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Title: The Barriers to Implementing National Spatial Data Infrastructure in Pakistan: Policy and Legislation Context

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The Barriers to Implementing National Spatial Data Infrastructure in Pakistan: Policy and Legislation Context

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Abstract

In today's world, information is the most valuable resource. Geospatial information, which refers to the location of various features on earth, plays a crucial role in policymaking, implementation, and monitoring the policy outcomes. The information about forests, roads, water bodies, health and education facilities, population, human settlements etc. is geospatial. Due to financial and human resource constraints a single government department cannot collect such diverse information. Therefore, each department is mandated to collect and maintain one particular type of information. The information collected is used as evidence in policymaking and to ensure its efficacy, various types of information collected by departments is integrated and utilized. The dilemma is, government departments often do not share their collected information, despite them being funded by public money. Consequently, informed decision-making is hampered. The reasons for non-sharing of the information may include lack of technical capacity, fear of loss of control over information assets, poor quality of the information and lack of legal and policy framework to share information. This article focuses on policy and legal barriers to geospatial information sharing in Pakistan. The study follows content analysis method, specifically used for deriving relevant information from the data. The data is collected through reviews of policy documents, minutes of meetings, and focused group discussions with experts on the subject. The article discusses how the current provisions are inadequate to deal with new developments in geospatial information sharing, and proposes recommendations for amending and updating existing laws and policies. The study finds that policymakers in Pakistan are still not aware of the potential of geospatial information and its sharing through NSDI for informing, and implementing public policies. Accordingly, the study recommends approving NSDI Act at the earliest.

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Keywords: geospatial information, national spatial data infrastructure, NSDI, legal framework, Pakistan, policy, sharing

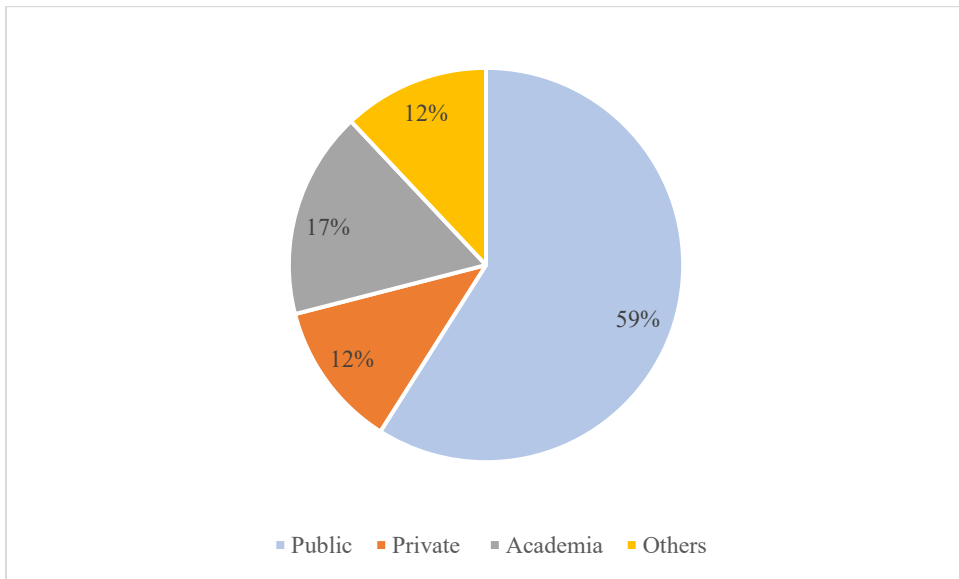
Introduction

Sound public policy depends on quality information (Tonchovska et al., [2012](#)). Increasingly, information and data are being utilized to enhance sustainable development, with practitioners and policymakers more and more tapping into data from diverse sectors to tackle the social determinants of the masses (Karim et al., [2022](#)). This is why the implementation of open data portals and open data initiatives is occurring at national and regional levels (Safarov, [2020](#)). Spatial also known as geospatial or geographic information refers to the location of objects on Earth. This information has emerged as a fundamental necessity for national development and decision-making across all countries and sectors (United Nations Global Geospatial Information Management [UN-GGIM], [2020](#)). Spatial information encompasses a wide array of interconnected disciplines within the realm of geospatial sciences, including geomatics, surveying, geography, land administration, geodesy, cartography, mapping, remote sensing, hydrography, oceanography, land and sea-based geographic information systems, as well as environmental sciences. Its importance is evident in numerous activities, including achieving Sustainable Development Goals (SDGs), and the planning, implementation, monitoring, and evaluation of socio-economic development projects.

