THE PEOPLE'S REPUBLIC OF BANGLADESH
SURVEY OF BANGLADESH (SOB)

THE PROJECT FOR ESATBLISHMENT OF NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI) FOR BANGLADESH

PROGRESS REPORT

December 2020

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ASIA AIR SURVEY CO., LTD.
PASCO CORPORATION

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(December 2020)

The project for establishment of national spatial data infrastructure (NSDI) for Bangladesh

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Acronyms and Abbreviations

No.	Abbreviation	Official name
1	a2i	Access to Information
2	API	Application Programming Interface
3	AMQP	Advanced Message Queuing Protocol
4	BBS	Bangladesh Bureau of Statistics
5	BCC	Bangladesh Computer Council
6	BDMAP	Bangladesh Digital Mapping Assistance Project
7	BDT	Bangladesh Taka
8	BFD	Bangladesh Forest Department
9	BFIS	Bangladesh Forest Information System
10	BGII	Bangladesh Geographic Information Infrastructure
11	BGISP	Bangladesh GIS Portal
12	BIWTA	Bangladesh Inland Water Transport Authority
13	BMD	Bangladesh Meteorological Department
14	BSI	British Standards Institution
15	BSTI	Bangladesh Standards and Testing Institution
16	BtoB	Business to Business
17	BTRC	Bangladesh Telecommunication Regulatory Commission
18	BUET	Bangladesh University of Engineering and Technology
19	BWDB	Bangladesh Water Development Board
20	BUTM	Bangladesh Universal Transverse Mercator
21	CEGIS	Center for Environmental and Geographic Information Services
22	CH	Clearing House
23	CORS	Continuously Operating Reference Station
24	COVID-19	Corona Virus Disease - 2019
25	CR	Completion Report
26	CSV	Comma-Separated Values
27	DDM	Department of Disaster Management
28	DESCO	Dhaka Electric Supply Company Limited
29	DEM	Digital Elevation Model
30	DFR	Draft Final Report
31	DGHS	Directorate General of Health Services
32	DLRS	Directorate of Land Records and Surveys
33	DMC	Digital Mapping Center
34	DMTCL	Dhaka Mass Transit Company Limited
35	DNCC	Dhaka North City Corporation
36	DoE	Department of Environment
37	DPDC	Dhaka Power Distribution Company
38	DPS	Data Product Specification
39	DSCC	Dhaka South City Corporation
40	DSM	Digital Surface Model

No.	Abbreviation	Official name
41	DTM	Digital Terrain Model
42	DWASA	Dhaka Water Supply and Sewerage Authority
43	ERD	Economic Relations Division, Ministry of Finance
44	GDB	Geodatabase format for ArcGIS
45	GIS	Geographic Information System
46	GML	Geography Markup Language
47	GNSS	Global Navigation Satellite System
48	GPS	Global Positioning System
49	GSB	Geological Survey of Bangladesh
50	GSI	Geospatial Information Authority of Japan
51	HDD	Hard Disk Drive
52	ICR	Inception Report
53	ICT	Information and Communication Technology
54	IDMS	Improvement of Digital Mapping System of Survey of Bangladesh
55	IEDCR	Institute of Epidemiology, Disease Control and Research
56	IMED	Implementation Monitoring and Evaluation Division
57	ISO	International Organization for Standardization
58	ISO/TC211	International Organization for Standardization/Technical Committee 211
59	IT	Information Technology
60	IWM	Institute of Water Modelling
61	JCC	Joint Coordinating Committee
62	JISC	Japanese Industrial Standards Committee
63	JMP2.0	Japan Metadata Profile 2.0
64	JPGIS	Japan Profile for Geographic Information Standards
65	LADM	Land Administration Domain Model
66	LCC	Lambert Conformal Conic
67	LGED	Local Government Engineering Department
68	LiDAR	Light Detection and Ranging
69	MoD	Ministry of Defence
70	MoDMR	Ministry of Disaster Management and Relief
71	MoPT	Ministry of Posts Telecommunication and Information Technology
72	MS	Monitoring Sheet
73	NDC	National Datacenter
74	NEC-ECNEC	National Economic Council – Executive Committee of the National Economic Council
75	NSDI	National Spatial Data Infrastructure
76	NSDI-PF	National Spatial Data Infrastructure Platform
77	NSDI-PP	National Spatial Data Infrastructure Pilot Project
78	NSDI-PPWG	National Spatial Data Infrastructure Pilot Project Working Group
79	NSDI-PS	National Spatial Data Infrastructure Prototype System
80	NSDI-WG	National Spatial Data Infrastructure Working Group
81	NWRD	National Water Resources Database

No.	Abbreviation	Official name
82	OGC	Open GIS Consortium
83	OJT	On-the-Job-Training
84	OSM	Open Street Map
85	PD	Project Director
86	PDB	Power Development Board
87	PDM	Project Design Matrix
88	PKSF	Palli Karma Sahayak Foundation
89	PM	Project Manager
90	PO	Plan of Operation
19	POI	Point of Interest
92	PR	Progress Report
93	PSC	Project Steering Committee
94	R/D	Record of Discussion
95	RAJUK	Rajdhani Unnayan Kartripakkha / Capital Development Authority
96	REB	Rural Electrification Board
97	RHD	Roads and Highways Department
98	RTK	Real Time Kinematic
99	SMS	Short Message Service
100	SoB	Survey of Bangladesh
101	SoB BM	Survey of Bangladesh's Base Map
102	SPARRSO	Bangladesh Space Research and Remote Sensing Organization
103	SRDI	Soil Resource Development Institute
104	SSD	Solid State Drive
105	SSH	Secure Shell
106	TAPP	Technical Assistance Project Proposal
107	TBT	Agreement on Technical Barriers to Trade
108	TC	Technical Committee
109	TITAS	Titas Gas Transmission and Distribution Company Limited
110	UAV	Unmanned Aerial Vehicle
111	UDD	Urban Development Directorate
112	UI	User Interface
113	UNFPA	United Nations Population Fund
114	UNVT Toolkit	United Nations Vector Tile Toolkit
115	USGS	United States Geological Survey
116	UX	User Experience
117	WARPO	Bangladesh Water Resources Planning Organization
118	WASA	Water Supply and Sewerage Authority
119	WTO	World Trade Organization
120	XML	Extensible Markup Language

CHAPTER 1. Background of the Project

1.1. Background of the Project

(1) Current Status of Redundant Investment in Geospatial Information Development

The People's Republic of Bangladesh (hereinafter referred to as Bangladesh) has forecast that large-scale infrastructure investment amounting to 74 – 100 billion dollars is required in ten years between 2011 and 2020 due to the steady economic growth at an annual average rate of 6%. Project studies / building construction will proceed through the proper steps for each project from the master plan to construction work, but maps with the accuracy corresponding to the planning stage will be required in order to grasp the topography and other details of the target location.

The Survey of Bangladesh (hereinafter referred to as "SoB"), the only organization in Bangladesh that conducts surveys and topographic mappings developed 1:25,000 scale topographic maps for the entire area of Bangladesh and 1:5,000 scale topographic maps for the five main cities under the Improvement of Digital Mapping System of Survey of Bangladesh (IDMS) using Japanese Debt Relief Grant Assistance-Counterpart Funds. These maps are the only ones that cover the entire country and serve as a standard for locations with guaranteed accuracy and quality. However, since there are no regulations or standard specifications concerning geospatial information development in Bangladesh, nor mechanisms for the sharing of the digital topographic maps created by SoB among government institutions, each government organization, under its own authority and according to its own requirements, creates, collects and uses geospatial information individually for infrastructure development, land use planning, urban development, as well as disaster prevention and other emergency plan formulation / management by using different formats, data models and map projection methods. Therefore, a new approach needs to be developed and measures need to be urgently implemented to avoid redundant investment by each organization for the development / management of geospatial information which will be the basis for economic development and national land development in the future.

(2) Approach to Facilitating Advanced Use of Geospatial Information

The government of Bangladesh has established the goal of becoming a middle income

country by the year 2021 which will mark the 50th anniversary of independence under the slogan "Vision 2021", and is advocating a "Digital Bangladesh" in order to facilitate the dissemination of computer technology and utilization of modern technology. The seventh 5 year plan (2016–2020) includes the following strategic policies: 1) Optimization of land management / utilization, 2) Infrastructure development strategy and 3) Digital Bangladesh. In light of this and other development plans, Honorable Prime Minister Sheikh Hasina talked about the importance and necessity of a National Spatial Data Infrastructure (NSDI) at the NSDI International Seminar held in June 2016, and issued instructions for activities to be promptly implemented for the building of an NSDI.

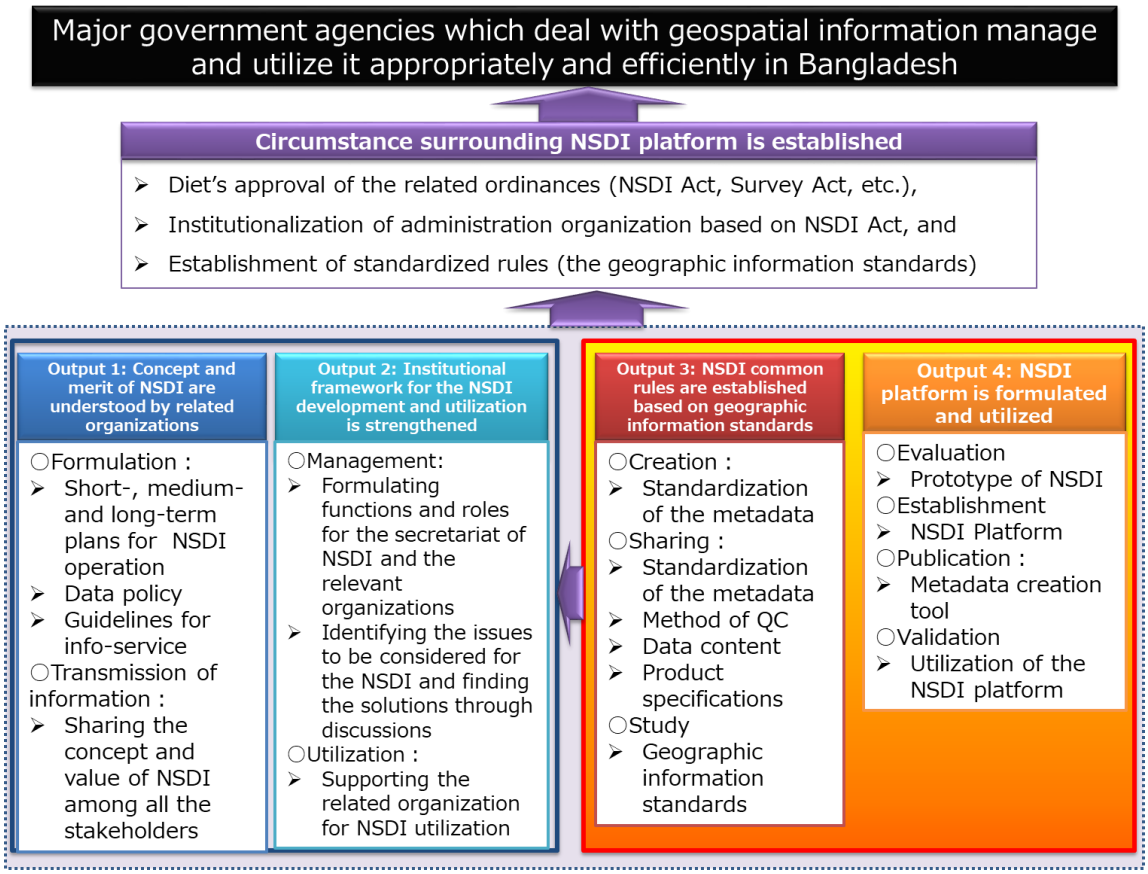
Upon receipt of these instructions, an NSDI Introduction Study Committee (tentative name) was formed under the Ministry of Defence (MoD), and it started activities in preparation for enactment of a new survey act and NSDI act. In addition, in the "Project for Strengthen the Capacity on Advanced Mapping of SoB for Building Digital Bangladesh" (the completed JICA-PJ), a roadmap was drafted to facilitate building of an NSDI, the NSDI Pilot Project Working Group (NSDI-PPWG) was formed, and a small-scale prototype system (NSDI-PS) was created as a pilot project (NSDI-PP) in order to demonstrate the NSDI concept and usefulness, and verify technical and operation issues. Bangladesh is implementing standardization of geospatial information and sharing / integration of data, and has started activities with the objective of attaining a society that can promote utilization of geospatial information in various fields.

Under these circumstances, the government of Bangladesh has requested the government of Japan for technical cooperation relating to the boosting of NSDI development (building and utilization) capabilities in order to launch a full-fledged NSDI Platform (NSDI-PF) based on the issue review results in NSDI development which consist of the results of the completed JICA-PJ.

1.2. Objective

The overall goal, project purpose, outputs and activities are set out below. The project purpose and outputs are detailed in Annex 1, "Project Design Matrix (PDM) Version 1.0" and "Plan of Operation (PO)".

The overall PDM for this project attached to the Record of Discussion (R/D) is organized in Figure 1-1.



Source: The Project Team

Figure 1-1 PDM of the Project

1.2.1. Overall goal

Major government agencies dealing with geospatial information manage and utilize it appropriately and efficiently in Bangladesh.

1.2.2. Project purpose

To enhance the NSDI capacity development of SoB and related organizations.

1.3. Target area

The target area for the Project shall be the whole area of Bangladesh, and the SoB Tejgaon office in Dhaka will be the operating base.

The NSDI should be widely utilized at a national level, and implementation of field

surveys, On-the-Job-Training (OJT) and other activities in Chittagong, Sylhet, Mongla and other regional cities and areas will be considered in order to facilitate alleviation of regional differences, which is one of the goals to be achieved by Digital Bangladesh.

However, due to the COVID-19 outbreak that began at the end of 2019, the immigration and travel restrictions started at the end of March 2020, and activities in the Bangladesh had been suspended. Since June 2020, when measures to control the spread of the disease in Bangladesh were relaxed, the project has been based in Japan and continued to work remotely with web conference.

1.4. Project scope

The Project will be implemented based on the R/D agreed upon on March 31, 2019. In order to achieve the above objectives, the activities for "Output 3" and "Output 4" will be implemented in collaboration with the activities for "Output 1" and "Output 2" that are to be implemented by the long-term experts through discussions / agreement concerning the content of this project with the SoB which is the counterpart organization in Bangladesh, and reports and other documents will be prepared according to the progress of this project.

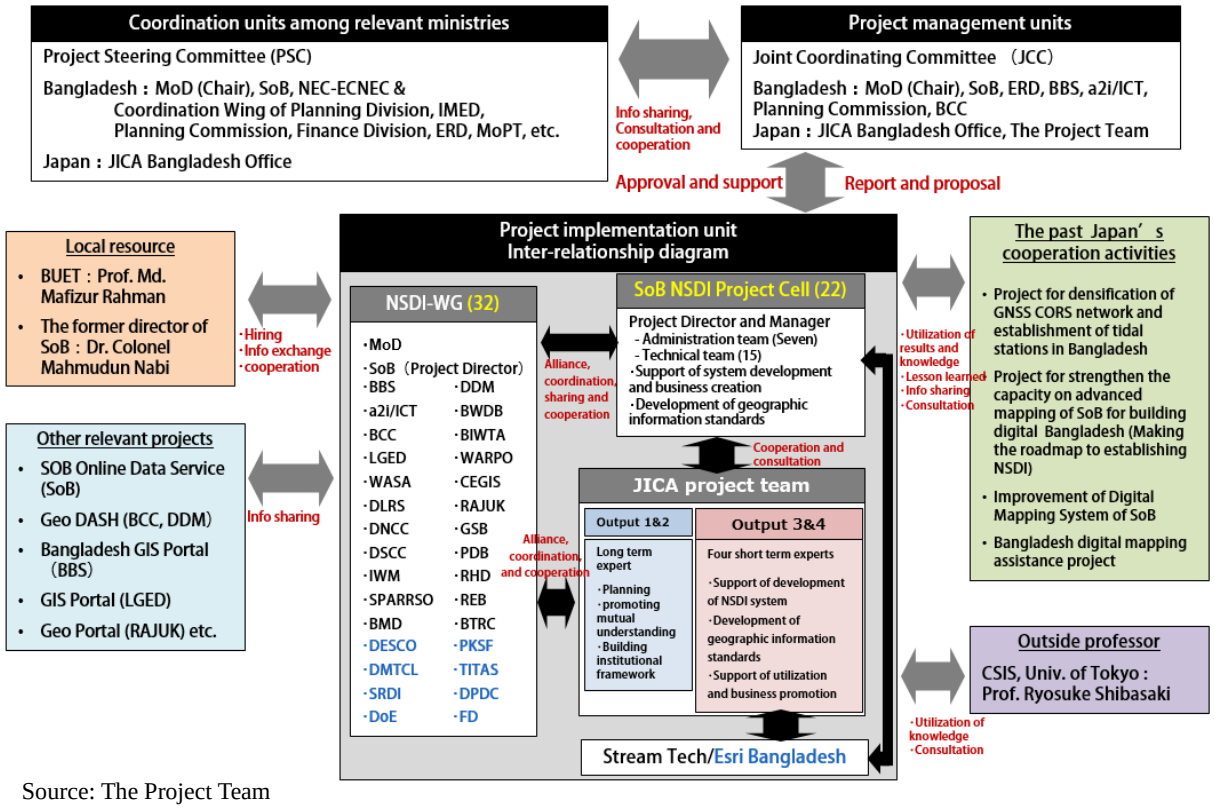
1.5. Project period

The R/D stipulated a period of two years after arrival of the long-term expert in Bangladesh. Since the expert arrived in Bangladesh on August 1, 2019, the period for this project is until July 31, 2021.

However, due to the impact of the COVID-19 pandemic, approval of the Technical Assistance Project Proposal (TAPP) in Bangladesh was delayed, resulting in the agreement being reached to extend the period for this project to June 2022 at the first Joint Coordinating Committee (JCC) meeting which was held on October 22, 2020. It is expected that the R/D will be amended from this point on.

1.6. Implementation structure of the Project

The implementation structure for this project is shown in Figure 1-2. The changes since the project was started consist of the inauguration of the NSDI Project Cell within the SoB, the addition of 8 organizations to the NSDI Working Group (NSDI-WG) for a total of 32 organizations, and the addition of Esri South Asia Pte. Ltd. Bangladesh Branch as a local consultant to provide support for the preparation of product specifications.



Source: The Project Team

Figure 1-2 Implementation structure of the Project

1.7. Considerations for project implementation

In consideration of the fact that the NSDI represents social infrastructure that integrates geospatial information related to all government organizations, academic organizations and private sector entities, it is important that a cooperation structure with the respective organizations be established in order to promote the establishment, operation and utilization of the NSDI based on an understanding of the NSDI by top management of each government organization.

As of December 2020, 32 organizations are participating in the NSDI-WG in order to promote the establishment, operation and utilization of the NSDI, and it will be necessary to establish the NSDI while taking into consideration opinions, advice, requests and other issues voiced by the participating organizations so that it is appropriate for Bangladesh.

Due to the spread of the COVID-19 pandemic, travel to Bangladesh was restricted from April 2020, but travel to the country was restarted on November 13, 2020, and it is expected that travel by short-terms experts will also restart following the return of the long-term expert in January 2021. However, in spite of the fact that government organizations in Bangladesh restarted normal operation from August 2020, the number of new cases per day in Bangladesh in November 2020 still exceeded an average of 2,000 cases, resulting in the expectation that it will take time for conditions to return to the level before the COVID-19 pandemic. Therefore, it will be necessary to implement work remotely which mainly consists of web meetings for the time being to facilitate cooperation with NSDI-WG members. Consequently, it will be difficult to proceed as scheduled in the original plan, requiring monitoring of the progress of work and amendment of the schedule as appropriate.

CHAPTER 2. Overview of the project's activities and results

2.1. Summary of project activities

A summary of the activities performed for this project from August 2019 to December 2020 is described in this section.

2.1.1. First meeting

Work for this project started with the dispatch of a long-term expert to Bangladesh on August 1, 2019. Subsequently, the shuttle-type dispatch of short-term experts began on August 24, 2019, and the first meeting of the related parties which was chaired by the MoD was held on August 29, 2019, at which time the overall activity plan for this project was explained, and an agreement was reached on the activity content (Inception Report) to prepare for establishment of the NSDI. The agreed upon content was compiled in Minutes of the Meeting, and a Technical Note describing the technical points concerning implementation of this project was prepared based on the pilot project evaluation review and provided as an attachment to the Minutes of the Meeting.

2.1.2. Approval of the TAPP

In Bangladesh, in order to secure a budget for the technical cooperation project, it is necessary to submit a budget application to the Ministry of Finance (MoF) one the overall project cost has been estimated. The application documents to be prepared for this procedure is called the TAPP (Technical Assistance Project Proposal) and contains the amount to be input by the Japanese side in addition to the amount to be contributed by the Bangladesh side.

The TAPP for this project was signed by the Minister of Planning on July 20, 2020, and the budget for this project was approved by the government of Bangladesh (Table 2-1). The overall budget amount for this project stated in the TAPP is BDT140,500,000.- (approx. 175.753 million yen). The funds to be prepared on the Bangladesh government side amount to BDT32,700,000.- (approx. 40.905 million yen), approximately 65% of which consist of expenses for the establishment of a full-scale version NSDI-PF. The term of validity for this budget is from February 2020 to June 2022.

Table 2-1 Summary of the TAPP approvals for NSDI project

Item	Description
Project title	Establishment of National Spatial Data Infrastructure (NSDI) for Bangladesh
Sponsoring Ministry	Ministry of Defence
Implementing Agency	Survey of Bangladesh
Objectives and targets of the project	The main objectives of the project is: To develop National Spatial Data infrastructure of Bangladesh for collection, preservation and exchange of spatial data.
Project implementation period	Date of commencement: February 2020 Date of completion: June 2022
Project budget	GOB: BDT 32,700,000.- Japan: BDT 107,800,000.- Total: BDT 140,500,000.-

Source: SoB

2.1.3. Joint Coordinating Committee (JCC)

The first JCC meeting was held on October 22, 2020 after approval of the TAPP, at which time discussions were held on changing of the project period, forming of the Project Steering Committee (PSC), status of NSDI policy formulation, NSDI-PS status and other current progress being made on the project, the NSDI-PF development plan and other issues. The discussions resulted in the decision to extend the project period to June 2022, have the PSC be chaired by the Joint Secretary of the MoD and consist of 17 designated members, formulate NSDI policy at an early point, and fixing of the full-scale NSDI-PF development plan.

2.1.4. Formulation of the NSDI policy

Formulation of NSDI policy is important to allow shared usage of geospatial information in an appropriate manner which is developed by governmental and non-governmental organizations in order to facilitate infrastructure development, land use plans, urban development, formulation/management of disaster prevention and other plans, and for other purposes. The SoB prepared a draft in February 2020, submitted it to the MoD, and circular consultation among related organizations (57 organizations) began in March 2020. However, due to the impact of COVID-19, circular consultation is still continuing. As of December 2020, responses had **been received from 23 organizations.**

Correction :Has been received from 25 organizations

2.1.5. Formation of the SoB Technical Team and the SoB NSDI Project Cell

A request was made for the selection of technical staff who will provide assistance on technical issues and practical issues to the project director and project officer for this project, and cooperate with the JICA project team. This resulted in the formation of the SoB technical team which consists **of 1 team leader and 4 technical staff.**

Correction: of 1 team leader(Incharge) and 13 technical staff

The main activities of the SoB technical team consist of coordination with related organizations, accompanying other staff to interviews, assistance for holding of the NSDI-WG member meetings and other such issues. In addition, after the change of the activity structure to a remote format from Japan due to the impact of COVID-19, web meetings were regularly held about once a week, furthering activities for this project.

After this, the TAPP was approved, and the NSDI Project Cell was formed within SoB which took over from the SoB technical team. A Project Director who is responsible for the project as a whole and a Project Manager who is in charge of implementation were selected for the NSDI Project Cell, and 7 staff (including Project Director and Project Manager) were appointed to the Administration Team which provides support for the respective project activities, and 15 staff were appointed to the Technical Team. Web meetings are periodically held with NSDI Project Cell members in the same manner as when activities were being conducted by the SoB technical team.

2.1.6. NSDI-WG members meeting

Efforts are being made to hold NSDI-WG member meetings about once every two months, and three meetings were held from September 2019 to February 2020, with all 24 organizations participating at least once. Opinions are exchanged at these meetings concerning the review of NSDI-PP, partial release of SoB base map on the NSDI-PS, approach to geographic information standards, NSDI case studies and other issues. During the third meeting, the addition of 8 organizations that prepare / possess geospatial information was proposed in order to facilitate wider utilization of the NSDI.

Holding of these meetings was suspended due to the spreading of the COVID-19 pandemic, but the fourth meeting was held as a web meeting on November 12, 2020. The 8 organizations proposed during the third meeting were also invited to the meeting, resulting in the participation of 14 organizations. Explanations were made of the activity

content review until the current point in time, current status of NSDI-PS, preparation of Data Product Specifications (DPS), schedule for full-scale NSDI-PF development and other issues, and an understanding of the roles and obligations of NSDI-WG members in preparation for establishment of the NSDI was fostered.

2.1.7. Review of the NSDI pilot project

The NSDI-PP evaluation report that was prepared through the use of the NSDI-PS was reviewed, and the system environment, implemented functions and data sharing status of the NSDI-PS in operation were understood.

Based on the functions requested for the NSDI-PS by NSDI-PPWG members through the activities of the NSDI-PP, the items to be incorporated in development of the full-scale version NSDI-PF and priority order were set, an explanation was made at the NSDI-WG meetings, and specifications (draft) were prepared as an attachment for the establishment of the full-scale version NSDI-PF.

And, three challenges which should be implemented within one year were designated, and suggestions were made for steps to tackle these challenges.

2.1.8. Geographic information standards

(1) Standardization of metadata and sharing of it with related organizations

A common data exchange rule is required in the NSDI framework to allow sharing of data, making it important to investigate how geospatial information is managed by each organization. Requests for the submission of census sheets which were implemented during the pilot project were made once more to all 23 organizations, and responses were received from 11 organizations.

Individual visits were made to 10 organizations together with the SoB technical team members, with a focus on organizations newly participating, and a survey on GIS data preparation procedures, metadata items, input methods and other issues was conducted.

A draft metadata guideline was prepared, taking into consideration the metadata items registered in the NSDI-PS, census sheet content and penetration of geographic information standards in Bangladesh.

(2) Standardization of quality control, data product specifications, and sharing of them with related organizations

The content related to the DPS and data quality management is indispensable to obtain a grasp of the data structure, accuracy and quality when geospatial information is used by an organization other than the organization that prepared the data.

The SOB prepares the 1:25,000 digital topographic map data definitions, and the Bangladesh Water Recourses Planning Organization (WARPO) prepares the product guidelines and data catalog for the National Water Resources Database (NWRD). These materials were obtained, and a draft data product specification and draft data quality guideline were prepared.

DPSs need to be prepared by the organizations that create and provide geospatial information, but due to the fact that it is currently difficult for each organization to independently prepare its own DPSs, a local consultant has been hired to assist with the creation of DPSs, and activities were started from the latter part of September 2020. Two technical staff were designated from the SoB to be in charge of DPS preparation support, and are conducting activities together with the local consultant. The JICA project team prepared basic draft guidelines and explanatory materials and provided prior guidance to the local consultant and SoB staff in the implementation of this DPS preparation support activity.

(3) Study and research on Geographic Information Standards

The Bangladesh Standards and Testing Institution (BSTI) is the representative of the International Organization for Standardization (ISO) in Bangladesh. The ISO has technical committees (TC) for each technical field, and ISO/TC211 is the dedicated committee for geographic information. TC member organizations are divided into P members (Participating members) which have voting rights concerning deliberation of standards, and O members (Observing members) which do not have voting rights. Since Bangladesh is not currently a member of this technical committee, the procedure for joining as an O-member was first investigated by the BSTI and it was found necessary to submit an official request to the BSTI from the SoB (which is considered suitable as the domestic deliberation committee).

2.1.9. Formulation and utilization of the NSDI platform

(1) Establishment of the NSDI platform

The functions lacking in the NSDI-PS and improvements that need to be made were

identified from the NSDI-PP evaluation report, discussions were held with the SoB technical team, functional requirements needed for full-scale version NSDI-PF were prepared, and an explanation was provided at the second NSDI-WG member meeting. After this, specifications (draft) for the full-scale version NSDI-PF development were prepared, and the specifications (draft) were finalized based on the opinions expressed by the SoB technical team.

The TAPP was approved in July 2020, and it is expected that the budget will be allocated to the SoB as a supplementary budget for fiscal year 2020. It was confirmed at the first JCC meeting that the budget is expected to be available from January 2021, and the SOB has declared an expression of interests (EOI) to recruit system engineers and programmers for the full-scale NSDI-PF. It is expected that the full-scale NSDI-PF development period will be 6 months after the contract is concluded.

(2) Development and publication of a metadata creation tool

The NSDI-PS has a function to register metadata, and registration is obligatory when data is uploaded. However, since only metadata can be registered with the NSDI-PS, improvements will be made to allow only registration of metadata when a full-scale NSDI-PF is established. In addition, the metadata items set for NSDI-PS were matched with the items defined in the metadata guidelines (draft), and the development of a tool capable of batch registration of Excel format and CSV format files as well as interactive registration on the Website were designated as functional requirements.

(3) Evaluation of utilization of the NSDI platform

The SoB base map (topographic map, orthophoto images, elevation models) is core content of the NSDI-PF, and the usage need from NSDI-WG members is the highest. Therefore, the SoB base map was loaded onto NSDI-PS for the period until the NSDI-PF is established. The data for the nationwide topographic map at a scale up to 1:25,000 was loaded onto the NSDI-PS, establishing an environment in which NSDI-WG members can utilize the data on the NSDI-PS. Since it was found that it would take an excessive amount of time to generate Web map tile data for release for the orthophoto images with existing SoB facilities, data generation equipment was provided, a manual was developed, and guidance was provided to SoB staff. The Web map tile data for release was completed at the end of October 2020. However, a publication on the NSDI-PF is in preparation. For digital elevation models (DEM), the original data is being produced by the SoB.

In order to promote the utilization of the NSDI within the NSDI-WG, the JICA project

team provided at the NSDI-WG members' meeting and the SoB technical team meeting a number of examples of the use of NSDI, such as the identification of the impact of river erosion on residents and damage to public facilities, and presented a proposal on how to provide information to prevent the spread of the COVID-19 pandemic, and a portion of the information and data collected was loaded onto the NSDI-PS.

2.1.10. Training in Japan

The first training period in Japan was implemented from Jan. 20 – 31, 2020 (with staff departing on Jan. 18 and returning on Feb. 2), in which 7 persons from 5 organizations participated, consisting of the MoD, SoB, Bangladesh Bureau of Statistics (BBS), WARPO and Bangladesh Water Development Board (BWDB).

The content of training consisted of diverse range, including the development of geospatial information by the national and local governments in Japan, utilization methods, approach to shared usage, current status and issues related to the NSDI of academic organizations in Japan, effectiveness of geospatial information for disaster prevention and during disasters, business model for the utilization of map information by private sector entities, navigation systems, up-to-date aerial triangulation technology, UAV operation experience and RTK-GNSS surveying.

At this point in time, the second training period in Japan is planned for September 2021 or after, and it is hoped that as many NSDI-WG members as possible will participate in the training to promote NSDI utilization.

2.1.11. NSDI workshop

A request was made by the Surveyor General of the SoB at the first NSDI-WG meeting for the holding of joint training (NSDI workshops) in Bangladesh for all stakeholders related to the NSDI. The first NSDI workshop was held on December 5, 2019, during which an explanation of the NSDI-PS concept was provided as well as the opportunity to experience operation, with a focus on new NSDI-WG members.

A total of three NSDI workshops are planned: NSDI-PS operation experience / DPS overview (1 day), data standardization measures (1 day), and a five-day workshop with the objective of teaching general knowledge related to the NSDI.

2.2. Summary of project outputs

The outputs from this project during the period from August 2019 to December 2020 are described in this section.

2.2.1. Input from Japanese side

Input from experts on the Japanese side is shown in Table 2-2. The assignment term of the chief advisor is until the end of July 2021, but the chief advisor temporarily returned to Japan on April 2, 2020 due to the impact of COVID-19. Web meetings have been used since June 2020 to proceed with work remotely from Japan together with other short-term experts.

