UNIT 3 INDIAN SCENARIO IN GEOINFORMATICS

Structure

3.1 INTRODUCTION

In Unit 1, you have been introduced to geoinformatics and its various components. In Unit 2, you have studied about the trends and developments taking place in different fields of geoinformatics, globally. You have also been

introduced to the expected future trends in geoinformatics in global perspectives.

You now know that geoinformatics is a synergism of various disciplines and because of its applications being oriented mainly to the real-world problems of management of natural and man-made environment, its presence is expanding at a rapid rate. There are various institutes and organisations which have contributed significantly to the growth of geoinformatics in India. Government of India has now included geoinformatics technology in many of its national level programmes. It is important for you to know about them. Hence this unit is particularly related to the Indian scenario in geoinformatics. In this unit, you shall study about major agencies, which have played significant role in shaping the present geoinformatics industry in India. You shall also study about major national initiatives involving geoinformatics, and the universities and institutes involved in geoinformatics education. This would give you an idea about the market potential of the geoinformatics technology and career prospects in this area.

Objectives

After studying this unit, you should be able to:

- list the national agencies and organisations which have shaped the Indian geoinformatics industry;
- elucidate about the major national initiatives involving geoinformatics component;
- discuss career options in the field of geoinformatics; and
- discuss about education scenario in the field of geoinformatics.

3.2 GEOINFORMATICS IN INDIA

Geoinformatics is fast expanding its presence in India. It has become an important component of planning and decision making in diverse sectors, such as urban planning, ascertaining natural resources, social forestry or location-based services. Public perception towards geoinformatics industry has also changed. What was once considered an impenetrable domain is now easily understood by the common man. The emergence of Web 2.0 with the power of mapping and collaborative initiatives has helped change the way people look at geospatial industry. Geoinformatics tools and technologies have empowered us to generate maps, create interactive queries, analyse information with its different attributes and use the outputs for decision making purposes. There are many resource planning and business activities now, which are unimaginable without input from geoinformatics.

GDP (Gross Domestic Product) is an indicator which is used to gauge the health of a country's economy. GDP represents market value of all goods and services produced over a specific time period within a country. GDP per capita is used as an indicator of a country's standard of living.

3.2.1 Growth of Geoinformatics Industry

Recent surveys suggest that the Indian geoinformatics industry is witnessing higher growth rate than the average global growth rate of any other nation. The significant rise in demand for geospatial information is likely to give it more weightage in both public and private planning across sectors. Fig. 3.1 shows the percentage growth for the Indian geoinformatics industry vis-a-vis worldwide growth. It is expected that like India's GDP, the growth of India's geospatial market will outpace growth rate for geospatial markets in the rest of the world.

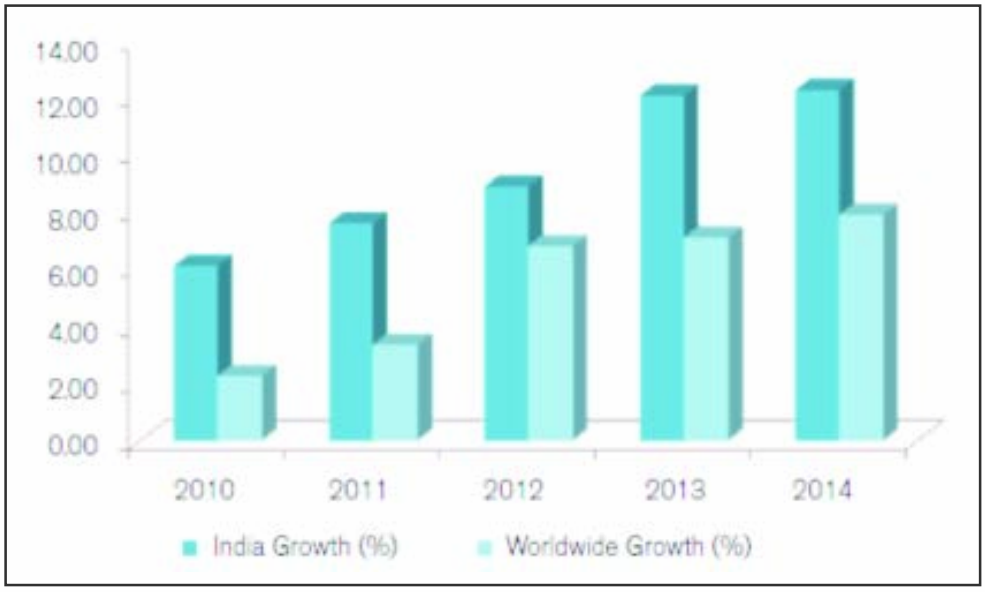

Fig. 3.1: Percentage growth of the Indian geoinformatics industry vis-a-vis worldwide (source: Geospatial World, Sep. 2010)

3.2.2 Challenges to Geoinformatics Industry

The efforts in geoinformatics and its allied fields are concentrated amongst a limited number of government agencies and a smaller number of the private sector agencies. Some of the common problems faced by the industry are:

- non-availability of quality and standardised data
- lack of adequate resources to collect and maintain data
- lack or absence of regular updation of available data
- data ownership issues
- issues with responsible processing of data
- cost (both software and hardware)
- gap between the expectations of the customers and the performance of the industry
- data safety and security issues.

It is felt that a good geographic framework for our country is needed. The time is not far when these issues would be addressed effectively to meet the challenges of the industry. It is often discussed and debated in different forums that the time is ripe to shed *licence raj* and secrecy policy because denial of data may stunt the industry's growth. The denial of data will dampen research spirit, competitiveness, talent, innovation, scientific and technical skills and above all stagnate the industry's growth. Limiting access to data can have far-reaching consequences, which could cripple the industry. In this direction, organisation, such as Survey of India having vast resources of spatial data, can play a pivotal role in generating and providing current, accurate and reliable framework of spatial data to other agencies for value addition. However, this is not achievable in the absence of a regulatory authority, which is required to put in place a framework where the industry can collaborate with the national mapping and survey agencies. Fig. 3.2 gives you an idea of the multiple tasks of geospatial authority.

