UNIT 14

INDIAN SCENARIO

Structure

14.1 INTRODUCTION

In Volume 1, you have been introduced to the geoinformatics and its various components. You have also 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.

As you now know that geoinformatics is a synergism of various disciplines and because of its applications being mainly oriented to the real-world problems of management of natural and man-made environment, it is fast expanding its presence. There are various institutes and organisations which have contributed significantly to the growth in India. Government of India has now included geoinformatics technology and derived outputs in many of its national level programmes. It is important 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 a significant role in shaping present geoinformatics industry what it is today in India. You shall also study about major national initiatives involving geoinformatics, the universities and institutes involved in geoinformatics education, which would give you an idea about the scope and market potential of the geoinformatics technology and career prospects.

Expected Learning Outcome

After studying this Unit, you should be able to:

- describe about 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 geoinformatics; and
- explain about education scenario in geoinformatics.

14.2 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, determining natural resources, social forestry or location-based services. Public perception towards geoinformatics industry has also changed. What we once considered an impenetrable domain is now easily understood by the average person. The emergence of Web 2.0 with the power of mapping, mashups and collaborative initiatives has helped change the way people look at the geospatial industry. Geoinformatics tools and technologies have empowered us to generate maps, create interactive queries, analyse information with its unique 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.

14.2.1 Growth of Geoinformatics Industry

As on 2021, India's geospatial economy is valued at ₹38,972 crore, but has the potential to grow to ₹63,100 crore at 12.8% by 2025, according to India Geospatial "Artha" Report.

Defence and intelligence, water resources and irrigation, construction, and utilities will continue to spearhead the growth of the Indian geospatial market. With certainty, the defence and the intelligence sector are valued at ₹3305 crore by 2025. Water resources and irrigation sector are worth at ₹5020 crore, urban development to account for ₹3030 crore, and utilities segment will touch ₹2,600 crore.

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On the historic note, Indian geoinformatics industry had witnessed higher growth rate than the average global growth rate of any other nation. According to the Indian Geospatial Industry Survey Report (2008), the GIS market was to grow to ~Rs.23,064 million by 2011-12, growing at a CAGR (Compound Annual Growth Rate) of 31.3%. The significant rise in demand for geospatial information was to give it more weightage in both public and private planning across sectors. The Indian geospatial industry's annual productive capacity was at Rs. 3,944 Cr (39.44 billion). The industry was growing at a cumulative average rate of 8.1% to a productive capacity of Rs. 5,818 Cr. (58.18 billion) in 2014. Fig.14.1 shows the percentage growth for the Indian geoinformatics industry *vis-à-vis* worldwide growth. We expect that like India's GDP, the growth of India's geospatial market will outpace the growth rate for geospatial markets in the rest of the world.

CAGR refers to an average growth rate over a period of time applied to an investment or some other elements of a business activity.

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.

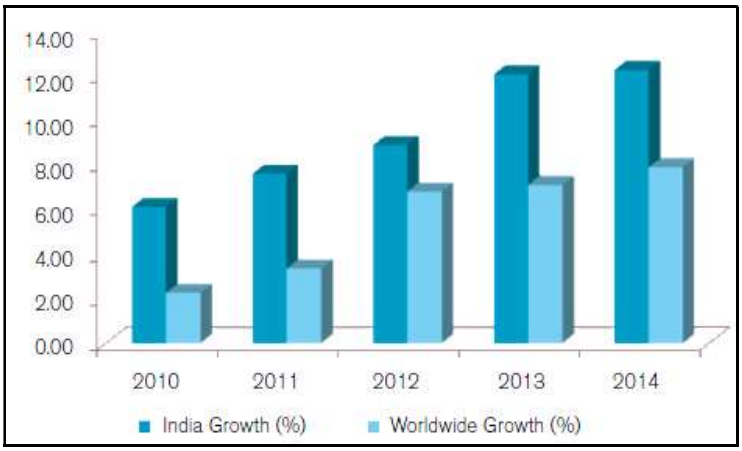

Fig. 14.1: Percentage growth of the Indian geoinformatics industry vis-a-vis worldwide (Source: Geospatial World, Sep. 2010).

14.2.2 Challenges to Geoinformatics Industry

The efforts in geoinformatics and its allied fields are concentrated amongst a few 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 updates of existing data
- data ownership issues
- issues with responsible processing of data
- cost (both software and hardware)
- gap between the expectations of the customers and performing 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

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denial of data may stunt the industry's growth. The denial of data will dampen the research spirit, competitiveness, talent, and 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 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.

