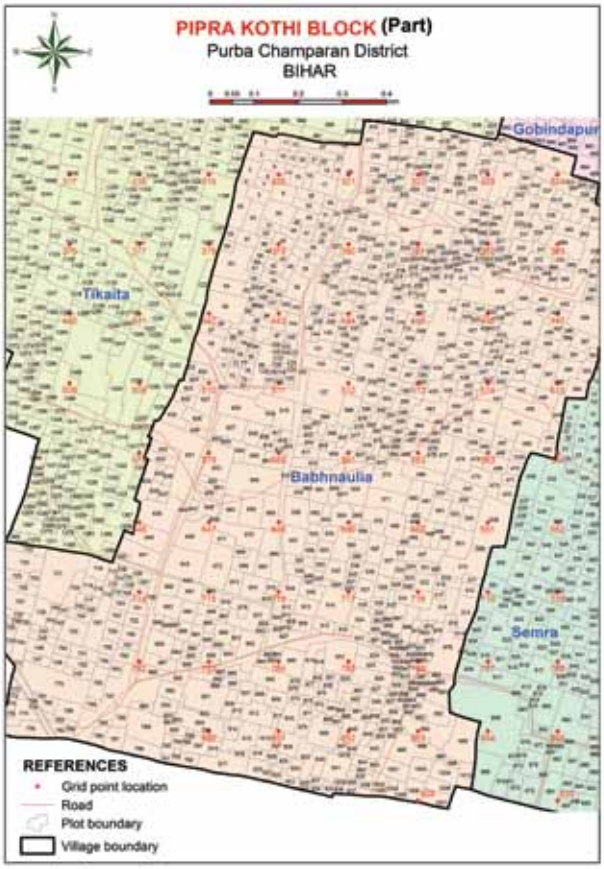


Fig. 2.4.14. Soil sampling schema of Piprakothi block, Purba Champaran District, Bihar

Fig. 2.4.15. Soil Health Card of Piprakothi block, Purba Champaran District, Bihar

Table 2.4.6. Low/ deficient nutrients in Piprakothi block

Low / Deficient	Area (ha)	% TGA
Organic carbon	13.4	20.26
N	27.8	42.02
P	40.1	60.58
K	5.6	8.51
S	5381.5	81.4
Fe	7.3	11.08
Mn	25.5	38.52
Cu	1.3	2.34
Zn	33.4	50.49
B	3.1	4.71

Development of Soil Health Card (SHC) using GIS techniques for Nagpur rural block, Nagpur district and Kelapur Taluka, Yavatmal district

Database has been generated for developing soil health cards of Nagpur Rural Block, Nagpur district and Kelapur block,Yavatmal district of Maharashtra. In Kelapur block, more than 5000 surface soil samples (0-15 cm depth) are collected at a grid interval of 325m x 325m using Global Positioning System (Fig. 2.4.16). Information related to name of farmers, address, present land use, crop history, traditional fertilizer use, irrigated or rainfed status and coordinates are collected. Samples are analyzed for soil reaction (pH), organic carbon and salinity (EC), available major nutrients (N, P, K), micronutrients (Fe, Mn, Zn, Cu) and sulphur. Sample proforma of SHC issued to famers of Kelapur is shown in figure 2.4.17. On the occasion of World Soil Day (5th December, 2016), the soil health cards are distributed to some of the progressive farmers of Kelapur and Nagpur Rural Block. Soil fertility status of Kelapur block is given in fig. 2.4.18.

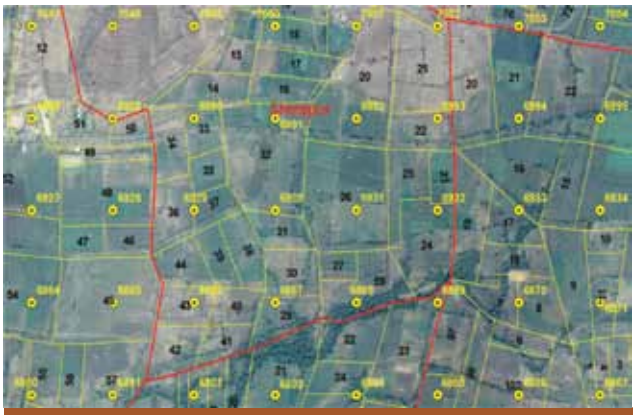
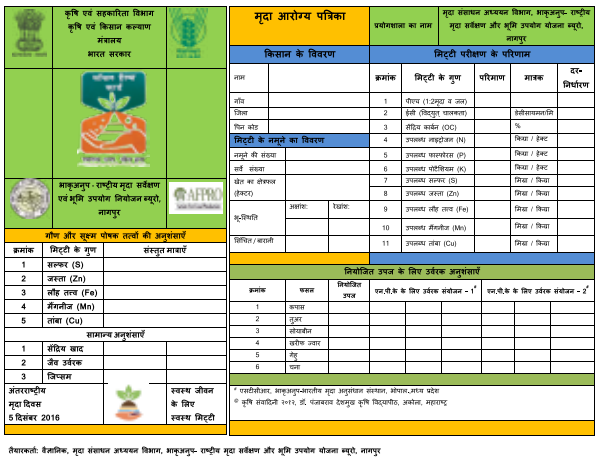


Fig. 2.4.16 Sampling schema of Kelapur and Nagpur Rural Blocks



कृषि एवं सहकारिता विभाग
कृषि एवं किसान कल्याण मंत्रालय
भारत सरकार

भाकृअनुप - राष्ट्रीय मृदा सर्वेक्षण एवं भूमि उपयोग नियोजन ब्यूरो, नागपुर

मृदा आरोग्य पत्रिका

प्रयोगशाला का नाम: मृदा संसाधन अध्ययन विभाग, भाकृअनुप- राष्ट्रीय मृदा सर्वेक्षण और भूमि उपयोग योजना ब्यूरो, नागपुर

किसान के विवरण

नाम	
गाँव	
जिला	
पिन कोड	
मिट्टी के नमूने का विवरण	
नमूने की संख्या	
कार्ड संख्या	
खेत का क्षेत्रफल (हेक्टर)	
भू-स्थिति	अक्षांश: रेखांश:
जिला / बारानी	

मिट्टी परीक्षण के परिणाम

क्रमांक	मिट्टी के गुण	परिमाण	मात्रक	दर-निर्धारण
1	पीएच (1:2मृदा व जल)			
2	ईसी (विद्युत चालकता)		डेसीसायमन/मि	
3	सेंद्रिय कार्बन (OC)		%	
4	उपलब्ध नाइट्रोजन (N)		किग्रा / हेक्ट	
5	उपलब्ध फास्फोरस (P)		किग्रा / हेक्ट	
6	उपलब्ध पोटैशियम (K)		किग्रा / हेक्ट	
7	उपलब्ध सल्फर (S)		मिग्रा / किग्रा	
8	उपलब्ध जस्ता (Zn)		मिग्रा / किग्रा	
9	उपलब्ध लौह तत्व (Fe)		मिग्रा / किग्रा	
10	उपलब्ध मैंगनीज (Mn)		मिग्रा / किग्रा	
11	उपलब्ध तांबा (Cu)		मिग्रा / किग्रा	

गौण और सूक्ष्म पोषक तत्वों की अनुशंसाएँ

क्रमांक	मिट्टी के गुण	संस्तुत मात्राएँ
1	सल्फर (S)	
2	जस्ता (Zn)	
3	लौह तत्व (Fe)	
4	मैंगनीज (Mn)	
5	तांबा (Cu)	

सामान्य अनुशंसाएँ

1	सेंद्रिय खाद	
2	जैव उर्वरक	
3	जिप्सम	

निर्योजित उपज के लिए उर्वरक अनुशंसाएँ

क्रमांक	फसल	निर्योजित उपज	एन,पी,के के लिए उर्वरक संयोजन - 1*			एन,पी,के के लिए उर्वरक संयोजन - 2#		
1	कपास							
2	तुअर							
3	सोयाबीन							
4	खरीफ ज्वार							
5	गेहूं							
6	चना							

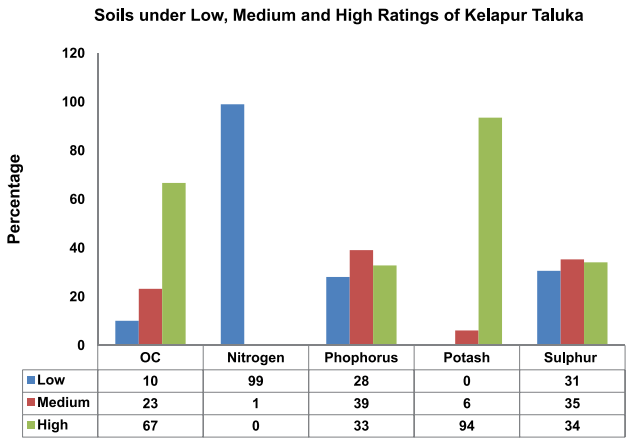
* एसडीसीएल, भाकृअनुप-भारतीय मृदा अनुसंधान संस्थान, भोपाल-अरुण प्रदेश
\# कृषि संवादिनी २०१२, डॉ. पंजाबराव देशमुख कृषि विद्यापीठ, अकोला, महाराष्ट्र

अंतरराष्ट्रीय मृदा दिवस 5 दिसंबर 2016

स्वस्थ जीवन के लिए स्वस्थ मिट्टी

तैयारकर्ता: वैज्ञानिक, मृदा संसाधन अध्ययन विभाग, भाकृअनुप- राष्ट्रीय मृदा सर्वेक्षण और भूमि उपयोग योजना ब्यूरो, नागपुर

Fig. 2.4.17. Sample proforma of SHC developed for Kelapur Taluka



	OC	Nitrogen	Phophorus	Potash	Sulphur
Low	10	99	28	0	31
Medium	23	1	39	6	35
High	67	0	33	94	34

Fig. 2.4.18. Fertility ratings of soils of Kelapur Taluka

Hyper-spectral remote sensing application in soil studies

Hyper-spectral characteristics of soils of rubber growing area of Kerala, Karnataka and Tamil Nadu (Fig. 2.4.19) and soils of Chamrajnagar district of Karnataka are studied (Fig. 2.4.20). A very strong absorption feature around 1400, 1900 and 2200 nm wavelength shows dominance of kaolinitic clay minerals in soils. Spectral data has been modelled for prediction of soil organic carbon (SOC) (Fig. 24.21).

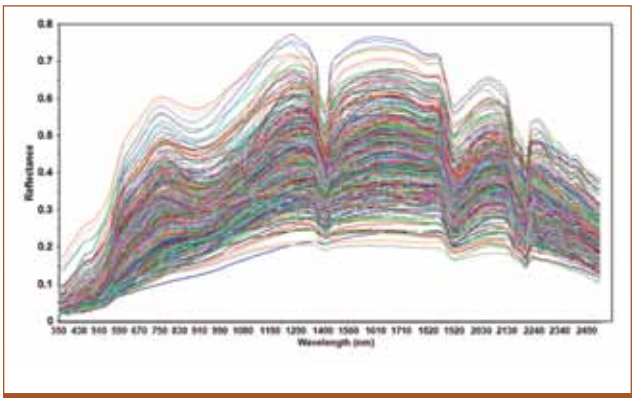


Fig. 2.4.19. Reflectance spectra of soils of rubber growing area

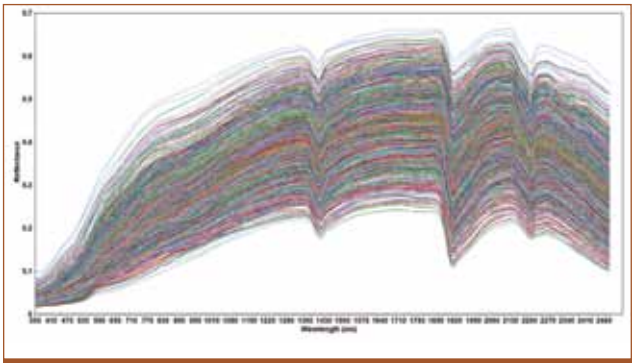
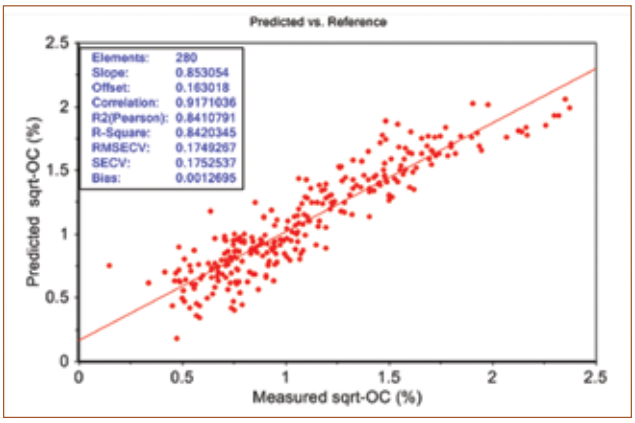


Fig. 2.4.20. Reflectance spectra of soils of Chamrajnagar district, Karnataka



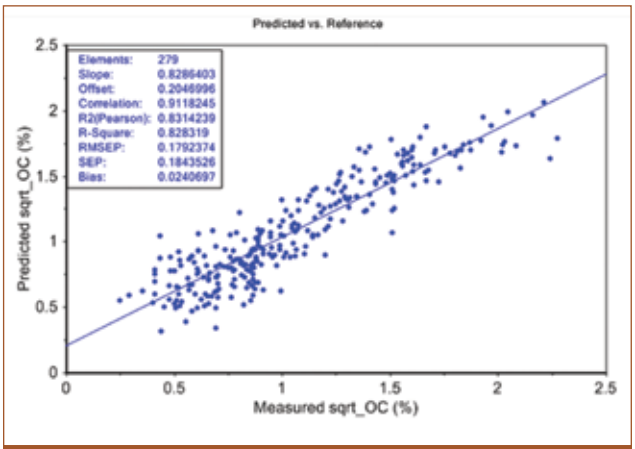


Fig. 2.4.21. Scatter plot of measured and predicted values of SOC in the calibration and validation datasets

Soil correlation

Soils of Goa state were correlated for all 33 soil series identified. The soil series with salient characteristics, extent, distribution and taxonomic classification is described in table 2.4.7.

Table 2.4.7. Identified soil series in Goa state

Soil series (1995)	Soil series (2017)	Area 50k (ha)	Area 10k (ha)	Dignostic soil characteristics (2017)	Taxonomy
Arukot	Arukot (Ark)	17629	15217	Deep, well drained, dark reddish brown to dark brown, clay soils with argillic horizon and 5 to 10 per cent iron and manganese concretions occuring on very gently to moderately sloping inter-hill valleys of quartzite/schistose with clay loam to clay surface and moderate erosion.	Very fine, mixed, Kandic Paleustalfs
Bandoli	Bandoli (Bnd)	29242	21871	Deep, well drained, yellowish brown to dak reddish brown, clay soils with argillic horizon and 5 to 10 per cent iron and manganese concretions occuring on very gently to moderately sloping inter-hill valleys and narrow valleys of quartzite/schistose with sandy clay loam to sandy clay surface, moderate erosion and none to slight gravelly.	Clayey , mixed, Typic Haplustults
Batim	Batim (Bat)	7288	15605	Very deep, moderately well drained, strong brown to yellowish brown, clay soils with argillic horizon and 5 to 10 per cent iron and manganese concretions occuring on level to nearly level to very gently sloping colluvial low lands of dissected hilly laterite hills with sandy loam to clay loam surface, slight to moderate erosion and none to slight gravelly .	Fine, mixed, Kanhaplic Haplustalfs
Chapora	Chapora (Chp)	9950	9320	Deep, well drained, yellowish brown to brown, sandy loam to sandy clay loam soils with cambic horizon occuring on very gently to moderately sloping undulating lands of dissected hills laterite with loamy sand to sandy loam surface and moderate erosion.	Fine-loamy, mixed, Typic Haplustepts
Dabolim	Dabolim (Dbl)	5980	9136	Very shallow, well drained, brown to dark brown, sandy clay loam soils occuring on very gently to gently sloping flat topped hills of dissected laterite hills with sandy loam to sandy clay loam surface and moderate eosion.	Loamy, mixed, Lithic Haplustults
Dande	Dande (Dan)	859	1392	Moderately deep, well drained, dark reddish brown, clay soils with argillic horizon occuring on steeply sloping hill side slopes of granite and granite gneiss with clay loam to sandy clay loam surface and severe erosion.	Clayey , mixed, Kanhaplic Haplustults
Darbandora	Darbandora (Drb)	5247	11947	Moderately deep, somewhat excessively drained, brown to dark reddish brown, clay soils with argillic horizon occuring on moderately steeply to very steeply sloping high hills of quartzite/schistose with clay loam surface, severe erosion and very strongly gravelly.	Very fine, mixed, Humic Dystrustepts
Devabag	Devabag	700	696	Shallow, somewhat excessively drained, dark red, clay soils with cambic horizon occuring on moderately to steeply sloping restricted sumitts of granite and granite-gneiss with clay loam to sandy clay loam surface, moderate to severe erosion.	Clayey-skeletal, mixed, Typic Haplustepts

Soil series (1995)	Soil series (2017)	Area 50k (ha)	Area 10k (ha)	Dignostic soil characteristics (2017)	Taxonomy
Gavane	Gavane (Dev)	18249	6524	Moderately deep, somewhat excessively drained, dark brown to dark reddish brown, clay soils with cambic horizon occuring on moderately steeply to very steeply sloping high hills of quartzite/schistose with clay loam to sandy clay surface, mderate to severe erosion and gravelly.	Clayey-skeletal, mixed, Typic Haplustepts
Gudi	Gudi (Gud)	1060	1198	Moderately deep, well drained, light yellowish brown to dark yellowish brown, sandy clay loam soils with cambic horizon occuring on steeply sloping hill side slopes of granite and granite-gneiss with sandy clay loam surface and severe erosion.	Fine-loamy, mixed, Ustoxic Dystrustepts
Harmal	Harmal (Hrm)	1334	1158	Very deep, somewhat excessively drained, bownish yellow to light yellowish brown, sandy soils occuring on level to nearly level beach and beach ridges of fluvio-littoral plain with sandy surface and none to slight eosion.	Mixed, (calcareous) Typic Ustipsamments
Kalangut	Kalangut (Kal)	9325	6852	Deep, imperfactly drained, dark yellowish brown to brown, sandy loam to sandy clay loam soils with cambic horizon and distinct light brown mottles occuring on level to nearly level plain lands and mudflats of fluvio-littoral plain with loamy sand to sandy loam surface and slight to moderate erosion.	Fine-loamy, mixed, Typic Endoaquepts
Karmali	Karmali (Krm)	3540	1255	Shallow, well drained, dark brown, clay soils with cambic horizon occuring on level to nearly level and gently sloping flat topped hills of dissected laterite hills with clay loam surface, slight to moderate erosion and gravelly.	Clayey, mixed, Lithic Dystrustepts
Karven	Karven (Krv)	12287	4066	Deep, well drained, dark reddish brown to red, clay soils with cambic horizon occuring on moderately steeply sloping escarpments of dissected laterite hills with sandy clay loam to clay surface, moderate to severe erosion and gravelly to extremely gravelly.	Clayey-skeletal, kaolinitic, Oxic Haplustepts
Kolva	Kolva (Kol)	558	3056	Deep, poorly drained, dark gray to grayish brown, sandy loam to sandy clay loam soils with cambic horizon occuring on level to nearly level and very gently sloping swamps and marshes of fluvio-littoral plain with sandy loam to sandy clay loam surface and slight to moderate erosion.	Fine-loamy, mixed, Typic Endoaquepts
Madgaon	Madgaon (Mdg)	22275	2926	Deep, well drained, reddish brown, clay loam soils with cambic horizon occuring on moderately to moderately steeply sloping escarpments of dissected hilly laterite with loamy sand to sandy loam surface, mderate to severe erosion and gravelly very gravelly.	Loamy-skeletal, mixed, Fluventic Haplustults
Mandavi	Mandavi (Mnd)	616	692	Deep, poorly drained, brown to dark gray, loamy sand soils on nearly level to very gently sloping mudflats of fluvio-littoral plain with sandy clay loam to sandy loam surface and slight to moderate erosion and slight salinity in patches.	mixed, Typic Psammaquents
Metaveda	Metaveda (Mtv)	18499	27660	Shallow, somewhat excessively drained, dark reddish brown, clay soils with cambic horizon on moderately to steeply sloping and occasionally on level to nearly level to gently sloping low hills of quartzite/schistose with clay loam to clay surface, moderate to severe erosion (occasionally slight erosion) and strongly gravelly.	Clayey-skeletal, mixed, Lithic Dystrustepts

Soil series (1995)	Soil series (2017)	Area 50k (ha)	Area 10k (ha)	Dignostic soil characteristics (2017)	Taxonomy
Nagowa	Nagowa (Ngw)	8252	4923	Deep, well drained, dark reddish brown to yellowish red, sandy clay soils with cambic horizon occuring on gently to moderately sloping conical hills and undulating lands of dissected laterite hills with clay loam to sandy clay loam surface, moderate erosion and strongly gravelly.	Fine, mixed, Oxic Dystrustepts
Netravali	Netravali (Ntv)	46804	17785	Moderately shallow, well drained, dark reddish brown, clay soils with cambic horizon occuring on moderately to steeply sloping low hills, high hills and restricted summits of quartzite/schistose with clay loam to clay surface, moderate to severe erosion and strongly gravelly.	Clayey-skeletal, mixed, Oxic Dystrustepts
Padi	Padi (Pad)	63	3704	Moderately shallow, well drained, brown to yellowish brown, clay soils with cambic horizon occuring on gently to moderately sloping conical hills of dissected laterite hills with sandy loam to sandy clay surface, moderate erosion and strongly gravelly.	Loamy-skeletal, mixed, Oxic Dystrustepts
Pali	Pali (Pal)	4198	3852	Moderately deep, moderately well drained, brown to dark yellowish brown, sandy clay soils with cambic horizon and distinct brown mottles occuring on very gently sloping narrow valleys of quartzite/schistose with sandy clay loam surface and moderate erosion.	Fine-loamy, mixed Typic Dystrustepts
Panaji	Panaji (Pnj)	600	647	Moderately shallow, imperfectly drained, gray, sandy soils with prominent strong brown mottles occuring on nearly level to very gently sloping salt pans of fluvio-littoral plain with loamy sand to sandy loam surface, slight to moderate erosion, surface salt encrustations, slight salinity and occasionally gravelly .	mixed, Typic Psammaquents
Raya	Raya (Ray)	3079	3677	Very shallow, well drained, dark brown, clay loam soils occuring on very gently to gently sloping flat topped hills undulating lands of dissected laterite hills with sandy clay loam to sandy clay surface, moderate erosion and none to slight gravelly.	Clayey-skeletal, mixed, Lithic Ustorthents
Saligaon	Saligaon (Sli)	2998	1932	Deep, well drained, brown to strong brown, clay soils with argillic horizon and 5 to 10 per cent iron and manganese concretions occuring on very gently to gently sloping undulating lands of dissected hilly laterite with sandy clay loam to sandy clay surface and moderate erosion and none to slight gravelly.	Clayey-skeletal, mixed, Typic Kanhaplustults
Surla	Surla (Sur)	1207	4330	Moderately deep, well drained, brown to dark brown, clay soils with cambic horizon occuring on gently to steeply sloping high hills of basalt with clay loam to clay surface, severe erosion and none to gravelly.	Very fine, mixed, Typic Haplustepts
Torse	Torse (Tor)	52574	88881	Shallow, somewhat excessively drained, dark reddish brown, clay soils with cambic horizon occuring on moderately to very steeply sloping high hills and restricted summits of quartzite/schistose with clay loam to sandy clay loam surface, moderate to very severe erosion and and gravelly to strongly gravelly gravelly.	Clayey, mixed, Lithic Dystropepts

Soil series (1995)	Soil series (2017)	Area 50k (ha)	Area 10k (ha)	Dignostic soil characteristics (2017)	Taxonomy
Uguem	Uguem (Ugm)	4543	1361	Deep, imperfectly drained, dark brown to very dark grayish brown, clay soils with cambic horizon and distinct brown mottles occuring on nearly level to very gently sloping fluvio-littoral plain with clay loam to clay surface and slight to moderate erosion.	Very fine, mixed, Fluventic Haplustepts
Velge	Velge (Vlg)	14596	2762	Very shallow, somewhat excessively drained, brown, sandy clay loam soils on moderately to moderately steeply sloping and occasionally nearly level to gently sloping low hills of quartzite/schistose with loam to sandy clay surface, moderate to severe and occasionally slight erosion and gravelly to strongly gravelly.	Loamy-skeletal, mixed, Lithic Ustorthents
Verna	Verna (Vrn)	8191	15090	Shallow, well drained, dark red, clay soils with cambic horizon on moderately to steeply sloping escarpments of dissected laterite hills with sandy clay loam surface, moderate to severe erosion and gravelly to strongly gravelly.	Clayey-skeletal, mixed, Lithic Dystrustepts
Zaimolo	Zaimolo (Zmo)	12500	2676	Deep, well drained, dark reddish brown to dark brown, clay soils with argillic horizon and 5 to 10 per cent iron and manganese concretions on very gently to gently sloping undulating lands of dissected laterite hills with clay loam to sandy clay surface, moderate erosion and gravelly to strongly gravelly.	Clayey, mixed, Typic Paleustults
Zuvari	Zuvari (Zuv)	16848	15884	Deep, imperfectly drained, light brown gray, clay soils with cambic horizon and distinct yellwish brown mottles on level to nearly level to gently sloping fluvio-littoral hills with clay loam to clay surface, slight to moderate erosion and slight salinity in patches.	Very fine, mixed, Aquic Haplustepts
	Acid Sulphte Soil (ASS)	-	18	Deep, poorly drained, very dark grayish brown to yellowish brown, sandy clay loam to sandy clay soils on level to nearly level of fluvio-littorals plains (sulfidic material) with silty clay loam surface, slight erosion on the organic substrates.	Fine-loamy, mixed, Aquic Haplustepts

2.5 LAND EVALUATION AND LAND USE PLANNING

Revised Agro-ecological region map (AER)

The agro-ecological region map published in the year 1992 (Fig.2.5.1) revised using the recent dataset available upto 2015. The revised AER map also defines twenty agro-ecological regions in the country (Fig. 2.5.2). Among them, first three regions (AER 1 to 3) cover arid ecosystem. In the year 1992, agro-ecological units 4 to 8 were assigned to cover semiarid ecosystem, whereas agro-ecological units 4 to 9 represent semiarid ecosystem in the revised edition of AER. In the year 1992, agro-ecological units 9 to 13 represented sub-humid agro-ecosystem, whereas agro-ecological units 10 to 15 represent this region in the AER map of 2015. Agro-ecological units 14 to 17 defined per humid agro-ecosystem in the year 1992, whereas in the revised AER map, agro-ecological units 16 to 18 cover this region. Agro-ecological unit 20 represents exclusively island agro-ecosystem in 1992, whereas in the revised edition, island agro-ecosystem is merged with the coastal agro-ecological units 19. Agro-ecological units 18 and 19 in the earlier map were exclusively devised for coastal agro-ecosystem. In the revised edition, east and west coast are covered under agro-ecological units 19 and 20 respectively.

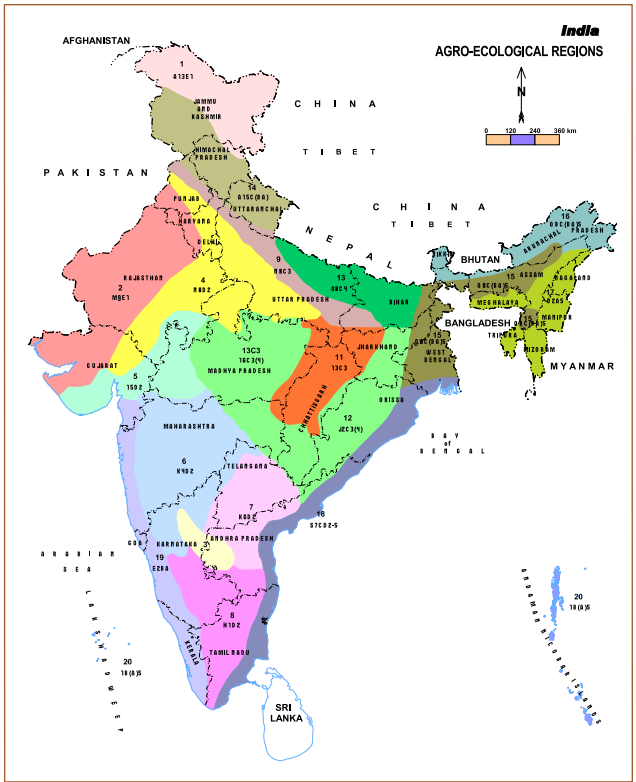


Fig. 2.5.1. Agro-ecological Regions map of the country (1992)

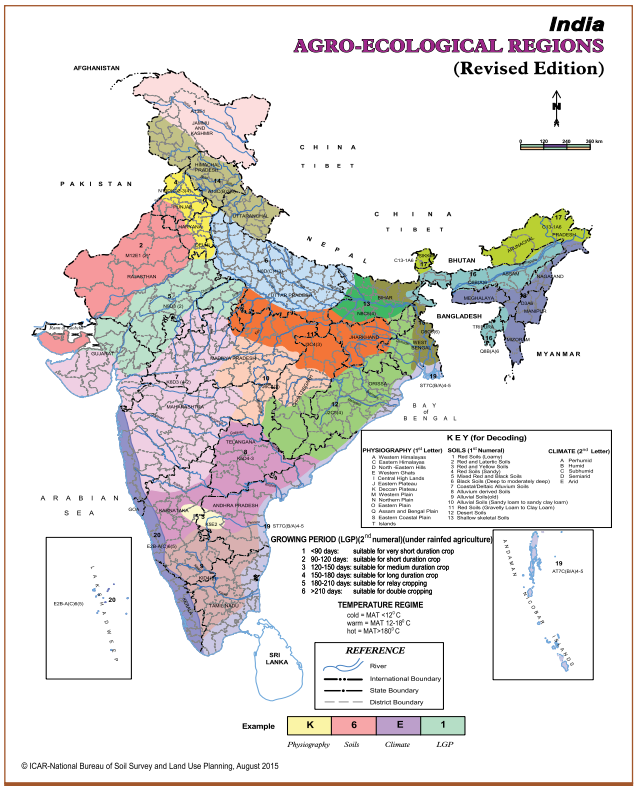


Fig. 2.5.2 Agro-ecological Regions map of the country (2015)

Revised Bio-climate type (A component of AER map)

Bio-climate a component of AER is also revised, using 1:1 million soil resource data base and the latest climate data of 600 agro-met stations. The area under Bio-climate type namely hyper arid and sub-humid moist is revised from 9.9 to 6.6 mha, and from 72.4 to 13.2 mha, respectively. The area under semiarid moist and sub-humid dry is revised from 78.9 to 98.6 mha, and 42.8 to 78.9 mha, respectively. The area under humid and per-humid is revised from 32.9 and 52.6 mha to 16.5 and 39.5 mha, respectively. The semi-arid (dry) areas have been revised from 26.3 mha to 49.4 mha. The difference in the extent of bio-climate

in 2015 in reference to earlier AER delineated in the year 1992 is shown in fig. 2.5.3, indicating an increase in the area of bio-climate type namely semi-arid (dry), semi-arid (moist) and sub-humid (dry) in place of sub-humid (moist), humid and per-humid, bio-climate.

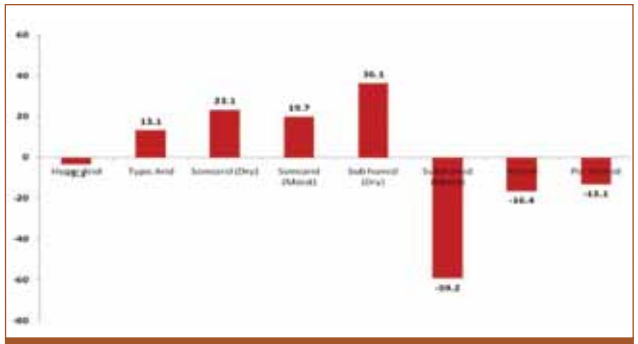


Fig. 2.5.3. Change in area (mha) of bio-climate type from 1992-2015

Length of growing period (Another component of AER map)

The revised map of length of growing period reveals that the area under <60 days is increased from 16.5 to 29.6 mha and the area under LGP class of 60-90 days belonging to the western Rajasthan, arid part of Gujarat and Ladakh region of Jammu and Kashmir is corrected from 16.4 to 9.9 mha. The area under LGP class of 120-150 days, LGP class of 150-180 and LGP class of 180-210 days belonging to the states Maharashtra, Madhya Pradesh, Uttar Pradesh,

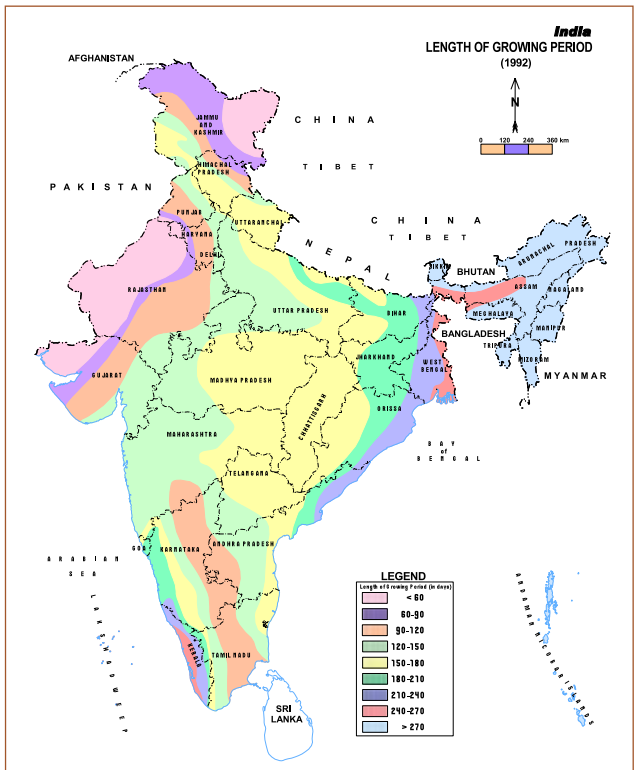


Fig. 2.5.4. LGPs of India (1992)

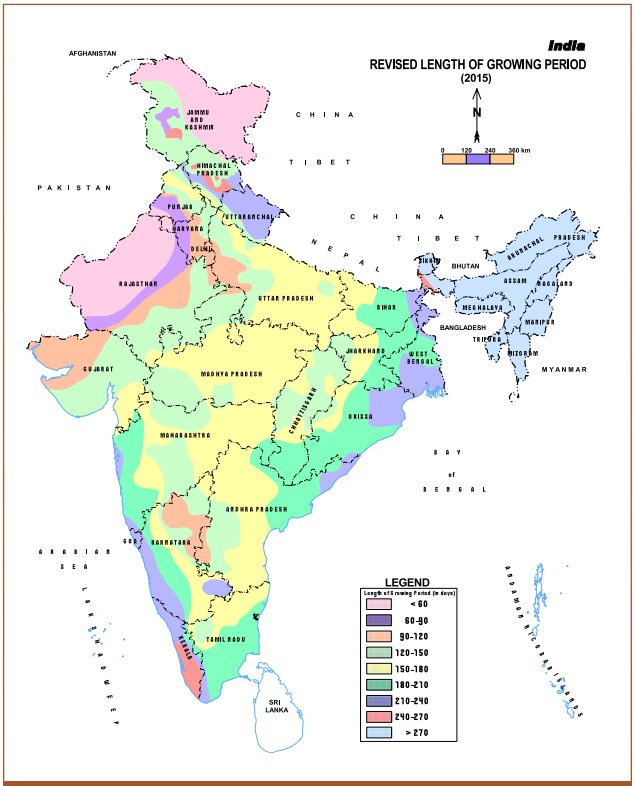


Fig. 2.5.5. Revised LGPs of India (2015)

Telangana and Karnataka is also refined. Area under LGP class of 210-240 covering Western Ghats of Kerala, Karnataka, Maharashtra and Uttaranchal state is revised from 6.6 to 26.3 mha. The area in LGP class of 240-270 and LGP class of >270 days encompassing western part of Assam and eastern part of West Bengal is also modified from 9.9 to 6.6 mha and from 13.2 to 23.0 mha, respectively (Figs. 2.5.4 and 2.5.5).

Potential crop zones

It refers to the specific regions /areas of crops and cropping sequences which are bio-physically suitable and also have high productivity and high spread. Potential crop zones have similar geographic setting in terms of soils, landforms, rainfall, temperature, length of growing period, irrigation potentials, suitable for a specific crops and cropping sequences and have the potentiality to response similarly for similar kind of management practices. Potential crop zoning involves development of Land Management units (LMUs), bio-physical suitability evaluation and linking of bio-physical suitable maps to the relative spread and productivity of reference crops and cropping sequences. Methodology for delineating potential crop zone is described hereunder (Fig. 2.5.6)

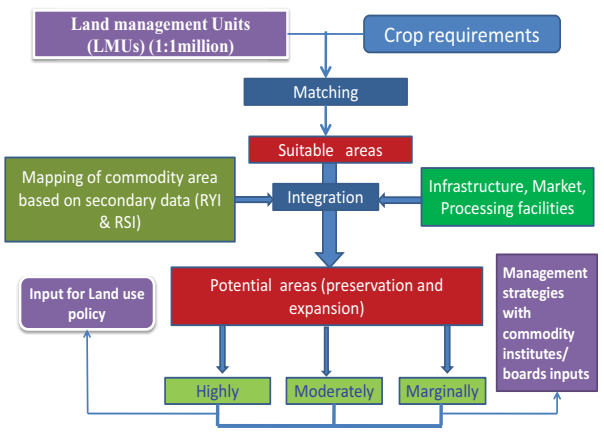


Fig. 2.5.6. Conception Model of identification of potential areas.

Step1: Delineation of Land Management Units (LMUs)

It is a grouping of soils/lands with the similar management needs using soil resource information on 1:1 million scale, recently developed agro-ecological region map, length of growing period, rainfall and irrigation potentials. LMUs begin with the grouping of soil map units of 1:1 million scale maps into the dominant soil regions, namely alluvial, black, red, lateritic, hill and forest, sandy, coastal and cold desert region soils. The soil regions are regrouped based on the physiography. The resultant soil/land units are further classified using region specific soil and site characteristics attracting management interventions like soil texture (sandy, coarse loamy, fine loamy and fine), salinity (moderate and strong), sodicity (moderate and strong) and flooding (moderate and strong) in the alluvial soil region; depth, salinity and sodicity in black soil region; depth, gravels, erosion, texture and pH in the red and lateritic soil region; salinity, acidity and risk of flooding together with soil texture in coastal region; soil moisture and temperature regime in the cold desert region. In the process 1649 soil map units on 1:1 million scales are regrouped into 610 land management units, which are linked with AER and land use / land cover map. Thus the land management unit maps refer to the group of soil map units which have similar geographic setting in terms of soils, rainfall, AER, LGP and irrigation. Based on the outlined methodology Land Management Units for India and for the states of India are developed. Fig.2.5.7 describes the Land Management units (LMUs) in the country whereas Fig. 2.5.8 elucidates LMUs for the state of Maharashtra and the legend of fig.2.5.8 is described in table 2.5.1.

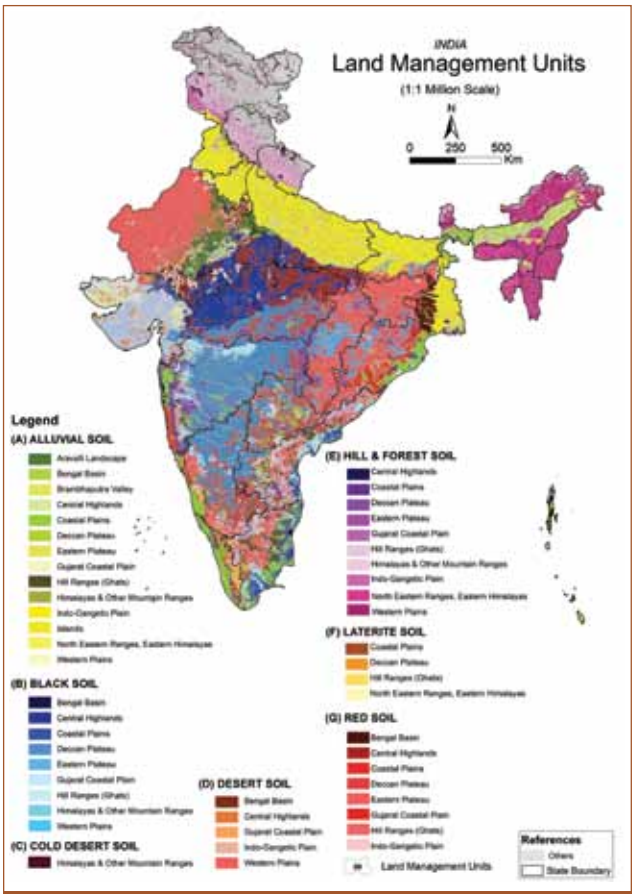


Fig. 2.5.7. Land management Unit map of India

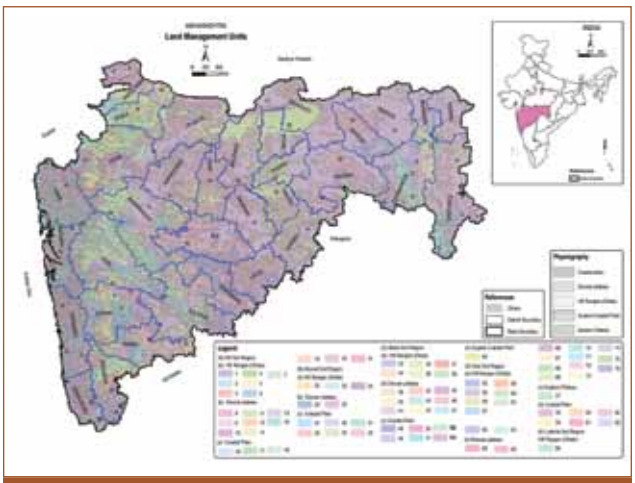


Fig. 2.5.8 Land management Unit map of Maharashtra

Table 2.5.1. Description of Land Management Units (LMUs), Maharashtra

LMUs	Description	Area (ha)		
		Rainfed	Irrigated	Total
1	Fine, moderately deep, moderately sloping, moderately eroded soils, western Ghats LGP 120 to 150 days and 600 to 1200 mm rainfall	41792	99802	141594
2	Fine, shallow, moderately sloping, moderately eroded soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	32702	66619	99321
3	Fine, shallow, steeply sloping, severely eroded soils, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	8763	57786	66549
4	Loamy, shallow, gently sloping, moderately eroded soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	5945	28457	34402
5	Loamy, shallow, moderately sloping, severely eroded soils, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	1817	8028	9846
6	Loamy, shallow, steeply sloping, severely eroded soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	48406	195105	243511
7	Loamy skeletal, shallow, steeply sloping, severely eroded soil, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	148490	348506	496996
8	Loamy, moderately deep, steeply sloping severely eroded soils, south Deccan Plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	84690	199765	284454
9	Coarse loamy, deep, very gently sloping, moderately eroded soils, north Deccan plateau, LGP 180 to 210 days and 1000-1600 mm rainfall	174267	976377	1150644
10	Fine, moderately deep, moderately sloping, moderately eroded soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	111811	306834	418646
11	Fine, shallow, gently sloping, severely eroded soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	3147	10771	13918
12	Loamy, shallow, gently sloping, severely eroded soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	72747	253722	326469
13	Loamy, shallow, moderately sloping, severely eroded soils, north Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	44190	228668	272858
14	Loamy, shallow, steeply sloping, severely eroded soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	75865	184767	260632
15	Loamy skeletal, shallow, steeply sloping, severely eroded soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	348658	694412	1043070
16	Fine, deep, steeply sloping, moderately eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	11282	45938	57220
17	Fine, shallow, gently sloping, severely eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	1979	3400	5379
18	Fine, shallow, moderately sloping, moderately eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	69168	211348	280516
19	Fine, shallow, steeply sloping, severely eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	29355	259472	288827
20	Loamy, shallow, steeply sloping, severely eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	123441	562862	686303
21	Loamy skeletal, shallow, steeply sloping, severely eroded soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	154227	343650	497877
22	Loamy, deep alluvial soils, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	124254	348858	473112
23	Loamy, deep, slightly saline alluvial soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	13487	38281	51768
24	Coarse loamy, alluvial soils, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	519	5354	5873
25	Loamy, deep, alluvial soils, south Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	386332	812844	1199176
26	Loamy, deep, slight saline alluvial soils, north Deccan Plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	7366	37079	44445

27	Fine, deep, alluvial soils, West coastal plain, LGP 210-240 days and 2000 to 3000 mm rainfall	194	2332	2526
28	Fine, deep, slightly saline alluvial soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	-	46	46
29	Fine, deep, strong saline alluvial soils, west coastal plain, LGP 210-240 days and 2000 to 3000 mm rainfall	16424	66201	82626
30	Fine loamy, deep, alluvial soils, west coastal plain, LGP 210-240 days and 2000 to 3000 mm rainfall	416	8065	8481
31	Loamy, deep, alluvial soils, west coast plain, LGP 210-240 days and 2000 to 3000 mm rainfall	93451	353232	446683
32	Loamy, deep, slightly saline alluvial soils, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	140994	591959	732953
33	Fine, deep black soils, western Ghats, LGP 90 to 150 days and 600 to 1000 mm rainfall	24558	45678	70236
34	Fine, deep, moderate saline with slightly sodic black soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	36916	120570	157486
35	Fine, deep, slightly saline black soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	1138755	2355516	3494271
36	Fine, moderately deep, slightly saline black soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	31476	87166	118642
37	Fine, shallow black soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	64922	197311	262233
38	Fine, shallow, slightly saline black soils, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	279592	597352	876944
39	Fine, deep black soils, wouth Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	161122	367892	529015
40	Fine, deep, moderately saline black soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	364658	784838	1149495
41	Fine, deep, slight saline black soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	3532960	7698538	11231498
42	Fine, deep, slightly saline and sodic black soils, south Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	2975	5331	8305
43	Fine, moderately deep black soils, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	85708	440352	526060
44	Fine, moderately deep, slightly saline black soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	557780	1123914	1681694
45	Fine, shallow black soils, south Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	327862	742043	1069904
46	Fine, shallow, slightly saline black soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	2076297	4600657	6676955
47	Fine, shallow, slightly saline and sodic black soils, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	326	594	920
48	Fine, deep black soils, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	29	350	379
49	Fine, moderately deep black soils, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	39297	169503	208801
50	Fine, deep, moderately saline with slightly sodic black soils, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	484	1788	2273
51	Fine, moderately deep, slight saline black soils, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	3531	26341	29872
52	Fine, moderately deep, strong saline black soils, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	36688	200664	237351
53	Loamy skeletal, shallow, red soils, gently sloping, western Ghats, LGP 120 to 150 days and 600 to 1200 mm rainfall	92606	347857	440463

54	Fine, deep, red soils, steeply sloping, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	30	3775	3806
55	Loamy skeletal, deep, red soils, gently sloping, western Ghats, LGP 90 to 150 days and 600 to 1000 mm rainfall	87	451	538
56	Loamy, shallow, red soils, gently sloping, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	11840	38365	50205
57	Loamy, shallow, red soils, moderately sloping, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	4217	34978	39195
58	Fine, deep, red soils, gently sloping, south Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	25597	73519	99115
59	Fine, deep, red soils, moderately sloping, south Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	8841	19488	28329
60	Loamy, deep red soils, gently sloping, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	4831	12351	17182
61	Loamy, deep, red soils, moderately sloping, south Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	245	2805	3049
62	Loamy, deep, red soils, very gently sloping, south Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	11128	81632	92760
63	Loamy skeletal, deep, red soils, gently sloping, south Deccan plateau, LGP 90 to 150 days and 600 to 1000 mm rainfall	890	2407	3297
64	Fine, moderately deep, red soils, gently sloping, south Deccan plateau, LGP 150 to 180 days and 1000 to 1200 mm rainfall	50	86	136
65	Loamy, moderately deep, red soils, moderately sloping, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	18468	43883	62352
66	Loamy, shallow, red soils, gently sloping, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	25004	58006	83009
67	Loamy, shallow, red soils, moderately sloping, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	1517	4635	6152
68	Loamy skeletal, shallow, red soils, moderately sloping, south Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	59053	160870	219923
69	Coarse loamy, shallow, red soils, gently sloping, south Deccan plateau, LGP 180-210 days and 1000 to 1500 mm rainfall	224540	519681	744221
70	Loamy, moderately deep, red soils, very gently sloping, sorth Deccan plateau, LGP 180 to 210 days and 1000-1600 mm rainfall	11	772	783
71	Coarse loamy, moderately deep, red soils, moderately sloping, north Deccan plateau, LGP 180 to 210 days and 1000-1600 mm rainfall	-	1585	1585
72	Loamy skeletal, shallow, red soils, gently sloping, north Deccan plateau, LGP 120 to 150 days and 600 to 1200 mm rainfall	123393	257880	381273
73	Loamy, moderately deep, red soils, moderately sloping, Dandakaranya, LGP 180 to 210 days and 1000-1600 mm rainfall	329	468	796
74	Fine, deep, red soils, gently sloping, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	6375	14620	20995
75	Fine, deep, red soils, steeply sloping, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	764	20191	20955
76	Coarse loamy, deep, red soils, gently sloping, West coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	1978	17219	19198
77	Coarse loamy, moderately deep, red soils, very gently sloping, west coast plains, LGP 210-240 days and 2000 to 3000 mm rainfall	67926	296798	364724
78	Loamy, shallow, red soils, moderately sloping, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	50624	269022	319646
79	Coarse loamy, shallow, red soils, moderately sloping, west coast, LGP 210-240 days and 2000 to 3000 mm rainfall	51991	221119	273111
80	Fine, moderately deep, laterite soils, moderately sloping, western Ghats, LGP 210-240 days and 2000 to 3000 mm rainfall	1750	10569	12319

Step 2: Bio-physical suitability evaluation

The bio-physical suitability of each LMU is assessed for major crops of the country considering the problems and the potentialities of each of them. The bio-physical suitability of cotton for India and for the state of Maharashtra is given here as an example (Fig. 2.5.9 and 2.5.10).

