

Department of Local Governance & Disaster Management

Ministry of Home Affairs

Royal Government of Bhutan

Terms of Reference

Hiring a consulting firm to develop and implement a GIS-based decision support system

1. Background

Bhutan is particularly exposed to earthquakes, landslides, flooding, Glacial Lake Outburst Floods, forest fires, and windstorms. Over the past 120 years, Bhutan has experienced over 18 earthquakes, with so far limited casualties but considerable material damages. Landslides and flash floods, typically triggered by seasonal monsoons, have dramatic consequences on the local communities, destroying villages and transport infrastructure, and impacting sectoral production and livelihood regionally.

Bhutan prioritizes the enhancement of disaster risk management and climate resilience in its strategic economic planning and development agenda. With financial support from the World Bank, Bhutan is in the process of strengthening the information and tools available to support multi-hazard risk assessment to enhance the effectiveness of Disaster Risk Management (DRM).

The Royal Government of Bhutan received a grant of USD 4.2 Million from the World Bank for the project “Strengthening Risk Information for Disaster Resilience in Bhutan”. The objective of the project is to enhance Bhutan’s capacity for risk-informed decision-making and development planning in targeted sectors. The project has three components as follows:

- Component A. Development and Piloting of a Multi-Hazard Risk Decision Support System (MHRDSS)
- Component B. Strengthening Hydromet and Agromet Services Delivery
- Component C. Professionalization of Construction Industry for Green and Resilient Infrastructure Development

This ToR is a part of the Component A.

The Department of Local Governance and Disaster Management (DLGDM), Ministry of Home Affairs, is mandated to coordinate all disaster risk management-related issues. DLGDM collaborates with other Royal Government of Bhutan (RGoB) agencies to manage information relating to preparedness, response, recovery, and risk mitigation. DLGDM is working closely with the GovTech Agency to host it in the Government Data Centre.

DLGDM worked with an international firm, that provided technical support and capacity building necessary for the conceptualization and prototyping of the MHRDSS (renamed Bhutan DRM Portal) using Geonode 3, an open source software for managing and sharing geospatial data. Furthermore, DLGDM and the other implementing agencies (IAs) have

been sensitized and educated extensively on various aspects of multi-hazard risk assessment methods and data-driven decision-making.

The Bhutan DRM Portal is a GIS-based decision support system to be used by decision makers, scientific community, and the general public for accessing information.

Under the “Strengthening Risk Information for Disaster Resilience in Bhutan” project, a fully functional Bhutan DRM Portal will be established. The IAs have invested resources for building internal capacity around GeoNode, and look forward to implementing the Bhutan DRM Portal using the same software. It is expected that the system will be developed using the latest version of GeoNode and will include customization to address the different needs of the implementing and relevant agencies while maintaining flexibility to upgrade to newer versions in the future.

Therefore, this project assignment is to fully operationalize the Bhutan DRM Portal. The Bhutan DRM Portal is to serve five broad functional objectives:

- a. **Decision Support System** – To serve as an integrated information system related to disaster risk management that can be accessed by relevant authorities to guide disaster preparedness, mitigation planning, response, and recovery.
- b. **Risk Information Sharing Platform** – To serve as a platform for government users to share risk information of the country.
- c. **Incident Reporting Tool** - To serve as a platform for reporting incidents from the place of occurrence.
- d. **Disaster Inventory Dashboard** - To enable users to explore data and find insights from interactive dashboards using historical disaster data for planning, projections, and designing programs and activities.
- e. **Data and Information Repository** - To serve as a repository of all the risk information and inventory of historical disaster data.

2. Objective(s) of the assignment

The main objective of the assignment is to operationalize the Bhutan DRM Portal, i.e., the GIS-based risk information decision support system, and build the capacity of users to operationalize the Bhutan DRM Portal.

3. Scope of the work

There are nine major tasks under this assignment. Each key task and their respective sub-tasks are described below. The Consultant is invited to propose how the delivery of these key tasks be programmed to optimize efficiency.