You would be happy to know that the Government of India is now considering making available a large amount of geospatial information to the citizens subject to security concerns. Further, to empower common people with this information, the government is framing a licensing and regulatory policy, which would streamline the activities of geoinformatics sector.

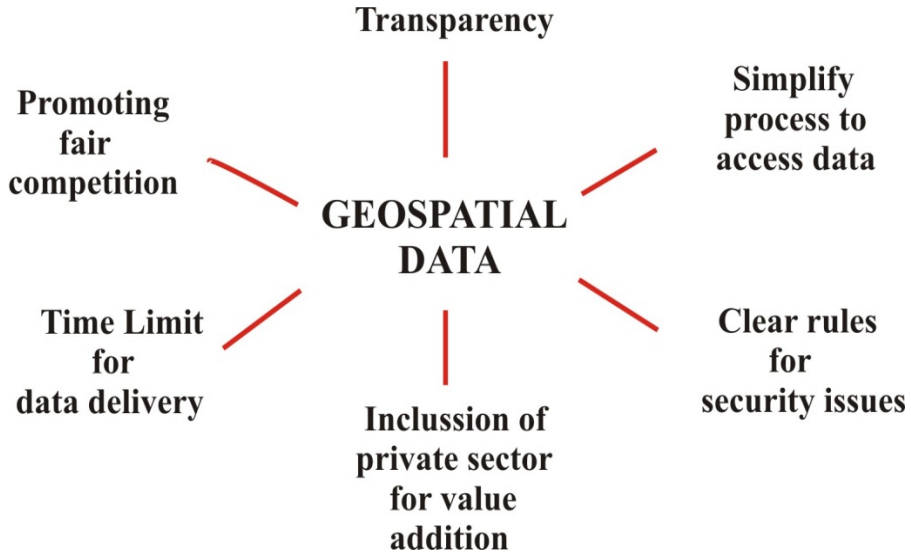

Fig. 3.2: Multiple tasks of Geospatial authority. (Source: www.geospatialtoday.com)

14.2.3 Looking Ahead

With the aim of unrestricted production, maintenance and dissemination of spatial data, the National Topographic Database of the SOI has declared a new map policy (NMP). 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 with limited 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 the Indian Space Research Organisation (ISRO) could release data of up to 5.8 meter resolution. The government strictly controlled all other better resolution data. Recently, when a Comptroller and

Auditor General of India (CAG) report found that about 80% of images of ISRO were not being used adequately, the Government of India announced its new data sharing policy for India's remote sensing satellites. Under this policy, it will make all remote sensing imagery and data up to 1 meter resolution easily available, which is a quantum jump from the past. However, release of data less than one meter in resolution will still be under some control by the authorities. We expect that this step would very much ease the infrastructure development in urban areas and sectors, such as telecom, roads and housing could benefit greatly.

14.3 NATIONAL AGENCIES

There are some agencies in India which have played a 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 some of the important national agencies, their role and contribution. We give list of these agencies in Table 14.1.

Table 14.1: List of some of the national agencies with their details.

Sl.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	http://drdo.gov.in/drdo/English/index.jsp?pg=homebody.jsp	1958	New Delhi

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	Organisation (DRDO)			
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

14.3.1 Indian Space Research Organisation (ISRO)

The objective of ISRO is to develop space technology and its application to various national tasks. The 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.

Table 14.2: Some of the recently launched Indian satellites.

Name of the Satellite	Launch date and vehicle used for launching
PSLV-C52/EOS-04	February 14, 2022 by PSLV-C52
Amazonia-1	February 28, 2021 by PSLV-C15
CMS-01	December 17, 2020 PSLV-C50
EOS-01	November 07, 2020 by PSLV-C49
RISAT-2BR1	December 11, 2019 by PSLV-C48
Cartosat-3	November 27, 2019 by PSLV-C47
RISAT-2B	May 22, 2019 by PSLV-C46
EMISAT	April 01, 2019 by PSLV-C45
HysIS	November 29, 2018 by PSLV-C43

The IRS satellite system is one of the largest constellations of satellites in operation in the world today. From the first satellite, i.e., Bhaskara, 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

satellites in Table 14.2, which continue to provide imageries with a variety of resolutions.

Images taken by 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 supportive strength to disaster management; and
- soil mapping at different scales and in archaeological survey.