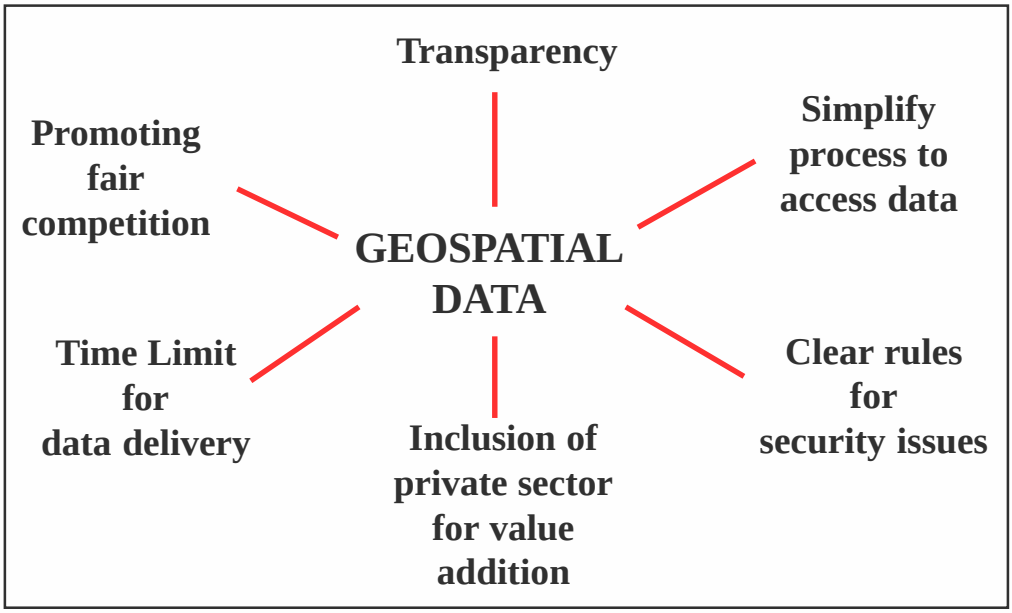

Fig. 3.2: Multiple tasks of geospatial authority (source: www.geospatialtoday.com)

3.2.3 Looking Ahead

With the objective of unrestricted production, maintenance and dissemination of spatial data, a new map policy (NMP) has been declared by the National Topographic Database of the Survey of India (SOI). This is an outcome of the consistent demand from several quarters, including the geoinformatics industry to consider the topographic database as a national asset and to make it available without much restriction. Keeping in view the national security objectives, two series of maps have been proposed in the policy, namely defence series map (DSM) and open series map (OSM). The DSM would cater to defence and national security requirements, whereas the OSM would cater to common civilian use.

The old remote sensing data policy was framed in 2001. According to the old policy, it was mandated that ISRO (Indian Space Research Organisation) could release data of up to 5.8 meter resolution. All other better resolution data were strictly controlled by the government. Recently, when a Comptroller and Auditor General of India (CAG) report found that about 80% of images of ISRO were not being used adequately, Government of India announced its new data sharing policy for India's remote sensing satellites. Under this policy, all remote sensing imagery and data up to 1 meter resolution will be made freely available without restriction, which is a quantum jump from the past. However, release of data less than one meter in resolution will still be under concerned control by the authorities. It is expected that this step would very much ease infrastructure development in urban areas and sectors, such as telecom, roads and housing could benefit greatly.

3.3 NATIONAL AGENCIES

There are some agencies in India which have played significant role in the development of geoinformatics technologies, development of methods and approaches for different applications, establishing geoinformatics industry and also imparting quality education in the field. In this section, we will discuss about some of the important national agencies, their role and contribution. List of these agencies is given in Table 3.1.

Table 3.1: List of some of the national agencies with their details

No	Agency	Website	Year of Inception	Location
1	Indian Space Research Organisation (ISRO)	www.isro.org	1960	Bangalore
2	Vikram Sarabhai Space Centre	www.vssc.gov.in	1963	Thiruvananth-apuram
3	National Remote Sensing Centre (NRSC)	www.nrsc.gov.in	2008	Hyderabad
4	Sathish Dawan Space Centre (SDSC)	www.shar.gov.in	2002	Sriharikota
5	Space Applications Centre (SAC)	www.sac.gov.in	1972	Ahmedabad
6	Regional Remote Sensing Centre (RRSCs)	www.isro.gov.in/isrocentres/rrssc.aspx	-	Kolkata, Dehradun, Jodhpur, Bangalore, Nagpur
7	Department of Science & Technology (DST)	www.dst.gov.in	1971	New Delhi
8	National Atlas & Thematic Mapping Organisation (NATMO)	http://natmo.gov.in	1956	Kolkatta
9	Survey of India (SOI)	www.surveyofindia.gov.in	1767	Dehradun
10	Geological Survey of India (GSI)	www.portal.gsi.gov.in/portal/page?_pageid=108,717695 &_dad = portal&_ schema=PORTAL	1851	Kolkata
11	Defence Research & Development Organisation (DRDO)	http://drdo.gov.in/drdo/English/index.jsp?pg=homebody.jsp	1958	New Delhi
12	Defence Terrain Research Laboratory (DTRL)	www.drdo.gov.in/drdo/labs/DTRL/English/index.jsp?pg=homebody.jsp	1988	New Delhi
13	National Informatics Centre (NIC)	www.nic.in	1976	New Delhi
14	Centre for Development of Advanced Computing (C-DAC)	www.cdac.in	1988	Pune
15	National Bureau of Soil Survey and Land Use Planning	www.nbsslup.in	1956	Nagpur
16	Town and Country Planning Organisation (TCPO)	www.urbanindia.nic.in/theministry/subordinateoff/tcpo/tcpo.htm	1962	New Delhi
17	National Capital Region Planning Board (NCRPB)	http://ncrpb.nic.in	1985	New Delhi

3.3.1 Indian Space Research Organisation (ISRO)

The objective of ISRO is to develop space technology and its application to various national tasks. ISRO has established two major series of satellite systems, INSAT (Indian National Satellites) system for communication, television broadcasting and meteorological services, and IRS (Indian Remote Sensing) system for natural resources monitoring and management. Satellites built by India are primarily designed to meet a national need first. Space activities in the country have concentrated on achieving self-reliance and developing capability to build and launch communication satellites for television broadcast, telecommunications and meteorological applications; and remote sensing satellites for management of natural resources.