*** In a scenario where there may be insufficient funding, Task 3 and/or Task 4 may be omitted. However, this will be decided depending on the financial evaluation.*

Task 1 – Plan for Successful Project Execution

- 1.1 Conduct a 'kick-off' workshop involving the Disaster Risk Information Technical Working Group (TWG), which includes DLGDM, GovTech, and other implementing agencies to capture user requirements. Before the kick-off workshop, the firm should have familiarized itself with and reviewed:
 - (i) The needs and existing documentation available on the DRM portal
 - (ii) The existing systems (development instance of DRM Portal and existing Disaster Management Information System (DMIS¹) of the country). Please see Section 12 for further details of inputs to be provided by the Government Agencies."
- 1.2 Present the Project Implementation plan for endorsement by the DLGDM and Disaster Risk Information TWG.
- 1.3 Prepare a succinct (25 pages maximum) Project Implementation Plan (including a Gantt chart) and a Preliminary System Architecture of the DRM Portal, for approval by the DLGDM and the Disaster Risk Information TWG.

Task 2 – Customization of the GeoNode with additional features

The GeoNode is already installed and running on a local server at the DLGDM. The consultant is expected to make a copy of the running instance, do the customization, and later deploy at GDC (production).

- 2.1 Create a copy of running instance.

¹ <http://43.230.208.53:8080/dmis/login>

- 2.2 Create a custom container for data of 72 Hour Rapid Assessment Approach for Earthquake² to store thematic data and for easy discovery, designing and publishing map
- 2.3 Create a custom container for data of 72 Hour Rapid Assessment Approach for flood to store thematic data and for easy discovery, designing and publishing map.
- 2.4 Customize the dashboard to display the disaster risk profile of the country (based on the probabilistic and/or deterministic multi-hazard risk assessment conducted by the different line agencies) and give glimpses of the past disaster recorded. The dashboard should have hazard types (for the disaster risk profile and for past disaster records), geolocations, and time (for past disaster records) as filters or slicers. The dashboard should have provisions for adding and visualizing any disaster-related spatial data, such as findings of the Social Vulnerability Assessment which is scheduled to be conducted under the same project in 2024. This dashboard should be as responsive as possible with smartphones and tablets. Features for subscription to notifications to keep users informed about disaster situations and the status of their uploads.
- 2.5 Integrate the Kobo toolbox Disaster Incident Reporting form to be designed and deployed as specified in Task 5 below.
- 2.6 Conduct a user needs assessment to identify line agencies that may be using the DRM Portal, and what type of information they would need to support their risk-informed planning. These should at least include the DLGDM, and Department of Human Settlements, Department of Surface Transport, and Department of Infrastructure Development under the Ministry of Infrastructure and Transport for the purposes of updating the local disaster management and contingency plans based on multi-hazard risk information and risk-informed urban and infrastructure planning. Based on the results of the assessment, the firm should develop necessary risk-informed planning features and/or dashboards in GeoNode. These features could consist of interactive dashboards for visualization and/or overlay of risk information layers available within the portal, in line with Activity 2.4 above.

² 72 Hour Rapid Assessment Approach for Earthquake in the context of MHRDSS or Bhutan DRM portal is collection of thematic spatial data for earthquake hazard as shakemap, various vulnerability indices computed for chiwog level.

Task 3 - Migrate Data from the Disaster Management Information System (DMIS) to the Bhutan DRM Portal

(Full access to the DMIS to be given and data can be downloaded in Excel sheet)

- 3.1 List all the data in DMIS and download as excel sheets.
- 3.2 Categorize data into two: 1. that can be spatialized (linked to location like specific point, chiwog, gewog, or dzongkhag) and 2. that cannot be spatialized.
- 3.3 Consult DLGDM on the data fields or attributes of the data to be maintained.
- 3.4 Validate data for anomalies, errors, and missing values and carry out necessary spatial reference transformations or data type conversions.
- 3.5 Upload the data that can be spatialized to the Bhutan DRM Portal. Test them by making some thematic maps like the distribution of resources, forest fire occurrences in a particular year, and so on.
- 3.6 Present or demonstrate to the DLGDM and IAs

Task 4 - Data wrangling (transforming unstructured information to structured data)

English newspaper articles compendium (in .pdf format and .doc format) will be provided from where the disaster incident data is to be extracted and tabulated in excel sheet capturing the thematic information of location, hazard, date, and impact of the disaster like loss of lives and properties. Approximately 750 pages in doc file format will be provided. This is to enrich and/or complete the information extracted from DMIS.

