15 Conclusion: Spatial Information Technology for Sustainable Development Goals

Abstract

Remote sensing, GPS and GIS play an important role in achieving SDGs through mapping, monitoring, measurement and modelling of the Earth's resources. Global communities are widely applying this technology for improving our understanding. There were global initiatives toward mapping technology launched in 1996 to prepare eight basic layers of information: boundaries, drainage, transportation, population centres, elevation, land use, land cover and vegetation. The World Geodetic System 84 (WGS 84) was developed for the uniform datum of global mapping. The United Nations Geospatial Information Section has also developed global multi-scale data sets named 'UNmap'. Similarly, India has initiated advanced GIS and satellite-based technologies for the application of natural resources. Various organisations such as Rastriya Krishi Vikas Yojana (RKVY), Niti Ayog, Department of Sciences and Technology, National Platform for Disaster Risk Reduction (NPDRR0) and many NGOs are utilising spatial information technology for development planning and management.

Keywords

Geospatial information authority · Human resources · Decision-making · Global maps Science and technology

15.1 Introduction

Spatial information technology is applied worldwide in the mapping, monitoring, measurement and modelling of natural and human resources and phenomena for decision-making processes. It includes GIS, remote sensing, GPS and other information technology such as computer systems and mobile technology for planning and management. Global academic communities are applying this technology for their planning and development of resources in an integrated manner.

15.2 Global Initiatives

The International Steering Committee for Global Mapping (ISCGM) and Geospatial Information Authority of Japan (GSI) launched its 'Global Mapping Project' in 1996. It is an international cooperation initiative through voluntary participation of national mapping organisations around the world. The aims of the project are to develop a digital geo-information framework, ensuring spatial resolution at 1 km, with standardised specifications, available to everyone at marginal cost. Global map data sets consist of eight basic layers: boundaries, drainage, transportation, population centres, elevation, land use, land cover and vegetation for 71 countries and 4 regions,

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collectively covering 60% of the whole land area. Global maps for elevation, land cover and vegetation (percentage of tree cover) layers wholly cover the land area of the globe. The US National Geospatial-Intelligence Agency (NGA) develops, maintains and enhances the World Geodetic System 84 (WGS 84) for a reference frame for the Earth. India is also converting all map references to WGS 84 for uniform datum for global mapping. This datum is widely used in cartography, geodesy and navigation as well as in GPS.

The United Nations Geospatial Information Section (UNGIS), formerly United Nations Cartographic Section (UNCS), has developed global multi-scale geospatial data sets named 'UNmap' for rapid map production and web mapping in support of the Security Council and the Secretariat, including UN field missions on the scale of 1:1 million, 1:5 million and 1:10 million. The purpose of UNmap is to develop and maintain a spatial data infrastructure for UN needs that will provide a single homogeneous data set of global geospatial features of the world for any mapping purpose. UNmap is a series of geo-databases for core mapping layers such as international and administrative boundaries, coastlines, drainage, water bodies, roads, railways, airports, populated places and urban areas on various scales enabling users to store, query, manipulate and exchange geospatial information. UNGIS is developing a GIS-based UN International Boundary Information System (UNIBIS) that provides a knowledge base of international boundary issues with treaties, relevant documents, maps and satellite imagery as well as status of disputed boundaries in support of the Security Council and the Secretariat as well as the Member States. The objective of this knowledge base is to prevent potential conflicts, resolve border disputes and support border demarcation as well as cross-border cooperation. UNIBIS allows the research of data related to the status of international boundaries, including analysis and interpretation of the satellite imagery, treaty maps and other relevant material. Updates and maintenance of international boundary geo-databases is carried out in order to build the capacity for rapid response to the growing demand of Member States, especially in conflict areas, and for assistance in international boundaries delineation and demarcation.

The Second Administrative Level Boundaries (SALB) data set project was launched in 2001, for the collection, management, visualisation and sharing of data/information down to the second administrative level. The administrative boundaries are the fundamental component of any national spatial data infrastructure and constitute vital basic data for the work of many decision-makers, managers, planners and other users in a variety of sectors: census, health, education, regional development, water, agriculture, energy and environmental resources etc., to name a few. The project has been developed under the leadership of WHO. Coordination and policy issues have been taken care of by UNSD, and technical aspects have been undertaken by UNGIS. UNGIS is also developing a global place-name database and search engine to find place-name locations worldwide by searching with a place name's phonetic spelling (how it sounds) and searching through a database that contains over 8 million entries. A search for a location may not return a result even though a different spelling is in the database. The database of place names will be incorporated into the UNmap geo-database for additional utilisation as well.