Table 2-2 Experts input from Japanese side

No.	Name	Assignment	Assignment period
1	Mr. URABE Bokuro	Chief Advisor/Legislative Framework/Organizational Structure	From 1st August 2019 to 2nd April 2020 (7.07 MM) (Due to COVID-19 outbreak, it was returned to Japan temporarily on 2nd April 2020.)
2	Mr. FUJITA Hiroto	Team leader/NSDI system development (1)	(1): 24th Aug. 2019 to 13th Sep. 2019 (0.7 MM) (2): 19th Oct. 2019 to 31st Oct. 2019 (0.43 MM) (3): 27th Nov. 2019 to 10th Dec. 2019 (0.47 MM) (4): 12th Feb. 2020 to 28th Feb. 2020 (0.57 MM) Total: four times (2.17 MM)
3	Mr. HATORI Tomohiko	Standardization of spatial information	(1): 24th Aug. 2019 to 13 the Sep. 2019 (0.7 MM) (2): 27th Nov. 2019 to 16th Dec. 2020 (0.67 MM) (3): 8th Feb. 2020 to 28th Feb. 2020 (0.7 MM) Total: Tree times (2.07 MM)
4	Mr. KATO Yoshihiko	NSDI system development (2)/NSDI commercialization support	(1): 24th Aug. 2019 to 6th Sep. 2019 (0.47 MM) Total: One time (0.47 MM)
5	Mr. LAMSAL Damodar	Training (Geospatial information)	(1): 30th Nov. 2019 to 10th Dec. 2019 (0.37 MM) Total: One time (0.37 MM)

Source: The Project Team

2.2.2. First training in Japan

A list of the trainees that participated in the first training period is shown in Table 2-3. The original plan was for 9 trainees, but two trainees from the Local Government Engineering Department (LGED) and Ministry of Disaster Management and Relief (MoDMR) were unable to make the trip due to considerations in Bangladesh resulting in cancellation of the trip for them. The training schedule and syllabus are shown in Table 2-4.

Table 2-3 List of participants in "National Spatial Data Infrastructure (NSDI)" in Japan

No.	Name	Organization/Title
1	Ms. KHATUN Aklima	Deputy Director, Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division, SDG Cell
2	Mr. ISTIAK BHUIYAN Sifat Mohammed	Assistant Chief ,Planning Cell, Ministry of Defence (MoD)
3	Mr. ALAUDDIN	Draftsman Grade-1, Survey of Bangladesh (SoB)
4	Mr. PRAMANIK Mohammad Momin Hossain	Assistant Manager, Survey of Bangladesh (SoB)
5	Ms. AKHTAR Fahmida	Principal Scientific Officer, Computer and Information Section, Water Resources Planning Organization (WARPO)
6	Mr. PERVEZ Jakaria	Executive Engineer, haor project, Bangladesh Water Development Board (BWDB)
7	Mr. MOLLA Md Liaquat Hossain	Deputy Director, Survey of Bangladesh (SoB)

Source: The Project Team

Table 2-4 Program schedule and syllabus of the first training in Japan

Date	Program schedule	Contents/Syllabus	Location
19 Jan. 2019 (Sun.)	Arrived in Japan	-	Tsukuba
20 Jan. (Mon.)	10:00-12:00: 1) Briefing 14:10-14:30: 2) Courtesy call Director General, GSI 14:40-15:10: 3) Lecture "Overview of GSI" 15:20-16:20: 4) Lecture "NSDI act and promotion measures"	1) Learn about usage methods/lifestyle at JICA Tsukuba. 2) Obtain understanding of deep technical cooperation relationship with Bangladesh in mapping/ surveying field before training. 3) Learn overview of Geographical Survey Institute. 4) Learn overview of NSDI law in Japan and promotion policies for geospatial information.	GSI in Tsukuba
21 Jan. (Tue.)	9:30-10:00: 5) Lecture "Introduction of Geodetic Observation Center" 10:10-11:40: 6) Lecture "Overview of GNSS base control station" 13:10-14:10: 7) Lecture "Provision of GEONET products" 14:20-15:20: 8) Site tour of GNSS CORS station 15:30-16:00: 9) Visit the Science Museum of Map and Survey	5) Learn overview of work at geodetic observation center, GNSS CORS (GEONET) and tide-gauge station. 6) Learn about case studies for GNSS base control stations, their structure and maintenance system. 7) Learn about data delivery structure in GEONET. 8) Site tour of a system related to GNSS CORS station for understanding of GEONET operation conditions. 9) Visit Science Museum of Map and Survey, enhancing understanding of history of mapping/surveying and new principles/structure/new technology.	GSI in Tsukuba

Date	Program schedule	Contents/Syllabus	Location
1/22 (Wed.)	9:30-10:10: 10) Lecture "Digital Japan Basic Map" 10:20-11:50: 11) Lecture "Web technology of GSI Maps" 13:10-13:50: 12) Lecture "UAV case study in GSI" 14:00-14:50: 13) Lecture "Operational plan for disaster prevention" 15:00-15:30: 14) Site tour of the seismic isolation facility	10) Learn about preparation, updating methods and case studies for Digital Japan Basic Map. 11) Learn about Web provision technology (tile usage technology) and case studies at Geographical Survey Institute. 12) Learn about UAV basic technology and UAV case studies at Geographical Survey Institute. 13) Learn about approach to disaster response and disaster prevention using survey technology and geospatial information. 14) Tour of seismic isolation facility at head office of Geographical Survey Institute.	GSI in Tsukuba
1/23 (Thu.)	10:30-12:00: 15) Lecture "Introduction of efforts to improve geospatial information infrastructure, National Land Numerical Information download service, etc." by MLIT 13:30-15:00: 16) Lecture "Statistic GIS-Small Area Analysis by Map (jSTAT MAP)" by MIC 16:00-17:00: 17) Courtesy call JICA HQ	15) Learn about National Land Numerical Information download service provided free of charge based on NSDI law, indoor positioning technology and land use maps. 16) Learn overview of "e-Stat" which allows batch browsing of statistics for various government agencies and "jSTAT MAP" which realizes statistic GIS functions. 17) Explanation of approach to NSDI in Bangladesh at JICA headquarters, and how this training will be used in activities in the future.	MLIT, MIC and JICA HQ in Tokyo
24 Jan. (Fri.)	10:00-11:30: 18) Lecture "NSDI in Japan –Progresses and issues-" by Professor MURAKAMI 13:00-14:00: 19) Lecture "Introduction of latest web technologies" by ONE COMPATH Co., Ltd. 14:00-15:00: 20) Lecture "Overview of vector tiles" by ONE COMPATH Co., Ltd. 15:00-16:30: 21) Lecture "Overview of Increment P Corporation", "Introduction of car navigation system" and "How to utilize QGIS for updating database in Increment P".	18) Learn about history of NSDI in Japan, current status and issues, trends for geospatial information technology and geographical information standards. 19) Learn about IT company business model which uses map information as pillar of income. 20) Learn about use of map tile vector tile structure. 21) Learn overview of car navigation and map updating methods using open source software QGIS.	Increment P Corp. in Tokyo
25 Jan. (Sat.)	*Holyday*		Tokyo
26 Jan. (Sun.)	*Travel from Tokyo to Fukuoka.*		Fukuoka

Date	Program schedule	Contents/Syllabus	Location
27 Jan. (Mon.)	10:00-12:00: 22) Lecture "Disaster management system for local municipals utilized geospatial information " by Professor MITANI 13:00-15:00: 23) Practical training of GIS software using by ArcGIS.	22) Learn about approach to disaster prevention / mitigation by local governments using geospatial information and details of geospatial information portal activity in Kyushu. 23) Learn about basic operation methods on ArcGIS Desktop, as well as simple methodology for data analysis.	Kyusyu University in Fukuoka
28 Jan. (Tue.)	9:30-11:20: 24) Lecture "Case study of utilization and cooperation of geospatial information by wide-area administrative organizations"	24) Learn about cases of shared GIS (G-motty) in northern Fukuoka prefecture and approach to joint procurement.	Kita-Kyusyu City in Fukuoka and Hiroshima
29 Jan. (Wed.)	10:00-11:30: 25) Site tour of GIS utilization for government business and lecture "Case study of sharing geospatial information between government organization and utility service firms" 13:15-14:30: 26) Site tour of aerial photogrammetry equipment and aircraft and lecture "Latest aerial photogrammetry technologies" by Asia Air Survey Co., Ltd. 15:30-16:10: 27) Lecture "Introduction of Osaka GIS Public-Private Council"	25) Learn about cases of GIS data sharing among the public and private sectors (infrastructure providers), mainly road administrators in local governments. 26) Learn about aircraft and photographing equipment (digital cameras, LiDAR) used for aerial photogrammetry while observing actual equipment. 27) Learn about activities implemented by Osaka GIS Public-Private Council.	Kadoma City, Yao airport and Osaka Prefecture in Osaka
30 Jan (Thu.)	9:30-10:15: Visit the Great Hanshin-Awaji Earthquake memorial museum 10:30-11:40:28) Lecture "What geo-spatial information and GIS can contribute to disaster reduction" by Associate Professor URAKAWA. 11:40-12:30 、 13:30-15:30: 29) Workshop and practical training of creation thematic layer using by cloud service by ESRI Japan Corporation.	28) Learn how geospatial information and GIS can be used for disaster prevention and rebuilding from case studies for Great Hanshin-Awaji Earthquake and Chuetsu-Oki Earthquake. 29) Practical training where trainees use their PCs and Smart Phones for field survey applications with commercial cloud services.	Kobe

Date	Program schedule	Contents/Syllabus	Location
31 Jan. (Fri.)	9:30-10:30:30) Lecture "Overview of UAV" and demonstration of drone flight by KM Sangyo Co., Ltd. 10:35-11:05: 31) Lecture "Introduction of utilization of 3D model by UAV" by FUKUI Computer Co., Ltd. 11:10-12:00: 32) Lecture "Introduction of utilization of GNSS-RTK survey" and practical training of GNSS-RTK survey by i System Research Corporation. 15:00-17:00: 33) Evaluation meeting and certificate.	30) Learn overview of UAV and photographing plans, control point plans, data acquisition methods, and have operation experience with actual drone. 31) Learn about software for UAV image processing and examples of 3D data utilization by survey-related manufacturers. 32) Learn about high precision coordinate determination and mapping techniques by RTK-GNSS development companies using RTK-GNSS through lecture and practical training. 33) Seven trainees will be divided into two groups, and based on this training trainees will present what kind of activities they can implement to establish NSDI in their own organizations.	Osaka and Kobe
2/1 (Sat.)	*Departure from Japan*	-	-

Source: The Project Team

2.2.3. Input equipment

The input equipment is shown in Table 2-5. The base map Web map tile generation PCs consists of equipment which was not envisioned in the original plan, but it was clarified by the results of the NSDI-PP evaluation review that it would take an extremely long amount of time to generate orthophoto image Web map tiles with the existing equipment at the SoB, leading to the decision to input equipment to facilitate sharing of this data on the NSDI-PS and NSDI-PF at an early point in time.

Table 2-5 Equipment list

Item	Plan	Progress	Location
IT equipment	Equipment for generating SoB base map web map tiles: - PC workstation 3 sets - UPS 3 sets - Microsoft Office Professional 3 licenses	Complete	Geoportal room in Digital Mapping Centre (DMC)
Other	A4 all-in-one printer	Complete	JICA project office in SoB Tejgaon office.

Source: The Project Team

2.2.4. Input from Bangladesh side

The input status on the Bangladesh side is shown in Table 2-6. Since the TAPP was approved on July 20, 2020 for the expenses for the development, utilization and operation of the NSDI-PF, these expenses will be budgeted from this point in time.

Table 2-6 Input of the Bangladesh side

No.	Plan	Progress
1	Assignment of Project Director Assignment of Project Manger Formulation of NSDI Project Cell	Completed Completed Formed. Consists of Administration Team (Seven members) and Technical Team (15 members)
2	Project office and ancillary facilities	Done
3	Miscellaneous (Water, electricity, etc.)	Done
4	Expenses related to the development, utilization, operation and maintenance for the NSDI platform	TAPP has approved on July 20, 2020. It will be allocated to the supplementary budget near future.
5	Security measures	SoB staff members have accompanied with JICA project team on traveling in/out of Dhaka as appropriate.
6	Formulation of NSDI Technical Team	Formed. After approval of TAPP, it was taken over by the NSDI Project Cell.

Source: The Project Team

2.2.5. Project overall goal and indicators

The purposes, indicators (means of verification) and levels of achievement of the Project are shown in Table 2-7.

Table 2-7 Purpose, means of verification and achievement of the Project

Purpose of the Project	Means of verification	Achievement
To enhance the NSDI capacity of SoB and related organizations	Increased number of NSDI data which shared among related organizations. 1. Information of the registered data of the NSDI platform 2. Monitoring and analyzing the access log of the NSDI platform.	Establishment of the NSDI-PF has not started due to a delay in the approval of the TAPP. However, efforts are being implemented in order to strengthen utilization capabilities using the NSDI-PS that was created with NSDI-PP. 1. The SoB base map has been loaded onto the NSDI-PS. Data that has been collected during countermeasure consideration using COVID-19 geographical information was loaded. 2. Utilization status from the log is unknown since the NSDI-PS does not have a function to acquire an access log. However, log acquisition has been added to the requested specifications for the full-scale NSDI-PF.

Source: The Project Team

2.2.6. Project outputs and indicators

The project outputs, indicators and levels of achievement are shown in Table 2-8.

Table 2-8 Outputs, indicators and achievement of each activity

Outputs	Indicators	Achievement
1. Concept and merit of NSDI are understood by related organizations. 2. Institutional Framework for the NSDI development and utilization is strengthened.	Establish and hold the WG, JCC, SC and other NSDI related workshops.	The first JCC meeting was held after the TAPP was approved. NSDI-WG member meetings have been held a total of four times, deepening the understanding of the participants in the NSDI concept, geographical information standards, NSDI-PF establishment and NSDI utilization. Workshops related to the NSDI have been held as explanatory meetings of NSDI-PS operation with a focus on organizations who are newly participating in the NSDI-WG.
3. NSDI common rules are established based on Geographic Information Standards.	Development and sharing of the NSDI common rules.	Census sheets, product specifications and other data on geospatial information possessed by each organization from NSDI-WG members were obtained, and three draft guidelines were prepared: draft metadata guidelines, draft quality control guidelines, and draft data product specifications.
4. NSDI platform is formulated and utilized.	Establishment and utilization of the NSDI platform. 1. Information of the registered data of the NSDI platform. 2. Monitoring and analyzing the access log of the NSDI platform. 3. Questionnaire Survey for utilization of the NSDI. 4. Best practices of the utilizations.	Establishment of the full-scale version NSDI-PF has not started, but the functional requirements have been organized based on the NSDI-PP evaluation report, and a draft TOR for development was prepared. 1. Data concerning medical institutions that can accept COVID-19 patients and diagrams of coastline variation due to river erosion were loaded onto the NSDI-PS as part of the SoB base map and as examples of utilization. 2. This is unknown since an NSDI-PS access log is not being acquired. Plans call for a function to be added to the NSDI-PF that is capable of verifying an access log. 3. Questionnaire surveys will be conducted among participants at NSDI workshops. Plans call for questionnaire surveys to be conducted in the future concerning utilization during establishment of the full-scale version NSDI-PF. 4. Multiple examples of utilization have been introduced at NSDI-WG member meetings. The BWDB, which handles a large volume of geospatial information for its work, has begun discussions to see if it can make an example of using NSDI.

Source: The Project Team

2.2.7. PDM updates

The PDM has not been revised as of December 2020. However, the work schedule which

comprises the activity period until June 2022 is being reviewed due to the impact of the spreading of the COVID-19 pandemic and delay in the approval of the TAPP. The R/D will be changed, and the PDM Planning of Operation (PO) will be updated.

In addition, the two monitoring sheets which compile the status of project progress (Ver. 1: March 2020, Ver. 2: November 2020) have been submitted to the JICA Bangladesh office.

CHAPTER 3. Environment surrounding the establishment and promotion of the NSDI

3.1. Legal system relevant to the NSDI

The legal system relevant to the NSDI in Bangladesh consists of the operational regulations of the Ministry of Defence (MoD) which prescribe the work content of the SoB, the acts that stipulate the handling of geospatial information possessed by the SoB, and the Survey Act which stipulates the implementation of cadastral surveys performed by the Department of Land Records and Surveys (DLRS). However, since there is no legal system that stipulates establishment / operation of an NSDI, the SoB is implementing activities to establish a new Survey Act and formulate NSDI policy.

3.1.1. Operational regulations of the Ministry of Defence

The content of work by the SoB which is the organization that performs national surveys and prepares maps is prescribed in the operational regulations of the Ministry of Defence (MoD). These regulations originated under martial law when General Ershad was in power, and were enacted in 1982. The role of the SoB is to prepare and maintain topographical maps and other types of maps for use by the MoD and other organizations in national projects. The main functions of the SoB are described in Table 3-1.

Table 3-1 Main functions of the SoB (Extracts)

No.	Main functions	Summary
1	Trigonometrical and geodetic control survey	- Establishment of Geodetic Control Points with construction of station and determination of value in a network over the country. - Maintenance of triangulation stations. - High precision levelling with construction of Bench Marks.
2	Topographical survey	- 1:25,000 scale topographical map of Hilly districts. - 1:50,000 scale topographical map. - Compilation of 1:250,000 maps from 1:50,000 sheets. - Re-printing of above maps to replenish the stock position occasionally.
3	1/M and 1:500,000 series map	- 1/M maps and 1:500,000 maps covering Bangladesh and surrounding countries are compiled, fair drawn and printed with occasional reprinting to maintain the stock.
4	Boundary demarcation	- Demarcation of international boundary lying in deferent Hilly areas.
5	Geographical/ political maps	- Political maps on 1:500,000 scale are prepared and maintained for government departments.

No.	Main functions	Summary
6	Large scale contour survey	- National development projects in flood control, power development, water development, irrigation, town planning, airport, communications, tele-communications, etc. are prepared and printed by this department for government and Non-government organizations.
7	Special maps	- Special maps for different government departments like geological survey, soil survey etc. are prepared and printed for requirement of those department.
8	Aerial photographs	- Control of aerial photography in Bangladesh; processing, development, printing, of air-photographs; maintenance and custodian of all air-photographic negatives under the control of Surveyor General.

Source: SoB (http://www.sob.gov.bd/site/page/b90704d1-b45a-4f15-914b-c9fe980f7eaa/-)

3.1.2. Acts related to geospatial information of SoB

The geospatial information that is possessed by the SoB is prescribed and strictly managed by two ordinances under the jurisdiction of the MoD: Ordinance on classification, provision, and management of maps (1972) and Ordinance on classification, provision, and management of aerial photos. (Year enacted unknown). Due to the fact that proceedings for the enactment of the new act to promote the opening up of geospatial information have not been completed at this point in time, these ordinances remain in effect. An overview of the ordinances is shown in Table 3-2.

Table 3-2 Overview of acts related to geospatial information in Bangladesh

Acts	Summary
Ordinance on classification, provision, and management of maps (1972)	• Four types of maps according to level of secrecy (top secret, secret, restricted, public) • Maps which indicate logistic route facilities, airports, armories, important power stations/substations, important waterworks facilities, petroleum refiners, railway workshops, wharves for petroleum/explosives, gas tanks, aircraft plants/research institutes, grain warehouses, pharmaceutical/chemical warehouses, jute processing plants, signal buoys or other such features will not become public maps. • Maps with a scale larger than 1:250,000 will not be classified as public maps. However, city guide maps and special large-scale maps can be deemed to be public maps with the approval of the MoD. • Private sector companies cannot publish maps with a scale larger than 1:1,000,000. • Text indicating restricted status (e.g. “Restricted”) must be displayed in a conspicuous location on the map in block letters. • Restricted maps can only be used for public purposes. • Maps other than public maps and maps with a scale of 1:250,000 or larger require the advance approval of the MoD in order to export them.

Acts	Summary
Ordinance on classification, provision, and management of aerial photos. (Year enacted unknown)	• Only applied to aerial photos that are managed/supplied by the SoB for purposes other than military. • Classified aerial photos consist of secret aerial photos or restricted aerial photos. • It is a classified aerial photograph if it shows logistic route facilities, weapon/gun carriage plants, aircraft plants/repair shops/parking facilities, all ports, naval facilities, all MoD facilities, power stations, substations, important waterworks facilities, petroleum refiners, railway workshops, gas tanks, pharmaceutical/chemical warehouses, jute processing plants, signal buoys or other such features. • Aerial photos of national boundary areas are classified aerial photos. • The Surveyor General of the SoB is the custodian of all aerial photos on behalf of the government of Bangladesh. • As a general rule, classified aerial photos can only be used for public purposes. • Aerial photos cannot be exported without special approval.

Source: Completion report (TAKAZAWA 2005)

However, due to the fact that the 1:5,000 scale topographic maps of the Dhaka metropolitan area, the 1:25,000 scale topographic maps of the entire country developed under the IDMS project, the 1:5,000 scale topographic maps for the five major cities and other such maps have a high level of communality, these maps and data can be purchased by those who wish to purchase them by submitting an application specifying the usage objective, data range, type of data and other details to the Surveyor General of the SoB and having it approved. The practical handling of the geospatial information possessed by the SoB at the current point in time is shown in Table 3-3.

Table 3-3 Current status of handling geospatial information by SoB

Geospatial information		Type	Handling status
Topographic maps	1:5,000	Open series and restricted maps	Open series maps are available for purchase as printed maps, PDF, and digital data.
	1:25,000	Open series and restricted maps	Open series maps are available for purchase as printed maps, PDF, and digital data.
	1:50,000	Restricted maps	With restrictions
Compilation maps	1:250,000	Restricted maps	With restrictions
	1:500,000	Restricted maps	With restrictions
	1:1,000,000	Open series maps	With restrictions
Orhtophoto	1:5,000	Unknown	Unknown. Aerial photos are permitted depending on the purpose of use.
	1:25,000	Unknown	Unknown. Aerial photos are permitted depending on the purpose of use.
DEM		Unknown	Unknown
Control point data		Open data	Available for purchase

Source: Final report of the Project for strengthen on capacity on advanced mapping of SoB for building digital Bangladesh (Making the roadmap to establishing NSDI)

3.1.3. Survey Act

The Survey Act (1875) in Bangladesh determines that cadastral surveys are to be implemented by the Department of Land Records and Surveys (DLRS). Accordingly, differing from the Survey Act of Japan, it does not regulate geodetic or topographical surveying.

Cadastral maps have been prepared for the entire country in the scale and land register area (Mouza) unit shown in Table 3-4. Cadastral maps can be purchased by anyone, and are widely used as a source map for editing various basic maps, such as the Upazila Map (district maps) produced by LGEDs. In addition, the administrative boundaries and place names listed in cadastral maps are in effect the standard in Bangladesh. However, while cadastral maps are prepared by means of polygonal / plane-table surveying based on cadastral map root points, the accuracy of positioning information is not necessarily high due to factors such as low field survey precision, and the lack of longitude/latitude and coordinate values on maps. Consequently, a number of problems emerge when attempting to edit cadastral maps as they are, such as the boundaries between cadastral maps not connecting.

Table 3-4 List of Mouza maps and compilation maps

No.	Type	Area classification	Scale
1	Mouza maps	Urban area	1:792 (80 inch 1 mile)
2		Regional city area	1:990 (64 inch 1 mile)
3		Settlement density area	1:1,980 (32 inch 1 mile)
4		Other	1:3,960 (16 inch 1 mile)
5	Compilation maps	Thana map	1:63,360 (1 inch 1 mile)
6		District map	1:253,440 (1 inch 4 mile)
7		National map	1:506,880 (1 inch 8 mile)
8		National administrative map	1:1,013,760 (1 inch 16 mile)
9		City map (Dhaka City and Chattogram City)	1:31,680 (2 inch 1 mile)

Source: Completion report (TAKAZAWA 2005)

3.1.4. Status of enactment of New Survey Act and formulation of NSDI policy

Following the statement by Prime Minister Hasina stating “The MoD needs to take the necessary measures to enact a law concerning the implementation of the NSDI in Bangladesh” at the NSDI international seminar that was held in May 2016, the SoB has conducted activities to enact the new Survey Act and NSDI Act to facilitate the establishment and operation of the NSDI.

The new Survey Act was submitted by the MoD to the office of the Prime Minister, and it is expected that it will be submitted to the cabinet and parliament following coordination by the MoD and related ministries and agencies.

On the other hand, it is expected that procedures to enact a law such as coordination between the office of the Prime Minister and related organizations, and deliberation by the cabinet and parliament, would require a period of 3 – 5 years.

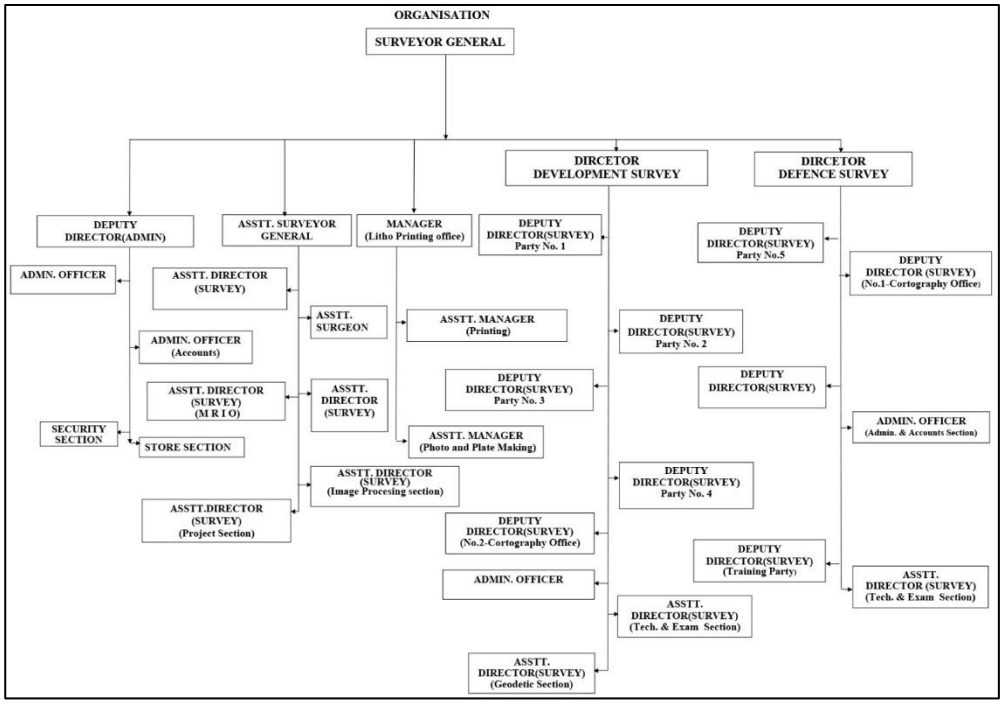
The SoB prepared a draft of the NSDI Act, and it was being considered within the MoD, but a change has been made to draw up an NSDI policy instead of the NSDI Act as a means to accelerate preparations for the establishment of the NSDI. A policy does not have the penal provisions prescribed in an act, but it has a similar level of force, and is effective for related organizations.

As of December 2020, the SoB has prepared a draft of NSDI policy, circular consultation is being performed by the MoD with 57 organizations, and responses have been received from 23 organizations. The draft NSDI policy indicates prevention of duplicate investment and uniformity of standards for geospatial information produced in Bangladesh, sharing of information on a national geoportal and mutual use among users, and roles of the executive committees and technical committees.

3.2. Organizational structure of the SoB

The organizational structure of the SoB consists of the Surveyor General of Bangladesh at the top, three managers under the direct control of the Surveyor General (Deputy Director of Administration, Assistant Surveyor General and Manager of Printing), and two directors under the Surveyor General (Director of Defence Survey and Director of Development Survey). An organogram of the SoB is shown in Figure 3-1. This organizational structure is based on the provisions of the document issued under martial law at the same time as the operational regulations of the Ministry of Defence described in section 3.1.1. Therefore, the SoB is flexibly responding on a project basis although it may not necessarily correspond to the new social structural and technical system brought about by current geospatial information.

The NSDI Project Cell was formed in September 2020 as the department in charge of establishment / promotion of the NSDI after approval of the TAPP in July 2020. The NSDI Project Cell has a total of 22 staff, consisting of an Administration Team (7 staff, including Project Director and Project Manager) and a Technical Team (15 staff).



Source: SoB

Figure 3-1 Organogram of SoB

3.3. Status of preparation of SoB base map

Geospatial information is the foundation of the NSDI, and topographic maps, orthophoto images, and DEMs that are prepared / managed by the SoB are indispensable for the national geoportal base map which is a constituent element of the NSDI.

3.3.1. Topographic maps and compilation maps

The topographic maps developed by the SoB are created based on a uniform national standard for which the accuracy is guaranteed. Japanese Debt Relief Grant Assistance-Counterpart Funds were used for the 1:25,000 scale topographic maps prepared between 2013 and 2018 based on the aerial photos taken in 2012, and were completed for the entire country at the end of 2018. In addition, the 1:5,000 scale topographic maps have been created for the six major cities of Dhaka, Sylhet, Rajshahi, Khulna, Barisal and Chittagong.

The topographic maps for the capital of Dhaka was created in 2004 based on the aerial photos taken in 2002, but the maps for the other five cities were developed based on the aerial photos taken in 2012 in the same manner as for the 1:25,000 scale maps. There has been significant change over the years due to economic development and the continued urbanization of Dhaka, resulting in extensive divergence from the current conditions for the topographic maps that was developed 16 years ago. Therefore, the SoB purchased multiple UAVs in 2020 which are capable of performing LiDAR measurements and photogrammetry in order to create a large-scale topographic map for Dhaka and the surrounding area. This equipment will be used hereafter to take up-to-date aerial photographs and make LiDAR measurements of Dhaka and the surrounding area, and it is expected that the digital stereo plotting equipment provided by the IDMS project will be used by the abundant technical staff within SoB who developed map compilation capabilities during the Bangladesh digital mapping assistance project (BDMAP) provided as technical assistance from Japan to create up-to-date new topographic maps. Furthermore, compilation maps (1:250,000, 1:500,000, 1:1,000,000) which cover the entire country are being developed from 1:50,000 medium scale topographic maps.

The topographic maps and compilation maps have been used to complete Web map tiles in raster format, this tile data has been loaded onto the NSDI-PS, and can be utilized by NSDI-WG members as a base map on the NSDI-PS (excluding 1:5,000 scale topographic maps).

3.3.2. Ortho photo image

Othophotos which cover the entire country of Bangladesh have been developed with a ground resolution of 50cm using the aerial photos taken in 2012. However, since aerial photos cannot be taken near the borders, pixelization (or mosaic processing) was performed using satellite images. Raster format Web map tile images are being generated based on orthophoto data for the entire country in order to use it on the NSDI-PS and the national geoportal.

3.3.3. DEM

The aerial photos taken in 2012 and other data is being used to develop DEMs by means of photogrammetry. Digital Surface Models (DSM) are being automatically generated using aerial triangulation with a DEM interval of 5m, and digital stereo plotters are being used after this to implement work to change the height of buildings, trees and other elevation control points on the ground. As of December 2020, approximately 50 sheets out of the 988 map sheets for the 1:25,000 scale topographic map have been completed.

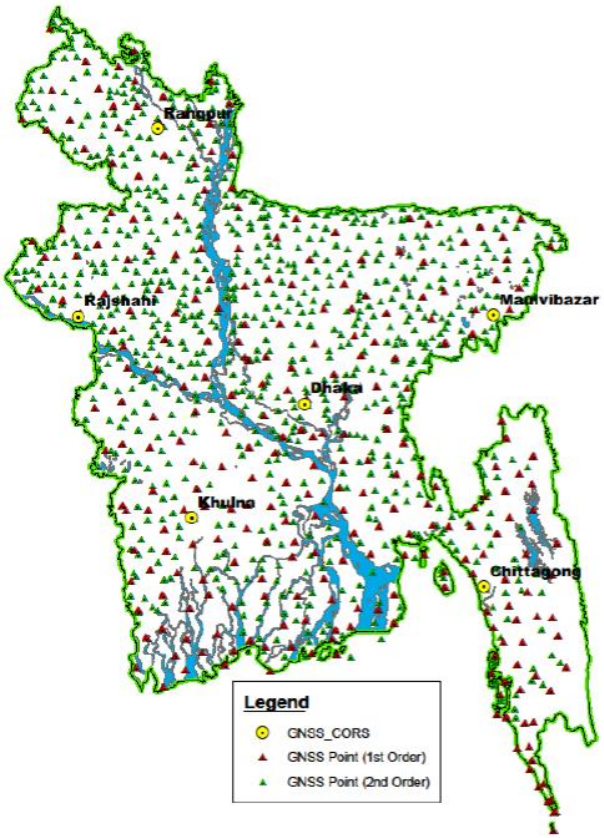
3.3.4. Ground control point

The SoB began development of the geodetic network which is the foundation for surveying / topographic mapping with technical assistance from Japan which started in the early part of the 1990s. As of this point in time, first order and second order GNSS points, and first class and second class leveling points have been created for all areas in Bangladesh, amounting to more than 4,000 points (Table 3-5, Figure 3-2). In addition, prior to the implementation of the IDMS project, the project "Short Term Consulting Services On Surveying and Mapping" was conducted to develop a concrete plan for the IDMS project, and a report (Total Design Document) was prepared in July 2008. This document proposed that 6 GNSS CORSs be developed, and this was performed by the SoB during the IDMS project in June 2011.