- 4.1 Design the structure of data based on the data extracted from DMIS or previously agreed format. The structure should have information about the location, hazard, date, and impact of the disaster like loss of lives and properties.
- 4.2 Consult DLGDM and finalize the structure of the data.
- 4.3 Compile the structured data in a table, and present it to the DLGDM, IAs, and TWG.
- 4.4 Upload the data to DRM and test by making some thematic maps like distribution of resources, forest fire occurrences in a particular year, and so on.
- 4.5 Check for duplicate data.

- 4.6 Demonstrate the final dataset in the Bhutan DRM Portal to the DLGDM, IAs, and TWG.

Task 5 – Develop an incident reporting form in Kobo toolbox or using ODK.

This form should be accessible and be used for reporting an incident from the site by two categories of users: designated users who are focal officials of DLGDM and relevant agencies, and the general public users who can be anyone wishing to alert or inform the authority. The form should have offline capabilities, i.e. to store and report instances, and when offline and push to the server when network is available. The form for general users may be developed using a responsive web application rather than using a dedicated client/app.

- 5.1 Design incident reporting form in Kobo toolbox or ODK.
- 5.2 Present to the DLGDM for endorsement.
- 5.3 Integrate the same in the Bhutan DRM Portal.

Task 6 – Capacity Building

Training two categories of participants: Non-technical and technical users. Non-technical users are government officials who will use the Bhutan DRM Portal for any sort of consumption, while technical users are those who will contribute data, design maps, conduct analysis, maintain the portal, and carry out necessary updates. This training for technical users should make technical users capable of developing, operating, and maintaining similar geo-portals.

- 6.1 Design two packages of training materials or contents along with training schedules, targeting two categories of participants: non-technical users and technical users.
- 6.2 Present the training contents and training schedule to DLGDM for input, suggestions, and endorsement.
- 6.3 Compile the training materials into two training handbooks for the two categories of training.

- 6.4 Conduct two trainings - one for non-technical users which technical users should also attend and the second training for technical users only.
- 6.5 On-the-job training through regular engagement of relevant officials from DLGDM and GovTech at every major development/task, besides the above two trainings so they get well acquainted with the whole process of development to ensure sustainability.

Task 7 - Deploy Bhutan DRM Portal to Government Data Center³ (GovTech)

- 7.1 Prepare a checklist /requirement of the deploying system at GDC.
- 7.2 Strategize, design, and successfully deploy the system at the Government Data Center (GDC) complying with the checklist or the requirements of GovTech for standards and security, including load balancing and 4 clustering nodes.
- 7.3 Deploy the Bhutan DRM Portal at GDC for production.
- 7.4 System testing and validation.

Task 8 - Documentation and knowledge transfer

This is necessary for maintenance and sustainability. The documentation should be done on the development process, system administration, user trainings, on-the-job training, and application user manual.

- 8.1 Document all the steps of the development process.
- 8.2 Compile training materials used for the non-technical user training.
- 8.3 Compile training materials used for the technical user training.
- 8.4 Develop training materials used as on-the-job training (System Administration Manual and Application User Manual).

³ GDC (Government Data Center) is data center housed by th Gov-Tech which is ICT arm of Royal Government Of Bhutan

Task 9 - Post-implementation support (up to 1 year)

The plan includes, but is not limited to, answering queries, analyzing issues, and advising the technical users accordingly. During the post-implementation period, the consultant must involve its key staff of the team to resolve any issue or bug that arises during the life of the system.

- 9.1 Prepare a plan providing up to 2 days of support per month of remote and *ad hoc* operational support and advice to DLGDM and the Disaster Risk Information TWG.
- 9.2 Present the plan to DLGDM, IAs, and TWG members for input or suggestions and endorsement.
- 9.3 Provide critical bug fixing and upgrade to major releases for GeoNode and KoboToolbox/ODK during the entire support period

4 Field Missions

The Consultant is expected to complete at least 2 missions to Bhutan. The Consultant is invited to propose when in the programme these missions should occur. However, DLGDM suggests that the mission should coincide either with Task 1 (planning and requirements gathering) or Task 6 (capacity building) and Task 7 (deployment to the GDC).

