

National Spatial Data Infrastructure (NSDI)

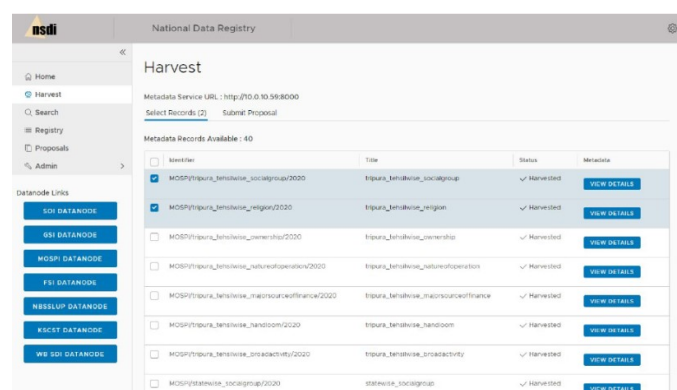
(Input material for the DST Annual Report - 2021-22)

National Spatial Data Infrastructure (NSDI)'s vision has been to ensure that "current, accurate and organized geospatial data sets are readily and continuously available and accessible on a national, state, district and village level basis to contribute to economic, environmental and social growth of the country". Five strategic goals set for NSDI include establishing required governance structure, ensuring capture, preservation, and maintenance of both fundamental and non-fundamental data sets; ensuring that the governmental geospatial data sets are readily discovered, appraised, and accessed; ensuring that the geospatial data sets, services, and systems owned by different government agencies are interoperable, and can be combined and reused for multiple times; and providing a coordinating framework for the delivery of the desired product space for its multiple stakeholders.

Towards the above goals, during 2021-22, focus of the NSDI has been on strengthening and using the National Data Registry (NDR) Geo-portal and the individual organisational Data Nodes; provisioning a proof-of-concept Geospatial Cloud based Infrastructure (NSDI Geo-platform) services for hosting geospatial data/ applications; maintaining the NSDI Clearinghouse Node as a single window gateway for access to digital geospatial data; maintaining the on-going and establishing new State Geoportals in various States; coordinating the development of National and State Level Geospatial Foundation Data and applications; framing and using geospatial data and process standards with the involvement of the Bureau of Standards (BIS); and the revision of the draft National Geospatial Policy.

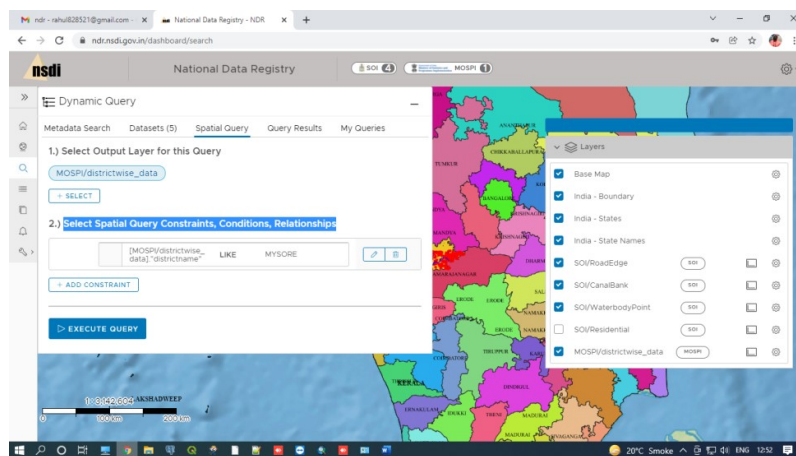
National Data Registry (NDR)

Under the National Data Registry (NDR) Initiative, a set of on-line registers has been developed to facilitate search, discovery, and utilisation of on-line geospatial data sets and services for interoperable access from 5 Central



(Figure 1: National Data Registry's Harvest Functionality to automatically harvest metadata from Partnering Agency Data Nodes in a decentralised mode)

Partnering Agency and 1 State Agency Data Nodes. The registers provide an array of meta-level information for each feature data item covering its uniquely assigned identification code, concept or meaning of each theme or feature; geometric and attribute details (standards-based schemas); and possible values (domain values or code lists) for the attributes. NDR is expected to facilitate registering of data sets and provision of data services of various agencies thereby creating a framework for minimising duplication in data acquisition and maximising utilisation of already acquired data sets in various organisations. During the year, the NDR Geo-portal has been further strengthened with registration of additional definitions of features/ themes, application schemas, and code list values etc. Fresh data services from Central/ State/ UT Agencies like Ministry of Statistics & Programme Implementation (MoSPI), National Atlas & Thematic Mapping Organisation (NATMO), Punjab Remote Sensing Service Centre (PRSC), State Department of Science & Technology, Govt. of West