Table 3-5 Status of GCP, leveling points and CORS in Bangladesh

Type	Grade	Number of points
Ground control point	First order GNSS points (X, Y)	260 points
	Second order GNSS points (X、Y)	817 points
	3D control points (X、Y、Z)	788 points
Leveling point	First class leveling points	662 points
	Second class leveling points	1,544 points
GNSS CORS	Installed in six capitals. Distance of approximately 150km between points.	6 points

Source: SoB



Source: SoB

Figure 3-2 Location map of GNSS CORSs and GCPs (1st Order and 2nd Order)

These ground control points are managed by the SoB, and are provided to users at a charge based on the submission of an application by the user specifying the ground control point to be used, output content and usage objective. In the past, users needed to go to the SoB building in Dhaka, but Websites have been established which enable ground control point output to be purchased online, reflecting the approach to enhance the convenience of users.

A national network of GNSS CORS is being developed with grant aid from Japan, and "The Project for the Densification of Global Navigation Satellite System Continuously Operating Reference Station Network and Modernization of Tidal Stations" is being implemented to install GNSS CORSs at a distance between points of approximately 40km to guarantee accuracy.

3.4. Current situation of web services of the SoB

As mentioned in section 3.3.4, the SoB has established a number of websites which enable ground control point a .;; nd topographic map data to be provided online to enhance the convenience of users. These include a website to confirm the location of geodetic control points, a 1:25,000 scale Map Index website, a website that allows the operating status of GNSS CORSs to be checked, and a website that allows ground control point and topographic map data to be purchased. The main objective of each website is described in Table 3-6.

Table 3-6 Overviews of websites published by SoB

Web site name	Overview
SoB Continuously Operating Reference Station (CORS)	Website where you can check the locations and operational status of the six GNSS CORSs that have been in operation since December 2011. Those who wish to use GNSS CORS data can apply to the SoB, and after permission is granted, they can obtain GNSS CORS observation data from this site by paying an amount corresponding to the scope of use.
Geodetic Control Points	Website which allows verification of the installed location of first order and second order GNSS points, 3D control points, and first class and second class leveling points which are developed by the SoB.
SoB Map Index 1:25,000	Website which allows sheet index of 1:25,000 scale topographic maps to be confirmed. Users who wish to purchase a 1:25,000 scale topographic map can find the desired drawing number on this website.
SoB Online Data Services	Website which allows geographic information provided to external parties by the SoB to be purchased online. Online banking is used as the payment method. A Bangladesh citizen ID is required for user registration.

Source: The Project Team

3.5. Road map for establishing the NSDI (draft version)

In the previous project, a road map for establishing the NSDI (draft version) was prepared in order to contribute to the achievement of the "Digital Bangladesh" policy to boost information and communications technology (ICT) throughout the country. The road map (draft) defines 45 activities in 6 fields. The overall period for these activities has been set until 2031 which is the last year of the 9th 5-year plan, and was divided into three periods. The first period is the base formation period (July 2018 to June 2021), the second period is the dissemination period (July 2021 to June 2026: 8th 5-year plan), and the third period is the operation period (July 2026 to June 2031: 9th 5-year plan).

This project mainly provides support for 16 activities in 5 fields out of the 45 activities in 6 fields defined in the road map (draft), excluding the geospatial information activities that can be independently implemented by the SoB (Table 3-7).

Table 3-7 List of activities of the road map for establishing NSDI

Classification	No.	Activity content (draft)
Legal framework	1.1	Establishment and promulgation of NSDI Act and new Survey Act, establishment and promulgation of their rules
	1.2	Short-term, mid-term and long-term planning for NSDI establishment and operation
	1.3	Discussion and formulation of government data policy
	1.4	Formulation of guidelines (protection of personal information, promotion of secondary use <correspondence to copyright>, consideration of national security <inc. KPI> and so on)
	1.5	Formulation of action plan of ministries and agencies utilizing geospatial information and satellite positioning and implementation
	1.6	Incorporation into the Digital Bangladesh and the eighth five-year plan, cooperation with other policies such as open data and so on
NSDI promotion structure	2.1	Establishment of NSDI Committee (3 levels) and holding (once a year)
	2.2	Establishment of Working group and Secretariat office (SoB + PMO), (Including NSDI Contributor meeting)
	2.3	Formulation of operation method of committee and working group bodies (covering methods of decision and reporting)
	2.4	Enhancement of the functions of the secretariat (ability to investigation, organize and solve for issues of discussion, coordination of the committee or working group, and so on)
	2.5	Setting for issues to be considered by the working group, and substantive discussion
	2.6	Establishment of collaborative system among industry, academia and government, and hold council (once a year)
Geographic information standards	3.1	Establishment of domestic deliberation organization (national committee) (summary of national opinion)
	3.2	Study and research on geographic information standards (government + private + university + etc.)
	3.3	Standardization of metadata, domestic standardization, implementation of preparation and publication
	3.4	Standardization of method of quality evaluation, data content, product specification, and domestic standardization
	3.5	Creation of product specifications of fundamental geospatial information
	3.6	Participation in ISO/TC211 and attendance at the general meeting
	3.7	Creation of domestic standard (profile) of geographic information standard
	3.8	Formulation and implementation of promotion plan of geographic information standard
Geospatial information	4.1	Definition of the fundamental geospatial information, specifications, formulation of update plan (horizontal position standard, and so on), and demonstration
	4.2	Demonstration of creation/update of thematic data (including data identification, collection and determination)
	4.3	Promotion of digitization of various geospatial information (including old topographic map), examination of coordinate transformation, and demonstration
	4.4	Promotion of collection and digitalization of aerial photographs and satellite images
	4.5	Create and update the national digital topographic map (1:25,000)
	4.6	Update of Dhaka City digital topographic map (1:5,000), or creating 1:2,500 topographic map
	4.7	Formulation of digital topographic map development plan (1:5,000) in other local cities, and implementation
	4.8	Extension of CORS and tidal observation station (grand aid), formulation of maintenance plan
	4.9	Accuracy evaluation of RTK-GNSS survey using CORS in Dhaka City

Classification	No.	Activity content (draft)
	4.10	Demonstration of creation of geospatial information of utility facilities (water supply, sewer, gas, electricity and so on) in Dhaka City
IT service/IT system	5.1	Construction and organization of NSDI platform including clearing house function (including SoB Geo-Portal)
	5.2	Development and publication of metadata creation tool
	5.3	Study of IT service/system (function requirement) to promote sharing, exchange, distribution of geospatial information, and demonstration
	5.4	Construction and demonstration of administrative information (statistics, disaster prevention, land, environment, and so on) provision system (cooperation with Open Data)
	5.5	Improvement of application method of utilization (acquisition) of digital topographic map of SoB
	5.6	Development and demonstration of model system for local government (cooperation with LGED)
	5.7	Improvement of GIS and open source software development capabilities (This refers to "GSI Map Partner Network" and conduct mainly on private enterprises) → also related to creation of new industries
	5.8	Demonstration and promotion of utilization of open GIS software
	5.9	Examination of publication method of reference point including CORS and construction of observation information (CORS) distribution system
Human resources development /Technology development /Promotion/ New industry creation	6.1	Introduction of new technology (3 dimensional, satellite positioning, MMS, drone and so on) based with the needs, and study and research
	6.2	Examination of human resource development methods including other ministries concerning GIS, and implementation (collaboration with universities, and so on)
	6.3	Dissemination of GIS into the work of government agencies (especially consideration of budgetary measures and support for local governments)
	6.4	Attendance and presentation to international conference or seminar on NSDI or geospatial information
	6.5	Holding domestic seminars and workshops on NSDI
	6.6	Consideration of creation of new services and industries using GIS and satellite positioning

※ Highlighted in blue mean items that support activities in this project

Source: Final report of the Project for strengthen on capacity on advanced mapping of SoB for building digital Bangladesh (Making the roadmap to establishing NSDI)

3.6. NSDI pilot project

During the previous project from August 2017 to July 2019, the NSDI-PPWG was formed in which organizations related to the NSDI participate, the small-scale NSDI-PS was developed, and an experimental project was implemented to verify the NSDI concept, functional requirements, activity methods and effect in preparation for establishment of a Bangladesh version NSDI (Table 3-8).

There were 5 participating organizations when NSDI-PP started, but 12 organizations were added after this as activities continued to expand the scope to include many organizations which use geospatial information, for a total of 17 organizations. These

results were compiled in the evaluation report. An overview of the NSDI-PP is shown below.

Table 3-8 Overview of the NSDI-PP

Item	Overview
Objective	- Verify a concept, utilization and effect of NSDI using by NSDI-PS. - Organize necessity functional requirements for NSDI platform in Bangladesh (system configuration, software, functions, and security measures). - Clarify operating rules and responsibilities of each organization.
Organizations	- Start: Five organizations (SoB, BCC, LGED, DLRS, and DWASA) - Add: 12 organizations (DSCC, DNCC, BBS, BIWTA, BWDB, DDM, WARPO, BTRC, BMD, and SPARSSO)
Specifications of NSDI prototype system	• All developed with open source software. • Application and database established at national data center for BCC, and delivered over the internet. SoB base map is delivered from Digital Mapping Center (DMC) server. • Can only be used by NSDI-PP member registered users. • Target area: Dhaka and Sylhet • Data: SoB base map and theme map data for participating organizations (126 layers) loaded.
Outputs	• SoB base maps (1:50,000 – 1:1,000,000) have been released. • Lists of projects conducted by various organizations using geospatial information were collected. • An example of utilization of the NSDI-PS modeled after the LGED project was discussed. • An evaluation report detailing the activities has been prepared.

Source: Evaluation report of NSDI pilot project

3.7. Status of preparation of geospatial information of other organizations

A number of government organizations in Bangladesh develop geospatial information required for operation of their organization and release it to the general public on a website under the Digital Bangladesh policy (Table 3-9). The BCC, with the support of the World Bank, operates the GeoDASH geoportal website in order to share geospatial information with the Department of Disaster Management (DDM) under the Ministry of Disaster Management and Relief. The BBS established the Bangladesh GIS Portal (BGISP) with the objective of consolidating geospatial information in Bangladesh on a single platform, and began releasing information from May 2019. In addition, the Capital Development Authority (RAJUK), Local Government Engineering Departments (LGED), Bangladesh Forest Department (BFD), Bangladesh Meteorological Department (BMD), Bangladesh Water Development Board (BWDB) and other agencies release theme data. Furthermore, although only for internal use, the DLRS and WARPO have established a web-based system for information sharing.

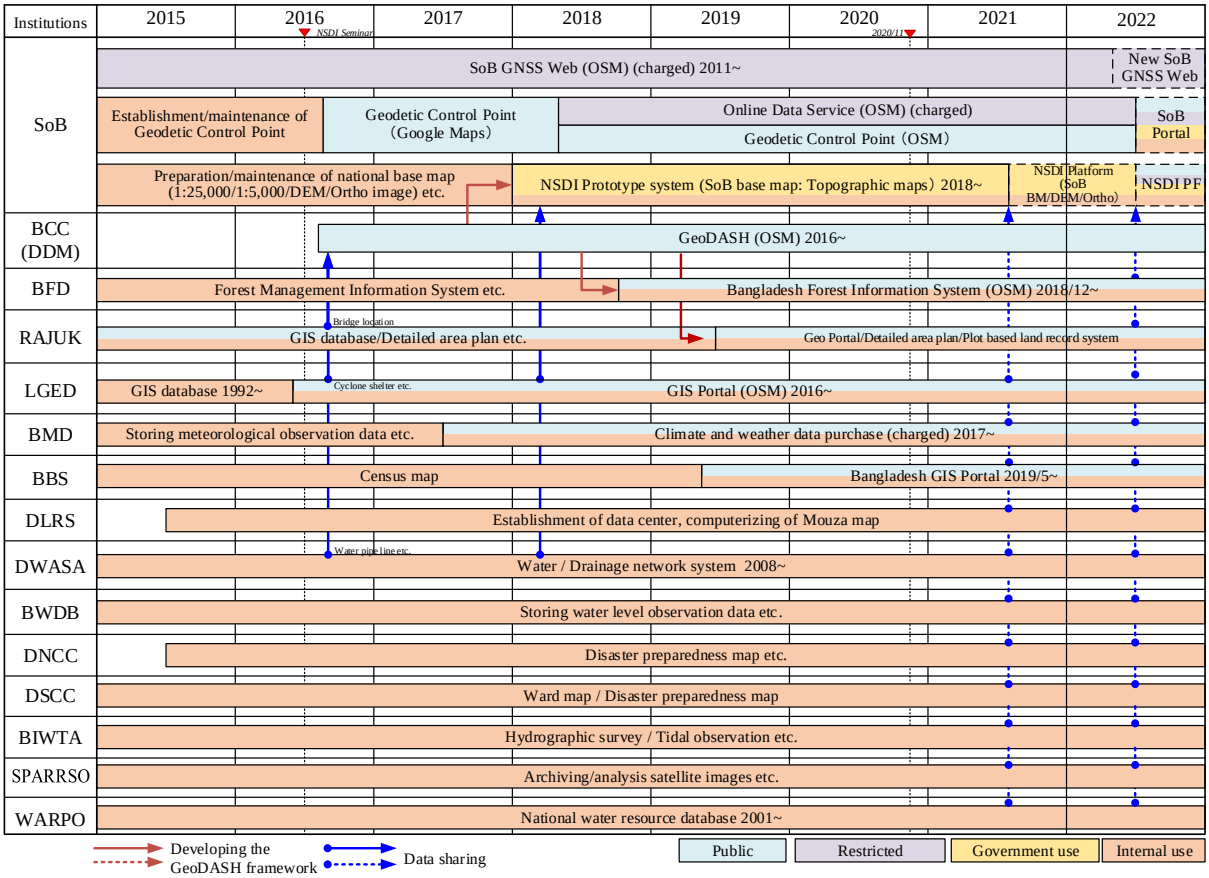
Table 3-9 List of web sites and systems developed by government organizations except SoB

Organization	Public/ Internal use	Web site/system name	Overview
BCC (DDM)	Public	GeoDASH https://geodash.gov.bd/	Web portal site for unified management and sharing of disaster information. As of December 2020, 54 organizations are participating and 740 layers have been registered. Users can upload data by registering. Ordinary users can browse and download released data.
BBS	Public	Bangladesh GIS Portal http://www.gis.gov.bd/en/index.php	In the project "Strengthening Statistical Capacity of BBS for Collecting Data on Population and Development (Stat4Dev)" support by United Nations Population Fund (UNFPA), has developed population and household census, education institutions cum cyclone, and multistoried buildings in disaster prone area. Establishes portal website to release and deliver above GIS related information based on a vision for the establishment of a unified national GIS platform. As of December 2020, 37 organizations are participating.
LGED	Public	GIS Portal http://gis.lged.gov.bd/	Establishes Web GIS application for the interactive display of District unit road network and public facility information. Reference to information for projects being implemented by LGEDs can also be performed.
BFD	Public	Bangladesh Forest Information System http://bfis.bforest.gov.bd/bfis/	System for the planning, implementation and monitoring of forest management and conservation. Browsing of geospatial information concerning forests and land cover can be performed on the GeoPortal website. As of December 2020, 39 layers have been registered. Same framework as for GeoDASH is being used.
BWDB	Public	Flood Forecasting & Warning Centre http://www.ffwc.gov.bd/	Uses amount of rainfall / water level / other data in real time, weather forecast information and mathematical models to generate and provide flood forecast and warning information.
DLRS	Internal use	Digitized Land Records Management System	Establishes system to digitize cadastral maps (Mouza Maps) and land ledgers and connect data center, backup center and 53 branch offices with a network. Only used internally within the DLRS.
WARPO	Internal use	National Water Resources Database (NWRD)	Creates database for geospatial information that contributes to water resource development being conducted by own organization and for other organizations. Data catalog and quality guidelines (space data / time series data) is released to the general public, but NWRD can only be accessed within WARPO. External organizations can obtain data by submitting a usage application to WARPO.

Source: The Project Team

Each system is individually established, but the BFD forest information system was established based on GeoDASH in the same manner in which NSDI-PS was established by the NSDI-PP, and it appears that a common framework has been used. The geospatial information development status and release status at the main NSDI-WG member

organizations are organized in chronological order in Figure 3-3.



Source: The Project Team

Figure 3-3 Development and publication of geospatial information by government in Bangladesh

CHAPTER 4. Progress and results of each activity

The progress and output of each activity from August 2019 to December 2020 are described in this section in consideration of the environment surrounding the establishment and promotion of the NSDI.

4.1. General activities

4.1.1. Discussion on the Inception Report

The content of the Inception Report was explained and discussed at the first meeting of related parties (held on August 29, 2019) prior to the starting of the project, and the content of discussion was compiled in Minutes of the Meeting after agreement on the project purposes, overall activity plan, items for which the Bangladesh side is responsible and other issues.

The content agreed upon is shown in Appendix 2.1 "Minutes of Meetings for the Project to Strengthen the Capacity on Advanced Mapping of SoB for Building Digital Bangladesh and the Project for Establishment of National Spatial Data Infrastructure (NSDI) for Bangladesh".

In addition, a Technical Note was prepared as an attachment to the Minutes of Meeting which describes the technical points to be implemented with this project based on the NSDI-PP evaluation review implemented with the previous project, consisting of: 1) Sharing SoB base map, 2) Sharing geospatial information data from each organization on NSDI platform, 3) Development of NSDI platform based on NSDI prototype system (NSDI-PS) evaluation results, 4) Plan for training in Japan and 5) Capacity building in NSDI-WG members shown in Table 4-1. Refer to the attachment 2.2 for the details of the Technical Note.

Table 4-1 Summary of the recommendations in the Technical Note

Item	Technical suggestion
1) Sharing SoB base map	- Understanding a current situation of preparing of SoB base map (topographic maps, orthophoto, DEM) and sharing these data on the NSDI-PS. - Monitoring for processing of 1:25,000 topographic maps' web map tile. - Improvement for processing of orthoimages' web map tile. - Preparation of vector data.
2) Sharing geospatial information data from each	- Creating of census of geospatial information data by NSDI WG member - Consideration of validation criteria at each organization.

Item	Technical suggestion
organization on NSDI platform	
3) Development of NSDI platform based on NSDI prototype evaluation results	- Consideration of pending requests from NSDI-WG members. - Estimation of hardware resources for full scale NSDI platform. - System engineers and programmers for development of full scale NSDI platform. - Promotion of utilization of NSDI
4) Training in Japan	- Visit the Geospatial Information Authority of Japan (GSI), government organizations, local municipalities, Universities, IT firms etc. and learn about NSDI, the latest geospatial information technology and good practice of utilization of geospatial information in various sectors. - Understand the prospects and challenges in NSDI establishment and promotion in Bangladesh based on the knowledge acquired through this training.
5) Capacity building in NSDI-WG members	- Hold seminar(s) inviting representatives from organizations of various sectors and make a promotion video and/or brochure for promoting understanding of the concept and importance of NSDI framework. - As technical and theoretical support, compile operation manuals and documents of case studies, carry out on-site training or workshops at NSDI-WG member organizations to support their roles on preparation of geospatial data.

Source: The Project Team

4.1.2. Preparation of the monitoring sheet

Monitoring sheets Ver. 1 and Ver. 2 were prepared to monitor current project activities and outputs, and to identify issues and other concerns and submitted to the JICA Bangladesh office after coordination with the SoB (Table 4-2). Refer to Appendix 3.1 and 3.2 for the details of the monitoring sheets.

Table 4-2 Submission of the monitoring sheet

Title	Period	Submission date
Monitoring sheet Ver.1	August 2019 to February 2020	24th March 2020
Monitoring sheet Ver.2	March 2020 to August 2020	18th November 2020

Source: The Project Team

4.1.3. Efforts to continue the Project under COVID-19 disease

Japanese experts, including the long-term expert, have not been able to travel to Bangladesh since April 2020. Remote meetings have been periodically held using Zoom after the lock-down regulations were relaxed in June 2020 in order to continue with the project on a remote basis from Japan. It is taking more time for activities compared to when Japanese experts are on site, but remote meetings have been held 18 times, and steady progress is being made. The main content of each meeting is described in Table

4-3.

Table 4-3 Summary of the web conference from June 2020

Date	Conference	Summary
11th June 2020	First SoB Technical team	• Status of progress on TAPP approval and NSDI policy formulation was confirmed. • Role of each person was verified to facilitate as much progress as possible under the restriction of action during the new coronavirus pandemic.
18th June 2020	Official meeting with SG	• Presented a draft of the revised overall work schedule due to the impact of the new coronavirus pandemic. • Milestones verified and agreement reached on extension of activity period.
23rd June 2020	Second SoB Technical team	• TAPP approval status confirmed. • DPS preparation support activity policy and full-scale version NSDI-PF development TOR (draft) were explained and shared.
2nd July 2020	Third SoB Technical team	• Status of progress and other issues concerning TAPP approval / NSDI policy circular consultation and orthophoto image Web map tile preparation were confirmed. • Request made for preparations for holding of first JCC online meeting. • Qualification requirements of technical staff for development of full-scale version NSDI-PF were discussed. • Effective information to be provided (draft) for measures to deal with COVID-19 pandemic was presented as an example of utilization of NSDI-PF, and request was made to investigate information that could be available.
9th July 2020	Forth SoB Technical team	• Status of progress on TAPP approval and NSDI policy circular consultation were confirmed. • Security measures for leakage, exploitation, falsification and other such issues related to loading of 1:25,000 scale topographic map Web map tile data onto NSDI-PS were discussed. • Survey results of publicly available information concerning COVID-19 in Bangladesh were explained and shared. • Opinions exchanged on theme for next NSDI workshop.
16th July 2020	Fifth SoB Technical team	• Status of TAPP approval and NSDI policy circular consultation were confirmed. TAPP expected to be signed next week. • Security measures for leakage, exploitation, falsification and other such issues related to loading of 1:25,000 scale topographic map Web map tile data onto NSDI-PS were discussed (continuation). Issues of concern were verified. • DPS preparation guideline (draft) and 1:25,000 scale topographic map DPS sample were shared. • Examples of information on COVID-19 shared in Japan introduced.
28th July 2020	Sixth SoB Technical team	• Report of TAPP approval (7/20). NSDI policy circular consultation status confirmed. • Security measures for leakage, exploitation, falsification and other such issues related to loading of 1:25,000 scale topographic map Web map tile data onto NSDI-PS were discussed (continuation). Explanatory materials on issues of concern were prepared and shared. • Screen image of COVID-19 related information on NSDI-PS shared.

Date	Conference	Summary
		• Mapping techniques for COVID-19 designated hospital list using SoB topographic map database were considered. • Updated version of the TOR (draft) for the development of the full-scale version of NSDI-PF with additional content on web application vulnerability countermeasures, user layer creation function, and training content was shared.
12th August 2020	Seventh SoB Technical team	• TAPP approval letter shared. Project period confirmed. • NSDI policy circular consultation status confirmed. • Request made for preparations for first JCC online meeting. • Report on results of discussion with Surveyor Generation of SoB concerning security measures for leakage, exploitation, falsification and other such issues related to loading of 1:25,000 scale topographic map Web map tile data onto NSDI-PS. Terms of service to be posted on the Website were prepared. • Agreed to explain DPS preparation guideline (draft) at next NSDI-WG member meeting. • Considered flow of converting COVID-19 designated hospital list (PDF) to Excel file and loading onto NSDI-PS. • Procurement schedule for full-scale version NSDI-PF development confirmed.
20th August 2020	Eighth SoB Technical team	• Time at which TAPP approved budget can be enacted verified. • Preparations for holding of first JCC online meeting and fourth NSDI-WG member meeting. • Status of 1:25,000 scale topographic map loading confirmed. Progress of orthophoto image Web map tile preparation confirmed. • TOR content of local consultant in charge of DPS preparation support explained.
10th September 2020	First SoB NSDI Project Cell	• NSDI Project Cell inaugurated. PM and PD appointed. Hand over from NSDI technical team. • Time at which TAPP approved budget can be enacted verified. • Preparations for holding of first JCC online meeting and fourth NSDI-WG member meeting. • Report on DPS preparation support local consultant procurement status. • Report on completion of loading 1:25,000 scale topographic map onto NSDI-PS. • Opinions exchanged concerning COVID-19 information provision methods using NSDI-PF. • Review of activity schedule due to delay in restarting of travel.
23rd September 2020	Second SoB NSDI Project Cell	• NSDI Project Cell structure preparation status confirmed. • Preparations for holding of first JCC online meeting and fourth NSDI-WG member meeting. Agenda (draft) shared. • Report on DPS preparation support local consultant procurement status. Local consultant (Esri Bangladesh) introduced. • Monitoring sheet Ver. 2 explained. • DEM preparation status confirmed and issues emerging during preparation shared.
6th October 2020	Third SoB NSDI Project Cell	• NSDI Project Cell structure preparation status confirmed. • Preparations for holding of first JCC online meeting and fourth NSDI-WG member meeting. • Time at which TAPP approved budget can be enacted verified. • Activity content concerning DPS preparation support explained. ICR shared.

Date	Conference	Summary
		• Orthophoto image Web map tile preparation and DEM preparation status confirmed.
13th October 2020	Forth SoB NSDI Project Cell	• NSDI Project Cell structure determination report. • Preparations for holding of first JCC online meeting and fourth NSDI-WG member meeting. Agenda (draft) fixed. • Time at which TAPP approved budget can be enacted verified. • Activity content concerning DPS preparation support explained. Request made to issue a letter requesting cooperation by each organization. • Orthophoto image Web map tile preparation status confirmed. Expect to be completed around end of October. • Preparations started for creation of SoB topographic map vector tiles.
22nd October 2020	First JCC	• Agreed to extend project activity period. • PSC comprising 17 organizations formed. • Activities to facilitate formulation of NSDI policy at early point. • Current status of NSDI-PS confirmed and future plans discussed. • Full-scale NSDI-PF development content and schedule shared. • Activity support to NSDI-WG members for NSDI establishment.
5th November 2020	Fifth SoB NSDI Project Cell	• Request for holding of first PSC meeting. • Preparations for holding of fourth NSDI-WG member meeting. Agenda (draft) fixed. Explanatory materials for project activity content shared in advance. • NSDI policy circular consultation status confirmed. • Details of the recruitment of consultants for the NSDI-PF development and overall schedule until contract confirmed. Request for an increase in the number of recruits from two. • DPS preparation support activity report. • Ortho-image Web map tile completion report. Request for survey of server environment to load onto NSDI-PS.
12th November 2020	Forth NSDI-WGM	• Report of TAPP approval and first JCC online meeting. • Explanation and review of project activities. • Explanation of current NSDI-PS status. Introduction and exchange of opinions on COVID-19 case study research using NSDI-PF. • Explanation of DPS preparation support and sharing of role of NSDI-WG members. • Explanation of full-scale version NSDI-PF development schedule and sharing of roles of NSDI-WG members.
2nd December 2020	Sixth SoB NSDI Project Cell	• Preparation status for holding of first PSC meeting confirmed. • NSDI policy circular consultation status confirmed (received from 23 organizations). • NSDI-PF development consultant recruitment status confirmed. • DPS preparation support activity report. • Sharing of NSDI workshop agenda. • DEM generation processing speed boosting methods considered (ongoing).
23rd December 2020	Seventh SoB NSDI Project Cell	• Preparation status for holding of first PSC meeting confirmed. Readjustment for holding in January or after. • NSDI-PF development consultant recruitment status confirmed. Not selected during 1st recruiting campaign, 2nd campaign being implemented. Request to focus on continuity from NSDI-PS. • DPS preparation support activity report.

Date	Conference	Summary
		• Mapping of COVID-19 related information (PCR test sites, vaccine sites) considered as an example of utilization of NSDI.

Source: The Project Team

4.2. Output 1: Activities of "Concept and merit of NSDI are understood by related organizations"

Activities related to Output 1 were implemented to achieve "Understanding of concept and merit of NSDI by related organizations". The NSDI consisting of social infrastructure which uses the topographic map data developed by the SoB as the standard for positions, integrates geospatial information possessed by organizations other than the SoB, enhancing the efficiency of land planning for infrastructure development, land use, urban development, disaster prevention, and helps promote the utilization of geospatial information by the public and private sectors in various fields. Therefore, the cooperation of related organizations that handle geospatial information is indispensable to facilitate the development and promotion of the NSDI, rather than the SoB implementing this work independently.

Ever since the NSDI international seminar was held in June 2016, the SoB has served a central role in the NSDI-PP (previous project) to accelerate movement in preparation for the establishment of the NSDI in Bangladesh, and has proceeded with activities together with the NSDI-WG members.

In this project, the formulation of short-term / mid-term / long-term plans required for establishment / operation of the NSDI in Bangladesh, preparation of various guidelines (draft), and activities to facilitate the dissemination of knowledge about NSDI by means of seminars and other events have been implemented.

[1-1] Formulation of the short-term, mid-term and long-term plans for the NSDI establishment and operation

1) Holding Joint Coordinating Committee meeting

The first JCC meeting was held on October 22, 2020 via Zoom following approval of the TAPP on July 20, 2020 by the government of Bangladesh. The attendees, venue, date/time and main agenda / decisions made at this meeting are shown in Table 4-4. Refer to Appendix 4 for the Minutes of the Meeting.

Table 4-4 Summary of the first JCC meeting

Item	Description
Date	22nd October 2020 9:00-11:00
Venue	Web conference by Zoom (Participants was from each office)
Objective	Review of the current status of establishing and promoting the NSDI and approval of future plans.

Item		Description
Attendees	MoD	Brigadier General Md. Mahfuz Alam, Joint Secretary
	SoB	Brigadier General Md. Muniruzzaman, Surveyor General Mr. Abdur Rouf Howlader, Director Defence Survey Md. Abul Kalam, Project Director (NSDI Project) Md. Saidus Jaman, Project Manager (NSDI Project) Md. Bashir Uddin, Technical Assistant
	ICTD	Mr Shariful
	ERD	Ms. Fatema Begum, Deputy Secretary
	JICA	JICA HQ, JICA Bangladesh Office, JICA Project Team
Agenda		1) Changes to the duration of technical cooperation projects 2) Formation of the Project Steering Committee (PSC) 3) Reports a current status of formulate the NSDI policy 4) Reports a current situation of the NSDI-PS and progress of this project 5) Explanation of the development plan for full-scale NSDI-PF 6) Roles and responsibilities of NSDI-WG members
Decisions		• Basic agreement was reached on the activity content for this project and the necessity of extending the overall project period. • Necessity of commencing development of NSDI platform at an early point was confirmed, and decision that MoD will promptly implement budget measures required for development. • Finalize the NSDI policy to facilitate its early formulation. • SoB will prepare Data Product Specifications (DPSs) and will propose unified data management rules for NSDI-WG members.

Source: The Project Team

2) Formation of the Project Steering Committee (PSC)

The cooperation of many related organizations is indispensable for the establishment and promotion of the NSDI. In order to facilitate activities concerning geographic information standardization, provision of data to the NSDI-PF, and utilization of the NSDI, it is important that coordination between the respective ministries and agencies can be smoothly performed.

Therefore, the judgment was made that the setting up of a PSC would be effective to facilitate cross-section activities among the ministries and agencies, resulting in the decision at the first JCC meeting to establish a PSC headed by the Secretary of the MoD with 18 designated members (Table 4-5). The schedule for the holding of the first PSC meeting is being discussed.

Table 4-5 List of the PSC

No.	Members
1	Secretary, Ministry of Defence
2	JICA representative
3	Joint Secretary, Ministry of Defence
4	Joint Secretary, Ministry of Defence
5	Surveyor General

No.	Members
6	Deputy Chief, Ministry of Defence
7	ECNEC representative
8	Planning Commission representative
9	Implementation, Monitoring and Evaluation Division (IMED) representative
10	Program Division, Planning Commission representative
11	Finance Division representative
12	Economic Relations Division (ERD) representative
13	General Economic Division (GED) representative
14	Project Director, Survey of Bangladesh
15	Project Manager, Survey of Bangladesh
16	Senior Assistant Chief, Ministry of Defence
17	ICT Division representative
18	Working Group representative

Source: Minutes of meeting of 1st JCC

[1-2] Discussion and formulation of the government data policies for the NSDI

1) Status of formulation of the NSDI policy

The SoB prepared a draft for the NSDI Act, and it was being discussed within the MoD, but the change was made to formulate an NSDI policy as a substitute for an NSDI Act in order to accelerate ongoing preparations for the establishment of the NSDI. A policy does not have the penal provisions stipulated in a law, but it has a similar level of force, and is effective for related organizations.