5 Development methodology

The consultant should strictly follow the **SCRUM** development methodology during the project development. Only successfully tested product backlog in the staging environment shall be migrated and released in the production environment. After the user acceptance test succeeds, the system has to be deployed into live operation at the GDC by the consultants.

The consultant should present updates on the system development twice a month, and incorporate changes as suggested. The focal persons from the DLGDM and GovTech should work closely with the consultant.

6 Duration of the Assignment and Delivery Schedule

The duration of the contract will be **ten (10)** months for Tasks 1 – 8, and an **additional 1 year** for Task 9, i.e. operational support. Deliverables are due as specified in the table below. Each deliverable will be reviewed by DLGDM, the Disaster Risk Information TWG, and the World Bank, and assessed for required content in line with this Terms of Reference.

SN	<i>Deliverable</i>	<i>Deliverable duration (from contract signing)</i>
1	Presentation of Project Implementation Plan to DLGDM, IAs and TWG members as per Task 1 and submission of the final plan	2 weeks
2	Customization of the GeoNode with additional features as per Task 2	3-10 weeks
3	Presentation and demonstration of DMIS data in DRM Portal to DLGDM, IAs, and TWG members as per Task 3	7 weeks
4	Data wrangling - Presentation of the data compilation from the compendium to DLGDM, IAs, and TWG members as per Task 4	8-10 weeks
5	Presentation and demonstration of DRM Portal data uploaded to DLGDM, IAs, and TWG members as per Task 4	10 weeks
6	Demonstration of the use of Kobo Toolbox on smartphones and web browsers for reporting and how reported data can be viewed in the portal to DLGDM, IAs and TWG members as per Task 5	12 weeks
7	Presentation of training contents to DLGDM and IAs for feedback to DLGDM, IAs and TWG members as per Task 6	12-14 weeks
8	Presentation of the final training contents to DLGDM, IAs and TWG members as per Task 6	4-14 weeks
9	On-job Training for Administration Trainings to DLGDM, IAs and TWG members as per Task 6	continuous
10	User Acceptance Test	20 weeks

11	Deployment of Bhutan DRM Portal at GDC (GovTech) through DevOps techniques as per Task 7	25 weeks
12	General user training as per Task 6	26 weeks
13	Technical User training as per Task 6	27 weeks
14	Submission of the following as per Task 8 A. Training materials for administrative users B. Training materials for technical users C. Training materials for non-technical users D. Record of the development process (System Administration Manual and Application User manual)	38 weeks
15	Presentation of 1Y Post-Implementation Plan to DLGDM, IAs, and TWG members as per Task 9	38 weeks
16	Submission of final 1Y Post Implementation Support Plan as per Task 9	39 weeks
17	Acceptance of final deliverables	40 weeks

7 Requirements for Organizational Expertise, Key Experts, and Project Personnel

Organizational Attributes:

DLGDM is seeking submissions from suitably qualified international consulting firms with demonstratable track records or relevant project success.

In addition to meeting the specifications of the Key Experts, the Consultant's organization or JV must demonstrate the following attributes:

- Deep domain knowledge of DRM and decision-making for risk reduction.
- Understanding of multi-hazard risk assessment and risk communication.
- Experience in successfully delivering and managing projects involving the same or similar technologies.

- Experience in government stakeholder engagement and implementation of effective capacity-building programmes.
- Familiarity with working conditions and arrangements in Bhutan or the South-Asian Asia region.
- Expertise in agile software development and user-centered design practice.
- Proven experience in administering successful support and maintenance contracts with clients.

Key Experts:

The Consultant is required to propose a project team that meets the following criteria.

