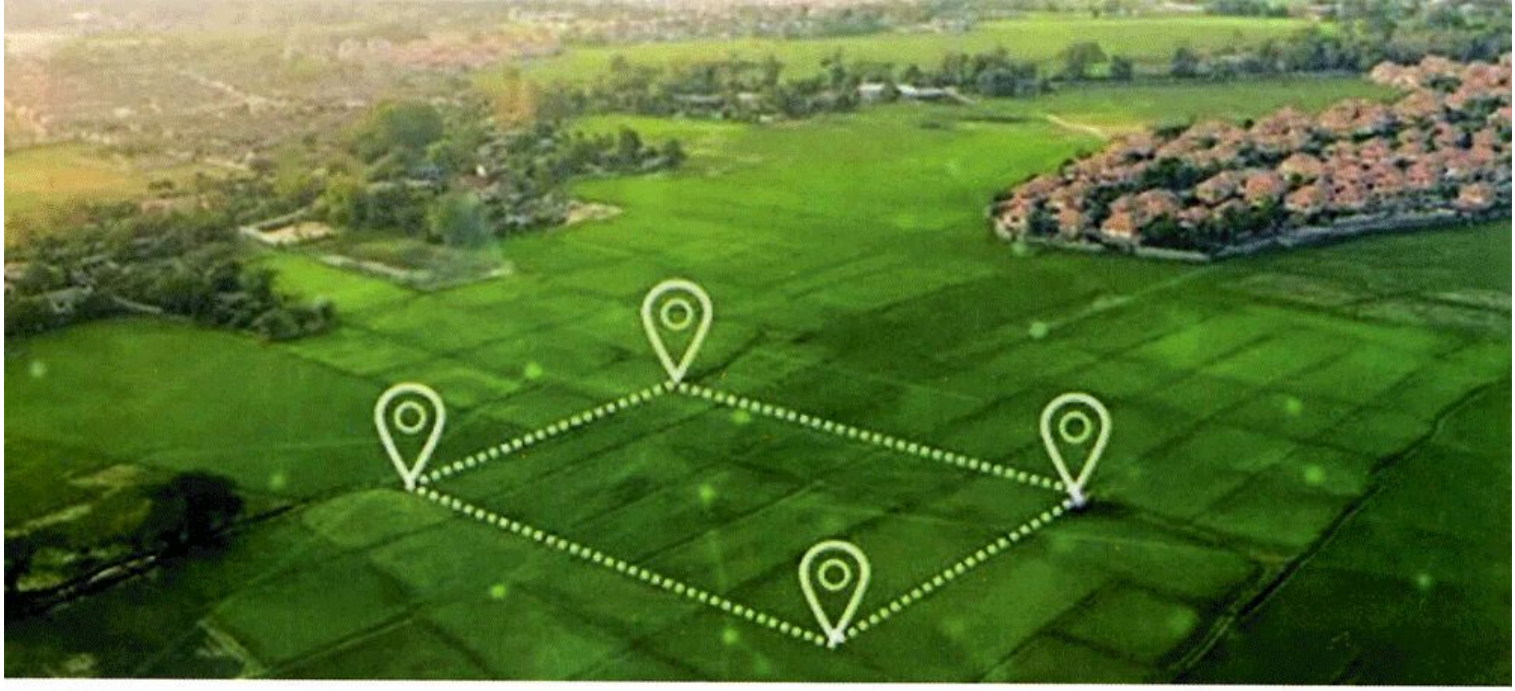

ISRO's Role in Rural Development

Space technology has emerged as a transformative tool in rural development, offering innovative solutions to challenges in agriculture, water management, disaster preparedness, health, education, and infrastructure. There are several initiatives / projects, which are taken up by State and Central Government departments at micro and macro level to enrich the assets required in rural sector for the sustainable development through growth of agriculture.