There are different centres of ISRO all over India, which are entrusted with and handle specific tasks. We briefly mentioned here some of these centres:

a) Vikram Sarabhai Space Centre (VSSC)

The VSSC, 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 centre pursues research and development activities for associated technologies, such as launch vehicle design, propellants, solid propulsion technology, aerodynamics, aero structural and aero thermal aspects, avionics, polymers and composites, guidance, control, and simulation, computer and information, mechanical engineering, aerospace mechanisms, vehicle integration and testing, space ordnance, chemicals and materials. 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)

The NRSC, at Hyderabad, has been recently converted into a full-fledged centre of ISRO. The centre handles remote sensing satellite data acquisition and processing, data dissemination, aerial remote sensing and decision support for disaster management. The NRSC has set up a data reception station at Shadnagar near Hyderabad for acquiring data from Indian remote sensing satellites and 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. According to the records available,

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users have utilised about 67,000 data products during 2010-11 in comparison with that of 50,000 during 2009-10.

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

The SDSC SHAR, in north of Chennai, has the 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)

The 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.

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

14.3.2 Department of Science and Technology (DST)

The DST plays the role of a nodal department for organising, coordinating and promoting scientific and technological activities in the country. The 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 (NATMO), which are involved in applying geoinformatics technologies in their work.

a) National Atlas and Thematic Mapping Organisation (NATMO)

The NATMO is at present has 15 divisions spread out into 4 different units in Kolkata and New Delhi. We list major functions of the NATMO below:

- compilation of the National Atlas of India and its preparation in regional languages;
- installation of an automated mapping system for increasing speed and efficiency in mapping;
- cartography for the visually impaired; and

- 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, is the oldest scientific department of the government of India. The 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 suitably, provide base maps for expeditious and integrated development and ensure that all resources contribute with their full measure to the progress, prosperity and security of our country now and for generations to come. Vision of the SOI is the advancement of theory, practice, collection and applications of geospatial data, and promotes an active exchange of information, ideas, and technological innovations amongst the data producers and users who will get access to such data of highest possible resolution at an affordable cost in the near real-time environment.

14.3.3 Geological Survey of India (GSI)

The GSI is over 150 years old organisation. The GSI provides technical consultancy, data and services to prospective investors and agencies, both national and multinational, on different commodities and aspects. Responsibilities of GSI include systematic geological, geotechnical, geophysical, geochemical and geo-environmental mapping and studies in India. It is involved in development and dissemination of geo-scientific databases, human resource development, information services and education.

14.3.4 Defence Research & Development Organisation (DRDO)

The DRDO 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). DTRL has now merged with SASE (Snow and Avalanche Studies Establishment), and are now renamed as DGRE (Defence Geoinformatics Research Establishment) stationed at Chandigarh.

Primary responsibility of DTRL includes research and development of techniques to evaluate 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 updates of road mobility maps for vehicles incorporating artificial intelligence techniques, and development of Landslide Information System (LIS) for some of the north-eastern states.

The DEAL, established in 1959, is entrusted with the responsibility of providing required resources, infrastructure and an effective quality management system for timely completion of the design and development of

the products. Some of the major achievements of DEAL in geoinformatics include: development of multispectral image classification system, microwave data processing software, and development of ship detection software package, etc.

14.3.5 National Informatics Centre (NIC)

Established in 1976, 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 geoinformatics include creation of digital data of different thematic layers, use of GIS for decision support, and e-governance.

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

The C-DAC 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 DSS based on geoinformatics is its niche area. Some 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.

14.3.7 National Center of Geo-Informatics (NCoG)

National Center of Geo-Informatics (NCoG) is a Geographic Information System (GIS) based decision support system platform, under National e-Governance Division (NeGD), which was launched on 28th December, 2015 (https://ncog.gov.in/about-us.html). NCoG is being supported by "Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG)", Gujarat, as its Knowledge partner.

NCoG provides one of its kind of 'GIS platform', for sharing and collaborating GIS data source, location based analytics and 'Decision support system' serving to Central/State government and departments across the country. Geo-Informatics is integral to planning, decision making & electronic delivery of services, geo-enabling e-governance to facilitate location based information for all. It has facilitated the integration of GIS platform with the MIS data for Ministries and Departments across India. By enabling a better understanding of the geographic aspects, NCoG via GIS is transforming India and taking good governance to a whole new level. Various applications can be seen at the link https://ncog.gov.in/dashboard/#.

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

The NBSS & LUP, 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.

14.3.9 Town and Country Planning Organisation (TCPO)

The TCPO, the technical arm of the Ministry of Urban Development, Government of India, is an apex technical advisory and consultant organization 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 geoinformatics is the development of National Urban Information System (NUIS) to develop attribute and spatial database for various levels of urban planning using remote sensing data.

14.3.10 National Capital Region Planning Board (NCRPB)

The NCRPB 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 the generation of spatial data and for planning.

14.3.11 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 many 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 agencies are listed below:

- Indian Agricultural Research Institute, 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.