As of December 2020, the SoB has prepared a draft of NSDI policy, circular consultation is being performed by the MoD with 57 organizations, and responses have been received from 23 organizations. The draft NSDI policy indicates prevention of duplicate investment and uniformity of standards for geospatial information produced in Bangladesh, sharing of information on a national geoportal and mutual use among users, and roles of the executive committees and technical committees. The constituent elements and an overview of the of the NSDI policy (draft) are shown in Table 4-6.

Table 4-6 Overview of the draft NSDI policy

No.	Item	Overview
1	Suggestions	Digital Bangladesh, SDGs, Utilization of geospatial information
2	Definition	Definition of words
3	Policy requirements	Structured Geo-portal, and providing opportunities to store, exchange and use the data.
4	Purpose	Ensure maximum avoidance and maximum utilization of all types of geospatial data produced and collect within the country. Open government. Same topographic method, subset, datum. Preparation and sharing of metadata. Digital library. Etc.

No.	Item	Overview
5	Functionality and application	Term of validity, role of SoB, scope of application
6	NSDI committee	Implementation committee, Technical committee
7	Benefits of geospatial data exchange	Best use, avoid duplication, reinforcement, manufacturer information, reasonable decision making, confirmation of equality, capacity increase.
8	Data sorting	Target of geospatial information
9	Type of data access	Open access, registered access, and limited access.
10	Data exchange techniques/technologies	Nation Geo-portal, e-Government, security measures.
11	Data legal structure	Relationship with existing Acts and Regulations
12	Data worth	Determination of the value of data.
13	Budget provision	Budget, research, education, etc.
14	Conclusion	Progress and dissemination of geospatial information technology, update NSDI policy.

Source：SoB (Original in Bengali, provisional translation by JICA Project Team)

The content of the NSDI policy (draft) was confirmed, and suggestions were made to the SoB regarding the following points. These suggestions were discussed within the SoB, and whether or not they will ultimately be reflected in the policy will be examined, taking into consideration the opinions expressed by related organizations.

Point 1) Clarification of roles and responsibilities of related parties

An NSDI policy does not have legal force that requires compliance by concerned parties, and there are no written penalties for violations. Accordingly, in order to achieve the objective of this policy, it is important that all related parties make the maximum effort possible. Consequently, it is proposed that an item entitled “5. Roles and responsibilities” be added after “4. Objective”.

<Addition 5. Roles and responsibilities>

Each organization in the NSDI framework has a role in order to achieve the objectives of the above NSDI policy. Each organization is responsible for making its best efforts to serve that role.

<Addition 5.1 Role of government>

- Formulation of NSDI committee
- Preparation of short-term, mid-term and long-term plans to facilitate implementation, monitoring and review based on NSDI policy

- Allocation of budget and personnel to implementing organizations

<Addition 5.2 Creation of geospatial data, role in organization related to utilization>

- Formulation of action plan for utilization of NSDI in operations and activities at each organization
- Preparation of geospatial information with methods described in NSDI policy and maintaining the quality and accuracy
- Allocate resources to activities in order to carry out responsibility under NSDI policy

Point 2) Importance of positioning of SoB base map and clarification of SoB responsibilities

There is a definition for the term “Base map” in section 2.6, but the importance and role of the base map is not explicitly specified. The role of the SoB which prepares, maintains and provides the base map should be clearly specified.

Point 3) Specification of organization that implements national geoportal

The NSDI policy appears to be biased toward sharing the geospatial information that is prepared by each organization on a national geoportal. For example, it is expected that other organizations will voice various opinions on item 4.3 “Organizations creating geospatial information shall save the data on a national geoportal that is developed with the same standard”, item 4-6 “Metadata shall be shared on the national geoportal” and item 4.7 “Updated data shall be voluntarily uploaded to the national geoportal”. In addition, it is expected that the opinions will be voiced asking “Who will create the national geoportal?”, “Who will operate it?”, and “Who will maintain it?”

Therefore, it is proposed that a description of the policy and implementation measures to proceed with geospatial information activities be added as a duty as an administrative organization.

For example, article 4 in the Basic Act on the Advancement of Utilizing Geospatial Information in Japan can be used as reference.

In accordance with “Article 4 Basic principle in previous article” (hereinafter referred to as basic principle), the country is responsible for formulating and implementing comprehensive policies concerning the utilization and promotion of geospatial

information.

Point 4) Correction of term definitions

Due to the fact that "2.2 Ellipsoid", "2.6 Base map" and "2.11 Catalog" defined in section 2 were not used in the main body of the document, it is recommended that they be deleted if they will not be used in the future.

[1-3] Formulation of guidelines (protection of personal information, promotion of secondary use, etc.)

Considerations for the protection of personal data, data integrity, copyrights and other such issues are included in the NSDI policy (draft). Based on formulation of this policy, plans call for prompting of concrete consideration of how these requests can be satisfied in the development and operation of the NSDI.

[1-4] Share the understanding of the NSDI concept and its values among all the stakeholders

1) Statements at NSDI-WG and consensus building

Explanations concerning the NSDI concept and effectiveness have been made to the participating organizations at the four NSDI-WG member meetings which have been held to date in an effort to deepen understanding of the concept through discussion and building consensus for project implementation. A certain level of common understanding was attained by participating organizations from the previous NSDI-PP, but further explanation to newly participating organizations is needed, and it is important that they be visited individually and discussions are held with the person in charge.

2) Lectures and introduction of usage examples during training in Japan

During the training in Japan which was implemented in January 2020, opportunities were provided by means of lectures and practical training at the Geographical Survey Institute and private sector companies to acquire knowledge and promote understanding of the latest technical trends related to the NSDI, concepts, introduction effects and other issues. Refer to section 2.2.2 for the content of training in Japan.

During the second training period in Japan which is planned for 2021, it is hoped even more trainees participate in the training in order to deepen understanding of the concepts,

and to promote the acquisition of useful knowledge applicable to the Bangladesh NSDI.

4.3. Output 2: Activities of "Institutional framework for the NSDI development and utilization is strengthened"

Activities related to Output 2 will be conducted to "Strengthen the institutional framework for NSDI development and utilization". NSDI development represents a project designed to create not only a system for the sharing of geospatial information, but also an institutional framework to manage / operate this system. It also includes the task allocation and the establishment of work processes under its jurisdiction. The activities include the formation of an institutional framework within the SoB, which will play a central role as a coordinator of the NSDI project, the strengthening and operation of the NSDI-WG, which is the project implementation body, and the preparation for the launch of the PSC, which will manage overall operations of this project on behalf of the government of Bangladesh.

In addition, ideas for case studies were recruited from NSDI-WG member organizations as activities to promote NSDI utilization, and consideration of the details of work was started.

[2-1] Identification of functions and roles for Secretariat, WG, JCC, etc.

Activities to date have resulted in the forming of the NSDI-WG responsible for the establishment / operation of the NSDI, and the number of participating member organizations has been expanded based on proposals from participating organizations.

In addition, the NSDI Project Cell which is the secretariat for the NSDI project was formed at the SoB which is the central organization in the NSDI-WG, creating a structure to lead overall activities related to this project.

Following the approval of the TAPP and the formal inauguration of the NSDI project on the Bangladesh side, a JCC meeting was held in order to share the status of the project between Japan and Bangladesh and discuss the overall plan.

The PSC which is made up of the main 17 organizations, and will manage overall operations of this project on behalf of the government of Bangladesh was stipulated in the TAPP. Preparations are proceeding for the first PSC meeting under the leadership of the MoD.

[2-2] Identifying the issues to be considered for the NSDI and find the solutions

through discussion and coordination among the stakeholders

Continued discussions have been held on the configuration, functions and operation structure for an NSDI system that is suited to Bangladesh at the four NSDI-WG meetings, and various issues have been raised. The main points are described below.

1) How to facilitate the provision of geospatial information from NSDI-WG member

Many of the persons in charge of each organization participating NSDI-WG meetings understand the significance of the NSDI and are highly motivated to provide the data that is possessed by their organization. However, in many cases, those persons do not have the authority to provide information, and must obtain approval from the top management of the organization in order to provide data. Since this is difficult depending upon the position of that person, consensus building concerning the provision of data among top management at the respective governmental organizations is extremely important. This perception has been frequently confirmed at discussions to date with the MoD/SoB, and preparations are proceeding with the formulation of NSDI policy as activities which are the most important to solve these issues.

2) Who manages the NSDI-PF data register?

In the NSDI draft road map which was proposed during the previous project, it was suggested that an NSDI Committee consisting of key organizations from among the participating organizations in the NSDI-WG be formed in order to manage the Bangladesh NSDI-PF, which was explained and agreed upon at the preliminary discussions and the JCC meetings on the overall plan for this project. Plans call for discussions to be held on the creation of the NSDI Committee at the first PSC meeting for which preparations are proceeding.

3) Training of geospatial information engineers in each organization

The problem has been raised at NSDI-WG meetings that there are not staff at many organizations who are proficient in the GIS technology used to handle geospatial information or create data, or the number is extremely limited. Currently, there are many cases in which the data that is created for an isolated project is not updated, or the technical staff are no longer there when wishing to edit or improve the data. There are plans with this project to provide training, seminars and workshops domestically to support the training of engineers, but it is also necessary that each organization promote efforts to strengthen its GIS and IT divisions to secure the required personnel.

[2-3] Supporting the related organizations for the NSDI utilization

During the previous NSDI-PP, a report was made on a case of LGED farmland development as an example of NSDI utilization. This project is calling on each participating organization to implement case studies in the same manner. Specific reviews have been conducted to date with the DLRS, DSCC, BWDB and other organizations. In particular, the BWDB has expressed the hope that the NSDI can be used for investigation for planned dam projects, and it is expected that detailed review of data collection and investigation techniques will proceed in the future.

4.4. Output 3: Activities of "NSDI common rules are established based on Geographic Information Standards."

The NSDI is the framework for the sharing / utilization of geographic data by many organizations, and it is important that common rules be established for the operation / utilization of the system. This project aims to draft common guidelines in order to facilitate the provision and utilization of geographic data through the full-scale NSDI-PF.

[3-1] Standardization of metadata and sharing of it with related organizations

Metadata is needed to search for all kinds of data, and this is not limited to geographic data. Users can identify the data that matches the desired objective by searching metadata. The importance of metadata increases when there are more types of data and a larger volume of data. Common rules are required in the NSDI framework in order to use metadata to search / evaluate data. In order for Bangladesh to establish common rules in the future, it would be useful to first understand the current situation and then develop draft guidelines based on that current situation.

1) Current situation of SoB

When an interview of SoB engineers was conducted regarding existing rules and materials concerning metadata for geographic information, it was found that metadata instructions have been prepared for 1:25,000 scale topographic maps (Figure 4-1). These metadata instructions were prepared by Mohammad A. Hadi of the Bangladesh Branch of the current Esri South Asia company as a consultant for SoB using ISO/TS 19139:2007 (Geographic information - Metadata - XML schema implementation) as reference.

Metadata Instruction for 1 : 25,000 Scale Map

Type	Name in GDB/Dataset	Title:	Tags:	Summary:	Description:	Credits:	Use Limitation:
GDB	78P05A	78P05A	FGDB, GDB, GIS Database, Geo-database	To provide digital geospatial data to users of different levels of different government, non-government organisations, institutions, researchers, private practitioners etc. with a view to undertake various development works of Bangladesh.	This database has been created on [Month Name Year] basing on the information of aerial photographs (Duration: [December 2010]; GSD: 50 cm; RGB; Orthorectified) and field survey data of survey season [2011-2012] under Improvement of Digital Mapping System (IDMS) project of Survey of Bangladesh. This data has been used to prepare cartographic database in order to create 1 : 25,000 scale topographic map. All horizontal and vertical data are linked with ITRF-1992. This database contains [11] Datasets and [40] Feature classes/layers. Each feature class has different sub-types as per their characteristics. Feature types are identified by "F_Code" and "F_Type" indicating Feature Code and Feature Type respectively. F_Code is a unique alphanumeric code consist of 8 digit (e.g. BLS1101P). First 3 digits indicate the abbriviated name of respective dataset, next 2 digits indicate geometry range (Point feature: 10-39; Line feature: 40-69; Polygon feature: 70-99), next 2 digits for subtype serial number and last digit indicating type of geometry ("P" for point feature, "L" for Line feature, "A" for	GIS Unit, IDMS project, Survey of Bangladesh. Members involved in GIS database creation: [Operator's Name with Designation] (Operator), [Supervisor's Name with Designation] (Supervisor) and [Administrator's Name with Designation] (Administrator & In-charge GIS Unit).	Administrative boundary information has been appended from WARPO, Bangladesh. Survey of Bangladesh takes no responsibility about the Administrative boundary shown in this database. The toponame shown has been appended from Bangladesh Bureau of Statistics (BBS) and verified during survey season [Year covering]. Vertical accuracy: 40 cm and Horizontal accuracy: 50 cm
Dataset	Administrative_Boundary	Administrative Boundary	ABD, Administrative Boundary	To provide Administrative Boundary data to users of different levels of different government, non-government organisations, institutions, researchers, private practitioners etc. with a view to undertake various development works within the boundary as delineated.	Local boundary data has been extracted from BD_Union_Poly_BUTMWGS.shp of WARPO dataset in 05 August 2012. International boundary has been updated by Survey of Bangladesh. This dataset consists of [PillarP], [BorderP], [AdminL], [CostalL], SheetBlockL, [AdminOthersA], [DivisionA], [DistrictA], [UpazilaA], [EnclavesA], [NeighborA] and SheetBlockA feature classes.	GIS Unit, IDMS project, Survey of Bangladesh; WARPO, Bangaldesh	Since administrative boundary information has been appended from WARPO, Bangladesh, hence Survey of Bangladesh takes no responsibility about the Administrative Boundary shown in this database. The toponame shown has been appended from Bangladesh Bureau of Statistics (BBS) and verified during survey season [2011-2012].
Dataset	Annotation	Annotation	Annotation	To provide Annotation data to users of different levels of different government, non-government organisations,	This dataset consists of [T_Administrative], [T_Communication], [T_Cultivation_Vegetation], [T_Hydrography] and [T_Other] annotation classes.	Cartographic Unit & GIS Unit, IDMS project, Survey of Bangladesh.	

Source: SoB

Figure 4-1 Instruction for metadata of 1:25,000 scale topographic maps of SoB (extract)

These metadata instructions describe an overview of each feature, explain the content and attributes, preparing organization, considerations when using and other issues. For example, it was explained that administrative boundaries were extracted from the domestic administrative boundaries in the data set prepared by WARPO on August 5, 2012, and that SoB updates the national borders. In addition, place name information was obtained from the BBS as a consideration when this data is used, and the suitability was checked by a field survey by the SoB in 2011–2012. Therefore, a common understanding has been attained among the persons preparing metadata through the metadata instructions concerning what points to pay attention to for metadata and what features should be described. In addition, this enables users to learn what kind of metadata items exist, and what standards are used for the preparation of the respective items.

2) Current status of NSDI-WG members

The JICA project team distributed the census sheets to the NSDI-WG member organizations, and requested each organization to provide information concerning GIS data under their jurisdiction. The NSDI-WG member organizations who have not submitted census sheets and organizations who have been invited to newly participate were visited and interviews were conducted concerning existing preparation rules and materials related to GIS data and metadata under their jurisdiction (Table 4-7). At the same time, a survey was conducted concerning data quality, expectations for the NSDI and other issues.

Table 4-7 List of interview survey

#	Organization	Abbreviation	Date	Remarks
1	Water Resources Planning Organization	WARPO	19 Feb 2020	Provided the metadata document for NWRD
2	Bangladesh Water Development Board	BWDB	9 Dec 2019	
3	Local Government Engineering Department	LGED	28 Aug 2019	
4	Access to information	a2i	10 Sep 2019	
5	Roads and Highways Department	RHD	27 Aug 2019	
6	Geological Survey of Bangladesh	GSB	12 Dec 2019	
7	Rajshahi Unnayan Kartripakkha	RAJUK	12 Sep 2019 12 Dec 2019	
8	Department of Disaster Management	DDM	23 Feb 2020	
9	Bangladesh Rural Electrification Board	BREB	8 Sep 2019 10 Dec 2019	
10	Bangladesh Telecommunication Regulatory Committee	BTRC	12 Dec 2019	
11	Bangladesh Power Development Board	BPDB	15 Dec 2019	
12	Center for Environmental and Geographic Information Services	CEGIS	16 Sep 2019 18 Feb 2020	
13	Institute of Water Modelling	IWM	26 Feb 2020	

(No particular order)

Source: The Project Team

An overview of the interviews of each organization is described below.

- WARPO:

WARPO is the organization which formulates and implements sustainable water resource development plans in Bangladesh. The interview focused on the content of the guideline content for the national water resource database (NWRD) developed by WARPO and expectations for the NSDI.

Interview date/time: February 19, 2020 (Tues.) 11:05 – 12:20

Overview of interview results: Shown in Table 4-8.

Table 4-8 Results of interview survey to WARPO

Interview items	Results
1) Handling of GIS data	National water resource database (NWRD) has been developed. The NWRD can only be accessed within the WARPO. It can be used by external organizations (for a charge) by filing an application with WARPO.
2) Rules and documentations on metadata	There is a metadata preparation report that was customized based on ISO metadata standards, but metadata guidelines have not been developed.
3) Data quality	NWRD space data quality guidelines and time series data quality guidelines have been released on the WARPO Website.
4) Expectations and requests to NSDI	It is taking time to update NWRD geographic data. Would like to use NSDI to efficiently update NWRD data provided by other organizations.
5) Other	Data Distribution Policy is not disclosed since it includes price and discount rate information. Division of roles of government organizations involved in water (WARPO, BWDB, BIWTA, WASA, other) was clarified in order to eliminate the duplication of work.

Source: The Project Team

The National Water Resources Database (NWRD) metadata related materials have been received from WARPO (Table 4-9).

Table 4-9 Metadata elements of the NWRD

No.	Name	Definition
1	Title	Name by which the dataset is known
2	Abstract	Brief narrative summery of the data set
3	Purpose	Summary of the intention with which the dataset was developed
4	Use constraints	Constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the dataset.
5	Lineage statement	Additional lineage information
6	Qualitative narrative report	Descriptive quality information for the qualitative report type
7	Metadata date	Date that the metadata were created or last updated
8	Responsible party individual name	Person having primary responsibility for the intellectual content of the data
9	Responsible party organization name	Name of the organization associated with the dataset
10	Postal address	Address line for the address
11	City	City of the address
12	Postal code	Postal code of the address
13	Country	Country of the address

No.	Name	Definition
14	Electronic mail	Address of the electronic mailbox of the organization or the individual
15	Dataset extent coordinate	Geographic area domain of the dataset
16	geographic extent name	Commonly used or well-known name of a place, area or region which describes a spatial domain of the dataset
17	Temporal extent date/time	Date and time of the content of the dataset
18	Category	Words or phrases summarizing a subject of the dataset
19	Keywords	Common used word(s) or phrases used to describe the subject of the dataset
20	Map projection	Name of the map projection
21	Feature type	Class of real world phenomena with common properties

Source: WARPO

- BWDB:

The BWDB is the organization which manages plans for water resource projects in order to reduce damage due to floods and facilitate effective use of water resources. The interview focused on the GIS data possessed by BWDB and the expectations for the NSDI.

Interview date/time: December 9, 2019 (Mon.) 11:45 – 13:05

Interview results: Shown in Table 4-10.

Table 4-10 Results of interview survey to BWDB

Interview item	Result
1) Handling of GIS data	The BWDB has observation stations throughout the country, and acquires river level, flow rate, rainfall amount and other data in real time. River code data is not disclosed. The BBS manages codes. Cooperates with SoB for river water/cliff line surveys. Cooperates with RHD/LGED for road height and inundation forecasts. Receiving river depth data from BIWTA.
2) Rules and documentations on metadata	Metadata guidelines have not been developed.
3) Data quality	Frequently consigns preparation of data to IWM and CEGIS.
4) Expectations and requests to NSDI	NSDI policy is important for cooperation with related organizations.
5) Other	Operates Flood Forecasting & Warning Centre. GIS cell has suspended activities (as of Dec. 2019), but plans to restart activities from Feb. 2020.

Source: The Project Team

- LGED

LGEDs are responsible for road development / maintenance and small-scale water resource development projects for agriculture / fisheries in Bangladesh. They provide technical support for various projects, boost the capability of local governments and contribute in other ways. They also prepare / manage road databases and digital maps which are released on a GIS Portal on their websites. The interview focused on the GIS data possessed by LGEDs and the expectations for the NSDI.

Interview date/time: August 28, 2019 (Wed.) 15:30 – 16:30

Interview results: Shown in Table 4-11.

Table 4-11 Results of interview survey to LGEDs

Interview items	Results
1) Handling of GIS data	The range of infrastructure development by LGED can be divided into three categories: Local, urban and water related. GIS data has been used since 1992 as a decision-making support tool for the implementation of infrastructure development projects. Upazila Maps with 19 features were developed at their own cost for 492 Upazila areas throughout the country, and are being used and provided to other government organizations and entities (Updated from 2008 – 2011 with the support from JICA).
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	Request that NSDI-PS will be able to handle not only Shape but also Geodatabase format data. Request that Time series data can be handled. Request that can be accessed with ArcGIS interface. Request that efforts be made to collect information for the NSDI (Putting Act into effect is important) Request that there be a person in charge of GIS at each NSDI participating organization. Request capacity building activities for each NSDI participating organization. Elevation information (DEM) is wanted the most. Habitation and forests information are also extremely useful.
5) Other	Since NSDI policy is a short document which only gives an overview, the establishment and enactment of the NSDI Act is essential. Since LGEDs use LCC projection (Lambert Conformal Conic projection) and NSDI uses BUTM projection, method needs to be unified in the future. Expect that method will be unified as BUTM when NSDI utilization has proceeded to a certain stage.

Source: The Project Team

- a2i

a2i consists of a project comprising an important portion of "Digital Bangladesh" being implemented by the government of Bangladesh to introduce IT throughout the country. This represents a position of overall integration rather than simple preparation of geographic information. The interview focused on an explanation of the NSDI project to the a2i and an exchange of opinions concerning the utilization of NSDI. In addition, a request was made again to participate in the WG.

Interview date/time: September 10, 2019 (Tues.) 9:30 – 11:05

Interview results: Shown in Table 4-12.

Table 4-12 Results of interview survey to a2i

Interview items	Results
1) Handling of GIS data	Information not available.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	There is the problem of different budgets being expended when the same type of map is prepared with individual projects. It can be expected that the NSDI will be utilized in various fields, such as for Dengue fever countermeasure portal sites, electoral district data processing, and establishment of 5,000 nationwide digital data centers for resident services, e-commerce and setting of school districts.
5) Other	For example, when road data differs between multiple organizations, the organization with jurisdiction of the data is responsible as a basic rule, but this will be discussed at the WG in the future. How data is collected by multiple organizations is the important thing. It is expected that cooperation of the National Data Coordination Committee (NDCC) will be effective.

Source: The Project Team

- RHD

The RHD is in charge of constructing and maintaining expressways and bridges in Bangladesh. The interview focused on an explanation of the NSDI project to the RHD and an exchange of opinions concerning the GIS data that it possesses and the utilization of the NSDI. In addition, a request was made again to participate in the WG.

Interview date/time: August 27, 2019 (Tues.) 16:00 – 17:00

Interview results: Shown in Table 4-13.

Table 4-13 Results of interview survey to RHD

Interview items	Results
1) Handling of GIS data	Upazila Maps are used as background maps in order to develop information on road networks (central line data), road type classification (administrator), and standard type (number of lanes). Vehicles with GPS are being used to perform road network surveying. Four vehicles were used for surveying, and the data is updated every year.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	Explanation of NSDI was made from J/E.
5) Other	This GIS data is not being used for planning and design since there are almost no new development projects. The main road development projects consist of widening and upgrading (there is one plan to build a new road along the northern border of the country).

Source: The Project Team

- GSB

The GSB is in charge of conducting surveys/research concerning geology and geoscience in Bangladesh. The interview focused on an explanation of the NSDI project to the GSB and an exchange of opinions concerning the GIS data that it possesses. In addition, a request was made again to participate in the WG.

Interview date/time: December 12, 2019 (Thurs.) 11:15 – 12:30

Interview results: Shown in Table 4-14.

Table 4-14 Results of interview survey to GSB

Interview items	Results
1) Handling of GIS data	The GSB is divided into 14 Scientific Branches, and they each independently prepare data. Therefore, the data is scattered, and has not been archived in the necessary manner. Staff involved in GIS and data management need to be trained. Efforts need to be devoted to this area in the future. Signed MoU with the RAJUK to collaborate on Geomorphology and Land Suitability of Infrastructure.
2) Rules and documentations on metadata	There are not preparation regulations and other rules for metadata.
3) Data quality	There is not a manual for data preparation and data quality management.
4) Expectations and requests to NSDI	Explanation about NSDI was made from J/E.

Interview items	Results
5) Other	Request was made to give lectures to staff at GSB concerning importance of NSDI. This matter will be coordinated from now on.

Source: The Project Team

- RAJUK

RAJUK is in charge of urban planning and development management for roads/bridges/ etc. in metropolitan Dhaka. It has the authority to grant approval of construction work within its jurisdiction. The interview focused on an explanation of the NSDI project to RAJUK and an exchange of opinions concerning the GIS data that it possesses. In addition, a request was made again to participate in the WG.

Interview date/time: September 12, 2019 (Thurs.) 10:30 – 12:10

Interview results: Shown in Table 4-15.

Table 4-15 Results of interview survey to RAJUK

Interview items	Results
1) Handling of GIS data	Requests have been made to consultant companies in Bangladesh (e.g. Development Design Consultants Limited (DDC) and Sheltech (Pvt.) Ltd.) to prepare GIS data for RAJUK. It is based on satellite images. The target area is 1,500km^2, including Dhaka city proper. RAJUK uses GIS data in order to manage the Dhaka Metropolitan Development Plan (DMDP) which is the master plan. The data at the Department of Land Records and Survey (DLRS) was digitized in order to create the mouza boundaries. Data at the Geological Survey of Bangladesh (GSB) was also used. Data for sewage system and other facilities was also provided from other organizations.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	If RAJUK data is to be uploaded to the NSDI, a MoU needs to be concluded between the RAJUK and SoB. Handling of the data maintenance expenses should also be included in the MoU.
5) Other	Work by the RAJUK consists of zoning of urban plans (residential areas, commercial areas, etc.) and approval of licenses. RAJUK is the planning organization, and shares information with Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC) which are the implementation organizations. For example, when WASA submits a sewerage development plan to RAJUK, it makes a judgment based on the master plan, and WASA performs work after approval.

Source: The Project Team

- DDM

DDM is the organization which manages the response to natural disasters in Bangladesh.

The interview focused on the GIS data that the DDM possesses and its expectations for the NSDI.

Interview date/time: February 23, 2020 (Sun.) 14:45 – 15:15

Interview results: Shown in Table 4-16.

Table 4-16 Results of interview survey to DDM

Interview items	Results
1) Handling of GIS data	DDM performs hazard risk evaluation of six types of natural disasters (floods, cyclones, droughts, earthquakes, tsunami, landslides) and two types of man-made disasters (disasters due to technology failures and health hazards) within the framework of the Multi Hazard Risk and Vulnerability Assessment Modeling and Mapping (MRVA) Project, and releases the output including map data on its website.
2) Rules and documentations on metadata	Metadata is not being prepared.
3) Data quality	There are no quality management standards.
4) Expectations and requests to NSDI	It appears the organization does not have the capacity to deal with the NSDI.
5) Other	DDM has uploaded 97 layers of data to the GeoDASH, but only the cyclone shelter layout map to the NSDI-PF. It is thought that the DDM needs support in order to upload data to the NSDI-PF. The IWM was in charge of flood risk evaluation for the MRVA.

Source: The Project Team

- BREB

The BREB is the organization that manages / promotes rural electrification in Bangladesh. It is in charge of power distribution rather than power development / supply. The interview focused on an explanation of the NSDI project to the BREB and an exchange of opinions concerning the GIS data that it possesses. In addition, a request was made again to participate in the WG.

Interview dates: Sept. 8, 2019 (Sun.) 14:55 – 16:15 & Dec. 10, 2019 (Sun.) 14:45 – 15:30

Interview results: Shown in Table 4-17.

Table 4-17 Results of interview survey to BREB

Interview items	Results
1) Handling of GIS data	BREB is integrating geographic information services (GIS) in its service stations (SS, substations, points) and lines.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.

Interview items	Results
4) Expectations and requests to NSDI	Approval by the BREB chairman is required for uploading data to the NSDI-PF.
5) Other	BREB manages data on cables, etc. separately from the BPDB. The BREB is considering burying power lines underground in the future.

Source: The Project Team

- BTRC

The BTRC is the organization that manages the communication services environment in Bangladesh. The interview focused on an explanation of the NSDI project to the BTRC and an exchange of opinions concerning the GIS data that it possesses. In addition, a request was made again to participate in the WG.

Interview date/time: December 12, 2019 (Thurs.) 12:45 – 13:50

Interview results: Shown in Table 4-18.

Table 4-18 Results of interview survey to BTRC

Interview items	Results
1) Handling of GIS data	The BTRC possesses 110 layers of map data. (The data is prepared by IWM and other organizations). BTRC data can be shared based on the conclusion of a MoU provided it is a government organization.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	Explanation about NSDI was made from J/E.
5) Other	Currently, an ICT Infrastructure Information System (ICT-IIS) is being developed, and connections have been made to approximately 3,000 locations out of the approx. 5,000 unions in the country. Plans call for the connection of all unions within two years, excluding remote islands and mountain districts.

Source: The Project Team

- BPDB

The BPDB is the organization that manages electric power development in Bangladesh. The interview focused on an explanation of the NSDI project to the BPDB and an exchange of opinions concerning the GIS data that it possesses. In addition, a request was made again to participate in the WG.

Interview date/time: December 15, 2019 (Sun.) 11:00 – 11:55

Interview results: Shown in Table 4-19.

Table 4-19 Results of interview survey to BPDB

Interview items	Results
1) Handling of GIS data	Being provided to substations throughout the country which perform 11KV (kilovolt) and 14KV conversion. Currently, 70% has been completed. Expect this process will be completed in June 2020. Survey of customers in Chittagong, Sylhet, Mymensingh and Comilla is being conducted, and is expected to be completed in June 2021.
2) Rules and documentations on metadata	Information not available.
3) Data quality	Information not available.
4) Expectations and requests to NSDI	Explanation about NSDI was made from J/E.
5) Other	Data for power lines and substations is managed by the Power Grid Company of Bangladesh (PGCB). The Dhaka Power Distribution Company (DPDC) and Dhaka Electric Supply Company (DESCO) are in charge of electric power supply in Dhaka. In Khulna, the Northern Electricity Supply Company (NESCO) is in charge of electric power supply.

Source: The Project Team

- CEGIS

CEGIS is the organization which is entrusted by the government of Bangladesh to oversee a wide range of issues related to earth science and socioeconomics, including the aquatic environment. It is commissioned by government organizations to create databases and conduct surveys / development. The interview focused on the GIS data that the CEGIS possesses and an exchange of opinions concerning the utilization of the NSDI.

Interview dates: Sept. 16, 2019 (Mon.) 10:00–11:30 & Feb. 18, 2019 (Tues.) 15:05–16:15

Interview results: Shown in Table 4-20.

Table 4-20 Results of interview survey to CEGIS

Interview items	Results
1) Handling of GIS data	The CEGIS has established a platform that is extremely close to the NSDI. Conversion / integrated management is achieved in accordance with common specifications (BTM) which guarantees ownership protection of data, access management and other issues for data that is procured or received from the respective organizations. However, usage is limited to within the CEGIS.
2) Rules and documentations on metadata	The CEGIS is working to standardize metadata as soon as possible in the country and formulate ISO compliant standards. In addition, the RS department is formulating land cover classification standards. The metadata guidelines concerning the WARPO database that CEGIS is in charge of can be provided by CEGIS to J/E with the approval of WARPO. The CEGIS created an inventory in 1997-98 and 2005 of the data (metadata) possessed by nearly 100 organizations.
3) Data quality	Spatial data quality guidelines and time series data quality guidelines related to the WARPO database handled by CEGIS can be provided by CEGIS to J/E

Interview items	Results
	with the approval of WARPO.
4) Expectations and requests to NSDI	The preparation of common guidelines, data exchange protocol and metadata standardization is vital to facilitate the integration of various data sources.
5) Other	The CEGIS started up the Bangladesh Geographic Information Infrastructure (BGII) project for government organizations in the late 1990s. The Prime Minister and the directors of all types of main organizations worked to achieve this, but it ended in failure. This was caused by no organization willing to assume responsibility.