* **Sudheer Kumar N**

Rural development is a critical component of the country's growth strategy, given that, in India, over 65% of its population resides in rural areas. Space technology has emerged as a transformative tool in this domain, offering innovative solutions to challenges in agriculture, water management, disaster preparedness, health, education, and infrastructure. Organizations like ISRO (Indian Space Research Organisation) and several government programmes leverage space-based applications to enhance the efficiency and reach of rural development initiatives. The satellite data and space applications contribute enormously for the sustainability of various domains.

Rural development applications are continuously focussing on water and land conservation through systematic planning and implementation of development plans in rural sector. Applications of geospatial solutions and their implementation in rural development sector provide customized near real time natural resources databases, tools for the analytics and drawing the water and land resources plans.

There are several initiatives / projects, which are taken up by State and Central Government departments at micro and macro level to enrich the assets required in rural sector for the sustainable development through growth of agriculture like Mahatma Gandhi National

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Rural Employment Guarantee Act (MGNREGA), Accelerated Irrigation Benefit Programme (AIBP), Integrated Watershed Management Programme (IWMP) and On Farm Water Management (OFWM), National Health Resource Repository (NHRR) Project, Rural connectivity, which uses the latest remote sensing and GIS technologies in operational modes.

Rural health sanitation improvement programmes are also playing major role in sustainable development. Several projects are being executed for supporting Ministry of Rural Development and are useful for governance.

Agriculture and Food Security

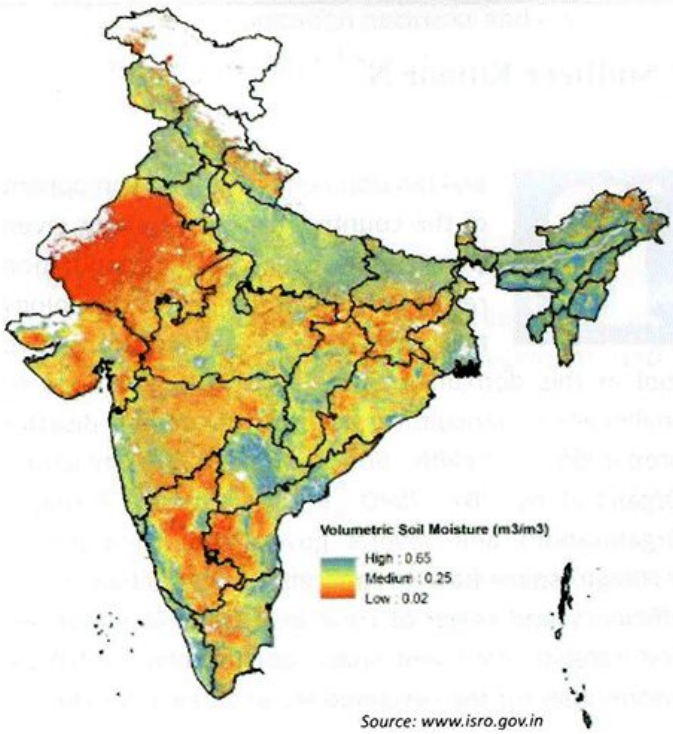
Agriculture in India holds a crucial place in the country's economy and society. As one of the largest agricultural economies in the world, India depends heavily on this sector for food security, employment, and economic development. Agriculture contributes approximately 18-20% of India's GDP. Despite a declining share in the GDP due to industrial and service sector growth, it remains vital for economic stability. India is the world's second-largest producer of rice and wheat and a leading producer of pulses. Initiatives like the Green Revolution in the 1960s boosted food grain production, making India self-sufficient in food. Agriculture accounts for about 12-15% of total exports from India.

Remote sensing satellites provide huge amount of data to assess the extent of crop for estimating the yield and analysing the productivity across various seasons and geographical regions. This facilitates planning the public distribution system and godowns for storing the food grains for ensuring the food security. It also enables the stakeholders to take decisions on the export potential of various agricultural products that are excess over domestic consumption.