S N	Key Expert Role	Candidate Minimum Specifications	Expected Input
1	Team Leader & Project Manager	<ul style="list-style-type: none"> • Over 15 years of experience in managing GeoNode or any other geoportal development project. • Minimum of master's degree in disaster risk management, planning, geospatial information systems, or engineering. • Be able to demonstrate 4–5 years of experience in agile system development and stakeholder engagement. • Must demonstrate experience in using, configuring, and implementing GeoNode. • Fluency in English (written & spoken) is essential. 	10 months
2	GeoNode System Administrator	<ul style="list-style-type: none"> • Over 8 years of relevant project experience. • Masters or PhD in disaster risk management, planning, geospatial information systems, computer 	5 months

		<p>science, humanitarian crisis management, or engineering.</p> <ul style="list-style-type: none"> ● Be able to demonstrate a minimum of 2 years of experience in GeoNode web server administration. ● Must demonstrate experience in using, configuring, and implementing GeoNode. ● Demonstrable familiarity with Kobo Toolbox is preferable. ● Fluency in English (written & spoken) is essential. 	
3	Solutions Architect	<ul style="list-style-type: none"> ● Over 8 years of relevant project experience. ● A Masters or PhD in geospatial information systems, computer science or related subject, science, or engineering is preferable. ● Able to demonstrate a minimum of 5 years of experience in administering web servers and virtual servers. ● Demonstrable familiarity with GeoNode is preferable. ● Demonstrable familiarity with Kobo Toolbox is preferable. ● Fluency in English (written & spoken) is essential. 	2 months

4	GIS Trainer / Support Technicians	<ul style="list-style-type: none"> ● Over 4 years of relevant project experience. ● A Masters or above in geospatial information systems, computer science or related subjects, science, or engineering is preferable. ● Demonstrable familiarity with GeoNode is preferable. ● Demonstrable familiarity with Kobo Toolbox is preferable. ● Fluency in English (written & spoken) is essential. 	5 months (part-time)
5	Full Stack Developer	<ul style="list-style-type: none"> ● 5 years of relevant technical work experience ● Expertise in Python and Django Web Framework ● A bachelor's degree or above in computer science/IT is preferred. ● Fluency in English (written & spoken) is essential. 	2 months
6	Database Specialist	<ul style="list-style-type: none"> ● Proficiency in PostgreSQL (PostGIS), Geo-server, tomcat, ● A bachelor's degree or above in computer science/IT is preferred. ● Fluency in English (written & spoken) is essential. 	1 month

All members of the team must confirm their commitment and availability to conduct the assignment in person.

8 Hardware and Operating System Server

All the staging and testing of the system shall be done on the latest stable open-source Linux server in the department.

The integrated system should be operational on the existing infrastructure of the department and that of the Government Data Center (GDC).

9 Presentation of Price

The Consultant is expected to present a lump sum price for Tasks 1 - 8, inclusive.

For Task 9 (Post Implementation Operational Support), the Consultant must provide a monthly rate for up to 2 working days of operational support per month.

Daily and weekly fee rates for each Key Expert must also be provided. Rates are required in USD Dollars and/or Ngultrum.

10 Pre-proposal Briefing and Questions

DLGDM will conduct a pre-proposal briefing. Consultants should register their interest in attending this briefing using the email [stshewang@moha.gov.bt]. A demonstration of the DRM Portal will be given during the briefing.

Questions can also be sent to this email address before the specified deadline for questions.

11 Implementation Arrangements

Consultant Responsibilities

The Consultant's Team Leader will be the principal contact and will be expected to be readily available during project implementation.

The Consultant shall be responsible for all aspects of the performance of services as set forth in the components of this TOR.

The Consultant will work closely with DLGDM, GovTech, and the Disaster Risk Information TWG, and will report to the DLGDM Task Team Lead. Payments to the firm will be contingent on signoff from the DLGDM Task Team Lead. The World Bank will also maintain a close oversight of the implementation and the Consultant may be expected, at times, to report on progress to the World Bank.

Contractual Terms

The contract is to be awarded on a lump sum basis for tasks 1-8, with task-based disbursement of payment, and on a rolling 6-month basis for up to 12 months for Task 9.

Renewal of the operational support phase contract will be subject to performance and ongoing needs.

Working Language

The working language for this project shall be English for communication. All final deliverables shall be in English.