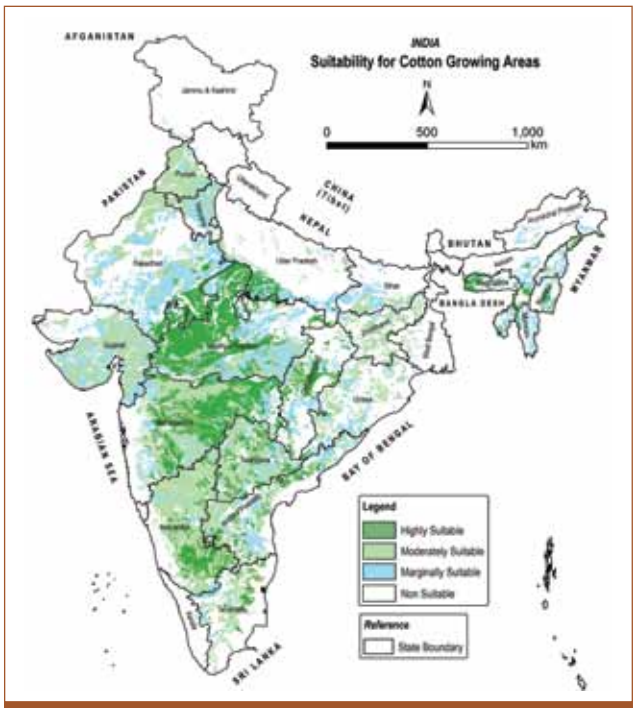


Fig. 2.5.9 Bio-physical suitability of cotton in India

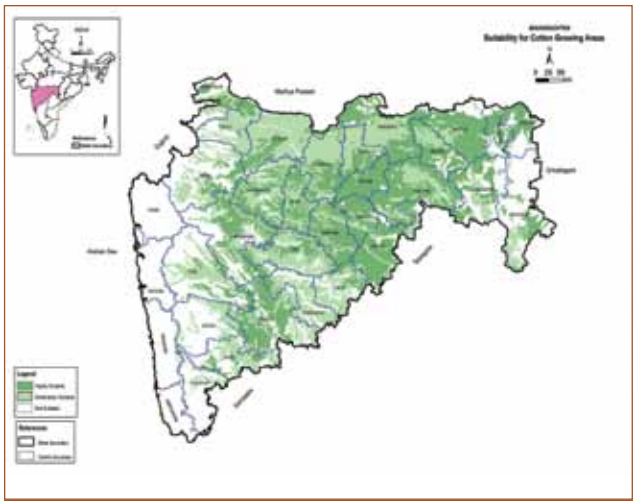


Fig. 2.5.10 Bio-physical suitability of cotton in Maharashtra

Step 3: Developing Relative yield Index (RYI) and Relative spread index (RSI)

Relative yield index (ratio of district productivity to national productivity for reference crop) and **relative spread yield index** (ratio of district area to national area of the reference crop) are calculated. RYI and RSI are graded in terms of high spread- high productivity, low spread-high productivity, high spread–low productivity and low spread-low productivity. The relative spread and productivity of cotton for the country and for the state of Maharashtra are shown as examples (Fig. 2.5.11 and 2.5.12).

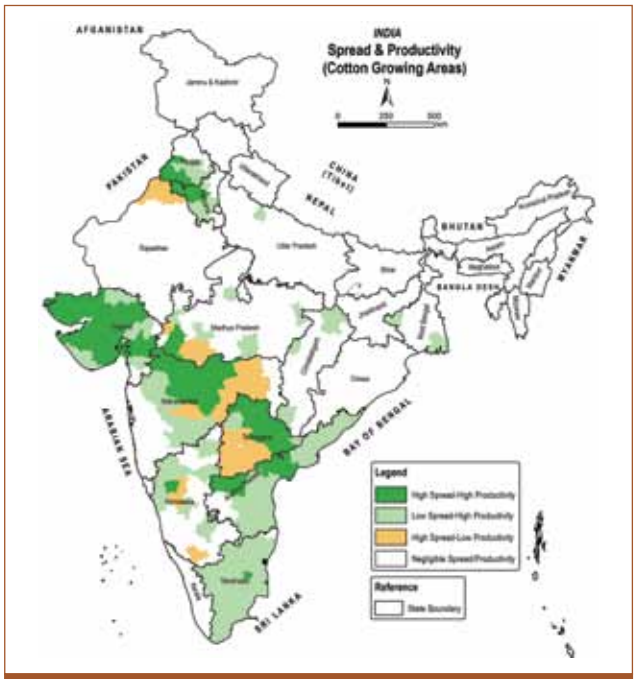


Fig. 2.5.11. Spread and productivity of cotton in Maharashtra state

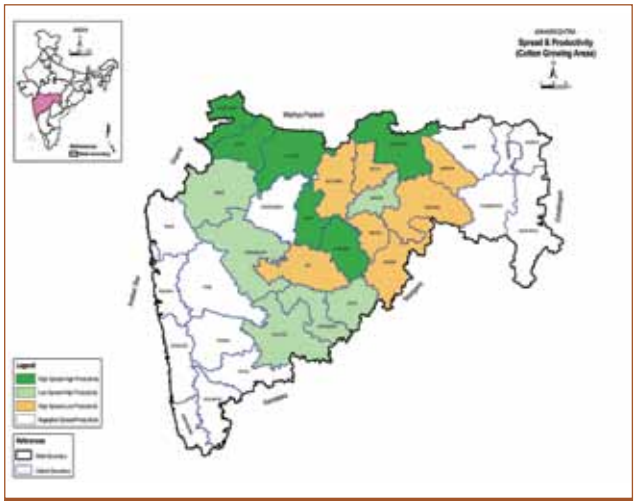


Fig. 2.5.12. Spread and productivity of cotton in Maharashtra state

Step 4: Developing potential crop zone map

Spread and productivity map are superimposed on bio-physically suitable map for defining potential zone in GIS. Thus the potential crop zone represents the areas/regions which are bio-physically suitable and also have high productivity and high spread. The potential zone for the cotton crop in India and in the state of Maharashtra is shown (Fig. 2.5.13 to 2.5.14).The potential crop zone for the two very

important crops of India rice and wheat is shown in fig. 2.5.15 and 2.5.16. Sunflower and mustard are considered as the most important oil seed crops in India, the potential zone of these crops is elucidated in fig.2.5.17 and 2.5.18. The potential crop growing areas of sunflower for the state of West Bengal and Karnataka are also shown in fig. 2.5.28 and 2.5.29. Following the similar principle, potential zones for rice, bengalgram, groundnut, cotton have been developed for the state of Karnataka (Fig. 2.5.19 to 2.5.22). Similar exercise has been conducted for the five crops namely cotton, red gram, rice, maize and soybean in the state of Telangana (Fig. 2.5.23 to 2.5.27). The results revealed that cotton and rice crops, red gram and soybean are competing for high potential zone in the state of Telangana.

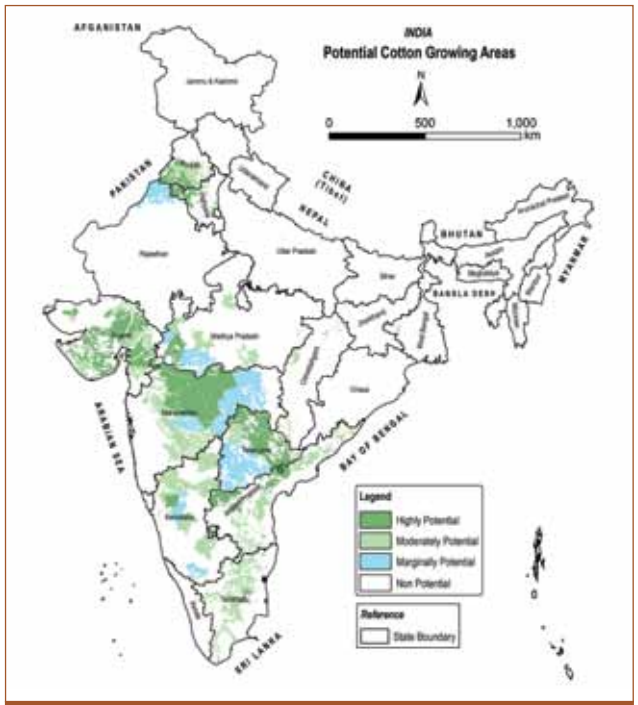


Fig. 2.5.13 Potential crop zone for cotton in India

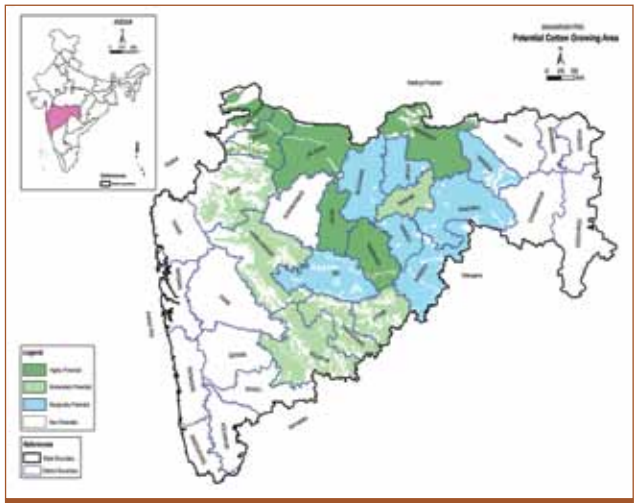


Fig. 2.5.14 Potential crop zone for cotton in Maharashtra

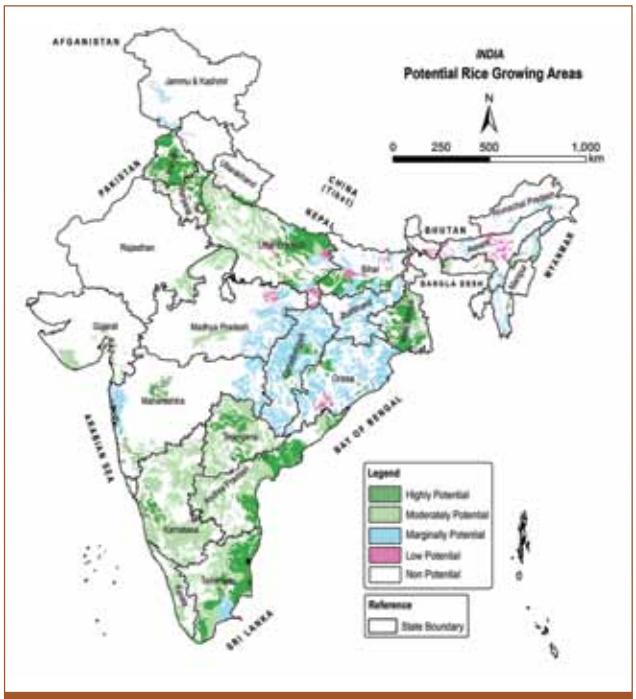


Fig. 2.5.15 Potential crop zone for rice in India

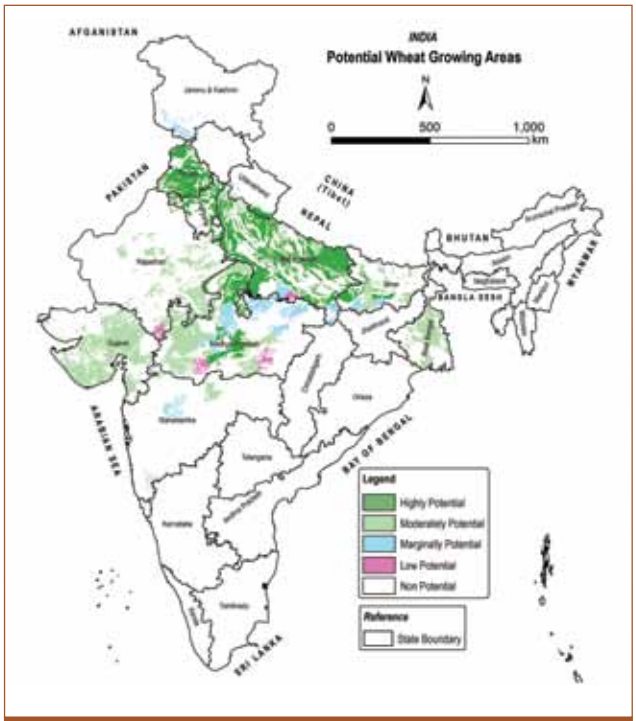


Fig. 2.5.16 Potential crop zone for wheat in India

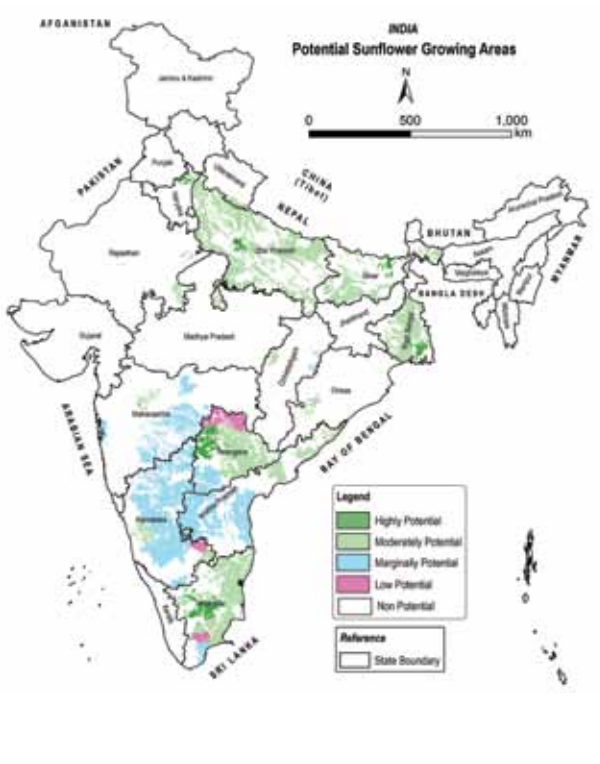


Fig. 2.5.17. Potential areas for growing sunflower in India.

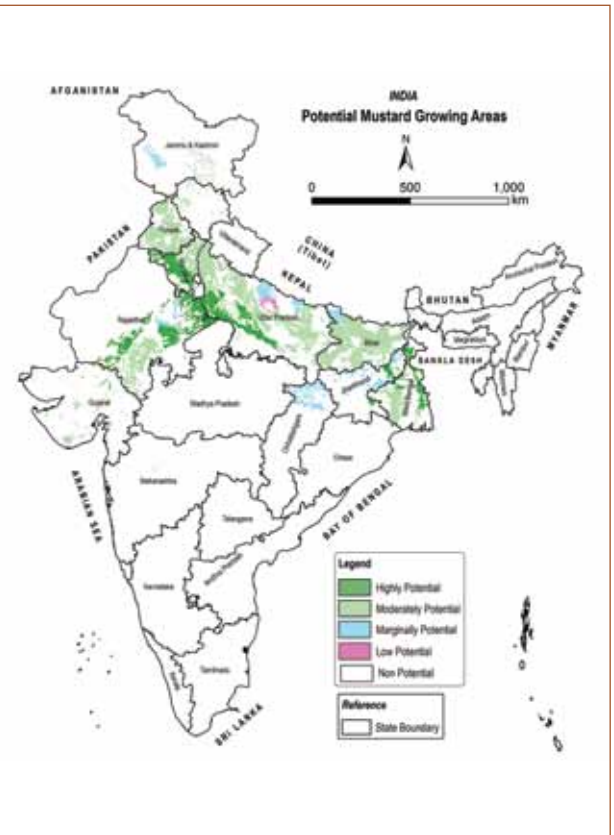


Fig. 2.5.18. Potential areas for growing mustard in India.

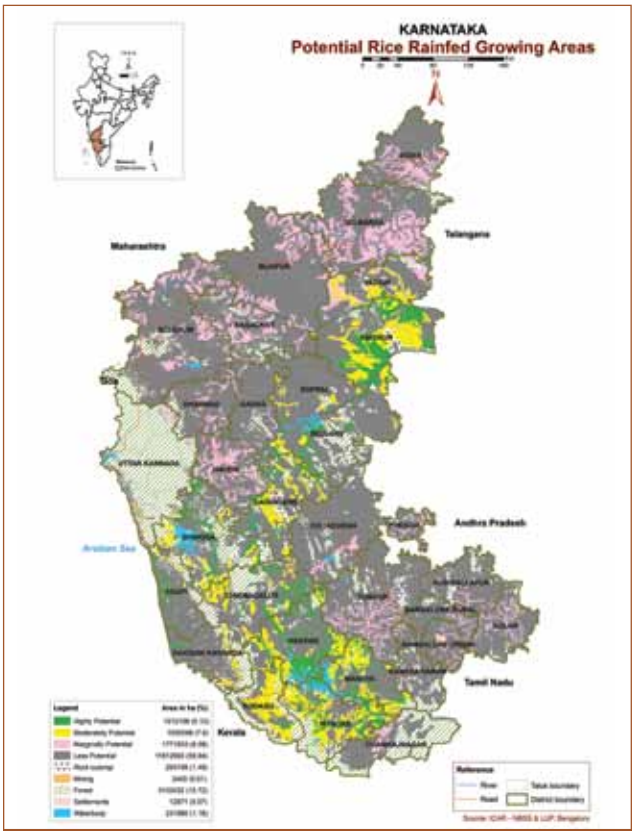


Fig. 2.5.19. Potential rainfed rice growing areas in Karnataka

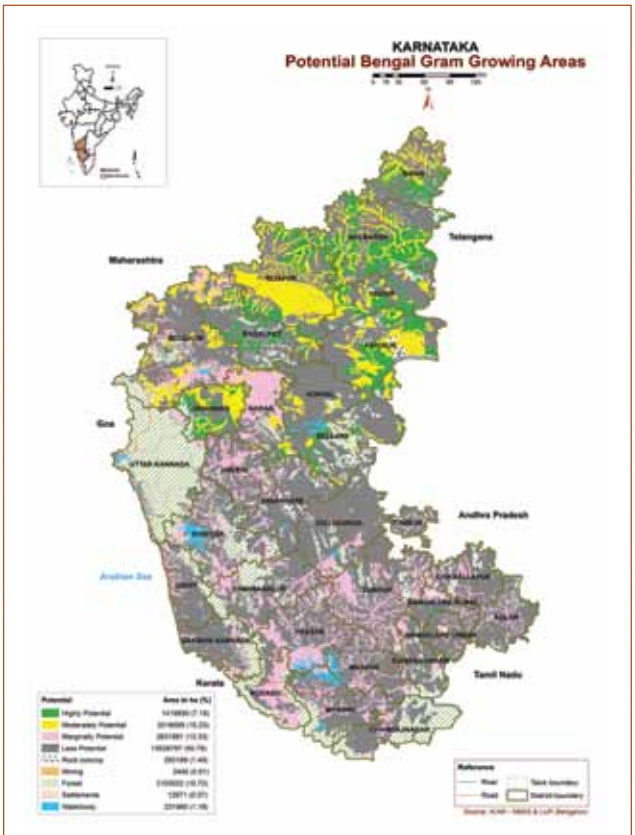


Fig. 2.5.20. Potential Bengal gram growing areas in Karnataka

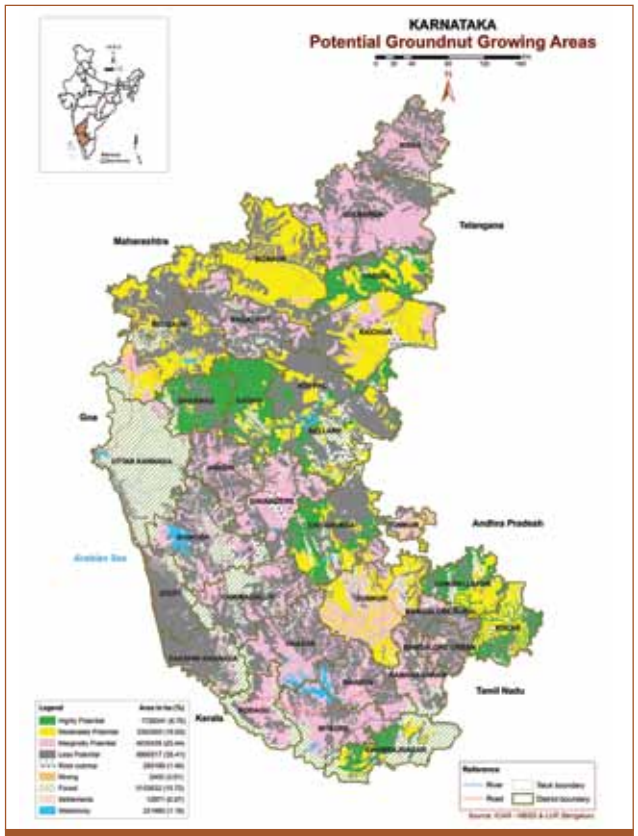


Fig. 2.5.21. Potential groundnut growing areas in Karnataka

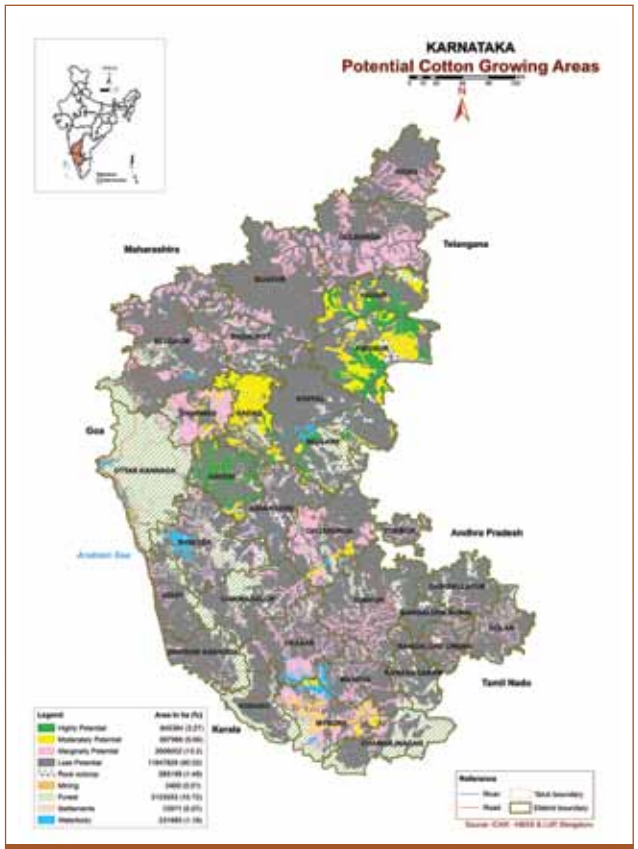


Fig. 2.5.22. Potential cotton growing areas in Karnataka

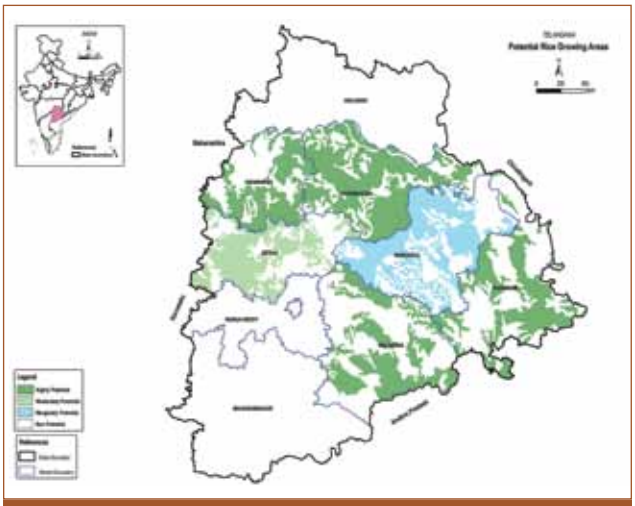


Fig. 2.5.23. Potential area of rice in Telangana

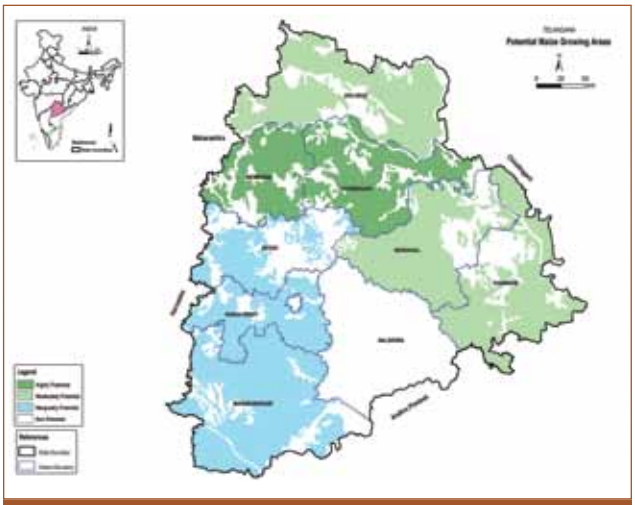


Fig. 2.5.24. Potential area of maize in Telangana

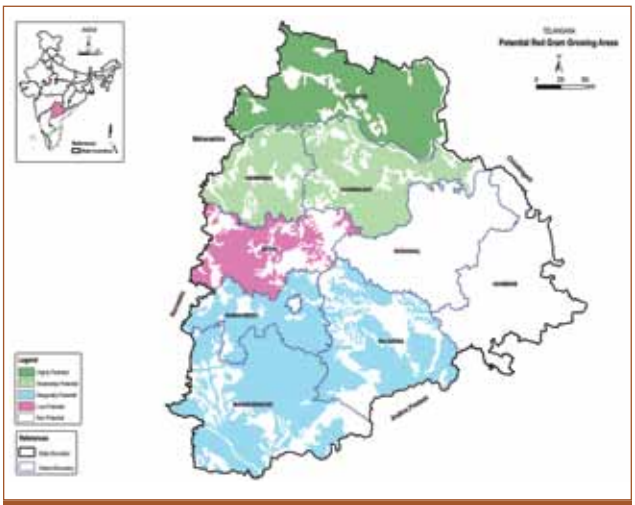


Fig. 2.5.25. Potential area of red gram in Telangana

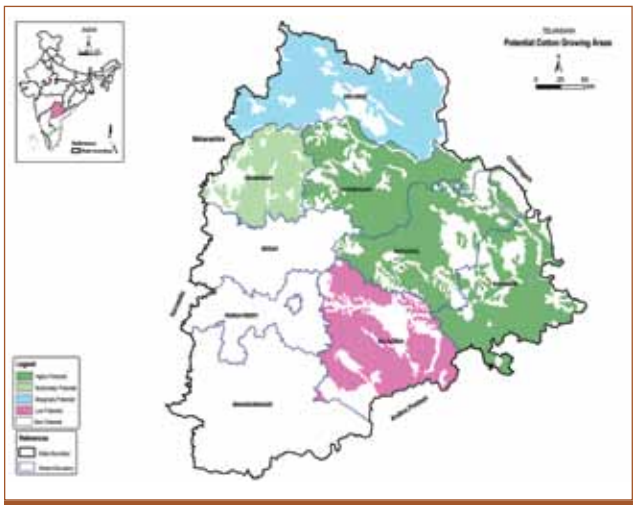


Fig. 2.5.26. Potential area of cotton in Telangana

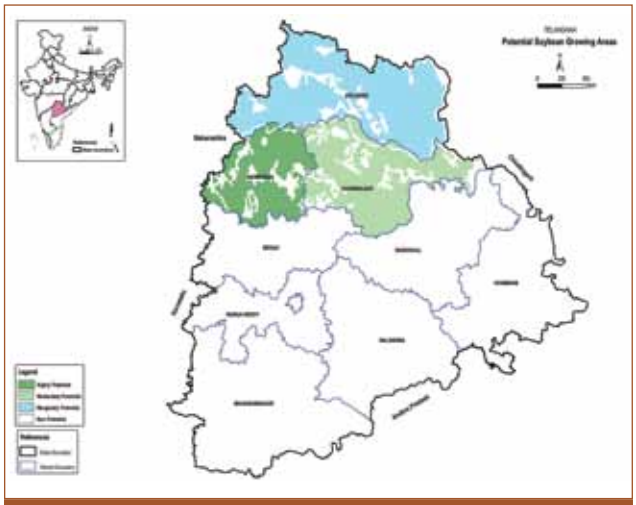


Fig. 2.5.27. Potential area of soybean in Telangana

For validation of the results, two locations in each moderate and marginal potential areas were selected for demonstration. For the crop sunflower, Bagalkote and Koppal district of Karnataka representing marginally potential area (Fig. 2.5.28); Bankura and west Midnipur of West Bengal (Fig 2.5.29) are classified to have moderate potential area. On-farm trials were conducted with two treatments *viz.,* Farmers' practice and best management practice (BMP). The data presented in Table 2.5.2 indicated that with BMP, productivity of crop on the marginal potential area was increased by 24% wheareas on moderate potential area with BMP productivity increased by 36%. Therefore selection of right type of land is very essential for increasing the productivity.

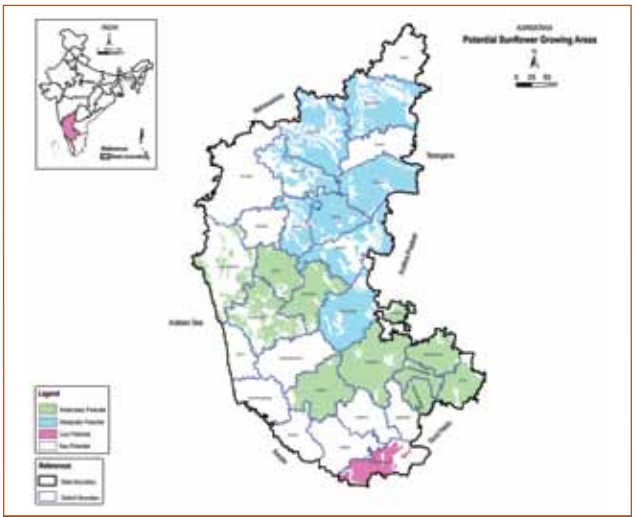


Fig. 2.5.28. Potential areas for growing sunflower in Karnataka

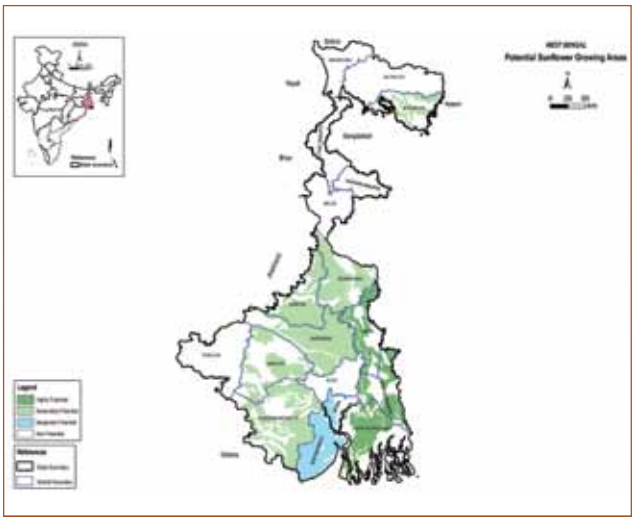


Fig. 2.5.29. Potential areas for growing sunflower growing in West Bengal

Table 2.5.2. On-farm trials on evaluation of performance of sunflower under best management practices over farmer's practice

	BMPs Yield (kg/ha)	FP Yield (kg/ha)	Increase over FP (%)
Marginal potential areas (Baghalkote and Koppal districts of Karnataka)	1116	899	24
Moderate potential areas (Bankura and West Midnapur dist. Of West Bengal)	1850	1356	36

In the same sequence economic evaluation of different potential crops have been conducted in Chamrajnagar district, Karnataka and the results are presented in table 2.5.3.

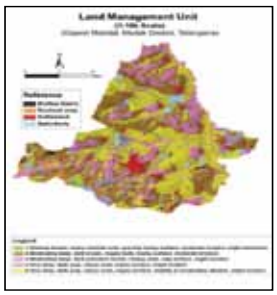
Table 2.5.3. Economic evaluation agricultural land use in Chamarajnagar district

Potential crop zone with	Area in ha (%)	Economic Land Evaluation (Benefit Cost Ratio)		
		Highly suitable (BCR >3)	Suitable (BCR >2 and < 3)	Marginally suitable (BCR >1 and < 2)
Very shallow, red gravelly loam soils	20435 (3.65)	Maize (4.04), Turmeric(4.01), Coriander(3.99) ,Groundnut(3.16)	Banana(2.89), Sunflower(2.73), Cotton(2.23),	Sorghum (1.48), Sesamum (1.18)
Shallow, red gravelly clay soils	44068 (7.87)	Brinjal(3.91), Turmeric(3.91)	Chilli(2.83), Groundnut(2.47)	Potato (1.93), Maize (1.72),Tomato (1.59), Bean (1.57) Onion (1.46)
Medium deep, red clayey soils	81292 (14.52)	Turmeric(4.41), Banana(3.97)	Potato(2.23), Chilli(2.19)	Cowpea (1.84), Groundnut (1.78), Sorghum (1.62), Onion (1.52), Ragi (1.41), Tomato (1.01)
Medium deep, red gravelly clay soils	192738 (34.42)	Watermelon (5.38), Banana(5.17), turmeric(5.06)	Chilli(2.52), Sunflower(2.25)	Cowpea (1.96), Horsegram (1.60), Cotton (1.59), greengram (1.53), sorghum (1.47),Tomato (1.45), Maize (1.39), Avere (1.29), Ragi (1.24),Onion (1.2)
Deep, red gravelly loam soils	14244 (2.54)		Turmeric(2.43, Beetroot(2.08)	Sunflower (1.95), Redgram (1.94), groundnut (1.78), sorghum (1.73), Maize (1.52), Bean (1.39), Avere (1.22), tomato (1.21) and Onion (1.14) Ragi(1.08)
Deep, red gravelly clay soils	27093 (4.84)		Turmeric (2.67), Marigold(2.51), Maize(1.98), Groundnut (1.76),Onion(1.68),Ragi (1.62),Horsegram(1.6) and Cucumber(1.2)	
Medium deep, laterite gravelly clay soils	28788 (5.14)		Horsegram(2.22, Turmeric(2.04),	Chilli(1.80),Sorghum(1.56), Cotton(1.5), Ragi(1.5),Tomato(1.17), Onion(1.05
Deep, laterite gravelly clay soils	5265 (0.94)	Banana(4.2), Turmeric(4.08), Chilli(4.02)	Sesamum(2.15), Maize(2.08), Ragi(2.05)	Tomato(1.37), J owar(1.08)
Deep, black calcareous clayey soils	36619 (6.54)	Banana(4.2), Sugarcane(4.01)	Green gram (2.29), Horsegram (1.81), Rice(1.63), Ragi(1.65)	
Deep, alluvial clayey soils (salt affected in patches)	31004 (5.54)	Turmeric(3.52)	Rice(2.03) Maize(1.87), Sesamum(1.65), Onion(1.17)	
Deep, forest brown clayey soils (gravelly in patches)	13490 (2.41)		Turmeric(2.47), Groundnut(2.09)	Sunflower(1.84), Onion(1.79), Beans(1.73),Beat root(1.61), Chilli(1 .42), Cotton(1.38), Tomato(1.35), Sorghum(1.2) and Ragi(1.08)
Rocky land associated with shallow, red gravelly clay. soil	50119 (8.95)	Turmeric(3.3), Brinjal(3.08), Banana(3.06)		Maize(1.9), Groundnut(1.87), Avare(1.73), Ragi(1.47), Onion(1.3)

Farm level planning using LRI dataset of 1:10000 scale data

Land use plan of 21 blocks / mandal / taluka representing different physiographic setting are arranged in figures 2.5.30 to 2.5.50. It includes available options of crops and cropping sequences for kharif and rabi season with benefit: cost ratio. The figure also includes the existing land use and management practices with B:C ratio. LMU wise recommended soil and water management practices are also given in the figures.

Deccan Peninsula Telengana Plateau
Gajwelmandal, Medakdistrict, Telangana



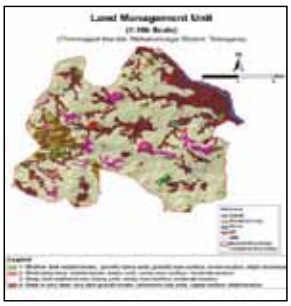
LMU	Description
1	Shallow to very shallow, somewhat excessively drained, loamy skeletal soils with moderate stoniness.
2	Moderately deep to deep, well drained to mod. Well drained, loamy sand soils with moderate erosion.
3	Moderately deep to deep, moderately well drained to well drained, clayey soils with slight erosion
4	Very deep, well to moderately well drained, loamy soils with slight to moderate erosion.
5	Very deep, well to moderately well drained, clayey soils with slight erosion.

Average B: C ratio (Existing/ Traditional): 1.31
Average B: C ratio (LRI based LUP with BMP): 2.28
Increase of B;C ratio over existing/ traditional: 74.1%

LMU	Existing		LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	B:C ratio	Kharif	Rabi	B:C ratio		
1	Cotton	0.75	Bajra		2.30	Bajra / jowar with appropriate soil & water conservation measures may enhance B: C Ratio many-folds	Agri-horti, mulching
	Maize	0.68	Jowar		2.00		
2	Maize	1.20	Maize		2.93	(i) Maize/ red gram/ jowar – sunflower (ii) Green gram/ black gram/ cowpea – Coriander	Intercropping, green manure as intercrop, INM, conservation tillage
	Cotton	1.25	Red gram		2.20		
	Pigeon pea	1.00	Jowar		2.20		
				Sunflower	2.47		
3	**Cotton**	**1.00**	**Cotton**		**2.34**	(i) Cotton – sunflower, maize-sunflower (ii) Chili/ pumpkin/ cluster bean/ tomato - coriander /sunflower	Vegetation strips, intercropping, land leveling
	Maize	**1.50**	**Maize**		**2.43**		
	Pigeon pea	1.10		Sunflower	2.00		
4	**Cotton**	**1.50**	**Maize**		**2.14**	(i) Cotton – sunflower, maize-sunflower (ii) Chili/ tomato/ cluster bean - coriander /sunflower	Vegetation strips, intercropping, land leveling
	Maize	1.80	Cotton		2.47		
	Pigeon pea	1.50		Sunflower	2.00		
5	**Cotton**	**1.60**	**Cotton**		**2.01**	(i) Maize-sunflower, (ii) cotton – sunflower, (iii) Chili/ tomato/ cluster bean - coriander /sunflower	Vegetation strips, intercropping, land leveling
	Maize	1.50	Maize		3.00		
	Pigeon pea	2.00	**Pigeon pea**		**2.00**		
				Sunflower	2.00		

Fig. 2.5.30

Thimmajipet mandal, Mahbubnagar district, Telangana



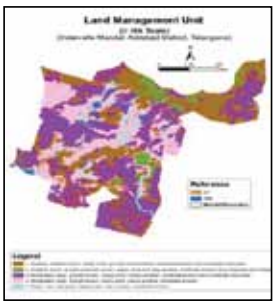
LMU	Description
1	Shallow to very shallow, excessively drained, red gravelly sandy soils occur on gently sloping uplands and escarpments with moderate erosion and stoniness.
2	Moderately deep, moderately well drained, black clayey soils occurring on very gently sloping valleys with moderate to severe erosion and slight calcareousness.
3	Moderately deep, well drained, red sandy loam soils occurring on very gently sloping pediments with moderate erosion.
4	Deep, well drained, red sandy loam soils occurring on very gently sloping pediments with slight to moderate erosion.
5	Deep to very deep, poorly drained, black clayey soils occur on very gently sloping valleys with slight to moderate erosion and calcareousness.