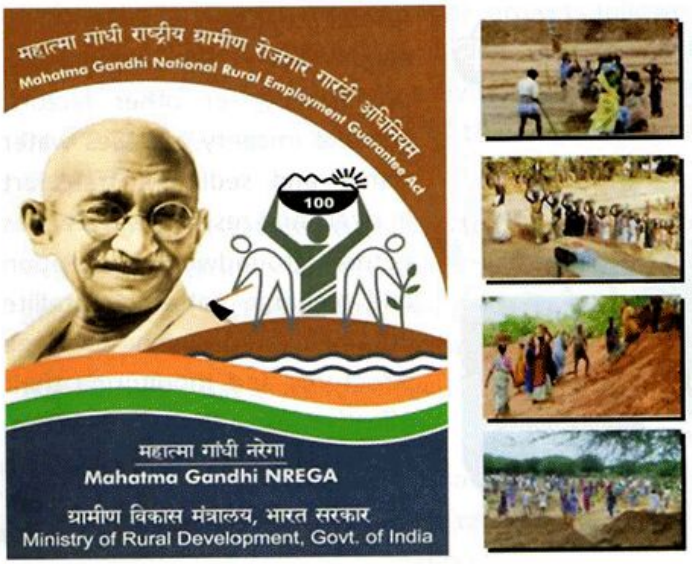
The satellite imagery also provides crucial information about the crops affected by pest and its propagation to contain the extent of damage. It also provides the demand of fertilisers and pesticides based on the crops and timely distribution for effective application and control.

The land records mapping and asset tagging is very important for the farmers for regularising the loans and insurance claims in case of any calamity. The transactions will be more authenticated and secured using the satellite images to assess the extent of damage and substantiate the claims.

Satellite data is much useful in assessing the soil moisture and super-impose the soil fertility information for assessing the water demand and suggesting a



Source: www.isro.gov.in

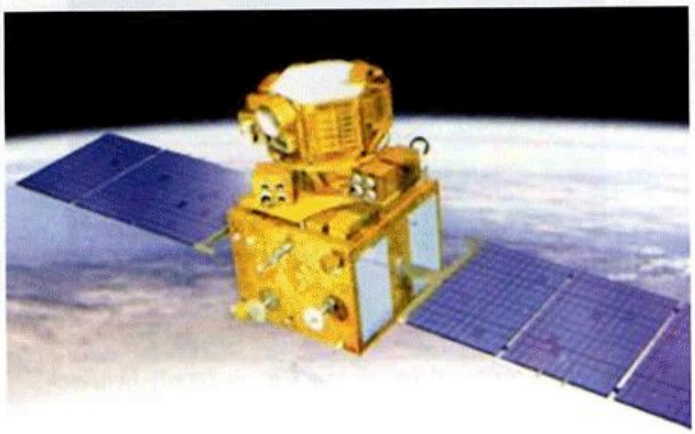


productive crop, that yields a balanced revenue for the farmers.

Majority of the farmers in India are in the small income groups and government supports them through various schemes such as *Pradhan Mantri Fasal Bima Yojana (PMFBY), Soil Health Card Scheme* etc. Satellite imagery is used to assess crop damage and determine insurance claims under this crop insurance programme, ensuring that farmers receive timely support in times of distress. The Soil Health Card provides farmers with information on soil health and fertility based on satellite and ground data. This helps them apply the right nutrients and improve productivity.

Horticulture

Another domain that contributes to the revenue is horticulture which includes vegetables, fruits, flowers, herbs and ornamental plants. Hyperspectral satellite data will be used to the extent of analysing stress and quality of leaves and monitoring the health of the plants. The production and yield of different seasonal fruits and vegetables play a vital role in the distribution system to



monitoring and control of the agriculture economy. This also leverages for proper planning of supply chain for a long term sustainability.