Source: The Project Team

- IWM

IWM is the organization which is entrusted by the government of Bangladesh to be in charge of water resource development / management. It is commissioned by government organizations to create databases and conduct surveys / development. The interview focused on the GIS data that the IWM possesses and an exchange of opinions concerning the utilization of the NSDI.

Interview date/time: February 26, 2020 (Wed.) 11:00 – 12:50

Interview results: Shown in Table 4-21.

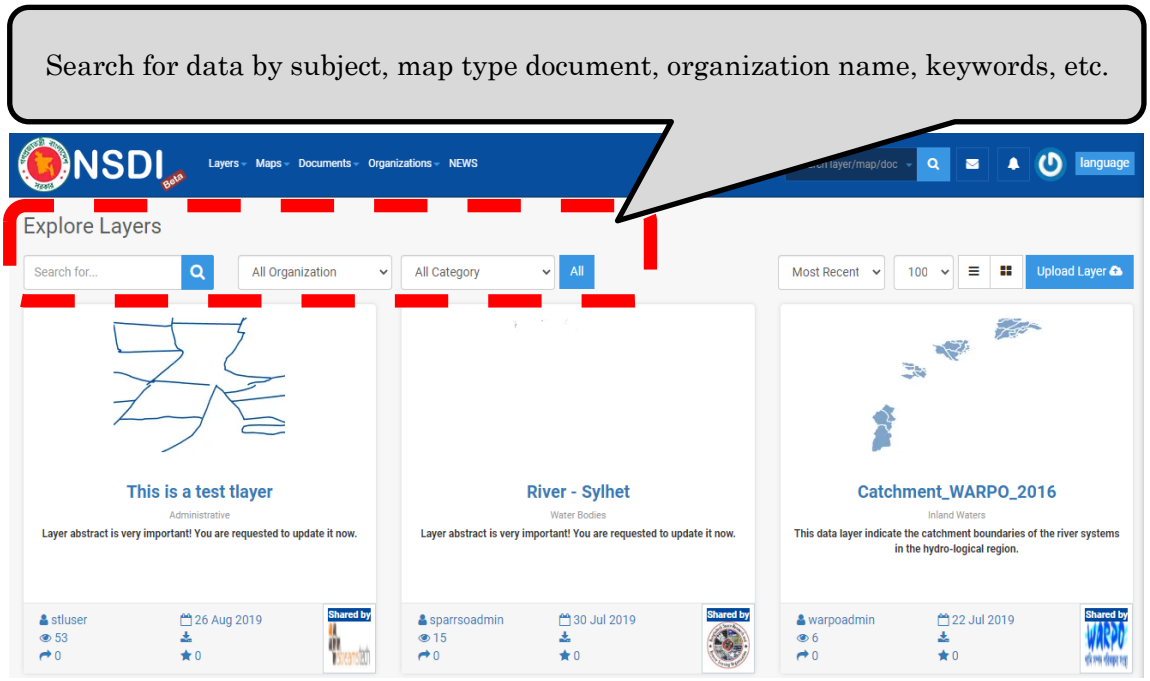
Table 4-21 Results of interview survey to IWM

Interview items	Results
1) Handling of GIS data	The IWM prepared the database for the BWDB Flood Early Warning System (FEWS). Since the BWDB is the owner of the data, it cannot be provided to the NSDI by the IWM. The same limitations apply to other projects.
2) Rules and documentations on metadata	The IWM does not have metadata guidelines. Metadata is not prepared for individual projects, resulting in metadata only being included in reports.
3) Data quality	Quality evaluation standards differ for each project.
4) Expectation and requests to NSDI	Currently, each time a new project is started, work must commence from the collection of basic data. It is hoped that the NSDI will eliminate this process.
5) Other	The establishment of the NSDI which is a national level system should use a corporate product rather than being open source. There are problems with the continuity / reliability when open source is used. Many projects using open source are not continuing.

Source: The Project Team

3) Metadata function on the NSDI-PS

Metadata registration / search functions (clearing house) contributed to the NSDI-PS which was developed with the previous NSDI-PP project.



Source: The Project Team

Figure 4-2 Screen shot of metadata search function on the NSDI-PS

During the review of the NSDI-PS by organizations that participate in NSDI-PP, the opinion was voiced that setting of the access level (Encapsulation) is also needed for metadata. Plans call for the reexamination of NSDI-PF implementation during the development process in the future.

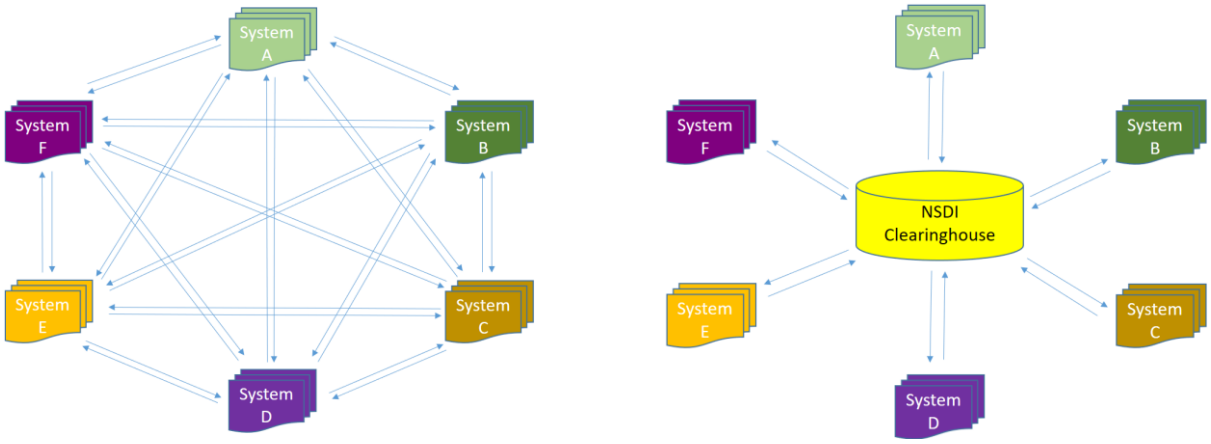
4) Development of the draft metadata guideline

The JICA project team formulated draft metadata guidelines based on this NSDI-PS review and the results of surveys conducted at related organizations including the SoB on

existing metadata specifications and other such details. International standard ISO 19115-1:2014 (Geographic information – metadata group 1: Basic items) issued by ISO/TC 211 (Technical committee concerning geographic information) and JMP2.0 which is the metadata profile in Japan were used as reference when formulating the draft. Furthermore, a portion of the metadata items required in ISO 19115-1:2014 etc. were omitted in order to reduce the initial burden on related organizations, consolidating the items into the minimum required as a NSDI-PF.

5) Improvement of efficiency search with metadata on the NSDI-PF

It can be expected that the efficiency of geographic data distribution will be enhanced by the sharing of geographic data on the NSDI-PF that is being developed.



(1) Without the NSDI (2) Within the NSDI

Source: The Project Team

Figure 4-3 Conceptual diagram of efficient geographic data search using the NSDI

[3-2] Standardization of quality control, data product specifications, and sharing of them with related organizations

The first step in the utilization of the NSDI in preparation for the elimination of duplication, enhancing the efficiency of existing work, and the creation of new industries and services consists of the sharing of what kind of data exists in which locations and the quality level of the data.

1) Basic structure of the data product specifications

The sharing of Data Product Specifications (DPS) and product specifications that indicate the type, content, structure, quality and other characteristics of the GIS data prepared /

managed by each organization is required for the NSDI. DPS is a term that is defined by ISO/TC 211 in ISO 19131 (Geographic information - Data product specifications), and JIS X 7107 (Geographic information - Data product specifications) which complies with ISO 19131 that has been established in Japan. Data product specifications is a term which is not generally known, but this content is naturally prepared by any organization that prepares / manages geographic data, including explanations/definitions, quality, metadata rules and other such content.

In other words, data product specifications consist of materials that indicate the content of data, structure, quality evaluation standards and other details, serving the role of design specifications when data is prepared, and as a user manual when data is used. The basic structure of the data product specifications prescribed by ISO/TC 211 with ISO 19131:2007 is described below.

1. Overview
2. Specification scopes
3. Data product identification
4. Data content and structure
5. Reference systems
6. Data quality
7. Data product delivery
8. Metadata
9. Others

Source：ISO 19131, JPGIS (Extract by JICA Project Team)

Figure 4-4 Basic structure of the DPS

An overview of the respective elements of the basic structure of the data product

specifications is described below.

- Overview

An overview of GIS data is described in "Overview". Specifically, data product specifications include the names of items, the preparing organization, date of preparation, target geospatial data, objective, space range, time range and other such information. These descriptions are required information when preparing metadata.

- Specification scopes

The "Specification scopes" section describes information on whether the data product specification applies to the entire data set, or to the layer or features below it.

- Data product identification

"Data product identification" section consists of information concerning the data itself as described in the data product specifications. This includes the data name, summary, theme classification, geographic range and other such information.

- Data content and structure

The "Data content and structure" section describes the names, definitions, spatial feature type (point, line, polygon, etc.), name of attribute, domain of value obtained, relationship between features and other information for all planimetric features included in the data. ISO 19131 and JIS X 7131 specify the data structure of UML class diagrams that can be expressed as an applied schema with Unified Modeling Language (UML), and that information which cannot be described with a class diagram be prepared with an applied schema document. However, in this project, the decision was made to use existing data explanatory documents and data definition documents instead of an applied schema. The reason for this is to reduce the burden on the organization preparing the data. In the future, it is hoped that applied schema that comply with international standards will be used to describe data content and structure.

- Reference system

The "Reference system" section describes the standards for space and time. The space reference system extracts the coordinate reference system which is defined by ISO 19111 (Geographic information – Referencing by coordinates) and the geographic identifiers defined by ISO 19112 (Geographic information – Spatial referencing by geographic identifiers). The time reference system is based on the definitions in ISO 19108

(Geographic information - Temporal schema), but use of the almanac that is generally used in Bangladesh was enabled.

- Data quality

"Data quality" section describes the quality requirements that indicate an acceptable level of quality for the data. The quality in this case targets the correctness of the attribute information, in addition to geometric elements such as the correctness of the feature position, shape and other. ISO 19157 (Geographic information – Data quality) classifies data quality into 15 types of elements, but quality requirements do not need to be made for all of these elements, with the ability to select the required data quality elements according to the objective of the data.

Specifically, regarding the selected respective quality elements, the content and scope of the data to be targeted should be described as the "Data Quality Applicable Scope" and what should be measured for the quality (indicators, e.g. standard deviation of position) and what level can be accepted (suitable quality level) should be described as the "Data Quality Basic Evaluation Scale".

In addition, the quality evaluation methodology should be described, although this is optional.

- Data product delivery

"Data product delivery" section describes the format (data format, etc.) and the form (CD-R etc.) in which the data is to be delivered. Geographic Markup Language (GML) is recommended as the data format in ISO /TC 211, but shape file, text or another such format will be adopted for this project in order to reduce the burden on the related organizations.

- Metadata

"Metadata" section describes the metadata specifications, including the definition of metadata. The point should be noted that metadata itself is not described.

- Others

"Others" section describes the important items when geospatial data is prepared / used as necessary. For example, the time at which data is updated, data acquisition procedure and other such details can be described.

The JICA project team prepared draft guidelines for the data product specifications that

conform to this basic structure. Provisions were made to enable referencing of data definition documents that indicate the content and structure of existing data, quality management standards, metadata rules and other such standards when they exist in consideration of the actual circumstances in Bangladesh. Draft data product specifications for the SoB 1:25,000 scale topographic map were prepared, and shared with the SoB and NSDI-WG members along with draft guidelines.

2) Current status of SoB

Technical instructions (Bengali language) for the Field verification of the 1:25,000 topographic (basic) map were obtained from the SoB as an indicator of data quality. Accordingly to the provisional English translation of the technical instructions, they specify that a Handheld GPS unit should be used in the field to acquire coordinates at an accuracy of 5 meters or less with the BUTM-2000 coordinate system. The codes for inputting the measured planimetric features into the GIS are to be entered at the same time.

Instructions:

01. A) Collect the required equipment / material for field verification before departure.After getting the blue print; the party office must check all the data, including print quality, seat dimensions.If a particular dataset was already established during the survey, it would have been surveyed if it had not been in blue print.
    B) Before going into the field, one should compare the plotter print with a map of the scale of 1:25,000 scales, and prepare the data during the field survey accordingly. After coming from the field, the GIS unit could not be called to add data from the previous 1:25,000scale map.
02. The map of the river area should be surveyed on river basin, tidal, non-tidal i.e. flow arrow, tidal arrow, high water line, low water line and steamer (Steamer Ship) service, launch (Mini Ship) service.
03. Data from various features should be collected according to a map specification of 1: 25,000 scale prepared by the Bangladesh Survey Directorate. On the other hand, the GIS feature code is very urgent so every feature code surveyed must be written in hard copy according to the recorder code (Record Code 2019) provided by GIS.
04. A) Insertion guides, dilation guides and color trace accessories must be completed before the survey begins. All the surveyed data should be collected using handheld GPS / PT.
    B) Camp officers / technicians will learn how to use handheld GPS before entering the field.
    For example, setting GPS receivers to BUTM-2010 and calibrating with control points check time, units and position formats from setup options.
    C) Upon leaving the field, the technician will compare the coordinates of the GPS near the camp and make an auxiliary point at the camp if necessary, to confirm the accuracy of the handheld GPS before going to field work.If at least four / five minutes of monitoring by the handheld GPS is displayed, then the stored coordinates will be saved / store and recorded in the co-ordinate list if Accuracy 5M or less is displayed. Download and save/store the collected data to the computer.

Source: SoB (Original in Bengali language, provisional English translation by JICA project team)

Figure 4-5 Instruction of the field verification survey on 1:25,000 scale topographic maps (English provisional translation) (extract)

3) Current situation of NSDI-WG members

Information on the general rules related to data quality could not be obtained by means of a survey of related organizations. Since each organization produces data, there should always be a predetermined procedure for data production and standards for accuracy. In reality, each organization that produces data is likely to make its own judgments on data quality for each project. The awareness of data quality by related organizations needs to be renewed in the future through activities to prepare data product specifications.

4) Data quality elements

The "data quality" of geographic information is classified into 15 types of quality elements by ISO 19157 (Geographic information - Data quality). The quality in this case targets the correctness of the attribute information, in addition to the correctness of the feature position, shape and other such geometric elements.

Table 4-22 List of data quality elements

No.	Data quality elements	Categories
1	Commission	Completeness
2	Omission	
3	Conceptual consistency	Logical consistency
4	Domain consistency	
5	Format consistency	
6	Topological consistency	
7	Absolute or external accuracy	Positional accuracy
8	Relative or internal accuracy	
9	Gridded data positional accuracy	
10	Classification correctness	Thematic accuracy
11	Non-quantitative attribute correctness	
12	Quantitative attribute accuracy	
13	Accuracy of a time measurement	Temporal quality
14	Temporal consistency	
15	Temporal validity	

Source: The Project Team

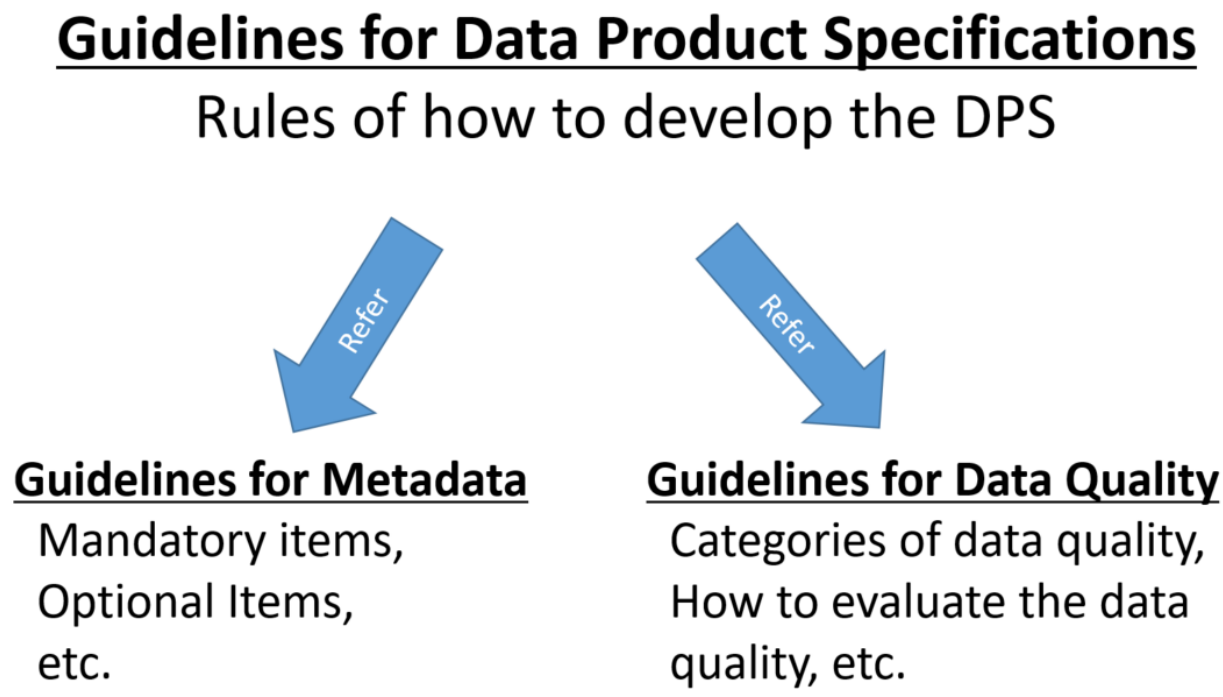
5) Draft data quality guidelines

Draft data quality guidelines were formulated for the data quality using ISO 19157:2013 (Geographic information - Data quality) as reference. The draft guidelines describe the data quality evaluation methodology in addition to the definition of the 15 types of data quality elements.

In fact, provisions were made to enable referencing of existing quality standards when such materials exist, in the same manner as for the technical instructions for the field verification of the 1:25,000 scale SOB topographic maps. This measure was taken to reduce the initial burden on related organizations, and help obtain a grasp of the current status and share this information.

6) Relationship with three draft guidelines

Draft data quality guidelines have a structure that refers to the draft data product specification guidelines and draft metadata guidelines. The reason for this is the respective ISO standard referenced by these guidelines differs. When the ISO standard that is reference is updated, the respective draft guidelines should be independently updated.



Source: The Project Team

Figure 4-6 Relationship with the draft guideline

7) Support for the development of the data product specifications by NSDI-WG members

The organization that has the jurisdiction over the data should be responsible for preparing the data product specifications, because that organization is the most familiar with the content, quality and other details for the required data. The JICA project team made the decision to hire a local consultant to provide support since it is difficult for all intents and purposes for NSDI-WG member organizations to prepare data product specifications with only self-supporting efforts. The Bangladesh Branch of the Esri South Asia Company was hired as a local consultant in September 2020 by means of bidding procedures.

In addition, two engineers from the SoB NSDI Project Cell were designated in order to provide support together with the local consultant for preparation of data product specifications for NSDI-WG member organizations.

The local consultant and SoB began visiting WG member organizations in November 2020. Work is proceeding with the objective of preparing the data product specifications for the WG member organizations (25 organizations) by about June 2021. The JICA experts will perform progress management and provide technical advice.

[3-3] Study and research on Geographic Information Standards

1) WTO and TBT agreements

Bangladesh is a member of the World Trade Organization (WTO). The Technical barriers to trade Agreement (TBT Agreement) obligates countries that are members of this organization to formulate domestic standards based on international standards. The objective of the TBT Agreement is to eliminate barriers to international trade caused by

differences in standards.

2) Procedure for Bangladesh's participation in ISO/TC 211

Technology related to geographic information is making rapid progress. In the future, it is necessary that the NSDI in Bangladesh continues to comply with international rules concerning geographic information in order to facilitate usage by organizations, companies and other entities inside and outside of Bangladesh without distinction. For this purpose, it is hoped that the government of Bangladesh will participate in activities to formulate / update the international standards in ISO/TC 211.

The JICA project team collects information on the procedure for Bangladesh to participate in the ISO/TC 211 from the Bangladesh Standards and Testing Institution (BSTI) which is the representative of ISO in Bangladesh. The ISO has technical committees (TC), which are divided into P members (Participating members) which have voting rights concerning deliberation of standards, and O members (Observing members) which do not have voting rights. Due to the fact that Bangladesh is not currently participating in the TC, it is appropriate that it first participate as an O member in order to acquire experience. It was found that the procedure to participate in the TC as an O member consists of selecting members that are suitable as a domestic deliberation committee in Bangladesh, and an official request needs to be made from the SoB to the BSTI. A domestic deliberation committee should basically consist of stakeholders from industry, government and academia. From this point on, it is necessary that an awareness among related organizations needs to be shared concerning the significance of participating in the ISO/TC 211, and this be used for coordination when selecting organizations which participate in the domestic deliberation committee.

An overview of the interview of the BSTI is described below.

Interview date/time: February 11, 2020 (Tues.) 10:05 – 10:50

Interview results: Shown in Table 4-23.

Table 4-23 Results of interview survey to BSTI

Interview items	Results
1) Overview	Procedure was verified to participate as O member (observing member) that represents Bangladesh at ISO / TC 211.
2) Procedure	(1) Surveyor General of SoB submits letter to BSTI Director General. At this

Interview items	Results
	time, it should state "Attention to: Director Standards". The letter needs to state the reason for participating in the ISO/TC 211 and the name(s) / position of the Expert(s) that will participate. (2) BSTI makes application to participate in the ISO based on this letter, and registration is completed when approved by the ISO.

Source: The Project Team

4.5. Output 4: Activities of "NSDI platform is formulated and utilized"

NSDI-PP was implemented in the previous project, developing a small-scale NSDI-PS, and preparing an evaluation report in which the NSDI concept, functional requirements, utilizations and effects were verified. The activities in Output 4 consisting of the "Start-up of the NSDI platform to be utilized for projects/services being implemented by various organizations" were reviewed for the NSDI-PS based on the evaluation report, the functional and non-functional aspects that needed strengthening were clarified, and used for the support of the establishment of the full-scale version NSDI-PF. Furthermore, demonstration experiments will be conducted with the objective of promoting utilization of the NSDI by various organizations after establishment of the NSDI-PF to facilitate implementation as a project which will be a model for good practices.

Plans called for the development of the full-scale version NSDI-PF to be implemented in the one year comprising the first half of the project, but due to the fact that the TAPP was approved by the government of Bangladesh in July 2020, resulting in allocation of the budget to the SoB in January 2021, it is expected that development will commence in January 2021 or after.

Consequently, the activities related to Output 4 focused on preparation of specifications (draft) for development of the full-scale version NSDI-PF, development of the SoB base map to be loaded onto the NSDI-PF and drafting of examples of NSDI utilization.

[4-1] Review of the evaluation of the NSDI Prototype System

1) Overview of the NSDI-PP evaluation report

As stated in section 3.6 above, 17 organizations participated in the NSDI pilot project working group (NSDI-PPWG) which was implemented during the two years from August 2017 to July 2019. A small-scale NSDI-PS was developed during the NSDI-PP activities, Dhaka and Sylhet were selected as the pilot areas, the geospatial information possessed by each organization was loaded onto the NSDI-PS, and an LGED project was implemented as a model case in order to examine NSDI-PS utilization methods.

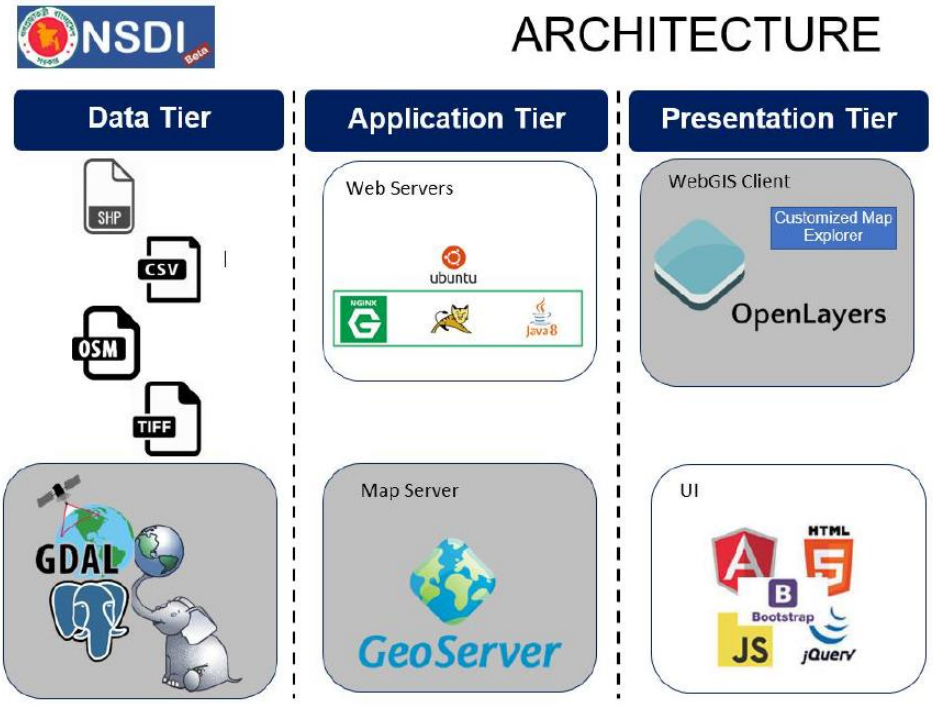
The NSDI-PP activity results were organized in the NSDI-PP evaluation report, and finalized in September 2019 (Appendix 5). The evaluation report describes the NSDI-PP background, NSDI-PP concept, NSDI-PS development content, NSDI-PPWG activities, data loaded onto the NSDI-PS, NSDI-PS trial operation, and validation/recommendation of the LGED project as a model.

2) Software configuration of the NSDI-PS

Since the objective of NSDI-PS was to establish a small-scale prototype system, rather than developing an original system starting from scratch, the functions required for the NSDI were added, based on GeoDASH which is a data sharing system (mainly used for disaster information management) operated with BCC which already exists.

GeoDASH was established by customizing GeoNode which is an open source geospatial information content management system. GeoNode is a package containing functions to prepare and share geospatial data, and provides a number of functions, such as uploading of map data, map display, and searching of map data and metadata. GeoNode is entirely comprised of open source software, and can be freely used by developers with a GNU General Public License Ver. 2.0. No special software such as ArcGIS or QGIS needs to be used on the user side, enabling the system to be utilized with only a Web browser.

The configuration of the software that is used with NSDI-PS is shown in Figure 4-7.



Source: System design document of the NSDI-PS Team

Figure 4-7 Software configuration of the NSDI-PS

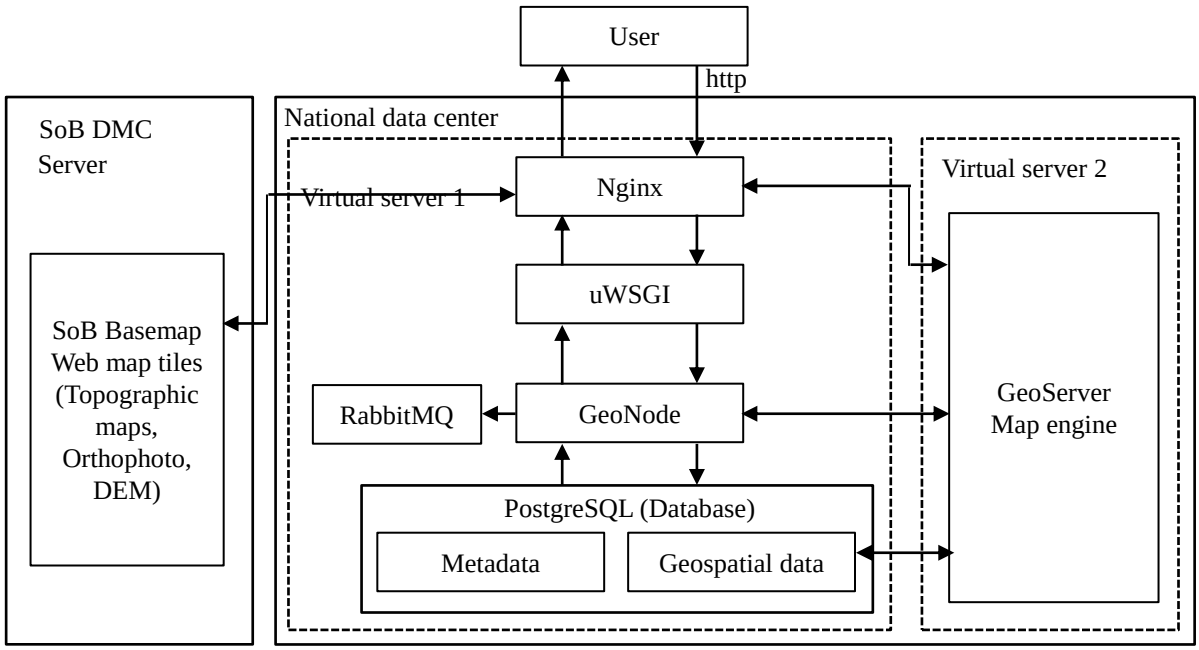
3) NSDI-PS hosting environment

The NSDI-PS is delivered over the internet by storing the applications as well as the map data and metadata that is uploaded from each organization on the servers at the national data center managed by the BCC, and using the network devices at the national data center.

The BCC national data center has acquired the Tier 3 level standard for evaluation and rating based on the redundancy and other characteristics of incidental facilities, which is one level below the Tier 4 top level.

All data was stored within the national data center when the NSDI-PP was implemented. Due to the fact that the volume of data would be enormous after completion of the Web map tile data for the SoB base map (topographic map), the system was changed to store the SoB base map data on the servers at the national data center and mash it up as a background map on the system.

The hosting environment for the NSDI-PS is shown in Figure 4-8. Users access the data with the Web server. NSDI-PS searches the geospatial information and metadata stored in the database via the content management system in response to user requests, and the results are displayed on the user Web browser. GeoServer, which converts the geospatial information stored in the database into images for display on a web browser, is separated into a virtual server due to the heavy load for image generation processing. The Web map tile data that is stored on the DMC server is referenced for the SoB base map, the required tile images are acquired according to the request by the user, and delivered as a background map on the Web system. An overview of the respective components is shown in Table 4-24.



Source: Design document of the NSDI-PS

Figure 4-8 Conceptual diagram of the NSDI-PS hosting environment

Table 4-24 Overview of the core component of the NSDI-PS

Component	Overview
Nginx	Nginx is the web server which accepts all the requests from the users. Then nginx delivers the request to the correct destinations. Requests with slashed GeoServer just after the domain name goes to the GeoServer and others goes to uWSGI.
uWSGI	uWSGI (Web Server Gateway Interface) is the Django server. uWSGI communicates with nginx through a socket connection.
RabbitMQ	RabbitMQ is the message broker. It is responsible for sending message asynchronously.
GeoNode	GeoNode is a CMS (Content Management System) written in python as well as Django web framework. A list of open source libraries and frameworks are responsible for running GeoNode.
PostgreSQL	PostgreSQL is the main data storage for the whole NSDI system. Database is divided into two parts. One is metadata database and another is vector data database. Metadata database holds data of data and vector data holds all the vector data of the layers as well as maps.
GeoServer	GeoServer is the main map server of NSDI system. It holds all the layers and communicates with PostgreSQL vector database. It also works as tile server and serves maps from the data store. GeoServer keeps track of corresponding styles for each layer on NSDI system. This style is responsible for generating legends and the visualization of map.

Source: Design document of the NSDI-PS

4) NSDI-PS functions

NSDI-PS functions are divided into functions that allow registration, searching, downloading and other such operations to manage geospatial information, documents, and users, and Web mapping functions that allow display, searching, extraction, printing and other such operations for registered geospatial information. In addition, there are a number of system administrator functions, including analysis of usage status, error log display and backup. An overview of the current NSDI-PS functions is shown in Table 4-25.