The Geo-Portal provides the full range of GEOSS data and information for decision-makers, managers and other users of Earth observations. It is run by the European Space Agency (ESA) and the Food and Agriculture Organization (FAO) of the United Nations. It provides a web-based interface for searching and accessing data, information, imagery, services and applications. OneGeology is another international initiative of the geological surveys of the world launched in 2007. The aim is to create dynamic digital geological map data for the world and make it accessible via its portal (OneGeology Portal). ReliefWeb is the humanitarian information service managed by OCHA, and has produced a series of location maps for use by the UN and the wider humanitarian community. These maps can be embedded into documents, reports, briefing notes and websites as needed. The ReliefWeb

Location Map is a map that highlights a country, its capital and the surrounding region. These 200 country location maps are now available and can be downloaded at http://reliefweb.int/location-maps. The United Nations initiative on Global Geospatial Information Management (UN-GGIM) was established in July 2011 to draw together national capabilities for global geospatial information development and promotion so that the benefits of geospatial information can be available to national policymakers and for key global challenges. The UN expert committee on UN-GGIM decided to prepare a document of the thoughts of leaders in the geospatial world on the future of this industry over the next five to ten years. In Europe, a preparatory committee has provided guidance on the process of establishing a regional committee.

15.3 National Perspective – India

In India, *Niti Ayog* focuses on advanced GIS and satellite based technologies for identification, distribution and utilisation of natural resources. Rashtriya Krishi Vikas Yojana (RKVY) is the government of India's XIIth Five Year Plan (2012–2017) to ensure holistic development of agriculture and allied sectors. One of the major objectives is to ensure the preparation of agriculture plans for the districts and states based on agro-climatic conditions, availability of technology and natural resources. It further mentions that, 'to the extent possible, assets created by this scheme should be captured digitally and be mapped on a GIS platform for future integration onto a National-GIS system'. The Department of Agriculture and Cooperation (DAC) has set up a Mahalanobis National Crop Forecasting Centre with ISRO collaboration to augment present crop forecasts and assessment with regular remote-sensing, GIS and GPS data. Land is the prime natural resource of which 140 million ha is net-sown area, which is still decreasing, and land is degrading in mechanical, chemical and biological terms. Over 120 million ha has been declared degraded or problem soils. Conservation agriculture, integrated nutrient management, carbon sequestration, erosion control, saline and alkaline soil management, legislation for soil protection, development of remote-sensing and GPS-based decision-support systems and amelioration of polluted soil are all required to rejuvenate deteriorated soils. Sustainable agriculture development and reliable and timely availability of forecasts of agricultural crops are prerequisite, especially for food grain and estimates of agricultural production losses due to pests, diseases, floods and drought. The available estimates generated through sample surveys suffer from organisational and operational problems introducing inconsistency in these surveys. Here, remote-sensing techniques with GPS and GIS tools help to develop reliable estimated areas of agricultural crops, land-use planning and precision farming.

The Department of Science and Technology of the Government of India started an ambitious programme on State Spatial Data Infrastructure (SSDI) for data development and management in different states such as management of spatial data assets of Uttarakhand (UK) State in India. A Geo-Portal database has been an important requirement. Guideline documents are required in management of the Uttarakhand Geo-Portal—the first is on the Administrative, the second on the Department-wise Data Management Plan; the third on the Uttarakhand Data Sharing Policy. Preparation of a road map for the Uttarakhand State Geospatial Data Asset Management was considered a prerequisite for continuous updation and management of geospatial data. It was thus recommended that a data management (updation/maintenance/sharing) plan be developed and implemented by UCOST and State Line Departments. Regular workshops at state and district levels are needed for reviewing the progress of the data management plan on a sustained basis. The Uttarakhand Geo-Portal database needs to be continuously improved with not only data updation but with high-resolution data additions for its updation depending on GIS applications for different projects.

The National Platform for Disaster Risk Reduction (NPDRR) is constituted in India for the assessment and spatial representation of hazard-risk, vulnerability and capacities associated with disasters and their management, using spatial information technology-enabled systems of mapping, and for the promotion of disaster-related database management systems to mitigate disasters and preparedness. State disaster databases, disaster reporting systems and India Disaster Response Network (IDRN) are the most important initiatives by the government of India for better disaster risk management.

15.4 Spatial Information Technology and SDGs

The indicators of the SDGs need accessible, timely and reliable disaggregated data. It is a challenge to all countries to create databases for the global indicators. Spatial information technology includes all forms of information technology that enable us to deal with geo-referenced spatial databases. Broadly, these includes remote sensing, GIS and GPS. Remote sensing provides reliable, unbiased and near real-time spatial data, while GPS provides coordinate information about features and phenomena on the Earth's surface. GIS includes all its components such as computer hardware, software, databases, procedures and trained people for the decision-making process by data capturing, managing, analysing and displaying geo-referenced databases to final mapping, and provides complete map visualisation to achieve UN SDGs. These technologies are complementary to each other in dealing with complex databases in a holistic manner to achieve the SDGs. The United Nations Global Geospatial Information Management (UN-GGIM) is an international-level committee led by the UN which has a vision to make accurate, authoritative and reliable spatial information readily available to support national, regional and global development. UN-GGIM also seeks to guide the making of joint decisions and set directions for the production and use of geospatial information within national and global policy frameworks. Chapters 1 to 8 deal with conceptual and methodological frameworks of spatial information technology in the above contexts.