SAQ I

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

b) Name few satellites data which are being provided by the NRSC.

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14.4 NATIONAL INITIATIVES

There are several initiatives by the Government of India (GOI) that have a significant geoinformatics component. Such initiatives of the government support use of geoinformatics data and technologies to a large extent through its ministries and various departments. As shown in Fig. 14.3, in the 11th Five-Year Plan, the 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 14.3 will give you an overview of national initiatives in the geoinformatics.

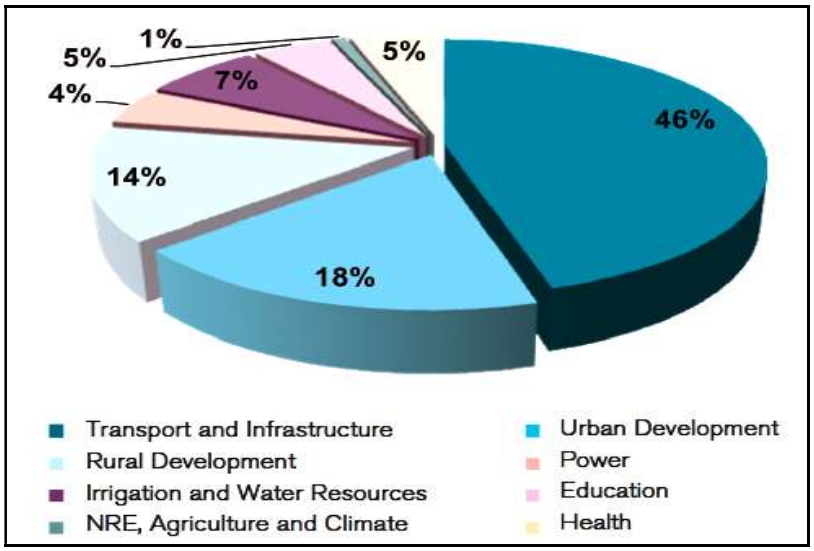

Fig. 14.3: Allocation of budget in 11th Five Year Plan (2007-2012) for different projects involving geoinformatics technologies. (Source: Geospatial World, Sep. 2010)

Table 14.3: List of some national initiatives.

S.N.	Initiative/Sector	Website	Geography
1	SVAMITVA	https://svamitva.nic.in/svamitva/about.html	National Level
2	Smart Cities	https://smartcities.gov.in/	National Level
3	Digital India	https://www.india.gov.in/digital-india-programme	National Level
4	AMRUT	https://www.myscheme.gov.in/schemes/amrut	National Level
5	Atmanirbhar Abhiyaan	https://www.investindia.gov.in/atmanirbhar-bharat-abhiyaan	National Level
6	Village Resource Centre	http://www.nrsc.gov.in/rsgisweb/vrc/vrc1.htm	Andhra Pradesh & Orissa
7	National Natural Resources Management System (NNRMS)	http://www.nnrms.gov.in/index.htm	Pan India
8	Natural Resources Census (NRC)	https://www.nrsc.gov.in/NaturalResourcesCensus?language_content_entity=en	Pan India

9	National Spatial Data Infrastructure (NSDI)	http://www.nsdiindia.gov.in/nsdi/nsdiportal/index.jsp	Pan India
10	Pradhan Mantri Gram Sadak Yojna	http://pmgsy.nic.in/	Pan India
11	Rajiv Gandhi National Drinking Water Mission	http://ddws.nic.in/popups/RuralDrinkingWater_2ndApril.pdf	Pan India
12	Crop Acreage and Production Estimation	-	
13	Telemedicine Programme	http://www.telemedindia.org/	Pan India
14	Biodiversity Information System	http://www.bisindia.org/	Pan India
15	Potential Fishing Zone	http://www.incois.gov.in/Incois/PFZForecast?Mode=Initialize&strLanguageID=0	Indian Coasts

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.

14.4.1 SVAMITVA

SVAMITVA (Survey of Village Abadi and Mapping with Improvised Technology in Village Areas) is a Central Sector Scheme of Ministry of Panchayati Raj. It was launched nation-wide on National Panchayati Raj Day (i.e. 24th April 2021) after successful completion of pilot phase of the scheme (during 2020-2021) in 9 pilot states (Haryana, Karnataka, Madhya Pradesh, Maharashtra, Uttar Pradesh and Uttarakhand, Punjab, Rajasthan, Andhra Pradesh) covering approx. 1 lakh villages. This scheme is a reformative step towards establishment of clear ownership of property in rural inhabited (“Abadi”) areas, by mapping of land parcels using drone technology and providing ‘Record of Rights’ to village household owners with issuance of legal ownership cards (Property cards/Title deeds) to the property owners. In the second Phase (during 2021–2025), complete survey of remaining villages is targeted.