Aquaculture

Satellite imagery is increasingly being used in aquaculture to enhance productivity, sustainability, and environmental management. The remote sensing capabilities of satellites allow aquaculture practitioners to monitor and manage fish farms and aquatic ecosystems efficiently. Satellite images can help analyze water parameters such as chlorophyll concentration, turbidity, and temperature, which are crucial for site selection. Geographic data from satellites assists in identifying locations with optimal conditions for aquaculture based on factors like salinity, nutrient availability, and proximity to pollution sources. Thermal imaging from satellites helps track surface water temperatures, essential for fish and shrimp health. Satellites can detect sediment levels, indicating water clarity, which affects aquatic species' growth. By analyzing chlorophyll levels, satellites provide insights into plankton abundance, an important food source for some aquatic species. Satellite images can detect and monitor algal blooms, helping farmers mitigate risks of oxygen depletion and toxins affecting fish health. Continuous monitoring provides early warnings about blooms, allowing timely interventions. High-resolution satellite images can map aquaculture ponds, cages, and other infrastructure, ensuring proper spatial planning. Regular monitoring of aquaculture sites can track changes in water levels, vegetation, and infrastructure over time. Satellite data helps identify stressors like poor water quality or temperature fluctuations that could lead to disease outbreaks.

Digital Agriculture Mission

The Digital Agriculture Mission is designed as an umbrella scheme to support various digital agriculture initiatives. These include creating Digital Public Infrastructure (DPI), implementing the Digital General Crop Estimation Survey (DGCES), and supporting IT initiatives by the Central Government, State Governments, and Academic and Research Institutions.

The scheme is built on two foundational pillars:

- Agri Stack
- Krishi Decision Support System.

Additionally, the mission includes *'Soil Profile Mapping'* and aims to enable farmer-centric digital services to provide timely and reliable information for the agriculture sector.

The Krishi Decision Support System (DSS) will integrate remote sensing data on crops, soil, weather, and water resources into a comprehensive geospatial system.

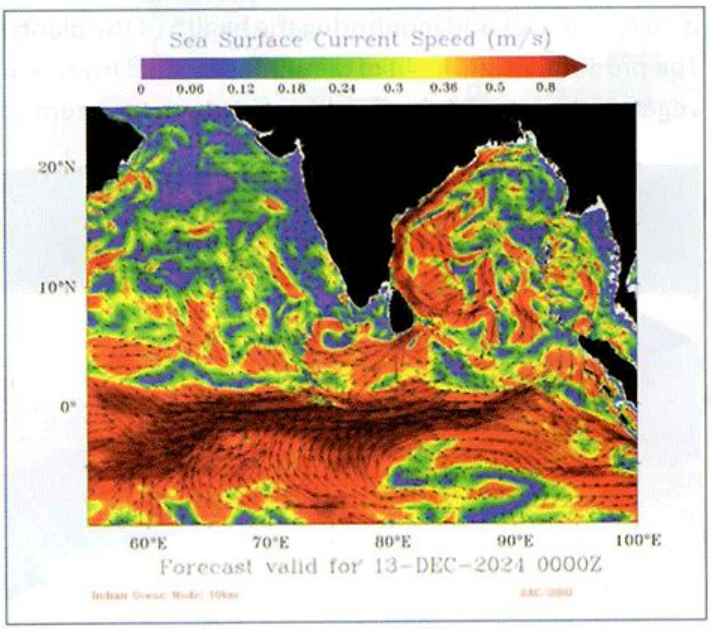
Water Resource Management

Satellite technology and data play a transformative role in water resource management by providing accurate, timely, and large-scale information about water availability, distribution, and quality. These tools aid in decision-making, planning, and sustainable management of water resources.

Mapping and Monitoring Water Bodies: Satellites can track the extent, volume, and seasonal variations of lakes, rivers, and reservoirs. High-resolution imagery maps the size of water bodies, helping assess storage capacities and trends. Multi-temporal satellite data reveals changes in water body extents due to climate variability, urbanization, or other factors. Satellite imagery assesses water clarity and sediment transport in rivers and reservoirs. Satellites detect groundwater depletion and recharge patterns. Satellite data helps in designing recharge structures and monitoring their effectiveness. Digital Elevation Models (DEMs) from satellites delineate watersheds and sub-basins.

Irrigation Management: Satellites provide data on vegetation health and evapotranspiration, optimizing irrigation schedules. Monitoring irrigated areas ensures efficient water allocation for agriculture. Satellites provide critical data on soil moisture levels, aiding drought forecasting.