15.5 Case Studies and SDGs

There are five case studies discussed in this book to address SDGs 1, 2, 3, 4, 6, 7, 9, 10, 12, 13 and 15. Ultimately, all the case studies directly or indirectly help to achieve SDG 1, to end poverty in all its forms everywhere over the next 15 years.

The case study on 'crop modelling for sustainable agricultural productivity', discussed in Chap. 13, will seek to help to overcome the problem of starvation and to achieve food security and improved nutrition and promote sustainable agriculture. SDG 2 urges access to sufficient nutritious food for everyone by doubling agricultural productivity, increasing investment and sustaining properly functioning food markets. The case study presents an idea to utilise spatial information technology in an integrated manner for crop simulation modelling to ensure optimum productivity. The bio-physical environments like soil, climate and landform characteristics are used to assess the potentiality of the land. According to InfoCrop modelling, the potentiality of study area for rice production will be around 8.5 tonne/ha, potentiality of wheat will be 7.5 tonne/ha, potentiality of sugarcane will be 85 tonne/ha and potentiality of maize will be 6 tonne/ha. These potentialities of the crops show that it is possible to increase crop yield through proper management of the input of irrigation, and the use of organic and inorganic fertilisers to eradicate the problem of starvation and achieve food security.

SDG 15 focuses on the protection, restoration and promotion of sustainable use of terrestrial ecosystems, sustainable management of forests, combatting of desertification, halting and reversing of land degradation and halting of

biodiversity loss. The case study on land-use modelling for micro-level planning can meet SDG 15 by using the technology of spatial information. On the basis of the geo-environmental conditions of a study area, alternate land use is suggested in three categories: management of agricultural lands, management of wasteland and management of forest land. Afforestation, agro-forestry, agro-horticulture, double crops, fishery, fodder and fuel plantation, forest plantation, gully-plugging measurement and silvipasture are all suggested for alternate land use to conserve and protect land resources. The land-use model is prepared in such a way that no land should be kept as wasteland, and no use or monetary returns made, or other environmental aspects under the prevailing geo-environmental conditions violated that would prevent the livelihood and preservation of the eco-system for future generations.

Infrastructure is the backbone of any nation for attaining prosperity and one of the major indicators for sustainable development. Likewise, information about infrastructure is also required to understand the distribution pattern of available facilities. The aim of SDG 9 focuses on the promotion of infrastructure development, industrialisation, innovation and access to information and communication technology. Therefore, information about infrastructure and services like education, health, availability of drinking water, transport, communication, post, telegraph and telephone, irrigation and electricity facilities plays an important role in sustainable development. Spatial information technology also plays a vital role in providing information about infrastructure spatially. The case study on 'Infrastructure Assessment for Sustainable Development' (Chap. 12) broadly provides an example for the achievement of SDG 9 as well as SDGs 3, 4, 6 and 7. The case study reveals that the development of infrastructure is high in the eastern part of the study area.

The case study on 'Monitoring and Assessment of Flood-Inundated Areas' (Chap. 11) represents one of the major issues in natural disasters. SDG 13 addresses how we must combat climate change and its impacts. It is also estimated that due to the rise in temperature of the Earth, most of the islands and low-lying areas will submerge and unpredicted spontaneous rainfall will lead to flood inundation along major rivers in the world. In India, monsoon floods are common in major rivers, which affects not only natural resources but also human life and livestock. An attempt is made to monitor, assess and manage flooded areas in Son-Karamnasa Interfluve in Bihar, India. The assessment is based on the multi-temporal Indian Remote Sensing Satellite-P6 (IRS-P6). The analysis reveals that low-lying areas along the river Ganga and Karamnasa are flooded during September to November, during monsoon and post-monsoon periods that affect not only the *kharif* crops but also the *rabi* crops. Preventive measures and preparedness are required in this area for sustainable development.

SDG 6 seeks to ensure the availability and sustainable management of water and sanitation for all. The sustainable development of water resources requires assessment in their natural boundaries, such as watersheds, and can be managed in natural conditions. The case study about watershed characterisation (Chap. 10) and priority for land and water resource management focuses on the development of these resources in watersheds, a hydrological unit, considered a more efficient and appropriate unit for soil and water resources. It is also important to determine the morphometric characteristics such as linear, areal and relief aspects of the watershed that control the flow of water resources, groundwater recharging and soil erosion. In this regard the research is done on the Son-Karamnasa interfluve for the prioritisation of watersheds on the basis of morphometric parameters for further management of soil and water resources to meet SDG 6.

As discussed above, spatial information technology plays an important role in providing unbiased information on the Earth's features within a very short time for the rational management of resources and environmental phenomena for human use in order to contribute towards SDGs. The UN SDGs seek to improve

the social, economic, environmental, institutional and governmental aspects of society. Spatial information technology provides a helping hand in decision-making processes through mapping, monitoring, measuring and modelling of the different phenomena of the world in order to contribute towards SDGs.

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