12 Inputs to be provided by the DLGDM, GovTech & Disaster Risk Information TWG

DLGDM and RGoB agencies will be responsible for the following provisions:

- A focal officer for the assignment at DLGDM, who will help coordinate and organize meetings and stakeholder workshops with relevant stakeholders.
- A point of contact and coordination at GovTech.
- Provision of a virtual server for staging will be provided at DLGDM and at GovTech Government Data Centre for production.
- All relevant reports, notes, and specifications on the Bhutan DRM Portal developed till date.
- Access to all relevant data on multi-hazard risk.
- Senior-level oversight and guidance from DLGDM and GovTech.
- Official correspondences with other stakeholders for requesting data, information, and coordination purposes.

13. Selection method

The consultant will be selected following the Quality and Cost Based Selection method as set forth in the World Bank Procurement Regulations for IPF Borrowers, November 2020.

ANNEXURE

1. A brief description about DMIS

The Disaster Management Information System (DMIS) is an online platform hosted and maintained at the Government Data Center, with the Department of Local Government and Disaster Management (DLGDM) acting as the system's administrator. Its primary purpose is to serve DLGM officials and other relevant government personnel for a range of functions, including program planning and disaster management

A crucial aspect of the DMIS is the involvement of local government officials who play a pivotal role in both reporting and contributing essential data and information to the system. The system offers the following key functionalities:

Resource Information:

It contains detailed data concerning the distribution of disaster management resources. This includes information on Search and Rescue equipment, trained personnel, and records of capacity-building programs that have been conducted.

Incident Reporting:

DMIS provides a designated channel for officials on the ground to report disaster incidents. The information submitted through this channel is carefully archived for future reference and analysis

Situation Assessment Reports:

The system also has the capability to generate Situation Assessment reports based on the data and information submitted by users. These reports are vital for understanding the current state of disaster management efforts

Despite its valuable features, there are certain limitations to consider. DMIS lacks spatial capabilities, meaning it cannot effectively display data in a geographic or map-based format. Furthermore, the system is static, which means it cannot be easily customized or modified to incorporate new features or adapt to changing requirements

Additionally, while there is a mobile application available for reporting incidents, users have raised concerns about the overall user interface's lack of visual appeal. Using the system on computers has also been criticized for being cumbersome and demanding. These challenges suggest room for improvement in terms of usability and user experience

2. Sample data from DMIS (sheet)

Hazard Type: Landslide		From Date: 01-01-2019		To Date: 09-11-2023																	
Col: 1	Col: 2	Col: 3	Col: 4	Col: 5	Col: 6	Col: 7	Col: 8	Col: 9	Col: 10	Col: 11	Col: 12	Col: 13	Col: 14	Col: 15	Col: 16	Col: 17	Col: 18	Col: 19	Col: 20		
Dzongkhag	Dungkhag	Gewog/Dhemkhong	Chiwog	Village	Household In Community	Total No. of Household Affected	Male (Below 15) Missing	Male (Below 15) Injured	Male (Below 15) Dead	Total Male (Below 15)	Female (Below 15) Missing	Female (Below 15) Injured	Female (Below 15) Dead	Total Female (Below 15)	Male (15-64) Missing	Male (15-64) Injured	Male (15-64) Dead	Total Male (15-64)	Female (15-64) Missing		
Bumthang		Chumey	Choongphel	Bhim	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chukha		Bjabchhog	Tsimalkha, Tsimasham	Tsimasham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Gelling	Kamji, Na-Yekha	Kamji	52	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Karmaling	Semchumthang	Upper Dorjiphu	21	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Karmaling	Laptakha	Laptakha A	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tashiding	Gangyab	Gangyab	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Laja	Kompa	Kompa	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					178	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Col: 20	Col: 21	Col: 22	Col: 23	Col: 24	Col: 25	Col: 26	Col: 27	Col: 28	Col: 29	Col: 30	Col: 31	Col: 32	Col: 33	Col: 34	Col: 35	Col: 36	Col: 37	Col: 38	Col: 39	Col: 40	Col: 41	Col: 42	Col: 43	Col: 44
Female (15-64) Missing	Female (15-64) Injured	Female (15-64) Dead	Total Female (15-64)	Male (Above 64) Missing	Male (Above 64) Injured	Male (Above 64) Dead	Total Male (Above 64)	Female (Above 64) Missing	Female (Above 64) Injured	Female (Above 64) Dead	Total Female (Above 64)	Male with Disability (Missing)	Male with Disability (Injured)	Male with Disability (Dead)	Male with Disability (Total)	Female with Disability (Missing)	Female with Disability (Injured)	Female with Disability (Dead)	Female with Disability (Total)	Below 15 with Disability (Missing)	Below 15 with Disability (Injured)	Below 15 with Disability (Dead)	Below 15 with Disability (Total)	Total Missing (Population)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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3. Line agencies and indicative data