Average B: C ratio (Existing/ Traditional): 1.33
Average B: C ratio (LRI based LUP with BMP): 2.23
Increase of B;C ratio over existing/ traditional: 67.7%

LMU	Existing		LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	B:C	Kharif	Rabi	B:C		
1	Cotton	0.75	Bajra		2.30	Bajra/Jowar may replace cotton to enhance B: C ratio with soil & water conservation measures	Conservation furrows, intercropping, mulching, INM
	Jower	0.68	Jower		2.00		
2	Maize	0.76	Maize		2.93	(i) Maize/ cotton/ pegionpea / jowar –sunflower (ii) Pumpkin/ cowpea/ coriander	Conservation furrows, intercropping, mulching, INM
	Cotton	1.66	Cotton		2.33		
	Pigeon pea	0.68	Pigeon pea		2.20		
			Jowar		2.20		
				Sunflower	2.47		
3	Cotton	1.60	Maize		2.00	(i) Maize/ jowar/ cotton -sunflower (ii) Chilies/ watermelon/ muskmelon/ tomato	Conservation furrows, conservation ditching, compartmental bunding, bio-fencing
	Maize	2.00	Cotton		2.00		
	Pigeon pea	1.50	Jowar		2.00		
				Sunflower	2.00		
4 & 5	**Cotton**	**1.60**	**Cotton**		**2.01**	(i) Maize/ jowar - sunflower (ii) Cluster bean/ pumpkin/ tomato/ chilies	Conservation furrows, conservation ditching, compartmental bunding, bio-fencing
	Maize	1.50	Maize		3.00		
	Pigeon pea	2.00	Jowar		2.00		
	Tomato	1.25		Sunflower	2.00		

Fig. 2.5.31

Indravelle mandal, Adilabad district, Telanagana



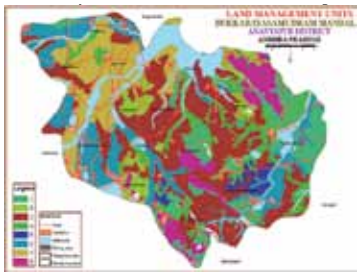
LMU	Description
1	Shallow to very shallow, well drained, reddish brown loamy soils with moderate to severe erosion and stoniness.
2	Shallow, well drained, brown to dark yellowish brown clayey soils with moderate to severe erosion and moderate stoniness.
3	Moderately shallow to moderately deep, well drained, grayish brown clayey soils with moderate erosion and moderate to severe stoniness.
4	Moderately shallow to moderately deep, well drained, grayish brown loamy soils with severe erosion and moderate stoniness.
5	Deep, well drained, very dark gray clayey soils with moderate erosion.
6	Deep, well drained, very dark gray loamy soils with moderate erosion

Average B: C ratio (Existing/ Traditional): 1.29
Average B: C ratio (LRI based LUP with BMP): 2.73
Increase of B;C ratio over existing/ traditional: 112%

LMU	Existing			LRI based LUP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	**Cotton**		**0.50**	**Cotton**		**2.01**	Bajra/ green gram/ black gram	Bunding, conservation furrows, intercropping, INM, mulching
	Soybean		1.00	Bajra		2.6		
	Jower		0.60	Green gram		3.0		
		Red gram	1.00	Black gram		3.0		
2	**Cotton**		**0.60**	**Soybean**		**3.0**	Soybean/ green gram/ black gram /cowpea	Bunding, conservation furrows, intercropping, INM, mulching
	Soybean		1.00	Cowpea		3.0		
	Paddy		0.50	Green gram		3.0		
	Maize		0.60	Black gram		3.0		
3	Cotton		1.00	Cotton		2.00	Maize/ soybean/ green gram/ black gram – gram /sunflower	Bunding, conservation furrows, intercropping, INM, mulching
	Maize		**1.50**	**Soybean**		**2.50**		
	Pigeon pea		**1.30**	**Maize**		**2.50**		
	Soybean		1.50	Green gram		3.30		
		Red gram	2.00	Black gram		3.00		
					Red gram	3.0		
					Sunflower	2.50		
4	Cotton		1.60	Maize		2.0	Soybean/ green gram/ black gram/maize/cotton – gram / sunflower	Bunding, conservation furrows, intercropping, INM, mulching
	Maize		2.00	Cotton		1.83		
	Pigeon pea		**1.00**	**Soybean**		**2.50**		
	Paddy		1.10	Green gram		3.0		
		Red gram	3.0	Black gram		3.0		
					Red gram	3.5		
					Sunflower	2.0		
5 & 6	**Cotton**		**1.60**	**Cotton**		**2.01**	Maize/ green gram/ black gram/ soybean - gram	Minimum tillage, intercropping, INM, vegetation strips
	Maize		**1.50**	**Maize**		**3.20**		
		Red gram	3.00	Soybean		2.60		
	Pigeon pea		1.00	Green gram		3.00		
	Paddy		0.70	Black gram		3.30		
	Tomato		1.25	Coriander		3.00		
					Red gram	3.50		
					Sunflower	**2.00**		

Fig. 2.5.32

Deccan Peninsula Telengana Plateau (Rayalseema)
Bukkarayasamudrum mandal, Anantapur District, Telengana



LMU	LMU description
1	Shallow to very shallow, well drained soils with loamy surface texture on very gently to gently sloping lands
2	Moderately shallow to moderately deep, well drained soils with sandy surface texture on very gently to gently sloping lands
3	Moderately shallow to moderately deep, well drained soils with loamy surface texture on nearly level to gently sloping
4	Moderately shallow, well drained calcareous soils with loamy surface texture on nearly level to very gently sloping lands
5	Deep, well drained soils with loamy surface texture on very gently to gently sloping lands formed from granite gneiss parent material
6	Moderately shallow to moderately deep alluvial soils with clayey surface texture on nearly level to very gently sloping lands on alluvium
7	Deep to very deep, moderately well drained alluvial soils with clayey surface texture on nearly level lowlands formed from alluvium
8	Very shallow to shallow soils associated with rocky lands on very gently sloping to moderately sloping lands

Average B: C ratio (Existing/ Traditional): 0.95
Average B: C ratio (LRI based LUP with BMP): 2.13
Increase of B;C ratio over existing/ traditional: 124%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Intercrop	B:C	Kharif	Intercrop/ Rabi	B:C		
1	Ground nut	Red gram	1.00	Horse gram		2.00	Green gram / Black gram/Horse gram/ Groundnut red gram intercropping	Bunding, conservation furrows, intercropping, INM, mulching
	Ground nut	-	0.70	Green gram		2.00		
	Jower		0.50	Black gram		2.00		
	Castor		1.00	Ground nut	Red gram	2.00		
2	Ground nut	Redgram	1.10	Cowpea		2.00	Green gram / Black gram /cowpea/ Groundnut red gram intercropping	Bunding, conservation furrows, intercropping, INM, mulching
	Ground nut	-	1.00	Green gram		2.00		
	Jower		0.80	Black gram		2.00		
	Castor		1.00	Ground nut	Red gram	2.00		
3	Ground nut	Red gram	1.10	Cowpea		2.00	Green gram / Black gram/cowpea / Groundnut-red gram intercropping	Bunding, conservation furrows, intercropping, INM, mulching
	Ground nut	-	1.00	Green gram		2.00		
	Jower		0.80	Black gram		2.00		
	Castor		1.00	**Ground nut**	**Red gram**	**2.00**		
4	Ground nut	Red gram	1.10	Green gram		2.0	(i) Green gram / Black gram – gram (ii) Chili/tomato/pumpkin/coriander	Bunding, conservation furrows, intercropping, INM, mulching
	Ground nut	-	1.00	Black gram		2.0		
	Jower		0.80		**Red gram**	**2.00**		
	Castor		1.00	**Ground nut**	**Red gram**	**2.00**		
5	Ground nut	Red gram	1.10	Ground nut		3.20	(i) Groundnut / black gram / jowar - gram (ii) Chillies/tomato/pumpkin/coriander	Bunding, conservation furrows, intercropping, INM, mulching
	Ground nut	-	1.00	Jowar		2.60		
	Jower		0.80	Black gram		3.00		
	Castor		1.00		**Red gram**	**2.00**		
6	Ground nut	Red gram	1.10	Green gram		2.00	(i) Black gram / green gram - sunflower (ii) Chillies/tomato/pumpkin/coriander	Minimum tillage, intercropping, INM, vegetation strips
	Ground nut	-	1.00	Black gram		2.30		
	Jower		0.80		Sunflower	2.00		
	Castor		1.00					
7	Ground nut	Red gram	1.10	Green gram		2.0	Black gram /green gram/ Groundnut red gram intercropping	Minimum tillage, intercropping, INM, vegetation strips
	Ground nut	-	1.00	Black gram		2.3		
	Jower	-	0.80	Ground nut	Red gram	2.0		
8	Fallow	-	-				Agro-forestry	Bunding, conservation furrows, intercropping, INM, mulching

Fig. 2.5.33

Deccan peninsula of Karnataka plateau
H.D. Kote Block, Mysore District, Karnataka

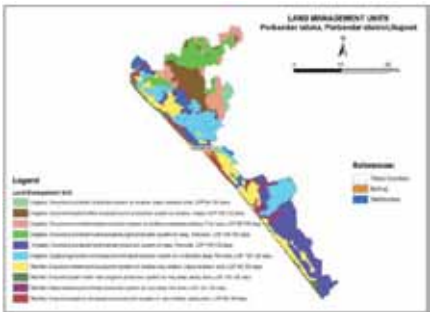
LMU	Description
1	Shallow, well drained, gravelly red loam soils with low WHC and low productivity
2	Medium deep, well drained, sandy clay loam soils with medium WHC and medium productivity
3	Deep, well drained, sandy clay loam soils with high water retention and low to medium productivity
4	Deep, moderately well drained, clayey soils with shade and low to medium productivity

Average B: C ratio (Existing/ Traditional): 1.19
Average B: C ratio (LRI based LUP with BMP): 2.52
Increase of B;C ratio over existing/ traditional: 112%

LMU	Existing		LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	B:C	Kharif	Rabi	B:C		
1	Cotton	0.57	**Fingermillet**	**Fieldbean**	**2.00**	Black gram- field bean, sesame- field bean,	Land leveling, bunding, vegetation strips, conservation tillage
			Sesame	Field bean	2.15		
			Marigold	**Finger millet**	**2.00**		
			Black gram	Field bean	2.80		
2	Cotton	1.10	Cotton	Cowpea	2.12	Cotton – horse gram / cowpea	Land leveling, bunding, vegetation strips, conservation tillage
	Fingermillet	0.87	Cotton	Horse gram	2.56		
			Finger millet	**Field bean**	**2.00**		
			Maize	**Field bean**	**2.40**		
			Cotton	**Rabi-veg.**	**2.00**		
			Fingermillet	Rabi-veg.	2.23		
3	Cotton	1.80	**Maize**	**Field bean**	**2.40**	Cotton-chilli, banana	Intercropping, mulching, INM, bunding, vegetation strips and conservation tillage
			Cotton	Chilli	3.66		
			Chilli	-	1.50		
			Fingermillet	Fieldbean	1.32		
			Banana		3.00		
4	Cotton	1.62	Banana		2.50	Coffee, Drumstick, spices / banana Vegetables	Intercropping, mulching, INM, bunding, vegetation strips and conservation tillage
			Coffee, drumstick, spices		5.51		
			Bhendi + cowpea +bitter gourd	Field bean+ Tomato	3.12		

Fig. 2.5.34

Central Kathiawar Peninsula and Arid Coastal Plains
Porbander Block, Porbander District, Gujrat



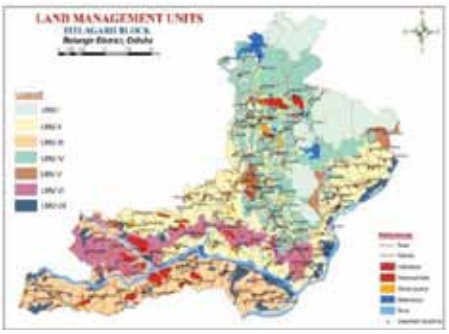
LMU	Description
1	Shallow, loamy-skeletal soils on very gently sloping plains
2	Shallow, clayey soils on very gently sloping plains
3	Shallow to moderately shallow, fine soils on very gently sloping plains
4	Deep, fine soils on very gently sloping arid coastal plains
5	Deep, fine soils on very gently sloping plains with moderate salinity problem
6	Moderately deep, fine soils on very gently sloping plains with slight salinity problem
7	Shallow to very shallow, clayey soils on very gently sloping plains
8	Very deep, sandy soils on very gently sloping plains
9	Very deep, fine soils on nearly level coastal plains with moderate salinity problem
10	Shallow, sandy soils on very gently sloping coastal plains

Average B: C ratio (Existing/ Traditional): 2.06
Average B: C ratio (LRI based LUP with BMP): 3.50
Increase of B;C ratio over existing/ traditional: 69.9%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	P. millet	Rabi Sorghum	2.53	Groundnut	Coriander	3.25	Goundnut - Coriander	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
2	Groundnut/ Castor/ Cotton	Coriander/ Cumin	2.37	Groundnut	Wheat/ Chickpea/ Cumin	3.99	Goundnut - Wheat/ Chickpea/ Cumin	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
3	Groundnut/ Cotton	Coriander/ Sorghum/ Wheat	2.09	Groundnut	Coriander/ Cumin/ Wheat	3.56	Goundnut - Coriander/ Cumin/ Wheat	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
4	Groundnut/ Cotton	Coriander/ Cumin/ Wheat/ Gram	2.46	Groundnut/ Castor/ Cotton	Wheat	4.00	Groundnut/ Castor/ Cotton - Wheat	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
5	Groundnut/ Cotton	Coriander/ Cumin/ Wheat/	2.35	Groundnut/ Castor/ Cotton	Wheat/ Chickpea/ Coriander/ Cumin	4.18	Groundnut/ Castor/ Cotton - Wheat/ Chickpea/ Coriander/ Cumin	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
6	Groundnut/ Sorghum	Coriander/ Cumin/ Wheat/ Cow pea	1.84	Groundnut	Wheat/ Coriander/ Cumin	3.56	Groundnut - Wheat/ Coriander/ Cumin	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
7	Groundnut	Cumin/ Wheat	2.05	Groundnut	Cumin/ Wheat	3.74	Groundnut - Cumin/ Wheat	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
8	P. millet/ Groundnut	Rabi Sorghum	1.59	Groundnut	Rabi Sorghum	2.48	Groundnut - Rabi Sorghum	Conservation bench terracing, compartmental bunding, intercropping, INM, mulching
9	Fallow	Gram	1.75	Groundnut	Wheat/ Chickpea	3.78	Groundnut - Wheat/ Chickpea	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching
10	Pasture	Cow Pea/ Cumin	1.52	Groundnut	Rabi Sorghum	2.48	Groundnut - Rabi Sorghum	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching

Fig. 2.5.35

Dandakaranya& Eastern Ghats
Titlagarh Block, Bolangir District-, Odisha



LMU	Description
1	Shallow to moderately deep, excessively well drained, moderately acidic, gravelly loamy soils, with very severe erosion
2	Moderately to very deep, excessive to well drained, neutral to slightly alkaline, fine loamy soils, moderate to severe erosion
3	Very deep, moderately drained, moderately acidic, gravelly silty to silty clay loam, slight erosion
4	Moderately shallow, well drained, strongly acidic, gravelly coarse loamy soils, severe erosion
5	Very deep, well drained, slightly acidic, fine loamy soils, slight erosion
6	Very deep, moderately well drained, neutral to slightly alkaline, silty clay loam, moderate erosion
7	Very deep, imperfectly drained, slightly alkaline to neutral, fine soils , very slight erosion

Average B: C ratio (Existing/ Traditional): 1.47
Average B: C ratio (LRI based LUP with BMP): 2.33
Increase of B;C ratio over existing/ traditional: 58.5%

LMU	Existing			LMU	LRI based LUP with BMP			Recommendations	Soil & water conservations
	Pre-kharif/Kharif	Pre-kharif/Rabi	B:C		Pre-kharif/ Kharif	Pre-kharif/ Rabi	B:C		
1	Forestry/ Agro-forestry		-	LMU 1	Forestry/ Agro-forestry			Forestry/ Agro-forestry	Agro-forestry, silvi-pasture and grass strips for LMU 1
2,3,4,5, 6 & 7	Rice (RF)	Fallow	1.21	LMU7 and LMU3	**Rice (RF)**	**Green gram**	**2.30**	Rice-Green gram/ Black gram	Intercropping, INM, vegetation strip, conservation tillage and land leveling for LMU 2
	Rice (IR)	Fallow	1.37		**Rice (IR)**	**Black gram**	**2.30**		
	Rice (RF)	Mustard	1.49	LMU6 and LMU2	**Finger millet**	**Fallow**	**2.00**	Goundnut/ sesame-mustard,	Conservation tillage, vegetation strip, liming and INM for LMU 3
	Finger millet	Fallow	1.24		Ground nut	Mustard	2.37		
	Maize	Fallow	1.31		Sesamum	Mustard	2.37		
	Black Gram	Mustard	1.79	LMU4 and LMU5	**Maize**	**Green gram**	**2.10**	Green gram/ black gram – mustard, maize	Alley cropping and trenching for LMU 4
	Green gram	Mustard	1.89		**Finger millet**	**Fallow**	**2.00**		
					Black gram	Mustard	2.60		Intercropping, minimum tillage, INM, vegetation strips for LMU 5 & 6
					Green gram	Mustard	2.92		
									Land leveling, conservation tillage and INM for LMU 7

Fig. 2.5.36

Eastern (Chhotanagpur) Plateau
Rajnagar block, Birbhum district, West Bengal

LMU	Description
1	Shallow, excessively well drained, moderately acidic, loamy skeletal gravelly soils with moderate to severe erosion occurring in plateau and upland regions.
2	Moderately shallow to moderately deep, well drained, slightly to moderately acidic, fine loamy to coarse loamy gravelly soils with moderate erosion occurring in plateau top and upland regions.
3	Moderately shallow to moderately deep, moderately well drained, slightly acidic, loamy skeletal gravelly soils with moderate to severe erosion occurring in plateau fringe and dissected plateau area.
4	Deep, somewhat poorly to poorly drained, neutral, fine loamy to coarse loamy soils with slight erosion occurring in plain, valley fill and a part of dissected plateau.
5	Deep, moderately well to well drained, neutral, fine loamy to coarse loamy soils with slight erosion occurring in plains and valley fill area.

Average B: C ratio (Existing/ Traditional): 1.25
Average B: C ratio (LRI based LUP with BMP): 2.19
Increase of B;C ratio over existing/ traditional: 75.2%

LMU	Existing				LRI based LUP with BMP				Recommendations	Soil & water conservations
	Pre-Kharif	Kharif	Rabi	B:C	Pre-Kharif	Kharif	Rabi	B:C		
1	Forest/ West land			--	Forestry/ Social forestry/ Silvi-pasture			-	Forestry/ Social forestry/ Silvi-pasture	Vegetation strips, intercropping, INM, conservation furrows
2	--	Rice	--	1.36	--	**Rice**	**Mustard**	**2.08**	Rice/finger millet – mustard	Vegetation strips, intercropping, INM, conservation furrows
					--	**Fingermillet**	**Mustard**	**2.22**		
3	--	Rice	--	1.09	--	**Rice**	**Mustard**	**2.08**	Rice/finger millet – mustard	Vegetation strips, intercropping, INM, conservation furrows
					--	**Fingermillet**	**Mustard**	**2.22**		
4	--	Rice	Mustard	1.39	Sesame	Rice	Mustard	2.04	Sesame- sunflower / rice – potato/ mustard, finger millet- chickpea	Vegetation strips, intercropping, INM, conservation furrows
					--	Fingermillet	Chickpea	2.09		
					--	**Soybean**	**Groundnut**	**2.34**		
					Sesame	Sunflower	Potato	2.39		
5	--	Rice	Mustard	1.39	Sesame	Rice	Mustard	2.04	Sesame- sunflower / rice – potato/ mustard, finger millet- chickpea	Vegetation strips, intercropping, INM, conservation furrows
	--	Rice	Potato	1.31	--	Fingermillet	Chickpea	2.09		
	Sugarcane			0.98	--	**Soybean**	**Groundnut**	**2.34**		
					Sesame	Sunflower	Potato	2.39		

Fig. 2.5.37

Northern Plain and Central Highlands of Aravallis
Jagner Block, Agra District, Uttar Pradesh

LMU	Description
1	Very shallow to shallow, excessively drained, neutral, coarse loamy (gravelly sandy loam) soils, scrabble stony & rocky and severe to very severe erosion
2	Moderately deep to deep, somewhat excessively drained, mildly alkaline, loamy sand to sandy loam soils and moderate erosion.
3	Very deep, well drained, sandy loam soils, moderately alkaline soils, slight erosion.
4	Very deep, well drained, loam to clay loam soils, moderately to strongly alkaline, with slight salinity.
5	Very deep, imperfectly drained, very strongly alkaline, clay loam soils and moderate salinity.
6	Very deep, imperfectly drained, very strongly alkaline, loam to clay loam soils and severe salinity (under wasteland and cultivation in patches).
7	Very deep, poorly drained, moderately alkaline, silty clay loam to clay loam soils on concave relief (low lying lands), slight salinity and moderate flooding.
8	Very deep, moderately well drained, strongly alkaline, stratified soils (sandy loam to clay loam) occurring on fluvial/ abandoned channels, slightly saline and slight to moderate erosion.

Average B: C ratio (Existing/ Traditional): 2.52
Average B: C ratio (LRI based LUP with BMP): 3.62
Increase of B;C ratio over existing/ traditional: 43.7%

LMU	Existing		LRI based LUP with BMP		Recommendations	Soil & water conservations
	Cropping system	B:C	Cropping system	B:C		
1	Forest & Plantation	--	Forestry/ Social Forestry ; Silvi- pasture; Dryland-Horticulture: False, Ber, Aola		Forestry/ Social Forestry ; Silvi- pasture; Dryland-Horticulture: False, Ber, Aola	Silvi-pasture, mulching and deep tillage
2	Fallow - Mustard	1.95	Pearl millet - Mustard	3.39	Black gram / Pigeon pea / Pearl millet – Mustard,	Intercropping, mulching and deep tillage
	Pearl millet - fallow/ lentil	3.18	Pearl millet - Lentil	2.00		
	Pigeon pea – fallow	3.73	Pigeon pea - Mustard	4.73		
			Black gram - Mustard	6.92		
3	Pearl millet- wheat	1.84	Pearl millet - wheat	2.30	Pigeon pea / Green gram/Urd / Pearl millet - Mustard	Deep tillage, mulching and organic amendments
	Pearl millet - Mustard	2.92	Pearl millet - Mustard + Funnel	3.39		
	Pigeon pea - wheat	2.73	Pigeon pea - Mustard	5.18		
	Pearl millet- /lentil	3.18	Green gram/Urd - Potato	4.65		
			Capsicum - Sorghum + Funnel	2.96		
4	Pearl millet-wheat	1.84	Pearl millet - Wheat	2.30	Black gram/ Green gram – Wheat, Pearl millet - Gram	Deep tillage, mulching and organic amendments
	Pearl millet -Mustard	2.92	Pigeon pea - Wheat	4.10		
	Pearl millet- lentil	3.18	Pearl millet - Gram	3.29		
			Black gram/ Green gram - Wheat	5.84		
			Pigeon pea - Mustard	2.62		
			Vegetable - Wheat/ Berseem	**2.00**		
5	Pearl millet-wheat	1.84	Pearl millet - Wheat/ Barley/ Berseem	2.30	Pearl millet - Wheat/ Barley/ Berseem	Deep tillage, mulching and organic amendments
	Pearl millet -Mustard	2.92				
6	Fallow –Mustard/ lentil	1.95	Pearl millet-mustard	3.39	Black gram / Pearl millet -Mustard/ barley	Deep tillage, mulching and organic amendments
			Black gram-Mustard/ barley	5.98		
			Rice –Mustard	3.17		
7	Fallow-wheat	0.76	Rice-wheat	2.03	Rice-wheat	Deep tillage, mulching and organic amendments
	Fallow-Lentil	2.21	**Rice-Gram/lentil**	**2.15**		
8	Fallow-mustard	1.95	Pearl millet -mustard	3.39	Pigen pea/sorghum-vegetables	Summer ploughing, INM, bunding, green manuring, intercropping
	Pigeon pea-fallow	3.73	Pigenpea/sorghum-vegetables	5.11		

Fig. 2.5.38

Middle Gangetic Plains
Mushahari Block, Samastipur District, Bihar

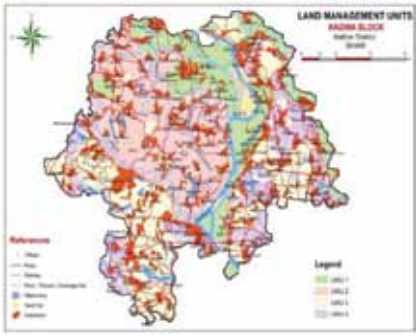
LMU	Description
1	Very deep, well drained, coarse silty soils, moderately alkaline with slight erosion on 1-3% slope, highly calcareous
2	Very deep, imperfectly drained, fine loamy soils, moderately alkaline with slight erosion on 1-3% slope, highly calcareous
3	Very deep, moderately well drained, fine silty soils, strongly alkaline with slight erosion on 1-3% slope, highly calcareous
4	Very Deep, well drained, fine loamy soils, moderately alkaline with slight erosion on 1-3% slope, highly calcareous
5	Very deep, well drained, fine loamy soils, strongly alkaline with very slight erosion on 0-1% slope, highly calcareous

Average B: C ratio (Existing/ Traditional): 1.40
Average B: C ratio (LRI based LUP with BMP): 2.49
Increase of B;C ratio over existing/ traditional: 77.9%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Maize	--	0.94	Maize	Wheat	2.62	Maize-wheat/ pulses/ mustard	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching and green manuring
				Maize	Mustard	2.39		
				Maize	Pulses	2.6		
2	Rice	--	0.78	Rice	Wheat	2.57	Rice – wheat/ pulses/ mustard	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching and green manuring
				Rice	Mustard	2.34		
				Rice	Pulses	2.56		
3	Rice	Maize	1.72	Rice	Maize	2.52	Rice – maize / pulses / mustard	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching and green manuring
				Rice	Mustard	2.34		
				Rice	Pulses	2.56		
4	Rice	Wheat	1.85	Rice	Maize	2.52	Rice – maize / pulses / mustard	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching and green manuring
				Rice	Mustard	2.34		
				Rice	Pulses	2.56		
5	Rice	Maize	1.72	Rice	Wheat	2.57	Rice – wheat/ pulses / maize / mustard	Bunding, vegetation strips, minimum tillage, intercropping, INM, mulching and green manuring
				Rice	Maize	2.52		
				Rice	Mustard	2.34		
				Rice	Pulses	2.56		

Fig. 2.5.39

Bengal Basin and North Bihar Plains
Kadwa Block, Katihar District, Bihar



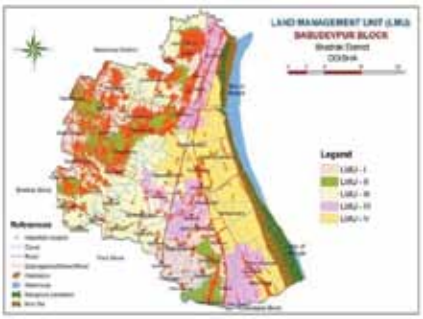
LMU	Description
1	Acidic soil with light surface texture, low fertility status, severe soil erosion under very frequent flooding
2	Neutral soil with medium surface texture, medium fertility, moderate erosion under very frequent flooding
3	Neutral soil with medium surface texture, medium fertility status, slight erosion
4	Acidic soil with heavy surface texture, low fertility status, slight erosion

Average B: C ratio (Existing/ Traditional): 1.55
Average B: C ratio (LRI based LUP with BMP): 2.10
Increase of B;C ratio over existing/ traditional: 35.5%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Fallow	Maize	1.61	**Jute**	**Maize**	**1.95**	Jute – potato /maize /mustard	Conservation tillage, intercropping, vegetation strips, INM, liming, desiltaion of reservoir
	Fallow	Potato	1.72	Jute	Potato	2.01		
				Jute	**Mustard**	**1.79**		
2	Paddy	Mustard	1.34	Paddy	Maize	3.42	Paddy-maize /wheat / potato	Raised bedded bunding, desiltaion of reservoir
	Paddy	Potato	1.54	**Paddy**	**Potato**	**2.00**		
				Paddy	**Mustard**	**2.01**		
				Paddy	**Wheat**	**2.00**		
3	Paddy	Wheat	1.56	**Paddy**	**Wheat**	**2.00**	Paddy- wheat / potato / maize	Conservation tillage, intercropping, vegetation strips, INM
				Paddy	**Maize**	**2.01**		
				Paddy	**Potato**	**2.01**		
4	Paddy	Wheat	1.55	**Paddy**	**Mustard**	**2.01**	Paddy – wheat / mustard	Conservation tillage, intercropping, vegetation strips, INM
				Paddy	**Wheat**	**2.00**		

Fig. 2.5.40

Eastern Coastal Plains & Eastern Ghats
Basudevpur Block, Bhadrak District, Odisha



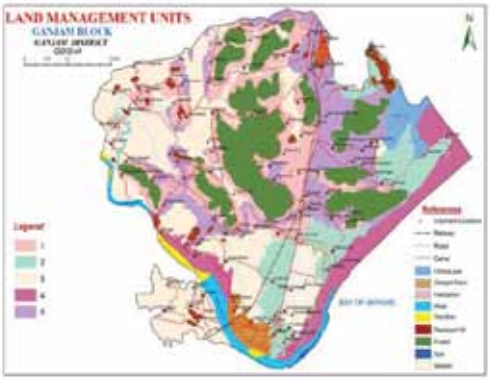
LMU	Description
1	Fine soils developed on very gently sloping (1-3% slope) old alluvial plain.
2	Fine-loamy soils developed on very gently sloping (1-3% slope) old alluvial plain.
3	Fine-silty soils developed on very gently sloping (1-3% slope) young alluvial plain with slight to moderate soil salinity.
4	Fine-silty soils developed on very gently sloping (1-3% slope) coastal plain with moderate to strong soil salinity.
5	Very fine soils developed on nearly level (0-1% slope) coastal plain with strong soil salinity.

Average B: C ratio (Existing/ Traditional): 1.35
Average B: C ratio (LRI based LUP with BMP): 2.67
Increase of B;C ratio over existing/ traditional: 97.8%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil& water conservations
	Kharif	Intercrop	B:C	Kharif	Rabi	B:C		
1	Paddy	Fallow	1.21	**Paddy**	**Mustard**	**2.00**	Paddy – green gram/ Rabi vegetable	Land leveling, intercropping and vegetation strips
	Paddy	Sunflower	1.55	Paddy	Sunflower	2.21		
				Paddy	Green gram	3.45		
				Paddy	Rabi-veg.	2.46		
2	Paddy	Fallow	1.14	**Paddy**	**Mustard**	**2.00**	Paddy – green gram/ Rabi vegetable	Land leveling, intercropping and vegetation strips
	Paddy	Sunflower	1.34	**Paddy**	**Sunflower**	**2.21**		
				Paddy	Green gram	2.60		
				Paddy	Rabi-veg.	2.56		
3	Paddy	Fallow	1.26	Paddy	Groundnut	3.78	Paddy – groundnut/ green gram	Land leveling, INM, vegetation strips and green manuring as inter crop.
	Paddy	Mustard	1.45	**Paddy**	**Sunflower**	**1.86**		
				Paddy	Green gram	2.64		
4	Paddy	Fallow	1.35	Paddy	Sunflower	2.21	Paddy – groundnut / sunflower	Land leveling, INM, vegetation strips and green manuring as inter crop.
				Paddy	Groundnut	3.78		
5	Paddy	Fallow	1.50	Paddy	Groundnut	3.60	Paddy - groundnut	Land leveling, INM, vegetation strips and green manuring as inter crop.

Fig. 2.5.41

Eastern Ghats & Eastern Coastal Plains
Ganjam Block of Ganjam District, Odisha



LMU	Description
1	Very deep, well drained, sandy clay loam texture, slightly acidic to neutral and moderate to severe soil erosion with gravelliness.
2	Very deep, somewhat poorly drained, sandy clay loam texture, neutral to slightly alkaline and moderate to severe soil salinity and frequent flooding.
3	Very deep, moderately well drained, silty clay texture, neutral to slightly alkaline and soils are cracks.
4	Very deep, somewhat excessive drained, sandy texture, alkaline nature, moderate to severe wind erosion.
5	Very deep, moderately well drained, fine texture, slightly alkaline and slight erosion with coarse texture.

Average B: C ratio (Existing/ Traditional): 1.11
Average B: C ratio (LRI based LUP with BMP): 2.07
Increase of B;C ratio over existing/ traditional: 86.5%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Intercrop	B:C	Kharif	Rabi	B:C		
1	Fallow	Groundnut	1.03	**Fingermillet**	**Green gram**	**2.09**	Pigeon pea-groundnut	Minimum tillage, agri-horti, mulching
				Pigeon pea	Groundnut	2.09		
2	Rice	Fallow	1.01	**Rice**	**Green gram**	**2.15**	Rice–green gram	Sub surface drainage, dug out pond
				Fingermillet	**Green gram**	**2.09**		
				Maize	**Green gram**	**2.00**		
3	Maize	Fallow	1.24	**Maize**	**Green gram**	**2.00**	Pigeon pea-groundnut	Sub surface drainage, dug out pond, soil amendments
				Pigeon pea	Groundnut	2.09		
				Rice	**Green gram**	**2.09**		
4	Fallow	Groundnut	1.03	Pigeon pea	Groundnut	2.09	Cashew, Casuarinas, Pigeon pea-groundnut	Windbreak trees (Casuarinas and Cashews)
				Fingermillet	**Green gram**	**2.00**		
5	Maize	Fallow	1.24	**Maize**	**Green gram**	**2.00**	Paddy- green gram, Pigeon pea-groundnut	Intercropping, mulching and INM
				Pigeon pea	Groundnut	2.09		
				Rice	**Green gram**	**2.09**		

Fig. 2.5.42

Eastern Coastal Plains & Lower Gangetic Delta
Gosaba Block, South 24 Pargana District, West Bengal

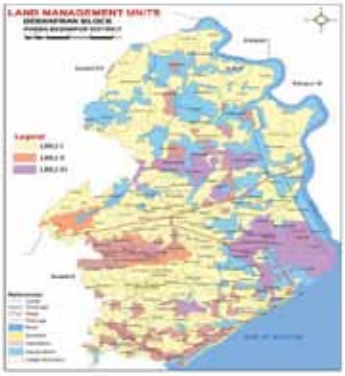
LMU	Description
1	Imperfectly drained, moderately saline, silt loam to silty clay loam soils under Rice-Fallow and Rice-Watermelon cropping system
2	Poorly drained, moderately to strongly saline (*Kharif*) - slightly acidic (*Rabi*), Silty clay to silty clay loam soils under Rice-Fallow and Rice-*Lathyrus* cropping system
3	Imperfectly drained, strongly saline (*Kharif*)-strongly-acidic (*Rabi*), silty clay loam soils under Rice-Fallow cropping system

Average B: C ratio (Existing/ Traditional): 1.28
Average B: C ratio (LRI based LUP with BMP): 2.64
Increase of B;C ratio over existing/ traditional: 100.0%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Rice	Watermelon	1.45	Rice	Rice	2.02	Fish-cum-rice – gourds, permanent pond fish	Land shaping with dug out pond, sub surface drainage, desiltation of drainage/ irrigation channels
				Rice	**Watermelon**	**2.22**		
				Fish-cum-Rice	Gourds	3.76		
				Pond Fishery		3.86		
2	Rice	Lathyrus	1.27	**Green Manuring**	**Green gram**	**2.28**	Rice-chilli/tomato/ potato	Land shaping with dug out pond, sub surface drainage, desiltation of drainage/ irrigation channels
				Rice	**Mustard**	**2.04**		
				Rice	Potato	2.41		
				Rice	Chilli/ Tomato	2.66		
3	Rice	Fallow	1.12	Rice	Cabbage/ Chilli	2.52	Rice- cabbage / chilli	Land shaping with dug out pond, sub surface drainage, desiltation of drainage/ irrigation channels

Fig. 2.5.43

Deshapran Block, PurbaMedinipur District, West Bengal



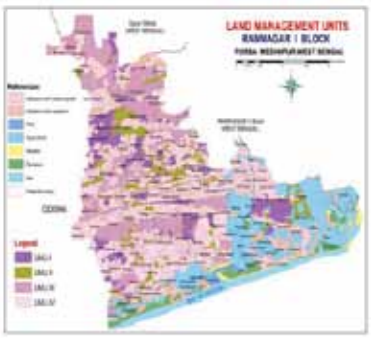
LMU	Description
1	Very deep, imperfectly drained, fine soils on very gently sloping /nearly level alluvial /coastal plain with moderate salinity.
2	Very deep, moderately well drained, coarse-loamy soils on very gently sloping /nearly level alluvial plain.
3	Very deep, imperfectly drained, fine-loamy soils on very gently sloping /nearly level coastal plain with moderate salinity.

Average B: C ratio (Existing/ Traditional): 1.35
Average B: C ratio (LRI based LUP with BMP): 2.22
Increase of B;C ratio over existing/ traditional: 64.4%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Paddy	Fallow	1.21	Paddy	Groundnut	2.39	Paddy- Groundnut/ chilli/paddy	Minimum tillage, intercropping, INM, mulching
	Paddy	Paddy	1.52	Paddy	Paddy	2.27		
				Paddy	Chili	2.36		
2	Paddy	Fallow	1.14	**Paddy**	**Mustard**	**2.01**	Paddy-mustard/ green gram / potato	Minimum tillage, intercropping, INM, mulching
				Paddy	**Potato**	**2.01**		
				Paddy	**Green gram**	**2.26**		
3	Paddy	Fallow	1.25	Paddy	Groundnut	2.26	Paddy- Groundnut/ chilli/paddy	Minimum tillage, intercropping, INM, mulching
	Paddy	Chili/ Tomato	1.65	Paddy	Paddy	2.17		
				Paddy	Chili	2.25		

Fig. 2.5.44

Ramnagar– I Block, East Midnapur District, West Bengal



LMU	Description
1	Very deep, moderately well drained, silt loam soils, slightly acidic to moderately alkaline with slight erosion on 1-3% slope
2	Very deep, moderately well drained, silt loam soils, slightly acidic to moderately alkaline with slight erosion on 0-1% slope
3	Very deep, well drained, loamy sand soils, slightly acidic to neutral with slight erosion on 3-5% slope
4	Very Deep, moderately well drained, fine loamy soils, neutral to moderately alkaline with slight erosion on 0-1% slope

Average B: C ratio (Existing/ Traditional): 1.51
Average B: C ratio (LRI based LUP with BMP): 2.13
Increase of B;C ratio over existing/ traditional: 41.1%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Paddy	Groundnut	1.38	**Paddy**	**Groundnut**	**2.06**	Paddy-green gram/ mustard / groundnut	Bunding, vegetation strips, intercropping, INM
				Paddy	**Mustard**	**2.09**		
				Paddy	**Green gram**	**2.00**		
2	Paddy	Mustard	1.51	**Paddy**	**Groundnut**	**2.06**	Paddy-green gram /mustard / potato / groundnut	Bunding, vegetation strips, intercropping, INM
				Paddy	**Mustard**	**2.24**		
				Paddy	Green gram	2.12		
				Paddy	**Potato**	**2.11**		
3	Paddy	Green gram	1.72	**Paddy**	**Groundnut**	**2.01**	Paddy-potato /ground nut/ green gram	Compartmental bunding, intercropping, INM
				Paddy	**Green gram**	**2.12**		
				Paddy	Potato	2.07		
4	Paddy	Potato	1.43	Paddy	Groundnut	2.04	Paddy-green gram /mustard / potato / groundnut	Compartmental bunding, intercropping, INM
				Paddy	Mustard	2.24		
				Paddy	Green gram	2.55		
				Paddy	Potato	2.12		

Fig. 2.5.45

Namkhana Block, South 24 Pargana District, West Bengal

LMU	Description
1	Strongly acidic (*Rabi Season*), silty clay texture, poorly drained, moderate fertility status, slight salinity (*Kharif Season*), frequent flooding and moderate erosion
2	Moderately acidic(*Rabi Season*), silty clay loam, moderately saline *(Kharif Season)*, frequent flooding and moderate erosion

Average B: C ratio (Existing/ Traditional): 1.56
Average B: C ratio (LRI based LUP with BMP): 2.30
Increase of B;C ratio over existing/ traditional: 47.4%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Rice	Rice	1.62	Rice	Rice	2.04	Rice-cum-Fishery, Rice-rice	Land shaping with dug out pond, INM, green manuring
	Rice	Fallow	1.13	Rice-cum-Fishery		2.82		
2	Rice	Rice	1.72	Rice	Potato	2.07	Rice –chilli/ potato /mustard	Land shaping with dug out pond, INM, green manuring
	Rice	Rabi-veg.	1.78	**Rice**	**Mustard**	**2.01**		
				Rice	Chili	2.61		
				Rice	Rabi-veg.	2.24		

Fig. 2.5.46

Canning - II Block, South 24 Paragana District, West Bengal

LMU	Description
1	Moderately acidic (*Rabi*), poorly drained silty clay loam soils with low fertility status under occasional flooding and slight erosion
2	Strongly acidic (*Rabi*), poorly drained silty clay, low permeability, high salinity (*Kharif*), low fertility status under occasional flooding and slight erosion

Average B: C ratio (Existing/ Traditional): 1.60
Average B: C ratio (LRI based LUP with BMP): 2.32
Increase of B;C ratio over existing/ traditional: 45.0%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Rice	Rice	1.74	Rice	Rice	2.21	Rice-cum-Fishery, Rice-rice	Land shaping with dug out pond, intercropping, INM
	Rice	Fallow	1.26	Rice-cum-Fishery		2.83		
2	Rice	Rice	1.42	Rice	Potato	2.22	Rice-chilli/ potato / green gram / mustard	Land shaping with dug out pond, intercropping, INM
	Rice	Chili	1.99	**Rice**	**Mustard**	**2.01**		
				Rice	Chili	2.36		
				Rice	**Green gram**	**2.26**		

Fig. 2.5.47

Kultali Block, South 24 Pargaganas District, West Bengal

LMU	Description
1	Very deep, somewhat poorly drained, fine silty soils ,neutral to slightly acidic, with occasional to frequent flooding and slight to moderate salinity
2	Very deep, somewhat poorly drained, fine silty soils, moderately acidic with occasional to frequent flooding and slight to moderate salinity
3	Very deep, somewhat poorly drained, fine silty soils moderately acidic with occasional to frequent flooding and slight to moderate salinity.
4	Very deep, somewhat poorly drained, fine soils, moderately acidic, with very frequent flooding and slight salinity.
5	Very deep, somewhat poorly drained, neutral to slightly alkaline, fine silty to fine soils with frequent to very frequent flooding and moderate salinity.

Average B: C ratio (Existing/ Traditional): 1.44
Average B: C ratio (LRI based LUP with BMP): 2.43
Increase of B;C ratio over existing/ traditional: 68.8%

LMU	Existing			LRI based LUP with BMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Fallow	Potato	2.12	Green manuring	Mustard	2.78	Green manuring-mustard	Land shaping with dug out pond, intercropping, grass strips
2	Rice (RF)	Lathyrus	1.18	Rice (RF)	Tomato/ Chilli	2.10	Rice(RF)-tomato/chilli	Land shaping with dug out pond, intercropping, grass strips
3	Rice (RF)	Watermelon	1.29	**Rice (RF)**	**Sesame**	**2.16**	Rice(RF)-sesame	Land shaping with dug out pond, intercropping, grass strips
4	Rice (RF)	Watermelon	1.29	Rice (RF)	Potato	2.01	Rice(RF)-potato/ rice (IR)	Land shaping with dug out pond, intercropping, grass strips
				Rice (RF)	**Rice (IR)**	**2.08**		
5	Rice (RF)	Fallow	1.32	**Rice (RF)**	**Watermelon**	**2.00**	Fish-cum-rice – gourd, Rice(RF)-watermelon, permanent fishpond	Land shaping with dug out pond, intercropping, grass strips
				Fish-cum-rice	Gourds	3.30		
				Permanent pond fishery		**3.00**		

Fig. 2.5.48

Lower Gangetic Plains
Hasnabad Block, North 24 Paraganas District, West Bengal

LMU	Description
1	Imperfectly drained, coarse-loamy, calcareous soils with occasional flooding
2	Poorly drained, fine-loamy soils with occasional flooding
3	Imperfectly drained, fine soils with frequent flooding and moderate erosion
4	Imperfectly drained, fine soils with frequent flooding and moderate erosion

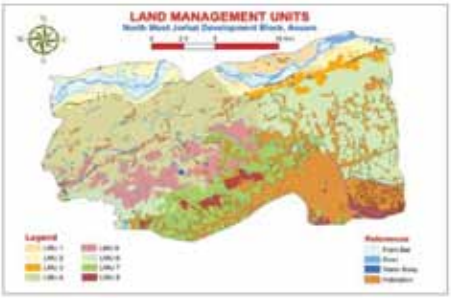
Average B: C ratio (Existing/ Traditional): 1.48
Average B: C ratio (LRI based LUP with BMP): 2.02
Increase of B;C ratio over existing/ traditional: 36.5%

LMU	Existing			LRI based LUP with CRMP			Recommendations	Soil & water conservations
	Kharif	Rabi	B:C	Kharif	Rabi	B:C		
1	Rice	Mustard	1.75	Rice	Mustard	2.01	Rice-mustard/ potato/ lentil/ chilli	Land leveling, bunding, vegetation strips, INM, minimum tillage
	Jute	Rice	1.34	**Rice**	**Lentil**	**2.16**		
				Rice	**Chili**	**2.00**		
				Rice	Potato	1.95		
2	Rice	Rice	1.37	**Rice**	**Rice**	**2.01**	Rice- mustard / rice	Land shaping with dug out pond
				Rice	Mustard	2.01		
3	Jute	Rice	1.34	Rice	Mustard	2.01	Rice-mustard/ potato/ lentil/ chilli	Land shaping with dug out pond
	Rice	Potato	1.69	**Rice**	**Lentil**	**2.16**		
				Rice	**Chili**	**2.00**		
				Rice	Potato	1.95		
4	Rice	Rice	1.37	**Rice**	**Rice**	**2.01**	Rice- mustard / rice	Land shaping with dug out pond
				Rice	Mustard	2.01		

Fig. 2.5.49

N-E- Regions: Upper Brahmaputra Valley

North West Jorhat Development Block, Jorhat District, Assam



LMU	Descriptions
1	Well drained, coarse-loamy, soils on active flood plains under multi-cropping
2	Imperfectly drained, fine-loamy, soils on active flood plains under mono-cropping
3	Very poorly drained, fine, gleyed soils on marshes & swamps under currently fallow
4	Imperfectly drained, fine-loamy soils on younger flood plains under multi-cropping
5	Imperfectly drained, coarse-loamy, soils on younger flood plains under currently fallow
6	Imperfectly drained, fine-loamy soils on older flood plains under double cropping
7	Imperfectly drained, coarse-loamy Soils on older flood plains under mono- cropping
8	Moderately well drained, fine-loamy soils on older flood plains under tea plantation

Average B: C ratio (Existing/ Traditional): 1.23
Average B: C ratio (LRI based LUP with BMP): 2.42
Increase of B;C ratio over existing/ traditional: 96.7%

LMU	Existing				LRI based LUP with BMP				Recommendations	Soil & water conservations
	Pre-Kharif	Kharif	Rabi	B:C	Pre-Kharif	Kharif	Rabi	B:C		
1	Ahu Rice	No Crop	Mustard	1.65	Ahu Rice	--	Mustard	2.89	Ahu rice-cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
	No Crop	No Crop	Cabbage	1.66	Ahu Rice	--	Cabbage	3.67		
	No Crop	No Crop	Potato	0.85	**Ahu Rice**	**--**	**Potato**	**2.00**		
					Ahu Rice	--	Pea	2.79		
2	Ahu Rice	No Crop	No Crop	0.82	Ahu Rice	Sali Rice	Mustard	2.52	Ahu rice – Sali rice - cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
					Ahu Rice	Sali Rice	Cabbage	3.04		
					Ahu Rice	**Sali Rice**	**Potato**	**2.18**		
					Ahu Rice	Sali Rice	Pea	2.46		
3	No Crop	No Crop	No Crop	--	Ahu Rice	Sali Rice	--	2.00	Ahu rice – Sali rice	Land shaping with dug out pond, raised bunding (≥ 1.0 m)
4	Ahu Rice	Sali Rice	Mustard	1.26	Ahu Rice	Sali Rice	Mustard	2.46	Ahu rice – Sali rice - cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
					Ahu Rice	Sali Rice	Cabbage	2.76		
					Ahu Rice	**Sali Rice**	**Potato**	**2.18**		
					Ahu Rice	Sali Rice	Pea	2.29		
5	No Crop	No Crop	No Crop	--	Ahu Rice	Sali Rice	Mustard	2.21	Ahu rice – Sali rice - cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
					Ahu Rice	Sali Rice	Cabbage	2.51		
					Ahu Rice	**Sali Rice**	**Potato**	**2.18**		
					Ahu Rice	Sali Rice	Pea	2.04		
6	Ahu Rice	Sali Rice	No Crop	1.03	Ahu Rice	Sali Rice	Mustard	2.35	Ahu rice – Sali rice - cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
					Ahu Rice	Sali Rice	Cabbage	2.45		
					Ahu Rice	**Sali Rice**	**Potato**	**2.18**		
					Ahu Rice	Sali Rice	Pea	2.29		
7	No Crop	Sali Rice	No Crop	1.07	Ahu Rice	Sali Rice	Mustard	2.37	Ahu rice – Sali rice - cabbage/ mustard / pea / potato	Bunding, vegetation strips, intercropping, INM
					Ahu Rice	Sali Rice	Cabbage	2.67		
					Ahu Rice	**Sali Rice**	**Potato**	**2.18**		
					Ahu Rice	Sali Rice	Pea	2.20		
8	Tea			1.5	Tea			2.00	Tea	Intermittent deep furrows

Fig. 2.5.50

Validation of LRI based land use planning

Coastal region of West Bengal : Gosaba block, South 24 Parganas, West Bengal

Soils of the block are grouped into three Land Management Unit (LMU). Land management unit and crop planning of each LMU is shown in **table 2.5.4.** The impact of the interventions is shown in table 2.5.5.

It reveals that the cropping intensity increased from existing 112 to 198 – 296 per cent, which reflected in terms of increased income and livelihood (Table 2.5.6 and 2.5.7).

Table 2.5.4. Land Management Units and Land Use Plan of Gosaba

LMU	Land Management Plan
LMU 1 (Acid sulphate layer below (m depth)	Liming, green manuring and fertilization with rock phosphate Adoption of 3-tier approach fish in pond, vegetables and fruit crops in upland, multipurpose tree species (MPTs) in pond dykes and paddy in low land with integrated soil nutrient management.
LMU 2 (Acid sulphate layer within 60 cm)	Liming, green manuring and fertilization with rock phosphate Adoption of 2 tier approach with vegetation/fruit crops on the ridge and paddy on the furrow with integrated soil nutrient management.
LMU 3 (Acid sulphate layer between 60 cm to 1m)	Adoption of 2 tier approach with wide dyke for vegetable cultivation, ditch for fish and main land for paddy and pulses.