The Indian Remote Sensing (IRS) satellite system is one of the largest constellations of remote sensing satellites in operation in the world today. From the first experimental remote sensing Satellite built in India i.e. Bhaskara-I to the recent Resourcesat-2, India's technological capability has increased manifold along with its coverage and value-added products. You will see a list of ten satellites in Table 3.2, which continue to provide imageries in a variety of resolutions.

Table 3.2: Recently launched important Indian satellites

No.	Name of the Satellite	Launch date and vehicle used for launching
1	RESOURCESAT-2	April 20, 2011 by PSLV-C16
2	CARTOSAT-2B	July 12, 2010 by PSLV-C15
3	OCEANSAT-2	Sept 23, 2009 by PSLV-C14
4	RISAT-2	Apr 20, 2009 by PSLV-C12
5	CARTOSAT-2A	Apr 28, 2008 by PSLV-C9
6	IMS-1	Apr 28, 2008 by PSLV-C9
7	CARTOSAT – 2	Jan 10, 2007 by PSLV-C7
8	CARTOSAT-1	May 05, 2005 by PSLV-C6
9	RESOURCESAT-1	Oct 17, 2003 by PSLV-C5
10	TES	Oct 22, 2001 by PSLV-C3

Images taken by Indian Remote Sensing (IRS) satellite system have found application in diverse fields. Some of them are listed below:

- crop health monitoring, crop yield estimation and drought assessment are the significant areas of application in the agriculture and the allied fields
- natural resource monitoring, management and its judicious combination with socio-economic data
- ground water potential zone mapping and mineral targeting
- ocean applications including potential fishing zone identification and coastal zone mapping
- forest cover mapping, biodiversity characterisation and monitoring of forest fire
- timely assessment of damages caused by flood and earthquake and providing the necessary supportive strength to disaster management, and

- soil mapping at different scales and in the field of archaeological survey.

There are different centres of ISRO located at different places in India, which are entrusted with and are responsible for specific tasks. Some of these centres are briefly mentioned here:

a) Vikram Sarabhai Space Centre (VSSC)

VSSC, located at Thiruvananthapuram, is the major centre of ISRO, where the design and development activities of satellite launch vehicles and sounding rockets are carried out and made ready for launch operations. The major programmes include launch vehicle projects of Polar Satellite Launch Vehicles (PSLV), Geosynchronous Satellite Launch Vehicles (GSLV Mark II and Mark III), Rohini Sounding Rockets, Space-capsule Recovery Experiments, Reusable Launch Vehicles (RLV) and Air Breathing Propulsion for Advanced Reusable Launch Vehicles (ARLV).

b) National Remote Sensing Centre (NRSC)

NRSC, located at Hyderabad, has been recently converted into a full-fledged centre of ISRO. The Centre is responsible for remote sensing satellite data acquisition and processing, data dissemination, aerial remote sensing and decision support for disaster management. NRSC has set up data reception station at Shadnagar near Hyderabad for acquiring data from Indian remote sensing satellites as well as others. The Centre is also engaged in executing remote sensing application projects in collaboration with the users. Currently NRSC is supplying data from CartoSat-1, 2, 2A & 2B, ResourceSat-1 & 2, OceanSat, TES, IRS-1D and IMS-1 to the users listed in Table 3.1.

We will discuss about different kinds of data products available to users in Unit 6 in *Remote Sensing Data Products and Formats* of MGY-001.

c) Satish Dawan Space Centre – Sriharikota (SDSC SHAR)

SDSC SHAR, located in north of Chennai, has the necessary infrastructure for launching satellites into low Earth orbit, polar orbit and geostationary transfer orbit. Apart from these, it also has facilities for launching sounding rockets meant for studying the Earth's atmosphere.

d) Space Applications Centre (SAC)

SAC is one of the major centres of the Indian Space Research Organisation (ISRO). SAC is responsible for realising the application oriented programmes of ISRO in the areas of Satellite Communications, Navigation and Remote Sensing, and is also responsible for design and development of space-borne instruments and payloads for communications and remote sensing satellites for ISRO missions.

e) Regional Remote Sensing Centres (RRSCs)

Under the National Natural Resources Management System (NNRMS) by Department of Space (DOS), five Regional Remote Sensing Service Centres (RRSSCs) have been established at Bangalore, Jodhpur, Kharagpur (recently relocated to Kolkata), Dehradun and Nagpur. The centres have been integrated with NRSC, and renamed as Regional Remote Sensing Centres (RRSCs) South, West, East, North and Central, respectively.

RRSCs support various geoinformatics related tasks specific to their regions as well as at the national level. RRSCs are carrying out application projects encompassing all the fields of natural resources, like agriculture and soils, water resources, forestry, oceanography, geology, environment and urban planning. They are also involved in software development and customisation as per user requirements and conducting training programmes.

3.3.2 Department of Science and Technology (DST)

DST located in New Delhi, plays the role of a nodal department for organising, coordinating and promoting scientific and technological activities in the country. DST has also supported the development of indigenous geoinformatics software and its promotion. Scientific services of DST include matters concerning the Survey of India and the National Atlas and Thematic Mapping Organisation, which are involved in applying geoinformatics technologies in their work.

a) National Atlas and Thematic Mapping Organisation (NATMO)

NATMO is at present having 15 divisions spread out into 4 different units located in Kolkata and New Delhi. Major functions of the NATMO are listed below:

- compilation of the National Atlas of India and its preparation in regional languages
- installation of automated mapping system for increasing speed and efficiency in mapping
- cartography for the visually impaired
- capacity and infrastructure building of NATMO to convert/to upgrade in digital mode.

b) Survey of India (SOI)

Survey of India, the national survey and mapping organisation of the country under the DST, has it's headquarter at Dehradun. It is the oldest scientific department of the government of India. SOI, in its assigned role as the nation's principal mapping agency, bears a special responsibility to ensure that the country's domain is explored and mapped. It provides base maps for expeditious and integrated development and ensures that all resources contribute with their full measure to the sustainable progress, prosperity and security of our country.

Vision of the SOI is the advancement of theory, practice, collection and applications of geospatial data. It promotes an active exchange of information, ideas, and technological innovations amongst the data producers and users.

3.3.3 Geological Survey of India (GSI)

GSI located in Kolkata, is more than 150 years old organisation. GSI is responsible for providing technical consultancy, data and services to prospective investors and agencies, both national and multinational.