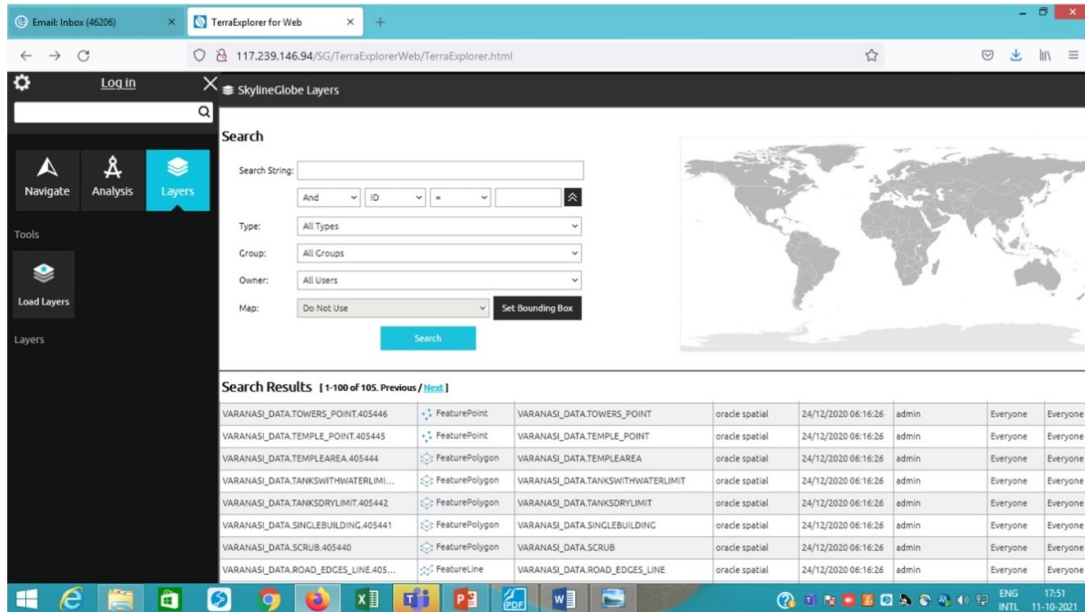
(Figure 2: Demonstration of interoperable integration of statistical data with geospatial data in the Global Statistical Geospatial Framework – GSGF)

Bengal; Nagaland Science & Technology Council, and J&K Remote Sensing Application Centre (J&KRSAC) etc. have been registered in the NDR along with metadata. The MoSPI Data Node has been used to demonstrate the principles of Global Statistical Geospatial Framework (GSGF). Based on the feedback on the security of the NDR Data Nodes including specific inputs from the concerned agencies in MHA/ State Government, fresh sets of credentials have been shared with the Partnering and User Agencies for access. Experiences of implementing the NDR have been useful in the drafting and finalising the National Standards to be published by the Bureau of Indian Standards (BIS).

Geospatial Cloud Platform

The proof-of-concept Geospatial Cloud-based Data Centre (NSDI Geo-platform) established in Survey of India (Hyderabad Campus) for demonstrating management of data life cycles has been upgraded during the year. Aimed at meeting the additional computing resource needs of NSDI and its Partnering Agencies, the up-gradation has provided deeper insights into issues and challenges in scaling up an existing Geo-platform for meeting higher order computing performance needs of geospatial data processing services..

Both the 2D and 3D data sets of Varanasi City, covering an area of approximately 146 square kilo meters have been processed and served from the NSDI Geo-platform after updating the existing 1:2,000 scale National Urban Information System (NUIS) data using drone-based surveys. Voluminous images/ data sets of the City have been stored unto a Relational Database Management System for sharing as standards-based data (GML/ CityGML) services for the development of application/ solutions for the stakeholders. The screenshot (Figure 3) shows on-line access to a set of 105 Varanasi feature data services