Table 4-25 Overview of the functions of the NSDI-PS (current)

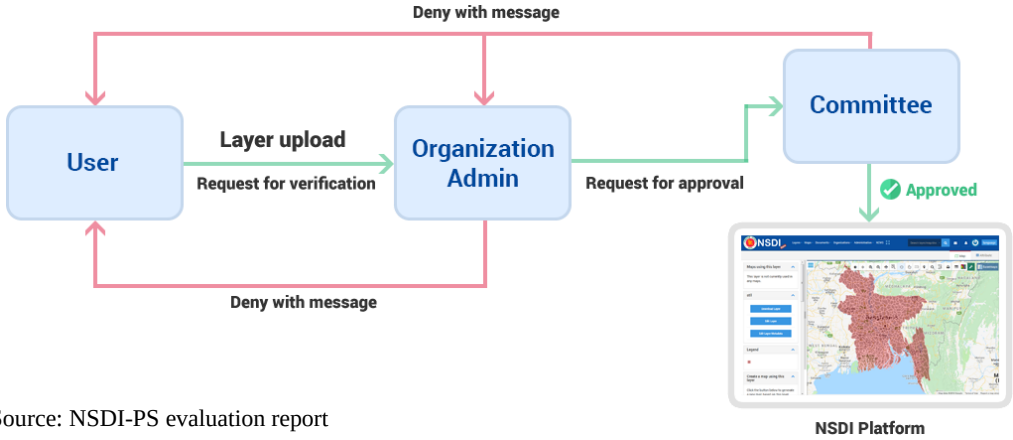
Type	Functions	Overview
Data and user management	Upload	Uploads resources (layers, maps, documents).
	Metadata registration	Registers, deletes and updates metadata for registered data.
	Publication range setting	Sets scope of disclosure of registered data.
	Search	Searches registered data, metadata and documents, and displays results.
	Organizational management	Registers, deletes and corrects information for organizations that use NSDI-PS.
	User management	Registers, deletes and corrects NSDI-PS user information.
	User list	Displays list of organizations and users registered in NSDI-PS.
	Map management	Displays list of maps created and disclosed by users.
Web mapping	Map creation	Uses data registered in NSDI-PS to create a map.
	Map display	Changes layer display, adds layer or changes display style.
	Search	Searches with specified range, buffer or attribute, and displays results.
	Attribute information	Displays list of attributes or individual attributes.
	Measure	Measures distance or area.
	Download	Downloads layer.
	Print	Prints map.
System management	Analysis of usage	Tabulates usage status of NSDI-PS for registration of maps, layers and documents, display and other such operations, and displays history.
	Error log display	Displays list of error logs from system.
	Backup	Backs up data (including metadata, etc.) registered in NSDI-PS.

Source: The Project Team

The approval process is one of the characteristics of NSDI-PS functions. Due to the fact that the NSDI-PS shares and distributes geospatial information owned by government organizations, approval by the organization to which the information belongs and the NSDI committee (tentative name) is required to register the information in the NSDI-PS.

The approval process is shown in Figure 4-9. After uploading information, NSDI-PS users request confirmation of the registered information from the administrator of the

organization to which the information belongs. After checking the information, the administrator of that organization makes an approval request to the NSDI committee (tentative name) for disclosing the information to other NSDI-PS users. The registered information can be used by NSDI-PS users after approval by the NSDI committee (tentative name). Accordingly, the structure prevents users other than the user that registered the information to use the information unless approved by the NSDI committee (tentative name). In addition, when approval is denied by the administrator of the organization to which the information belongs and the NSDI committee (tentative name), a notice of this content is sent to the user that registered the information and administrator of the organization to which the information belongs.

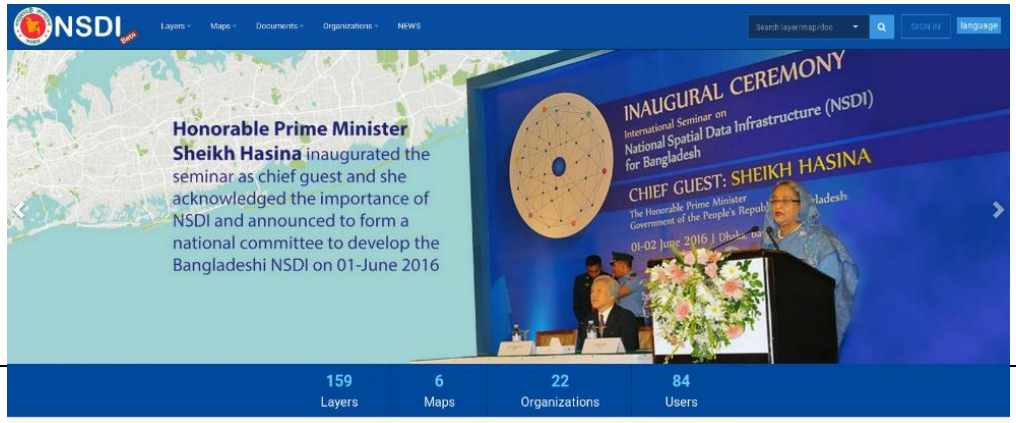


Source: NSDI-PS evaluation report

Figure 4-9 Workflow of the approval process

Furthermore, at this point in time, the NSDI-PS can only be used by registered users, and general users (unregistered users) can only view the Web portal website Top screen and the registered organizations / users. The top screen enables the total number of layers, number of maps, number of organizations and number of users that have been registered to be confirmed (Figure 4-10). The NSDI-PS website address is https://nsdi.gov.bd/.

It is expected that the range of general users will be expanded in the future upon development of the full-scale version NSDI-PF and the starting of usage as a national geoportal.



Source: https://nsdi.gov.bd

Figure 4-10 Screenshot of the NSDI-PS portal site

5) Status of the data sharing on the NSDI-PS

The NSDI-PPWG member organizations registered the geospatial information possessed by each organization in the Dhaka and Sylhet pilot areas in the NSDI-PS during the NSDI-PP activities. A total of 154 layers were registered by 11 organizations, of which 126 layers were shared. The SoB released zoom level 7 to 15 raster format Web map tile topographic maps (currently up to level 17) as background maps. In addition, 3 sheets of vector format 1:25,000 scale topographic map data was registered.

Administrative boundaries, road networks, buildings, water supply/sewage facilities, water catchment areas, population statistics and other such theme data possessed by each organization was registered by LGED, DWASA, DNCC, DSC, BBS, BMD, UDD, SPARRSO, WARPO and DDM.

An overview of the number of layers and data registered by each organization is shown in Table 4-26. This table shows that the same type of information is being prepared for administrative boundaries and roads by multiple organizations.

Table 4-26 List of information uploaded into the NSDI-PS

Organization	Number of layers	Feature type of administrative boundary	Feature type of road shape	Buildings	Water body	Other
SoB	86	Polyline	Polyline	○	○	Topographic maps, DEM, etc.
LGED	7	-	Polyline with attribute	-	○	POI (School, market, hospital, etc.)
DWASA	10	-	Polygon with attribute	○	-	Water/sewerage facilities, zone, etc.
DNCC	2	Polygon(Ward)	-	-	-	Plot number
DSCC	3	Polygon(Ward)	Polyline	-	-	-
BBS	2	Polygon with statistics information	-	-	-	Statistics information (Population)
BMD	7	Polyline	-	-	-	Meteorological information
UDD	1	-	Polyline with attribute	-	-	-
SPARRSO	5	-	Polyline/ Polygon	-	○	Satellite image
WARPO	2	-	-	-	-	River information, catchment area.

Organization	Number of layers	Feature type of administrative boundary	Feature type of road shape	Buildings	Water body	Other
DDM	1	-	-	-	-	POI (Cyclone shelter)

Source: The Project Team

6) Functions requested for NSDI-PS

It was verified through NSDI-PP activities that the NSDI-PS has the basic functions required for an NSDI platform, consisting of functions to register/update data, display/search in catalog format, download, as well as functions to set information release range, and a two-stage approval process and other such functions.

However, an enormous volume of data needs to be managed with the full-scale version NSDI-PF, and requests were made by NSDI-PPWG members, including performance improvements in order to process large volumes of data, implementation of a more user friend UI, and structure that facilitates easy linkage of information possessed by each organization, and these requests were compiled in the NSDI-PP evaluation report.

Whether or not these requests will be included in development of the full-scale version NSDI-PF, the priority and difficulty level have been organized in Table 4-27. Functions selected as candidates that have high priority and are required to promote utilization of the NSDI-PF consisted of: Loading of each organization's thematic maps along with SOB base map, Addition of data formats that can be registered, and Searching of all available layers displayed on the map. On the other hand, SMS notifications during the approval process, even if they are less difficult, were given a lower priority due to the high cost of communication.

Table 4-27 List of remaining requests on the functions of the NSDI-PS

No.	Request	Point of view	Priority	Difficulty level
1	Should have some public layer/map to be accessed by any user other than NSDI WG organization.	Priority is low since operation within NSDI-WG members is expected for the time being.	Low	Low
2	Restricted meta data, any other organization/user will not be able to see those metadata.	Priority is middle since metadata is released as a basic rule. Metadata items will be discussed in the future, and whether there are items that should be kept undisclosed will be considered.	Middle	Low

No.	Request	Point of view	Priority	Difficulty level
3	Each organization thematic map along with SOB base map	Priority is high since amount of deviation is checked when thematic map of each organization is superimposed on SoB base map, requiring consideration of what types of corrections / revisions when deviation is found.	High	Low
4	Add extra feature like Earth Explorer operating by USGS.	Function needs to be newly developed as it is not a GeoNode package function. In addition, priority is low since data to be loaded onto NSDI-PF needs to be enhanced.	Low	High
5	Map annotating (like a data type of ArcGIS).	Difficulty level is high due to load applied by processing for annotation display with Web application. Priority is low for time being since this can be handled with label display.	Low	High
6	Additional data type import facilities like: GDB, AutoCAD/DXF.	Difficulty level is high, but a lot of the data is prepared in ArcGIS GDB format, so priority is high in order to reduce burden on data registrant.	High	High
7	Search all available layers in current map extend.	Priority is high for searching of entire content in the same manner as with Google search in order to enhance user operability.	High	Middle
8	External tile API add from NSDI admin panel.	External API import setting is supported with program source. Priority is middle since frequency of adding API is not high.	Middle	Middle
9	Create raster layer/tile for different zoom level with different symbology and threshold.	Difficulty level is high since this is not provided as GeoNode package function, and improvements are needed in order to match symbol setting with display level.	Low	High
10	Layer approval notification through SMS.	Technically less difficult, but a small amount of communication expenses are incurred to send SMS message. Therefore, priority is set as low.	Low	Low (Charged)

Source: The Project Team

7) Suggestions for development of the full-scale NSDI platform

The NSDI-PP evaluation report and NSDI-PS operation status were checked, three challenges which should be implemented within one year were designated, and suggestions were made for steps to tackle these challenges.

Challenge 1：Publish SoB base map on the NSDI-PS

Raster format Web map tile data from Zoom level 7 to 15 has been loaded onto the NSDI-PS for the 1:1,000,000 scale national map to the 1:50,000 scale topographic map out of the base maps at the SoB. However, the 1:25,000 scale topographic map covering the entire country which is the latest topographic map has not been loaded onto the NSDI-PS, meaning that the information with the highest utility value has not been

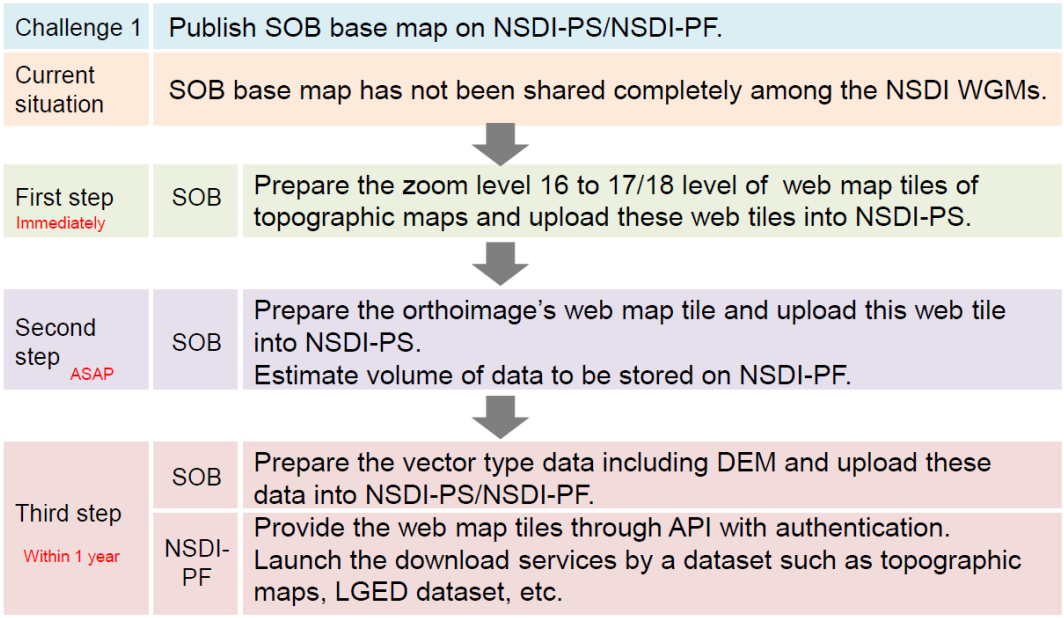
released. In addition, there is only a very small portion of sample data for orthophoto images and DEMs.

Therefore, raster format Web map tile data for the 1:25,000 scale topographic map from Zoom level 16 to 17 will be generated and loaded onto the NSDI-PS as the first step.

Next, Web map tile data for the orthophoto images will be prepared, and the volume of that data will be estimated.

Finally, it was suggested that vector format NSDI-PS data which includes DEMs be prepared, a structure be established that is capable of providing Web map tile data for base map to external parties using API, along with the establishment of the full-scale version NSDI-PF (Figure 4-11).

Therefore, as of December 2020, Web map tile data at a scale of 1:25,000 has been released on the NSDI-PS, and preparations for completing generation of the orthophoto image Web map tile data and release of this data are being conducted.



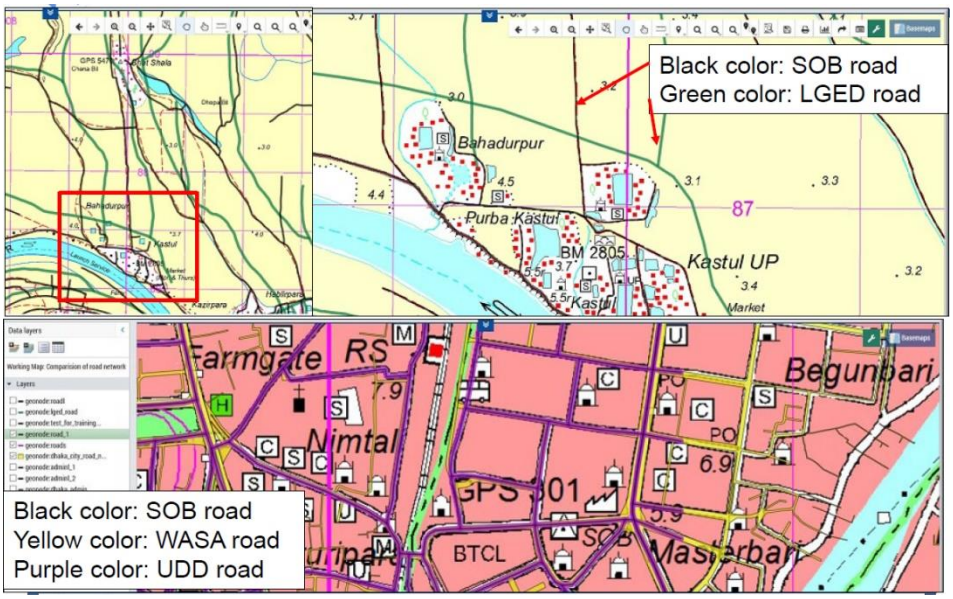
Source: The Project Team

Figure 4-11 Steps to publication of the SoB base map

Challenge 2：Share geospatial data from each organization on NSDI platform

A total of 154 layers of data from 11 organizations has been loaded onto the NSDI-PS, and 124 layers are being shared, but data from all organizations is not currently being shared, and there are some organizations which are newly participating as a NSDI-WG

member since this project was started. In addition, as shown in Table 4-26, duplicate development of the same features is being performed by different organizations, resulting in individual data items not matching since the data preparation methods, accuracy, time and other details differ. The road data from the SoB, LGED, WASA and UDD is superimposed on the SoB base map in Figure 4-12. The upper portion of the diagram shows that there is a large deviation between SoB road data and LGED road data. The lower portion of the diagram indicates that the source is probably the same for the SoB road data and UDD road data since they match, but there is a difference from the WASA road data.



Source: The Project Team

Figure 4-12 Example for comparison of different data source (road data)

Consequently, as the first step, census sheets will be distributed again to each organization to conduct a survey on the status of the geospatial information that is possessed.

Next, geospatial information that can be shared among NSDI-WG members will be prepared based on the information described in the census sheets, and loaded onto the NSDI-PS. After this, the registered data will be verified on the SoB base map.

Finally, it was suggested that the specifications for geospatial information be standardized, and data upload functions be expanded (Figure 4-13).

Challenge 2		Share geospatial data from each organization on NSDI platform.
Current situation		11 organizations have uploaded 154 data into NSDI-PS and 124 layers have been shared.
First step Immediately	SOB, NSDI WGM	Survey a census of geospatial information data.
Second step ASAP	NSDI WGM	Prepare and upload geospatial information data which can be shared among NSDI WG members into NSDI-PS. Compare and validate these registered data from each organizations on SOB base map.

Source: The Project Team

Figure 4-13 Steps to sharing geospatial information between organizations

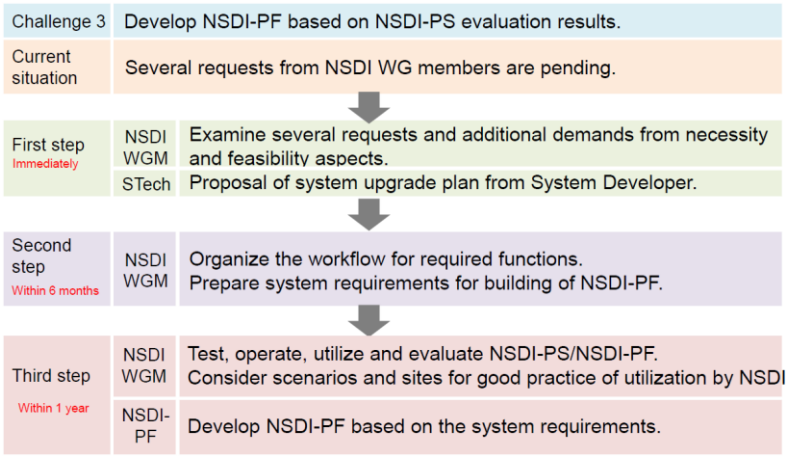
Challenge 3：Develop the NSDI-PF based on the NSDI-PS evaluation report

Requests for improvements were made by a number of NSDI-PPWG members during trial operation of the NSDI-PS, but they were put on hold since a response could not be made during the NSDI-PP.

Therefore, in the first step, the requested items will be reexamined from the standpoint of necessity and feasibility. In addition, a suggestion was made to expand the system by an NSDI-PS developer.

Next, the work flow of functions required to establish a full-scale version NSDI-PF will be organized and the system requirements will be prepared.

Subsequently, the NSDI-WG members will perform testing, operation, usage and evaluation after the full-scale version NSDI-PF has been developed. Furthermore, it was suggested that consideration of a scenario to facilitate good practices for the utilization of the NSDI by NSDI-WG members be implemented (Figure 4-14).



Source: The Project Team

Figure 4-14 Steps to development of the full-scale NSDI-PF

[4-2] Establishment of the NSDI platform including clearing house function

1) SoB base map in raster format for the NSDI-PF

The SoB base map data that is loaded onto the NSDI-PF consists of three types of data: topographic maps, orthophoto images and DEMs. As of the completion of the NSDI-PP activities, a wide range of maps have been loaded, from a map at a scale 1:1,000,000 that covers the entire country to 1:50,000 scale maps and topographic maps. Orthophoto images and DEMs for a portion of Chittagong and Sylhet have been loaded as a trial case.

Subsequently, up to 1:25,000 scale topographic maps were loaded onto the NSDI-PS, enabling NSDI-WG members to utilize this output.

As of the end of October 2020, Web map tile data has been completed for orthophoto images with the entire country divided into 54 blocks, and a survey is being conducted on server capacity and folder configuration in preparation for release on the NSDI-PS.

The results of aerial photographic surveying conducted in 2012 were used to create a 5m mesh DSM for the DEM with the stereo matching method. After this, the DSM point clouds were displayed on the aerial photo using a digital stereo plotter, and work to visually change elevation points of trees, buildings and other features (non-ground points) to the ground points is being performed, with a progress rate of approximately 5% as of December 2020.

The specifications for the raster format Web map tile data for the respective base map data are described below.

a) Topographic map data

Web map tiles in raster format of topographic maps were generated using the PDF data of topographic maps and compilation maps produced by the SoB as a data source, and using the tile image generation tool created by long-term experts in the previous project. Technology transfer to SoBL engineers has been performed for the tile image generation tool usage procedure, and raster format Web map tile images were being prepared for loading onto the NSDI-PF after the previous project ended.

However, when the status of progress was verified upon starting of this project, it was found that topographic map tile image generation of level 16 and 17 at a scale of 1:25,000 had stopped. When the status was checked with the SoB engineers, an error caused by an

incorrect designation of adjoining map sheet name was identified, and the problem was solved by setting the correct sheet name.

This illustrates the issue of the long-term expert not being there after the project ended as the person that SoB engineers can consult with when they do not understand the reason for an error that has occurred, and the error being left unsolved. In the future, it is necessary that SoB engineers learn the procedures to resolve errors that can be expected so that they can identify the causes of errors themselves.

As of December 2020, Zoom level 7 to 17 compilation maps and topographic maps have been loaded onto the NSDI-PS. The number of folders, number of files and data volume for each level of raster format Web map tiles for the topographic maps are listed in Table 4-28.

Zoom level 7 to 10 consist of 1:1,000,000 scale compilation maps, level 11 to 12 consist of 1:500,000 scale compilation maps, level 13 consists of 1:250,000 scale compilation maps, level 14 to 15 consist of 1:50,000 scale topographic maps, and level 16 to 17 consist of 1:25,000 scale topographic maps.

Table 4-28 Composition of the web map tiles in raster format of SoB base map

Zoom level	Approximate on-screen scale of tile image (near Dhaka)	Map scale of data source	Number of folders	Number of files	Data volume (MB)
7	1:4,220,000	1:1,000,000	6	24	1.1
8	1:2,110,000	1:1,000,000	10	70	3.8
9	1:1,050,000	1:1,000,000	18	234	12.3
10	1:528,000	1:1,000,000	36	936	35.5
11	1:264,000	1:500,000	37	1,411	72.3
12	1:132,000	1:500,000	72	5,396	208.0
13	1:66,000	1:250,000	115	15,616	790.0
14	1:33,000	1:50,000	218	38,494	1,228.8
15	1:16,500	1:50,000	434	152,400	3,727.4
16	1:8,250	1:25,000	866	546,118	4,362.2
17	1:4,125	1:25,000	1,731	2,213,306	10,025.0
Total	-	-	3,543	2,974,005	20,466,4 (約 20.0GB)

Source: The Project Team

b) Orthophoto image data

Orthophoto image Web map tile data to be loaded onto the NSDI-PF was prepared by combining ground resolution 50cm images created from the results of the aerial

triangulation conducted in 2012 with the satellite images near the border.

When this project was started, attempts were being made to create orthophoto image Web map tile data using the same program as for the topographic map Web map tile data. However, the file size for one image file was very large at approximately 2.7GB, making it difficult to effectively process images in this manner.

Therefore, verification was performed for the use of QGIS and QMetaTiles plug-in open source software using image data for 4 sheets (images). This resulted in confirmation that Web map tile data can be created without any problems from multiple sheets of image data.

However, when attempting to create orthophoto image Web map tile data using existing equipment at the SoB, it was found that it takes approximately 2.6 times more than the time compared to when using the notebook PCs used by the JICA project team for image loading and image generation processing.

Orthophoto image data is the next most important type of data in the SoB base map to be loaded onto the NSDI-PS after topographic maps, and the data to be loaded needs to be prepared as soon as possible in order to promote utilization of the NSDI. Therefore, the decision was made to provide 3 sets of equipment to generate orthophoto image Web map tile data, using the specifications of the PCs used by the JICA project team as reference (Table 4-29).

Table 4-29 Specifications of the equipment for generating orthophoto image web map tile

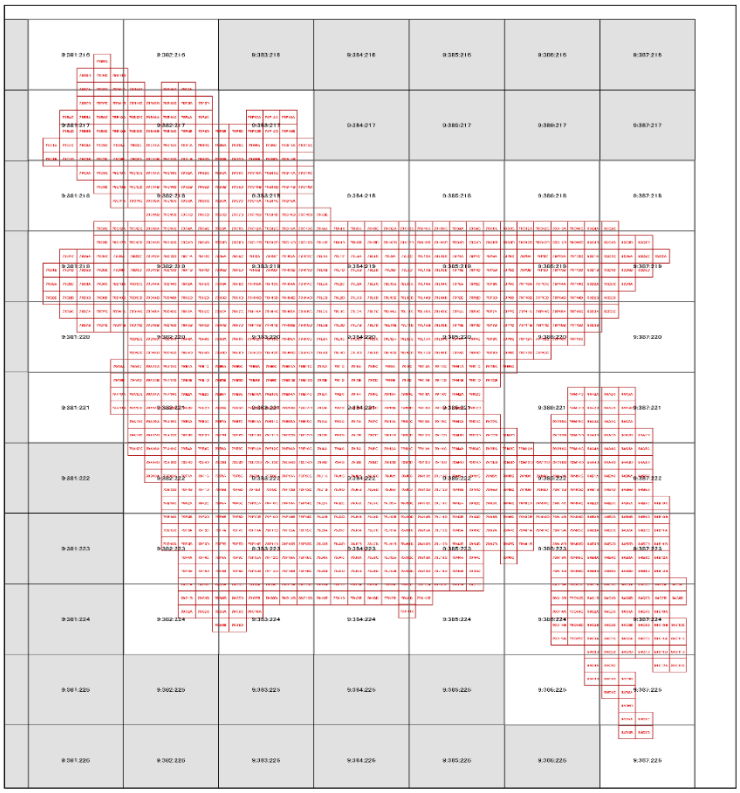
Equipment	Specification	Description	Number
Desktop PC	CPU	Intel Xeon® E 2136G (3.30GHz, 12MB, 6Core)	3 sets
	Memory	32GB (4x8GB DDR4 2666MHz ECC)	
	HDD	3.5 inch 2TB SSD Hard Drive	
	Graphic board	5GB DDR5 NVIDA Quadro-P2000	
	Monitor	FHD 23 inch Monitor	
	OS	Windows 10 Professional for Workstation 64bit	
	Office	Microsoft Office 2016 Professional	
UPS	Capacity	2.0KVA	3 sets
	Back up time	15 minutes	

Source: The Project Team

Due to the fact that batch processing using all 980 images cannot be performed, the decision was made in consideration of work efficiency and data management to prepare Zoom level 9 as the minimum level, and dividing the entire country into 54 blocks as the implementation method was adopted. The sheet division for the orthophoto images and

demarcation diagram of the 54 blocks are shown in Figure 4-15.

In addition, a manual providing instructions to the SoB engineers on the generation procedure (Appendix 6 Procedure for generating orthoimage map tiles by using QGIS + QMetaTiles plugin) and check sheet used to perform progress management (Figure 4-16) were prepared, and an explanation was provided in OJT format to facilitate technology transfer.



Source: The Project Team

	A	B	C	D	E	F	G	H	I	J	K
1	54							8			63.66
2		UserNo	Z	X	Y	Flag	Remarks	Date	Start	End	Data_size (GB)
36	1	gpo21	9	381	216	1	Completed	2019/12/5	15:01	15:35	2.82
37	2	gpo21	9	382	216	1	Completed	2020/2/23	15:58	17:30	1.93
38	3	gpo21	9	382	223	1	Completed	2020/2/23	11:15	15:53	9.2
39	4	gpo21	9	382	224	1					

Source: The Project Team

Figure 4-16 Example of check sheet for generating the web map tile of orthophoto image

The orthophoto image Web map tile data for all ranges had been generated at the end of October 2020, with a total data volume of approximately 1.5TB. The data which was divided into 54 blocks was compiled in one folder structure as of December 2020, reaching the stage at which designation of the delivery server for display on the NSDI-PS is being performed.

c) DEM data

SoB is preparing 5m mesh DEM data from the results of the aerial triangulation conducted in 2012, and had completed approximately 50 sheets as of November 2020 out of the total of 980 sheets. One sheet of DEM data (TIFF format) has been used as sample data and loaded onto the NSDI-PS as a color coded elevation diagram.

Based on the DSM which was automatically created from the aerial triangulation results, DEM data is being used to create a Digital Terrain Model (DTM) for which the surface elevation has been manually corrected.

Therefore, differing from other base maps, it is expected to take a certain amount of time to load the data onto the NSDI-PF. However, after the generation of the DTM data in a certain range is completed, color coded elevation map Web map tile data will be sequentially created and loaded onto the NSDI-PF.

2) 1:25,000 scale SoB base map in vector format

One of the functions of NSDI-PF, the SoB base map displayed on the Web GIS, is designed to use data in map tile format as a background map.

On the other hand, some users want to create a thematic map by overlaying their own data on a map, using only the skeleton of administrative boundaries, roads, rivers, etc. as a background map, rather than data in map tile format that displays all terrain and map elements.

However, as shown in Table 4-26, administrative boundaries, roads and other such features were independently developed by multiple organizations, and it has become clear that there are gaps in the data due to differences in the preparation methods and source materials. Accordingly, in order for the data created by each user to be superimposed on the SoB topographic map and displayed in a consistent manner, it is necessary to share the

same map as the background.

All elements of the three layers of 1:25,000 scale digital topographic map data has been loaded onto the NSDI-PS as sample data. Users can select the required layers to enable display on the NSDI-PS Web GIS by individually adding layers.

However, at present, since the data is registered layer by layer, it cannot be displayed properly unless the user knows what the layer means and what range it covers, a situation that depends on the data processing capabilities of the users.

In addition, when providing 1:25,000 scale digital topographic maps to other organizations, they are distributed after payment of a charge, making it very difficult to load all layers onto the NSDI-PF and allowing them to be freely utilized.

Accordingly, users need to narrow down the elements to only those required for the preparation of thematic maps such as administrative boundaries, roads, rivers, buildings and other such features, as well as contour lines and other geographic / map framework elements, and then consider which features to load onto the NSDI-PF as one package in a map unit.

3) Study the vector tile of 1:25,000 scale SoB base map

Web map tiles are divided into small tile images for each map scale in advance, with a structure created that allows exchange of only tile images between the server and client in order to enable display of maps at high speed even when the system is accessed by multiple clients at the same time.

Raster format Web map tiles were mainstream in the past, and Web map tiles loaded onto the NSDI-PS are also in raster format. When raster format is used, the source map images or map display style on the GIS is prepared, and generated according to the scale by simply clipping the 256x256 pixel image. Since the generated data is in image format (PNG), it has the feature of allowing the results to be easily confirmed.

However, when image format is used, since the data is prepared following the format of the source map image or set map display style, when changing the mode of expression, Web map tile data needs to be created in each case. For example, when wishing to change between the display of maps in which place names, facility names and other names are in English or Bengali, two types of Web map tile data are required.

Therefore, in recent years, Google Maps, Geospatial Information Authority (of Japan)

maps and other such organizations distribute Web maps in encoded vector tile format.

The adoption of vector tiles enables the map expression to be freely changed by changing the map style file. In addition, multiple languages can be handled by saving notes as text data, allowing a wide range of information to be provided by storing attribute information such as road width and facility guides.

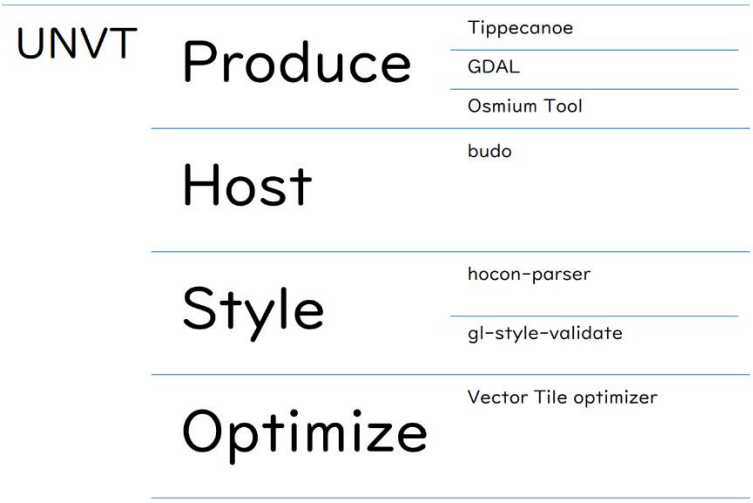
Furthermore, it has been said that the file size of vector tiles is smaller compared to raster format files, enabling the communication load between the server and client to be reduced.

However, differing from raster format tile images, the tools and procedure to generate vector tiles are complicated, and cannot be created by simply preparing the map data that the party wishes to distribute.

Therefore, in this project it is planned that the United Nations Vector Tile Toolkit (UNVT Toolkit) which is the basis for the vector tile mapping technique used by the Geographic Information Authority will be utilized, issues will be organized through trial production of SoB base maps (1:25,000 topographic map) for sample areas, a manual that enables SoB engineers to create vector tiles will be prepared, and guidance will be provided.