Responsibilities of GSI include systematic geological, geotechnical, geophysical, geochemical and geoenvironmental mapping and studies in India. It is involved in development and dissemination of geo-scientific databases, human resource development, information services and education.

3.3.4 Defence Research & Development Organisation (DRDO)

DRDO, located in New Delhi, has been involved in the research and development activities to support and meet the requirement of the defence forces. Though there are many laboratories which are involved in deriving intelligence information from geospatial data, we will briefly discuss here about two laboratories namely, Defence Terrain Research Laboratory (DTRL) and Defence Electronics Applications Laboratory (DEAL).

a) Defence Terrain Research Laboratory (DTRL)

Primary responsibility of DTRL includes research and development of techniques to evaluate various types of terrains and assess vehicle mobility potential of inaccessible areas. Major achievements of DTRL include use of satellite data for preparation of different thematic maps and generating terrain information, development of software for extracting terrain parameters, generation and regular updation of road mobility maps for vehicles incorporating artificial intelligence techniques, and development of Landslide Information System (LIS) for some of the north-eastern states.

b) Defence Electronics Applications Laboratory (DEAL)

DEAL, established in 1959, is entrusted with the responsibility of providing required resources, infrastructure and an effective and efficient quality management system for timely completion of the design and development of the products. Some of the major achievements of DEAL in the field of geoinformatics include development of multispectral image classification system, microwave data processing software, and development of ship detection software package, etc.

3.3.5 National Informatics Centre (NIC)

Established in 1976, and located in New Delhi, NIC is providing state-of-art solutions for information management and decision support in government and corporate sector. Some of the significant works of NIC in the field of geoinformatics include creation of digital data of different thematic layers, use of GIS for decision support and e-governance.

3.3.6 Centre for Development of Advanced Computing (C-DAC)

C-DAC, located in Pune, is primarily an R&D institution involved in the design, development and deployment of advanced information technology products and solutions. It is also involved in geoinformatics software development/ customisation and training. Development of Decision Support Systems based on geoinformatics is its niche area. Some of the achievements of C-DAC include: Digital Elevation Model (DEM) generation for lunar surface, development of GIS-enabled Road Information Management & Monitoring System (GRIMMS) for PMGSY (Pradhan Mantri Gram Sadak Yojna) initiative of the Government of India, development of mobile GIS software 'SAARTHY' for navigation solutions, development of vehicle management & information system and land management system, generation of thematic layers, and development of spatial decision support systems for natural hazards, and contribution in the web-based National Geospatial Data Clearinghouse initiative, etc.

3.3.7 National Bureau of Soil Survey and Land Use Planning (NBSS & LUP)

The NBSS & LUP, located at Nagpur, under the Indian Council of Agricultural Research (ICAR), is involved in applied and basic research in application of remote sensing in soils and agriculture along with imparting training in soils and agriculture.

3.3.8 Town and Country Planning Organisation (TCPO)

TCPO, the technical arm of the Ministry of Urban Development, Government of India, located in New Delhi,is an apex technical advisory and consultant organisation on matters concerning urban and regional planning strategies, research, appraisal, and monitoring of central government schemes and development policies. One of the important works of TCPO in the field of geoinformatics is development of National Urban Information System (NUIS) to develop attribute as well as spatial database for various levels of urban planning using remote sensing data.

3.3.9 National Capital Region Planning Board (NCRPB)

NCRPB, located in New Delhi, deals with the problems of land, housing, transportation and management of essential infrastructure, like water supply and sewerage in the National Capital Region. It uses geoinformatics technology for generation of spatial data and for planning purposes.

3.3.10 Other Organisations/Agencies

There are many other agencies and organisations in India, which are actively involved in utilising the benefits of geoinformatics technology in a variety of fields and application areas. Besides, there are numerous educational institutes, universities, National Institutes of Technology (NITs) and Indian Institute of Technologies (IITs), which are involved in providing research input for solving problems, development and promotion of the technology, and also in developing human resources. Some of the agencies are listed below:

- Indian Agricultural Research Institute (IARI), New Delhi
- National Centre for Antarctic and Ocean Research (NCAOR), Goa
- National Institute of Oceanography (NIO), Goa
- Bombay Metropolitan Region Development Authority (BMRDA), Mumbai
- All India Soils and Land Use Survey (AISLUS), Bangalore
- Various state departments and organisations, private sector agencies.

Spend 5 mins

Check Your Progress I

1) What do ISRO, NRSC, C-DAC and NCAOR stand for?

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2) Name few satellites data which are being provided by NRSC, Hyderabad.

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3.4 NATIONAL INITIATIVES

There are a number of initiatives of the Government of India (GOI) that have a significant geoinformatics component. Use of geoinformatics data and technologies is supported to a large extent by such initiatives of the government through its ministries and various departments. As shown in Fig. 3.3, in the 11th Five Year Plan, majority of the sectors have emphasised on the usage of geoinformatics data in their current functioning and launched various new schemes which mandate the use of geoinformatics technology. Table 3.3 will give you an overview of national initiatives in the geoinformatics.

Now, let us discuss briefly about some of the national initiatives in which geoinformatics technologies have been used either as a major source of data or as a planning tool.

