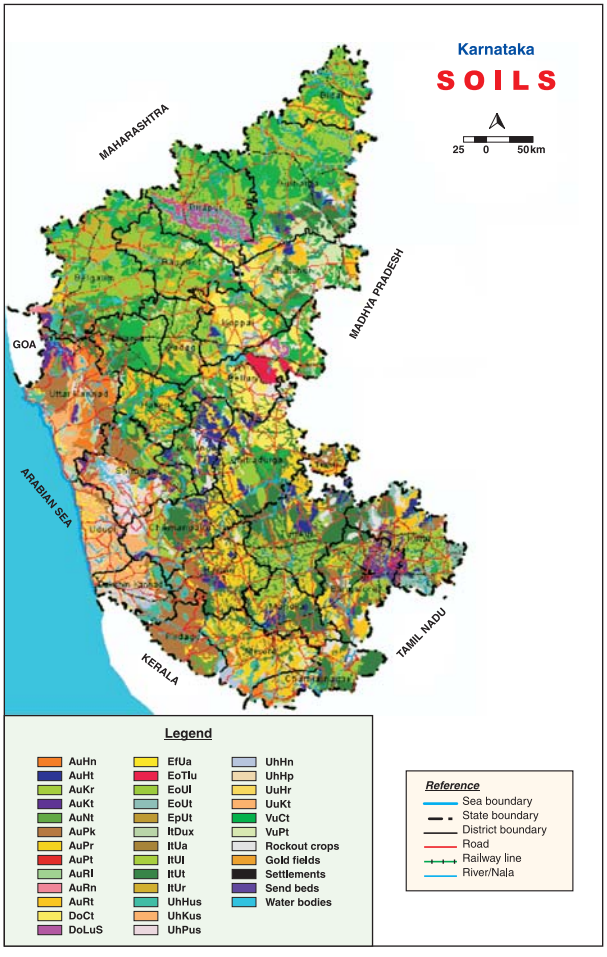
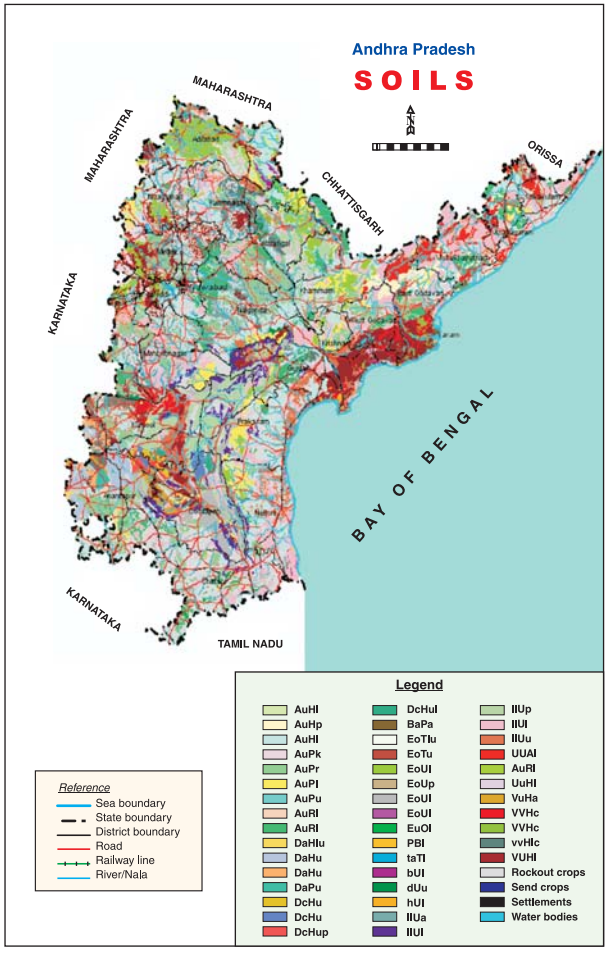
2. Soil and Water Productivity