The Scheme is being implemented with the collaborative efforts of the Ministry of Panchayati Raj, State Revenue Department, State Panchayati Raj Department and Survey of India. The scheme covers multifarious aspects viz. facilitating monetisation of properties and enabling bank loan; reducing property related disputes; and comprehensive village level planning. It is expected that it would be the stepping-stone towards achieving Gram Swaraj in true sense and making rural India Atmanirbhar as the scheme is expected to result in Inclusive Society, enable Land Governance (by addressing the root cause for any disputes at local level), Sustainable Habitats (by improvement across infrastructure like schools, community health centres, rivers, street light, roads, etc. through efficient allocation of funds and increased accessibility), and Economic Growth (by helping people monetize their property as collateral and streamlining of property tax) (https://svamitva.nic.in/svamitva/about.html?OWASP_CSRFTOKEN=5Y7U-SR6G-N690-0BF8-SNF7-R928-0VE3-JYO8).

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The scheme seeks to achieve the following objectives:

- Creation of accurate land records for rural planning and reduce property related disputes.
- To bring financial stability to the citizens in rural India by enabling them to use their property as a financial asset for taking loans and other financial benefits.
- Determination of property tax, which would accrue to the Gram Panchayats (GPs) directly in States where it is devolved or else, add to the State exchequer.
- Creation of survey infrastructure and GIS maps that can be leveraged by any department for their use.
- To support in preparation of better-quality Gram Panchayat Development Plan (GPDP) by making use of GIS maps.

14.4.2 Smart Cities

Purpose of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology, especially the technology that leads to Smart outcomes. Area-based development will transform existing areas (retrofit and redevelop), including slums, into better planned ones, thereby improving liveability of the whole City. New areas (greenfield) will be developed around cities (https://smartcities.gov.in/sites/default/files/SmartCityGuidelines.pdf).

Some typical features of comprehensive development in Smart Cities are (i) promoting mixed land use in area-based developments; (ii) expanding housing opportunities for all; (iii) creating walkable localities; (iv) preserving and developing open spaces such as parks, playgrounds, and recreational spaces in order to enhance the quality of life of citizens, (v) reduce the urban heat effects and generally promote eco-balance; (vi) promoting a variety of transport options; (vii) making governance citizen-friendly and cost effective by increasingly relying on online services to bring about accountability and transparency; (viii) form e-groups to listen to people and obtain feedback and use online monitoring of programs and activities with the aid of cyber tour of worksites; (ix) giving an identity to the city based on its main economic activity, such as local cuisine, health, education, arts and craft, culture, sports goods, furniture, hosiery, textile, dairy, etc; (x) applying Smart Solutions to infrastructure and services in area-based development in order to make them better. For example, making Areas less vulnerable to disasters, using fewer resources, and providing cheaper services (https://smartcities.gov.in/sites/default/files/SmartCityGuidelines.pdf).

14.4.3 Digital India

The Digital India Programme is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy (https://www.india.gov.in/digital-india-programme). It is a programme to transform India into a digitally empowered society and knowledge economy.

Vision of Digital India is centered on three key areas i.e. Digital Infrastructure as a Utility to Every Citizen, Governance and Services on Demand, and Digital Empowerment of Citizens.

One of the plans under Vision Area 1 is to connect rural areas with high-speed internet networks. It is envisioned as a cradle to grave digital identity -unique, lifelong, online, authenticable. It also includes mobile phone and bank account enabling participation in digital and financial space, and easy access to a Common Service Centre (https://www.meity.gov.in/sites/upload_files/dit/files/Digital%20India.pdf).

Vision Area 2 includes seamless integration across departments or jurisdictions, availability of services in real time from online and mobile platform, services digitally transformed for improving Ease of Doing Business, and leveraging GIS technology for better planning and implementation, decision support systems and development. It also includes promotion of digital payments, which has been accorded the highest priority by the Government of India to extend digital payment services to every segment in the country (https://www.meity.gov.in/sites/upload_files/dit/files/Digital%20India.pdf). The idea is to provide digital payments facilities to all citizens in a convenient, easy, affordable, quick and secured manner (https://www.meity.gov.in/digidhan).