Integrated Watershed Management Programme (IWMP) creates wide network of farm ponds, check dams and other soil conservation measures apart from supporting many other natural resource management actions. A geospatial data oriented Web GIS solution along with smart phone based application for achieving transparent and precise governance is developed and hosted on Bhuvan-IWMP. High resolution time series satellite images rendered in natural colour coupled with smartphone uploaded field inventory of activities are done under IWMP. With spatially explicit and detailed space based imaging of the watersheds for time periods



before the implementation of IWMP projects followed by post-implementation period, it is possible to watch the changes brought in due to activities duly validated by the near real time inventory of the field structures and activities.

8200 micro watershed projects to be monitored for five years. Utilisation smart phone application based geotagging of activities are being handled by State agencies. Visualization of assets brought in high level transparency that is acknowledged widely.

- Space technology facilitates mapping of water bodies, groundwater recharge zones, and watershed areas. This data is crucial for irrigation planning and drought mitigation.
- **Government Initiative**: Under the Jal Shakti Abhiyan, satellite data is used to monitor water conservation projects and rejuvenation of water bodies in rural areas.

Disaster Management and Preparedness

Flood Monitoring and Management

Flood Prediction and Early Warning: Real-time satellite data identifies areas at risk by monitoring rainfall, river discharge, and water levels.

Damage Assessment: Post-flood imagery maps inundated areas to evaluate the extent of damage and aid in recovery efforts.

- **National Agricultural Drought Assessment and Management System (NADAMS):** This initiative combines satellite data with meteorological data to assess drought conditions, providing timely information for farmers and policymakers to manage agricultural risk.
- **Early Warning Systems**: Satellites like INSAT provide timely weather updates and disaster alerts, reducing vulnerability to cyclones, floods, and droughts.
- **Post-Disaster Assessment**: High-resolution imagery aids in damage assessment and planning for relief operations.
- ISRO's Flood Early Warning System (FEWS) has been integrated into rural flood-prone areas, enhancing disaster preparedness.

Rural Connectivity, Employment and Infrastructure

To demonstrate the potential of satellite technology for development of rural areas, ISRO established Village Resource Centres (VRCs) on a pilot scale, in association with selected NGOs, Trusts and State Government Departments. VRCs have provided various space technology enabled services such as tele-healthcare, tele-education, natural resources information, advisories related to agriculture, career guidance to rural students, skill development and vocational training etc. About Rs 18 crore was spent for establishing 473 VRCs.

The Ministry of Rural Development is utilizing the Geographic Information System (GIS) for improvement in planning and implementation of projects. GIS planning is being used for Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and Pradhan Mantri Gram Sadak Yojana (PMGSY).

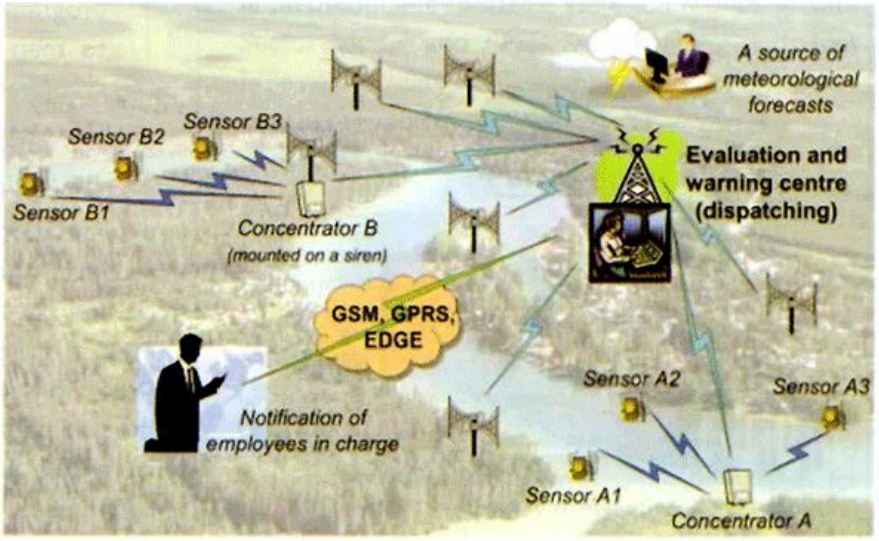
Healthcare and Education

- **Telemedicine**: ISRO's satellite-based telemedicine services bridge the healthcare gap in rural areas, enabling specialist consultations remotely.