Soil resource inventory

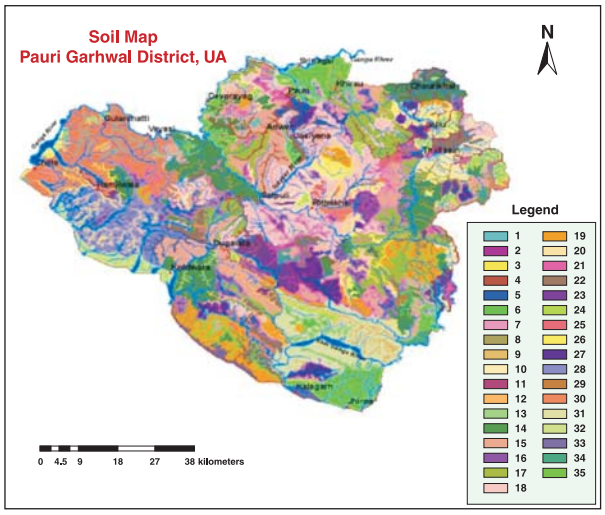
Digitization of soil database: Soil information of the states on 1 : 500,000 was digitized on toposheet basis (1 : 250,000 scale) to create parity in soil resource database. The toposheets were scanned, geo-referenced and edge-matched in ArcInfo GIS software. The soil boundaries and associated layers were digitized in shape format to build topology. The values of soil parameters were assigned to the soil polygons. The databases on site and physical and chemical parameters were created in MS-Access. From the soil coverage and attribute database, thematic maps for Karnataka and Andhra Pradesh states were generated in ArcMap and SPANS/Agroma GIS softwares respectively.



Digitized soil map of Karnataka



Digitized soil map of Andhra Pradesh



Digitized soil map of Pauri Garhwal district of Uttarakhand for perspective land-use planning

Similarly, soil map of Pauri Garhwal district (1: 50,000 scale) of Uttarakhand containing 25 soil series and 35 soil mapping units has been digitized for perspective land-use planning. The database would be used for generation of thematic maps like slope, erosion, surface texture, stoniness, soil reaction, organic carbon status, soil depth and textural class etc.

Block level land resource inventory and GIS database for farm planning: Soil survey and mapping in all the 48 villages of Sivaganga block, Tamil Nadu, revealed existence of about 18 soil series. About 62% of the area is moderately good (Class III lands) for cultivation. Good (Class II), fairly good (Class IV) and lands unfit for cultivation occur in a limited area. About 60% of the area has severe limitations for irrigation due to factors such as soil, drainage and to some extent topography. The land resources are moderately suitable for cultivation of cereal, oilseed, pulse and tree crops.

Assessment of ravinous land in Bundi district: Detailed physiographic distribution of different landforms was delineated for Bundi district of eastern Rajasthan from satellite data of IRS–ID of 2003 on 1: 50,000 scale. Variability in soils was mapped through geo-statistical model in GIS environment and extent, and distribution of ravine land in the district were estimated. In eastern Rajasthan upland, severely eroded ravinous land is 27,770 ha (5.4%) and in Vindhyan landform ravinous land constitutes 69,017 ha (13.3%). Ravines are predominantly occurring in Indergarh, Keshoraipatan, Bundi and Nenwa tehsils.

In 1972, the ravinous land in Bundi district was assessed as 86,000 ha (16.6%). Thus with a span of 30 years, there has been increase in ravine land by 11,000 ha to 97,000 ha which constitutes 18.7% area of the district.

Crop diversification to improve productivity and profitability of reclaimed ravines – Vasad (Gujarat): Plantation of drumstick as pure block plantation with greengram–fennel intercropping was found more remunerative than the prevalent tobacco monocropping system in reclaimed Mahi ravines. The highest net returns of Rs 36,260/ha was obtained from pure drumstick and Rs 27,758/ ha from greengram–fennel compared to Rs 9,518/ ha from tobacco. Crop diversification also reduced irrigation water requirement by 70–75% in the region. Productivity of these marginal rainfed ravine lands can also be enhanced by cultivating improved sorghum (SSG 59-3) with either sub-soiler or contour furrow land treatment.