Table 2.5.5. Impact of adopted technology on cropping pattern (model for 1ha land)

Land Management unit	Land Shaping Model	Pre-intervention		Post- intervention			Cropping Intensity (%)	
		Kharif season	*Rabi* season	Land situation created (area in m²)	*Kharif* season	*Rabi/* summer season	Before	After
LMU 1	Farm Pond (50% area)	Rice	Mostly fallow	Pond (400)	Fish	Fish	112	283
				Dikes (162)	Vegetables & fruit crops	Vegetables & fruit crops		
				High land (1438)	Vegetables	Vegetables		
				Medium land (3000)	Rice	Vegetables, Pulses		
	Low land	Rice	Mostly fallow	Trenches (396)	Fish	Fish		
				Dike (432)	Vegetables	Vegetables		
				Original low land (4172)	Paddy	Pulse/oilseed		
LMU 2	Shallow furrow and medium ridges (75%)	Rice	Mostly fallow	Ridges (3750)	Vegetables & fruit crops	Vegetables & fruit crops	112	296
				Furrow (3750)	Paddy cum fish	Pulses/oilseed		
	Original low land (25%)			Original low land (2500)	Paddy	Pulse/oilseed		
LMU 3	**Option 1** Deep furrow and high ridges (50%)	Rice	Mostly fallow	Ridges (3750)	Vegetables, fruit crops & horticultural crops	Vegetables, fruit crops& horticultural crops	112	257
				Furrow (3750)	Fish	Fish		
	Original low land (50%)			Original low land (2500)	Paddy	Pulse/oilseed		
	Option 2 Paddy-cum-fish			Trenches (846)	Fish	Fish	112	198
				Field dikes (882)	Vegetables	Vegetables		
				Original low land (8272)	Rice	Pulses/ Vegetables		

Table 2.5.6. Impact of adopted technology on Farm income (model for 1ha land)

LMU	Land Shaping Model	Pre- intervention		Land situation created	Net income (Rs)		Difference in net income (Rs)	
		Kharif season	*Rabi* season		*Kharif*	*Rabi/* summer season	Pre-intervention	Post-intervention
LMU 1	Farm Pond (50% area)	Rice	Mostly fallow	Pond	-	1.26,000/	**26,090/-**	**2,38,950/-**
				Pond dike	11,300/-	13,500/-		
				High land	65,000/-	55,000/-		
				Medium land	16,400/-	9,800/-		
	Paddy cum fish in Original Low Land (50%)	Rice	Mostly fallow	Trenches	-	9,200/-		
				Trenches dike	23,100/-	19,050/-		
				Original low land	21,000/-	6,400/-		
LMU 2	Shallow furrow and medium ridges (75%)	Rice	Mostly fallow	Ridges	91,000/-	72,350/-	**30,275/-**	**2,74,700/-**
				Furrow	83,000/-			
	Original low land (25%)			Original low land	21,000/-	7,350/-		
LMU 3	**Option 1** Deep furrow and high ridges (50%)	Rice	Mostly fallow	Ridges	96,700/-	84,100/-	**31,500/-**	**3,02,300/-**
				Furrow		93,000/-		
	Original low land (50%)			Original low land	22,000/-	6,500/-		
	Option 2 Paddy-cum-fish			Trenches	-	70,000/-	**31,500/-**	**2,22,800/-**
				Dikes / field bunds	45,000/-	40,000/-		
				Original low land	43,200/-	24,600/-		

Table 2.5.7. Impact of adopted technology on farmers' income in Gosaba block, W.B.

LMU	Area under LMU (ha)	Adopted technology	Net income ha^{-1} (Rs)	Income generated by the block (in lakhs)	Increase in livelihood with 1 ha of land (times)
LMU 1	3159	Farm Pond & Paddy cum fish	**2,38,950/-**	**7548.43**	**9.15**
LMU 2	8107	Shallow furrow and medium ridges	**2,74,700/-**	**22269.92**	**9.07**
LMU 3	5085	**Option 1** Deep furrow and high ridges	**3,02,300/-**	**15371.95**	**9.59**
		Option 2 Paddy cum fish	**2,22,800/-**	**11329.38**	**7.07**

Deccan peninsula of Karnataka plateau : H.D. Kote, Mysore, Karnataka

Soils of the mandal are grouped under four Land Management Units (LMUs). LMU wise existing land use, constraints and crop suitability is given in table 2.5.8. Customized recommended management and LRI practices (CRMP) and Recommendation based on only LRI dataset for each LMU been developed. Both were compared with farmers' practice average yield, net return, B: C ratio and per cent increase over farmers practice and presented in tables 2.5.9. to 2.5.12.

Table 2.5.8. Land use, constraints and crop suitability of LMUs

LMU	Existing land use	Characteristics	Crop suitability
LMU 1	Cotton	Shallow, well drained, gravelly red loam soils with low WHC and low productivity	Cotton-N; Finger millet-S3; Maize-S3; Horse gram/Green gram-S1; Field bean-S2; Pigeon pea-N; Cowpea-S2
LMU 2	Cotton, Finger millet,	Medium deep, well drained, sandy clay loam soils with medium WHC and medium productivity	Cotton-S3; Finger millet-S2; Maize-S2; Pigeonpea-S2;Green gram/cowpea/black gram-S1
LMU 3	Cotton	Deep, well drained, sandy clay loam soils with high water retention and low to medium productivity	Cotton-S2; Finger millet-S1; Maize-S1; Pigeonpea-S1;Green gram/cowpea/black gram-S1;Mango-S2, Amla-S1; Banana-S1
LMU 4	Cotton	Deep to very deep, moderately well drained, clayey soils with shade and low to medium productivity.	Cotton-S1; Finger millet-S1; Maize-S2; Pigeonpea-S1;Green gram/cowpea/black gram-S1;Mangeo-S2, Amla-S1; Banana-S1

Table 2.5.9. Economic analysis of recommendations of LMU 1

LUP	Land Use (Cropping system)		Av. Yield (q/ha)		Net return of CS (Rs./ha/yr)	B:C ratio	Increase over farmers' practice (%)
	Kharif	*Rabi*	*Kharif*	*Rabi*			
Farmers	Cotton	--	4.50	-	5750	0.57	-
LRI based	Cotton	-	6.0	-	9000	0.75	
	Finger millet	Field bean	18	3.0	17000	1.70	
	Sesame	Field bean	3.0	7.5	21500	2.15	
	Black gram	Field bean	5.0	8.0	18000	2.80	
	Average				16375	1.85	184
CRMP	Cotton	-	6.0	-	9000	0.75	
	Finger millet	Field bean	18	3.0	17000	1.70	
	Sesame	Field bean	3.0	7.5	21500	2.15	
	Marigold	Finger millet	40	15	23000	1.92	
	Black gram	Field bean	5.0	8.0	18000	2.80	
	Average				17700	1.86	208

Table 2.5.10. Economic analysis of recommendations of LMU 2

LUP	Land Use (Cropping system)		Av. Yield (q/ha)		Net return of CS (Rs./ha/yr)	B:C ratio	Increase over farmers' practice (%)
	Kharif	Rabi	Kharif	Rabi			
Farmers	Cotton	-	6.0	-	11000	1.10	-
	Finger millet	--	15.0	-	7000	0.87	
	Average				9000	0.98	
LRI based	Cotton	-	11.0	-	23500	1.57	
	Cotton	Cowpea	10.0	5.0	34000	2.12	
	Cotton	Horse gram	12.0	5.0	41000	2.56	
	Finger millet	-	22.0	-	11500	1.09	
	Finger millet	Field bean	20.0	3.0	17500	1.52	
	Finger millet	Rabi-veg.		35.0	56200	2.23	
	Average				30616	1.85	240

LUP	Land Use (Cropping system)		Av. Yield (q/ha)		Net return of CS (Rs./ha/yr)	B:C ratio	Increase over farmers' practice (%)
	Kharif	Rabi	Kharif	Rabi			
CRMP	Cotton	-	11.0	-	23500	1.57	
	Cotton	Cowpea	10.0	5.0	34000	2.12	
	Cotton	Horse gram	12.0	5.0	41000	2.56	
	Finger millet	-	22.0	-	11500	1.09	
	Finger millet	Field bean	20.0	3.0	17500	1.52	
	Maize	Banana	35.0	200.0	255000	1.75	
	Cotton	Rabi-veg.			46950	1.82	
	Finger millet	Rabi-veg.			56200	2.23	
	Average				60706	1.83	574

Table 2.5.11. Economic analysis of recommendations of LMU 3

LUP	**Land Use (Cropping system)**		**Av. Yield (q/ha)**		**Net return of CS (Rs./ha/yr)**	**B:C ratio**	**Increase over farmers' practice (%)**
	Kharif	***Rabi***	***Kharif***	***Rabi***			
Farmers	Cotton	--	8.0	-	**18000**	**1.80**	-
LRI based	Maize	-	40.0	-	25000	1.67	
	Cotton	Chilli	10	50	55000	3.66	
	Chilli	-	80.0	-	15000	1.50	
	Finger millet	-	25.0	-	35000	1.32	
	Average				32500	2.04	80
CRMP	Maize	-	40.0	-	25000	1.67	
	Cotton	Chilli	10	50	55000	3.66	
	Chilli	-	80.0	-	15000	1.50	
	Finger millet	-	25.0	-	35000	1.32	
	Banana	-	400	-	250000	3.00	
	Average				76000	2.23	322

Table 2.5.12. Economic analysis of recommendations of LMU 4

LUP	**Land Use (Cropping system)**		**Av. Yield (q/ha)**		**Net return of CS (Rs./ha/yr)**	**B:C ratio**	**Increase over farmers' practice (%)**
	Kharif	***Rabi***	***Kharif***	***Rabi***			
Farmers	Cotton	--	7.5	-	**16250**	**1.62**	-
LRI based	Cotton		10	-	23000	1.92	
	Maize	Veg. cowpea	35.0	50.0	70000	2.00	
	Average				**46500**	**1.96**	**186**
CRMP	Banana		350	-	200000	2.50	
	Coffee, Drumstick, spices				135000	5.51	
	Field bean + Tomato + Beans + okra + veg. cowpea +bitter gourd				156000	3.12	
	Average				163667	3.71	907

Northern Deccan plateau :Vidarbha region, Maharashtra

Pigeon pea (*Cajanuscajan*) is cultivated as intercrop with orange (Nagpur Mandarin) followed by wheat (*Triticumaestivum*) in Vidarbha region, Maharashtra. Their productivity is low due to low cropping intensity, inappropriate soil fertility management, poor management of water conservation structures and unavailability of water for irrigation in post monsoon season. About 620 m^3 of silt deposited in drain line had filled the existing check dam/bunds resulting in less than 30% water storage. Hence, the storage capacity of 925 m^3 was largely unutilized. Soil and water

management strategies were developed to increase the crop productivity. The check dam and bunds in the area were repaired. As a result the water overflow occurred at non-erosive velocity which reduced siltation. The stream was desilted before the onset of southwest monsoon in May 2016 along a stretch of 300 m and the storage capacity was enhanced to 6.1 lakh litres. For increasing the efficiency of water, drip irrigation was adopted in the orange orchards.

For managing the soil fertility, three LMUs were identified. LMU 1 represents shallow red soils; LMU2 and LMU3 were delineated for calcareous and non-calcareous black soils, respectively. Soil samples were collected and analysed for major and micro-nutrients and soil health cards were distributed among the farmers'.The soils were deficient in nitrogen (<240 kg/ha) and zinc (<0.6 mg/kg). Soil test crop response (STCR) based recommendations were adopted for pigeon pea in *kharif* 2016 and for wheat in *rabi* 2016-17 season in the fields of 50 selected beneficiary farmers. The results indicated that the average farmers' yield of pigeon pea was 9.1 q/ha

in the farmers practice, whereas average yield of pigeon pea was 15.4 q/ha under improved practice. Moreover, a higher yield (16.1, 16.8 and 17.4 q/ha) of pigeon pea was recorded in LMU3.

However in LMU 2 and LMU3, the yield of pigeon pea intercropped with mandarin plantations was lower, ranging from 7.4 to 9.2 q/ha with an average of 8.3 q/ha due to the limited space (45% of total area), competition for light, water and nutrients as the canopy of citrus plantations occupied 55% of the area. For increasing the productivity in the second season broad bed furrow (BBF) was recommended

to increase the water holding capacity and moisture availability during the crop growth. The water stored in the bunds was used for irrigation at critical stage. Results were compared with farmers' practice. The average wheat yield was 27.4 q/ha in LMU2 and LMU3 under BBF system and the observed yield increase over the farmers practice was 23.4%.The additional gross income per hectare were Rs. 31,815 (B: C ratio 2.4) and 14,400 (B: C ratio 1.6) for pigeon pea and wheat, respectively (Table 2.5.13 and 2.5.14). However, LMU1 with shallow red soils are found not suitable for holding pigeon pea-wheat cropping system intercropped with citrus. Thus viability and productivity of pigeon pea- wheat cropping system intercropped with citrus could be enhanced by the use of soil resource based management practices involving integrated nutrient and water management. In case of chickpea (Variety - vishal), 92 and 137 per cent increase registered in LMU 2 and 3 over farmers' practice with B: C ratio of 2.9 and 3.4, respectively (Table 2.5.15).

Table 2.5.13 Pigeon pea yield under different soils and management practices

LMU with	Soil based management	FP	% yield increase over FP	B:C ratio
Shallow red soil	6.3	6.1	3.2	1.2
Calcareous black soil	15.4	8.5	81	2.1
Non-calcareous black soil	17.4	9.1	91	2.4

Table 2.5.14. Wheat yield under different soils and management practices

Soil type	BBF	FP	% yield increase over FP	B:C ratio
LMU 2 (Calcareous black soil)	24.1	20.9	15	1.4
LMU 3 (Non-calcareous black soil)	27.4	22.2	23	1.6

Table 2.5.15. Chickpea yield under different soils and management practices

Soil type	BBF	FP	% yield increase over FP	B:C ratio
LMU 2 (Calcareous black soil)	16.1	8.4	92	2.9
LMU 3 (Non-calcareous black soil)	23.5	12.9	137	3.4

Economic land evaluation of Bukkaraya Samudrum mandal for groundnut crop

Data were collected from 100 rainfed groundnut system respondents across the Bukkarayasamudrum mandal and analysed for benefit cost analysis (table 2.5.16). The Groundnut yield ranged from 7.4-24.7 q/ha and the average cost of cultivation per ha is Rs. 15911. Crop on the soils of 75-100 cm depth have BC ratio of 2.05 compared to crop on the soils of 50-75 cm (2.00) and 25-50 cm (1.97) depth. Higher B:C ratio of 2.42 was recorded in the crops grown on loamy soils as compared to other soils. Higher B:C Ratio of 2.02 for the crop was registered in non calcareous soils than their calcareous counterparts (1.95).

Table 2.5.16. Economic land evaluation of Bukkarayasamudrum mandal for Groundnut crop

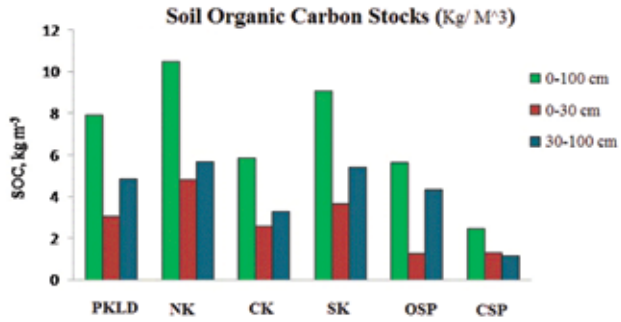
Soil Unit	Depth	Surface texture	Erosion	Gravelliness (%)	Large farmers		Medium farmers		Small farmers	
					Yield (q/ha)	BC Ratio	Yield (q/ha)	BC Ratio	Yield (q/ha)	BC Ratio
CPb2B1	25-50	b	moderate	15-35	-	-	22.2	2.5	-	-
CPc2B	25-50	c	moderate	<15	4.4	1.9	9.9	2.2	16.7	1.5
CPc2B1	25-50	c	moderate	15-35	7.4	1.5	-	-	-	-
DPb2B	50-75	b	moderate	<15	-	-	-	-	24.7	2.3

Soil Unit	Depth	Surface texture	Erosion	Gravelliness (%)	Large farmers		Medium farmers		Small farmers	
					Yield (q/ha)	BC Ratio	Yield (q/ha)	BC Ratio	Yield (q/ha)	BC Ratio
DPc2B	50-75	c	moderate	<15	-	-	8.2	2.1	-	-
DPc2B1	50-75	c	moderate	15-35	-	-	9.9	2.6	-	-
DPh2B	50-75	h	moderate	<15	7.4	0.9	8.2	1.3	-	-
DPhA	50-75	h	slight	<15	-	-	14.8	1.8	-	-
DPiB1	50-75	i	slight	15-35	-	-	14.1	1.9	18.1	1.5
GPiA	100-150	i	slight	<15	5.6	0.7	17.0	2.3	23.9	2.3
NPc2A	75-100	c	moderate	<15	-	-	-	-	22.2	2.8
NPc2B	75-100	c	moderate	<15	7.4	0.7	-	-	-	-
NPc2C	75-100	c	moderate	<15	7.4	1.9	-	-	22.2	1.6
NPc2C1	75-100	c	moderate	15-35	-	-	-	-	22.2	2.9
NPCB	75-100	c	slight	<15	-	-	22.2	2.6	-	-
NPcC1	75-100	c	slight	15-35	-	-	11.1	1.6	-	-
NPcC2	75-100	c	slight	35-60	-	-	-	-	22.2	2.4
NPh2B	75-100	h	moderate	<15	-	-	-	-	24.7	2.4
NPh2B1	75-100	h	moderate	15-35	-	-	19.8	1.1	22.2	2.2
NPHA	75-100	h	slight	<15	-	-	8.5	1.7	22.2	1.9
RPcc2C	100-150	c	moderate	<15	8.2	1.1	-	-	-	-
VphA	50-75	h	slight	<15	3.7	0.8	9.2	1.7	11.1	2.5
YPhA	50-75	h	slight	<15	-	-	8.2	1.7	12.4	2.1
YPmA	50-75	m	slight	<15	-	-	16.5	2.2	-	-

b-loamy sand; c- sandy loam, h-sandy clay loam, i- sandy clay, m-clay:

Land use planning of coconut based land use systems in Kerala

A project is initiated under the leadership of ICAR-NBSS&LUP with ICAR-CPCRI, ICAR-CTCRI, ICAR-IISR and KVKs in Kerala where the productivity of coconut (*Kera*), is around 35 nuts per palm per year. This is less than half the productivity of palms in Tamil Nadu and Karnataka. The nutrient mapping has been done and the results indicated that besides the problems of acidity, calcium, magnesium, zinc, boron and chlorine are the deficient nutrients both in the surface and the sub-surface. The organic carbon stock was estimated at different depth of coconut growing soils in different agro-ecological zones (Fig. 2.5.51). The treatment combinations have been developed with the best agronomic practices involving return of palm residues to the base of palm and zero tillage.



PLKD-Palakkad (Typic Haplustalfs) NK-North Kerala (Plinthic Palehumults) CK-Central Kerala (Plinthic Kandiustults) SK-South Kerala (Typic Plinthustults) OSP-Onattukara Sandy Plain (Aquic Ustipsamments)

Fig.2.5.51. Depth-wise distribution of organic carbon stocks (SOC kg m-3) in coconut-growing soils of Kerala under different AEZs

Soil and water conservation planning using LRI database

Very precise and quantified information on degree and length of slope and curvature together with contour, drainage, hill shades and land uses collected in LRI project are very useful in estimating water harvesting potentials and planning soil conservation measures. In a study in eight watersheds of Karnataka (Table. 2.5.17), water harvesting potentiality has been estimated using LRI database with existing and proposed water body. The estimated command area watershed wise is also calculated for 10, 15 and 20 cm irrigation.

Table 2.5.17. Water harvesting potential of eight watersheds in Karnataka

Micro-watershed	Area (ha)	LMU	Soil erosion (t ha^{-1})	Runoff (% rainfall)	Water harvesting potential* (m^3)	Storage structure (20m x 20m x 3m)	Command area (ha) for different level of irrigation		
							10cm	15cm	20cm
Dharjaganga	559.2	LMU 1 to 8	2.30-3.82	32.4-45.4	592752	494	296	198	148
Kinhi	649.7	LMU 1 to 5	3.22-4.12	36.5-52.4	750404	625	375	250	188
Marguti	637.8	LMU 1 to 6	1.84-2.42	24.5-32.6	401814	335	201	134	100
Shirol West-2	432.3	LMU 1 to 6	1.62-2.86	22.6-38.6	320334	267	160	107	80
Shirunj	611.3	LMU 1 to 7	2.6404.28	34.6-56.8	672430	560	336	224	168
Yelishirur-1	588.5	LMU 1 to 10	2.26-3.46	28.6-45.6	554956	462	277	185	139
Yelishirur-2	624.0	LMU 1 to 9	1.24-1.88	18.6-2.12	299520	250	150	100	75
Yelishirur-3	723.6	LMU 1 to 7	2.30-3.82	32.4-45.4	808985	674	404	270	202
	4826.4				4401195	3667	2199	1468	1100

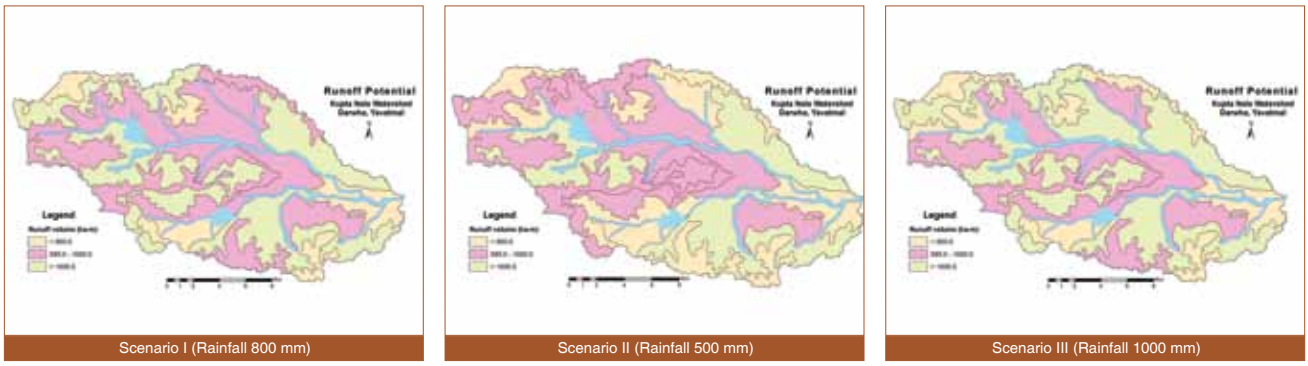
Another study conducted in Darwha block of Yavatmal district, Maharashtra using LRI database (Fig.2.5.53 to 2.5.58, Table 2.5.18 and 2.5.19) for soil and water conservation measures (Fig.-2.5.59) and for projecting water harvesting potentials in three situations of rainfall (Fig. 2.5.52). The database is further very useful for predicting ground water potentials. The study reveals that shallow soils with high slopes have very low prospects of ground water potentials, whereas the prospects for ground water is very high on nearly level deep loamy soils (Fig. 2.5.59).

Table 2.5.18. Criteria for deciding type of structure for watershed development

Structure	Slope (%)	Permeability	Runoff potential	Stream order	Watershed area (ha)
Farm ponds	0-5	Low	Medium/high	1	1-2
Check dams	< 15	low	Medium/high	1-4	25
Subsurface dykes	0-3	High	Medium/Low	>4	> 50
Percolation tanks	6-7	High	Low	1-4	25-40

Table 2.5.19. Criteria for selecting appropriate water conservation structure

Types of Structure	Lithology	Land Use/ Land Cover	Slope	Drainage	Soil texture*
Storage Tank	Sandstone/ Limestone	Wasteland	Steep Slope	2nd or 3rd order Stream	Clay, clay loam
Percolation Tank	Sandstone/ Quartzite	Land with Scrub	Moderate Slope	2nd, 3rd or 4th order stream	Loam, sandy loam
Stop Dam	Phylite / Schist	Forest	Very Gentle Slope	3rd and 4th order Stream	Not applicable
Check Dam	Granite/ Genissic	Cropland	Gentle Slope	5th and 6th order Stream	Clay , clay loam



Scenario I (Rainfall 800 mm) | Scenario II (Rainfall 500 mm) | Scenario III (Rainfall 1000 mm)

Fig. 2.5.52 Runoff harvesting potential

Table 2.5.20. Comparison of water harvesting structures over exsting water bodies

Scenario	Scenario I (800mm)	Scenario II (500 mm)	Scenario III (1000 mm)
Volume of water that can be stored by the existing water bodies	about 2500 ha-m	about 2500 ha-m	about 2500 ha-m
Volume of water that can be harvested by the proposed WHS about 6000 ha-m about 2400 ha-m			about 8200 ha-m

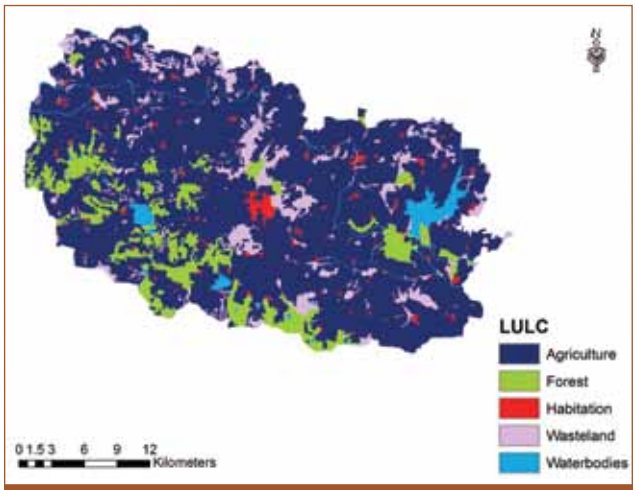


Fig 2.5.53. Land use map of Darwha block of Yavatmal district, Maharashtra

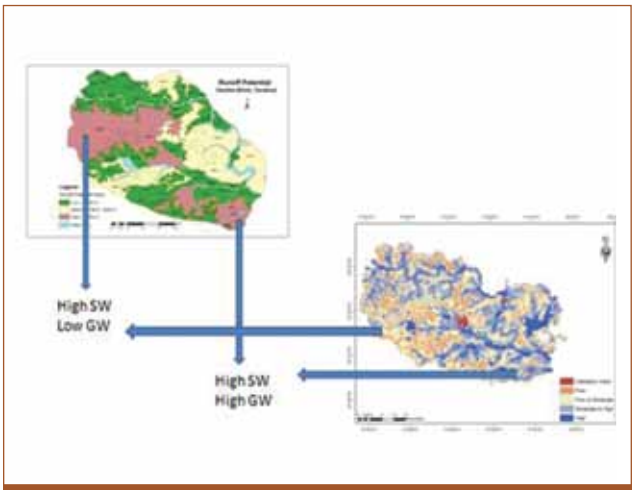


Fig. 2.5.54. Ground water prospect map of Darwha block of Yavatmal district, Maharashtra

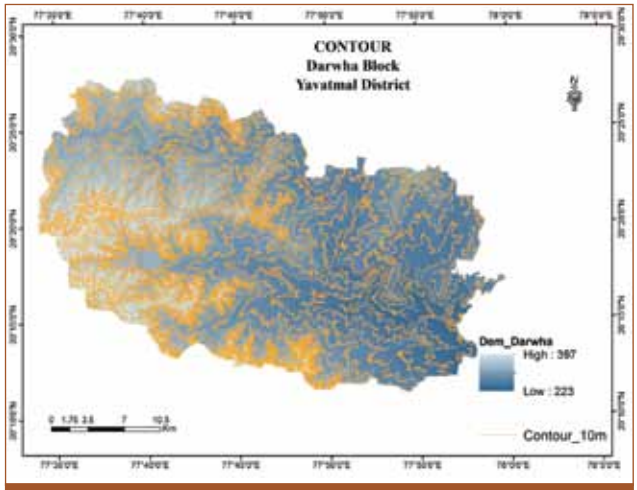


Fig. 2.5.55. Contour map of Darwha block of Yavatmal district, Maharashtra

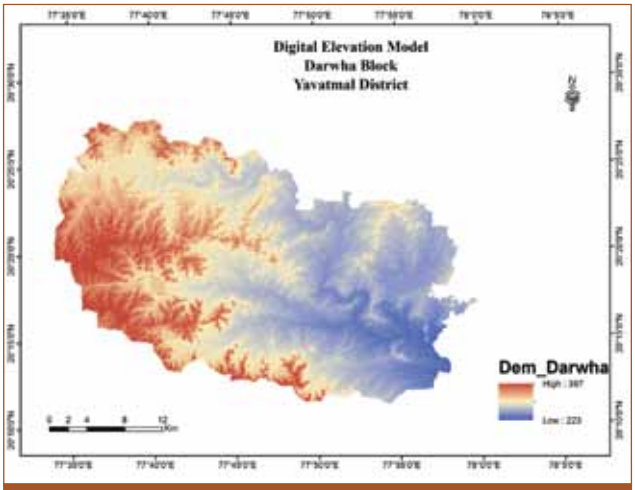


Fig.2.5.56 Digital elevation model map of Darwha block of Yavatmal district, Maharashtra

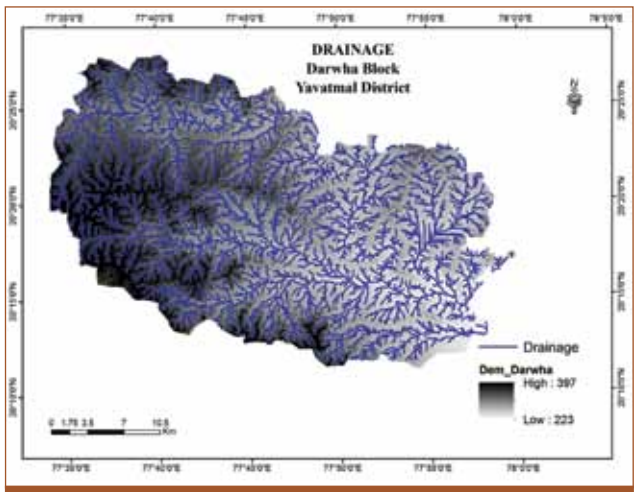


Fig. 2.5.57 Drainage of Darwha block of Yavatmal district, Maharashtra

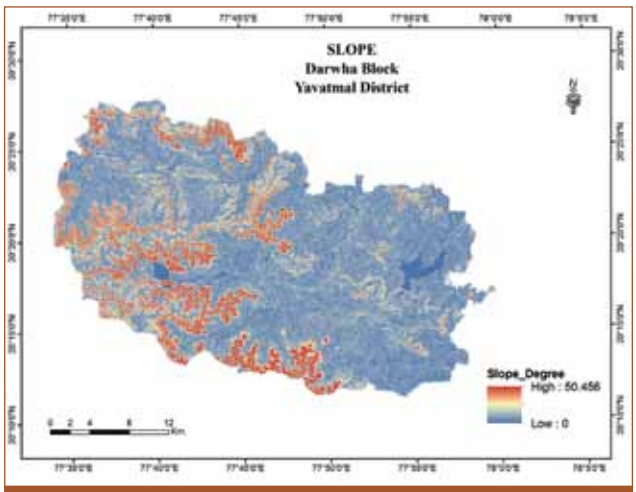


Fig. 2.5.58 Slope map of Darwha block of Yavatmal district, Maharashtra

The database of LRI could also be used execution of govt. sponsored land based activity in conjunction with socio-economic conditions of the farmers. The study claims that shallow soils generally owned by small and marginal farmers should be targeted for soil conservation plans, whereas medium farmer's owner of medium and deep soils should be chosen for diversification of agriculture. Non eroded deep soils owned by large farmers are the ideal family for targeting value added crops (Fig. 2.5.59).

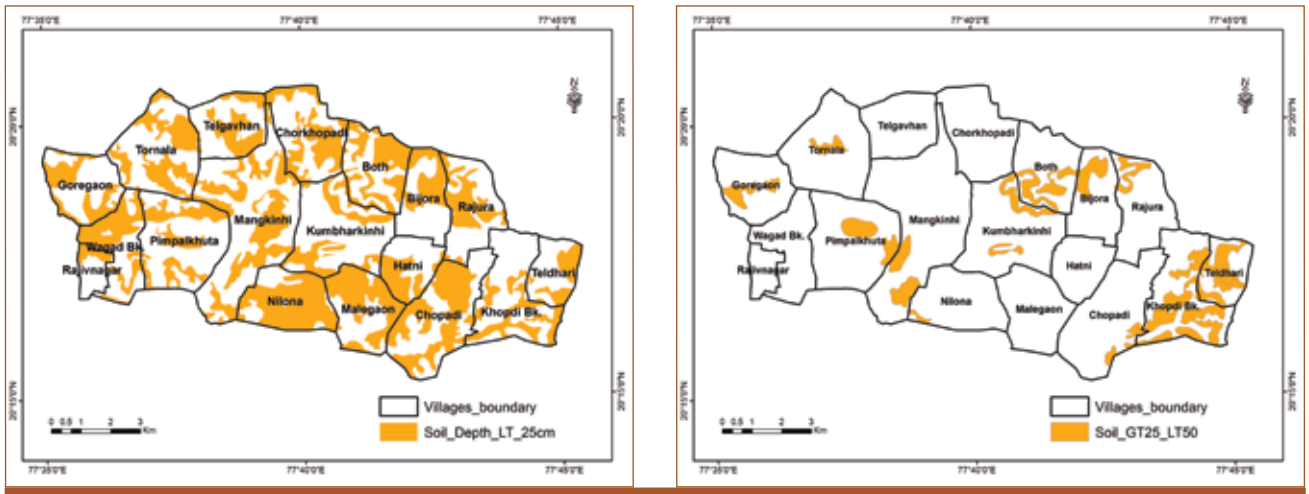


Fig. 2.5.59 Targeted farmer Group for adoption of soil moisture conservation

The study has done on unit area of watershed and claims that LRI database with socio-economic fabric society has potential to set the road map of transforming rainfed agriculture in India.

2.6 EXTENSION PROGRAMME

Development of Soil Geo-portal 'BHOOMI' and ICAR agriculture data repository portal 'KRISHI' - Application of information technologies

A Geo-portal is a web portalused to find and access geographic information (geo-spatial information) and associated geographic services (display, editing, analysis, etc.) via internet. It is important for effective use of geographic information system (GIS) and a key element of Spatial Data Infrastructures (SDI).The importance of such spatial databases in management and optimum utilization of natural resources is well recognized. Information on several soil parameters is available in the country and these are in scattered form in different research papers and reports. Keeping this in view, a dedicated Geo-portal "Bhoomi" on soils by collating geo-referenced soil and allied resources database in Geographic Information System (GIS),

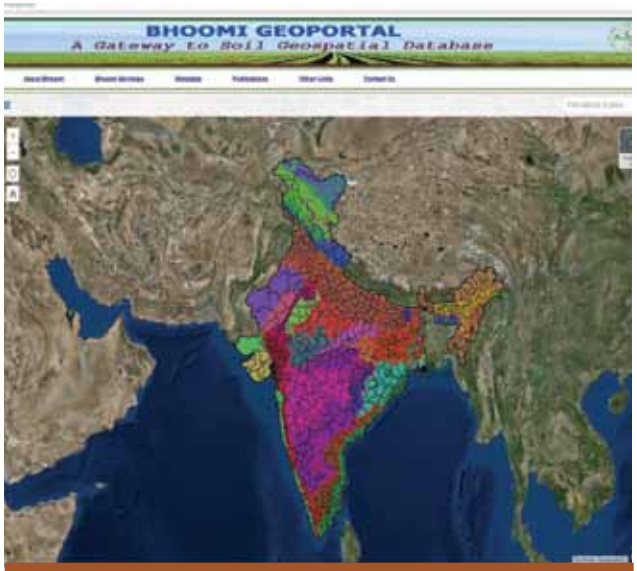


Fig. 2.6.1. Ground water prospect map of Darwha block of Yavatmal district, Maharashtra

Geo-portal provides platform for exchange of soils research data with national and international agencies for monitoring of soil quality and carrying out research in ecology, climate change and land use planning.

In the Geo-portal *Bhoomi*, the soil and site characteristics in terms of polygon, line and point data and administrative division of the country like boundaries of states, districts, tehsils and village are arranged in systematic manner and the database structure is kept open to link cadastral boundary in future. Soil maps of 1:1M, 1:250000, 1:50000 and 1:10000; various thematic maps on natural resources depicting type, spatial distribution and severity of degradation and desertification; degradation in crop land, prime agriculture land, soil nutrient status map depicting area of sufficiency, deficiency and toxicity of nutrients in the country; area vulnerability to drought (type and severity) and flood (extent and severity) are structured in a systematic manner.Attempt has been made to depict potential area for crops and cropping pattern and horticultural crops in an organized manner. A framework has been developed for placing the information on agro-ecological zones to agro-ecological units via sub-regions and zones.

ICAR-NBSS&LUP is also actively involved as key partner in conceptualization of theme and development of ICAR Research Data Repository for Knowledge Management (KRISHI). The design and development of front end of ICAR Geoportal has been developed to show case Indian agricultural research capabilities in various domains. KRISHI Geoportal provides a gateway to explore and discover geospatial databases with specific emphasis on Indian Agriculture. This portal makes available geo-referenced data collected by ICAR institutions on climate, soil, cropping systems, land-use pattern *etc*. KRISHI Geo-portal is an initiative to make geo-spatial data related to Agriculture to all the stakeholders. Front end and thematic services developed in ICAR KRISHI Geo-portal are shown in **fig. 2.6.2.**

BHOOMI is a dedicated portal for soil related information; KRISHI Geo-portal is an initiative to make geo-spatial data related to Agriculture accessible to all the stakeholders. These Geo-portals will eliminate redundancies and duplication of efforts, and enforce

Fig. 2.6.2. Krishi Geo portal

consistency, standards, and sharable protocols to build a cross-domain soil knowledge base for effective utilization of limited natural resources in the country.

Rubber Soil Information System

National Bureau of Soil Survey and Land Use Planning (NBSS & LUP), ICAR in collaboration with Rubber Research Institute of India (RRII), Rubber Board under took a detailed survey of rubber growing soils of south India with an objective to bring the entire rubber area in the country within the ambit of soil test based fertilizer recommendation. Rubber growing area (three years and older) in each panchayat was mapped with medium resolution satellite images of scale 1:50000 and one composite soil sample (0-30 cm) was collected from each 50 ha rubber area. Total 11000 soil samples were collected from rubber growing regions of south India during December 2012 and May 2013. Soil samples were analysed following standard analytical protocols for soil pH, organic carbon and primary, secondary and micronutrients in the laboratories of RRII and NBSS & LUP and nutrient content in the fine earth fraction was mapped with geostatistical techniques for deriving a surface using the values from the measured locations to predict values for each location in the landscape Kriging interpolation technique was used. Web based fertilizer recommendation "Rubber Soil Information System" was developed based on interpolated soil fertility data in collaboration with Indian Institute of Information Technology and Management - Kerala (IIITM-K). Rubber Soil Information was released for use to public by Hon'ble Minister of Commerce, Dr. Nirmala Sitaraman at Udyog Bhavan, New Delhi on 23. 02. 2017.

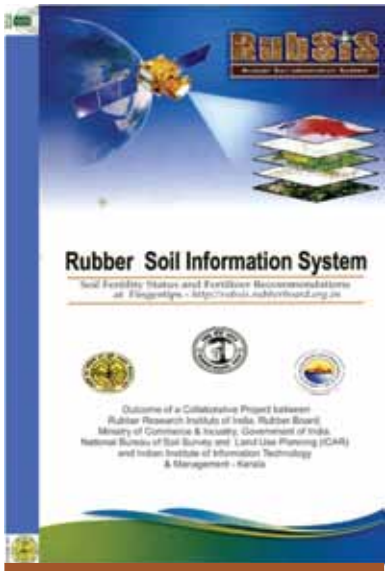


Fig. 2.6.3. Rubber Soil Information System

Digital soil library-An Application of Information Technology

The spatial data is being created in File Geo-database format in ArcGIS environment and the Digital Library (DL) software is being developed using Visual Studio.NET. Fig. 2.6.4 shows the opening screen of the DL software, where the user has to select the

micro watershed and Fig. 2.6.5 shows the soil map of selected watershed. The software displays all the information of the selected land parcel *i.e.* soils, current land use, existing hydrological structures, proposed conservation measures, fertility status and suitability to different crops. Software module is developed to display the village wise land parcels with selected soil or fertility status. Using the software, one can also generate reports and excel file with properties of all the land parcels for the selected village (Fig. 2.6.6). Using digital library one can prepare village or micro watershed reports. The software also includes the facility to view the photos and pedon description forms of the selected soil series (Fig. 2.6.7). Using the digital library, LRI database of 60 watersheds has been generated. The thematic maps for depth, LCC, slope, texture, erosion, gravelliness and suitability maps for 11 horticultural crops *i.e.* Amla, Cashew, Custard Apple, Guava, Jackfruit, Black berry (Jamun), Lime, Mango, Orange (moosambi), Sapota (Chikoo), and Tamarind have been developed. Soil fertility maps have also been prepared.

Fig. 2.6.4. Opening screen of the Digital Library software

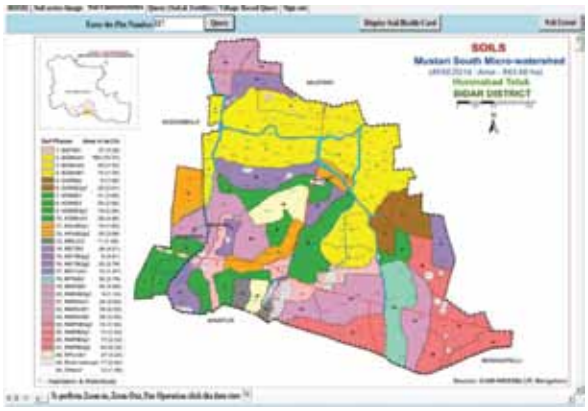
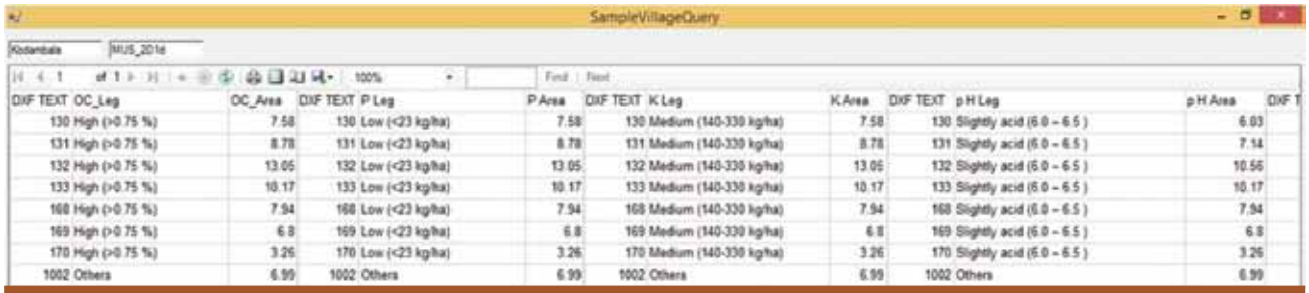


Fig. 2.6.5. Computer screen showing the soil map of selected watershed



SampleVillageQuery

Kodambala | MUS_2016

DXF TEXT	OC_Leg	OC_Area	DXF TEXT	P Leg	P Area	DXF TEXT	K Leg	K Area	DXF TEXT	p H Leg	p H Area	DXF T
130	High (>0.75 %)	7.58	130	Low (<23 kg/ha)	7.58	130	Medium (140-330 kg/ha)	7.58	130	Slightly acid (6.0 – 6.5)	6.03	
131	High (>0.75 %)	8.78	131	Low (<23 kg/ha)	8.78	131	Medium (140-330 kg/ha)	8.78	131	Slightly acid (6.0 – 6.5)	7.14	
132	High (>0.75 %)	13.05	132	Low (<23 kg/ha)	13.05	132	Medium (140-330 kg/ha)	13.05	132	Slightly acid (6.0 – 6.5)	10.56	
133	High (>0.75 %)	10.17	133	Low (<23 kg/ha)	10.17	133	Medium (140-330 kg/ha)	10.17	133	Slightly acid (6.0 – 6.5)	10.17	
168	High (>0.75 %)	7.94	168	Low (<23 kg/ha)	7.94	168	Medium (140-330 kg/ha)	7.94	168	Slightly acid (6.0 – 6.5)	7.94	
169	High (>0.75 %)	6.8	169	Low (<23 kg/ha)	6.8	169	Medium (140-330 kg/ha)	6.8	169	Slightly acid (6.0 – 6.5)	6.8	
170	High (>0.75 %)	3.26	170	Low (<23 kg/ha)	3.26	170	Medium (140-330 kg/ha)	3.26	170	Slightly acid (6.0 – 6.5)	3.26	
1002	Others	6.99	1002	Others	6.99	1002	Others	6.99	1002	Others	6.99	

Fig. 2.6.6. Computer screen with the results of the selected village

Fig. 2.6.7. Computer screen showing the soil profile photo of the selected soil series

3 RESEARCH PROGRAMME

Institute Projects (Ongoing)

Inventorying Natural Resources

Land Resource Inventory at 1:10000 scale for agricultural land use planning using geo-spatial techniques.