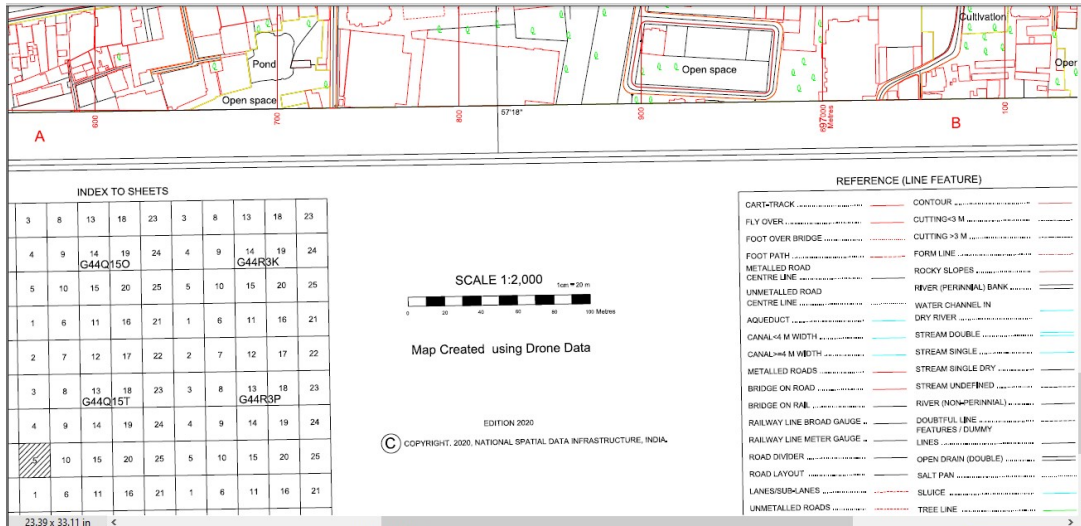


(Figure 3: Screenshot showing on-line access to Varanasi City standards-based Geospatial Feature Data Services useful in the development applications/ solutions using GIS)

from the Relational Database as per the NUIS Data Model. A part of an up-to-date 1:2,000 scale NUIS topographic map of Varanasi City prepared using drone surveys conducted during October - November 2020 has been shown in Figure 4.

To facilitate integration of larger scale drone-based surveys with the National Topographic Frame of Survey of India in 1:50,000 scale and digitally monitor the progress of data gathering at the local level, a framework of high resolution grids as per the provisions of the National Map Policy has been designed, developed and made accessible from the India Geo-portal (Figure 5).

Sharing of Virtual Machine (VM) with the State DST, Govt. of West Bengal for hosting the State Geo-portal services and collaboratively developing the interoperable State data services has been formalised.



(Figure 4: Focus on Data Life Cycle Management - Display of a part of an up-to-date 1:2,000 scale National Urban Information System topographic map of Varanasi City prepared using drone surveys conducted during October - November 2020. Local level network of high resolution topographic grids with index numbers consistent with the National Topographic Frame for monitoring drone-based surveys has been shown)

Partnering Agency Data Nodes

NSDI and State SDI Partnering Agency Data Nodes provide interoperable access to map (display/ visualisation) services. Metadata and Data Services of the geospatial Data Nodes of the NSDI and State SDI Partnering Agency Data Nodes have been maintained in collaboration with the respective Ministries/ Departments and the State Governments for sustained access to their data sets. Efforts have been made to host the Surveykshan Geoportal from the NSDI Geo-platform for providing the topographic map services of Survey of India. Bhoomi Geoportal of NBSS&LUP has been reoriented towards providing soil feature data services.

Data Nodes/ Geoportals for States/ Union Territories (UTs) like Karnataka, Kerala; West Bengal; Uttarakhand; Jharkhand; Haryana; Odisha; NCT of Delhi; Jammu & Kashmir (including Ladakh UT); Madhya Pradesh; Himachal Pradesh; Nagaland; and Pujab have been maintained/ developed for providing standards-based interoperable access to the geospatial data sets of the respective State/ UT Governments. During the year, steps have been taken to launch Geoportals for Arunachal Pradesh, Andhra Pradesh; Goa; and Sikkim.

The Partnering Agency Data Nodes have been accessible from the single window gateway of the India Geoportal (<https://nsdiclearinghouse.gov.in>) that is evolving as a Data Clearinghouse to support orchestration of Data Services and development of on-line GIS applications.

Application Services

State-wide consistent and seamless high resolution foundation spatial data sets have been identified as the starting point for developing geospatial applications. Based on the recommendations of the State SDI workshops, State Geo-portals are being upgraded and re-oriented to capture and share high resolution foundation data sets over the web for the Line Departments to add

their thematic details, attaching attributes; geo-registering their maps; and linking & orienting their results of applications to the local landscapes. It has thus been recommended by the NSDI Executive Committee to prepare and share through the State Geo-portals foundation data sets in 1:2000 (panchayat level, 2D) and 1:500 (ward level, 2D/3D) scales. Towards coverage of one block and one city/ town each in Arunachal Pradesh and Odisha under the application development initiative, System Integrators have been identified by each of the Partnering Agencies in the States.

The study areas dominated by scheduled tribe population have been surveyed during the year using airborne optical and LIDAR sensors for sharing the resulting high resolution data sets as standards-based data services for the preparation of panchayat and ward level geospatial applications.