Drumstick plantation as pure block with greengram-fennel intercropping is more beneficial than tobacco monocropping in reclaimed Mahi ravines

Evaluating land management practices in watershed: Five watersheds were selected in Agro-ecological sub-region 7.2 in Telangana region of Andhra Pradesh, to assess the impact of land management practices in watersheds. The average yields of crops were substantially higher in treated micro-watershed (3.62 tonnes/ha) than untreated micro-watershed (1.72 tonnes/ha). Average net income accrued by farmers in the treated micro-watershed was Rs 13.19/caput/day with a maximum of Rs 44.35/caput/day. In the untreated micro-watershed, average net income was Rs 4.31/caput/ day with a maximum of Rs 13.34/caput/day.

Soil fertility and nutrient management

Soil carbon stock (SOC): The soils of the hot region contain less organic carbon due to unfavourable climatic conditions. The total mass of organic carbon stored in the upper 30 cm and 150 cm of the soils in India is 9.5 and 29.5 Pg respectively. The SOC stock of Indian soils is 10–12% of the tropical regions and about 3% of the total carbon mass of the world. Thus, the

share of India in overall SOC stock of the world is not substantial, although it covers 11.9% of the total geographical area of the world.

Methodology for preparing district soil fertility maps using GIS and GPS tools: The digital soil fertility map with tehsil boundaries of Hoshangabad district on the scale 1: 50,000 was prepared by digitization and mosaicing (merging of digitized boundary) of toposheets. Geo-referenced soil samples were collected and assigned the point values of N, P and K based on laboratory analyses.

Site-specific nutrient management (SSNM) in rice–wheat cropping system: The SSNM experiments with rice–wheat system were conducted at 10 locations under All-India Co-ordinated Research Project on Cropping Systems. Both crops received recommended doses of N, P and K while rice received S and micronutrients in addition. The average annual grain yields under SSNM were 15-17 tonnes/ha compared to 13.3 tonnes/ha under farmers' practices.

Balanced fertilization in cotton: Balanced fertilization for cotton comprising N, P, K + Zn + B as foliar spray twice resulted in 13 to 41% more yield over farmers' practice under on-farm demonstration in Balwada village of Khargoan district, Madhya Pradesh.

A field kit method for assessing decomposability of farm-waste during composting: A new rapid biological method has been developed to assess decomposability of farm-waste during composting. Method is based on conversion of 2, 3, 5-tetrazoliumchloride to triphenyl formazan by micro-organisms growing on farm-waste. Growth of micro-organisms is rapid on easily decomposable farm-waste leading to higher conversion of 2, 3, 5-tetrazoliumchloride to triphenyl formazan, imparting residues dark red colour. The intensity of the red colour and the time taken for its development indicate compostability. Decomposability of 11 farm-wastes was assessed using this method and these were classified into 3 categories as easily decomposable, moderately decomposable and slowly decomposable.

Screening for micro-organisms tolerant to salt and temperature: Out of the total 55 strains collected, 10 *Bacillus* and 12 *Pseudomonas* strains were evaluated for thermo- and osmo-tolerance. *Pseudomonas* strains P1, P4, P6 and P7 could grow up to 7% NaCl (1.2 M) and temperatures up to 50°C, while *Bacillus* strain B2 could grow up to 11% NaCl (2 M) and strains B4, B6 and B7 up to 50°C.

Water management

Assessment of water utilization in lift irrigation schemes (LIS): Two schemes, namely 'Amarachinta' in Mahabubnagar and 'Kanuparthy' in Prakasam district of Andhra Pradesh were selected for evaluation having command area of 1,943 ha and 1,984 ha respectively. The depth of water-table in Amarachinta LIS rose from 13.30 to 9.78 m below ground level during pre-monsoon and 8.55 to 5.01 m during post-monsoon over a span of just 5 years, indicating chances of waterlogging and salinity in near future. An increase in command area from 1,182 to 1,567 ha as well as per cent water utilization (50 to 81) was noticed with transfer of management of LIS from state authority to water user's society. In case of Amarachinta LIS, the field water-use efficiency was found to be 3.85 and 5.11 kg/ha-mm during monsoon and post-monsoon season, respectively, whereas the crop water-use efficiency was found to be 12.48 and 9.40 kg/ha-mm for monsoon and post-monsoon season respectively. On the other hand in case of Kanuparthy LIS, these values