- Bukkarayasamudrum Mandal, Anantapur district, Andhra Pradesh
- Elamdesom block, Idukki district, Kerala
- Erravally village, Jagdeopur Mandal, Medak district, Telangana
- Kangayam block, Tiruppur distrcit, Tamil Nadu
- Kaveripattinam block, Krishnagiri district, Tamil Nadu.
- Kolapura Micro- watersheds, Bangalore district, Karnataka
- Sidlaiahnakote village, Hiriyur taluk, Chitradurga district, Karnataka
- Adopted villages under farmers first project of ICAR-IIHR, Bangalore
- Baragaon block, Varanasi district, Uttar Pradesh
- Chamba block, Tehri Garhwal district, Uttarakhand
- Jagner block, Agra district, Uttar Pradesh
- Lahul block, Lahul and Spiti district, Himachal Pradesh
- Leh block, Leh (Ladakh) district, Jammu & Kashmir
- Nagrota Bagwan block, Kangra district, Himachal Pradesh
- Odhan block, Sirsa district, Haryana
- Pangi block, Chamba district, Himachal Pradesh
- Rajpura block, Patiala district, Punjab
- Shahpur block, Muzaffarnagar district, Uttar Pradesh
- Bishalgarh block, Sepahijala District, Tripura
- Chakchaka block, Barpeta district, Assam
- Diyun block, Changlang district, Arunachal Pradesh
- Kolasib district, Mizoram
- Mokokchung district, Nagaland (Jhum intensified area)
- Thadlaskein block, West Jaintia Hills district, Meghalaya
- Baisi block, Purnea district, Bihar
- Basudevpur block, Bhadrak district, Odisha
- Borio block, Sahibganj district, Jharkhand
- Chakia block, East Champaran district, Bihar
- Dumka block, Dumka district, Jharkhand
- Ganjam block, Ganjam district, Odisha
- Katkamdag block, Hazaribagh district, Jharkhand
- Mangan block, north Sikkim district, Sikkim
- Maynaguri block, Jalpaiguri district, West Bengal
- Mushahari block, Muzaffarpur district, Bihar
- Piprakothi block, Purba Champaran district, Bihar
- Rajnagar block Birbhum district, West Bengal
- Tangi block, Khurda district, Odisha
- Titlagarh block, Bolangir district, Odisha
- Anupgarh taluka, Sriganganagar district, Rajasthan
- Central State Farm Sardargarh, Suratgarh and Sriganganagar district, Rajasthan.
- Deesa taluka, Banaskantha district, Gujarat
- Dholka taluka, Ahmadabad district, Gujarat
- Fatehgarh block, Jaisalmer district, Rajasthan
- Neem Ka Thana block, Sikar district, Rajasthan
- Porbandar taluka, Porbander district, Gujarat
- Rapar taluka, Kutch district, Gujarat
- Gujarat state- A step towards enhancing agricultural productivity and transfer of technology
- Suratgarh block, Sriganganagar district, Rajasthan
- Bemetara block, Bemetara district, Chattisgarh
- Darwah block, Yavatmal district, Maharashtra
- Dhanora block, Seoni district, Madhya Pradesh
- Rawatsar block, Hanumangarh district, Rajasthan
- Sriganganagar block, Sriganganagar district, Rajasthan

Soil Correlation

- Correlation of soil series of India

Remote Sensing and GIS Applications

- Design and Development of Land Resource

Information System and NBSS Geoportal for geospatial database management and dissemination

- Development of digital terrain database and landform mapping at tehsil/block level in different Agro-Ecological Sub-Regions of central India using geospatial techniques
- Landform and land use / land cover mapping of some selected blocks of eastern and north eastern India
- Landform and land use/land cover mapping of some selected blocks using remote sensing and GIS for land resource inventory at 1:10000 scale
- Soil erosion assessment and conservation planning using remote sensing and GIS of Dhanora block, Seoni district, Madhya Pradesh

Basic Pedological Research

- Genesis and Classification of soils of Bemetara Block, Chattisgarh
- Genesis of Vertisols in peninsular India: Evidence from Mineralogy and Geochemistry (Subproject of Modeling Genesis of Red and Black Soils of Peninsular India)
- Modeling genesis of red and black soils of peninsular India

Land Evaluation for Land Use Planning

- Agricultural land use planning for Basudevpur Block of Bhadrak district Odisha using land Resource Inventory Database on 1:10000 scale
- Agricultural land use planning for Bemetara block, Chattisgarh using land resource inventory database on 1:10000 scale
- Agricultural land use planning for Neem Ka Thana block, Sikar district (Rajasthan) using land resource inventory database on 1:10000 scale
- Agricultural land use planning for Porbandar taluka, Porbandar district using land resource inventory database on 1:10000 scale.
- Agricultural land use planning for Rajnagar block of Birbhum district, West Bengal using land resource inventory database on 1:10000 scale
- Agricultural land use planning of Baragaon Block of Varanasi District of Uttar Pradesh using land resource data on 1:10000 scale.
- Agricultural land use planning of Bukkarayasmudrum Mandal of Anantapur district, Andhra Pradesh and Gajwel mandal of Medak district of Telangana Using land resources inventory database on 1:10000 scale.
- Agricultural land use planning of Nagrota Bagwan block of Kangra district, H.P. using land resource data on 1:10000 scale.
- Agricultural land use planning of umsning block of Ri-Bhoi district, Meghalaya using land resources inventory database on 1:10000 scale.
- Agricultural land use planning using land resource inventory database on 1:10000 scale for Darwah block, Yavatmal district, Maharashtra.
- Agricultural Land Use Planning using Land Resource Inventory Database on 1:10000 scale for Dhanora block, Seoni district, Madhya Pradesh.
- Agricultural land use planning using land Resource inventory database on 1:10000 scale for Dhanora block, Seoni district, Madhya Pradesh
- Analysis of temporal and spatial land use Changes and its impacts in basaltic terrain of Vidarbha Region in Maharashtra
- Delineation of prime agricultural lands in Central India – An approximation at 1:250000 scale
- Developing alternate farming system model using soil resource information in the Sonagachhi village of Baruipur Block (District South 24-Parganas) of West Bengal
- Development of decision support system for agricultural land use planning
- Devising soil and water conservation measures for Tiswadi block in Coastal region of Goa
- Management of natural resources and climate risk for environmentally sustainable land use planning – a case study of Rajpura block, Punjab
- Prime agricultural land identification and their spatial distribution in West Bengal
- Socio-economic assessment of agricultural land use pattern in selected villages of agro-ecological sub region six and ten.

Tribal Sub Plan (TSP) Programme

- Improving livelihoods through integrated natural resource management in Chanawada watershed, Girwa Tehsil, Udaipur district.
- Land use option for enhancing productivity and improving livelihood in Bali Island of Sundarbans
- Livelihood improvement of tribal communities in selected hamlets of H.D. Kote, Mysore through integrated land use planning
- Soil and water management strategies for enhancing agricultural productivity in a cluster of tribal villages in Warud tehsil, Amravati district.

Human Resource Development

- Human Resource Development in Post Graduate

Education and Research in Land Resource Management (LRM), PDKV, Akola and ICAR-NBSS&LUP, Nagpur collaborative project

Institute Projects (Completed)

Inventorying Natural Resources

Land resource inventory at 1:10000 scale for agricultural land use planning using geo-spatial techniques

- Kadwa block, Katihar district, Bihar
- Madahalli and Singanallur micro-watershed, Chamrajnagar district, Karnataka
- North west Jorhat development block, Jorhat district, Assam

Externally Funded Project (Ongoing)

Inventorying Natural Resources

- Characterization and mapping of land resources of Goa in Reference to cultivated and fallow land use systems - A step towards enhancing agricultural productivity
- Characterization of mulberry growing soils in selected seri-villages of Golaghat district of Assam
- Desertification status mapping of India (2nd cycle)
- Land resource inventory in Sujala watersheds of Chikmagalur district
- Land resource inventory of Ri-Bhoi district (Umsning, Umling and Jirang blocks), Meghalaya at 1:10000 scale for agricultural land use planning using geospatial technique.
- Land resource inventory of selected micro-watersheds in seven backward districts of Karnataka under Sujala-Watershed Development Project (Karnataka Watershed Project-III)

Remote Sensing and GIS Applications

- GIS based Digital Library (DL) for the Land resources of Sujala III watershed development project
- Hyperspectral remote sensing in characterization and mapping of red and associated soils of Southern India
- ICAR KRISHI Geoportal-Experts Knowledge based Resources Information Systems Hub for Innovations in Agriculture (ICAR Research Data Repository for Knowledge Management)
- Mapping and assessment of land degradation in major ecosystems of India using geospatial technologies (ICAR Extramural Research Projects)

Basic Pedological Research

- Generation and modeling of carbon datasets in different agro-ecosystems for climate resilient agricultural planning (NICRA)
- Influence of organic and inorganic carbon sequestration on soil and land quality in selected benchmark spots of India (DST-IS-STAC)
- Soil quality assessment and developing indices for major soil and production regions of India (ICAR Extramural Research Projects)

Land Evaluation and Land Use Planning

- Adoption of irrigated agriculture to climate change (ATCHA) (partnering with ongoing International project of IISC, Bangalore and INRA, France)
- Assessment of environmental and economic input of the new agricultural policy of Karnataka in land use, land productivity and rural livelihood (DST)
- Bridging the production gaps in potential districts of sunflower and sesame through dynamic technology transfer
- Economic land evaluation of Bukkarayasamudrum Mandal for groundnut crop
- Enhancing economic viability of coconut based land use systems for land use planning of Kerala
- Land suitability mapping for optimum crop plan based on food security requirements of Karnataka (*Karnataka Agricultural Price Commission (KAPC), Government of Karnataka*)
- Socio economic evaluation of agricultural land use in India- phase-I

Externally Funded Project (Completed)

- Assessment of salt affected soils of Tamil Nadu and its impact on crop (Tamil Nadu State Land Use Research Board)
- Development of Soil Health Card (SHC) using GIS techniques for Nagpur rural block, Nagpur district and Kelapur Taluka, Yavatmal district
- Fallow lands of Tamil Nadu – cause, effects and measures to arrest the march of fallows.
- Gajwel mandal, Medak district, Telangana
- Indervelly mandal, Adilabad district, Telangana
- Soil fertility assessment and soil health monitoring in traditional coffee-growing areas of Karnataka, Kerala and Tamil Nadu
- Soil fertility assessment and aoil health monitoring in traditional rubber-growing areas of Kerala, Tamil Nadu and Karnataka
- Thimajipet mandal, Mehboobnagar district, Telangana

4 PUBLICATIONS

Research Papers

Anil Kumar, K.S., Kalaiselvi, B., Nair, K.M. and Singh, S.K. 2016. Characterization of red and lateritic soils formed under varied climates and their management, *Clay Research,* **35(1):**42-52.

Anil Kumar, K.S., Lalitha, M., Kalaiselvi, B., Patil, Siddaram, Nair, K.M. and Sujatha, K., 2015. Soil organic carbon stocks: A potential land quality indicator for soils of western Karnataka, *Agropedology*, **25(2**):161-168.

Bandyopadhyay, Siladitya, Obi Reddy, G.P., Dutta, D., Reza, S.K., Dutta, D.P., Baruah, Utpal, Sah, K.D. and Singh, S.K. 2015. Assessment of erosion susceptibility zones in Diring-Thanglong watershed north eastern hill regions of Assam using GIS techniques, *Agropedology,* **25(2):**169-180.

Bhaskar, B. P., Prasad, J. and Tiwari, G. 2017. Evaluation of agricultural land resources for irrigation in the cotton growing Yavatmal district, Maharashtra, India. *Journal of Applied and Natural Science,* **9(1):** 102 –113.

Bhaskar, B. P., Tiwari, G. and Prasad, J. 2017. Pedogenic influence on profile distribution of total and DTPA - extractable micronutrients in rice growing hydric soils of Majuli river island, Assam, India. *Spanish Journal of Soil Science,* **7(1):** 45-71.

Bhaskar, B.P. and Tiwari, G. 2017. Geochemical interpretations of laterite associated soils of east coast Andhra Pradesh. *Chemical Science Review and Letters,* **6(21**):187-197.

Bhaskar, B.P., Anantwar, S.G., Gaikwad, S.S. and Bobade, S.V. 2016. Land resource assessment for agricultural development in Seoni district, Madhya Pradesh, India. *Journal of Applied and Natural Science,* **8(2):**750-759.

Bhattacharyya T., Tiwary P., Pal D.K., Khobragade R., Telpande B. and Kuchankar H. 2017. Estimating soil organic matter and available N : A ready reckoner for soil testing laboratories. *Advanced Agricultural Research & Technology Journal*, **1(1):**3-13.

Bhattacharyya, T., Wani S P., Pal, D.K., Sahrawat, K.L., Pillai, S., Nimje A., Telpande, B.,Chandran, P. and Chaudhury, S. 2016. ICRISAT, India soils: yesterday, today and tomorrow, C*urrent Science*, **110**:1652 -1670.

Chattaraj, S., Srivastava, R., Barthwal, A. K., Giri, J. D., Mohekar, D. S., Obi Reddy, G. P., Daripa, A., Chatterji S. and Singh S.K. 2017. Semi-automated object-based landform classification modelling in a part of the Deccan Plateau of central India, *International Journal of Remote Sensing* **38(17):**4855-4867.

Chattopadhyay, T., Nayak, D.C., Mukhopadhyay, S., Sahoo, A.K. and Singh, S.K. 2017. Land evaluation for crop planning in soils of Indo-Gangetic Plains of Hugli district, West Bengal, *Indian Agriculturist*, **59(4):**215-222.

Chaudhury, S., Bhattacharyya, T., Wani, S.P., Pal, D.K., Sahrawat, K.L., Nimje, A., Chandran, P., Venugopalan, M.V. and Telpande, B. 2016. Land use and cropping effects on carbon in black soils of semi-arid tropical India C*urrent Science*, **110**:1692 -1698.

Dharumarajan, S., Lalitha, M., Natarajan, A., Naidu, L.G.K., Balasubramanian, R., Hegde, R., Vasundhara, R., Anil Kumar, K. S. and Singh, S.K. 2017. Biophysical and socio economic causes for increasing fallow lands in Tamil Nadu. *Soil Use and Management*. DOI:10.1111/sum.12361

Dharumarajan, S., Naidu, L.G.K., Lalitha, M., Vasundhara, R., Anil Kumar, K.S., Rajendra Hegde and Singh, S.K. 2016. Assessment of suitability of fallow lands for major medicinal plants in Tamil Nadu. *International Journal of Bio-resource and Stress Management*. **7(4):**877-884.

Dongare, V., Maji, A.K., Obi Reddy, G.P. and Ramteke, I.K. 2016. Land Suitability Evaluation for Rice (*Oryza sativa L.*) in Tirora tehsil of Gondia district, Maharashtra - A GIS approach, *Agropedology,* **26(01):**69-78.

Dubey, P.N., Bhaskar, B.P., Chandran, P., Singh, B. and Mishra, B.K. 2016. Geochemistry of some ferruginous soils of Kerala, India. *Journal of Applied and Natural Science,* **8(1):**196-207.

Dutta, D., Bandyopadhyay, S., Baruah, U. and Sarkar, D. 2016. Characterizations of soil at different landforms in hilly areas of Meghalaya state. *Journal of the Indian Society of Soil Science,* **64(3):**302-309.

Fagodiya, R.K., Pathak, H., Meena, B.L., Meena, R.K., Nagdev, R. 2017. Need to estimate the net global warming potential of nitrogenous fertilizers. *Advances in Plants and Agriculture Research,* **6(4):**00220.

Gajare A.S., Mandal D.K. and, Jagdish Prasad 2016. Assessment of different pools of organic carbon for better C management in cotton-growing shrink-swell soils of Jalgaon district, Maharashtra. *The Indian Journal of Agricultural Sciences,* **85(5):**77-80.

Gangopadhyay, S.K., Nayak, D.C. and Singh, S.K. 2016. Characteristics of tea growing soils in relation to soil acidity in upper Brahmaputra valley of Assam. *Journal of the Indian Society of Soil Science*, **64(4)**:341-350.

Giri, J.D., Nagaraju, M.S.S., Srivastava, R., Singh, D.S., Nasre, R.A., Barthwal, A.K. and Mohekar, D.S. 2016. Accuracy assessment of large-scale soil map prepared by remote sensing approach. *International Journal of Agricultural and Statistical Sciences* **12(1):**229-237.

Goswami, S.N., Sen, T.K., Jagdish Prasad and Chatterji, S.

2014. Effect of climatic and socio-ecnomic factors on under-utilization of land in Maharashtra. *Agropedology* **24(1):**41-51.

Hegde, R., Niranjana, K.V., Natarajan, A. and Singh, S.K. 2016. Detailed land resources inventory for effective planning of land based rural development programs. *Special Publication of Geological Society of India*. No.1-5 P.

Jagdish Prasad. 2015. Soil health management- A key for sustainable production. *Journal of the Indian Society of Soil Science,* **63:(**Supplement page S6-S13).

Jena, R.K., Duraisami, V.P., Sivasamy, R., Shanmugasundaram, R., Krishnan, R., Padua, S., Bandyopadhyay, S., Ramachandran, S., Ray, P., Deb Roy, P., Singh, S.K. and Ray, S.K. 2016. Characterization and classification of soils of Jirang block in Meghalaya plateau, *Agropedology,* **26(1):**47-57.

Jena, R.K., Duraisami, V.P., Sivasamy, R., Shanmugasundaram, R., Krishnan, R., Padua, S., Bandyopadhyay, S., Ramachandran, S., Ray, P., Deb Roy, P., Singh, S.K. and Ray, S.K. 2015. Spatial variability of soil fertility parameters in Jirang block of Ri-Bhoi district, Meghalaya. *Clay Research*, **34(1):**35-45.

Keshavarzi, A., Omran, E.S.E., Bateni, S.M., Pradhan, B., Vasu, D., Bhagerzadeh, A. **2016**. Modelling of available soil phosphorus (ASP) using multi-objective group method of data handling. *Model Earth System and Environment* **2**:157.

Lalitha, M., Dharumarajan, M., Natarajan, A., Niranjana, K.V., Srinivas, S., Naidu, L.G.K. and Sarkar, Dipak. 2016. Need for site specific land resource database for integrated watershed management. *Indian Journal of Soil Conservation*, **44(22):**168-176.

Meena, R.K., Parihar, S.S., Singh, M. and Khanna, M., 2016. Effects of sowing dates and irrigation regimes on grain quality of wheat grown under semi-arid condition of India. *Journal of Applied and Natural Science*, **8**(2):960- 966.

Meena, R.S., Meena, R.L., Rao, S.S., Singh, R.S., Verma, T.P. and Singh, S.K. 2017. Characterization of classification of soils of Jhalarapatan block, Jhalawar district of Rajasthan. *Journal of Plant Development Studies,* **9(3):**265-68.

Meena, R.S., Rao, S.S., Natrajan, A., Hegde, R. and Singh, S.K. 2017. Available micronutrient in soils of Chikkersinkere hobli of Maddur taluka, Mandya district of Karnataka. *Journal of plant development Studies,* **9(3):**229-233.

Minhas, P.S. and Obi Reddy, G.P. 2017. Edaphic stresses and agricultural sustainability: An Indian Perspective, *Agricultural Research* **6(1):**8-21.

Moharana, P.C**.** and Biswas, D.R. 2016. Assessment of maturity indices of rock phosphate enriched composts using variable crop residues. *Bioresource Technology,* **222:**1-13.

Moharana, P.C. and Biswas, D.R. 2017. Nutrient transformations in soil amended with rock phosphate enriched composts for improving productivity of wheat-green gram sequence. *Journal of Plant Nutrition*. DOI: 10.1080/01904167.2016.1269346.

Moharana, P.C**.**, Naitam, R.K., Verma, T.P., Meena, R.L., Sunil Kumar, Tailor, B.L., Singh, R.S., Singh, S.K. and Samal, S.K. 2017. Effect of long-term cropping systems on soil organic carbon pools and soil quality in western plain of hot arid India. *Archives of Agronomy and Soil Science*, DOI: 10.1080/03650340.2017.1304637.

Moharana, P.C., Sharma, B.M. and Biswas, D.R. 2017. Changes in the soil properties and availability of micronutrients after six year application of organic and chemical fertilizers using STCR-based targeted yield equations under pearl millet-wheat cropping system. *Journal of Plant Nutrition,* **40**:165-176.

Naitam, R.K. and Kharche, V.K. 2016. Characterization and classification of soils of Ramagarh village of Amravati district of Maharashtra. *Multilogic in Science*, **6(17):**211-218.

Naitam, R.K., Singh, R.S., Mohrana, P.C. and Singh, S.K. 2016. Characterization and evaluation of soils occurring on toposequence in eastern plain, Bhilwara district, Rajasthan for land use planning. *Agropedology,* **26(1**):94-104.

Naitam, R.K., Singh, R.S., Sharma, R.P., Verma, T.P. and Arora, S. 2016. Morphometric analysis of Chanavada-II watershed in Aravalli hills of southern Rajasthan using geospatial technique. *Journal of Soil and Water Conservation*, **15(4):**318-324.

Nalina, C.N., Anil Kumar, K.S., Chandrakala, M., Sheela Rani, S., Sujata, K., Shilpashree, K.G., Rajendra Hegde and Singh, S.K. 2016. Soil nutrient status mapping of Nagenahalli micro-watershed under Eastern Dry Zone of Karnataka by remote sensing, detailed soil survey and GIS, *Indian Journal of Agriculture Research* **50(5**):389-397

Nogiya, M., Pandey, R. N. and Singh, Bhupinder. 2016. Physiological basis of iron chlorosis tolerance in rice (*Oryza Sativa*) in relation to the root exudation capacity, *Journal of Plant Nutrition*, **39(11):**1536-1546.

Padekar D., Bhattacharyya T., Ray S.K., Tiwary P. and Chandran P. 2016. Influence of irrigation water on black soils in Amravati district, Maharashtra. *Current Science*, **110(9):**1740-1755.

Patangray, A.J., Patil, N.G., Singh, S.K., Mishra, V.N., Reddy, C.V.P. and Ramteke, I.K. 2017. Land use/land cover change detection using geospatial techniques in Kupti watershed of Darwha block of Yavatmal district, Maharashtra *Journal of Soil and Water Conservation* **16(1):**10-17.

Patil, N.G. and Singh S.K. 2016. Pedotransfer functions for estimating soil hydraulic properties: A Review. *Pedosphere* **26(4):**417–430.

Patil, N.G., Chaturvedi, A. and Singh, S.K. 2016. Land use issues in selected disadvantaged districts of Eastern India. *Agropedology* **26(1):**57-68.

Potdar, S.S., Gabhane, V.V., Potdar, H.S., Srivastava, Rajeev, Nasre, R.A. and Nagaraju, M.S.S. 2016.

Characterization, classification and mapping the soils of shegaon watershed, Chandrapur district of Maharashtra, using remote sensing and GIS technique. *Advances in Life Sciences* **5(18):**7489-7495.

Pradhan, S., Gorai, T., Ahmed, N., Bandopadhyay, K.K., Sahoo, R.N., Mahapatra, S.K. and Singh, R. 2016. Estimating S index, unsaturated hydraulic conductivity and diffusivity through RETC in Indian Agricultural Research Institute farm. *Journal of the Indian Society of Soil Science*, **64(2):**120-127.

Prasad, R., Yadav, S.K., Kumar, P. and Yadav, R.P. 2016. Performance of mango cultivars in eroded soils of Shiwalik foot hills. *Indian Journal of Soil Conservation,* **44(1)**:67-72.

Ramachandran, S., Nagender Rao, C., Dinesh, D., Srinivasan, R., Sankar, M., Ramesh, T. and Shelton Padua. 2015. Effect of tillage management practices on soil physical properties and yield of groundnut in rice-based cropping system. *International Journal of Bio-resource and Stress Management,* **6(6):**765-777.

Ramamurthy, V., Singh, M., Srinivas, A., Silpasree, Ramesh Babu, A.C., Naidu, L.G.K. and Prakasa Rao, E.V.S. 2016. Effect of age of plantation and season on leaf yield, content and composition of oil of *Eucalyptus citriodora* Hook and soil properties in semi-arid conditions of Karnataka. *Res. on Crops,* **17(1):**112-117.

Ramesh Kumar, S.C., Tejaswini, A.B., Prakashanaik, M.K., Nandini, S., Rajendra Hedge and Singh, S.K. 2016. Economics of kharif sorghum production in southern dry zone of Karnataka. *Agropedology*, **26(1):**29-33.

Ravindra Naik, M. and Anil Kumar, K.S**.** 2016. Mapping of crop growing soils in Kannur micro watershed Kollegal taluk, Chamarajnagar district, Karnataka, *International Journal of Science and Research (IJSR)* ISSN (Online): 2319-7064: **5(4):**474-481.

Ray, P. and Datta, S.P. 2016. Solid phase speciation of Zn and Cd in zinc smelter effluent-irrigated soils. *Chemical Speciation and Bioavailability*, **29(1**):6-14.

Ray, P., Datta, S.P., Rakshit, R. and Golui, D. 2016. Agronomic bio-fortification of food crops with zinc and iron for ameliorating their deficiencies in humans: constraints and possibilities. *Indian Journal of Fertilisers*, **12(7**):28-35.

Reza, S.K., Baruah, U. and Singh, S.K. 2016. Spatial distribution of Fe and Mn in paper mill effluent affected agricultural soils in Morigaon, Assam. *Agropedology,* **26(2):**87-93.

Reza, S.K., Baruah, U., Sarkar, D. and Singh, S.K. 2016. Spatial variability of soil properties using geostatistical method: a case study of lower Brahmaputra plains, India. *Arabian Journal of Geosciences,* **9**:446.

Reza, S.K., Baruah, U., Singh, S.K. and Srinivasan, R. 2016. Spatial heterogeneity of soil metal cations in the plains of humid subtropical northeastern India. *Agricultural Research,* **5(4):**346–352.

Reza, S.K., Nayak, D.C., Mukhopadhyay, S., Chattopadhyay, T. and Singh, S.K. 2017. Characterizing spatial variability of soil properties in alluvial soils of India using geostatistics and geographical information system. *Archives of Agronomy and Soil Science,* (DOI 10.1080/03650340.2017.1296134).

Reza, S.K., Singh, S., Datta, S.C., Purakayastha, T.J. and Singh, S.K. 2017. Phosphorus solubilization through organic acids production in pressmud composted with rockphosphate. *National Academy Science Letters,* **40(1):**13–16 (DOI 10.1007/s40009-016-0511-8).

Sahoo, A.K., Nayak, D.C., Mukhopadhyay, S., Banerjee, T., Singh, S.K., Sarkar, D., Sarkar, A.K., Agarwal, B.K. and Shahi, D.K. 2016. Mapping of block level soil fertility status of Dumka district, Jharkhand using GPS and GIS, *Indian Journal of Fertilisers*, **12(7):**50-57.

Sahu, Nisha and Sahu, Asha. 2016. Influence of phosphamidon on microbial biomass carbon, FDA and soil respiration in black soil (Entic Chromusterts). *International Journal of Agricultural Sciences,* **8(39):**1796-1798.

Sahu, Nisha, Obi Reddy, G.P., Nirmal Kumar, Nagaraju, M.S.S., Srivastava, Rajeev and Singh, S.K. 2016. Morphometric analysis in basaltic terrain of Central India using GIS techniques - A case study, *Applied Water Science.* DOI 10.1007/s13201-016-0442-z.

Sahu, Nisha, Singh, S.K., Obi Reddy, G.P., Nirmal Kumar, Nagaraju, M.S.S. and Srivastava, Rajeev 2016. Large-Scale Soil Resource Mapping using IRS-P6 LISS-IV and Cartosat-1 DEM in Basaltic Terrain of Central India. *Journal of Indian Society of Remote Sensing,* **44(5):**811-819.

Sharma, R.P., Singh, R.S., Singh, S.K. and Obi Reddy, G.P. 2016. Extent of land degradation and status of wastelands in Rajasthan (NW India) with a focus on the Bhilwara District, *Journal of Agriculture and Environment for International Development - JAEID*, **110(1**):97–115.

Singh, R., Singh, R.S., Purohit, H.S., Verma**,** T.P. and Garhwal, R.S. 2016. Productivity and suitability evaluation of orange (citrus reticulata)-growing soils of hot and semi-arid region of Rajasthan (AESR 5.2). *Journal of the Indian Society of Soil Science*, **64(1):**46-57.

Srinivasan, R., Jeevan Rao, K., Reza, S.K. Shelton Padua, Dinesh, D. and Dharumarajan, S. 2016. Influence of inorganic fertilizers and organic amendments on plant nutrients and soil enzyme activities under incubation. *International Journal of Bio-resource and Stress Management,* **7(4):**924-932.

Srinivasan, R., Natarajan, A., Anil Kumar, K.S., Dharumarajan, S. and Kalaivanan, D. 2016. Distribution of different forms of soil acidity in selective laterite soils under cashew plantations in coastal Karnataka. *International Journal of Bio-resource and Stress Management*, **7(2**):222-228.

Srinivasan, R., Reza, S.K., Nayak, D.C., Singh, S.K. and Sarkar, G.C. 2016. Characterization and classification of major vegetables growing soils of Odisha coastal system – A case study, *Agropedology,* **25(2):**232-239.

Srinivasan, R.; Mukhopadhyay, S.; Nayak, D.C. and

Singh, S.K. 2016. Characterization, classification and evaluation of soil resources in coastal eco-system – A case study of Gosaba block (Part), South 24-Parganas, West Bengal, *Agropedology,* **25(2):**195-201.

Srivastava, R., Sethi, M., Yadav, R.K., Bundela, D.S., Singh, M., Chattaraj, S., Singh, S.K., Nasre, R.A., Bishnoi, Sita Ram, Dhale, Sanjay, Mohekar, D.S. and Barthwal, A.K. 2016. Visible-near infrared reflectance spectroscopy for rapid characterization of salt- affected soil in the Indo-Gangetic plains of Haryana, India. *Journal of the Indian Society of Remote Sensing: DOI 10.1007/s12524-016-0587-0*

Suresh Kumar, Raizada, A., Biswas, H., Srinivas, S. and Mondal, B. 2016. Application of indicators for identifying climate change vulnerable areas in semi-arid regions of India. *Ecological Indicators*, **70**:507–517.

Surya, Jaya N., Sidhu, G.S., Lal, T., Katiyar, D.K. and Sarkar, Dipak. 2016. Impact of temporal change of land use and cropping system on some soils properties in Northwestern Parts of Indo-Gangetic Plain. *Current Science.* **111(1):**207-212.

Surya, J.N., Walia, C.S., Ahamad, N., Singh, H., Giyal, V. and Khajuria, V. 2016. Characterization and clay minerals copmosition of soils derived from metamorphic formations of Kumaun Himalayas., *Clay Research* **34(1**):15-24.

Vasu D., Singh S.K., Ray S.K., Duraisami V.P., Tiwary P., Chandran P., Nimkar A.M. and Anantwar S.G. 2016. Soil quality index as a tool to evaluate crop productivity in semi-arid Deccan plateau, India. *Geoderma*, **282**:70-79.

Vasu D., Singh S.K., Sahu N., Tiwary P., Chandran P., Duraisami V.P., Ramamurthy V., Lalitha M. and Kalaiselvi B. 2017. Assessment of spatial variability of soil properties using geospatial techniques for farm level nutrient management. *Soil and Tillage Research*, **169**: 25-34.

Vasu D., Singh S.K., Tiwary P, Chandran P., Ray S.K. and Duraisami V.P. 2017. Pedogenic processes and soil–landform relationships for identification of yield-limiting soil properties. *Soil Research*, **55(3):**273-284.

Vasu, D., Singh, S.K., Duraisami, V.P., Jangir, A. and Butte, P.S. 2016. Fertility status of cotton growing soils in Thimmajipet mandal, Mahabubnagar district, Telangana. *Andhra Pradesh Journal of Agricultural Sciences,* **2(1):**10-15.

Vasu, D., Singh, S.K., Karthikeyan, K., and Duraisami, V.P. 2016. Fertility Capability Classification (FCC): A case study in rainfed soils of semi-arid Deccan plateau. *Agropedology* **26(1):**22-28.

Vasu, D., Singh, S.K., Tiwary, P., Sahu, N., Ray, S.K. and Butte, P. 2017. Influence of geochemical processes on hydrochemistry and irrigation suitablity of groundwater in place of semi-arid Deccan Plateau, India. *Applied Water Science*, pp. 1-13. DOI: 10.1007/s13201-017-0528-2.

Vasundhara, R., Dharumarajan, S., Hegde, Rajendra, Srinivas, S., Niranjana, K.V., Srinivasan, R. and Singh, S.K. 2017. Characterization and evaluation of soils of Singanallur watershed using remote sensing and GIS. *International Journal of Bio-resource and Stress Management.* **8(1):**51-56.

Book Chapter

Anil Kumar, K.S., Lalitha, M., Patil, Sidharam, Kalaiselvi, B., Nair, K.M. and Singh, S.K. 2017. Assessment of Land Degradation Vulnerability: A Case Study from Parts of Western Ghats and West Coast of India Chapter 8**.** Part I: *Land Resource Inventory and Characterization* in *Ed.:* G. P. Obi Reddy, N.G. Patil and Arun Chaturvedi, 2017. *Sustainable Management of Land Resources*: An Indian Perspective. *Appl Academic Press*.

Anil Kumar, K.S., Nair, K.M., Ramesh Kumar, S.C., Srinivas, S., Ramamurthy, V., Sunil P. Maske, Jessy, M.D., Rajendra Hegde, James Jacob and Singh, S.K. 2016. Soil Quality Monitoring Sites (SQMS) for Traditional Rubber-growing Areas of South India, NBSS Publ. No. 1096, National Bureau of Soil Survey and Land Use Planning, Nagpur, India 1010 p.

Banerjee, T., Gupta Choudhury, S., Das, K., Nayak, D.C., Singh, S.K. 2016. Land Resource Inventory to Land Use Planning: A Tool for Sustainable Watershed Management. In Book: Land Use Planning and Management published by Institute of Landscape, Ecology and Ekistics, September, Vol.1.

Bhaskar B.P., Satyavathi P.L.A., Mandal C., Singh S.K. and Jagdish Prasad. 2017. Analysis of Aridity in Relation to Climate and Sustainability of Cotton Production in India. Climate Change and Sustainable Technology Environ. Sci. & Engg. 12: 84-114.

Bhaskar, B.P., Chaturvedi, A., Bhattacharyya, T. and Gaikwad, S.S. 2017. Land resource inventory and evaluation for agricultural land use planning in semiarid ecosystem of western India. (ed. by G.P. Obi Reddy, N.G. Patil and Arun Chaturvedi "Sustainable Management of Land resources- an Indian perspective"). *Apple Academic press*. pp.48-72.

Desertification and Land Degradation Atlas of India (Based on IRS AWiFS data of 2011-13 and 2003-05), Space Applications Centre, ISRO, Ahmedabad, India, 219 pages ISBN: ISBN: 978–93–82760-20-7.

Dubey, P.N., Bhaskar, B.P., Chandran, P., Singh, B. and Mishra, B.K. 2017. Major and trace element geochemistry in ferruginous soils developed under hot humid Malabar region, India. (Ed. G.P. Obi Reddy, N.G. Patil and Arun Chaturvedi "in Sustainable Management of Land resources- an Indian perspective"). *Apple Academic press*. pp.240-265.

Jagdish Prasad (2016). Land Resource Inventory at Different Levels: Needs and Methods. *In: Land Use Planning for Arresting Land Degradation, Combating Climate Change and Ensuring Food Security* (A training manual). NBSS&LUP Pub. No. **171**:16-23.

Jagdish Prasad and Singh A.K. 2016. Land Degradation in India- A Menace. In: Souvenir of Global Ravine Conference on Mananging Ravines for Food and Livelihood Security (March 7-10, 2016) held at Rajmata

Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior M.P., India, p.118-127.

Jatav, M.K., Dua, V.K., Govindakrishnan, P.M. and Sharma, R.P. 2016. Impact of climate change on potato production in India. In *Sustainable Potato Production and the Impact of Climate Change* (Edited by Sunil Londhe)). IGI Global, ISBN13: 9781522517153**,** DOI: 10.4018/978-1-5225-1715-3.ch002, pp 87-104.

Meena, R.S., Meena, R.L., Singh, R.S. and Verma, T.P. 2016. Soil-site suitability evaluation for Orange (*Citrus reticulata*) in soils of Jhalarapatan block, Jhalawar district (Rajasthan). *Soil Conservation Society of India*, New Delhi.

Mukherjee, A., Rakshit, S., Nag, A., Ray, M., Kharbikar, H.L., Shubha Kumari., Sarkar, S., Paul, S., Roy, S., Maity, A., Meena, Vijay Singh., Burman, R. Roy. 2016. Climate change risk perception, adaptation and mitigation strategy: An extension outlook in mountain Himalaya. Conservation Agriculture: An approach to combat climate change in Indian Himalaya. Springer Publisher, Singapore. pp. 257-292.

Nair, K.M., Anil Kumar, K.S., Srinivas, S., Nagaraj, J.S., Violet D'Souza, M., Raghuramulu,Y., Hegde, R. and Singh, S.K. 2016. Soil Quality Monitoring Sites (SQMS) for Traditional Coffee-Growing Areas of India, NBSS Publ. No.1095, National Bureau of Soil Survey and Land Use Planning, Nagpur, India, 530 p.

Naitam, R.K., Deshmukh, P., Moharana, P.C**.,** Ramteke, I.K., Singh, R.S., and Singh, S.K. 2016. Climate change and land suitability for Potato Cultivation in India. In: Sustainable Potato Production and the Impact of Climate Change, S. L. Londhe (Ed.), IGI Global Publications.

Obi Reddy, G.P. 2016. Geospatial database mangement in GIS, *In*: Land Use Planning for Arresting Land degrdation, Combating Climate Change and Ensuring Food Security- A Training Manual, NBSS&LUP Publ. No.171, p 34-40.

Obi Reddy, G.P. 2016. Soil Geoportal Developemental and Its Applications, *In*: Land Use Planning for Arresting Land degrdation, Combating Climate Change and Ensuring Food Security- A Training Manual, NBSS&LUP Publ. No.171, p 50-56.

Obi Reddy, G.P. and Singh, S.K. 2016. Role of remote sensing and geospatial technologies in climate smart agriculture, *In:* Climate Resilient Agronomy (Eds: B. Venkateshwarulu *et al.*), *Indian Society of Agronomy*, New Delhi, p.368-378.

Ramamurthy, V., Singh, S.K., Chattaraj, S., Obi Reddy, G.P. and Ramesh Kumar, S.C. 2016. Land Resource Inventory Towards Village Level Agricultural Land Use Planning. In: *Sustainable Management of Land Resources* (ed: G.P. Obi Reddy, N.G. Patil and A. Chaturvedi). Apple Academy Press.

Ramesh Kumar, S.C., Hegde, Rajendra and Singh, S.K. 2016. Socio-economic Assessment for Land Use Planning in Training Manual on Land Use Planning, NBSS&LUP Publication.

Sahu, N., Obi Reddy, G.P., Nirmal Kumar, Nagaraju, M.S.S., Srivastava, R. and Singh, S.K. 2016. Sustainable Management of Land Resources: An Indian Perspective. Chapter-11 Morphometric Analysis Using GIS Techniques: A Case Study from the Basaltic Terrain of Central India. Published by CRC Press.

Sahu, N., Vasu, D., Sahu, A., Lal, Narayan and Singh, S.K. 2017. Agriculturally Important Microbes for Sustainable Agriculture - Volume I: Plant-Soil-Microbe nexus. Chapter: Strength of microbes in nutrient cycling: a key to soil health. Springer Publication. (Accepted).

Sharma, R.P., Jatav, M.K., Dua, V.K. and Manoj Kumar 2016. Nutrient Management for Sustainable Potato Production in India: New Initiative. In *Sustainable Potato Production and the Impact of Climate Change* (Edited by S. Londhe). IGI Global, ISBN13: 9781522517153**,** DOI: 10.4018/978-1-5225-1715-3.ch002, pp 17-49.

Sidhu, G.S. and Yadav, R.P. 2016. Soil Degradation in North-West Himalayas (NWH): A case study of Himachal Pradesh. Conservation Agriculture: An Approach to Combat Climate Change in Indian Himalaya" (Eds. J.K. Bisht, V.S. Meena, P.K. Mishra, A. Pattanayak) ISBN: 978-981-10-2557-0, p. 381-408.

Singh, R.S. and Naitam, R.K. 2016. Land Resource Inventory and Agricultural Land Use Planning. In: N. K. Pareek and S. Arora (Eds.) Natural Resource Management in Arid and Semi-Arid Ecosystem for Climate Resilient Agriculture, Soil Conservation Society of India, New Delhi. pp. 464.

Singh, S.K., Chattaraj, S., Patil, N.G., Ray, S.K. and Chatterji, S. 2016. Soils of India: Problems and Potentialities. *In* Ed. R. Lal Encyclopedia of Soil Science, Third Edition, CRC Press, ISBN 9781498738903.

Space Applications Centre (SAC). 2016. Desertification and Land Degradation Atlas of India (Based on IRS AWiFS data of 2011-13 and 2003-05). Space Applications Centre, Indian Space Research Organisation, Department of Space, Government of India, Ahamedabad. 252 p. (One among the contributors for South India).

Surya, J.N, Yadav, R.P., Sidhu, G.S. and Singh, S.K. 2016. Soils of Indo-Gangetic Plains: Constraints and Potentials in Relevance of to Agro-ecological Regions. *In* Ed. R. Lal Encyclopedia of Soil science, 3rd Edition. p.1168-1177.

Yadav, R.P. 2016. Torrential Erosion in Himalayas. *In* Ed. R. Lal Encyclopedia of Soil science, 3rd Edition.

Popular Article

Nirmal Kumar, Singh, S.K., Mishra, V.N., Obi Reddy, G.P., Bajpai, R.K. 2016. Effect of Increase of Soybean acreage on Crop Diversification of Wardha District. Bhartiya Krishi Anusandhan Patrika, **31(3):**191-196.

Ashok Kumar, Mohd. Arif, Kadam, S.S. evam Gupta, Versa. 2017. Krishi vaniki-vartman evam bhavishya. *Vishwa Krishi Sanchar*. pp. 17-18.

Ashok Kumar, Nagdev, Ritu, Mahapatra, S.K. and Yadav, R.P. 2017. Relevance of agricultural land use planning

for farming community. *Indian Farmer* **4(2):**209-213.

Ashok Kumar, Kadam, S.S. and Mohd. Arif. 2017. Alley cropping - A way forward for sustainable agriculture. *Indian Farmer* **4(1):**31-35.

Bandyopadhyay, S., Ray, P., Padua, S., Jena, R.K., Sah, K.D., Baruah, U., Singh, S.K. and Ray, S.K. (2016) Agro-technology transfer through tribal sub-plan. Indian Farming, **66(2):**42-44.

Daripa, A. and Chattaraj, S. 2017. Heavy metals in ecosystem and environment. Agrobios Newsletter, **XV(12):**136-137.

Daripa, A. and Chattaraj, S. 2017. Major air pollutants and their effect on vegetation. Agrobios Newsletter, **XV(11)**:36-37.

Daripa, A. and Chattaraj, S. 2017. Soil biodiversity and methods to augment it. Agrobios Newsletter, **XV(10)**:48-49.

Das, K. 2016. Biochar for Sustainable Soil Health, Environments, Vol.19, Issue I, April-June, 2016. P.4.

Ingle, Sagar N., Sahu, Nisha, Patangray, A.J. and Pawar, Yogesh S. 2017. Management of Waterlogged Soils. *Kisan World* **44(1):**25-27.

Meena K., Kumari, A.R., Singh, S. and Sharma, R.P. 2016. Alu Se Adhik Paidawar Ke Liye Poshak Tatavon Ka Prabhandhan. *Ful Phool*, July-August 2016, ICAR, New Delhi, pp. 21-23.

Meena, Kamlesh, Sharma, R.P., Kumari, A.R. and Singh, Shamsher 2017. Prakritik Sanshadhan Sanrakshan Hetu Adhunik Krishi Taknikiyon Ka Prayog. *Kheti*, February 2017, ICAR, New Delhi, pp. 9-11.

Mohd. Arif, Ashok Kumar and Kadam, S.S. 2016. Azolla - As bio-fertilizer and animal feed. *Indian Farmer* **3(11):**788-790.

Mohd. Arif, Ashok Kumar, and Kadam, S.S. 2016. Silage chara sanrakshan ki vidhi. *Vishwa Krishi Sanchar*. pp. 45-46.

Mohd. Arif, Ashok Kumar, Kadam, S.S. and Versa Gupta. 2017. Marusthal ka kalpataru- khejri. *Vishwa Krishi Sanchar*. pp. 45-49.

Mohd. Arif, Ashok Kumar, Versa Gupta and Kadam, S.S. 2017. Adhik pedavar ke liye krishi yantrikaran ek uttam vikalapa. *Vishwa Krishi Sanchar*. pp. 39-43.

Mohd. Arif, Kadam, S.S. and Ashok Kumar. 2017. Vermi-technology: A need of the day. *Indian Farmer* **4(2**):214-208.

NAAS, 2017. Strategy Paper 4, Sustaining Soybean productivity and production in India, National Academy of Agricultural Sciences, New Delhi, 52 p. (Contributors, S.M. Virmani, K.V. Rao, G.P. Obi Reddy, G. Ravindra Chary, V.S. Bhatia and P. Padmavathi).

Nagdev, R., Ashok Kumar, Yadav, R.P. and Singh, S.K. 2016. Tikau kheti ke liye bhoomi upyog niyojan: ek mahatvpurn aayam. Rajbhasha Aalok, Varshikank. pp. 39-41.

Nagdev, R., Ashok Kumar, Mahapatra, S.K. and Yadav, R.P. 2017. Participatory land use planning for sustainable agriculture - A community centric approach. *Indian Farmer* **4(2):** 225-228.

Nagdev, R., Fagodiya, R.K., Surya, J.N., Yadav, R.P. and Amit Kumar. 2016. Vayu Pradushan evam Krishi par iska prabhav. Trin hindi patrika. pp. 35-37.

Kadam, S.S., Ashok Kumar and Mohd. Arif. 2017. Crop diversification for sustainable food and fodder production. *Indian Farmer,* **4(1):**41-44.

Tiwari, G., Gosh, A.K., Singh, S., Jhangir, A. and Jagdish Prasad. 2016. Importance of micro-arthropods in soil. *Science India* (The National Science Magazine), **19(5):**30-32.

Reports / Bulletins / Project Reports

Staff NBSS&LUP, 2016. Effect of different land uses on total Soil Organic Carbon (SOC) and its active pools in humid to per-humid ecoregion of West Bengal. NBSS Publ.No.1097, 40p.

Staff NBSS&LUP, 2016. Field Guide for Land Resources Inventory, Sujala III project Karnataka, NBSS Publ. ICAR-NBSSLUP, Bangalore 154p.

Staff NBSS&LUP, 2016. Agro-Ecological Regions of India (Revised), NBSS&LUP Publ. No 170, ICAR-NBSS&LUP, Nagpur, India, 89p.

Staff NBSS&LUP, 2016. Area prioritization for land use planning in some selected blocks of Bankura, Purulia and Paschim Medinipur districts – A remote sensing and GIS approach. NBSS Publ.No.1090.

Staff NBSS&LUP, 2016. Extent and Distribution of Fallow Lands in Goa. NBSS Publ. No. 173, ICAR–NBSS&LUP, Regional Centre, Bangalore. 264 p.

Staff NBSS&LUP, 2016. Geochemical characterization and pedogenic transformation of soils in Purna valley, Maharashtra, Central India. PS-1/42. 78p.

Staff NBSS&LUP, 2016. Implementation manual for Sujala III project, Karnataka watershed development, GOK 189p.

Staff NBSS&LUP, 2016. Influence of organic and inorganic carbon sequestration on soil and land quality in selected benchmark spots of India. Project Completion Report, 140p. + Annexure lx.

Staff NBSS&LUP, 2016. Land Resource Inventory (LRI) on 1:10000 scale, Why and How? NBSS Publ. No. 172. ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, India. 94p.

Staff NBSS&LUP, 2016. Land Resource Inventory at 1:10000 scale in Ganjam block of Ganjam district, Odisha for Optimal Agricultural Land Use Planning Using Geospatial Technique. NBSS Publ., NBSS&LUP, Nagpur.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of parts of Nilogal, Belhatti, Hadgali and Hullur Subwatersheds, Sujala SWS Publ.1, ICAR–NBSS&LUP, RC, Bangalore. 163p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of parts

of Hangala, Basavapura, Shivapura, Annurkeri and Gopalpur Subwatersheds, Gundlupet Taluk, Chamarajanagara District, Karnataka, Sujala SWS Publ.2, ICAR–NBSS&LUP, RC, Bangalore. 155p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Yelishirur-1 Microwatershed, Gadag Taluk and District, Karnataka, Sujala MWS Publ.2, ICAR–NBSS&LUP, RC, Bangalore. 83p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Yelishirur-3 Microwatershed, Gadag Taluk and District, Karnataka, Sujala MWS Publ.3, ICAR – NBSS & LUP, RC, Bangalore. 87p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Shirunj Microwatershed, Gadag Taluk and District, Karnataka, Sujala MWS Publ.4, ICAR–NBSS&LUP, RC, Bangalore. 87p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Shirol West-2 Microwatershed, Gadag Taluk and District, Karnataka, Sujala MWS Publ.5, ICAR–NBSS&LUP, RC, Bangalore. 85p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Yelishirur-2 Microwatershed, Gadag Taluk and District, Karnataka, Sujala MWS Publ.6, ICAR–NBSS&LUP, RC, Bangalore. 99p.