Digital India aims to establish end to end geo-spatial electronics delivery systems as part of Mission Mode Projects in e-Governance domain and envisages "National GIS Mission" as core foundation of location based Electronic Delivery of Services for Planning and Governance. NIC/DeitY has created Multi-Layer GIS Platform named "Bharat Maps" which depicts core foundation data as "NICMAPS", an integrated base map service using 1:50,000 scale reference data from Survey of India, ISRO, FSI, RGI and so on. This encompass 23 layers containing administrative boundaries, transport layers such as roads and railways, forest layer, settlement locations, etc., including terrain map services (https://bharatmaps.gov.in/). Some of the outcome of the Bharat Maps initiative can be found at https://dda.gov.in/gis, https://schoolgis.nic.in/, https://postalgis.nic.in/view/, https://parivesh.nic.in/.

14.4.4 AMRUT

The purpose of the **AMRUT (Atal Mission For Rejuvenation And Urban Transformation)** scheme is to (i) Ensure that every household has access to a tap with the assured supply of water and a sewerage connection; (ii) Increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks), and (iii) Reduce pollution by switching to public transport or constructing facilities for non-motorised transport (e.g. walking and cycling). Indicators and standards have been prescribed by the Ministry of Housing and Urban Affairs (MoHUA) in the form of Service Level Benchmarks (SLBs) (https://www.myscheme.gov.in/schemes/amrut).

The Mission focuses on the five thrust areas, namely, Water Supply, Sewerage and septage management, Storm Water Drainage to reduce flooding, Non-motorised Urban Transport and Green space/parks. It coverage is **Five hundred cities** categorised as following:

1. All Cities and Towns with a population of over one lakh with notified Municipalities as per Census 2011, including Cantonment Boards (Civilian areas),
2. All Capital Cities/Towns of States/ UTs, not covered in above,
3. All Cities/ Towns classified as Heritage Cities by MoHUA under the HRIDAY Scheme,
4. Thirteen Cities and Towns on the stem of the main rivers with a population above 75,000 and less than 1 lakh, and
5. Ten Cities from hill states, islands and tourist destinations (not more than one from each State).

14.4.5 Atmanirbhar Bharat Abhiyaan

Atmanirbhar Bharat Abhiyaan or **Self-reliant India** campaign is the vision of new India under which Special economic and comprehensive package of INR 20 lakh crores (equivalent to 10% of India's GDP) was announced to fight COVID-19 pandemic in India. The aim is to make the country and its citizens independent and self-reliant in all senses. The five pillars of Aatmanirbhar Bharat are – Economy, Infrastructure, System, Vibrant Demography and Demand.

The government has taken several reforms such as Supply Chain Reforms for Agriculture, Rational Tax Systems, Simple and Clear Laws, Capable Human Resource and Strong Financial System. India faced the COVID-19 situation with fortitude and a spirit of self-reliance, that is evident in several outcomes including Arogya Setu App.

The availability of data and modern mapping technologies to Indian companies is also crucial for achieving India's policy aim of Atmanirbhar Bharat and the vision for a five trillion-dollar economy. India presently relies heavily on foreign resources for mapping technologies and services. Liberalisation of the mapping industry and democratisation of existing datasets will spur domestic innovation and enable Indian companies to compete in the global mapping ecosystem by leveraging modern geospatial technologies. Locally available and locally relevant Maps and Geospatial Data would also help in improved planning and management of resources and better serve the specific needs of the Indian population (https://geospatial.dst.gov.in/Guidelines.aspx).

Location information is an integral part of the modern digital ecosystem and critical for unlocking economic, social and environmental opportunities for sustainable growth and development of the country. It is critical to the success of modern industry offering location-based services such as e-Commerce, delivery and logistics and urban transport. It is also essential for more traditional sectors of the economy such as agriculture, construction and development and mines and minerals (https://geospatial.dst.gov.in/Guidelines.aspx).

With the advent of publicly available geospatial services, a lot of Geospatial Data that used to be in restricted zone are freely and commonly available now and some of the policies/guidelines that used to regulate such information have been rendered obsolete and redundant. Hence, guidelines regarding liberalisation of acquisition and production of geospatial data and geospatial data services including maps have been issued. These guidelines are applicable to Geospatial Data, Maps, products, solutions and services offered by government agencies, autonomous bodies, academic and research institutions, private organisations, Non- Governmental Organisations and individuals.

14.4.6 Village Resource Centre (VRC)

VRCs is 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 the local level; interactive advisories on agriculture, fisheries, and land and water resources management; livestock management; interactive vocational training towards skill improvement, alternate livelihood; e-governance services; weather information and many more.

14.4.7 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 is maintained. A large volume of thematic layers has already been organised as per the 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 have been set up for the purpose.

14.4.8 Natural Resources Census (NRC)

The 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 the remaining work would soon be completed. Embedded in the NRC programme is the ability to spot areas requiring immediate attention because of a distinct change detected and undertaking a more detailed inventory for those areas.