Developing and Utilising ISO/ OGC/ BIS Geospatial Standards

National standards on 'Rules for Application Schema', 'Conceptual Schema Language'; and 'Geography Mark-up Language (GML)' co-branded and published from the ISO/ OGC in the previous years have been utilised in strengthening the NDR and State Geo-portals. ISO 19135 standard specifications for the procedures for registering geospatial objects have been used by the Geological Survey of India (GSI) in registering its data services in the NDR. NSDI has participated in the 20th meeting of the eElectronics & Information Technology Division (LITD) Council of the Bureau of Indian Standards (BIS) for the review of the Council's activities on the development of the National Standards in the domain of Electronics & Information Technology. Intensive deliberations have been made in the 7th meeting of the LITD-22 Sectional Committee for firming up the Data Content Standards for 'Surface Geology', 'Soils'; 'Forestry'; 'Land Resource Management'; and Standards relating to 'LIDAR'. NSDI has participated in the meetings of the LITD-28 Sectional Committee on 'Smart Cities'.

GISE Hub at IIT Bombay

A Geo-Information Science & Engineering (GISE) Hub has been launched at the Department of Computer Science & Engineering (CSE), Indian Institute of Technology (IIT), Bombay to support the implementation of the NSDI and the State SDIs with the involvement of all the stakeholders of the geospatial ecosystem.

Training and Capacity Building

A 2-Day Training Workshop on "Geodetic Network Adjustment for High Resolution 2D/ 3D Surveys for NSDI Application Development" has been organised by the National Centre of Geodesy (NCG), Indian Institute of Technology, Kanpur for the NSDI and the State SDI Nodal Officers on 26-27 August 2021 in Virtual Mode. Two course modules, one week duration each, has been drawn up for regular training programmes on 'Geospatial Standards' and 'NDR and Geo-platform' by the National Institute for Geo-Informatics Science & Technology (NIGST), Survey of India, Hyderabad. A set of 5 demonstration-cum-training workshops have been organised for exposing the representatives of the NSDI and the State SDI Partnering Agencies on 'Standards', 'NDR' and the 'Geo-platform'.

Interaction with OGC

A physical meeting of the Open Geo-spatial Consortium - India (OGC-India) Forum has taken place on 08 December 2021 with the stakeholders of open geo-spatial standards from the Government, Academia; and the Private Enterprises on the sidelines of the Geo-Smart India 2021 held at Hyderabad. Status of development and adoption of OGC standard specifications for interoperable sharing of geospatial data over the web have been discussed for working out the future strategies on Interoperability with the help of the OGC-India Forum.

R&D priorities

Based on the recommendations of the NSDI Expert Committees, R&D projects have been evaluated and supported in areas like 'Geospatial Data Quality Evaluation and Certification', 'Block Chain and Distributed Ledger Technologies'; 'Geo-Cloud/ Edge Computing'; 'Geo-data/ Spatio-temporal Data Analytics'; 'Geospatial Machine / Deep Learning Techniques in various Application Domains' etc.

Draft National Geospatial Policy

For further consultation with the NSDI stakeholders, the draft National Geospatial Policy has been revised to incorporate mandatory registration of all the data sets in the NDR to help develop a centrally-coordinated geospatial catalogues to facilitate search, access, delivery and utilisation of standards-based geospatial data. For easy access to geospatial data/ products/ services and solutions by efficient processing on a scalable PoC-based Geo-platform, the revised Policy provides for establishing a suitable geospatial infrastructure with the help of a managing technical partner. Interactions have been made with the Potential Industry Partners for working out strategies for increased investment by Industry in the management of data sets on the National Foundation Spatial Data Themes and the Application Data Themes.

Future

In order to draw up a strategy for the implementation of NSDI, a study has been conducted by the International Institute of Information Technology Bengaluru (IIITB) for a Third Party Review. Some of the major recommendations of the study include appointing NSDI as the spatial data regulator of the country, NSDI should persuade data creators both in government and in private to contribute to NDR while taking recourse to legal route to enforce this; NSDI should actively catalyse and support hubs which will work with a network of spokes in creating and disseminating tools, applications and methods built upon open source technologies. Hub should be located in academic institutions of national eminence and spokes could be in other academic institutions, government departments, NGOs, private enterprises and start-ups with each hub focussing on one vertical e.g. Agriculture, Health, School Education and for hosting data created by citizen groups, private companies and smaller government departments. Each of these hubs could be a section 8 company. NSDI should become an autonomous agency governed by an independent board with a complement of full-time staff.

Designed to be mounted on the NDR and a fully functional Geo-platform, NSDI 2.0 should be made operational by leveraging the outputs of NSDI 1.0 including the distributed network of geo-portals from the Partnering Central and State Government organisations; a well-knit team of scientists and experts built over the past years; and an innovative group of Private Enterprises/ Start-Ups/ System Integrators. With the framing of the National Geospatial Policy, the start-ups should be supported with the help of a group of identified coordinating hubs for developing and providing geospatial application and solution services towards addressing the social, economic, and environmental challenges facing the country.