Staff NBSS&LUP, 2016. Land Resource Inventory for Watershed Planning and Development of Chincholi Khurd -1 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.7, ICAR–NBSS&LUP, RC, Bangalore. 91p.

Staff NBSS&LUP, 2016. Land Resource Inventory of Central State Farm Jetsar, Sri Ganganagar district, Rajasthan. NBSS Publ.1093, National Bureau of Soil Survey and Land Use Planning, Nagpur, India. 112p.

Staff NBSS&LUP, 2016. Land Resource Inventory of KVK Farms in South Eastern Rajasthan-MPUAT, Udaipur. NBSS Publ. 1092, National Bureau of Soil Survey and Land Use Planning, Nagpur, India.pp. 176p.

Staff NBSS&LUP, 2016. Land Use Planning for Arresting Land Degradation, Combating Climate Change and Ensuring Food Security – A Training manual, NBSS&LUP Publ. 171**,** 135p.

Staff NBSS&LUP, 2016. Scientific planning for watershed development – A case study of Hosahalli Micro-watershed, Harvehobli, Chamarajanagar taluk & district, Karnataka, Sujala MWS Publ.1, ICAR–NBSS&LUP, RC, Bangalore. 68p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Nirgudi West Microwatershed, Aland Taluk, Gulbarga District, Karnataka", Sujala MWS Publ.12, ICAR–NBSS&LUP, RC, Bangalore. 83p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Padasavli-1 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.13, ICAR–NBSS&LUP, RC, Bangalore. 85p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Nirgudi-1 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.10, ICAR–NBSS&LUP, RC, Bangalore. 83p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Nirgudi-2 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.11, ICAR–NBSS&LUP, RC, Bangalore. 89p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Chincholi Khurd-2 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.8, ICAR–NBSS&LUP, RC, Bangalore. 81p.

Staff NBSS&LUP, 2017. Land Resource Inventory for Watershed Planning and Development of Matki-3 Microwatershed, Aland Taluk, Gulbarga District, Karnataka, Sujala MWS Publ.9, ICAR–NBSS&LUP, RC, Bangalore. 87p.

Staff NBSS&LUP, 2017. Land Resource Inventory of Kadwa block, Katihar district, Bihar on 1:10,000 scale for optimal agricultural land use planning, using geo-spatial techniques. NBSS Publ. No. 1098, NBSS&LUP, Nagpur, 36p.

Staff NBSS&LUP, 2017. Land use planning of Jorhat district, Assam. NBSS&LUP Publ. No. 1077, February 2017, 92p.

Review Article

Bhattacharyya, R., Ghosh, B.N., Dogra, P., Mishra, P.K., Santra, P., Suresh Kumar, Fullen, Michael Augustine, Mandal, Uttam Kumar, Anil Kumar, K.S., Lalitha, M., Sarkar, D. Mukhopadhyay, D., Das, K., Pal, M., Yadav, R., Chaudhary, V.P., Parmar, B. 2016. Soil Conservation Issues in India. *Sustainability* **565**:1-37.

Seminar/Symposium/Conference/Poster/ Abstracts

International

International Conference on "Integrated Land Use Planning for Smart Agriculture – An Agenda for Sustainable Land Management" (ICILUPSA2016) during 10-13 November, 2016, Nagpur

Anil Kumar, K.S. 2016. Detailed Soil Resources Inventory of Karlapura Micro-watershed, Bangalore Urban District, Karnataka for Land Use Planning, Abstract, p.47.

Ashok Kumar 2016. Socio –Economic and Bio- Physical Constraints in Agricultural Land Use Planning – A Case of Nagrota Bagwan Block of Kangra District, Himachal Pradesh, India, Abstract, p.331.

Bandopadhyay, S. 2016. Pedological significance of lithological discontinuity and its effect on various land

use systems in Upper Brahmapurta Valley Region of Assam, Abstract, p.52.

Barman, A. 2016. Modelling salinity effects based on soil reflectance using VNIR of salt affected soils of Haryana, India. Abstract,

Bokde, V. 2016. Role of Digital Technology for sustainable Development of Agriculture Sector in India: A Review. Abstract, p.129.

Chandran, P. 2016. Temporal Changes in Carbon Stocks in Selected Soils of Semi-arid and Subhumid Regions of India. Abstract, p.231.

Chaudhuri, S. 2016. Post-tsunami soil quality in agricultural lands and mangrove areas oof Andaman and Nicobar Islands. Abstract, p.174.

Chinchamalatpure, Anil R. 2016. Characterization and assessment of salt affected soils of south Haryana using remote sensing and GIS, Abstract, p.11.

Choudhari, P.L., Jagdish Prasad, and Gurav, P. 2016. Characterization and classification of some typical teak and sandalwood growing soils of Seoni district, Madhya Pradesh. Abstract, p.79.

Choudhury, S. Gupta. 2016. GIS based Multi Criteria Analysis (MCA) for land use planning in Rajnaggar block of Birbhum district, West Bengal. Abstract, p.242.

Damre, P.R. 2016. Soil properties as influenced by organic and conventional farming systems in Yaotmal district of Maharashtra, Abstract, p.249.

Daripa, A. 2016. Land use change influence on soil biological quality in black soils-A case study, Abstract, p.258.

Das, K. 2016. Soil resources of Titlagarh block, Bolangir district, Odisha – their assessment for formulating agricultural landuse plan, Abstract, p.49.

Dash, B. 2016. Morphometric analysis of watershed using GIS- A case study from Baruband watershed, Seoni district, Madhya Pradesh. Abstract, p.322.

Deb Roy, P. 2016. A closer look at the nature of soil acidity in Ri-Bhoi district, Meghalaya, India, Abstract, p. 51.

Dharamurajan, S. 2016. Assessment and Mapping of Desertification Status in Anantapur District, Andhra Pradesh, Abstract, p.93

Gaikwad, S.S. 2016. Integrated Rural Landscape Appraisal for Agridevelopment in Malegaon Plateau, Darwha tehsil, Maharashtra, India. Abstract, p.256.

Gangopadhyay, S.K. 2016. Soils of Indo-Gangetic plain of Bihar – their characteristics and management for land use planning, Abstract, p.44.

Gopal, Ram 2016. Characterization and Classification of Soils in Semi – Arid Region of Western Uttar Pradesh for Land Use Planning, Abstract, p. 63.

Gurav, P. 2016. Morphological and Physico-Chemical Soil Properties of Vertisols Developed in Different Agro-Ecological Regions of India, Abstract, p.82.

Hajare, T.N. 2016. Development of efficient farming systems through participatory land use planning. Abstract, p.282.

Jangir, A. 2016. Effect of P and Zn fertilization on growth, yield and nutrient uptake of the maize. Abstract, p.228.

Jena, R.K. 2016. Differential pedogenesis in the soils of Meghalaya plateau, Abstract, p. 50.

Kabber, A. 2016. Coconut-growing soils of Karnataka: Their potentials and consequences towards tender coconut production and marketing system. Abstract: (PS1/41): 111p.

Kar, R. 2016. Spatio-temporal dynamics of urban sprawl and peri-urban agriculture around Nagpur city, Central India: A remote sensing and GIS approach. Abstract, p.277.

Karthikeyan, K. 2016. Pedogenetic investigation on soils of Bemetara in Chhattisgarh basin. Abstract, p.85.

Kharbikar, H.L. 2016. Economics of vegetable cultivation in different irrigation treatments in hills of Uttarakhand. Abstract, p. 332.

Kharbikar, H.L. 2016. Impact of water conservation technology on area, production and yield of vegetables in hills of Uttarakhand. Abstract, p. 317.

Lalita, M. 2016. Climate-soil interactions on pastoral land use in a semi-arid ecosystem of Kangayam, Tamil Nadu, Abstract, p.252

Mahapatra, S.K. 2016. Assessment of soil degradation status of Uttrakhand state for their amelioration, Abstract, p. 95.

Meena, R.K. 2016. Study of variations in physical and chemical soil parameters using principal component analysis in the Buraka micro–watershed, Haryana, India, Abstract, p. 86.

Meena, R.L. 2016. Soil-site suitability evaluation of groundnut in soils of Porbandar taluka, Gujarat for improved livelihood and sustainable agriculture in the region. Abstract, p. 243.

Meshram, D.T. 2016. Identification of suitable land for pomegranate (*Punica Granatum L.*) cultivation in Gujarat, India. Abstract,

Moharana, P.C. 2016. Impact of cropping intensification on soil properties, available nutrients and organic carbon pools in western plain of hot arid Rajasthan, Abstract, p.198.

Mohekar, D.S. 2016. Soil-landform relationship in Gajwel Mandal, Medak district, Telangana, Abstract, p.84.

Nagdev, R. 2016. Monitoring of climate change for agricultural land use planning in North– estern Himalayas –A case study, Abstract, p. 246.

Nair, K.M. 2016. Conversion of forests to rubber plantations: Consequences on soil properties. Abstract: (OS/13): p.21

Naitam, R.K. 2016. Land resource inventory of Chanavada watershed of Aravalli Hills, Rajasthan for land use planning, Abstract, p.141.

Nayak, D.C. 2016. Characterization of soils developed on Rajmahal basaltic landscape in Sahibganj district, Jharkhand for agricultural development, Abstract, p.67.

Nirmal Kumar 2016. Application of MODIS NDVI time series data for detecting degraded lands in a semi-arid region of Central India, Abstract, p.102.

Nogiya, M. 2016. Efficiency evaluation of iron

phytosiderophore in aerobic rice genotypes under hydroponics technique. Abstract, p.132.

Obi Reddy, G.P. 2016. Design and development of land resource information system and NBSS BHOOMI GeoPortal for agricultural land use planning, Abstract, p.39.

Padua, S. 2016. Soil formation in Medziphema block of Nagaland, Abstract, p. 66.

Pagdhune, A. 2016. Characterization of soils for agricultural land use planning: A case study of Kuptinala watershed. Abstract, p. 87.

Patangray, A. 2016. Soil-site suitability mapping for major crops of Kupti watershed of Darwha block of Yavatmal district in Maharashtra. Abstract, p.266.

Patil, N.G. 2016. Assessment of groundwater recharge potential of Darwha block for land use planning. Abstract, p.326.

Paul, Ranjan 2016. X-Ray Crystallinity of Different Soil Nanoclays in Relation to Phosphatase Adsorption. Abstract, p.235.

Potdar, S.S. 2016. Geospatial technique for characterization, evaluation and management of land resources of Shegaon watershed in Chandrapur district of Maharashtra. Abstract, p.69.

Pushpanjali. 2016. Large scale mapping (1:10,000) for crop planning in semi-arid climate of central India using geo-spatial techniques: A case study. Abstract, p.88.

Raja, P. 2016. Geochemical characterization and pedogenic transformation of soils in Purna Valley, Maharashtra, Central India. Abstract, p.78.

Ram Gopal. 2016. Characterization and classification of soils in semi-arid region of western Uttar Pradesh for land use planning. Abstract,

Ramachandran, S. 2016. Soil formation in south eastern Arunachal Pradesh of the Himalayan Region, Abstract, p. 53-54.

Ramesh Kumar, S.C. 2016. Impact of fertilizer policy on land use, land productivity and rural livelihood in Karnataka, Abstract: p.330.

Ramteke, I.K. 2016. Change monitoring of land use/cover future of Bali Islands, Sundarban Delta, West Bengal, using Geospatial techniques, Abstract, p.240.

Rao, S.S. 2016. Efficient water management for improved water productivity in arid western zone - A short review. Abstract,

Ray, P. 2016. Fertility status of mulberry growing soils in seri-villages of Golaghat district of Assam, Abstract, p. 185-186.

Reddy, C.V.P. 2016. Analysis of water resources in Kuptanala agricultural watershed using SWAT. Abstract,

Reza, S.K. 2016. Geostatistical and GIS analysis of different forms of potassium in intensively cultivated alluvial soils of Bihar, India. Abstract, p.177.

Sadanshiv, N.A. 2016. Assessment of spatial variability in soil properties and fertility for smart agricultural input management using geospatial techniques- A case study in Nagalvadi micro-watershed in Wardha district of Maharashtra, India. Abstract, p.121.

Sah, K.D. 2016. Adoption of land shaping technology in potential acid sulphate soils of Bali Island, Sundarbans for enhancing livelihood, Abstract, p.108.

Sahu, N. 2016. Geostatistical techniques in mapping the variability of soil macronutrients on basaltic landscape of Central India, Abstract, p.76.

Sen, T.K. 2016. Soil quality of Bali Island, Sundarban Delta, West Bengal, India, Abstract, p.205.

Sharma R.P. 2016. Land resource inventorization (LRI) of Pata Meghpar Village, Jamnagar District, Gujarat. Abstract, p.65.

Singh, D. 2016. Productivity of rice – based cropping system in Bhogdai soil series, Abstract, p. 292.

Singh, R. 2016. Land resource inventory of Khedbrahma Taluka, Sabarkantha district (Gujarat). Abstract,

Singh, S.K. 2016. Soil survey and land use planning towards sustainable agriculture production in India, Abstract, p. 4-10.

Sinha, Y. 2016. Spectral reflectance characteristics of salinized shrink-swell soils of Nagpur district, Maharashtra. Abstract, p.137.

Srivastava, R. 2016. Proximal VIS-NIR sensing for rapid assessment of organic carbon in soils of the Indo-Gangetic plains of Punjab. Abstract, p.113.

Surwase, S.A. 2016. Characterization and classification of soils in nagpur mandarin growing areas in part of Nagpur district, Maharashtra, Central India. Abstract,

Surya, Jaya N. 2016. Land resources inventory for farm planning – A case Study of irrigated ecosystem of Haryana, India. Abstract, p. 58.

Surya, J.N. 2016. Land Resources Characterization Techniques for Farm Level Planning in Middle Gangetic Plains, India, Abstract, p. 59.

Tailor, B.L. 2016. Large-scale soil mapping using geospatial techniques- A case study in Ankleshwar taluka, Bharuch district, Gujarat using high resolution data, Abstract, p.72.

Thayalan, S. 2016. Land evaluation for french beans in eastern dry zone of Karnataka, Abstract, p.251.

Thelkar, S.I. 2016. Soil erosion mapping in Nagpur district of maharashtra using remote sensing and GIS Techniques. Abstract, p.104.

Tiwari, G. 2016. Impact of temperature gradient on abundance of soil collembola under different management systems. Abstract, p.282.

Tiwary, P. 2016. Topographic modelling of soil wetness in a river basin using digital elevation models. Abstract, p.146.

Vasu, D. 2016. Large scale land resource inventory using geospatial techniques in Deccan plateau – A case study in Thimmajipet Mandal, Telangana. Abstract, p.142.

Vasundhara, R. 2016. Characterization and evaluation of soils in Madahalli watershed using remote sensing and GIS. Abstract, p.48.

Verma, T.P. 2016. Land resource inventory and optimal

land land use options for arid and semi- arid regions of Gujarat using geo-spatial techniques. Abstract, p.270.

Vikas, N.K. 2016. Characterization and classification of soils of a micro-watershed of semi-arid agro-ecosystem: Gollarahatti-2, Jagalur Taluk, Davanagere District, Karnataka. Abstract: (PS1/41): 77p.

Vikas, Mahapatra. 2016. Delineation of landscape ecological units (LEU) of Lahaul Block, Lahaul & Spiti district of Himachal Pradesh for perspective land use planning, Abstract, p. 64.

Vishal, M.K. 2016. Agro Ecological Sub Regions (AESR) based land use planning for enhancement of productivity of major seed spices in potential western dry region of India. Abstract, p. 286.

Wakode, R. 2016. Characterization, classification and evaluation of soils formed in toposequence in Raipur district of Chhattisgarh. Abstract, p.80.

Yadav, R.P. 2016. Assessment of soil loss in northern states of India using soil resource mapping, Abstract, p. 103.

4th International Agronomy Congress, Nov. 22–26, 2016, New Delhi, India, Organized by Indian Society of Agronomy

Meena, R.L. 2016. Soil-site suitability evaluation of Central State Farm, Jetsar, Sriganganagar of Rajasthan for Chickpea (*Cicer arietinum*) production. 207.

Singh, Dharam. 2016. Crops productivity of major production systems in different soils of Jagner Block Agra District, Uttar Pradesh Extended Summaries 1:183-184.

International Symposium on "Eco-Efficiency in Agriculture & Allied Research (EEAAR 17) organized by the Crop and Weed Science Society (CWSS) under the umbrella of BCKV, Mohanpur, Nadia at Farmers Academy & Convention Centre (FACC), BCKV, Kalyani, Nadia, West Bengal during 20-23 January, 2017.

Ghosh, B.N. 2017. Carbon and Energy Efficient Land Use Planning under Climate Change Scenario in India.

Geospatial World Forum 2017 held on 25th January, 2017

Obi Reddy, G.P. 2017. Geoportal for land resource management and Agricultural Land Use Planning.

Indian Ecological Society: International Conference held at SKUAS&T, Jammu during February 18-20, 2016.

Kharbikar, H.L. 2016. Economic impact of different water conservation practices used for vegetable production in hills of Uttarakhand. In. Natural Resource Management: Ecological Perspectives.Vol.1. pp. 105-106.

International Seminar on Oilseed Brassica (ISOB 2017)" Organized by State Institute of Agriculture Management, Jaipur Rajasthan (India) and ICAR-Directorate of Rapeseed-Mustard research, Bharatpur, Rajasthan (India) , Feb.23-27,2017, Jaipur, India.

Singh, R. 2017. Soil suitability assessment for rapeseed-mustard (*Brassica Juncea*) cultivation in semi- arid agro- eco- region of south- eastern Rajasthan, India.

Tailor, B.L. 2017. Large-scale soil resource mapping using geospatial techniques to assess soil suitability for rapeseed-mustard (*Brassica Juncea*)- A case study in Bhadesar, Chittaurgarh, Rajasthan.

8th World Congress on Agriculture & Horticulture March 02-03, 2017. Amsterdam, Netherlands on "Growing Aspects of Agriculture

Anil Kumar, K.S. 2017. Establishment of Land quality monitoring systems for managing soil health.

National

National Symposium on Statistics for Sustainable Agricultural Development by Indian Association for Productivity, Quality & Reliability at Kolkata during 17-18 June, 2016

Reza, S.K. 2016. Geostatistical and multivariate analysis of heavy metal pollution of coal mine- affected agricultural soils. Abstracts p. 26.

Chattaraj, S. 2016. GEOBIA based automated landform modeling – a pilot study in a part of Deccan Plateau of Central India.

तीन दिवसीय राष्ट्रीय कृषि विज्ञान संगोष्ठी सह कार्यशाला, 28–30 सितम्बर 2016, इंदिरा गांधी कृषि विश्वविद्यालय, रायपुर (छत्तीसगढ़).

- निर्मल कुमार. 2016. वर्धा जिला में फसल विविधिकरण पर सोयाबीन के प्रभाव का आकलन, "कृषक समृद्धि हेतु कृषि की विभिन्न विधाओं में नवाचार व कौशल विकासः संदर्भ कृषकों के आय में दोगुना वृद्धि'' विषय पर

National Seminar on *"Developments in Soil Science - 2016"* and 81st Annual Convention of the Indian Society of Soil Science, held during October 20-23, 2016 at Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior

Mahapatra, S.K. 2016. Suitability Classification of the Soils of Buraka Micro-watershed in Mewat District of Haryana. Abstracts, p11.

Nirmal Kumar. 2016. Mapping extent and type of degraded lands in a part of IGP using MODIS NDVI time series data.

Rajan, K. 2016. Effect of soil erosion on organic carbon stocks in undulating terrain of Semi Arid Tropics Research.

Vishal, M.K. 2017. A discussion on AESR based production scenarios of seed spices of two major states of India - Rajasthan and Gujarat. *Research and Developmental Advances in Spices, Medicinal & Aromatic Crops Cultivation, Processing and Trade for prosperity of Indian Farmers*, Society for Integrated Development of Agriculture. Abstracts, 134-142.

FAI – Eastern Region Seminar on "Soil Health Governance – Role of Fertiliser Policy" at IFFCO State Marketing Office, Lok Nayak Bhavan, Patna on 16th November, 2016 organized by Fertilizer Association of India

Sahoo, A.K. 2016. Soils of Bihar – Their distribution, characteristics, problems and potentials for optimum land use plan.

PLACROSYM 22, of Indian Society of Plantation Crops, Kasargod on 15-17 December 2016 at ICAR-CPCRI,

Kasargod

Nagaraja, J.S. 2016. Soil organic carbon (SOC) stock of coffee agro-forestry system in traditional coffee growing areas of India and its comparison with natural forest ecosystem.

104th Indian Science Congress 2017 organized by Indian Science Congress Association during 03-07 January, 2017 at S.V. University, Tirupati.

Das, K. 2017. Environmental Influence on Physico-chemical Characteristics of Soils in Tangi Block of Odisha.

Singh, S.K. 2017. Land Resource Inventory (1:10000 scale) towards Land Use Planning for Arresting Land Degradation, Combating Climate Change and Ensuring Food Security.

Workshop on "Balanced Fertilisation – Key to Sustainable Agriculture" organized by Fertilizer Association of India, Eastern India, Ranchi held on 10th January, 2017 at School of Agriculture and Rural Development Rama Krishna Mission Vivekananda University, Rama Krishna Mission, Morabadi, Ranchi

Sahoo, A.K. 2017. Soil Characteristics of Jharkhand and its Management for better productivity.

National Seminar on Seed Spices for Enhancing Farmers Prosperity and Livelihood Security held at ICAR-NRC Seed Spices, Ajmer (Raj.), January 21-22, 2017.

Vishal, M.K. 2017. Delineating the important seed spices growing areas and their AESR for Rajasthan and a discussion on past climate scenarios, Book of lead papers and abstracts for P. 256.

Sharma, S.S. 2017. Prospect of coriander cultivation in Ajmer district of Rajasthan.

Conference on Farmers First for Conserving Soil and Water Resources in North Eastern region, February 9-11, 2017, Guwahati, Assam organized by Indian Association of Soil and Water Conservationist, Dehradun, Uttarakhand

Pal, Shamistha. 2017. Effect of tillage and residue management on resource conservation and soil organic carbon status in degraded soils of Shivalik. p. 37

Jena, R.K. 2017. Assessment of soil erosion in subtropical ecosystem of Meghalaya, India using RUSLE-A case study, p. 10.

Twentieth Annual Convocation and the National Conference of CMSI on "Harnessing Clay Science for Human Welfare" organized at ICAR-NBSS&LUP, Nagpur during 17-18 February, 2017.

Ray, S.K. 2017. Soil Quality Perspective of North Eastern Region of India, Abstract, p.123-126.

Anil Kumar, K.S. 2017. Aluminium saturation in forest and plantation soils of Western Ghats and West Coast of South India, its causes, consequences and amelioration, Abstract, p.79-80.

Bandyopadhyay, S. 2017. Pedogenesis of some hydromorphic soils of Upper Bramhaputra Valley regions, Assam India, Abstract, p.32-33.

Chattaraj, S. 2017. Characterization of Watersheds by Using High Resolution Remote Sensing Techniques and Digital Terrain Model, Abstract, p.93-94

Choudhari, P.L. 2017. Mineralogy of Teak-supporting Soils of Seoni District, Madhya Pradesh, Abstract, p.46.

Das, K. 2017. Nature and distribution of soil acidity under different landscape situations in Titlagarh block of Bolangir district of Odisha, Abstract, p.49.

Dharumarajan, S. 2017. Spatial Prediction of Major Soil Physiochemical Properties Using Recent Machine Language Techniques, Abstract, p.86.

Ghosh, B.N. 2017.Soil organic carbon research in Indian Himalayan Region – Terminology, estimation and landuse system evaluation under varied soil mineralogy and physiography, Abstract, p.100-101.

Gupta Choudhury, Shreyasi. 2017. Influence of land uses on soil characteristics and organic carbon stock along the toposequence in Rajnagar block, Birbhum district, West Bengal, Abstract, p.47.

Gurav, Priya, P. 2017. Mineralogy of Some Vertisols in Different Agro-ecological Regions of India, Abstract, p.45.

Kalaiselvi, B. 2017. Land qualities of rubber-growing areas and forests under humid tropics, Abstract, 61-62.

Kumar, Ashok. 2017. Role of clay content in determining soil suitability for sustainable crop production, Abstract, p. 59-60.

Maske, S.P. 2017. Estimation of Soil Erodibility and Rainfall Erosivity in Rubber (*Heveabrasiliensis*) – Growing Soils in Parts of Kerala and Karnataka, Abstract, p.58.

Meena, R.L. 2016. Soil-site suitability evaluation for Cotton in fine texture, land management units of Porbandar taluka, District Porbandar, Gujarat, India, Abstract, p.52-53.

Moharana, P.C. 2017. Effect of Long Term Rice Cultivation on Soil Chemical Properties in Western Plain of Hot Arid Rajasthan, Abstract, p 69.

Nagdev, Ritu. 2017. Role of finer soil particles in watershed planning: A case study or Buraka micro-watershed, Haryana, Abstract, p. 56-57.

Naitam, R.K. 2017. Assessment of Soil Organic Carbon Sequestration Under Different Land Use Systems in Swell-Shrink Soils of Nagpur district, Maharashtra, India, Abstract, p.84.

Nayak, D.C. 2017. Soils of alluvial plains of Borio block, Sahibganj district, Jharkhand – their characteristics, problems and potentials, Abstract, p.81-82.

Nogiya, M. 2017. Effect of nano clay iron complex (NCIC) on iron nutrition in aerobically grown rice crop, Abstract, p.90

Obi Reddy, G.P. 2017. BHOOMI Geo-Portal – a robust platform of land resource information system for agricultural land use planning, Abstract, p. 14.

Patil, B.A. 2017. Genesis of Soils in a Catenary Sequence in Bemetara District, Chhattisgarh, Abstract, p.66-67.

Patil, N.G. 2017. Assesment of water resources for land use planning, Abstract, p.102.

Patil, N.G. 2017. Mapping groundwater recharge potential

using GIS approach in Darwha, Abstract, p.68

Paul, R. 2017. Activity and stability of nanoclays-immobilized phosphatase for increasing P availability in soil, Abstract, p.18.

Paul, R. 2017. Characterization of Nanoclay-Phosphatase Complex with IR Spectroscopy and Electron Microscopy, Abstract, p.37

Ramesh Kumar, S.C. 2017. Agricultural Land Evaluation using Soil Potential Rating- A Case Study in Karnataka, Abstract, p.104 - 105.

Ray, S.K. 2017. Soil Clay Minerals Research in India : Advances And Challenges, Abstract, p. 17.

Reza, S.K. 2017. Spatial distribution of soil zinc deficiency in Bharamputra plain, India, Abstract, p.87.

Sah, K.D. 2017. Climate-smart agriculture for marginal and small farmers in Gosaba block of Sundarbans, West Bengal - A Case Study, Abstract, p.50.

Sharma, R.P. 2017. Mineralogy of Soils Developed on Alluvium of Kothari River in Eastern Rajasthan Uplands, Abstract, p.30-31.

Sinha, Yagani. 2017. Predicting Soil Salinity in Shrink-Swell Soils Based on Visible and Near-infrared Reflectance Spectroscopy, Abstract, p.65.

Srinivasan, R. 2017. Characterization of soil and water salinity in Utkal Coastal Plain, Abstract, p.85.

Surya, Jaya N. 2017. Profile development and clay composition of soils developed over schist and slate in Kumaon Himalayas, Abstract, p. 28- 29.

Tiwary, P. 2017. Application of land resource inventory in assessment of runoff water potential, Abstract, p.51.

Vasu, D. 2017. Role of Magnesium in Controlling Saturated Hydraulic Conductivity in Sodic Vertisols, Abstract, p.83.

Vasundhara, R. 2017. Characterization of Soils of Singanallur microwatershed, Chamaraj Nagar, Karnataka, Abstract, p.88.

Wakode, Roshan R. 2017. Clay mineral assemblage on a chhota urla toposequence in Raipur district, Chhattisgarh, Abstract, p.44.

Yadav, R.P. 2017. Watershed planning based on LRI for soil conservation and sustainable agricultural production in Himalayan ecosystem, Abstract, p.97-99.

XIII Agricultural Science Congress-Climate Smart Agriculture organised at UAS, Bangalore during 21-24 Feb 2017

Anil Kumar, K.S. 2017. Paddy growing soils of Kerala and their future sustainability. Abstract A076, p. 60.

Dharumarajan, S. 2017. Prediction of effect of climate change on soil salinity using recent machine language techniques. p.28.

Gaikwad, S.S. 2016. Integrated rural landscape appraisal for agri-development in Malegaon plateau, Darwha tehsil, Maharashtra, India. PS-III/22. p.256.

Hegde, Rajendra. 2017. Spatial variability of soil nutrients in some sub-watersheds of Shirahatti taluk in Gadag district, Karnataka. p. 620.

Lalitha, M.K. 2017. Sub-soil sodicity in Semi-arid Agro-ecosystem, A068, 54p.

Maske, S.P. 2017. Estimation of soil erodibility and rainfall erosivity patterns in rubber (*Hevea brasiliensis*)-growing soils in parts of Kerala and Karnataka, A078, 62p.

Ramesh Kumar, S.C. 2017. Application of soil information in multi objective crop planning of Karnataka, India. Abstract No.F005, p.605.

Vasundhara. R. 2017. Spatial and temporal variability in soil fertility of Gajwel mandal, Medak dist Telengana. p.621.

Technical Compendium of National Conference on Hill Agriculture in Perspective (HAP-2016) held at GBPUA&T, Pantnagar during 26-28 February, 2016.

Kharbikar, H.L. 2016. Production, value addition and marketing of mushrooms in North Western Himalaya: A case of Almora district in Uttarakhand. In: pp 389-390.

National Seminar on Natural Resource Management for Horticultural Crops under Changing Climatic Conditions (with special reference to Drought Management of Plantation Crops and Spices) held on 16 March 2017.

Anil Kumar, K.S. 2017. Conversion of forests to rubber plantations and the consequences on land qualities.

Dhanokar, B.A. 2017. Land resource inventory to assess the Potentials, Problems and thier Management in Raipalle Subwatershed, Humanabad Taluk, Bidar District, Karnataka, India. PSI/47, p.83.

Niranjana, K.V. 2017. Land Suitability Assessment for major crops grown in a Subwatershed, Shirahatti Taluk, Gadag District, Karnataka, India. PSI/56, p.283.

Videography

- Videography of the different activities (landshaping, liming, vermicompost units, plantation of crops, vegetables gardens, harvesting of rice, fisheries *etc.*) along with the farmers was undertaken in the villages under TSP Programme.

Pamphlets

- Dharam Singh, Ritu Nagdev, S.K. Mahapatra and R.P Yadav. 2017. Krishi Bhumi Upyog Viklpo ke Madhyam se Shikopurgaon Ka aviral Satat Vikash.
- Dharam Singh, Ritu Nagdev, S.K. Mahapatra and R.P Yadav. 2017. Shikohpur Gaon ki Mradaon ka Uchit Bhumi Upyog avam Parbandhan.
- Jaya N Surya and R.P. Yadav. 2016. Mrida Swastha Card; Behatar Uppaj Prapt karne hetu Mrida Swastha ki Samiksha. NBS/RCD Vistar Prasar-02-2017.

Lectures Delivered

- Dr. Jagdish Prasad delivered a lecture on 'Organic farming –Some thought' and 'Soil health management' at National Centre of Organic Farming, Nagpur on 2nd April 2016.
- Dr. S.K. Ray delivered an invited lecture on "Soil

and Land Quality: An Essential Pre-requisite for Second Green Revolution in India" in the International Conference on "Integrated Land Use Planning for Smart Agriculture–An Agenda for Sustainable Land Management (ICILUPSA–2016)" held at ICAR-NBSS&LUP, Nagpur on 13th November 2016.

- Dr. (Mrs) Nisha Sahu delivered lecture and practicals in "Fundamentals of Remote Sensing" to 50 Life Science teachers of Undergraduate from various Universities of Maharashtra organized by Botany Department, RTM Nagpur University on 15th November, 2016.
- Dr. R.P. Sharma delivered a lecture to B.Sc. (Horticulture) students and faculty of College of Horticulture, Kolar, University of Horticulture Sciences, Bagalkot, on "Soils of India for fruits and vegetable production" on 19.11.2016.
- G.P. Obi Reddy (2016). Delivered a lecture on "Geoinformatics applications in soil resources management" at NIRD, Hyderabad on 14th December, 2016 in the International Training programme on" Smart Agriculture" held during 12th -21st Dec., 2016 at NIRD, Hyderabad.
- G.P. Obi Reddy delivered a lecture on "Geospatial technologies in sustainable land management for smart agriculture" on 14th December, 2016 in the International Training programme on 'Geoinformatics Applications in Rural Development' held during 28th Nov., 2016 to 8th Jan., 2017 at NIRD, Hyderabad.
- Dr. (Mrs) Nisha Sahu acted as a Faculty member to deliver two theory and one practical classes to M.Sc. LRM students in the course title: Introduction to Land Resource Management (2+1) for 29th Batch (Academic Year 2016-17).
- Dr. Jagdish Prasad delivered a lecture on 'Soil and Ecosystem Services' on 19th January 2017 at 6th Science Expo organised at Raman Science Centre Nagpur from January 18 to 22, 2017.
- Dr. D.C Nayak, Principal Scientist and Head, ICAR-NBSS & LUP, Regional Centre, Kolkata delivered the lecture on "Land Use Planning for Future Agriculture" on 21.01.2017 at State Agricultural Management and Extension Training Institute, West Bengal, Rama Krishna Mission Ashram, Narendrapur, Kolkata
- Dr. R.P. Sharma delivered a lecture to Graduate students and Faculty (Agriculture) of Sitaram Chaudhary Science Mahavidyalaya, Warud, Amravati on "Soils of India and its Mineralogy" and laboratory visit on 10.03.2017.
- Dr. A.K. Sahoo, Principal Scientist delivered the lecture on "Soil Testing and Soil Health Management of Barddhaman district, West Bengal for Quality Seed Production" in the farmers Skilled Development training programme for "Quality Seed Grower" organized by Krishi Vigyan Kendra, Burdwan on 17.03.2017.

Land Resource Inventory (LRI) Atlas

Staff, NBSS&LUP, Regional Centre, Bangalore. 2016. Sujala Land Resource Inventory Atlas: Micro-watershed for Watershed Planning and Development.

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5 PARTICIPATION IN WORKSHOP AND MEETING

Workshops

Date	Details of the Programme	Participants
2016		
April 26-27	NRCES workshop and PME meeting at NRSC Hyderabad	Dr. G.P. Obi Reddy
April 28-29	Workshop on DST's Knowledge Networking on Climate Change and Agriculture at NASC Complex, DPS Marg, Pusa, New Delhi.	Miss. Ritu Nagdev
August 22	One day Workshop of NSDI on "Data Content Standards on Forest at FSI, Dehradun	Dr. G.P. Obi Reddy
October 13-14	Two days workshop on Sexual Harassment of Women at Work Place at ISTM, New Delhi	Dr. (Mrs) Nisha Sahu
December 2	Workshop to introduce the global initiative *Economics of Land Degradation* and the study on the *Economics of Land Degradation* in India at New Delhi	Dr. R.P Yadav Dr. Jaya N Surya
2017		
January 13	One day National Workshop on "Data Content Standards on Soils" by National Spatial Data Infrastructure (NSDI), Department of Science & Technology (DST) held at ICAR-NBSS&LUP, Nagpur	Dr. Rajeev Srivastava Mr. Benukantha Dash Dr (Mrs) Nisha Sahu
January 28	One day Workshop of NAIP-ICAR SSN project on "Regional Crop Planning for Improving Resource Use Efficiency and Sustainability" at AAU, Jorhat	Dr. S.K. Ray
March 18	Review Workshop on 'Mapping and Assessment of Land Degradation in Major Ecosystems of India Using Geospatial Technologies' under ICAR funded Extramural Project organized by the RSA Division, ICAR-NBSS&LUP, Nagpur.	Dr. D.C. Nayak Dr. S.K. Gangopadhyay Dr. S. Mukhopadhyay Dr. S.K. Ray Dr. R.P Yadav Dr. S.K Mahapatra Dr. S. S. Rao

Important Meetings

Date	Description of meeting	Venue
2016		
April 7	Meeting of International Research Training group CIRDG, Germany with scientists of UASB, IISC Bengaluru at GKVK Bengaluru	Dr. Rajendra Hegde
April 28	Meeting with Dr. Girin Hazarika, Director of Research, AAU, Jorhat in connection with State Coordination Committee meeting for Second Green Revolution in the Assam state	Dr. S.K. Ray
3rd May	Review meeting on "Second Green Revolution in Eastern India" organized by ICAR-Research Complex for Eastern Region, Patna	Dr. S.K. Ray
May 16	Review meeting of the DST-ISTAC project on "Influence of organic and inorganic carbon sequestration on soil and land quality in selected benchmark spots of India" at JNU, New Delhi	Dr. P. Tiwary

June 8	Interface meeting with Agriculture and Allied Departments regarding contingent planning in Agriculture Sector on "Perspective contingent plan for the agriculture and allied sectors in West Bengal along with its implementation aspects" organised by Govt. of West Bengal, Directorate of Agriculture at Nabanna, Kolkata.	Dr. A.K. Sahoo
June 13	Regional Research Advisory Committee (RRAC) meeting of Regional Sericultural Research Station (RSRS), Jorhat and presented the progress of the collaborative project (with RSRS, Jorhat) sponsored by Central Silk Board, Bangalore.	Dr. S.K. Ray Dr. P. Ray
June 14	Video Conference of Hon'ble Union Agriculture & Farmer's Welfare Minister Shri Radha Mohan Singh with Journalists of 9 States and Scientists of ICAR Institutes organized by Press Information Bureau, Govt. of India at NIC Centre, Nizam Palace, Kolkata.	Dr. K. Das
June 17	Meeting of PCs of KVKs and HODs of ICAR Institutes with Shri Radha Mohan Singh, Hon'ble Union Minister of Agriculture and Farmers Welfare and Dr. T. Mohapatra, Hon'ble DG, ICAR and Secretary DARE, New Delhi held in Guwahati	Dr. S.K. Ray
June 17	Meeting with Shri Sarbananda Sonowal, Hon'ble Chief Minister, Assam; Shri Atul Bora, Hon'ble Agriculture Minister, Assam; Dr. T. Mohapatra, Hon'ble DG, ICAR and Secretary DARE, New Delhi and other dignitaries of the State government at Guwahati	Dr. S.K. Ray
June 20	Review meeting of the officers of ICAR Institute/Regional Centres, KVK under the Chairmanship of Hon'ble Union Minister of Agriculture and Farmers' Welfare, Govt. of India in presence of Dr. T. Mahapatra, Secretary, DARE, Govt. of India and DG, ICAR, New Delhi at Lalit Great Eastern Hotel, Kolkata.	Dr. D.C. Nayak
June 24-25	XXIII Meeting of ICAR Regional Committee – II during, 2016 at NAARM, Hyderabad	Dr. D.C.Nayak
June 27	An interface meeting on 'Enhancing the Preparedness for Agricultural Contingencies for Assam' held at the Conference Hall, Office of Director (Agriculture), Govt. of Assam, Khanapara, Guwahati	Dr. S.K. Ray
June 28	One day interface meeting on 'Enhancing the Preparedness for Agricultural Contingencies during Kharif 2016' at ICAR Research Complex for NEH Region, Umiam	Dr. S.K. Ray
June 29	Meeting with Director of ICAR Research Complex for NEH Region held in Shillong to discuss about the actions being taken on the recommendations of the last ICAR Regional Committee Meeting No.-III held in Agartala, Tripura on 22nd-23rd May, 2015	Dr. S.K. Ray
June 29	State Interface meeting with Govt. of Karnataka, on feasibility of setting up of a centre of excellence on Dryland Agriculture.	Dr. Rajendra Hegde
July 14	State Coordination Committee Meeting of West Bengal in relation to 2nd Green Revolution in Eastern India at Conference Hall, Department of Agriculture, Nabanna, West Bengal	Dr. D.C. Nayak Dr. A.K. Sahoo
July 19	Midterm review meeting on the 22nd Regional Committee Meeting at ICAR Research Complex for NEH Region, Umiam, Meghalaya	Dr. S.K. Ray
July 20	Research Advisory Committee (RAC) meeting of the Central Sericultural Research &Training Institute (CSR&TI), Berhampore, W.B.	Dr. P. Ray
July 21	Meeting with MBDA officials, Govt. of Meghalaya, for land use planning work in Meghalaya	Dr. S.K. Ray Dr. R.K. Jena Mr. P. Deb Roy
August 2	State Coordination Committee meeting on Second Green Revolution (SGR) for Assam held at College of Veterinary Science, AAU, Khanapara, Guwahati	Dr. S.K. Ray

August 3	Midterm review meeting of policy research studies to presented the progress on " Land Suitability Mapping for Optimum Crop Plan based on food security requirement of Karnataka" at Karnataka Agricultural Price Commission, Bangalore	Dr. S.C. Ramesh Kumar
August 10	Brainstorming meeting on the project entitled "Mitigation of Arsenic Problems in Food Chain in the Arsenic Prone Blocks of West Bengal" at Directorate of Agriculture, Govt. of West Bengal, Jessop Building, Kolkata	Dr. D.C. Nayak
August 30	Stakeholders meeting of policy research studies on "Assessing Demand & Supply of Horticultural Commodities in Karnataka" at College of Horticulture, University of Horticultural Sciences Campus, Bengaluru.	Dr. S.C Ramesh Kumar
September 2	Meeting with Sri Ranjit Dutta, Hon'ble Minister of Irrigation, Govt. of Assam and discussed how the activities of ICAR-NBSS&LUP can be useful to his ministry in implementing Pradhan Mantri Sinchan Yojana programme	Dr. S.K. Ray
September 8-9	24th meeting of ICAR Regional committee No.VII at Goa	Dr. Jagdish Prasad
September 27	13th Scientific Advisory Committee meeting of KVK, Burdwan (CRIJAF) on at KVK, Bud Bud, Burdwan, West Bengal.	Dr. D.C. Nayak
October 3-4	24th meeting of the ICAR-Regional Committee–V at IARI New Delhi	Dr. S.K. Mahapatra
October 18-19	RAC meeting as a member at Rain Forest Research Institute (Indian Council of Forestry Research & Education), Ministry of Environment, Forests & Climate Change, Govt. of India, Jorhat	Dr. S.K. Ray
October 19	Council Meeting of The Clay Minerals Society of India at ICAR- NBSS & LUP, Regional Centre Delhi	Dr. R.P Yadav Dr. S.K. Mahapatra Dr. (Mrs.) Jaya N. Surya Dr. Dharam Singh Miss. Ritu Nagdev
October 26	KRISHI project Partners meeting on 25th October, 2016 and KRISHI project Steering Committee Meeting at New Delhi	Dr. G.P. Obi Reddy
October 26	Special lecture on the topic "Water-logging and salinity interactions – implications for crop production in the coastal zone of West Bengal" delivered by Dr. Mohammed Mainuddin (CSIRO) and Dr. Richard Bell & Dr. Ed. Barrett Lennard (Murdoch University, Australia as three way presentation organized by Indian Society of Coastal Agricultural Research (ISCAR), ICAR-CSSRI, Canning Town, West Bengal at ICAR-NBSS & LUP, Regional Centre, Kolkata	Dr. D.C. Nayak Dr. A.K. Sahoo Dr.S.K.Gangopadhyay Dr.S.Ghoshal Chaudhuri Dr. K. Das Dr. D. Dutta Dr. B.N. Ghosh Dr. K.D. Sah Dr. S. Mukhopadhyay Dr. S.K. Reza Dr. S.Bandopadhyay Dr.(Mrs.) S.Gupta Choudhuri
November 19	Meeting for submission of fresh proposal(s) under Farmer FIRST project sponsored by ICAR held at Horticultural Research Station, AAU, Kahikuchi, Guwahati	Dr. S.K. Ray
November 21	Meeting with Director of Agriculture, Govt. of Assam and discussed the Land Resource Inventory and Land Use Planning prospects of Assam state.	Dr. S.K. Ray
November 26	North-Eastern Tribal Meeting organized by ICAR-CIFA, Kalyani in collaboration with Bharatiya Kisan Sangh	Dr. K. Das
December 8	'Panel Discussion' on "Research, Practice and Policy Interconnection - Towards Evidence Based Policy Making for Healthy Soils in India" and attended Exhibition on "Healthy Soils- Living Soils	Dr. (Mrs.) Jaya N Surya
December 9-10	5th Annual workshop of NICRA project at NASC, New Delhi.	Dr. P. Tiwary

December 14	Farmers' Interface Meet organized by ICAR-Indian Vaterinary Research Institute, Eastern Regional Station, Belgachia Road, Kolkata in collaboration with Sasya Shyamala KVK, Ramakrishna Mission Vivekananda University at Sasya Shyamala KVK, Arapanch, Sonarpur, South 24-Parganas, West Bengal.	Dr. A.K. Sahoo
December 14-16	Tenth Annual Review Meeting organized by India Meteorological Department (IMD) and Orissa University of Agriculture and Technology (OUAT), Bhubaneswar under Gramin Krishi Mausam Seva project in the country at OUAT, Bhubaneswar, Odisha.	Dr. D.C.Nayak
December 20	Presented the work progress of a collaborative project (with RSRS, Jorhat) sponsored by Central Silk Board, Bangalore in the 22nd Regional Research Advisory Committee (RRAC) meeting of the Regional Sericultural Research Station (RSRS), Jorhat at RSRS, Jorhat, Assam.	Dr. P. Ray
2017		
January 10	Meeting with Dr. K.M. Bujarbaruah, Hon'ble Vice Chancellor, AAU, Jorhat on regarding visit of Hon'ble Director General, ICAR and Secretary, DARE, Govt. of India	Dr. S.K. Ray
January 11	Attend an interaction meeting with Dr. P.R. Ojasvi, Principal Investigator of DMIWR (Water platform) project at ICAR-IISWC, Dehradun	Dr. P. Tiwary
January 18-19	Research Advisory Committee (RAC) meeting of the Central Sericultural Research &Training Institute (CSR&TI), Berhampore, W.B. held at Berhampore, W.B. and discussed on the progress of the collaborative project with RSRS, Jorhat sponsored by Central Silk Board.	Dr. S.K. Ray
March 14	Participated in the meeting on "Aquifer management/mapping in Karnataka – CGWD & Ministry of Water Resource	Dr. Rajendra Hegde Dr. B.P. Bhaskar
March 14	Meeting on Sujala Project Planning and Monitoring Unit chaired by Principal Secretary, Agriculture, GoK, Bangalore.	Dr. Rajendra Hegde
March 16	Interface Meeting on Updation of District Agriculture Contingency Plans jointly organized by Junagadh Agricultural University and CRIDA, Hyderabad at Junagadh	Sh. Roshan Lal Meena Sh. Mahaveer Nogiya
March 19	Review meeting of progress under Land Resource Inventory and Agricultural Land Use Planning-Head's meeting at NBSS&LUP, Nagpur	Dr. R.P Yadav
March 24	4th Dr. Sushil Kumar Mukherjee and Dr. Krishna Kamini Rohatgi-Mukherjee Annual Endowment Lecture organized by Raman Centre for Applied and Interdisciplinary Sciences (RCAIS), 16A, Jheel Road, Kolkata at Amity University, Action Area II, Kadampukur, Rajarhat New Town, Kolkata.	Dr. D.C. Nayak Dr. S.K. Gangopadhyay Dr. K.Das Dr. D. Dutta Dr. K.D. Sah Dr. T. Chattopadhyay Dr. S. Bandyopadhyay

6 MEETINGS ORGANIZED

Research Advisory Committee (RAC)

The third meeting of the RAC (2013-2016) of ICAR-NBSS&LUP was held at its HQrs. during July 11-12, 2016 under the Chairmanship of Prof. S.K. Sanyal, Ex-Vice Chancellor, BCKV, Nadia, Mohanpur, West Bengal. Dr. S.K. Chaudhari, ADG (SWM), Dr. D.K. Das, Member, Dr. N.S. Pasricha, Member, Dr. J. S. Parihar, Member, Dr. T. Ravisankar, Member, Dr. S.S. Magar, Member, Mr. Ramesh Jichkar, Farmers' Representative Member and Dr. S.K. Singh, Director, Heads of Regional Centres / Divisions. Dr. P. Chandran, Pr. Scientist and Member Secretary, RAC and Dr. S. Chatterji, Pr. Scientist and In-Charge, PME Cell participated in the meeting.