Strengthening Multi-Hazard Information in Bhutan

Table 1: Indicative summary of datasets for which each agency is responsible

Agency	Indicative datasets
DDM	<ul style="list-style-type: none"> • Inventories of historical disaster events and their impacts • Records of resilience programmes and capacity-building • Multi-hazard risk assessments (reports, maps, metrics, etc)
NLCS	<ul style="list-style-type: none"> • Administrative boundaries • Topographic maps (at various scales) • Land Use Land Cover (LULC) maps • Cadastral maps (with appropriate access rights)
NSB	<ul style="list-style-type: none"> • Census data (highest resolution available, ideally attributed to geospatial polygons) • Other population, demography or socio-economic survey data • Infrastructure mapping surveys
DHS	<ul style="list-style-type: none"> • Geotechnical surveys (including multi-hazard zoning) • Topographical surveys • Household surveys • Disaster Management Contingency Plans
NCHM	<ul style="list-style-type: none"> • Meteorological gauges - locations & properties • Hydrological gauges - locations & properties • Flood hazard/risk assessments (maps, reports, etc)
DGM	<ul style="list-style-type: none"> • Seismic monitoring stations • Historical earthquake inventory • Historical landslide inventory • Geological hazard/risk assessments (maps, reports, etc) • Geological maps
DoR	<ul style="list-style-type: none"> • Road network (locations and condition) • Railway lines and stations (locations and condition) • Bridges (locations and condition) • Vulnerability assessments (maps, reports, etc)
DoA	<ul style="list-style-type: none"> • Farm Road Atlas • Locations of RNR Centres • Locations of large markets • Land Use Land Cover (LULC) maps • Farm gate prices for agricultural products • Forestry datasets (infrastructure, revenues, forest fires, etc)

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DoC	<ul style="list-style-type: none"> • Locations of significant cultural/historical sites • Structural typologies relevant to cultural/historical sites • Historical impacts of hazards on cultural/historical sites • Reports on DoC's ongoing disaster resilience projects • Visitor numbers and tourism revenues by cultural/historical site
DITT ¹	<ul style="list-style-type: none"> • Fibre optic cable network • Mobile/cell tower locations • Fixed line telephone network • Radio & TV broadcasting stations • VSAT terminals in emergency backup system • Regular coordination with Bhutan Telecom & Tashi Cell to collate relevant data
EARRD	<ul style="list-style-type: none"> • Structural typologies defined (relating to hazard impacts) • Vulnerability/fragility curves defined for each structural typology • Distribution of structural typologies around country (when available) • Seismic hazard/risk assessments (maps, reports, etc) • Construction guidelines for resilient infrastructure
FEMD	<ul style="list-style-type: none"> • Flood hazard/risk assessments (maps, reports, etc) • Historical flood inventory
BPC	<ul style="list-style-type: none"> • Transmission lines • Substation locations • Distribution lines (above/below ground) • Transformer locations • Emergency backup (diesel) generator locations • Mini/micro-hydropower station locations & connections to distribution networks • Fibre optic cable network
DGPC	<ul style="list-style-type: none"> • Hydropower stations (locations & capacity)

1 As noted in the table, it is recommended that **DITT** be responsible for coordinating with **Bhutan Telecom** and **Tashi Cell** on a regular basis (at least quarterly) regarding any updates made to their infrastructure/networks, so that the corresponding MHR-DSS datasets are kept up to date.