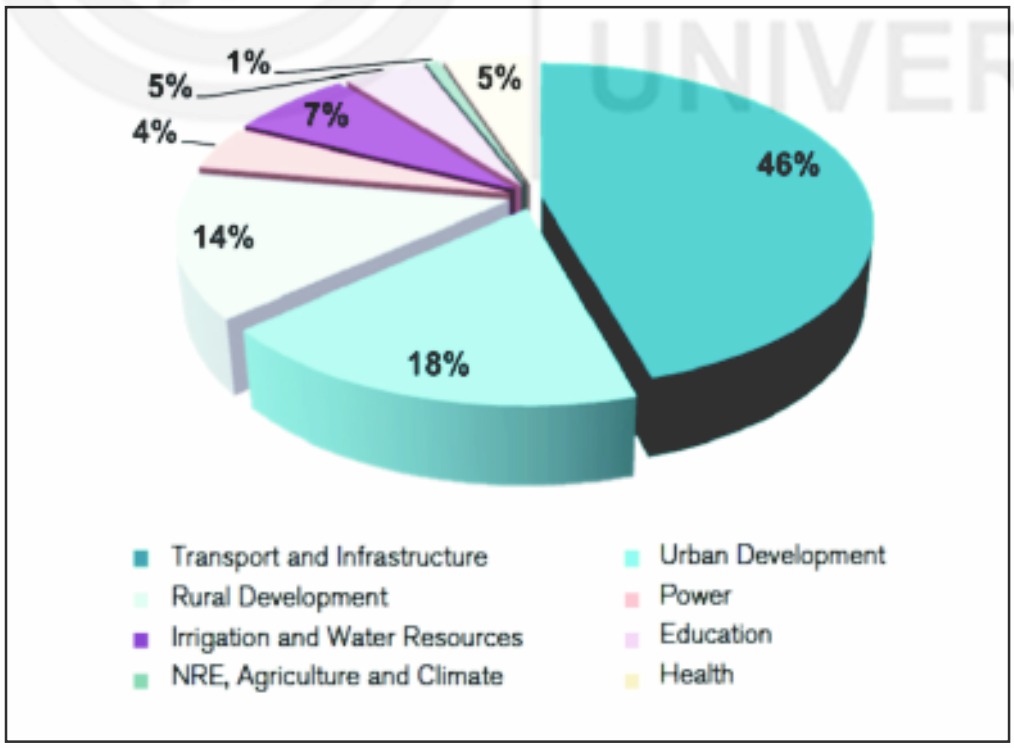

Fig. 3.3: Allocation of budget in 11th Five Year Plan (2007-2012) for different projects involving geoinformatics technologies (source: Geospatial World, Sep. 2010)

Table 3.3: List of some national initiatives

No.	Initiative/Sector	Website	Geography
1	Village Resource Centre	http://www.nrsc.gov.in/rsgisweb/vrc/vrc1.htm	Andhra Pradesh & Orissa
2	National Natural Resource Management System (NNRMS)	http://www.nnrms.gov.in/index.htm	Pan India
3	Natural Resources Census (NRC)	-	Pan India
4	National Spatial Data Infrastructure (NSDI)	http://www.nsdiindia.gov.in/nsdi/nsdiportal/index.jsp	Pan India
5	Pradhan Mantri Gram Sadak Yojna	http://pmgsy.nic.in/	Pan India
6	Rajiv Gandhi National Drinking Water Mission	http://ddws.nic.in/popups/RuralDrinkingWater_2nd April.pdf	Pan India
7	Crop Acreage and Production Estimation	-	
8	Telemedicine Programme	http://www.telemedindia.org/	Pan India
9	Biodiversity Information System	http://www.bisindia.org/	Pan India
10	Potential Fishing Zone	http://www.incois.gov.in	Indian Coast

3.4.1 Village Resource Centre (VRC)

VRCs are envisaged as the single window delivery mechanism for a variety of space-enabled services and deliverables, such as telemedicine; tele-education; information on natural resources for planning and development at local level; interactive advisories on agriculture, fisheries, land and water resources management; livestock management; interactive vocational training towards skill improvement, alternate livelihood; e-governance services; weather information and many more.

3.4.2 National Natural Resource Management System (NNRMS)

Major activities of NNRMS include determining user/application needs for remote sensing; conceptualisation and implementing remote sensing space segments with necessary ground-based data reception, processing and interpretation facilities; establishing utilisation systems for using remote sensing images and conventional data for various applications and resource management activities. A standardised GIS database of all space based spatial information generated under the NNRMS programme would be maintained. A large volume of thematic layers have already been organised as per NNRMS standards and populated in the database named as Natural Resources Database (NRDB) to serve the needs of different users coming from government, business and citizens at large. Master node and regional nodes for this purpose have been set up.

3.4.3 Natural Resources Census (NRC)

NRC aims to provide the nation a 'snap-shot' of the country's status of natural resources by systematic inventory and creation of standardised GIS database in every 5 years for the land use/land cover, land degradation, vegetation, wetlands, geomorphological and lineament mapping, etc. A major portion of the database has been created and remaining work would soon be completed. Embedded in the NR Census programme is the ability to spot areas requiring immediate attention due to distinct changes detected and undertaking a more detailed inventory for those areas.

Natural resources census is the census of land, water, soils, forests and other elements conducted in a systematic manner and with a repeat cycle to depict changes.

3.4.4 National Spatial Data Infrastructure (NSDI)

DST had set up a task force for preparing strategy for National Spatial Data Infrastructure (NSDI) for the availability of and access to organised spatial data and use of this infrastructure at community, local, state, regional and national level towards sustainable economic growth. The NSDI involves 16 agencies in the country, with an objective to provide gateway for dissemination of spatial data, being generated by different government agencies. As a part of NSDI, digital databases of different natural resources created under NRDB will cater to the needs of user communities in the country.

3.4.5 Pradhan Mantri Gram Sadak Yojna (PMGSY)

PMGSY – Prime Minister's Rural Roads Programme aims at connecting all habitations above 500 population with all-weather roads. The main goal of the geoinformatics component of the project is to develop and operationalise a computerised database for rural roads in GIS environment. Web GIS version of the software developed under the programme provides user-friendly access to PMGSY for online dissemination of selected information, maps and reports.

3.4.6 Rajiv Gandhi National Drinking Water Mission (RGNDWM)

Earlier, hydrogeomorphic maps showing groundwater prospect areas at 1:250000 scale were prepared for the entire country. Under the RGNDWM, scientific source finding of drinking water for all the problem habitation areas using high resolution satellite data and ground data is being carried out. The ground water prospect maps are being prepared based on the spatial analysis of a number of information such as lithology, geological structures, hydrogeomorphology, landuse/landcover, etc. Outcome of the project are ground water prospect maps at 1:50000 scale for priority states.

3.4.7 Crop Acreage and Production Estimation (CAPE)

Under the CAPE project, pre-harvest district level crop area estimation and yield forecasting for six crops in 15 states has been developed utilising the characteristics of IRS satellites data, crop discrimination analysis, crop growth pattern and other parameters.

Another programme, named as FASAL (Forecasting Agriculture using Space, Agrometeorology and Landbased observations), has been institutionalised. Its efforts are towards sustainable agriculture by way of integrated watershed development.