A view of the Review Research Advisory Committee

Institute Research Committee (IRC)

Institute Research Committee (IRC) Meeting was held during September 19-22, 2016, at NBSS&LUP, Nagpur. Dr. S.K. Singh, Director and Chairman, IRC, Dr. S. Chatterji, Principal Scientist and Member Secretary, IRC and scientists of the Bureau participated in the meeting for presentation of their research projects.


Institute Research Committee (IRC)

Institute Joint Staff Council (IJSC)

Institute Joint Staff Council Meeting of the Bureau were held on 22.9.2016 and 3.3.2017 at HQrs., NBSS&LUP, Nagpur to discuss various matters related to the staff of the Bureau under the chairmanship of the Dr. S.K. Singh Director, NBSS&LUP, Nagpur. Sh. Sanjay Bokoliya, Chief Administrative Officer was also present in the meeting.

Other Meetings Organized

- Organized Third Interactive Meeting of the Administrative Officers along with Finance Officers of ICAR Institutes with AS & FA, DARE/ ICAR on 31.08.2016 at S.N.Bose Silver Jubilee Hall, Salt Lake, Kolkata.
- Organized a review meeting on **"Inspection of 2nd Parliamentary sub-committee on official language"** at Conference Hall, Hotel Hyatt Regency, Kolkata on 15.10.2016 and ICAR-NBSS&LUP, Regional Centre, Kolkata acted as Nodal organization for conducting the same for three organizations namely (1) Bose Institute (2) Indian Meteorology Department, Kolkata and (3) ICAR-NBSS&LUP, Regional Centre, Kolkata.

7 MAJOR EVENTS

Swachhata Pakhwada (16-26 May 2016)

The Bureau observed Swachhata Pakhwada during 16-26 May 2016 by taking Swachhata Abhiyan oath by all the staff members. During the period, cleanliness of laboratories, office premises including roads and garden. The special swachhata Abhiyan observed with all sincerity and whole heartedly.

Staff of the Regional Centre, Kolkata taken part in the cleanliness drive of the Office Campus and staff of the Centre in the Bhumi Vihar Complex in the Swachhta Pakhwara

Swachhta Pakhwada (16-31st October, 2016)

Staff of the Regional Centre, Jorhat engaged in cleaning of campus

The staff of Regional Centre, Kolkata taken part in rally on Swachha Bharat Mission on 31st October, 2016.

Celebration of International Yoga Day

The Bureau celebrated International Yoga Day on 21st June 2016 at its HQrs. and regional centres.

Celebration Yog Shivir

The staff of ICAR-NBSS&LUP, HQrs. and Regional Centres celebrating the Yoga day

The staff the Director taken part in 2nd International Day of Yoga, 2016 held on 21.06.2016

Foundation Day Celebration

The Bureau celebrated 39th Foundation Day on 25th August 2016 at Hqrs., Nagpur. Dr. Panjab Singh, Former Secretary DARE and Director General, ICAR was Chief Guest of the function and also delivered Foundation Day lecture. The other dignitaries who attended the function as Guest Honour were Dr. Pratap Narain, Ex-Vice Chancellor, RAU, Bikaner, Dr. Vijay Ghawate, Joint Director, Agriculture, Govt. of Maharashtra. During the programme, farmers of the Vidarbha region were felicitated and also Best Worker Awards to all categories for the year 2015-16 were given to the employees of the Bureau.

Felicitation of farmers during Foundation Day celebration

Visit of Secretary, DARE and Director General, ICAR : Dr. T. Mohapatra, Secretary DARE and Director General, ICAR visited Bureau on 27th October 2016 and interacted with the staff of the Bureau.

World Soil Day Celebration (5th December 2016)

World soil day was celebrated at Hqrs. Nagpur on 5th December 2016. Dr. S. K. Chaudhari, ADG (S&WM), ICAR, New Delhi was present on the occasion. Soil health cards were distributed to the farmers of Nagpur Taluka, Nagpur and Kelapur Taluka, Yavatmal district, Maharashtra.

Celebration of world soil day and distribition of soil health cards to the farmers

World Soil Day celebrated at Regional Centre, Delhi

Soil health card is distributed to the farmers by Dr. Utpal Baruah, Former Head, ICAR-NBSS&LUP, Regional Centre, Jorhat on World Soil Day

Dr. S.K. Ray, Head of the Regional Centre, distributing pump set to the tribal farmers of Bahphala village of Jorhat district, Assam under TSP programme of the Centre

Dr. R.K. Jena distributing soil health card to the mulberry farmer of Golaghat, district, Assam

International Conferen1ce on Integrated Land use Planning for Smart Agriculture

Organized by ISSLUP at Indian Society of Soil Survey and Land Use Planning, Nagpur during November 10-13, 2016. More than 300 researchers were presented their paper.

NSDI Sponsored National Workshop on Data Content Standard on Soils held on 13 January 2017 at ICAR-NBSS&LUP, Nagpur

National Conference of Clay Minerals Society of India (CMSI) was organized at ICAR-NBSS&LUP, Nagpur during February 17-18, 2017.

Bureau in collaboration with CMSI organized Twentieth Annual Convocation and the National Conference of CMSI on “Harnessing Clay Science

for Human Welfare" organized at ICAR-NBSS&LUP, Nagpur during 17-18 February, 2017. More than 100 researchers presented their papers.

Dr. S.S. Khanna, former Vice Chancellor delivered lecture on "an important topic of contemporary relevance on agricultural research" at ICAR-NBSS&LUP on the eve of National Science Day celebrated on 27 February 2017.

Dr. S.S. Khanna delivering lecture

Kisan Mela

- Participated in the exhibition for displaying the activities of ICAR-NBSS & LUP and also **Farmers' Interface Meet** in **Kisan Mela-cum-Technology Demonstration** and **Pre-Rabi Kishan Sammelan** organised by ICAR-Indian Vaterinary Research Institute, Eastern Regional Station, Belgachia Road, Kolkata in collaboration with Sasya Shyamala KVK, Ramakrishna Mission Vivekananda University on 14th December, 2016 at Sasya Shyamala KVK, Arapanch, Sonarpur, South 24-Parganas, West Bengal.
- Participated in the exhibition for displaying the activities of ICAR-NBSS & LUP in 21 Sundarban Krishi Mela O Loko Utsab, 2016 during 20-29 December, 2016 at Kultali Milon Tirtha Ground of Narayantala, District 24-Parganas (South), West Bengal.

Staff of Regional Centre Koklata participated in the exhibition in 21 Sundarban Krishi Mela

Celebration of District Level Kisan Mela at Nuh, Haryana

ICAR-NBSS&LUP, Regional Centre Delhi participated in Kisan Mela Cum Exhibition organised by Agriculture and Farmers Welfare's Department, Govt. of Haryana on January 04, 2017, held at Sangam Public School, Village Indri, Nuh district.

Celebration of Krishi Unnati Mela-2017, at IARI, New Delhi

Regional Centre Delhi participated in "**KRISHI UNNATI MELA**" inaugurated by Sh. Radha Mohan Singh, Hon'ble Union Minister of Agriculture & Farmers Welfare, Government of India held at ICAR–IARI, New Delhi.

Kisan Mela conducted at Regional Centre, Jorhat

- Dr. Prasenjit Ray and Dr. R.K. Jena, Scientists of the Regional Centre participated in Farmers'

fair organized by Regional Agricultural Research Station (RARS), AAU, Titabar at Titabar, Jorhat, Assam on 8th November 2016.

- Dr. Prasenjit Ray and Mr. Partha Deb Roy, Scientists of the Regional Centre, Jorhat participated in the Farmers' Fair organized by Sugarcane Research Station, AAU, Buralikson, Golaghat, Assam on 29.11.2016.

Exibition in Farmers Fair

- Participated in IFFFCO Kisan Sahkar Mela organized by IFFCO Regional Office,Udaipur on the occasion of Golden Jubilee Celebration on Feb 28, 2017 at MLSU, Udaipur.
- Regional Centre, Delhi participated in "KRISHI UNNATI MELA" inaugurated by Hon'ble Prime Minister of India, Shri Narendra Modi and organized by Ministry of Agriculture & Farmers Welfare, Government of India held at ICAR– IARI, New Delhi during 15-17 March 2017.

Vigilance Awareness Week

- Vigilance Awareness Week was observed at ICAR-NBSS&LUP, HQrs., Nagpur during October 31- Nov. 5, 2016. Different programmes were organized during 31 Oct to 5 nov. 2016. Banners and posters were displayed both, outside and inside of HQrs. On 31st October (FN), the staff was administered vigilance related pledge and vigilance related posters in Administrative and Research Building. On 2nd November, Essay writing competition on vigilance related topics was organized and on 3rd November, an extempore lecture was delivered by the staff members. On 4th November, Vigilance Officer visited the various Divisions/Sections and interacted with the Heads/ In-Charges. On 5th November, the function ended with preparation of a report on observance of Vigilance Awareness week.

Display of placards inside the office campus of ICAR-NBSS&LUP, Regional Centre, Jorhat, Assam during Vigilance Awareness Week

Observance of Central Vigilance Awareness Week (31st October to 5th November, 2016)

Vigilance Awarness Week on 31st October, 2016, at Regional Centre, Kolkata

Visit of Hon'ble Director General, ICAR to the Regional Centre (27th February, 2017)

Release of publication in a programme at ICAR-NBSS&LUP, RC, Jorhat during the visit of Hon'ble Director General, ICAR to this Centre

Mera Gaon And Mera Gourav Programme

Interacted with ADA, Gram Panchayet Pradhan and farmers of Baruipur block of 24-Parganas (S), Habra-II blocks of 24-Parganas (N) and Chakdah block of Nadia district, West Bengal, under Mera Gaon Mera Gourav Programme.

Suggesting Farmers

- **Mera Gaon Mera Gaurav:** Soil health card has been distributed to the 200 farmers of Golwara and Wajmiya villages of Mavli tehsil, Udaipur district under the soil health card campaign "Mera Gaon Mera Gaurav" on the occasion of Kisan Divas on 23/12/2016.

Others

- Dr. Trilochan Mahapatra, Hon'ble Director General, ICAR & Secretary, Govt. of India, **Dr. Joykrushna Jena**, DDG (Fisheries Science), ICAR, Dr. S.K. Singh, Director, and Directors of other ICAR Institute at Kolkata visited the Centre on 15.06.2016 and discussed the various activities of the Regional Centre.

Dr. Trilochan Mahapatra, Hon'ble Director General, ICAR & Secretary, Govt. of India address to the staff members of Kolkata Centre.

- Shri Radha Mohan Singh, Hon'ble Union Minister of Agriculture and Farmer's Welfare visited the Centre on 21.06.2016 and addressed to the Scientists and staff of the Centre.

Shri Radha Mohan Singh, Hon'ble Union Minister of Agriculture and Farmer's Welfare, Govt. of India, Dr. S.K. Singh, Director and Dr. D. Nag, Director, ICAR-NIRJAFT, on dias and Dr.D.C.Nayak delivering welcome address

- The Regional Centre, Kolkata was celebrated the Hindi Karyasala on 10th September, 2016.

Regional Centre, Kolkata celebrating the Hindi Karyasala

- Regional Centre, Kolkata was celebrated the Hindi Pakhwada during 14 – 29th September, 2016.

Regional Centre, Kolkata celebrating the Hindi Pakhwada during 14 – 29th September, 2016.

- A review meeting on **"Inspection of 2nd Parliamentary sub-committee on official language"** was organized at Conference Hall, Hotel Hyatt Regency, Kolkata on 15.10.2016 and ICAR-NBSS&LUP, Regional Centre, Kolkata acted as Nodal organization for conducting the same for three organizations namely (1) Bose Institute (2) Indian Meteorology Department, Kolkata and (3) ICAR-NBSS&LUP, Regional Centre, Kolkata.

8 LINKAGES AND COLLABORATIONS

Name of the Institution	Purpose
Department of Agriculture, Govt. of West Bengal.	Collaboration in Soil Survey, Fertility Mapping and Soil Correlation activities.
National Informatic Centre (NIC), Govt. of India.	Collaboration in development of Web based farmers advisory.
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.	Research, Teaching and Training programme.
Department of Agriculture and Cane Development, Govt. of Jharkhand.	Block level fertility mapping in Jharkhand.
CIMMYT India (International Maize and Wheat Improvement Centre)	Developing demonstration for Borlaugh Institute of South Asia, Samastipur, Bihar
International Plant Nutritional Institute, Asia & Africa programme, Gurgaon, Haryana.	For exchanging ideals for Integrated Nutrient Management Programme in Eastern Region of India.
Odisha Watershed Development Mission (OWDM), Bhubaneswar.	For developing linkage in Watershed Management in Odisha State.
Department of Agriculture, Govt. of Sikkim	Collaboration in Soil Survey, Fertility Mapping and Soil Correlation activities.
West Bengal State Watershed Development Agency (WBSWDA)	Integrated Watershed Management Programme (IWMP) in West Bengal
Department of Science & Technology (DST)	Externally funded projects
ICAR-Indian Institute of Soil and Water Conservation (IISWC), Dehradun	Land Degradation status
ICAR-Central Soil Salinity Research Institute (CSSRI)	Land Degradation status
ICAR-Indian Institute of Soil Science (IISS), Bhopal	Soil Fertility status
National Remote Sensing Centre, Deptt. of Space, GOI, Hyderabad	Satellite Data
Bhaskaracharya Institute for Space Applications and Geo Informatics (BISAG) Gandhinagar, Gujarat	Land Resource Inventory (LRI) on 1:10000 scale

9 TRAINING AND CAPACITY BUILDING

9.1 Training

A. Participation in training

Bureau Officials

Date	Training details and venue	Participants
2016		
	Scientists	
May 02-June 24	54 Days training programme on Certificate course on RS and GIS in Soils and Land Use Planning going held at Indian Institute of Remote Sensing Dehradun	Dr. Rajesh Kumar Meena Sh. Vikas
August 12	Free Patent (IPR) awareness programme ICAR-NBSS&LUP, Nagpur	Scientists and technical officers of Hqrs., Nagpur
November 8-28	21 days winter school entitled as "Assessing natural resource management, climate risk and environment sustainability using simulation models" at IISS, Bhopal, Madhya Pradesh	Dr. P. C. Moharana Mr. R.L.Meena,
November 28 to December 18	21 days winter school entitled as "DST-NRDMS sponsored national level winter school on geospatial technologies" at Department of Geography, University College of Social Science & Humanities, Mohanlal Sukhadia University, Udaipur.	Mr. Mahaveer Nogiya & Mr. Sunil Kumar
October 13-14	Two days training programme on Sexual Harassments in Workshop at Institute of Secretariat Training And Management, Govt. of India, Ministry of Personnel, Public Grievance and Pension, New Delhi	Dr. Jaya N Surya
October 15 to November 21	One month Orientation training programme at the HQrs, ICAR-NBSS & LUP, Nagpur	Dr.Ranjan Paul
October 18–27	10 days training entitled as "Geospatial Analysis for Natural Resources Management" at ICAR- NAARM, Hyderabad.	Dr. S. S. Rao
23rd November, 2016 to 4th March, 2017	Three months Professional attachment training programme at ICAR - IISWC, Dehradun	Dr. Ranjan Paul
December 19-30	Management Development Program on Leadership Development (a pre-RMP Program) at NAARM, Hyderabad	Dr. S.K. Ray Dr. P. Chandran
December 20-24	Training & Workshop for Network program on "Imaging Spectroscopy and Applications (NISA-2016)" funded by Department of Science & Technology, Government of India, organized by Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi	Dr. Rajeev Srivastava Dr. M.S.S. Nagaraju Mr. Roshan Wakode
2017		
28 Dec. 2016 to 2 January 2017	5 days training programme on Managerial Effectiveness Enhancement Programme (NEEP), Sponsored by DST Institute of Management Training and Research (IMTR), Goa	Dr. S.K Mahapatra
February 2-4	Training on "Developing Internal Talent and Leadership" at IIM, Ahmedabad	Dr. S.K. Singh

Technical Staff/Administrative Staff		
2016		
June 1-10	Competency Enhancement Programme for Technical Officers of ICAR (T5 & Above) at NAARM, Hyderabad	Mr. S.V. Bobade
July 25-30	6 days training programme on Networking: Basics and Management	Sh. Sabu Samuel
August 8-12	Advances in instrumental analysis of soils at IISS, Bhopal	Mr. S.G. Anantwar
August 8-13	Use and Maintenance of Advanced Instruments in Soil and Plants Analysis at ICAR-Central Institute of Agricultural Engineering, Bhopal	Dr. Abhijit Haldar
September 20-29	Application of Remote Sensing and GIS in Natural Resource Management" organized by ICAR-Institute of Soil and Water Conservation, Dehradun	Dr.(Smt.) J. Mukhopadhyay Mr. P.K. Dutta
October 18–27	Geo-spatial analysis for Natural Resources Management using Statistical Tools at ICAR-NAARM, Hyderabad	Dr. K. Das
November 24-30	Enhancing efficiency & behavioural skills of Steno/PA/PS & PPS of ICAR and its Institutes at ICAR-NAARM, Hyderabad	Mr. Madan Das and Mrs. R.M. Watekar
December 6-9	Efficiency Enhancement of Skilled Supporting Staff at ICAR-NBSS&LUP, Regional Centre, Kolkata	Mr. Nirmal Saikia, Mr. J.P. Gogoi, Mr. Bipin Gogoi and Mr. R.C. Rajak
2017		
February 27-28	2 days Training Programme on e-Procurement at ICAR-IASRI, New Delhi	Sh. Sumit Sindhu

b. Training organized for others

Date	Topic	Sponsored by/Venue	Beneficiary/ Number of trainees/
2016			
December 6-9	4 days Training programme on "Efficiency Enhancement of Skilled Supporting Staff" under Annual Training Programme (ATP)	ICAR-NBSS&LUP, Regional Centre, Kolkata	10 participants from Nagpur, Jorhat and West Bengal
2017			
January 17-21	Soil Survey Training Programme	Regional Centre, Bangalore	Project scientists & Project staff
January 20-22	Soil survey to the staff of ICAR-RC for NEH Region, Manipur Centre at Imphal, Manipur	ICAR-NBSS & LUP, Regional Centre, Jorhat	18
February 1-6	Poultry rearing and vermicomposting methodology to the tribal farmers of Upperdeurigaon, Namdeurigaon, Bahphalagaon, Kalbari villages of Jorhat district and Natunchaporigaon of Golaghat district of Assam under TSP programme	ICAR-NBSS&LUP, Regional Centre, Jorhat	15
February 13-15	Farmers' training programme on "Integrated Farming Practices for the Farmers of Bali Island, Gosaba, South 24-Parganas, West Bengal" under Tribal Sub Plan Project in collaboration with Sasya Shyamala Krishi Vigyan Kendra	ATC, R.K. Mission Ashrama, Narendrapur	33
23-26, May, 2016	Training programme for the students of PG and Ph.D. of TNAU, Coimbatore on Advancements in Pedological Research, Mineralogical Studies and Interpretation	ICAR-NBSS&LUP, Nagpur	25

Dr. D.C. Nayak, Regional Centre, Kolkata delivering address

Dr. A.K. Sahoo, Principal Scientist giving demonstration to the Trainees of the training programme.

9.2. Post Graduate Education in Land Resource Management (LRM)

Human Resource Development in Post-Graduate Education and Research in Land Resource Management (LRM), Dr. PDKV, Akola and ICAR-NBSS&LUP, Nagpur.

A post graduate teaching and research programme is being conducted by the National Bureau of Soil Survey and Land Use Planning, Nagpur in collaboration with Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Dr. PDKV), Akola since 1987. Subsequently, this activity was introduced at Regional Centre, Kolkata in collaboration with BCKV, Mohanpur in 1999, at Regional Centre, Bangalore with UAS, Bangalore in 2002 and at Regional Centre, Udaipur with RAU, Udaipur in 2004. Besides, the Scientists of Regional Centre, Jorhat are participating as visiting faculty at Department of Soil Science, AAU, Jorhat.

A Memorandum of Understanding (MOU) has been signed between NBSS&LUP, Nagpur and Department of Soil Science and Agricultural Chemistry, Indira Gandhi Agricultural University, Raipur (C.G.) for undertaking collaborating teaching and research programmes. Under this MOU two students are pursuing their Ph.D. programmes at NBSS&LUP, Nagpur.

At the HQrs., Nagpur, this programme is coordinated by the Division of Land Use Planning. The programme has two major components i.e. Teaching and Research.

The Regional Centre, Kolkata undertakes a collaborative programme with Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal for Post Graduate teaching in Agricultural Chemistry and Soil Science with specialization in Land Resource Management (LRM). Two courses, namely, **Soil Genesis and Classification** (ACSS-508) and **Remote Sensing and its Applications** (ACSS-754) for M.Sc. students is being carried out in BCKV, Mohanpur, Nadia.

Achievements	Nagpur		Bangalore		Kolkata		Udaipur		Total	
	M.Sc.	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Ph.D.
Degree awarded up to 2015-2016	134	22	--	--	--	--	--	--	134	22
On Roll	06	06	--	--	--	--	--	--	06	06

9.2a HQrs., Nagpur

9.2a (i) Post Graduate Teaching

Courses offered for M.Sc. Programme		
Course No.	Title	Credit
Soils-516	Introduction to Land Resource Management	(2+1)
Soils-517	Land Evaluation	(2+1)
Soils-518	Land Resource Constraints and their Management	(1+1)
Soils-591	Seminar	(0+1)

Courses offered for Ph.D. Programme		
Course No.	Course Title	
Soils-608	Advanced Soil Genesis	(2+0)
Soils-609	Advanced Soil Mineralogy	(2+1)
Soils-610	Land Evaluation for Land Use Planning	(2+1)
Soils-611	Remote Sensing and Geographical Information System for Land Resource Management	(2+1)
Soils-612	Visual and Digital Interpretation Techniques in Soil Mapping	(2+1)
Soils-691	Seminar-I and Seminar-II	(0+1)

Scientists of the Regional Centre, Udaipur are associated with Maharana Pratap University of Agriculture and Technology, Udaipur with post graduate teaching and research guidance to M.Sc., B.E., M.E. and Ph.D. students.

(ii) Research

M.Sc. Programme

The following M.Sc. (LRM) students have admitted in 2014 at Dr.PDKV, Akola and later joined NBSS&LUP, Nagpur in September 2015 for their specialized course in LRM and have completed their courses and have submitted their thesis.

Sr. No.	Name of student	Thesis Title
1.	Ms. Ankita R. Pagdhune	Land suitability evaluation for cotton-based cropping system in Kupri watershed, Yavatmal district, Maharashtra using geospatial techniques
2.	Ms. Yagani G. Sinha	Effect of salinity levels on spectral reflectance properties of some shrink-swell soils in Nagpur district of Maharashtra
3.	Mr. Gopal M. Bedre	Characterization and evaluation of rice-growing soils of Jhal watershed of Bemetara block of Chhattisgarh
4.	M. Ganesh A. Kumbhar	Oxidizable soil organic carbon (SOC) fractions under major cropping systems in shrink-swell soils of Central India

Ph.D. Programme

The following have submitted their theses.

Sr. No.	Name of student	Thesis Title
1.	Ms. Nilima S. Sadanshiv	Assessment of spatial variability in soil properties of Nagalvadi micro-watershed using geospatial techniques for land resources management in Wardha district of Maharashtra
2.	Mr. Ashishkumar S. Gajre	Evaluation of land quality indicators for major cotton growing soils of Jalgaon district

The following M.Sc.(LRM) students were admitted in 2015 at Dr. PDKV, Akola and who later joined NBSS&LUP, Nagpur in August 2016 for their specialized course in LRM. They have completed their course work and at present engaged in research work for their theses. Name of the students along with the respective thesis title are mentioned below.

Sr. No.	Name of student	Thesis Title
1.	Mr. Jadhav Vijay R.	Forms of phosphorus and zinc in swell-swell soils of Adan river basin in Darwha tehsil, Yavatmal district, Maharashtra
2.	Mr. Rakesh R.	Predictive mapping of soil hydrological properties in Nilona micro-watershed of Darwha block in Yavatmal district, Maharashtra
3.	Mr. Tande Tushar G.	Assessment of soil organic carbon fractions under major cropping systems of agro-ecological region 6.0
4.	Mr. Jadhao Laxman B.	Characterization of some pomegranate growing soils of Solapur district, Maharashtra for their suitability evaluation

The following Ph.D.(LRM) students was admitted in 2015 at Dr. PDKV, Akola who later joined NBSS&LUP, Nagpur in October 2016 for their specialized course in LRM. They are undergoing the course work along with research work. Name of the students and their guide along with their theses title is mentioned below.

Sr. No.	Name of student	Thesis Title
1.	Mr. Surwage Samadhan A.	Characterization of land resources for development of land use plan in part of basaltic terrain, Central India using geospatial techniques
2.	Ms. Vanave Rohini H.	Carbon stock and sequestration potential of some Vertisols under soybean and cotton based cropping systems in Akola district of Maharashtra

9.2b Human Resource Development (HRD)

A. Physical targets and achievements

Sl. No.	Category	Total No. of Employees	No. of trainings planned for 2016-17 as per ATP	No. of employees undergone training during April-Sept 2016	No. of employees undergone training during Oct 2016 to March 2017	Total no. of employees undergone training during April 2016 to March 2017	% realization of trainings planned during 2016-17
1	2	3	4	5	6	Col. 5 + 6 =7	Col. 7*100/ Col. 4 = 8
1	Scientist	73	24	4	6	10	41.7
2	Technical	133	21	11	4	15	71.4
3	Administrative & Finance	45	10	11	16	27	270.0
4	SSS	41	7	1	10	11	157.1
Total		292	62	27	36	63	102.0

B. Financial targets and achievements (All employees)

S. No.	RE 2016-17 for HRD			Actual Expenditure up to 31st March, 2017 for HRD			% Utilization of RE
	Plan	Non-plan	Total	Plan	Non-plan	Total	
	(Lakh Rs.)	(Lakh Rs.)	(Lakh Rs.)	(Lakh Rs.)	(Lakh Rs.)	(Lakh Rs.)	2016-17
1	2	3	2+3=4	5	6	Col. 5+6=7	Col. 7*100/ Col.4=8
1	7.0	0.0	7.0	6.60	0.0	6.6	94.30

10 WORKSHOPS / SEMINARS ORGANIZED

Seminar/Symposia/Workshops/Trainings organized

Date	Topic	Venue
2016		
April 25	Sujala Workshop on Monitoring & Evaluation in collaboration with ICAR- IISWC, RC , Bellary	Regional Centre, Bangalore
May 2	First stakeholders consultation workshop	Regional Centre, Bangalore
June 6	Sujala Workshop for Project expansion to 12 taluks of the state of Karnataka	Regional Centre, Bangalore
June 17-18	National Seminar on "Statistics for Sustainable Agricultural Development (Dedicated to the Memory of Late Professor P.K. Bose)"	Regional Centre, Kolkata
June 20-25	Geographical Information System (GIS) and Remote Sensing	Regional Centre, Bangalore
September 28- 29	Sujala training program and workshop on Sujala project expansion methodology.	Regional Centre, Bangalore
September 30	Training cum workshop of submitted first phase report of Fallow lands of Goa.	Regional Centre, Bangalore
October 3	Sujala Workshop on "Watershed saturation, Hebbur sub watershed, Tumkur District".	Regional Centre, Bangalore
October 4-6	GIS based Digital Library implementation	Regional Centre, Bangalore
October 5-6	Sujala workshop on M & E component at ICAR – NBSS & LUP	Regional Centre, Bangalore
October 6-7 & 18-20	Workshop on Decision Support System of Sujala	Regional Centre, Bangalore
November 10-13	International Conference on "Integrated Land Use Planning for Smart Agriculture-An Agenda for Sustainable Land Management (ICILUPSA-2016)"	NBSS&LUP, Nagpur

Release of publications in inaugural session of International Conference

November 16-17	Workshop – Sujala – INRA on Soil Hydrological modelling. Field visit to MGMG villages.	Regional Centre, Bangalore

December 1	Orientation training for soil fertility sampling	Regional Centre, Bangalore
December 1-2	Sujala field workshop at Chamarajanagar on Watershed Saturation Plan Preparation.	Regional Centre, Bangalore
December 1-9	Soil Survey Field Training Programme	Regional Centre, Bangalore
December 5	Organised and distributed of soil health cards to the farmers of Niduvalalu gram panchayat Hebburu, Tumkuru District on the occasion of World soil day in association with Raitha Samparka Kendra, Hebbur, Tumkuru District.	Regional Centre, Bangalore
December 6-8	GIS based Digital Library Implementation	Regional Centre, Bangalore
December 13-15	Training program of District Training centre under Sujala on Watershed Planning with Sujala LRI database	Regional Centre, Bangalore
December 21	Workshop for the officers of Neeranchal State	Regional Centre, Bangalore
2017		
January 6-8	GIS based Digital Library implementation	Regional Centre, Bangalore
January 17-21	Soil Survey Training Program	Regional Centre, Bangalore
February 27-March 1	Sujala Training Program & Workshop of 5 Districts of Karnataka on LRI based Saturation Plan Preparation	Regional Centre, Bangalore
March 7	Sunflower farmer's day organized in Hegdoli village, Nizamabad, Telangana State.	Regional Centre, Bangalore
March 27	Workshop on *'ICAR KRISHI Geoportal-Experts"* organized to showcase the progress made, various functionalities and utilities of KRISHI Geoportal	NBSS&LUP, Nagpur

Glimpse of ICAR KRISHI Geoportal workshop-Experts organized at NBSS&LUP, Nagpur

March 13	One day NSDI (DST) Sponsored National Workshop on *"Data Content Standard-Soils"*	NBSS&LUP, HQrs., Nagpur
March, 18	One day Review Workshop on *'Mapping and Assessment of Land Degradation in Major Ecosystems of India Using Geospatial Technologies'* under ICAR funded extramural project	ICAR-NBSS&LUP, Nagpur

Glimpse of Review Workshop organized at NBSS&LUP, Nagpur

11 AWARDS, RECOGNITIONS AND FOREIGN VISITS

Awards

- ICAR awarded Dwitiya Puraskar of Rajarshi Tondon Rajbhasha Puraskar for outstanding work in Hindi during 2016-17.
- Nagar Rajbhasaha Karyanvayan Samiti, Nagpur awarded Tritiya Puraskar for publication of Hindi magazine Dharati during 2015-16.
- Nagar Rajbhasaha Karyanvayan Samiti, New Delhi awarded Dwitiya Puraskar for Outstanding work in Hindi during 2015-16.
- The Regional Centre, Jorhat has received Hindi excellence award from Town Official Language Implementation Committee (TOLIC), Jorhat for the year 2015-16 on 17th February, 2017.
- Dr. T.K. Sen, Principal scientist, Division of LUP has been awarded for "Reviewer Excellence Award – as reviewer of Indian Journal of Agricultural Research and Legume Research – An International Journal".
- Dr. S.K Mahapatra, Principal Scientist, Regional Centre Delhi have been awarded with "Fellow of CMSI" for the year 2016 during National Conference on Harnessing Clay Science for Human Welfare, February 17-18, 2017, Nagpur, and also received "Bharat Gaurav Award" in a National Seminar on "Economic Growth and National Integration" organised by India International Friendship Society (IIFS) held at India International Centre (IIC), New Delhi on March 25, 2017.
- Regional Centre, Delhi awarded with 2nd Position for Excellent Work in Hindi (2016) by NARAKAS, North Delhi.
- Dr. Jaya N. Surya received 'Loksurya Puraskar-2016 –*"Loksurya Mrudagandha Award"* from Loksurya Multipurpose Society , Nagpur on 09-10-2016 at Nagpur, and also received "*Reviewer Excellence Award*" by Agricultural Research Communication Centre as Reviewer of Indian journal of Agricultural Research & Legume Research –An International Journal.
- Dr. S. Dharumarajan and Dr. S. Bandyopadhyay, Scientists received outstanding young scientist and outstanding scientist award, Mr. P.S. Butte, Sr. Tech. Officer and Smt. Sujatha, Tech. Officer received best technical personnel award, Mrs. R. Gayatri Devi, Asstt. Admn. Officer, Sh. R.K. Dutta, Assistant, Sh. Wakeel Ahmed, Asstt. Admn. Officer, Mr. B.V. Gogoi, Asstt. Admn. Officer received admin/audit/accounts staff award and Sh. A.L. Kathikar, and Sh. Krishna Guchait, SSS received award under Supporting Staff category for the year 2015-16 conferred by the Bureau on Foundation Day celebration held on 23.8.2016.
- Dr. T.K. Sen, Principal Scientist was awarded Fellow of the Institution of Chemist (India), 2016.
- Dr. (Mrs) Nisha Sahu received the Bharat Jyoti Award by India International Friendship Society, New Delhi.
- Dr. S.K. Ray, Head elected as Vice President, of Soil Conservation Society of India, Assam Chapter, Assam Agricultural University, Jorhat, Assam, and nominated as Member of the Academic Council of the Assam Agricultural University, Jorhat.

Best Poster/Paper Award

- Dr. S. Dharumarajan, Scientist awarded best poster presentation for the research paper entitled, Assessment and mapping of desertification status in Anantapur District, Andhra Pradesh in International Conference on "Integrated Land Use Planning for Smart Agriculture" to be held at Nagpur, India during 10-13 November, 2016, p93
- Ritu Nagdev, Scientist, Regional Centre Delhi, received best poster presentation award for the paper entitled "Role of finer soil particles in watershed planning: A case study or Buraka micro-watershed, Haryana" in Twentieth Annual Convention and the National Conference on Harnessing Clay Science for Human Welfare, February 17-18, 2017, Nagpur.
- Dr. S.S. Rao, Pr. Scientist received ICAR–CAZRI, Jodhpur 'Foundation day Award- 2016' on October 1, 2016 for the "Best Research Paper" Published in Agricultural Water Management.
- Dr. R.P. Sharma received best paper award from

Soil Conservation Society of India, New Delhi on April 17, 2015 for the paper entitled, "Soil moisture release behavior and irrigation scheduling for Aravalli soils of Eastern Rajasthan Uplands".

- Dr. R.P. Yadav, Head, Regional Centre, Delhi and others received best poster award for paper entitled, "Effect of tillage and residue management on resource conservation and soil organic carbon status in degraded soils of Shivalik" in the Conference on Farmers First for Conserving Soil and Water Resources in North Eastern region, during February 9-11, 2017, Guwahati, Assam.
- Dr. S.K. Ray, Head awarded the Fellowship of the Clay Minerals Society of India for the year 2016 for significant contribution in the field of Clay Science in the Twentieth Annual Convention of CMSI held at ICAR-NBSS&LUP, Nagpur during February 17-18, 2017, and Fellowship of the Indian Society of Soil Survey and Land Use Planning (ISSLUP), Nagpur for the year 2016 for significant contribution in the field of Soil survey and Land Use Planning.
- Dr. Rajeev Srivastava, Head, Division of RSA and others received best poster award for paper entitled, "Modelling salinity effects based on soil reflectance using VNIR of salt affected soils of Haryana, India" in International Conference on "Integrated Land Use Planning for Smart Agriculture" held at Nagpur during 10-13 November, 2016.
- Dr. G.P. Obi Reddy, Pr. Scientist and others received second best poster award for the paper entitled, "Delineating the important seed spices growing areas and their AESR for Rajasthan and a discussion on past climate scenarios, Book of lead papers and abstracts for National Seminar on 'Seed Spices for Enhancing Farmers Prosperity and Livelihood Security' during January, 21-22, 2017, at ICAR-NRCC, Ajmer.
- Dr. Ranjan Paul, Scientist received best poster presentation award for the paper entitled, "Characterization of Nanoclay-Phosphatase Complex with IR Spectroscopy and Electron Microscopy" during in National Seminar of the CMSI at ICAR-NBSS&LUP, Nagpur.
- Mr. Baburao Anant Patil, SRF and others received best poster presentation award for the paper entitled, "Genesis of soils in a catenary sequence in Bemetara district, Chhattisgarh" in National Seminar of the CMSI during February 17-18, 2017 at Nagpur.

Recognitions/Scientific Leadership

- Dr. S.K. Singh, Director acted as:
  - Chairman, Technical Session–IV on Climate change, land use/land cover dynamics and land use planning, in the International Conference on "Integrated Land Use Planning for Smart Agriculture–An Agenda for Sustainable Land Management" from Nov.,10-13, 2016.
  - Nominated as Member, Selection Committee of ASRB for appointing Heads of Regional Centers of NBSS&LUP.
  - Expert from India for the development of SOC map of the world by Land and Water Division, Food and Agriculture Organization of the United Nations (FAO).
  - Expert member of MCAER, Pune, Maharashtra.
  - Expert Member, Monitoring Committee of the Task Force on Himalayan Agriculture under the National Mission on Sustaining Himalayan Ecosystems.
  - Faculty Member of Committee for appointing Assistant Professor in the JNKVV, Jabalpur.
  - Member of Academic Council of Banaras Hindu University, Varanasi (2016-2019).
  - Member of Academic Council of Prof. Jaishankar University of Agriculture and Technology, Hyderabad.
  - Member of Team of Experts constituted by Ministry of Agriculture and Farmer Welfare, Department of Agriculture, Co-operation and Farmers Welfare (INM Division) Fertilizer Use Cell, Krishi Bhavan, New Delhi for verify and validate results of soil testing through mobile phone technique to that of conventional laboratory analysis.
  - Member of the Executive Council of Dr. PDKV Akola, Maharashtra.
  - Member, Executive Committee, NSDI, Department of Science and Technology under the Ministry of Science and Technology, New Delhi on constituted for developing national spatial data infrastructure.
  - Member, Expert committee constituted by Ministry of Drinking Water and Sanitation to study and firm up the definition of Kandi areas (commonly identified as foothill region in north and north western states), India.
  - Member, Technical Committee constituted by Ministry of Environment, New Delhi for

Data Harmonization of Desertification, Land Degradation and Drought.

- Invited as Member for NMSHE Vulnerability Analysis Workshop at ICAR-Indian Institute of Soil and Water Conservation (IISWC), Dehradun in GIS format for using as input to vulnerability analysis.
- Nodal officer, Committee on effective use of Space Technology tools in Central Ministries, constituted by Secretary, Department of Space, Chairman, Space Commission.
- Nodal officer, National Monitoring Committee (NMC) to review and monitor the implementation of rehabilitation and resettlement schemes or plans under Right to fair compensation, and Transparency in Land Acquisition. Rehabilitation and Resettlement Act 2013 and NRRP, 2007".
- Nominated as Expert for representing NBSS&LUP on expert organization for undertaking peer group review of the chapter on Environmental Sustainability; No.13033/1/2015-E&F, Govt. India, National Institution for Transforming India, E&F Division, 352, NITI Aayog, Parliament Street, New Delhi.
- President, Indian Science Congress, Agriculture and Forestry Sciences Section (2017-2018).
- President, Indian Society of Soil Science, Nagpur Chapter (2014-Onword).
- Chairman, Soil Correlation Committee of the country (2014-onwards)

Foreign Visit

- Dr. (Mrs.) Shreyasi Gupta Choudhury, Scientist visited University of Cambridge, UK for Woman Leadership Workshop on Female Leaders in Crop and Agricultural Science" in September, 2016 at Clare College, London.
- Dr. S. Dharumarajan, Scientist undergone Post doctoral fellowship programme under Endeavour Research Fellowship from 10th April 2016 to 9th October 2016 at Faculty of Agriculture and Environment, The University of Sydney.
- Dr. N.G. Patil visited Australia for Australian Awards Fellowship of Digital Agriculture for Food and Soil Security: Training Agricultural Trade Partners (India)" from 4-19 November 2016 at the University of Sydney.

12 DISTINGUISHED VISITORS

Headquarters, Nagpur

1. Sh. Sudarshan Bhagat, State Minister for Agriculture and Farmers Welfare, Govt. of India, Krishi Bhavan, New Delhi
2. Dr. T. Mohapatra, Secretary, DARE and DG, ICAR, Govt. of India, New Delhi
3. Dr. S.K. Chaudhari, ADG (S&WM), NRM Division, ICAR, New Delhi
4. Dr. S.K. Sanyal, Ex-Vice Chancellor, BCKV, Kalyani, West Bengal
5. Dr. J.C. Katyal, Ex-Vice Chancellor, HAU, Hissar
6. Dr. J.S. Parihar, Outstanding Scientist and Deputy Director (RESA), Space Application Centre (ISRO), Govt. of India, Ahmedabad
7. Dr.S.S. Magar, Ex-Vice Chancellor, Konkan Krishi Vidyapeeth, Dapoli
8. Dr. Ramesh P. Jichkar, At Nagziri, Post Jamgaon (kh), Taluka Warud, Dist. Amravati
9. Dr. T. Ravishankar, Group Head, Land Resource and Land Use Planning Monitoring Cell, NRSC (ISRO), Hyderabad
10. Dr. D.M. Mankar, Director of Research, Dr. PDKV, Akola
11. Dr. Ashok Patra, Director, IISS, Bhopal
12. Mr. Akhil Sarath R., Ms Kavya L.S., Vajuhulla, M.Sc. Student (Agriculture), TNAU, Coimbatore
13. Dr.(Mrs.) D. Selvi, Professor and Dr. D. Jegadeeswari, Asstt. Professor of TNAU, Coimbatore
14. Ms Devyani Chaphale, Ms Devika Abad, Ms Deepshikha Komre, Ms Kajor Dhosewan, Gokulpeth, Nagpur
15. Dr. S.K. Kamra, Pr. Scientist, Central Soil Salinity Research Institute, Karnal
16. 30 Farmers from Warud, District-Amravati and Kelapur Taluka, Yavatmal district, Maharashtra
17. Dr. N. Palanisamy, Ariyalur, Dist. Ariyalur Block, Tamil Nadu
18. Dr. K.V. Prasad, Director, ICAR-DFR, College of Agriculture, Pune
19. Dr. S.K. Singh, IAS, Addl Secretary & FA, DARE, ICAR, New Delhi
20. Dr. R.S. Waghmare, Associate Professor with 50 students, Agriculture College, Gadchiroli
21. Dr. S.S. Rahangdale, Agriculture Officer, Katangi, Balaghat
22. Sh. C.L. Daharwal, Soil Survey and Conservation Officer, Dist. Chhindwara, M.P.
23. Dr. N.M. Konde and Dr. S.M. Jadhao, Asstt. Professor, Dept of Soil Science & Agri. Chemistry, Dr. PDKV, Akola
24. Dr. Shiv Charan Meena, Sr. Research Associate, Agro-Economic Research Centre, JNKVV, Jabalpur
25. Dr. T. Srijaya, Scientist, AICRP on STCR, Hyderabad
26. Dr. A. Prasanthi, Asstt. Professor, Dept of Soil Science & Agri. Chemistry, S.V. Agri. College, Tirupathi, ANGRAU
27. Sh. Jaideep Teosia, CARD, New Delhi
28. Dr. Shashikant Sitre, N.S. Science & Arts College, Bhadrawati, Dist. Chandrapur
29. Dr. Sandeep G. Hote, DRB Sindhu Mahavidyalaya, Nagpur
30. Mr. Manmohan S. Bhaisare, Late N.P.W. College, Lakhani
31. Dr. M.P. Nandeshwar, S.A.Science College, Salekasa
32. Dr. P.N. Nasre, N.S. Science College, Bhadrawati, Dist. Chandrapur
33. Dr. Doddabasappa, B. and Dr. Sadanand K.M., College of Horticulture, Kolar
34. Institute of Agro-Economic, ETDH Kofi Ajouyo, Togo
35. Mr. Sachin, R.M. and Ashay D'Souza,, Dr. PDKV, Akola
36. Dr. Srinivas, N., Asstt. Professor with 60 students, DOH, Bidar, UHS, Bagalkot, Karnataka
37. Sh. T.R. Tripathi, SADO, Agriculture Department, Rewa, M.P.
38. B.Sc. student of Mahatma Phule Mahavidyalaya, Warud, Dist. Amravati.