14.4.9 National Spatial Data Infrastructure (NSDI)

The 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

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and national level towards sustainable economic growth. The NSDI involves 16 agencies in the country, with an aim to provide a 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.

14.4.10 Pradhan Mantri Gram Sadak Yojna (PMGSY)

The PMGSY-Prime Ministers Rural Roads Program aims at connecting all habitations above 500 population with all-weather roads. The major goal of the geoinformatics component of the project is to develop and operationalize a computerised database for rural roads in the 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.

14.4.11 Rajiv Gandhi National Drinking Water Mission (RGNDWM)

Earlier, hydrogeomorphic maps showing groundwater prospect areas on a 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 good deal of information such as lithology, geological structures, hydrogeomorphology, land use/land cover, etc. Outcome of the project are ground water prospect maps on a 1:50000 scale for priority states.

14.4.12 Crop Acreage and Production Estimation (CAPE)

Under the CAPE project, pre harvest district level crop area estimation and yield forecasting maps have been developed for six crops in 15 states 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 Land based observations) has been institutionalised. Its efforts are towards sustainable agriculture through integrated watershed development.

14.4.13 Telemedicine Programme

The ISRO's telemedicine pilot project was started in the year 2001 to introduce the telemedicine facility to the grassroot 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 specialty hospitals in major cities. The mobile vans are extensively used for tele-ophthalmology, diabetic screening, mammography, childcare and community health.

14.4.14 Potential Fishing Zone (PFZ) Forecast

Indian National Centre for Ocean Information Services (INCOIS) provides a 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. Fishermen use this information to select their fishing sites.

14.4.15 Biodiversity Information System (BIS)

Departments of Space and Biotechnology have developed the biodiversity related database of India. Under this, they prepared remote sensing data-based vegetation type map 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 five 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.

14.4.16 Other Programmes

It is difficult to list here all the programmes because there are many national and state level initiatives which either have geoinformatics as the principal component or utilise 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 the National Land Records Modernisation Programme (NLRMP). Under the R-APDRP programme, we envisaged it 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, computerization of land records, computerization 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.

SAQ II

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

b) What is the aim of the telemedicine programme?

c) In what way PMGSY and RGNDWM programmes are benefitted from geoinformatics technology?

14.5 GEOSPATIAL RELATED STARTUPS

With Government of India relaxing on map policies, many Indian start-ups have utilised this opportunity to tap the hidden potential of spatial data to the broader audience. Each start-up involves its own specialisation in meeting the

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needs of industry, general public and support different government drives to the advantage of both.

Table 14.4: Start-ups and their innovative contribution to geospatial growth in India.

Company Name	Focus Areas	Year
Geo Climate Risk Solutions	They aim to make Earth a better and safer place to live in. Geo Climate Risk Solutions (GCRS) offers its solution- geo spatial services, environment and spatial planning, disaster and climate risk reduction. They focus on innovations and spatial platforms to address on climate change, disaster risk reduction, and integrated water resource management and other developments. They combine GIS and IT to provide innovation and cutting-edge solutions.	2014
Geoinfosys	This geospatial service provider founded in 2007, offers cost-effective solutions and services in geo-intelligence. They offer services in GIS, image processing, digital photogrammetry, etc. They undertake projects from GIS ready data creation, satellite image processing, digital photogrammetry, LiDAR services, geotechnical investigations and surveys using modern technologies, like Differential Global Positioning Systems (DGPS), Ground Penetrating Radar (GPR), to Electronic Total Stations (ETS). In this, geospatial services form the core. They offer support to geospatially redefine, monitor, maintain and measure the growth aspects in a host of infrastructure domain such as agriculture, water resources conservation, civic administration, rural planning, and facilitating healthcare to remote locations.	2007
Pixxel, Bangalore	Pixxel provides satellite-based imaging solutions. The company is developing the constellation of Earth-imaging small satellites to provide real-time insights to monitor agriculture, oil & gas, and climate change parameters. Its constellation of nano satellites will provide Earth imagery daily.	2019
TartanSense, Bangalore	Engaged in providing an AI-based robot for agriculture. They embed the robot with a camera used to capture plants & weeds. It uses computer vision technology to identify weeds. The robot can spray chemicals only on the	2015