Predicting changes in SOC stock due to climate change

The SOC stocks for the year 2020, 2050 and 2080 were predicted for different locations of India. The data on SOC stock (Mg/ha) of 1980 was considered as the base year. The maximum increase in organic stock predicted to be in eastern Maharashtra and parts of Chhattisgarh containing Agro-ecological Region No.10, 11 and 12 preferably due to increase in predicted rainfall.

The maximum decrease in SOC stock is predicted for southern Kerala and southern Tamil Nadu containing Agro-ecological region No. 8, 18 and 19. The soils of these Regions have comparatively high SOC stock and the decrease in SOC can perhaps be because of rise in temperature.

Rainfall-runoff-groundwater dynamics in semi-arid region–A case study

The study was taken up in Kurmapally watershed with an area 107 km² falling in Nalgonda and Mahabubnagar districts of semi-arid region in Andhra Pradesh. The topography is undulating and is underlined by crystalline rocks. Its average annual rainfall is 575 mm and is erratic both temporally and spatially.

Seasonal variability (estimated for 4 years from 2003-07) between the availability and utilization pattern in the watershed indicated higher groundwater utilization compared to the groundwater recharge potential resulting in more withdrawal from deeper aquifers. The potential recharge is almost equivalent to utilization only in one (2005–2006) out of 4 years of study period that received rainfall of 1,141 mm. This calls for attention of farmers and decision makers for judicious use of available groundwater for sustainability and discouragement of water loving crops.

Adoption of tank-cum-well system increased the cropping intensity within 4 years in a tribal village of Keonjhar district of Orissa. A tank with rice in its command (*left*); an open well with rice in its command (*right*)

were found comparatively low (field water-use efficiency 1.86 and 2.43 kg/ha-mm and crop water-use efficiency 14.8 kg/ha-mm).

System of rice intensification—an alternative for enhancing land and water productivity: The System of Rice Intensification (SRI) has received considerable attention globally, particularly owing to its potential for yield improvement and water saving. In Bhubaneshwar area, SRI with spacing of 20 cm × 20 cm gave highest grain yield up to 6 tonnes/ha which was 36–49% higher than conventional transplanted crop.

In SRI, only 1,571 litres water was required to produce 1 kg seed, but with conventional method 2,801 litres water was needed for 1 kg seed production. The SRI method also showed reduction in labour inputs by 14% than the conventional transplanting method for various cultural practices.

Rainwater harvesting to increase cropping intensity: A tank-cum-well system was developed for micro-level water harvesting in the plateau region of eastern India in a tribal village of Keonjhar district of Orissa. Through this technology tanks and wells were constructed in a series along the drainage line of a watershed to harvest rainwater in high rainfall areas. The adoption of technology resulted in increase in cropping intensity by 100-180% within 4 years of intervention. Due to the intervention, farmers shifted from direct sown rice to transplanted rice. Availability of irrigation water, application of fertilizer and use of high-yielding varieties resulted in increase in crop productivity from 1.2 to 3.1 tonnes/ha. The total investment on tank-cum-well system (Rs 25,000–30,000) can be recovered within 3–4 years. The technology is suitable for plateau areas with slope of 2 to 5%.

Effective utilization of gypsum for reclamation of sodic soils with high salts: The recommended practice of addition of gypsum @ 50% gypsum requirement followed by vertical leaching is not suited to heavy textured (silt + clay > 60%) sodic soils, especially those containing high levels of soluble sodium carbonate. Field studies showed that two horizontal flushings to remove soluble salts, each followed by addition of gypsum @ 25% gypsum requirement could considerably enhance the effectiveness of applied gypsum and thus can be recommended for reclamation of saline sodic soils with high concentration of soluble salts (EC > 15 dS/m).

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