Telemedicine initiative has been broadly divided into the following areas:

a. Providing Telemedicine Technology & Connectivity between remote/rural hospitals and Super Speciality Hospital for Teleconsultation & Treatment and Training of doctors & paramedics.

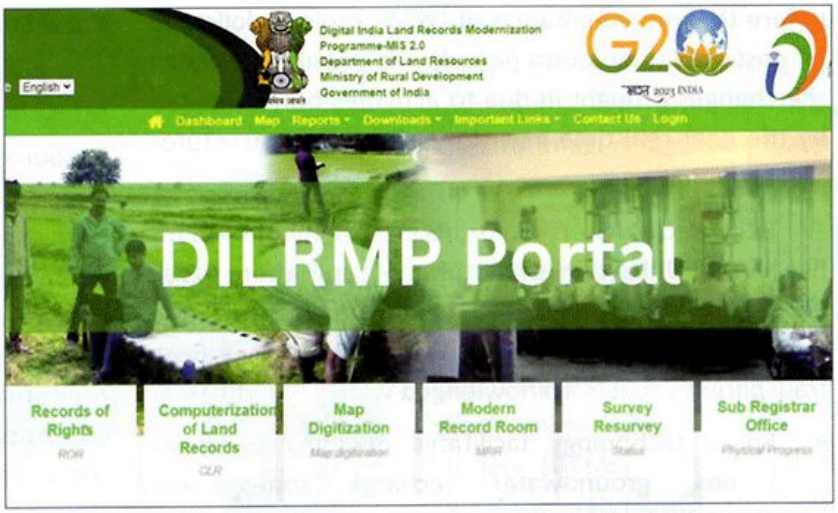
b. Providing the Technology & Connectivity for Continuing Medical Education (CME) between Medical Colleges & Post Graduate Medical Institutions/Hospitals.



c. Providing Technology & Connectivity for Mobile Telemedicine units for rural health camps especially in the areas of ophthalmology and community health.

d. Providing Technology and Connectivity for Disaster Management Support and Relief.

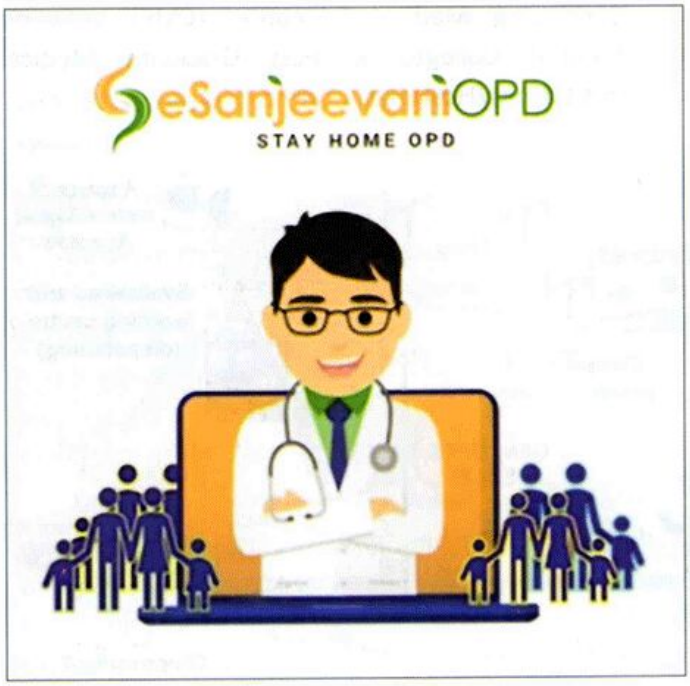
ISRO's Telemedicine pilot project was started in the year 2001 with the aim of introducing the Telemedicine facility to the grassroots level population as a part of 'proof of concept technology demonstration' programme.