	detected weeds, and generate analytic reports.	
Lechal, Secunderabad	Provider of haptic and bluetooth-enabled shoes and insoles. The feature includes a navigation system, where the user can set the destination on the mobile app, and the phone's GPS is used to calculate location data, and the directions are conveyed to the user *via* haptics (simple vibrations) in the footwear. It has a fitness application, where the interaction between the phone app and the footwear counts the user's steps and tracks calories burned displayed on the app. Users can customise fitness goals and create user friendly workout sessions on the app. The footwear offers interactive features such as tagging locations, setting destinations, controlling navigation by executing foot gestures. It offers two products: an insole that can be fit into any shoe and a complete shoe product with the same technology.	2011
SatSure, Bangalore	Engaged in providing the satellite data for multi-industry. It uses the combination of satellite imagery, machine learning, and big data analytics to offer data and information to agriculture finance corporations, agriculture input providers, and other related team for crop health monitoring and assessment. The company's platform offers features, such as variable rate prescriptions, vegetation index maps, soil nutrient analysis, and fertilizer recommendations.	2016
HUVIAiR, Bangalore	It is a drone-based data insight company for multiple industries. It enables drone data collection, through training companies to in-house drone operations or conducts drone operations. It processes the collected data in the proprietary web-based software. It allows the user to visualize outputs and perform analytics on the same. Applications caters to construction, infrastructure, smart cities, insurance, renewable energy, and natural resource management.	2015
Data Sutram, Kolkatta	Engaged in AI-enabled location data platform for local businesses. It uses artificial intelligence to process unstructured data from satellite and multiple public and private sources.	2018

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	The location data helps businesses by pinpointing new locations for businesses, improving the performance of existing physical assets, digital assets, and micro-targeting using the geo-targeting techniques. It has specific use case in retail, e-commerce, banking, real estate, and pharma to name a few.	
Attentive AI, New Delhi	It provides AI-based mapping product for the delivery of actionable insights to businesses. Its mapping solution also helps in object detection and change detection (time series). The company leverages its proprietary deep remote sensing algorithm to perform human-like reasoning and derive actionable insights from the collected data.	2017

14.6 ACTIVITY

1. As a student or as a working professional, you can find it very useful to be associated with the prestigious organisations, such as ISRO, NATMO, SOI, etc. who have been empowering India towards the sustainable growth through the use of space technology. You can visualise the developmental programmes started by these agencies using the recently launched high resolution satellites for various development activities.
2. Career options are dazzling in recent times and with the technology taking its route practically to every geography related issue, 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 the government sector and IT companies as well. Find out your prospects through GIS job profile in popular job search engines.

14.7 SUMMARY

- 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 for thousands of young aspirants aiming to make a difference in their chosen field.
- There are a 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 a number of institutes, organisations and universities offering training and educational programmes on geoinformatics at different levels ranging from certificate to doctoral levels.

14.8 TERMINAL QUESTIONS

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 the geoinformatics?
3. Discuss in brief the role of various national agencies.

14.9 REFERENCES

- Venugopal, K. and Senthil, R. (2001) Geoinformatics Education in India - A view point. Asian Conference on Remote Sensing, November 2001, Singapore.
- www.geospatialtoday.com
- www.nnrms.gov.in
- http://nsdiindia.gov.in
- www.surveyofindia.gov.in
- www.nrsc.gov.in
- https://tracxn.com/explore/Geographic-Information-Systems-Startups-in-India
- https://analyticsindiamag.com/10-leading-startups-india-working-geointelligence/
- https://www.geospatialworld.net/geosmart-india-2021/indian-geospatial-market-is-set-to-grow-at-13-3-cagr-to-%E2%82%B923200-crore/

14.10 FURTHER / SUGGESTED READINGS

- Chang, K.T. (2002) *Introduction to Geographic Information Systems*, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN 0-07-049552-1, 4th Ed., 450 p.
- Garg, P.K. (2021) Digital Land Surveying and Mapping, New Age India (International) Publishers, New Delhi.
- George B. Korte, P.E. Onward Press (1997) *The GIS Book, Understanding the Value and Implementation of Geographic Information Systems*, 4th Ed, 440 p.
- Indian Geospatial Handbook (2008)
- www.gisinindia.com

14.11 ANSWERS

SAQ I

a) Indian Space Research Organisation, National Remote Sensing Centre, Center for Development of Advanced Computing, National Centre for Antarctic and Ocean Research.

b) CartoSat - 1, 2, 2A & 2B, ResourceSat - 1 & 2, OceanSat, TES, IRS - 1D and IMS - 1

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SAQ II

a) Please refer to Table 14.3.

b) Please refer subsection 14.4.8

c) Please refer subsections 14.4.5 and 14.4.6.

Terminal Questions

1. Please refer to Table 14.1 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 including archaeological survey.

2. Please refer sub section 14.2.2.

3. Please refer to section 14.4.