Regional Centre, Bangalore

1. Dr. Trilochan Mohapatra, DG's ICAR.
2. Dr. S. Ayyappan – DG (Former)-ICAR
3. Dr. C.S. Ramasesha Former Commissioner (GW) CGWD, Govt of India
4. Dr. T.N. Prakash, Chairman KAPC Govt. of Karnataka
5. Dr. K. Shantakumar – Chairman Farmer's Association, Karnataka
6. Dr. Prabhakar, PC, ICAR, AICRP, Small Millet, Bangalore
7. Dr. Srinivasan, Research Head, TAFE
8. Sri U D Singh, IFS, Commissioner for WDD, Government of Gujarat
9. Sri Rajeev Ranjan, IFS, Project Director & Commissioner, WDD, GoK.
10. Sri Amit Kumar, DD, DoLR, MoRD, Govt of India
11. Dr. Shekar Muddu, Professor, IISc, Bangalore
12. Mr. B. Nijalingappa, IFS, CCF, Jharkhand
13. Mr. H.K. Panda, CEO-Watershed Dept, Orissa
14. Mr. C.N. Swamy, Director, WDD Bangalore.
15. Mr. Kaushalendra Kumar, Technical Expert, SLNA-JSWM, Jharkhand
16. Mr. N.P. Mathur, Ex En Watershed Bheernwang , Rajathan
17. Mr. Viajy Chowdhary, IT. Division, WDD, Rajathan
18. Mr. Kasturi Basu, Coordinator, Neeranchal, West Bengal
19. Mr. Vivek Dave, Joint Development Commissioner, GOMadhya Pradesh
20. Mr. Narendra Singh, Exe.Eng Bhilwara Rajasthan
21. Mr. Tarun Bhatnagar, Watershed Development and Soil Conservation (WDSC), Rajathan
22. Mr. Mr. Shirishkumar V. Jadav, A.P.M, Ahmednagar, Maharashtra
23. Mr. D.G Murey, D&AO, Amravati, Maharashtra
24. Mr. L.N. Jadeja, Project Director Kutch, Gujarat
25. Mr. Shyamakantanth Pvadhan, GSWMA, Gujarat
26. Mr. Rawish Maraviya, Professional Expert, GSWMA,Gujarat
27. Mr. Soham H.Jat, DWDU, Surendranagar, Gujarat
28. Mr. S.K. Bopidan, DSC&WD, Odisha
29. Mr. S.K. Swain, DSC&WD, Odisha
30. Mr. S. N. Naik, PDWS, Kendujhar, Odisha
31. Mr. R.Ch. Dash, PDWS, Mayurbhanja, Odisha
32. Mr. S. Motilal, Additional CEO, Telangana
33. Mr. R. Anjaiah, DRDO, Gadwall, Telangana
34. Mr. K. Damodar Reddy,DRDO, Mahabubnagar, Telangana
35. Mr. D. Madhu Sudhakar, DRDO, Gadwall, Telangana
36. Mr. Sharad Kumar Jain, RGMWM Bhopal MP, Karnataka
37. Mr. K.R. Gurumurthy, SDM, WDD,Karnataka

International visitors:

1. Mrs. Farida Mahamoodi, Mr. Abdul Hakim Amiri and Mr. Jamaluddin Barekzaie, Ministry of Mines and Petroleum, Afghanistan
2. Mr. Sangay Jamtsho, Ms. Kinley Zam, Mr. Pema Dendup, Ministry of Education, Bhutan
3. Dr. Ahmed Mohamed El Sawy Abd El, Dr. Zakaria Yahia Mahmoud Elsayed, Central laboratory for Agriculture Climate (CLAC), Egypt
4. Mr. Bukari Musah Kwaku and Mr. Joshua Ngoah, Ghana Education Service, Ghana
5. Ms. Pipit Ardhi Putri, Ministry of Agrarian Affairs and Spatial Management, Indonesia
6. Mr. Roochan Vimal and Mr. Rosunsingh Saulick, Ministry of Housing and Lands, Mauritius
7. Mr. Harouna Ouessou Malam Moussa, High Communication Council, Niger
8. Mr. Soumaila Seyni, Ministry of Agriculture, Niger
9. Mr. Jorge Manrique Vela, Dept. of Performance Audit in Supreme Audit Institution of per & uacute, Peru
10. Ms. Upeksha Wickramage and Ms. Kankanamalage Priyanka Jayakody, Ministry of Science Technology and Research, Srilanka
11. Mr. Olim Kasimov, National Television and Radio Company of Uzbekistan, Uzbekistan
12. Ms. Delight Mukozho, Ministry of Lands and Rural Resettlement, Zimbabwe
13. Mr. Magwaza Tafadzwa Brian, Ministry of Lands, Zimbabwe

Regional Centre, Delhi

1. Dr. J.S Samra, Ex. CEO, NRAA, Planning Commission, Government of India
2. Dr. Gurbachan Singh, Chairman, ASRB, New Delhi
3. Dr. V.N Sharda, Member, ASRB, New Delhi
4. Dr. A.K Sikka, Former DDG (NRM), ICAR, New Delhi
5. Dr. J.S Parihar, Ex. DDG, SAC, Ahmedabad

6. Dr. Ravinder Kaur, Former Director (Acting), ICAR-IARI, New Delhi
7. Dr. Kuldeep Singh, Director, ICAR- NBPGR, New Delhi
8. Dr. Jitendra Kumar, Former Director, Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat

Regional Centre, Jorhat

1. Dr. Brijmohan Singh Bhau, Head of the Biological Sciences & Technology Division (BSTD), CSIR-North-East Institute of Science & Technology (CSIR-NEIST), Jorhat, Assam
2. Dr. R.S.C. Jayaraj, Director, Rain Forest Research Institute (Indian Council of Forestry Research & Education), Ministry of Environment, Forests & Climate Change, Govt. of India, Jorhat, Assam
3. Padma Shree Jadav Payeng, Jorhat, Assam
4. Dr. Kanika Trivedi, Director, Central Sericultural Research and Training Institute (CSR&TI), Berhampore, West Bengal
5. Dr. S.N. Gogoi, Scientist-D, Regional Sericultural Research Station (RSRS), Jorhat, Assam
6. Dr. R.M. Karmakar, Head, Dept. of Soil Science, AAU, Jorhat, Assam
7. Shri V.K. Sharma, Deputy Secretary (NRM), Indian Council of Agricultural Research, Krishi Anusandhan Bhawan-II, Pusa, New Delhi-12
8. Dr. K.L. Meena, Programme Coordinator, KVK, Longleng, Nagaland
9. Mr. Jawarharlal Pande, Principal, Rajbhasha Vidyalaya, Jorhat, Assam
10. Dr. Ranjumoni Pathak, Senior Medical & Health Officer, Public Health Centre, Baghchung Block, Jorhat, Assam
11. Dr. T.J. Ghosh and Dr. Prodip Ch. Dey, Principal Scientists, Regional Agricultural Research Station, AAU, Titabor, Jorhat, Assam
12. Mr. Jatin Nath, I/c Vigilance, ONGC, Jorhat, Assam
13. Mr. Debanjan Das, Deputy I/c Vigilance, ONGC, Jorhat, Assam
14. Dr. D.C. Nayak, Head, ICAR-NBSS&LUP, Regional Centre, Kolkata
15. Mr. Swen P.M. Bos, ETH Zurich, Switzerland
16. Dr. T. Mohapatra, Hon'ble Director General, ICAR and Secretary, DARE, Govt. of India visited the Centre, laid the foundation stone for the construction of training hostel-cum-museum, inaugurated the newly constructed type-IV quarters, addressed the gathering, visited all the sections of the Centre and had a special meeting with the scientists, Director and Head of the Centre on 27th February 2017
17. Mr. Kamakhya Prasad Tasa, Hon'ble Member of Parliament, Jorhat Constituency, Assam
18. Dr. K.M. Bujarbaruah, Hon'ble Vice Chancellor, AAU, Jorhat, Assam
19. Dr. S.K. Chaudhari, ADG (S&WM), ICAR, New Delhi
20. Dr. S.K. Singh, Director, ICAR-NBSS&LUP, Nagpur
21. Dr. Abhijit Mitra, Director, National Research Centre on Mithun, Jharnapani, Nagaland
22. Dr. Bidyut Deka, Director, ICAR-ATARI, Umium, Barapani, Meghalaya
23. Dr. A.K. Barooah, Director, Tocklai Tea Research Institute, Jorhat, Assam
24. Dr.(Mrs) Urmimala Hazarika, Scientist-D, Central Muga Eri Research and Training Institute, Lahdoigarh, Jorhat, Assam
25. ER. Udaivir Singh, Executive Engineer, Assam Aviation Works Div., CPWD, Guwahati, Assam
26. Dr. B.M. Reddy, Consultant, CRIDA, Hyderabad

Regional Centre, Kolkata

1. Shri Radha Mohan Singh, Hon'ble Union Minister of Agriculture and Farmer's Welfare, Govt. of India.
2. Dr. Trilochan Mahapatra, Hon'ble Director General, ICAR & Secretary, Govt. of India.
3. Dr. Joykrushna Jena, DDG (Fisheries Science), ICAR, New Delhi.
4. Dr. S.K. Sanyal, Ex-Vice Chancellor, BCKV, Mohanpur, Nadia.
5. Dr. S.M. Virmani, Advisor, Indian Resources Information and Management Technologies Ltd. (INRIMT), Hyderabad.
6. Mr. Jayanta Basu, Journalist, The Telegraph Patrika.
7. Dr. Lalu Das, Professor & Head, Agricultural Metereology and Physics, BCKV, Nadia, West Bengal.

13 PERSONNEL

Scientific

Dr. S.K. Singh, Director

Priority setting, monitoring and evaluation cell

Dr. S. Chatterji, Principal Scientist (Soil Science) & In-charge

Division of soil resource studies

1. Dr. P. Chandran, Principal Scientist (Soil Science) & Head
2. Dr. Jagdish Prasad, Principal Scientist (Soil Science)
3. Dr. (Mrs.) P.L.A. Satyawathi, Senior Scientist (Soil Science)
4. Dr. Pramod Tiwari, Scientist (SWCE)
5. Dr. R.P. Sharma, Scientist (Soil Science)
6. Dr. K. Karthikeyan, Scientist (Soil Science)
7. Sh. Vasu, D., Scientist (Soil Science)
8. Sh. Abhishek Jangir, Scientist (Soil Science)
9. Sh. Gopal Tiwary, Scientist (Soil Science)
10. Sh. Ranjan Paul, Scientist (Soil Science)

Division of remote sensing applications

1. Dr. Rajeev Srivastava, Principal Scientist (Soil Science) & I/C Head
2. Dr. M.S.S. Nagaraju, Principal Scientist (Soil Science)
3. Dr. G.P. Obi Reddy, Principal Scientist (Geography)
4. Sh. Nirmal Kumar, Scientist (Soil Physics)
5. Dr.(Ms) Nisha Sahu, Scientist (Soil Science)
6. Dr. Sudipta Chattaraj, Scientist (Soil Physics)
7. Sh. Benukantha Dash, Scientist (SWCE)

Division of land use planning

1. Dr. T.K. Sen, Principal Scientist (Soil Science), Incharge Head from 1.3.2017
2. Dr. S. Chatterji, Principal Scientist (Soil Science)
3. Dr. N.G. Patil, Principal Scientist (SWCE)
4. Sh. Ravinder Naitam, Scientist (Soil Science)
5. Dr. (Mrs.) Amrita Daripa, Scientist (Environmental Science)
6. Sh. H.L. Kharbikar, Scientist (Agril.Economics)
7. Smt. C. Radhika, Scientist (Agril. Economics)

Regional Centre, Kolkata

1. Dr. D.C. Nayak, Principal Scientist (Soil Science) & In-charge Head (from 1.2.2015)
2. Dr. S.K. Gangopadhyay, Principal Scientist (Soil Science)
3. Dr. A.K. Sahoo, Principal Scientist (Soil Science)
4. Dr. Krishnendu Das, Principal Scientist (Soil Science)
5. Dr. Dipak Dutta, Principal Scientist (Soil Science)
6. Dr. S.G. Chaudhary, Principal Scientist (Soil Science)
7. Dr. (Mrs.) Tapti Banerjee, Principal Scientist (Geography)
8. Dr. T. Chatopadhyay, Senior Scientist (Soil Science)
9. Dr. S. Mukhopadhyay, Senior Scientist (Soil Science)
10. Dr. Sah Kausar Reza, Scientist (Soil Science)
11. Dr. (Ms) S. Gupta Chaudhary, Scientist (Soil Science)
12. Dr. S. Bandopadhyay, Scientist (Soil Science)
13. Dr. B.N. Ghosh, Principal Scientist (Soil Science)

Regional Centre, Bangalore

1. Dr. Rajendra Hegde, Principal Scientist (Agronomy) & Head
2. Dr. B.P. Bhaskar, Principal Scientist (Soil Science)
3. Dr. K.S. Anil Kumar, Principal Scientist (Soil Science)
4. Dr. V. Ramamurthy, Principal Scientist (Agronomy)
5. Dr. S.C. Ramesh Kumar, Principal Scientist (Agril. Economics)
6. Sh. S. Srinivas, Senior Scientist (Computer Application)
7. Sh. S.P. Maske, Scientist (SWCE)
8. Dr. S. Dharumarajan, Scientist (Soil Science)
9. Mrs. Vasundhara R., Scientist (Soil Science)
10. Sh. R. Srinivasan, Scientist (Soil Science)
11. Dr. (Mrs) M. Lalitha, Scientist (Soil Science)

12. Ms M. Chandrakala, Scientist (Soil Science)
13. Dr. (Mrs) B. Kalaiselvi, Scientist (Soil Science)

Regional Centre, New Delhi

1. Dr. R.P. Yadav, Principal Scientist (Soil Science) & Head
2. Dr. S.K. Mahapatra, Principal Scientist (Soil Science)
3. Dr. (Mrs) J. D. Surya, Principal Scientist (Soil Science)
4. Dr. T.P. Verma, Principal Scientist (Soil Science)
5. Dr. Dharam Singh, Senior Scientist (Agronomy)
6. Sh. Ashok Kumar, Scientist (Agronomy)
7. Sh. Rajesh Kumar Meena, Scientist (Soil Science)
8. Sh. Vikas, Scientist (Agricultural Statistics)
9. Ms. Ritu Nagdev, Scientist (Environmental Science)

Regional Centre, Jorhat

1. Dr. S.K. Ray, Principal Scientist (Soil Science) & Head (w.e.f.12.5.2015)
2. Dr. S. Ramchandran, Scientist (Soil Science)
3. Sh. Roomesh Kumar Jena, Scientist (Soil Science)
4. Sh. Prasanjit Ray, Scientist (Soil Science)
5. Mr. Partha Deb Roy, Scientist (Soil Science)
6. Sh. Gulshan Kumar Sharma, Scientist (Environmental Science)

Regional Centre, Udaipur

1. Dr. Ram Sakal Singh, Principal Scientist (Soil Science) & I/C Head
2. Dr. S.S. Rao, Principal Scientist (Agronomy)
3. Sh. R.S. Meena, Scientist (Soil Science)
4. Sh. Roshan Lal Meena, Scientist (Agronomy)
5. Sh. Pravash C. Moharana, Scientist (Soil Science)
6. Sh. Sunil Kumar, Scientist
7. Sh. Mahaveer Nogia, Scientist (Soil Science)

Technical

Headquarters, nagpur

1. Dr. N.C. Khandare, Chief Technical Officer (FFT)
2. Dr. S.S. Nimkhedkar, Chief Technical Officer (FFT)
3. Sh. S.V. Bobade, Chief Technical Officer (FFT)
4. Dr. R.A. Nasre, Chief Technical Officer (FFT)
5. Dr. (Mrs.) Ratna P. Roy, Asstt. Chief Technical Officer (FFT)
6. Sh. S.G. Anantwar, Chief Technical Officer (FFT)
7. Sh. V.P. Patil, Chief Technical Officer (FFT)
8. Mrs. Smita Patil, Asstt. Chief Technical Officer (FFT)
9. Dr. A.M. Nimkar, Asstt. Chief Technical Officer (FFT)
10. Dr. A.P. Nagar, Chief Technical Officer (FFT)
11. Sh. Vijay Bhongade, Asstt. Chief Technical Officer (Photo.)
12. Sh. V.N. Parhad, Asstt. Chief Technical Officer (FFT)
13. Dr. M.T. Sahu, Asstt. Chief Technical Officer (P&E)
14. Sh. P.V. Ambekar, Asstt. Chief Technical Officer (Photo.)
15. Sh. S.S. Gaikawad, Asstt. Chief Technical Officer (FFT)
16. Dr. (Mrs.) Jiji Cyriac, Asstt. Chief Technical Officer (LID)
17. Sh. T.L. Khobragade, Senior Technical Officer (WS)
18. Sh. P.S. Butte, Senior Technical Officer (FFT)
19. Sh. D.S. Mohekar, Senior Technical Officer (FFT)
20. Sh. K.S. Banasure, Technical Officer (WS)
21. Sh. M.P. Khobradage, Technical Officer (WS)
22. Sh. H.J. Bhondwe, Technical Officer (FFT)
23. Sh. S.D. Meshram, Senior Technical Officer (LT)
24. Sh. S.C. Gharami, Senior Technical Officer (LT)
25. Sh. R.N. Zambre, Technical Officer (WS)
26. Sh. M.D. Kadav, Technical Officer (WS)
27. Sh. S.K. Kalbande, Technical Officer (WS)
28. Mrs. Ujwala Tijare, Technical Officer (WS)
29. Sh. B.M. Khorge, Technical Officer (WS)
30. Sh. S.S. Dohatre, Senior Technical Assistant (FFT)
31. Sh. R.K. Bhalasagar, Technical Officer (FFT)
32. Sh. V.R. Vinchurkar, Technical Assistant (FFT)
33. Sh. W.B. Mate, Technical Assistant (FFT)
34. Sh. G.V. Manmode, Senior Technical Assistant (FFT)
35. Sh. S.G. Khapekar, Technical Assistant (FFT)
36. Sh. U.B. Gaikawad, Senior Technical Assistant (WS)
37. Sh. V.T. Sahu, Senior Technical Assistant (FFT)
38. Sh. S.K. Mendhekar, Technical Assistant (FFT)
39. Sh. M.M. Bhagat, Senior Technician (FFT)

40. Sh. D.R. Borkar, Senior Technician (WS)
41. Sh. P.N. Jadhav, Senior Technician (FFT)
42. Sh. S.R. Singade, Senior Technician (FFT)
43. Sh. A.M.G. Sheikh, Senior Technician (FFT)
44. Sh. J.B. Padole, Senior Technician (FFT)
45. Sh. Atul Dankhade, Technician (WS)
46. Smt. Nisha A. Lade, Technician (FFT)
47. Sh. Lokesh Sontakke, Technician (WS)
48. Sh. S.A. Bhoyar, Technician (FFT)

Regional Centre, Kolkata

1. Mrs. S. Das, Asstt. Chief Technical Officer (LT)
2. Dr. (Mrs.) J. J. Mukhopadhyay, Asstt. Chief Technical Officer (FFT)
3. Dr. Abhijit Haldar, Senior Technical Officer (FFT)
4. Sh. A.K. Maitra, Senior Technical Assistant (FFT)
5. Sh. S. Islam, Senior Technical Assistant (FFT)
6. Sh. R.K. Dutta, Senior Technical Assistant (FFT)
7. Mrs. R. Basu, Senior Technical Assistant (LT)
8. Sh. S. Sarkar, Technical Assistant (FFT)
9. Mrs. S. Saha, Senior Technical Assistant (WS)
10. Sh. P. Mondal, Senior Technical Assistant (WS)
11. Sh. G.C. Sarkar, Senior Technician (FFT)
12. Sh. Sukonto Pal, Senior Technician (FFT)
13. Sh. Siddharth Karamkar, Senior Technician (LT)
14. Smt. Zharna Kar, Technician (FFT)
15. Sh. Deepak Maurya, Technical Assistant (FFT)
16. Sh. Sita Ram, Technical Assistant (FFT)
17. Sh. Mahesh Roy, Technician (FFT)
18. Smt. Kalpana Biswas, Technician (LT)
19. Sh. V. Mohan, Senior Technical Officer (LT)

Regional Centre, Bangalore

1. Dr. B.A. Dhanorkar, Chief Technical Officer (FFT)
2. Mrs. Arti Koyal, Chief Technical Officer (FFT)
3. Sh. K.V. Niranjane, Chief Technical Officer (FFT)
4. Mrs. P. Chandramathi, Chief Technical Officer (LID)
5. Dr. M. Ramesh, Asstt. Chief Technical Officer (LT)
6. Sh. Bhoora Prasad, Senior Technical Officer (FFT)
7. Sh. D.H. Venkatesh, Asstt. Chief Technical Officer (LT)
8. Mrs. K. Sujatha, Senior Technical Officer (WS)
9. Sh. Shivappa Agadi, Senior Technical Officer (FFT)
10. Sh. C. Bache Gawda, Technical Officer (FFT)
11. Sh. R. Venkatgiriappa, Technical Officer (FFT)
12. Sh. K. Paramesha, Technical Officer (FFT)
13. Sh. Jairamaiah, Technical Officer (FFT)
14. Sh. N. Somasekhara, Senior Technical Assistant (FFT)
15. Sh. B.M.N. Reddy, Senior Technical Assistant (FFT)
16. Ku. K.V. Archana, Technical Assistant (FFT)
17. Sh. N. Maddileti, Senior Technician (FFT)
18. Ms. S. Parvathy, Senior Technician (LT)

Regional Centre, New Delhi

1. Dr. Ram Gopal, Chief Technical Officer (FFT)
2. Sh. K.M. Pal, Asstt. Chief Technical Officer (WS)
3. Dr. D.K. Katiyar, Senior Technical Officer (FFT)
4. Sh. Arvind Kumar, Asstt. Chief Technical Officer (LT)
5. Sh. Harjit Singh, Senior Technical Officer (FFT)
6. Sh. K.K. Bharadwaj, Technical Officer (P&E)
7. Sh. Jai Mangal, Technical Officer (P&E)
8. Sh. S. Saboo, Technical Officer (WS)
9. Sh. Vijay Singh, Technical Officer (WS)
10. Sh. P.R. Kharwar, Senior Technical Assistant (FFT)
11. Sh. Shiv Kumar, Technical Assistant (FFT)
12. Sh. Rajneesh Kumar, Technical Assistant (FFT)
13. Sh. Makhan Singh, Technical Assistant (FFT)
14. Sh. Nawab Khan, Technical Assistant (FFT)
15. Sh. Vas Dev, Technical Assistant (FFT)
16. Sh. Rajesh Rajpal, Technical Assistant (FFT)
17. Sh. Kuldeep Singh, Technical Assistant (FFT)
18. Sh. P.S. Chaudhary, Senior Technician (FFT)
19. Sh. Roshan Lal, Senior Technician (FFT

Regional Centre, Jorhat

1. Sh. Durnan Gogai, Technical Officer (WS)
2. Sh. P.K. Dutta, Technical Officer (WS)
3. Mrs. Shamoli Chetia, Technical Officer (WS)
4. Sh. Dilip K. Dutta, Senior Technical Assistant (WS)
5. Sh. Lokeshwar Gogai, Technical Assistant (FFT)
6. Sh. Pradip Kotoky, Technical Assistant (FFT)
7. Sh. N. Saikia, Technical Assistant (FFT)
8. Sh. Chandeshwar Das, Technical Assistant (FFT)
9. Sh. Gopi Saikia, Technical Officer (WS)
10. Sh. Someshwar Das, Technical Assistant (FFT)
11. Sh. Amitabh Baruah, Senior Technician (FFT)

Regional Centre, Udaipur

1. Sh. S.S. Sharma, Senior Technical Officer (FFT)
2. Sh. Bhagwati Lal Trailor, Senior Technical Officer (WS)
3. Sh. Bansilal Jat, Technical Officer (FFT)
4. Sh. Nola Ram Ola, Senior Technical Assistant (FFT)
5. Sh. Devilal Oad, Senior Technical Assistant (FFT)
6. Sh. N.D. Khan, Technical Officer (WS)
7. Sh. Rameshwar Singh, Technical Officer (FFT)
8. Sh. B.S. Kumawat, Senior Technical Assistant (FFT)
9. Sh. B.R. Meena, Technical Assistant (WS)
10. Sh. Ambalal Bhoi, Technical Assistant (WS)
11. Sh. C.K. Kumawat, Senior Technician (FFT)
12. Sh. Sohanlal Sharma, Senior Technician (FFT)
13. Sh. J.S. Rao, Senior Technician (FFT)
14. Sh. Shiv Pal Singh, Senior Technician (FFT)
15. Sh. Manish Choudhary, Technician (WS)
16. Sh. K.M. Soni, Technical Officer (FFT)
17. Smt. Vandana Patil, Technician (FFT)

Administrative

Headquarters, Nagpur

1. Sh. Sanjay Bokolia, Chief Admn. Officer
2. Sh. Z.H. Khilji, Sr. Finance & Accounts Officer
3. Sh. A.A. Goswami, Admn. Officer
4. Sh. Anshul Gupta, Admn. Officer (From 18.11.2016)
5. Smt. Girija Rangari, Assistant Administrative Officer
6. Sh. Toran Prasad, Asstt. Admn. Officer
7. Sh. A.P.Tembhurnikar, Assistant
8. Sh. S.C. Kolhe, Assistant
9. Sh. Wakeel Ahmed, Assistant Admn. Officer
10. Sh. A.M. Kosare, Assistant
11. Sh. Y.L. Misal, Assistant
12. Sh. M.M. Khan, Private Secretary
13. Sh. S.M. Pathak, Private Secretary
14. Mrs. Rohini Watekar, Personal Assistant
15. Mrs. W.D. Khandwe, Personal Assistant
16. Mrs. Ranjana Sharma, Personal Assistant
17. Mrs. Vaishali Arbat, Personal Assistant
18. Sh. S.P. Awale, Assistant
19. Sh. U.S. Kapse, Upper Division Clerk
20. Mrs. Shalu Nandanwar, Upper Division Clerk
21. Sh. Nitin Mohurle, Upper Division Clerk
22. Sh. Ajay Meshram, Assistant
23. Sh. N.B. Mankar, Upper Division Clerk
24. Sh. S.S. Kamble, Upper Division Clerk
25. Sh. S.J. Patil, Upper Division Clerk

Regional Centre, Kolkata

1. Sh. A.P. Chaitupune, Assistant Administrative Officer
2. Sh. R.K. Dutta, Assistant
3. Mrs. Nirmala Kumar, Assistant
4. Ms Bedantika Dutta, Assistant
5. Mrs. Aparna Das, Personal Assistant

Regional Centre, Bangalore

1. Mrs. R. Gayatri Devi, Assistant Administrative Officer
2. Mrs. P. Chandrakala, Upper Division Clerk
3. Mrs. Priti Chamuah, Upper Division Clerk

Regional Centre, New Delhi

1. Sh. Rajesh Chaudhury, Assistant Admn. Officer
2. Sh. Sumit Sindhu, Assistant
3. Mrs. Sunita Mittal, Assistant
4. Sh. Kamlesh Sharma, Assistant

Regional Centre, Jorhat

1. Sh. P.K. Das, Assistant
2. Sh. N.C. Baruah, Personal Assistant
3. Sh. Madan Das, Private Secretary

Regional Centre, Udaipur

1. Sh. Harish Rajput, Personal Assistant
2. Sh. Unikrishnan Nair, K.K., Upper Division Clerk
3. Sh. V.S. Sankhla, Upper Division Clerk
4. Sh. Bhawar Singh Devra, Lower Division Clerk

Skilled Supporting Staff

Headquarters, Nagpur

1. Sh. S.P. Dimothe
2. Sh. D.B. Thombre
3. Sh. A.T. Kantode
4. Sh. A.Z. Sarode
5. Sh. R.M. Parate
6. Sh. A.L. Kathikar

1. Sh. G.B. Topre
2. Sh. N.T. Thawkar
3. Sh. S.A. Bhoyar
4. Sh. Ramesh Khawle
5. Sh. Lokesh Sontakke
6. Mrs. S.N. Gajbhiye
7. Sh. A.B. Bhasme

Regional Centre, Kolkata

1. Smt Usha Kujur
2. Sh. Nandlal Pramanik
3. Sh. V.N. Mishra

1. Mrs. Radha Turi
2. Mrs. Alpana Roy
3. Shr Krishna Guchait

Regional Centre, Bangalore

1. Sh. Rudrappa
2. Sh. M.T.N. Murthy
3. Sh. N. Sampangi

1. Sh. R. Balakrishna
2. Sh. C. Nagraj

Regional Centre, New Delhi

1. Sh. Jagdish Mehto
2. Sh. Radhey Shyam
3. Sh. Ram Sewak

1. Sh. R.B. Mehto
2. Sh. Rakesh Kumar
3. Sh. Harender Singh Rawat

Regional Centre, Jorhat

1. Sh. N.C. Saikia
2. Sh. Nirmal Saikia
3. Sh. Raju Balmiki
4. Sh. J.C. Baruah
5. Sh. J.P. Gogai

1. Sh. Dilip Borah
2. Sh. Bipin Gogai
3. Sh. R.C. Rajak
4. Sh. Pabitra Gogai

Regional Centre, Udaipur

1. Sh. J.S. Vasava
2. Sh. Devilal Prajapat

1. Sh. Mohanlal Meghwal
2. Sh. Shambhulal Meena

Retirements

- Dr.(Mrs) C. Mandal, Principal Scientist (Geography) (retired on 31.7.2016)
- Dr. A. Chaturvedi, Principal Scientist (Geography) & Head (retired on 28.2.2017)
- Dr. T.N. Hajare, Principal Scientist (Agronomy) (retired on 30.9.2016)
- Dr. K.M. Nair, Principal Scientist (Soil Science) (retired on 30.11.2016)
- Dr. Tarsem Lal, Principal Scientist (Geography) (retired on 30.4.2016)
- Sh. Anil Kumar, Technical Officer, retired on superannuation on 31/05/2016 from Regional Centre Delhi
- Mrs. Vimal Kharabe, Assistant, HQrs. retired on superannuation on 30 November 2016.
- Sh. D.B. Asrat, Skilled Supporting Staff retired on superannuation on 31 March 2017
- Sh. B.C. Wahane, Skilled Supporting Staff retired on superannuation on 31 May 2016

Promotion

The following officials are promoted to the next higher grade in 2016-17.

- Dr. R.A. Nasre, Chief Technical Officer (FFT)
- Sh. S.G. Anantwar, Chief Technical Officer (FFT)
- Sh. V.P. Patil, Chief Technical Officer (FFT)
- Dr. A.P. Nagar, Chief Technical Officer (FFT)
- Mrs. S. Das, Asstt. Chief Technical Officer (LT)
- Mrs. P. Chandramathi, Chief Technical Officer (LID)
- Sh. D.H. Venkatesh, Asstt. Chief Technical Officer (LT)
- Dr. M.T. Sahu, Asstt. Chief Technical Officer (P&E)
- Sh. P.V. Ambekar, Asstt. Chief Technical Officer (Photo.)
- Sh. S.S. Gaikawad, Asstt. Chief Technical Officer (FFT)
- Dr. (Mrs.) Jiji Cyriac, Asstt. Chief Technical Officer (LID)
- Dr. (Mrs.) J. J. Mukhopadhyay, Asstt. Chief Technical Officer (FFT)
- Sh. Arvind Kumar, Asstt. Chief Technical Officer (LT)
- Sh. S.D. Meshram, Senior Technical Officer (LT)
- Sh. S.C. Gharami, Senior Technical Officer (LT)
- Mrs. K. Sujatha, Senior Technical Officer (WS)
- Sh. Shivappa Agadi, Senior Technical Officer (FFT)
- Sh. Bhagwati Lal Trailor, Senior Technical Officer (WS)
- Sh. R.N. Zambre, Technical Officer (WS)
- Sh. M.D. Kadav, Technical Officer (WS)
- Sh. S.K. Kalbande, Technical Officer (WS)
- Mrs. Ujwala Tijare, Technical Officer (WS)
- Sh. B.M. Khorge, Technical Officer (WS)
- Sh. Bansilal Jat, Technical Officer (FFT)
- Sh. N.D. Khan, Technical Officer (WS)
- Sh. Rameshwar Singh, Technical Officer (FFT)
- Sh. R. Venkatgiriappa, Technical Officer (FFT)
- Sh. K. Paramesha, Technical Officer (FFT)

- Sh. Jairamaiah, Technical Officer (FFT)
- Sh. Jai Mangal, Technical Officer (P&E)
- Sh. S. Saboo, Technical Officer (WS)
- Sh. Vijay Singh, Technical Officer (WS)
- Mrs. Shamoli Chetia, Technical Officer (WS)
- Sh. Gopi Saikia, Technical Officer (WS)
- Sh. K.M. Soni, Technical Officer (FFT)
- Sh. Vijay Singh, Sr. Technical Assistant
- Sh. G.V. Manmode, Senior Technical Assistant (FFT)
- Sh. U.B. Gaikawad, Senior Technical Assistant (WS)
- Sh. V.T. Sahu, Senior Technical Assistant (FFT)
- Mrs. R. Basu, Senior Technical Assistant (LT)
- Mrs. S. Saha, Senior Technical Assistant (WS)
- Sh. P. Mondal, Senior Technical Assistant (WS)
- Sh. B.S. Kumawat, Senior Technical Assistant (FFT)
- Sh. Kuldeep Singh, Technical Assistant (FFT)
- Sh. Someshwar Das, Technical Assistant (FFT)
- Sh. Ambalal Bhoi, Technical Assistant (WS)
- Sh. D.R. Borkar, Senior Technician (WS)
- Sh. P.N. Jadhav, Senior Technician (FFT)
- Sh. J.B. Padole, Senior Technician (FFT)
- Sh. A.M.G. Sheikh, Senior Technician (FFT)
- Sh. S.R. Singade, Senior Technician (FFT)
- Sh. Sukonto Pal, Senior Technician (FFT)
- Sh. Siddharth Karamkar, Senior Technician (LT)
- Sh. N. Maddileti, Senior Technician (FFT)
- Ms. S. Parvathy, Senior Technician (LT)
- Sh. C.K. Kumawat, Senior Technician (FFT)
- Sh. J.S. Rao, Senior Technician (FFT)
- Sh. Sohanlal Sharma, Senior Technician (FFT)
- Sh. Shiv Pal Singh, Senior Technician (FFT)
- Smt. Vandana Patil, Technician (FFT)
- Sh. Manish Choudhary, Technician (WS)
- Sh. Rajesh Chaudhury, Assistant Admn. Officer
- Sh. S.P. Awale, Assistant
- Sh. Ajay Meshram, Assistant
- Mrs. Sunita Mittal, Assistant
- Sh. Kamlesh Sharma, Assistant
- Sh. Madan Das, Private Secretary
- Mrs. Aparna Das, Personal Assistant
- Sh. Kamlesh Sharma, Upper Division Clerk
- Mrs. Priti Chamuah, Upper Division Clerk
- Sh. S.S. Kamble, Upper Division Clerk
- Sh. S.J. Patil, Upper Division Clerk
- Sh. Bhawar Singh Devra, Lower Division Clerk

Transfer

- Sh. Rajesh Chaudhary, Asstt. Admn. Officer joined Regional Centre Delhi on 21/12/2016 on transfer from ICAR-NBSS&LUP, Hdqrs, Nagpur
- Sh. Kamlesh Sharma, UDC, Sh. joined Regional Centre Delhi on 08/04/2016 on transfer from ICAR-NBSS&LUP, Hdqrs, Nagpur
- Sh. R.K. Fagodia, Scientist was relived from Regional Centre Delhi on 15/11/2016 on transfer to ICAR-CSSRI Karnal.
- Sh. Ashok Kumar, Scientist, joined Regional Centre Delhi on 01.03.2017 after completion of course works of Ph.D programme from RAU, Udaipur.
- Dr. S. Bandopadhyay, Scientist joined Regional Centre Kolkata on transfer from Regional Centre, Jorhat.
- Dr. R. Srinivasan, Scientist joined Regional Centre Bangalore on transfer from Regional Centre, Kolkata
- Dr. T.P. Verma, Pr. Scientist joined Regional Centre Delhi on transfer from Regional Centre, Udaipur
- Sh. B.M.N. Reddy, Sr. Tech. Assistant joined Regional Centre, Bangalore on transfer from Regional Centre, Kolkata
- Shri. Nandu Thawkar was transferred to Bajajnagar Campus on 1.04.2016.

Study Leave

- Shri. D.S. Mohekar went on study leave to pursue Ph.D.

New Entrants

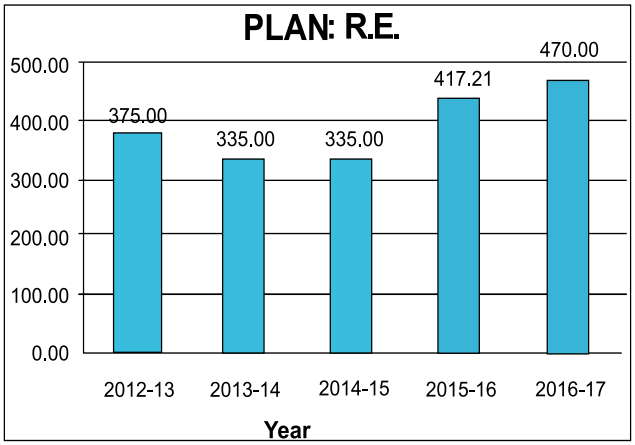
- Sh. Ranjan Paul, Scientist
- Smt. C. Radhika, Scientist
- Sh. Gulshan Kumar Sharma, Scientist
- Sh. Anshul Gupta, Admn. Officer
- Smt. Nisha A. Lade, Technician (FFT)

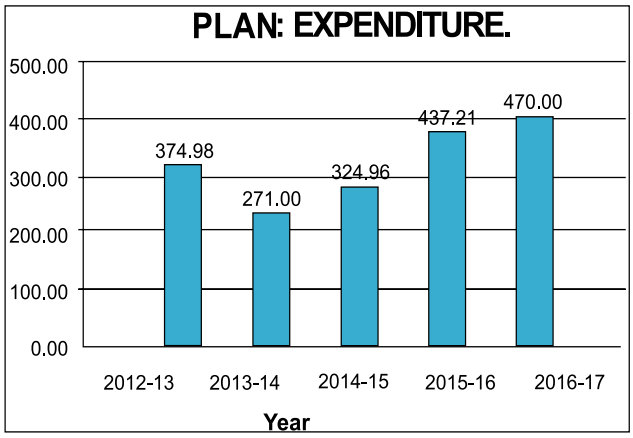
Deceased

- Dr. D.K. Mandal, Principal Scientist (Soil Science) expired on 30 June 2016.

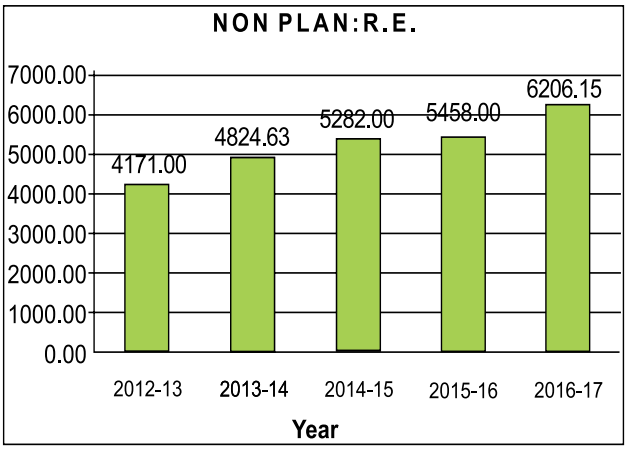
14 BUDGET

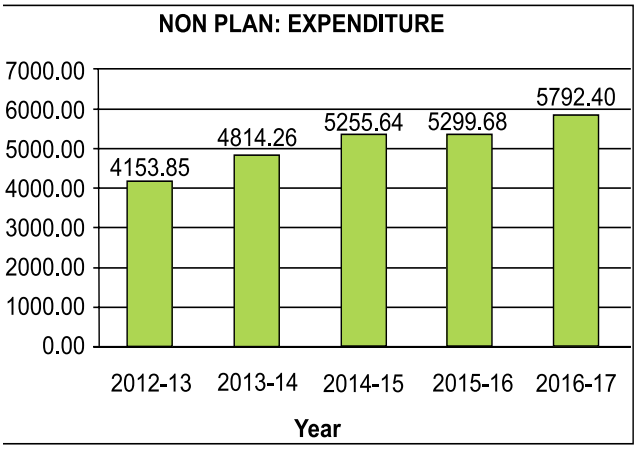
Plan





Non Plan





ICAR-NBSS&LUP IN MEDIA

The Hitavada
CityLine
FRIDAY, NOVEMBER 4, 2016

ICAR Director Dr Mohapatra asks scientists to compute sustainability index of crops

■ Staff Reporter

"NATIONAL Bureau of Soil Survey & Land Utilization Planning (NBSS&LUP) should compute sustainability index of crops and link it to the market to highlight their commercial advantages," said Dr. Trilochan Mohapatra, Secretary, Department of Agriculture Research and Education, Government of India and Director General, Indian Council of Agricultural Research, New Delhi.

He was interacting with scientists at NBSS&LUP recently. Dr. Mohapatra advised the scientists to also highlight commercial advantages of land and validate the developed land use plans before providing the same to stakeholders.

Dr. Mohapatra was welcomed by Director of the organization, Dr. S.K. Singh. He interacted with scientists of the organization on various aspects of on-going research programmes namely, Land Resource Inventory (LRI) (on 1:10000 scale), Development of National Soil Geoportal Bhumi and Agricultural Land Use Planning using LRI database.

Dr S K Singh felicitating Dr Trilochan Mohapatra.

Dr. Mohapatra also asked Dr. S K Singh to ensure that comprehensive land use plans of all the 29 states are developed within six months that should take into account their sustainability, profitability and impact on environment. He desired that monitoring of changes in soil properties under dominant land use systems be studied so that stakeholders could be warned of encountering adverse impact, to enable them undertake timely appropriate measures.

In response to Dr Mohapatra's query on the utility of geoportal for stakeholders in the agricultural sector, Dr S K Singh and Dr G P Obi Reddy, Principal Scientist explained that the geoportal would contain exhaustive information on soils, landforms, slope, land use, land degradation, land capability, land suitability, etc. Such information is very useful for deciding suitable interventions for land use and management of natural resources. The stakeholders engaged in crop planning and agricultural land resource managers will hence find the Geoportal very useful.

Dr Mohapatra also addressed the staff of the city based ICAR institutes namely, CCRI, CICR and Ginning Training Centre (CIRCOT, Mumbai). Prior to his address, he was felicitated by the Directors of the four ICAR institutes. He lauded the efforts of the NBSS&LUP for developing Bhoomi Geoportal. Dr Sushamoy Chatterji, Principal Scientist conducted the proceedings.

The Hitavada
CityLine
EXCLUSIVE FOR THE READERS IN NAGPUR
WEDNESDAY, August 24, 2016

Research on soil for improving agriculture need of hour: Dr Singh

■ Staff Reporter

"STUDY of soil for improvement of agriculture is need of the hour and National Bureau of Soil Survey and Land Utilization Planning (NBSS&LUP) is playing a major role for soil growth," said Dr Panjab Singh, Chancellor, Rani Lakshmi Bai Central Agriculture University during the 40th Foundation Day celebration of NBSS&LUP at Dr S P Raychaudhuri auditorium, Amravati Road on Tuesday.

He said that Pradhan Mantri Sinchai Yojana is a revolutionary step by Central Government and it will be benefited for farmers. The bureau is working on different aspects of soil and 'Bhoomi Geoportal' is a revolutionary research which will help farmers also.

Dr Pratap Narain, Ex-Vice Chancellor, RSU, Bikaner delivered the Foundation Day lecture on 'Sustainable Land Management in India' while Vijay Ghawate, Joint Director of Agriculture, Government of Maharashtra also shared the dais as guest of honour.

Dr S K Singh, Director, NBSS&LUP presided over the event. The programme commenced with lighting of traditional lamp while guests were felicitated with shawl, mementos and a bouquet by the Director of the institutions.

(From left) Dr Pratap Narain, Dr Panjab Singh, Dr S K Singh and Vijay Ghawate releasing the souvenir during the 40th Foundation Day programme. (Pic by Anil Futane)

Progressive farmers of Nagpur rural and Warud were also felicitated for their contribution in the field of agriculture. All farmers were honoured with shawl and a bouquet at the hands of the guests.

Couple of Power Point Presentations were also displayed by senior scientists of the institution during the programme. A souvenir about the working of the institution was also released at the hands of the guests.

A large number of scientists, researchers, former directors of NBSS&LUP, senior officials of government departments, farmers and scholars were present during the programme.

Release of ICAR-NBSS&LUP publication Agro-ecological Regions of India–Revised edition.
20th Annual Convention and National Conference on Harnessing Clay Science for Human Welfare was organized at Nagpur during February 17-18, 2017 by CMSI in association with ICAR-NBSS&LUP, Nagpur.

The Hitavada
CityLine
FRIDAY, DECEMBER 4, 2015

Soil Health Cards useful to kharif, rabi crop growing farmers

■ Staff Reporter

ICAR - National Bureau of Soil Survey and Land Use Planning (Bureau) observed World Soil Day recently.

Dr S K Chaudhari, Assistant Director General (Soil & Water Management) was the special invitee on the occasion while Dr Milind Sahle, Project Director, Action for Production (AFPRO), Yavatmal district, Maharashtra was the chief guest.

It may be mentioned that 4,200 Soil Health Cards were developed by the Bureau in collaboration with Action for Food Production (AFPRO), Kelapur, Yavatmal district for the farmers of Kelapur block and 1,700 cards were developed for the farmers of Nagpur rural areas in collaboration with Agricultural Produce Market Committee (APMC), Nagpur.

Dr Chaudhari distributed the cards among farmers of the two blocks who attended the function. He also elaborated on the usefulness of Soil Health Cards particularly in that the farmers would be able to know the exact dose of chemical fertilizers to be applied for kharif and rabi crops. Scientists can be of great help to farmers to ensure balanced fertilisation, he added.

Dr S K Singh, Director of the Bureau in his remarks mentioned that the Bureau had earlier distributed 1.5 lakh soil health cards to the farmers of Telangana state. Apart from this, five regional centres of the Bureau distributed soil health cards to the farmers of the states under their jurisdictions. The function concluded with a formal vote of thanks proposed by Dr. G.P. Obi Reddy, Principal Scientist. Dr Sushamoy Chatterji, Principal Scientist and In-charge PME Cell conducted the proceedings.

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- *Soil Land Resources of Medak Distt. Andhra Pradesh for Land Use Planning. NBSS Publ.791(SSR), 2005.
- + Soil Resource data of Patiala Dist. of Punjab for perspective land use planning, NBSS Report No.795, 2004.
- +Soil Resource for Land Use Planning, Balaghat Distt. (M.P.). NBSS Publ.827(SSR), 2005.
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BOOKS

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- *Soil Survey Staff, USDA. Soil Taxonomy, Indian Reprint, 1978.
- +Sehgal, J., Blum, W.E. and Gajbhiye, K.S. Red and Lateritic Soils, 1998. Vol.1, 453p., Vol.11, Oxford & IBH, New Delhi, 113p
- Sehgal, J., Gajbhiye, K.S., Batta, R.K. and Sarma, V.A.K., Eds. Swell-Shrink Soils (Vertisols) of India: Resource Appraisal and Management. Kalyani Publishers, New Delhi, 1999, 202p.

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RESEARCH BULLETINS

- *Glossary of Geomorphological Terms, Bull. No.1, 1980, 30p.
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- *Land Use Plan for Development of Bundelkhand Region based on Region Land and Soil Resources Survey, Bull.No.3, 1981, 33p.
- *Soils and Suggested Land Use of Maharashtra, Bull.No.4, 1980.
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- *Soil Survey of ICRISAT Farm and Type Area around Patancheru, AndhraPradesh,Bull.No.8(rev.ed.)1993,71p.ISBN:81-85460-08-6.
- *Geomorphology, Soils and Land Use of Haryana, Bull.No.9, 1983. 21p+5 maps.
- +Memorandum of Soil Correlation, Bull.No.10, 1984, 31p.
- *The Soils of Mondha Village (Nagpur) for Agrotechnology Transfer, Bull.No.11, 1986, 65p.
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- * Soil Resource Mapping of different States in India:Field Manual, Rev. ed. Bull.No.13, 1987, 73p.
- *Soil Resource Mapping of different States in India:Laboratory Methods, Bull.No.14, 1987, 49p.
- *Benchmark Soils of India: Mondha Series(Typic Chromustert) : Characteristics, classification and interpretation for land use planning. Bull.No.15, 1987, 24p.
- *Benchmark Soils of India: Pali Series(Lithic Calciorthid) :Characteristics, classification and interpretation for land use planning. Bull.No.16, 1987,32p.
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- *NBSS&LUP Publications: 1976-1988, Bull.No.18, 1988, 70p.
- *NBSS&LUP Publications: 1988-1999, Bull.No.18 (Supplement), 2000, 142p.
- +NBSSLUP Publications: 1976-2008, updated, NBSS Publ.18, 2009, 130p.
- *Benchmark Swell-Shrink Soils of India-their Morphology, Characteristics and Classification, Bull.No.19, 1988,116p.
- *The Soils of Kolar District (Karnataka) for Land Use Planning, Bull.No.20, 1988, 65p.+10 maps.
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- *Agro-ecological Regions of India, 2nd ed. (with one colored map)Bull.No.24, 1990, 130p. ISBN:81-85460-15-9 (Contact for order: M/s Oxford & IBH; 66, Janpath, New Delhi-110 001)
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