3.4.8 Telemedicine Programme

ISRO's telemedicine pilot project was started in the year 2001 with the aim of introducing the telemedicine facility to the grass root level population as a part of proof of concept technology demonstration. Presently, ISRO's Telemedicine Network has enabled 382 hospitals with the telemedicine facility. 306 Remote/ Rural/District Hospital/Health Centres and 16 Mobile Telemedicine units are connected to 60 Super Speciality Hospitals located in major cities. The mobile vans are extensively used for tele-ophthalmology, diabetic screening, mammography, childcare and community health.

3.4.9 Potential Fishing Zone (PFZ) Forecast

Indian National Centre for Ocean Information Services (INCOIS) provides forecast of potential fishing zone (PFZ) up to 2 to 3 days in advance. The technique utilises and combines chlorophyll information derived from Oceansat data with the Sea Surface Temperature (SST) information derived from NOAA-AVHRR data to identify potential fishing zones. This information is used by fishermen to select their fishing sites.

3.4.10 Biodiversity Information System (BIS)

Departments of Space and Biotechnology have developed biodiversity related database of India. Under this, remote sensing data based vegetation type map were prepared in association with ground based field samples of key community characteristics. The entire spatial and non-spatial data on Indian plant biodiversity has been organised and made available in BIS, with its four major components i.e. BIOSPATIAL (Biodiversity spatial query shell), PHYTOSIS (Plant information system), FRIS (Forest Resource Information System), BIOSPEC (Biodiversity Conservation Spatial Decision Support System). Most of the data is accessible through authentic username and password.

3.4.11 Other Programmes

It is difficult to list here all the programmes because there are many national and state level initiatives which either has geoinformatics as the main component or utilises some amount of input derived from geospatial data. Two of the recently launched programmes are Re-structured Accelerated Power Development & Reform Programme (R-APDRP) and National Land Records Modernisation Programme (NLRMP). Under the R-APDRP programme, it is envisaged to develop a system for automatic data logging for all distribution transformers and feeders and supervisory control and data acquisition/ document management system. Under the NLRMP programme, creation and updation of cadastral records, computerisation of land records, computerisation of registration and its integration with land records maintenance system is envisioned to usher in the system of conclusive titling.

Besides the above initiatives, there are various other schemes which are not essentially geospatial but use geoinformatics tools and technologies as an aid, such as schemes for construction and maintenance of roads, railways and waterways, civil aviation, public utility services, education, command area development, flood control and management programme and urban planning.

Check Your Progress II

Spend 5 mins

1) List out some of the national initiatives utilising geoinformatics input.

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2) What is the aim of the telemedicine programme?

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3) In what way PMGSY and RGNDWM programmes are benefitting from geoinformatics technology?

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3.5 CAREER OPTIONS AND PREPARATIONS

In this section we would discuss about the career options and education scenario in India in the field of geoinformatics.

3.5.1 Career Options

We shall first discuss about the kinds of employment available in the field. Spanning a period of more than three decades, the usage of geoinformatics technology in India has come a long way as evident in the 11th five year plan. Having realised the potential of the technology, Government of India has initiated the extensive use of it in all possible fields, which in turn, has opened the avenues for large scale employment opportunity to geoinformatics professionals.

The jobs available in the industry may be broadly categorised into the followings:

- data generation involving data conversion, digitising and processing
- involving software product marketing
- involving data analysis and data management
- software development related (involves writing codes and testing software)
- involves imparting trainings and teaching to educators.

Though, geoinformatics professionals come from a variety of backgrounds, most common among them are from the following background:

- Geography
- Geology
- Environmental science
- Botany
- Mathematics
- Physics
- Chemistry
- Zoology
- Engineering
- Agriculture
- Computer Science

In India, government agencies are the major employer of geoinformatics professionals in almost all categories of employment. However, there are many private sector companies, non-governmental organisations and consulting firms which hire geoinformatics professionals. Majority of the employment in the private sector are related to data generation, marketing and software development. There are also the consulting firms which hire people at the senior level for a specialised application or task.

3.5.2 Educational Programmes

We will now discuss about the geoinformatics education scenario in India. There are varieties of courses and programmes across India in the field ranging from certificate level to masters to doctoral level, from a few days to 2-3 years and in regular to open and distance learning programmes. The programmes can be broadly categorised into two types namely, training and education progammes. The training programmes are generally offered and conducted by software companies with emphasis on use of a particular software, whereas the education programmes are mostly offered and conducted by universities with more emphasis on underlying fundamental principles. If you are a new comer in the field and wish to apply this technology in your domain, it would be suitable to undergo some kind of formal education, such as a certificate or diploma programme. For people who already have some prior experience in this field, a specialised educational programme such as specific theme based training or certificates may be helpful.

Besides the Indian Institutes of Technologies (IITs) and Indian Institutes of Information Technologies (IIITs), an indicative list of universities who are offering courses on geoinformatics at different levels are alphabetically listed below as per the place names:

- CEPT University, Ahmedabad
- MDS University, Ajmer
- Aligarh Muslim University, Aligarh
- Allahabad Agriculture University, Allahabad

- Kumaun University, Almora
- Sri Krishnadevaya University, Anantpur
- Annamalai University, Annamalai
- Bangalore University, Bangalore
- The University of Burdwan, Bardhaman
- North Orissa University, Baripada
- Barakatullah University, Bhopal
- Utkal University, Bhubaneswar
- Punjab University, Chandigarh
- University of Madras, Chennai
- Anna University, Chennai
- Mahatma Gandhi Chitrakoot Gramodaya Viswavidyalaya, Chitrakoot
- Bharathiar University, Coimbatore
- Yogi Vemana University, Cuddapah
- University of Petroleum and Energy Studies, Dehradun
- Jamia Millia Islamia, Delhi
- TERI University, Delhi
- University of Petroleum and Energy Studies, Delhi
- Jiwaji University, Gwalior
- Guru Jambeshwar University, Hissar
- JNT University, Hyderabad
- Osmania University, Hyderabad
- Devi Ahilya University, Indore
- Manipur University, Imphal
- University of Jammu, Jammu
- Bundelkhand University, Jhansi
- SRM University, Chennai
- Jadavpur University, Kolkata
- University of Kota, Kota
- University of Lucknow, Lucknow
- Madurai Kamaraj University, Madurai
- Mangalore University, Mangalore
- Vidyasagar Univesity, Midnapore
- University of Mysore, Mysore
- Nalanda Open University, Nalanda
- Patan University, Patan
- Bharati Vidyapeeth University, Pune
- University of Pune, Pune
- Symbiosis University, Pune
- Adikavi Nannaya University, Rajahmundry

- Pt. Ravishankar Shukla University, Raipur
- Birla Institute of Technology, Ranchi
- Dr. H.S Gaur University, Sagar
- Sambalpur University, Sambalpur
- North-Eastern Hill University, Shillong
- Solapur University, Solapur
- Kashmir University, Srinagar
- Bharatidasan University, Tiruchirapalli
- Indian Institute of Space Technology, Thiruvananthapuram
- Mohanlal Sukhadia University, Udaipur
- Rajasthan Vidyapeeth, Udaipur
- Vikram University, Ujjain
- Banaras Hindu University, Varanasi
- Andhra University College of Engineering, Vishakhapatnam.