• **eSanjeevani:** the National Telemedicine Service of MoHFW, Government of India has evolved into the world's largest documented telemedicine implementation in the primary healthcare.

For several decades, not only state-space agencies but also international organisations like the United Nations Office of Outer Space Affairs (UNOOSA) and United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) have also been promoting the use of space technologies for global health.

• **Tele-Education**: Initiatives like EDUSAT provide distance learning opportunities for rural students, improving access to quality education. ISRO's Tele-education programme provides satellite-based distance education services for bridging rural-urban divide and improve quality in education sector across the country.



Objectives :

- Supplementing curriculum based teaching
- E-learning through satellites
- Access to quality resourcepersons and education
- Taking education to every nook and corner of the country

Land and Property Management

- **Digital India Land Records Modernization Program (DILRMP)**:
  - Integrates satellite imagery for accurate mapping of land parcels, ensuring better land governance.
  - The *Bhoomi* initiative uses satellite imagery along with Ground Control Points (GCPs) to maintain accurate land records and streamline land transfer processes, thus promoting transparency in land dealings.
- **SVAMITVA Scheme**: Launched in 2020, this programme uses drones and geospatial technology to map rural land parcels, providing ownership records and resolving property disputes.

Bhuvan Panchayat

Bhuvan Panchayat portal is specifically designed to provide information and tools for utilisation on all the products and services developed under the National Natural Resources Management System (NNRMS) project called Space-based Information System for Decentralised Planning (SISDP). With an aim to support the geospatial data requirements for entire country at a large scale of 1:10k thematic products like LULC, Drainage, Settlements, Slope, Rail & Road along with collateral data

and high resolution satellite imagery base of 2.5m, the project has successfully completed two phases i.e. SISDP and SISDP-U by generating and disseminating generated datasets on Bhuvan Panchayat portal.

Bhuvan Panchayat presents a comprehensive information on the project, its activities, facilities to download the data directly as a shape file or use the data as OGC WMS/WMTS services thus facilitating all the users of different geospatial domains to integrate the data directly in their value added services or showcase as mashups / overlays in their existing value chains. A pan India seamless coverage of thematic data at this large scale of 1:10k scale is made available to support growing needs of g-governance, societal applications, R&D activities in environment and land use studies and geospatial industry needs at absolutely no cost along with free access based on the governing policies as on date.

BharatNet

BharatNet, one of the biggest rural telecom projects in the world, implemented in a phased manner across all Gram Panchayats (approximately 2.5 lakh) in the country for providing non-discriminatory access to broadband connectivity to all the telecom service providers. Objective is to enable access providers like mobile operators, Internet Service Providers (ISPs), Cable TV operators and content providers to launch various services such as applications like e-health, e-education and e-governance in rural and remote India. Approved by Union Cabinet on 25.10.2011, the project is being executed by a Special Purpose Vehicle (SPV) namely Bharat Broadband Network Limited (BBNL). Till Oct end, 2024, under BharatNet Phase-I and Phase-II; 2,14,283 GPs are service ready.

i. **Objectives**: BharatNet aims to provide high-speed broadband to over 2.5 lakh Gram Panchayats (GPs) across India using optical fiber, enabling access to e-governance, e-health, e-education, and other digital services. Its last-mile connectivity extends broadband access to households, schools, hospitals, and other public institutions.

ii. **Implementation**: The project has progressed through phases:

- Phase I (completed in 2017) covered over 1.25 lakh Gram Panchayats.
- Phase II: GPs are to be connected through multiple implementing models like State-led Model, Private Sector Model and CPSU Model, along with Last Mile connectivity in GPs through Wi-Fi or any other suitable broadband technology. ❑

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