In Pakistan, geospatial data is being collected at the federal and provincial levels by several government departments, private companies and nongovernmental organizations (NGOs). At the federal level, the Survey of Pakistan (SoP), Space and Upper Atmosphere Research Commission (SUPARCO), Geological Survey of Pakistan (GSP), National Highway Authority (NHA), Pakistan Meteorological Department (PMD), and Pakistan Agricultural Research Council (PARC) are some of the key departments collecting geospatial data. All education, health as well as planning and development (P & D) departments are producing the data in different provinces. Academia is also collecting the data to be utilized for research purposes by students. Similarly, NGOs such as the World-Wide Fund (WWF) and World Food Programme (WFP) are busy in geospatial data acquisition in the country. Figure 1 shows the various sectors in Pakistan that are involved in the collection of geospatial data.

Figure 1

Sectors in Pakistan producing geospatial data (Ali & Imran, [2021](#))



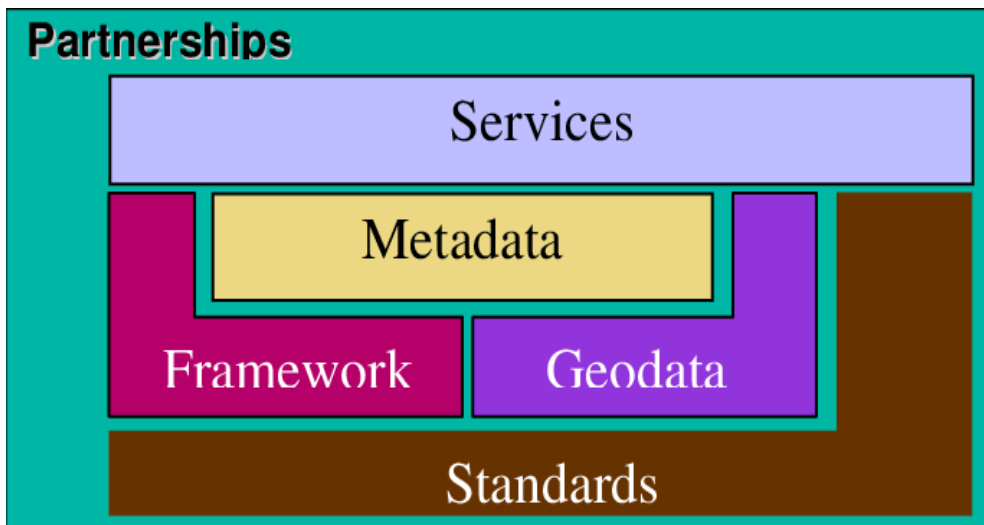
From Figure 1, it is evident that almost all sectors in Pakistan are collecting geospatial data, however, the data is not being shared, resulting in a collection of duplicated data, wastage of public funds and compromised quality of the data. Hence only a fractional part of the collected data is used in making and implementing policies. The full potential of geospatial data can only be realized through its efficient management and sharing. Governments play an important role in realizing the potential of geospatial data by making it discoverable, available and accessible through the establishment of National Spatial Data Infrastructure (NSDI). However, a strong legal framework is a prerequisite for implementing NSDI.

NSDI is a framework for the production, sharing, and utilization of geospatial information. This infrastructure enhances decision-making and improves service delivery across various sectors (Tonchovska et al., [2012](#)). The core components of NSDI include geodata, metadata, standards, framework, services and partnerships (Figure 2). Geodata contains location information usually expressed in terms of a pair of coordinates i.e., latitude and longitude of the objects on the earth's surface along with their important characteristics referred to as metadata. For example, mountains, rivers, crops, human settlements, and animals and tree species etc. The metadata

information can include the elevation of a mountain, the depth of a river, crop sowing and harvesting season, and population etc. The purpose of a framework is to make institutional and technical arrangements to share the collected data. Furthermore, partnerships make legal arrangements to share and exchange the data among producers and users. Standards are the specifications according to which data are produced by various organizations. Standards are essential to maintain the quality and compatibility of the data being produced by several organizations. Lastly, services refer to the online or remote access provided to users for viewing, analyzing, downloading, and purchasing geospatial data. These services facilitate easy interaction with the data, allowing users to utilize geospatial information effectively for various applications.