Apart from the separate programme on geoinformatics, there are many universities which are offering this component as a part of different programmes on geography, geology, botany, ecology, environmental science, civil engineering, electronics, computer science, etc.

Besides the above mentioned universities, there are many other institutes and organisations which are offering geoinformatics related programmes. An indicative list is provided below:

- Shri Shivaji College, Akola
- Karnataka State Remote Sensing Applications Centre, Bangalore
- School of Planning and Architecture, Bhopal
- All India Institute of Local Self Government, Cochin & Delhi
- Indian Institute of Remote Sensing (IIRS), Dehradun
- Chaudhary Charan Singh Polytechnic Institute, Delhi
- Cotton College, Guwahati
- National Power Training Institute, Faridabad
- Centre for Development of Advanced Computing (C-DAC), Pune & Noida
- Indian Institute of Surveying and Mapping (Survey of India), Hyderabad
- Institute of Science and Technology, Hyderabad
- Survey Training Institute, Hyderabad, Thiruvananthapuram, and Bhubaneswar
- IIRMR, Jaipur
- Institute of Geoinformatics & Remote Sensing, Kolkata
- UNIGIS at different universities in India
- Geological Survey of India Training Institute (GSITI) at different locations.

Apart from the above mentioned institutes and organisations, there are many private institutes which are offering training and educational programmes.

The effective introduction of GIS into the education process is complicated by the high cost of hardware, software and the teaching material. It is felt that the institutes along with industry should build 'centres of excellence' in geoinformatics to create intellectual property, which can generate income for the institution. Also institutions need to build a skillset database of their alumni who can be motivated to guide teams/projects.

Further, the government should have high level national GIS academy having a wide network of universities, industry partners and private GIS institutes. This network can also be utilised to the maximum extent possible for education in geoinformatics. Learning and web-based programme can be organised with state remote sensing service centers acting as practical laboratories.

With rise in demand of geoinformatics professionals and prospective future of geospatial technology, career options have widened and now many universities have initiated such course as part of science or at engineering level attached to civil engineering or as a special course, like geoinformatics. In the recent past, open and distance education centres have initiated course at graduate and post-graduate levels. Recently, the subject has also been introduced at the higher secondary level by CBSE board. The basic concepts of geoinformatics have been incorporated in the geography books published by NCERT, New Delhi.

3.6 ACTIVITY

Career options are very bright in recent times and with the technology taking its route practically to every geography related issues, finding a good job is not very difficult. With a science degree or engineering degree and some experience in geoinformatics technology could land you in government sector and IT companies as well. Find out your prospects through GIS job profile in popular job search engines. List those out according to your qualifications.

3.7 SUMMARY

In this unit you have learnt:

- In India, geoinformatics is fast expanding its presence and has become an important component of planning and decision making.
- Growth of geoinformatics industry has created immense opportunity to thousands of young aspirants aiming to make a difference in their chosen field.
- There are number of national agencies who have given life to the geospatial industry and their pioneering work has contributed towards sustainable growth and there are other agencies who are contributing to the growth and promotion of geoinformatics in India.
- At the national level, many programmes are being executed which derive some input from the geoinformatics technologies.
- There are number of institutes, organisations and universities offering training and educational programmes on geoinformatics at different levels ranging from certificate to doctoral level.

3.8 UNIT END QUESTIONS

Spend 30 mins

1) Explain about the recently launched remote sensing satellite of India, its salient features and application potential.
2) What do you think are the challenges facing geoinformatics?
3) Discuss in brief two national agencies you think are impacting.

3.9 REFERENCES

1) www.geospatialworld.net/images/magazines/GW_sept10_18-28CoverStory.pdf or www.gisdevelopment.net/magazine/global/2010/September/18-india-on-a-roll.htm.
2) www.geospatialtoday.com.

The data/information from all the above websites was retrieved between 10th and 15th July 2011.

3.10 FURTHER / SUGGESTED READING

Yang, C., Wong, D., Miao, Q. and Yang. R. (2011), Advanced Geoinformation Science, CRC Press, 485 p.

3.11 ANSWERS

Check Your Progress I

1) Indian Space Research Organisation, National Remote Sensing Centre, Center for Development of Advanced Computing, National Centre for Antarctic and Ocean Research.
2) CartoSat - 1, 2, 2A & 2B, ResourceSat - 1 & 2, OceanSat, TES, IRS - 1D and IMS - 1

Check Your Progress II

1) Refer to Table 3.3
2) Refer to sub-section 3.4.8
3) Refer to sub-sections 3.4.5 and 3.4.6.

Unit End Questions

1) Refer to Table 3.1 for satellites. Further you are required to elaborate on following:

   Images from the satellite system have found application in crop health monitoring, soil mapping, natural resources mapping and monitoring, identifying ground water potential zones, ocean applications, forest cover mapping, biodiversity characterisation and monitoring of forest fire, providing timely inputs to natural disasters and also in the field of archaeological survey.
2) Refer to sub-section 3.2.2.
3) Refer to section 3.3.