The UNVT Toolkit is based on the Rasbery Pi platform, and assembles multiple pieces of software required to create vector tiles in a single package (Figure 4-17). This software is entirely existing open source software.

Since this software is provided as one package, anyone can derive a certain level of results by understanding the role of each software component.



Source: https://github.com/unvt/pm/issues/22

Figure 4-17 Geospatial information software comprising the UNVT Toolkit

The manual is being edited based on the UNVT Toolkit manual which is available on GitHub in order to enable SoB engineers to understand the content and flow of work with UNVT Toolkit.

4) Estimation of the resources required for the full-scale NSDI-PF

The NSDI-PS was established as a small-scale database system targeting a portion of Dhaka and Sylhet as candidate areas, and is delivered from servers at the BCC national data center. Therefore, the system is comprised of the minimum amount of hardware resources necessary for operation, with two server instances allocated from the BCC.

When establishing a full-scale version NSDI-PF, it will be necessary to have a server configuration that has sufficient disk capacity to handle the geospatial information for the entire country of Bangladesh, and is capable of withstanding access from many users.

Plans call for discussions to be held with the BCC concerning the data storage capability and allocation of the required server instances.

a) Data volume

The data capacity was estimated from the values described in the census sheets provided by each organization as shown in Table 4-30, amounting to approximately 2.6TB. This includes the SoB base map Web map tile data, with the orthophoto image data comprising the largest portion at approximately 1.5TB.

Plans call for the SoB base map to be delivered from the SoB Digital Mapping Center server, with it not being necessary to store this data at the BCC data center. However, the availability of the data can be upgraded by storing this data on the BCC server so that service can be continued in the event the SoB base map cannot be distributed due to a DMC server or other such problem.

Table 4-30 Approximate capacity of data stored on the NSDI-PF (from census sheets)

Organization	Category	Data type	Volume (MB)	Volume (GB)	Remarks
SoB	Topographic maps	Raster tile	21,000	21	Zoom level 7 to 17
	Orthophoto image	Raster tile	1,550,000	1,514	Zoom level 9 to 18
	DEM	Raster tile	102,000	100	Zoom level 9 to 18
	Topographic maps	Vector tile	17,000	17	Zoom level 7 to 17

Organization	Category	Data type	Volume (MB)	Volume (GB)	Remarks
	1:25,000 topographic maps	Vector data	300,000	293	62 layers
	1:1,000,000 map	Vector data	80	0.1	50 layers
	DEM	Vector data	500,000	488	5m mesh point data
	Other	Vector data	10,000	10	Index, GCP, etc.
LGED	Thematic layer	Vector data	20,000	20	Road, public facilities, etc.
DWASA	Thematic layer	Vector data	15,000	15	Water/sewerage facilities, etc.
DNCC	Thematic layer	Vector data	200	0.2	Administrative boundaries, etc.
DSCC	Thematic layer	Vector data	500	0.5	Administrative boundaries, etc.
BMD	Thematic layer	Vector data	2,000	2	Metrological information (five years)
Other 20 organizations	Thematic layer	Vector data	135,000	131	
		raster data	100,000	98	
Total			2,772,780	2,708	≒2.6TB

Source: The Project Team

b) Server configuration

The hardware requirements shown in Table 4-31 are recommended as the server configuration required to operate the full-scale version NSDI-PF properly. There are a total of 14 instances for each server role and purpose. Linux was adopted for all operating systems (OS), and open source software is used for each software component.

The only servers that are directly accessed from the outside consist of the tile server, application server load server and the SSH server, with the other servers being isolated from the external network, and connected through conversion to the internal network IP address.

It is assumed that half the memory capacity for the Web server, DB server and application server will not pose a problem when operation is started, enabling capacity to be increased later according to the increase in load.

Table 4-31 Server configuration for the full-scale SDI-PF (draft)

Role	Purpose	CPU core	Memory capacity	Disk capacity	Disk type	IP
Tile server	Load balancer	2 Core	4GB	50GB	SSD	Public
	Tile server one with memory caching	4 Core	16GB	1TB	SSD	Private
	Tile server two with memory caching	4 Core	16GB	1TB	SSD	Private
Web server	Portal site, nsdi.gov.bd	8 Core	16GB	500GB	SSD	Public
DB server	Write only	4 Core	16GB	500GB	SSD	Private

Role	Purpose	CPU core	Memory capacity	Disk capacity	Disk type	IP
	Read only	8 Core	16 GB	500GB	SSD	Private
Application server	Load balancer	2 Core	4GB	50GB	SSD	Private
	Shared disk storage	4 Core	4GB	500GB	SSD	Private
	Message queue	2 Core	4GB	50GB	HDD	Private
	GeoServer (write only)	4 Core	12GB	100GB	SSD	Private
	GeoServer (read only 1)	4 Core	8GB	100GB	SSD	Private
	GeoServer (read only 2)	4 Core	8GB	100GB	SSD	Private
	GeoServer (read only 3)	4 Core	8GB	100GB	SSD	Private
SSH	Connect via SSH from external IP	2 Core	2GB	50GB	HDD	Public

Source: The Project Team

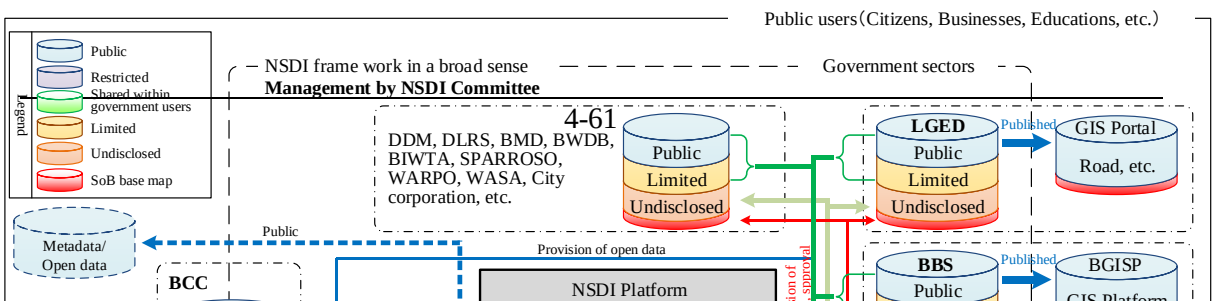
5) Consideration of the TOR for the development of the full-scale NSDI-PF

The full-scale version NSDI-PF will be positioned as the core system in the NSDI framework.

When developing the NSDI, the final form of system functions is that the NSDI-PF will consolidate base map data, common thematic data from each government organization, and metadata, and that the data will be shared and distributed within the authority given to users. Metadata for geospatial information in Bangladesh is stored on the NSDI-PF, and users can easily learn the location, quality and accuracy of the data by conducting searches.

Furthermore, by distributing SoB base map data (1:25,000 topographic maps, 1:5,000 topographic maps, orthophoto images, DEMs etc.) on the Web with an API that complies with the OGC (Open GIS Consortium) standard, users can refer to and utilize this map data as background maps in the same manners as Geographic Information Authority maps, Google Maps and Open Street Maps without providing a data server for the base map data at their organization, dramatically enhancing convenience.

At the current point in time, the NSDI-PF release range during this project period is assumed to be only within NSDI-WG members. The government of Bangladesh understands that the NSDI is beneficial for Bangladesh, and is implementing development support for the NSDI system with a view to the future concept shown in Figure 4-18 to make the NSDI highly sustainable.



Source: The Project Team

Figure 4-18 Conceptual diagram of geospatial information distribution in NSDI (future plan)

a) Basic policy for the full-scale NSDI-PF development

The NSDI-PS which was developed through the NSDI-PP activities has the basic functions to serve as the core system of the NSDI, and has received a certain level of reputation as a structure that will allow geospatial information to be shared in Bangladesh and circulated within related organizations.

At the same time, the NSDI-PP evaluation report has organized the functions lacking in NSDI-PS and the functions which should be improved, and additional opinions and requests have been voiced at the NSDI-WG member meetings and the first NSDI workshop.

A full-scale version NSDI-PF could use the method of creating a new system from scratch. However, this system is being developed with the budget of the Bangladesh government, and it needs to be completed within a limited amount of time to achieve a certain level of results during the period for this project. Accordingly, an agreement has been reached to develop a full-scale version NSDI-PF as the basic policy in order to reduce development costs and shorten the development period.

b) Functional enhancements

Additional and improved functions (draft) for the full-scale version NSDI-PF based on the NSDI-PP evaluation report and review, and opinions and requests voiced at the NSDI-WG member meetings and the first NSDI workshop are shown in Table 4-32.

Fundamentally, the content was prepared based on the priority set in the review of the evaluation report, but since the opinion was strongly voiced that there is the possibility the authorizer or administrator may overlook e-mails for SMS notice functions, the decision was made to include them in the functional requirements (draft) this time.

Table 4-32 List of the functional enhancements of the NSDI-PF (draft)

No.	Item	Description
1	Completely new UI/UX	The National Geo-portal should focus on what user wants from NSDI. - Showcasing most common layer categories - Quick, easy to use search with sophisticated result display - Simplified layer upload and approval process - Ensure compatibility with Microsoft Edge, Firefox and Chrome - A unique design
2	Tile server with caching	Since current infrastructure serves everything from on server/instance, it's recommenced to move the tile server in different instances with load balancing and memory based caching for reducing I/O operation.
3	ArcGIS extension for uploading layer	The function to upload data from Shape format and geodatabase format directly into the NSDI-PF as an extension of ArcGIS.
4	System wide searching	The National Geo-portal should have a nice and quick searching, which should search in layer name, tile, metadata, map, document, users and organization and grouped the search result based on the match. That means, from the search result, if it's a layer, then navigate to layer preview page when selected.
5	Extended cross layer buffer search	Search in multiple layers against one reference layer and then highlight the buffer region with different color code for different layer. A provision to save the buffer result as a new layer.
6	Searching layers for a given bounding box	A set of dropdown of the catchment tree of Bangladesh such as "Select Division", "Select District", "Select Upazila/Thana", "Select Union/Ward".
7	API	An API key will be generated for whoever wants to use the National Geo-portal API. So that, system can track which API key is being used to get data from the National Geo-portal or are the misusing/fishing the API facilities or not. For a start following API can be exposed from the National Geo-portal.
8	Overlaying multiple SoB base maps	The NSDI-PS doesn't treat tile map as layer. So during map creation, user wouldn't see the tile map as a layer. Now we need a provision to overlay one or more tile layer on top of base layer and set the opacity level to each tile layer.

No.	Item	Description
9	Uploading and registering metadata without actual data	The NSDI-PS can register metadata when spatial data, table format data and time series data are uploaded. However, it is not possible to register only metadata. Some of information prepared by each organization is not available to upload actual data in the National Geo-portal. Therefore, in order to share the existence of the data among the related organizations concerned, it is necessary to be able to register even just metadata. Metadata items shall be updated in accordance with the separately created draft guidelines for metadata, data quality and data product specifications.
10	Improvement of clearing house function	The NSDI-PS can search layers, maps, documents, organization and user by free word, organization name and category and browse and download the result of search. Currently, draft guidelines for metadata, data quality and data product specifications are being developed at NSDI-WGMs under "the Project for Establishment of NSDI in Bangladesh". Therefore, the clearinghouse function should be improved in accordance with these draft guidelines.
11	Notification through SMS	In the NSDI-PS, these approval processes are conducted by e-mail. However, since the approver sometimes overlooks the e-mail, it is necessary to add a SMS notification function in order to operate the system more flexible.
12	Enhancement of system usage monitoring	In the NSDI-PS, there are some functions for system usage monitoring and system administrator can see number of counts and activities date of map loads, layer loads, document loads, pan, clicks and so on. However, since there is no function to check each user's login status and data upload status and so on, it is a need to add a function to monitor each user's usage.
13	Bengali web site	The websites of the Bangladeshi government organizations are available in Bengali and English versions. The National Geo-portal should also prepare articles and menus in Bengali notation.
14	Loading user's layer and editing user's layer	Some users of the National Geo-portal do not have GIS software. For such users, functions that draw figures easily and display own data without registering in database shall be added. - Loading user's layer - Drawing figures - Editing and deleting figures - Saving user's layer - Displaying user's layer

Source: The Project Team

c) Preparation of the draft TOR for the development of the full-scale NSDI-PF

Development for the NSDI-PS proceeded during the previous project with the assistance of Japan. On the other hand, the development of the full-scale version NSDI-PF was agreed upon by both Bangladesh and Japan as a matter to be borne by the government of Bangladesh at the time of planning this project.

Rather than the development of the system being the objective, the important thing is that the system being managed in a suitable manner after it is developed so that it can be utilized without any problems by users.

Accordingly, the SoB which is responsible for operation and maintenance should play the primary role in the development in order to ensure the sustainability of the system.

However, since the full-scale version NSDI-PF cannot be developed by the staff within the SoB alone, an external consultant, system engineers and programmers need to be hired. Therefore, specifications (draft) which describe the system objective, scope of work, security measures, implementation system and development period for the full-scale version NSDI-PF to be developed by use of external workforce were prepared. The items and overview of the specifications (draft) are shown in Table 4-33.

Table 4-33 Summary of the draft TOR

No.	Section	Summary
A	Introduction	Concept necessity, effect of the NSDI, etc.
B	Background	Background to the development of the full-scale NSDI-PF.
C	Objectives of the Consultancy	Objectives of the development of the full-scale NSDI-PF.
D	Overview of the proposed system	Overview of the full-scale NSDI-PF, expected user groups, list of functions for each user group, system development requirements, etc.
E	Scope of work	Scope of work as defined in the draft TOR. 1.Gather requirements and development user stories/use cases 2. Develop and test the web-based application 3. Survey on the utilization of NSDI in NSDI-WG members 4. Finalized the web-based application 5. Orient the users and SoB staff 6. Hand over the software 7. Provide troubleshooting support
F	Fixing vulnerabilities of the web application	Prevent internet threats such as website defacement, viewing sensitive data stored in the database, attacking and manipulating the database, embedding fraudulent data and malware on the web site, and so on. The web application to be developed shall be checked for vulnerabilities, and security measures shall be taken to ensure the secure operation of the National Geo-portal.
G	Expected deliverables	List of expected deliverables.
H	Vendor responsibilities	Managing the software development team, attending the meeting, reporting, delivering software, supporting SoB and NSDI-WG members in troubleshooting, etc.
I	SoB's responsibilities	Liaison with NSDI-WG members and involving them in the process, setting meetings, providing technical feedback on the process, review of the software and providing feedback to finalize, releasing the payments upon satisfactory delivery by the vendor, etc.
J	Timeframe	Expected timeframe of each process, inception report, development, testing, training and delivery.
K	Financial proposal	Estimation of costs based on the scope of work.
L	Proposed payment schedule	A draft payment schedule for the deliverables of each process.
M	Reporting arrangement	Weekly reports to monitor the progress of the project.

No.	Section	Summary
N	Minimum qualification and experience required	Fields and skills of engineers expected and number of them, etc.
O	Submission of proposal	Notes on the submission of proposals.
A-I	List of NSDI-WG members	List of NSDI-WG organizations (including proposed).
A-2	Enhancement (draft)	List of a tentative requirements and expected features of the software
A-3	Training	On-site training of the National Geo-portal
A-4	Web application security implementation	A list of vulnerabilities that should be checked and resolved in the security implementation of a web application.

Source: The Project Team

[4-3] Development and publication of a metadata creation tool

Metadata contains a record of explanatory information (quality, date prepared, person who prepared it, method of acquisition, data format, title, place name, scale, etc.) related to geospatial information.

The registration of metadata in the NSDI-PF enables users to search for what type of geospatial data has been developed. In the event the user finds similar data as a result of searches, the user can compare the content that is registered in the metadata, and select the geospatial data that is most suited to the intended use.

Accordingly, the more metadata that has been registered, the easier it is for users to obtain the desired geospatial data, enhancing the usefulness of the NSDI-PF.

A number of screens used to register the metadata have already been prepared with NSDI-PS. However, the structure is such that metadata is registered so that it is associated with the actual geospatial data. In addition, since the method has been adopted of entry using a Web browser when the actual data is registered, a considerable amount of effort and time is required when registering a large volume of information.

The mechanism to register only metadata without registering actual data is included in the development specifications of the full-scale version NSDI-PF, and will be implemented.

Therefore, a registration method will be added that enables uploading of an Excel file containing multiple metadata items to the NSDI-PF, while retaining the method in which data is registered with a Web browser as with the current NSDI-PS.

The items entered into the Excel file will conform to the metadata specifications (draft) prepared during this project. The fact that Excel files can be freely edited results in these files having a high level of versatility. However, when using as basic data that is registered in the system, unforeseen errors may occur in the event the data is not entered in accordance with predetermined rules. Therefore, Excel file(s) for metadata registration that specifies editable cells and sets input rules will be prepared.

The metadata registration Excel file(s) will be loaded onto the NSDI-PF together with a manual, and it will be possible to freely download this data.

Plans call for examination of the specifications for the metadata preparation tool in accordance with the metadata specifications (draft).

[4-4] Evaluation of utilization of NSDI platform

1) Case studies of utilization of the NSDI platform

In order to establish an NSDI and facilitate an understanding that the NSDI is beneficial for government organizations, plans call for an NSDI-PF collaborative project (NSDI-PF demonstration experiment) to be implemented by the NSDI-WG members during this project.

The objective of the NSDI-PF collaborative project is to visualize the advantages of the NSDI, accumulate successful experiences using the NSDI and in turn promote the generalization and utilization of the NSDI.

The following six points are important in order to implement this joint project.

1. Participants understand the significance of the collaborative project.

2. Clarify the specific merits that the collaborative project will provide to the daily operations of the participants.

3. Participants proactively participate.

4. All participants are equal.

5. Necessary work for this collaborative project is shared among the participants.

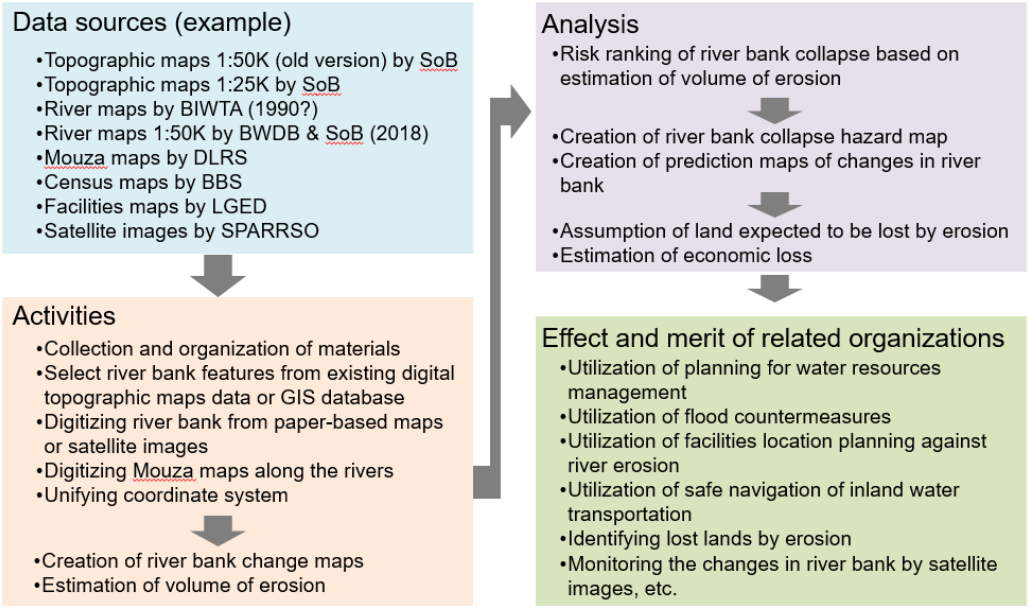
6. Participants will evaluate the results of this collaborative project.

In consideration of the above objectives, the project team has listed the four proposals shown in Table 4-34 as proposed examples of utilization by NSDI-WG members to promote the utilization of the NSDI-PF. The second proposal related to natural disasters which frequently occur every year in Bangladesh was taken as a theme, and a work flow (Figure 4-19) and sample image (Figure 4-20) were prepared and explained at the second NSDI-WG member meeting in an attempt to achieve a mutual understanding of the collaborative project.

Table 4-34 Case study examples of utilization of NSDI-PF

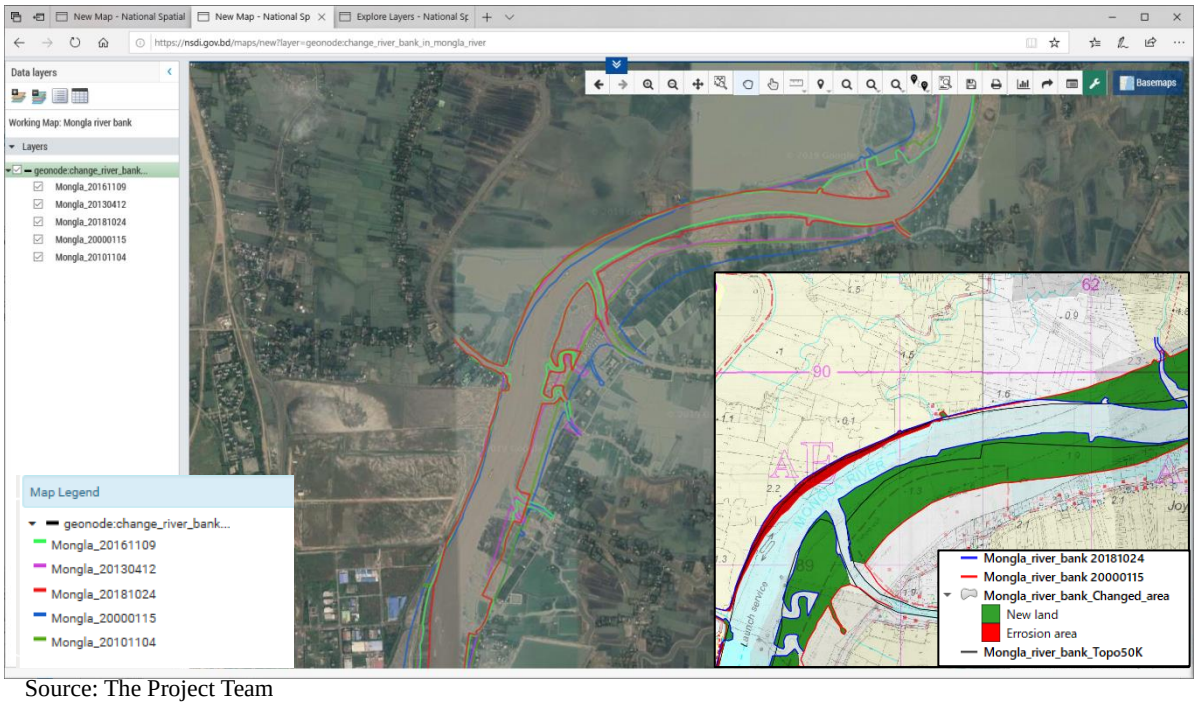
No.	Theme	Related organizations
1	Problem-solving of the difference in level between SoB and BWDB, and predicting and providing flood area map (flood hazard map)	SoB, BBS, BWDB, BIWTA, DDM, BMD, LGED, WARPO, IWM, CEGIS
2	Understanding the changes in river bank and the risk of river bank collapse	SoB, BBS, BWDB, BITWA, DDM, DLRS, GSB, LGED, SPARROSO, WARPO, IWM, CEGIS
3	Utilization for facility planning	SoB, BBS, LGED, RAJUK, DNCC, DSCC, CEGIS, (Ministry of Primary and Mass Education, Ministry of Health and Family Welfare)
4	Consolidated facility information like underground utility line and road	SoB, DWASA, DNCC, DSCC, RAJUK, RHD, BTRC, PDB, REB, (DESCO, DPDC, TITAS)

Source: The Project Team



Source: The Project Team

Figure 4-19 Workflow of the collaborative project in case 2



Source: The Project Team

Figure 4-20 Example of the river bank change between 2010 and 2018

2) Understanding the impact on residents and damage to public facilities due to riverbank erosion

In the year of 2019 alone in Bangladesh, floods displaced approximately 187,000 people and caused damage to health centers, markets, roads, schools and various other public facilities as a result of overflowing rivers.

Based on the discussion on examples of utilization of NSDI-PF, with the theme of "Understanding the impact on residents and damage to public facilities due to riverbank erosion" taken as a more familiar and specific case, the necessary information, procedures for the case study, as well as the effect and merit of the case study for the related organizations were organized and the results were shared at the third NSDI-WG member meeting.

a) Necessary information for case study

The ten information items shown in Table 4-35 were selected as the information required for this case study.

This information consists of topographic maps (including old ones created in the past) and orthophoto images possessed by the SoB, administrative boundaries and cadastral maps

possessed by the DLRS, river data possessed by the organizations related to river management, and the public facility data possessed by LGED, RHD, BPDB, REB and City Corporation.

Table 4-35 Example of necessary information for understanding of the impact on residents and the damage to public facilities due to the riverbank erosion

No.	Necessary information	Related organizations
1	River data	BWDB, WARPO, BIWTA, CEGIS, etc.
2	Topographic maps, DEM	SoB
3	Orthophoto image	SoB
4	Historical topographic maps	SoB
5	Administrative boundaries and village location	SoB、DLRS
6	Population census of village level	BBS
7	Location data of public facilities (school, hospital, road network, location of bridge, power transmission line, etc.)	LGED、RHD、BPDB、City Corporation
8	Mouza map	DLRS
9	Land cover map	Forest Department、RAJUK
10	Satellite images (Landsat, Sentinel-2, Google Earth, etc.)	Each Web site

Source: The Project Team

b) Procedure of case study

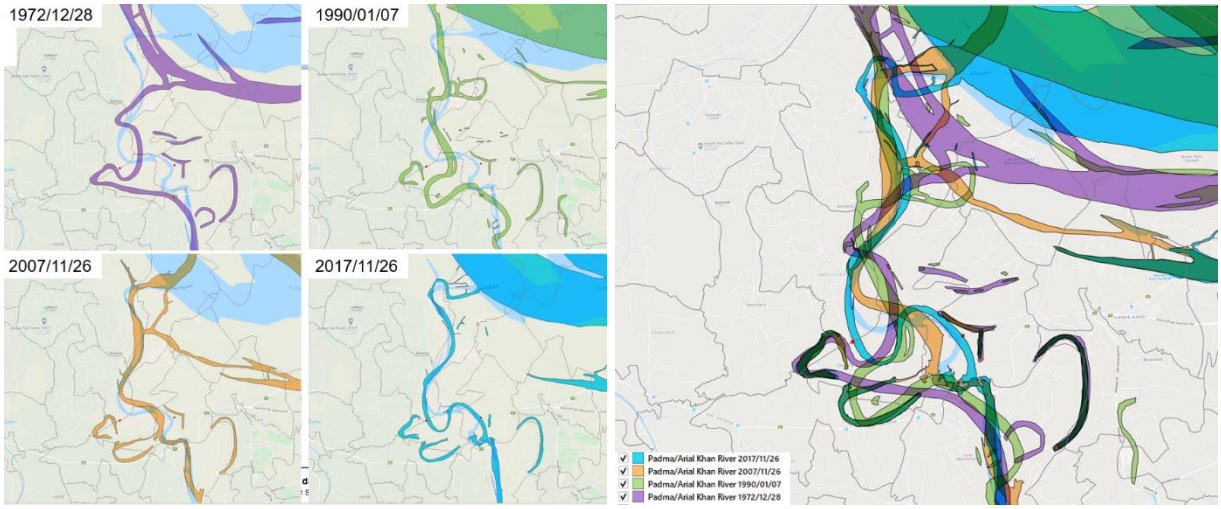
The procedure outlined below will be performed in order to collect the information shown in Table 4-34, share it on the NSDI-PF and identify the impact on residents and damage to public facilities due to riverbank erosion.

1. Prepare riverbank lines in past years from satellite images, orthophoto images and past topographic maps.
2. Extract land lost due to riverbank erosion from past riverbank lines.
3. Overlay data for target area population census, land cover maps, public facilities (schools, hospital, roads, power transmission lines, etc.) with lost area.
4. Analyze amount of impact of riverbank erosion on residents and extent of damage to public facilities.
5. Load analysis results onto NSDI-PF in order to share with related organizations.

In order to heighten the image of the transition in riverbank lines, the lines for the Arial Khan River which is a tributary of the Jamuna River on the South side of Dhaka were

prepared for four periods from 1972 to 2017 (Figure 4-21).

Since this data provides an understanding of the population and public facilities that have been impacted by the change in the riverbank lines by overlaying them with the population census and public facility data, it is expected that the data will be utilized as training materials at NSDI workshops and other such events.



Source: The Project Team

Figure 4-21 Example of changed water body of Arial Khan River (4 periods)

c) Effect and merit of related organization by case study

The effect and merit of the case study for the related organizations was organized in Table 4-36. Obtaining a comprehension of the change of the river shape over the years can be used as underlying materials for river management plans and the layout plans for public facilities, and can also be utilized for the updating of SoB base maps.

Table 4-36 Example of effect and merit of related organizations by case study

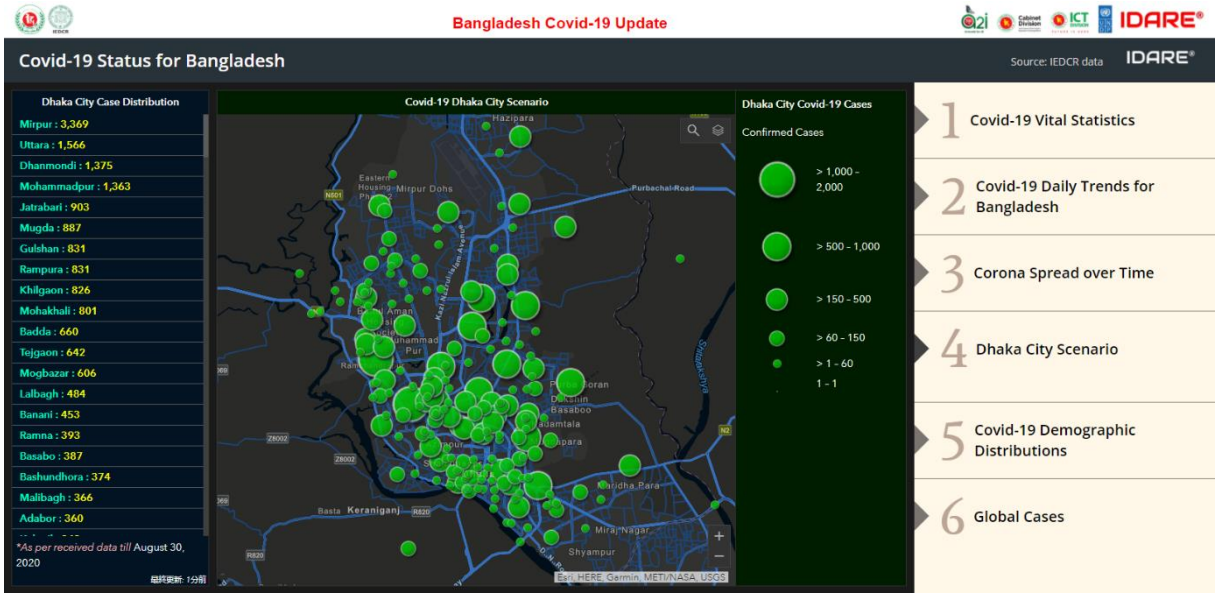
No.	Related organizations	Summary of effect and merit
1	SoB	- Updating topographic maps
2	BWDB、WARPO、BIWTA	- Utilization of flood countermeasures - Utilization of planning for water resources management
3	LGED, City Corporation etc.	- Understanding the volume of damage to public facilities - Utilization of facilities location planning against river erosions
4	BBS	- Understanding the volume of impact on residents
5	BPDB, REB	- Understanding the volume of damage of power transmission lines
6	DLRS, Forest Department, RAJUK, City Corporation etc.	- Understanding the land lost

Source: The Project Team

3) Case study of utilization on the NSDI related to COVID-19

COVID-19, which began to spread at the end of 2019, was confirmed in Bangladesh in March 2020, and remained at a low level until the end of March, but infections increased after this, with reports verifying of a total of more than 420,000 infections as of December 2020, and approximately 7,000 deaths.

The Institute of Epidemiology, Disease Control and Research (IEDCR) in Bangladesh released a dashboard (Website) in August 2020 (Figure 4-22) that provides a visual illustration of the daily total infections, distribution of infections in District units throughout the country and Ward units in Dhaka, and the increase in infections in District units. This provides information at a glance on which districts where infections are spreading and the number of infections.