Figure 2

Core Components of NSDI



Note. Source: <http://www.fgdc.gov/>

The benefits of having NSDI are well established in theory and practice., ranging from economic, social and environmental benefits. NSDI helps to overcome duplication of data leading to saving huge amounts of public money which is clearly an economic benefit. The data collected by one organization is accessible to other organizations and users as well. The basic principle is, to collect data once and use it multiple times in various sectors and applications. The increasing prevalence of social issues such as gender inequality, poverty, and inadequate access to clean drinking water

necessitates the use of multiple datasets to identify root causes and develop effective as well as evidence-based policies. Additionally, addressing the challenges posed by climate change, and safeguarding regional ecosystems requires policymakers and practitioners to access diverse datasets, enabling informed decision-making and coordinated action. This can only be achieved through the sharing of data collected by various stakeholders.

NSDIs empower stakeholders to manage, assemble, and share geospatial data (Ali et al., [2024](#)). Through NSDIs, governments can enable smooth data exchange 24/7, enhance interoperability, and foster collaboration among stakeholders. This ultimately improves decision-making and supports sustainability. NSDIs bring together information that is collected and maintained by various government departments and private companies. For example, topographic data collected by the Survey of Pakistan, demographic information maintained by the Pakistan Bureau of Statistics (PBS) as well as weather-related data collected by the Pakistan Meteorological Department (PMD) would be available in an NSDI for evidence-based decision-making and sustainable socio-economic development.

In Pakistan, efforts to establish Pakistan's National Spatial Data Infrastructure (NSDI) have been in progress for the past 15 years (Ahmad et al., [2024](#)). However, the NSDI implementation efforts have not been successful due to various reasons such as lack of NSDI Act, institutional egos, and lack of awareness of the potential of geospatial data and the value of information sharing by the policymakers in the country. Moreover, implementation of NSDI is a long-term endeavor, typically spanning 10 to 15 years. This prolonged timeline contributes to the lack of prioritization at the national level, as governments in the country often change soon. As a result, NSDI, the primary objective of which is to facilitate the sharing of geospatial data (Masser, [2019](#); Schade et al., [2020](#)), has not yet been realized in Pakistan.

Up till now, there has been no extensive study undertaken to evaluate the policy and legal barriers to geospatial information sharing in Pakistan. Therefore, the main research question of this study is, to analyze the extent to which the current policies and laws in Pakistan are conducive to the implementation of a National Spatial Data Infrastructure (NSDI) that impacts the sharing of geospatial information among stakeholders. The

main research question is addressed with the help of the following objectives of this study:

1. To identify the legal barriers to NSDI implementation in Pakistan
2. To identify legal barriers in both developed and developing countries and compare them with those in Pakistan
3. To give recommendations for overcoming legal barriers to Pakistan's NSDI

Pakistan's Information-Related Laws and Policies

Timely access to relevant and objective information is a key element for sound decision-making to successfully address socio-economic issues faced by the people of Pakistan. To enable access, defining legal frameworks is required for appropriate sharing and exchanging of information (Radovic & Djurdjevic, [2016](#)). The Government of Pakistan (GOP) has passed some laws, policies, legal documents, strategies, and action plans as discussed in this section.

The Constitution of the Islamic Republic of Pakistan

This Constitution was passed in 1973 by the national assembly of the country. Article 19A of the Constitution (Government of Pakistan, [2012](#)) states that all citizens of Pakistan have the right to access information in all matters of public importance, subject to regulation and reasonable restrictions imposed by law.

The Constitution guarantees that every citizen has the right to access information related to matters of public importance. Spatial information is also a type of information that is specifically geared to the location of objects on earth (Rajabifard et al., [2003](#)) and is used by all governments and sectors for public service delivery (Rosenthal, [2018](#); UN-GGIM, [2020](#)). Thus, spatial information, being of public interest and importance, aligns with the principles outlined in the Constitution.

Pakistan Agricultural Research Council Ordinance

The Ordinance (GOP, [1981](#)) seeks to streamline, endorse, encourage, and synchronize agricultural research endeavors, while also aiming to generate, procure, and disseminate information relevant to agriculture. This includes fostering collaboration among researchers, supporting the

acquisition of pertinent data, and ensuring its widespread distribution within the agricultural community.

E-Government Strategy Five-Year Plan

The E-government strategy (GOP, 2005; as cited in Shahzad & Sandhu, [2007](#)) encompasses various strategic components, notably the integration of geographical information systems (GIS) for agriculture, natural resources, and urban property of Pakistan. This initiative also entails the establishment of comprehensive mapping and database systems for national cartographic data. Consequently, geospatial information has long been recognized as a pivotal asset for national planning, fostering socio-economic development, and ultimately contributing to the prosperity of the country.

Hand Book on Planning Commission

The Policy Handbook on Planning Commission (GOP, [2008](#)) highlights the significance of data and its sharing in various sections of the book. For example, function 7 of the macro-economic section involves the upkeep of data related to the macroeconomic framework, while function 8 entails providing data to both national and international organizations.