GLOSSARY

- **Active remote sensing :** Remote sensing methods that provide their own source of electromagnetic radiation to illuminate the terrain. Radar is one example.
- **Band or spectral band :** A range of wavelengths of electromagnetic radiation. Remote sensing devices commonly collect images in discrete bands, such as visible red, green, and blue, and the invisible near-infrared.
- **Bandwidth :** It refers to the highest signal frequency a monitor's circuit can display. The higher the bandwidth, the higher resolution and the sharper the image will be.
- **Base data :** Basic level of map data on which other information is placed for purposes of comparison or geographical correlation.
- **Cartography :** The art or science of making maps.
- **CARTOSAT-2B :** It is an Earth observation satellite in a sun-synchronous orbit carrying sensor designed for the purpose of cartographic applications. The satellite is the seventeenth satellite in the Indian Remote Sensing (IRS) satellite series to be built by the Indian Space Research Organisation
- **GeoEye :** It is a series of commercial Earth imaging satellites providing very high resolution panchromatic and multispectral images.
- **Geographic Information System :** It is a computer system designed to allow users to collect, manage, and analyse large volumes of spatially referenced and associated attribute data.
- **Global Positioning System :** It is a network of radio-emitting satellites deployed by the U.S. Department of Defense.
- **Hardware :** The physical components of a GIS - the computer, plotters, printers, CRTs, and soon.
- **IKONOS :** It is a commercial earth observation satellite, and was the first to collect publicly available high-resolution imagery at 1 and 4 meter resolution. It offers multispectral (MS) and panchromatic (PAN) imagery.
- **MERIS (Medium Resolution Imaging Spectrometer) :** It is one of the main instruments on board the European Space Agency (ESA)'s Envisat platform.
- **MODIS (Moderate-resolution Imaging Spectroradiometer) :** It is a payload scientific instrument launched into Earth orbit by NASA in 1999.
- **Photogrammetry :** Obtaining precise measurements from images.
- **QuickBird :** It is a high-resolution commercial Earth observation satellite owned by Digital Globe and launched in 2001.

- **Radar :** Acronym for radio detection and ranging. Radar is an active form of remote sensing that operates in the microwave and radio wavelength regions.
- **Remote sensing :** The act of detection and/or identification of an object without having the sensor in direct contact with the object. It includes satellite imagery and aerial photography.
- **WorldView :** It is a series of Earth imaging satellites of Digital Globe providing high-resolution commercial images.

ABBREVIATIONS

AISLUS	:	All India Soils and Land Use Survey
ARLV	:	Air Breathing Propulsion for Advanced Reusable Launch Vehicles
ASPRS	:	American Society for Photogrammetry and Remote Sensing
BIOSPATIAL	:	Biodiversity Spatial Query Shell
BIOSPEC	:	Biodiversity Conservation Spatial Decision Support System
BIS	:	Biodiversity Information System
BMRDA	:	Bombay Metropolitan Region Development Authority
BTAD	:	Bodoland Territorial Areas District
CAG	:	Comptroller and Auditor General of India
CAPE	:	Crop Acreage and Production Estimation
C-DAC	:	Centre for Development of Advanced Computing
CRZ	:	Coastal Regulation Zone
DEAL	:	Defence Electronics Applications Laboratory
DEM	:	Digital Elevation Model
DOS	:	Department of Space
DRDO	:	Defence Research & Development Organisation
DST	:	Department of Science and Technology
DTRL	:	Defence Terrain Research Laboratory
EMS	:	Electromagnetic Spectrum
ES	:	Expert System
FRIS	:	Forest Resource Information System
GAGAN	:	GPS Aided Geo Augmented Navigation or GPS and Geo Augmented Navigation system
GDP	:	Gross Domestic Product
GIAC	:	Geomatics Industry Association of Canada
GIS	:	Geographic Information System
GNSS	:	Global Navigation Satellite Systems
GPS	:	Global Positioning System
GRACE	:	Gravity Recovery and Climate Experiment
GRIMMS	:	GIS-enabled Road Information Management & Monitoring System
GSI	:	Geological Survey of India
GSLV	:	Geosynchronous Satellite Launch Vehicles

ICAR	:	Indian Council of Agricultural Research
INSAT	:	Indian National Satellites
IRS	:	Indian Remote Sensing
ISRO	:	Indian Space Research Organisation
ITC	:	International Institute for Aerospace Survey
LBS	:	Location Based Services
LIDAR	:	Light Detecting and Ranging
LIS	:	Landslide Information System
LISS	:	Linear Imaging Self Scanning
MODIS	:	Moderate-resolution Imaging Spectroradiometer
MSS	:	Multispectral Scanners System
NASA	:	National Aeronautics and Space Agency
NATMO	:	National Atlas and Thematic Mapping Organisation
NBSS & LUP	:	National Bureau of Soil Survey and Land Use Planning
NCAOR	:	National Centre for Antarctic and Ocean Research
NCRPB	:	National Capital Region Planning Board
NGA	:	National Geospatial-Intelligence Agency
NIC	:	National Informatics Centre
NIO	:	National Institute of Oceanography
NLRMP	:	National Land Records Modernisation Programme
NMP	:	New Map Policy
NNRMS	:	National Natural Resources Management System
NRC	:	Natural Resources Census
NRDB	:	Natural Resources Database
NRSC	:	National Remote Sensing Centre
OGC	:	Open Geospatial Consortiums
PFZ	:	Potential Fishing Zone
PHYTOSIS	:	Plant information system
PMGSY	:	Pradhan Mantri Gram Sadak Yojna
PND	:	Portable Navigation Devices
PSLV	:	Polar Satellite Launch Vehicles
QGIS	:	Quantum GIS
RADAR	:	Radio Detection And Ranging
Radsat	:	Radar Satellite
R-APDRP	:	Re-structured Accelerated Power Development & Reform Programme
RGNDWM	:	Rajiv Gandhi National Drinking Water Mission

RLV	:	Reusable Launch Vehicles
RRSC	:	Regional Remote Sensing Centres
RRSSC	:	Regional Remote Sensing Service Centres
RS	:	Remote Sensing
SAC	:	Space Applications Centre
SAR	:	Synthetic Aperture Radar
SBAS	:	Satellite Based Augmentation System
SDBMS	:	Spatial Database Management Systems
SDSC SHAR	:	Satish Dawan Space Centre – Sriharikota
SDSS	:	Spatial Decision Support System
SLAR	:	Side Looking Airborne Radar
SOI	:	Survey of India
SRTM	:	Shuttle Radar Topography Mission
TCPO	:	Town and Country Planning Organisation
TIR	:	Thermal Infrared
VGIS	:	Virtual GIS
VRC	:	Village Resource Centre
VSSC	:	Vikram Sarabhai Space Centre