Source: https://covid19bd.idare.io/

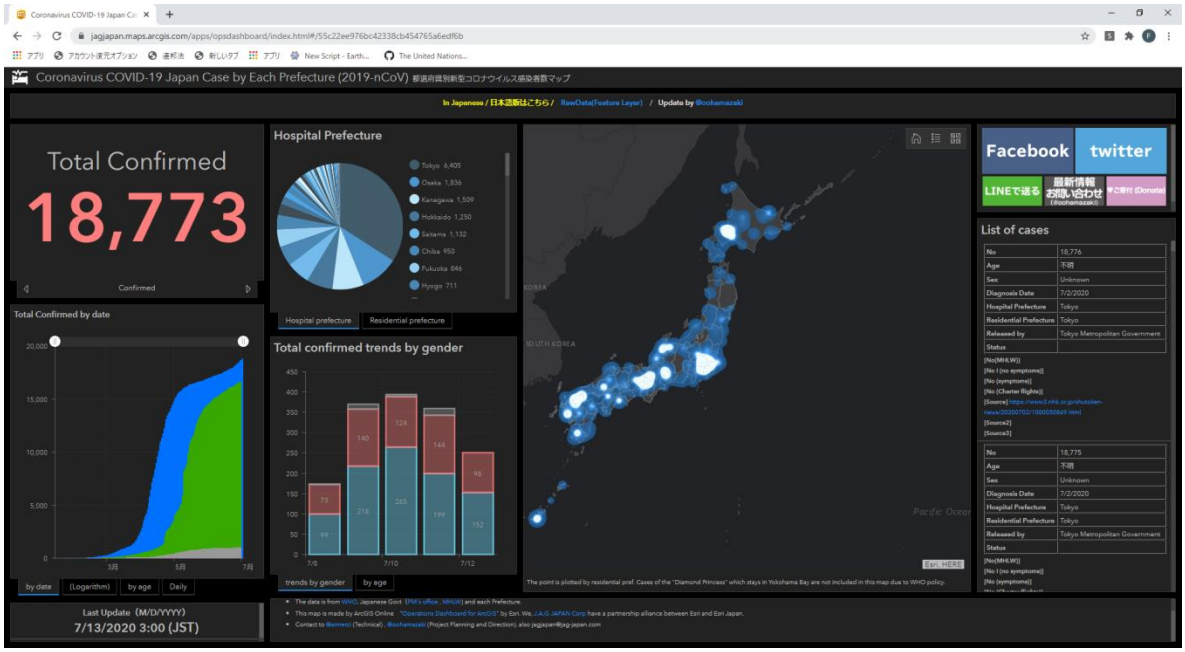
Figure 4-22 Screen shot of Covid-19 status for Dhaka City (IEDCR)

a) Case study examples in Japan

Case study examples in Japan were organized in order to review the methods to provide information in Bangladesh using the NSDI-PF. In Japan, the Ministry of Health, Labour and Welfare, consulting companies, communications companies, IT companies and other companies are utilizing information possessed by their own organization and public information to provide a variety of information.

The Ministry of Health, Labour and Welfare displays the total infections in each prefecture on a map on its website in order to release the daily number of infections on a graph (however, this website has been closed as of December 2020).

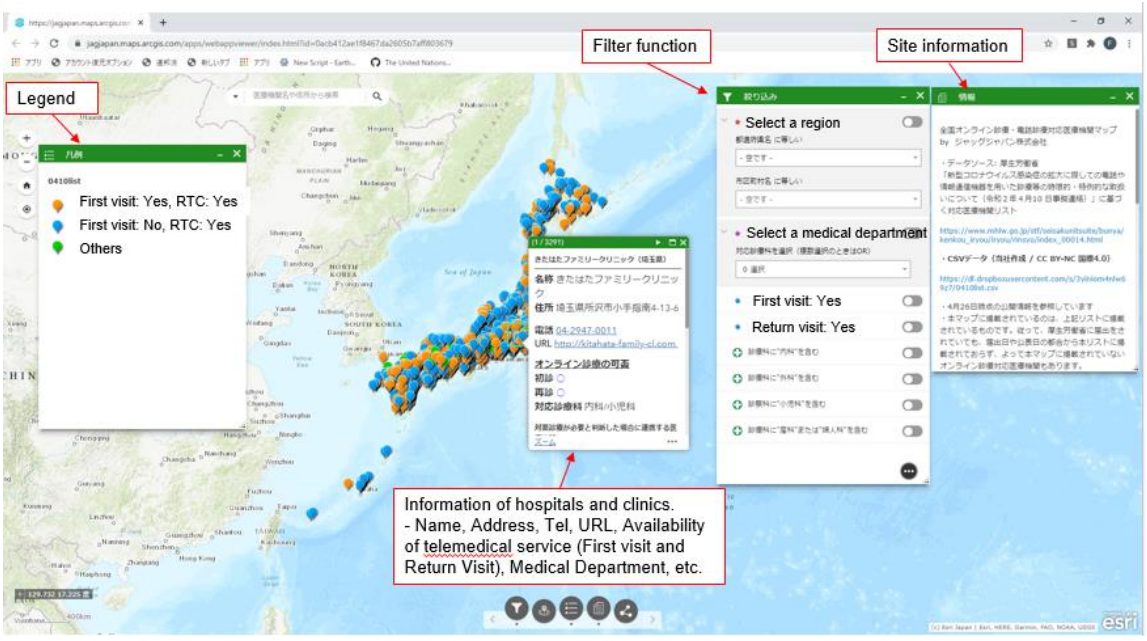
J.A.G. Japan Corporation which is a consulting company has established a dashboard that displays the distribution of infections in each prefecture on a map, information on the most recent infections (excluding personal information), and the number of infections in each age group and other information (Figure 4-23). This information is all based on information provided by the WHO and government of Japan.



Source: https://jagjapan.maps.arcgis.com/apps/opsdashboard/index.html#/55c22ee976bc42338cb454765a6edf6b
J.A.G JAPAN Corporation

Figure 4-23 Screen shot of the dashboard of COVID-19 Japan case by each prefecture

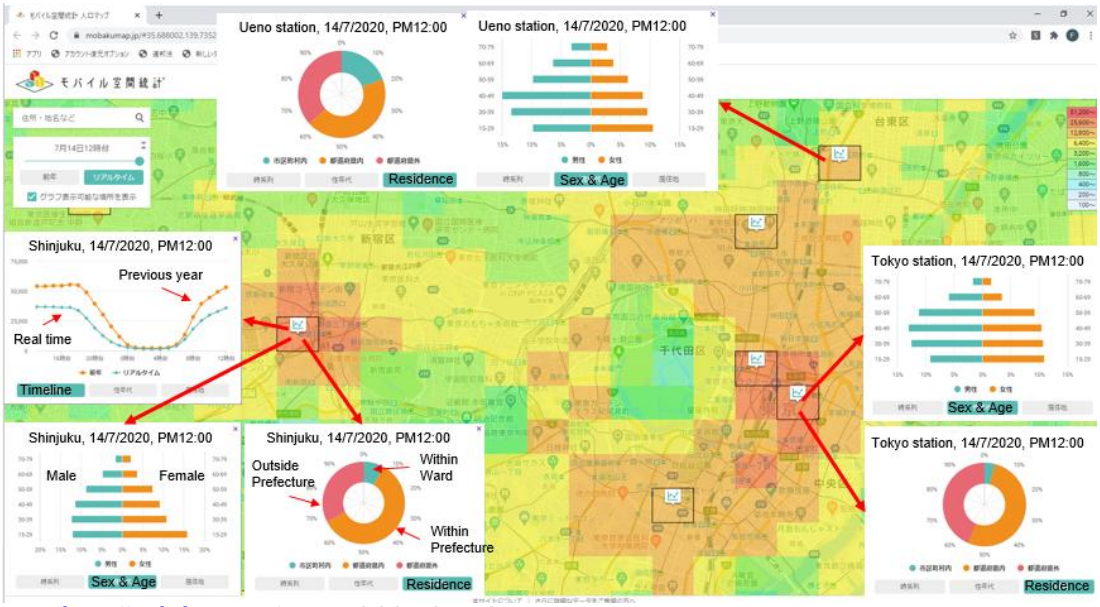
In addition, this company has established a website for people who wish to use telemedical service to investigate on a map where hospitals are located (Figure 4-24). The list of medical institutions that provide online medical care released by the Ministry of Health, Labour and Welfare is the source of the information. This enables users who want online medical care to find the location of the facilities in the area in which they live and the content of service that they provide.



Source: https://jagjapan.maps.arcgis.com/apps/webappviewer/index.html?id=0acb412ae1f8467da2605b7aff803679
J.A.G JAPAN Corporation

Figure 4-24 Screen shot of the telemedical service map in Japan

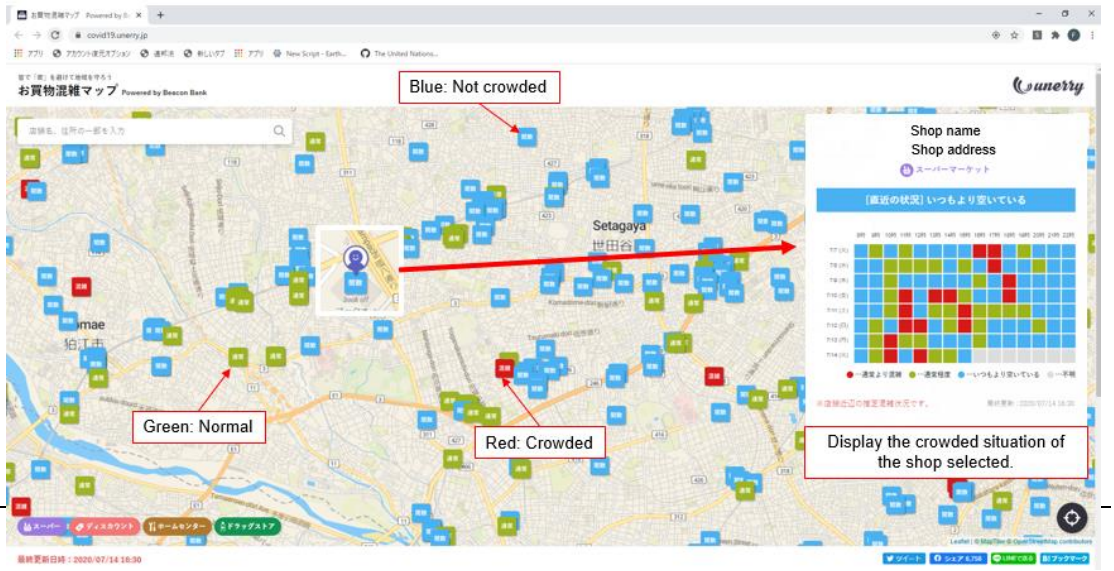
NTT Docomo which is a telecommunications company has published a website that uses mobile terminal device information and subscriber information to display the population distribution in real time in 1km mesh units from the current point in time to one day before. It is expected that the use of this population distribution data will provide an understanding of the status of the population in areas with a high density of COVID-19 infections (Figure 4-25).



Source: https://mobakumap.jp/ NTT DOCOMO, INC.

Figure 4-25 Screen shot of the real-time population distribution map from mobile device data

The Unerry Company has established a website that provides a color-coded indication of the estimated level of crowding at 28,000 supermarkets and other stores where people go shopping throughout Japan (Figure 4-26). The source data is prepared by performing AI analysis of the big data on the flow of people possessed by its "Beacon Bank" offline behavior data platform that it operates. This information helps users avoid crowds when going shopping and in turn serves as one measure to prevent COVID-19 infections.



Source: https://covid19.unerry.jp/ unerry Inc.

Figure 4-26 Screen shot of the real-time crowded situations map at shops from mobile device data

b) Study of effective methods and contents used to provide information for COVID-19 measures through the NSDI-PF

Consideration of whether or not information can be provided through the NSDI-PF that is effective as measures to responding to the COVID-19 is being performed by means of superimposing information on infections in district units onto information regarding hospitals, testing laboratories, roads, vacant land, inundated areas etc.

The procedure consists of collecting information on the number of infections from the IEDCR, information on hospitals that can accept COVID-19 patients and other such information, as well as collecting road network maps and DEMs, inundated areas during the rainy season, and land use maps which indicate where there is vacant land.

It is presumed that this information will enable three case studies to be performed on effective measures to respond to the COVID-19 pandemic.

1. Identify medical facilities with a high level of need for Personal Protective Equipment (PPE) from position information for medical facilities and information on districts where there are many infections.
2. Predict access limits to medical facilities during the rainy season using information on areas where roads are inundated during the rainy season and position information for medical facilities.
3. Utilize vacant land data and road data to select locations in which temporary medical facilities should be established in districts with a high number of infected people and a shortage of medical facilities.

c) Public information on COVID-19 in Bangladesh

There is the information in Bangladesh shown in Table 4-37 related to COVID-19 and information that is beneficial for measures to respond to the COVID-19 pandemic. A portion of this information has been released on a website, enabling this information to be

viewed by anyone.

Table 4-37 List of the public information on COVID-19 in Bangladesh

Web site name, etc.	Organization	URL
COVID-19 Public Dashboard	IEDCR	http://119.40.84.187/surveillance/
Timeline: Bangladesh's COVID-19 response	IEDCR	https://iedcr.gov.bd/
COVID-19 Dashboard, 2020, Summary information of COVID-19 dedicated hospital (EXCEL)	DGHS	http://103.247.238.92/webportal/pages/covid19.php
List of COVID-19 dedicated hospital (PDF)	DGHA	https://dghs.gov.bd/images/docs/Notice/2020/corona/covid19_hospital_information.pdf
List of RT-PCR Lab (PDF)	DGHS	https://dghs.gov.bd/images/docs/Notice/rt_pcr_lab.pdf
DGHS authorized Private Hospitals to perform COVID-19 Test (PDF)	DGHS	https://dghs.gov.bd/images/docs/Notice/Govt.%20authorized%20Pvt.%20lab%20list%20to%20conduct%20COVID-19%20Test%201.pdf
Bangladesh: Coronavirus Pandemic Country Report (EXCEL, CSV)	Global Change Data Lab	https://ourworldindata.org/coronavirus/country/bangladesh?country=~BGD
Reported Cases and Deaths by Country or Territory	Worldometer	https://www.worldometers.info/coronavirus/#countries
COVID-19: Mobility report	Google	https://www.google.com/covid19/mobility/
Flood Forecasting & Warning Centre	BWDB	http://ffwc.gov.bd/
National Water Resources Database Data Catalogue	WARPO	http://www.warpo.gov.bd/sites/default/files/files/warpo.portal.gov.bd/files/a30172e4_98e8_4f9b_ab96_b49e6bd2f65e/DatacatalogueNWRD.pdf
Road, hospital, clinic, etc. (GIS Portal)	LGED	http://gis.lged.gov.bd/
Topographic maps database	SoB	-
Population census	BBS	-

Source: The Project Team

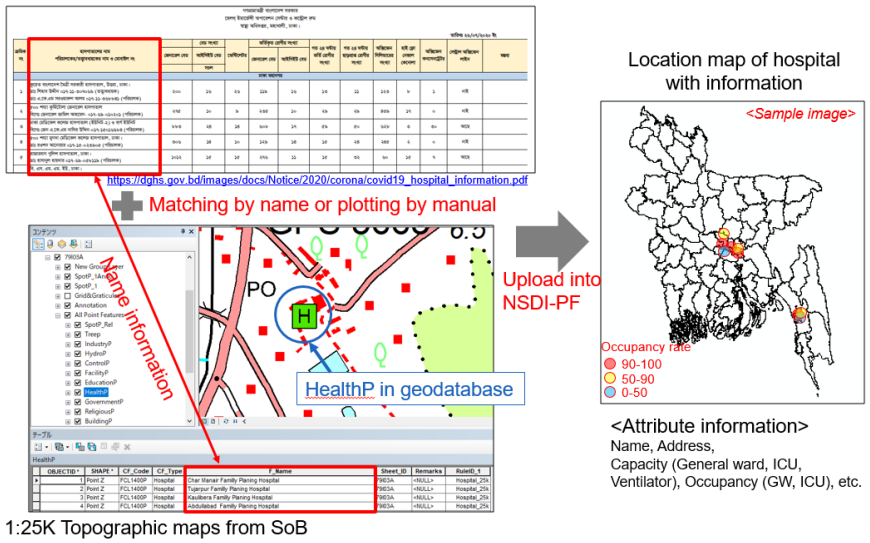
In addition to the IEDCR Website which visualizes the infection status in each area on the map, there are websites which focus on designated hospitals for COVID-19 infected persons, testing laboratories and lists of other such information.

The list of designated hospitals for COVID-19 infected persons describes the hospital name, name of location, point of contact, capacity (general ward, ICU beds, ventilators) and other such information. However, only the area name is listed as the location, making it difficult to identify the location from the list, and not providing a visual indication of the location of the hospital. The list of testing laboratories only describes the area name and facility name.

d) Consideration of mapping COVID-19 designated hospitals and laboratories

The use of the SoB 1:25,000 scale topographic map database and designated hospital list was considered as the method used for mapping of COVID-19 designated hospitals.

Position information for hospitals has been registered in the 1:25,000 scale topographic map database as point data. The hospital names are stored as attribute information in the point data, and the hospital names can be cross checked as a reference key with the list. However, since the designated hospital list was prepared in Bengali, it needs to be converted to alphanumeric display beforehand. The results of cross-checking of the topographic map database with the designated hospital list are uploaded to the NSDI-PF. An image of the procedure is shown in Figure 4-27.



Source: The Project Team

Figure 4-27 Example of mapping COVID-19 designated hospitals

It is expected that conversion of PDF files to Excel and mapping for private hospitals that perform COVID-19 tests (DGHS approved) and RT-PCR testing laboratories can be

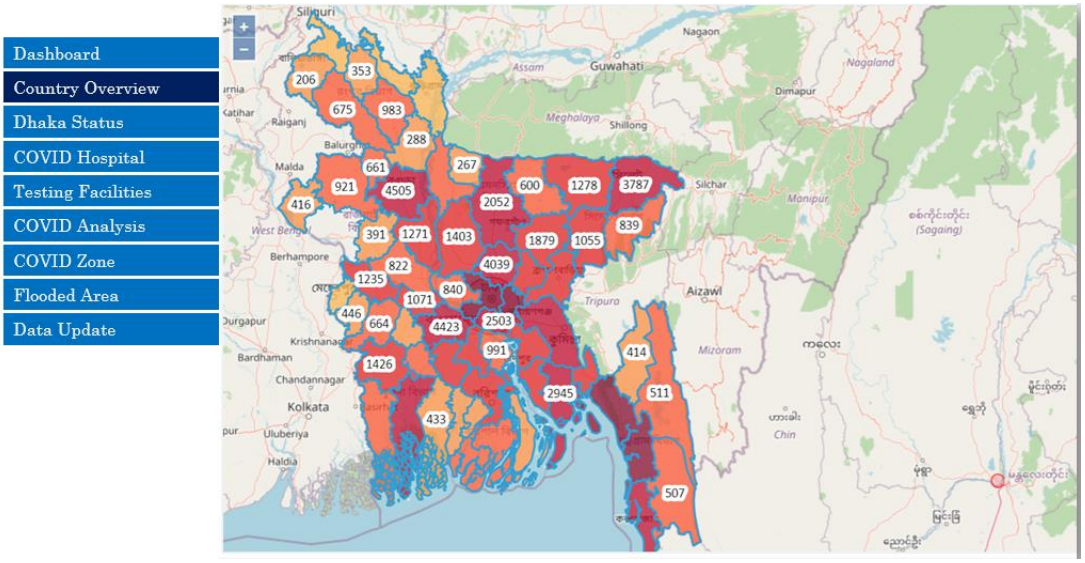
performed in the same manner as the procedure for COVID-19 designated hospitals.

Plans call for cross-checking work to be implemented using the 1:25,000 scale topographic map database after travel to Bangladesh by experts from Japan is restarted.

e) Consideration of how to publish on the NSDI-PF

Consideration was performed on how to release information related to COVID-19 on the NSDI-PF after it is collected.

In addition to displaying the infection status in each administrative unit in the same manner as for the IEDCR website, it is expected that the locations of COVID-19 designated hospitals and testing laboratories, as well as the analysis results described in "b) Study of effective methods and contents used to provide information for COVID-19 measures through the NSDI-PF" will be added to the menu displayed. An image of the information provided related to COVID-19 on the NSDI-PF and the menu configuration (draft) is shown in Figure 4-28.



Source: The Project Team

Figure 4-28 Example of the providing information related to COVID-19 on the NSDI-PF

Study of utilizing the NSDI-PF to provide information related to COVID-19 measures is

currently proceeding. Plans call for discussions to be held at NSDI-WG member and other meetings on how geospatial information can be utilized and what kind of information is effective for measures to deal with the pandemic.

In addition to COVID-19 infectious disease countermeasures, the project team will also create scenarios for demonstration experiments for the utilization of the NSDI-PF, including other cases.

CHAPTER 5. Current awareness of the establishment and promotion of the NSDI in Bangladesh

5.1. Current awareness of the establishment and promotion of the NSDI based on activities to date

The current awareness of the institutional issues, organizational issues, data issues and system issues concerning the establishment and promotion of the NSDI in Bangladesh have been organized in Table 5-1, taking into consideration the environment surrounding the establishment and promotion of the NSDI and the activities that have been conducted up until November 2020.

Compared to when this project was started, it can be appreciated that circular consultation regarding NSDI policy within the relevant organizations, inauguration of the NSDI Project Cell within the SoB, increase in the number of NSDI-WG members and regular meetings, preparation of three guidelines (draft) concerning geographic information standards, loading and release of the SoB base map (topographic map) onto the NSDI-PS, recruitment of local consultant to help in the development of the full-scale version NSDI-PF and other activities formulated to proceed with the establishment and promotion of the NSDI have achieved a certain level of results.

However, there are many issues which need to be addressed, such as the uncertainty of when the NSDI policy will be formulated, lack of understanding of geographic information standards, fact that development of the full-scale version NSDI-PF has not been started, and specific case studies in preparation for the utilization and application of the NSDI have not been selected.

Table 5-1 Current awareness of the establishment and promotion of the NSDI in Bangladesh (As of December 2020)

Aspect	Evaluation points	Issues
Inst.	• Honorable Prime Minister Sheikh Hasina instructed that activities be promptly implemented to determine policies for the building of an NSDI at the NSDI Seminar in 2016. • The NSDI policy is currently circulating within the relevant organizations. • A National Data Center was developed with a high	• The dates the new Survey Act and NSDI Act will take effect are not clear. • 15 organization have responded to the draft NSDI policy, however the timing of its formulation is unknown. • NSDI related concepts have not been unified between organizations.

Aspect	Evaluation points	Issues
	level of information security, and government organizations can use it free of charge. • A roadmap (draft) was prepared to facilitate building of an NSDI in the completed JICA-PJ.	• Geographic information standards have not been established. • Divisions between "national secrets" and "public property" have not been made for geospatial information.
Org.	• NSDI Project Cell has been formed in SoB. • NSDI-WG has been formed with 32 organizations and it is an increase from the start of this project. • NSDI-PPWG was formed, and 15 organizations are participating. • NSDI-PPWG meetings are periodically held. • Data release approval process has been started by the NSDI-PPWG. • SoB has adequate capabilities to develop geospatial information through the technical cooperation provided by Japan since 1991. • A number of organizations have a GIS unit.	• There is not an organization dedicated to promoting NSDI within the SoB. • Some organizations are not participating in the NSDI-PPWG that have a lot of geospatial information (Examples: RAJUK, BFD etc.). • There are differences between organizations / regions for knowledge / capabilities for geospatial information. • End-user organizations (government organizations) feel hesitant to use SoB base map data (1:25,000 topographic maps, 1:5,000 topographic maps, DEM, ortho-images, etc.), because the procedures to use them are difficult.
Data	• SoB topographic maps (1:25,000) and orthophoto images were prepared, and web map tiles in raster format has been generated. • SoB has created a 1:25,000-scale topographic map for the entire country. • SoB has created a 1:5,000-scale topographic map for 5 main cities. • The UAV equipment was procured and the correction of the topographic maps (1:5,000) in Dhaka City was started. • NSDI-WG members are providing data to the NSDI-PS. • Three draft guidelines on geographic information standards, metadata, quality control and data product specifications were prepared. • Activities for supporting of the development of data product specifications by each organization was started. • A number of organizations that are NSDI-WG members have the capacity to develop geospatial information.	• DEM and ortho-images for NSDI-PS pilot districts are being prepared. • Knowledge of geographic information standards is not sufficiently widespread. • Completion date for national DEM/ortho-images has not been determined. • Each organization is individually creating maps with different standards. • Data quality is not known since there are no quality control guidelines or because data is not being shared. • Some organizations are reluctant to release data to NSDI-PS due to accuracy issues.
System	• NSDI-PS has been established and evaluation/ verification of NSDI has been started. • 1:1,000,000 scale national maps to 1:25,000 topographic maps of SoB base map were installed into the NSDI-PS. • The draft TOR for the development of the full-scale NSDI-PF was prepared and the Expression of Interest for the recruitment of local consultants for the development has been published. • SoB has released Online Data Service on the Web, and is selling control point and topographic map PDF data online. • A number of organizations such as BCC, LGED,	• Orthophoto images and DEM of SoB base map were not installed into the NSDI-PS. • Practical activities of utilization on the NSDI have yet to be organized. • The status of usage of the NSDI-PS is unknown because there is no function on the NSDI-PS to get access logs. • The development of full-scale NSDI-PF has not been started. • SoB base map data has not been registered on NSDI-PS. • Uploading of data to NSDI-PS cannot be performed from terminals at respective

Aspect	Evaluation points	Issues
	BBS and BMD are releasing/selling geospatial information on the Web.	organizations. • There are problems with a portion of the NSDI-PS functions. • Various systems such as GeoDASH, BGISP, GIS Portal and Geo Portal have been established, but they are not linked.

※Red text means progress made since the start of this project.

Source: The Project Team

CHAPTER 6. Future plan

The future activity policy is established as described in this section, taking into consideration the activity status to date and the current status of the establishment and promotion of the NSDI in Bangladesh.

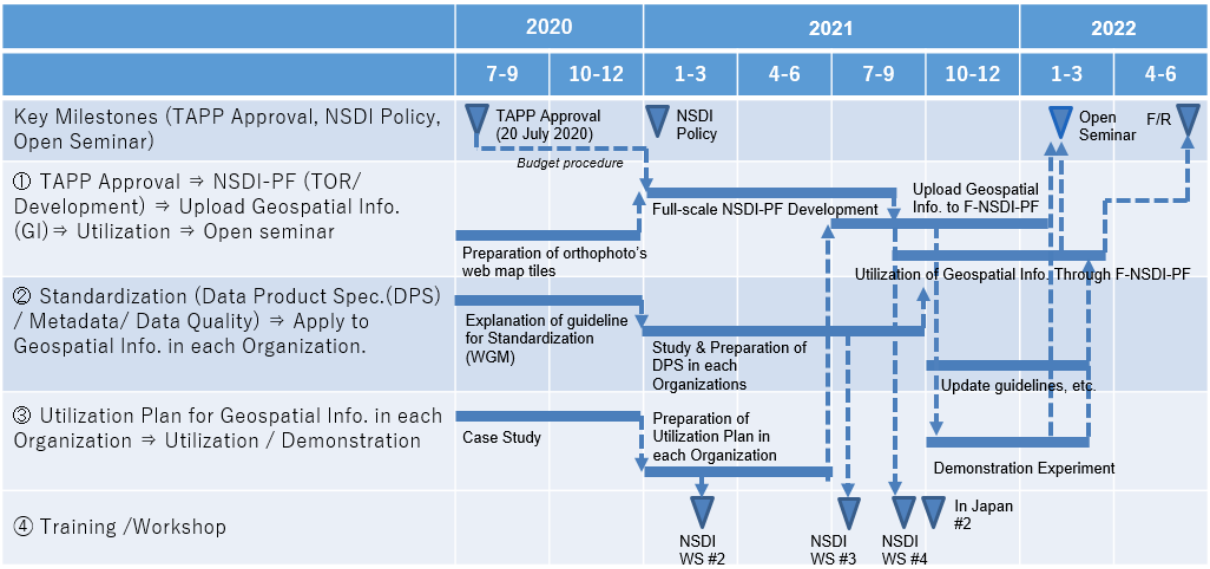
Extension of the activity period for this project until June 2022 was approved at the first JCC meeting. Therefore, the overall schedule was reexamined, and the main activities were designated as shown in Figure 6-1. Refer to "7. Schedule of activities for establishment of National Spatial Data Infrastructure (NSDI) for Bangladesh" for a schedule of the activities concerning each result.

Development of the full-scale version NSDI-PF will be performed in the first half of 2021, geospatial information possessed by related organizations will be loaded onto the NSDI-PF starting from the latter half of 2021, and activities to facilitate the utilization of the NSDI will proceed through operation of the NSDI-PF.

Regarding geographic information standards, activities to deepen understanding of three guidelines (draft) will be conducted through support of DPS preparation by each organization, and development of geospatial information and metadata in accordance with guidelines will proceed.

As for utilization of the NSDI-PF, first, NSDI utilization plans at each organization will be prepared, then NSDI-PF good practices will be shared among related organizations through the demonstration experiments using NSDI-PF.

These results (outcomes) will be presented at the 2022 NSDI Open Seminar.



Source: The Project Team

Figure 6-1 Schedule of main activities for the establishment and promotion of the NSDI

6.1. General activities in the future plan

- Holding of PSC and JCC meetings
- Periodic holding of NSDI-WG meetings
- Development support for NSDI-PF
- Implementation of trainings in Japan

6.2. Activities related to Output 1 in the future plan

- Encouragement of and support for the MoD / SoB will be strengthened in order to facilitate formulation of NSDI policy at an early stage.
- Support will be provided for inauguration and operation of the PSC, and short-term / mid-term / long-term plans related to NSDI policy will be formulated.
- Specific operation standards related to data policy, personal information and security stipulated in the NSDI policy will be considered by the WG.
- After the outline of NSDI-PF is established, seminars will be held for related

organizations inside and outside of the country in order to further understanding of an overview, objective and effectiveness of the Bangladesh NSDI.

6.3. Activities related to Output 2 in the future plan

- Full-scale support will be provided for the activities of the SoB NSDI Cell, guidance will be given on actions that should be taken by the PD/PM, and advice concerning the solving of issues will be provided.
- Encouragement of the PSC and discussions at the WG will be conducted in order to facilitate development of the NSDI Committee organization.
- WG member organizations will be asked to make proposals for examples of utilization, and as many case studies as possible will be implemented. In addition, discussions with the BWDB which has suspended study work will be restarted, and work will proceed to realize case studies.

6.4. Activities related to Output 3 in the future plan

- Preparation and sharing of data product specifications (product specifications) by related organizations will be promoted. Domestic work will consist of achieving an understanding of the support of related organizations by the local consultant and persons in charge at the SoB, and providing suitable advice. After personnel travel to Bangladesh, the project team will cooperate with related organizations, SoB and the local consultant with the objective of facilitating the sharing of the types, content and structure of geographic information and metadata information between WG member organizations on the NSDI-PF.
- As the preparation and sharing of data product specifications proceed, the project team will confirm the current status of activity at each organization, identify issues, and consider measures to be taken for data quality and metadata.
- The project team will consider the proper framework in Bangladesh for updating draft guidelines for the data product specifications, data quality and metadata from a practical and sustainable standpoint, and this awareness will be shared among WG members.
- The project team will consider the establishment of a geographic information standards deliberation organization will be considered in preparation for the

participation of Bangladesh in the ISO/TC 211. The participation of industry, government, academic and the general public is required, and an awareness on the significance of geographic information standards complying with international standards will be shared at open seminars and other such events.

6.5. Activities related to Output 4 in the future plan

- Due to the fact that generation of DEMs from raw data to be loaded onto the NSDI-PF as part of the SoB base map is taking time, study will be performed to obtain an understanding of the current status and consider improvement methods.
- The conversion from the SoB base map (topographic map) into vector tiles will be checked using the United Nations Vector Tile Toolkit, and training on vector tile preparation will be provided to the SoB engineers.
- The issues related to achieving seamless topographic map data will be organized and measures to deal with issues will be examined in preparation for release of the SoB base map vector data.
- Support will be provided for the finalizing of requirement definition document (RDD), screen design and function design in preparation for starting of full-scale version NSDI-PF development in January 2021.
- The metadata preparation tool specifications will be determined and support for development will be provided based on the three guidelines (drafts) for geographic information standards.
- Some organization of NSDI-WGM has developed websites and systems related a geospatial information. Since some of them are similar to the NSDI-PF as portal sites, the project team will examine the functions of these systems and the types of scope of information they handle, and consider how they can be separated with the NSDI-PF.
- Surveys will be conducted concerning NSDI utilization plans at each organization, NSDI-PF demonstration experiment models will be examined, and support for implementation will be provided.

Annex

Record of Discussion