Surveying and Mapping Act

Before June 2014, Pakistan lacked a legal framework for sharing geospatial data and establishing a National Spatial Data Infrastructure (NSDI). However, this situation changed with the passing of the Surveying and Mapping Act 2014 (GOP, [2014](#)) by the national assembly of Pakistan in May 2014. This act empowered the federal government to assign the responsibility of establishing the NSDI to the survey of Pakistan in collaboration with relevant stakeholders (Appendix-I) across the country.

The act serves as the legal foundation for the regulated sharing and exchange of geospatial data in Pakistan, with the Survey of Pakistan (SoP) deriving its authority from this legislation. It consists of 25 clauses divided into 8 sections. The main clauses, numbered 1 to 6, cover key definitions related to land surveying and mapping, along with the formation and management of the SoP and its functions.

Regarding the management of geospatial data, clause 15 of the act delineates specific provisions that can be summarized as the following:

- The Survey of Pakistan will develop and maintain a National Spatial Data Infrastructure (NSDI) in collaboration with key stakeholders. This initiative aims to create a unified system for maintaining, distributing, and sharing geospatial data among users, minimizing redundancy in data collection and maintenance. Ultimately, it seeks to enhance objective decision-making processes.
- All base data, including geodetic, magnetic, topographical, and geographical information, along with aerial photographs and pertinent records in both analogue and digital formats, created and held by the Survey of Pakistan is meant to be stored and managed within a national geospatial database.

In 2014, the Surveying and Mapping Act was enacted, serving as the fundamental legal framework for the development of the National Spatial Data Infrastructure (NSDI). This legislation was further supported by the implementation of the surveying and mapping rules in 2015 (Government of Pakistan, 2015a). These regulations serve as a comprehensive framework under which the NSDI initiative operates within the country, providing a structured and standardized approach to spatial data management and utilization.

Surveying and Mapping Rules

The Surveying and Mapping Rules (GOP, [2015](#)) approved by the federal cabinet in 2015 offer comprehensive guidance on geospatial data sharing through the NSDI portal, surpassing the details provided in the Surveying and Mapping Act. According to these rules, both public and private sector organizations are required to share their data with the Survey of Pakistan and upload it to the NSDI portal. However, effective implementation depends on the initial development of the NSDI.

Right of Access to Information Act

The Right of Access to Information Act 2017 (GOP, [2017](#)), upholds transparency and the right to access information as fundamental principles to enhance the public's access to records maintained by public authorities within the Islamic Republic of Pakistan. The act aims to enhance the government's accountability to its citizens, increase public involvement in governmental processes, reduce corruption and inefficiency, support

sustainable economic growth, promote good governance, and safeguard human rights.

Digital Pakistan Policy

Digital Pakistan Policy (GOP, [2018a](#)) aims to transform the country into a knowledge-based economy by leveraging technology and digital innovation. It includes access to digital services, enhancing infrastructure, and fostering digital literacy among the population. The policy emphasizes the importance of e-governance to improve public service delivery, promote transparency, and encourage citizen engagement. Additionally, it seeks to support the growth of the geospatial industry, stimulate job creation, and facilitate economic development.

National Food Security Policy

The National Food Security Policy 2018 (GOP, [2018b](#)) emphasizes the pressing nature of climate change and underscores the importance of utilizing IT-based information sharing to promptly adapt production plans. It advocates for enhancing data collection and knowledge sharing regarding food losses and wastage, as well as regularly disseminating weather forecast information.

IT Policy and Action Plan

IT Policy and Action Plan 2018 (GOP, [2000](#)) has been intact since 2018. Section 3.4.14 standards and subclass 3.4.14.1 of the policy, emphasizes the importance of enabling easier sharing of data. On the other hand, section 3.4.2 IT education and subclause 3.4.2.10.4 highlights the necessity of establishing a national educational intranet, interconnected with the internet to facilitate the exchange of electronic teaching and research materials as well as faculty among educational institutions.

Under section 3.4.5 on infrastructure development, sub-section 3.4.5.1 emphasizes the importance of establishing a supportive infrastructure to foster the growth of the local IT industry. This infrastructure includes data banks and their connectivity.

National Cyber Security Policy

One of the objectives of the National Cyber Security Policy 2012 (GOP, [2021b](#)) is to establish an information-sharing mechanism across all levels

of government for monitoring, detecting, protecting and responding to the threats to national information security systems.

National Climate Change Policy

Section 5.1 of the National Climate Change Policy (GOP, [2021a](#)) focuses on enhancing the technical capabilities and institutional frameworks of the current GHG emissions, data collection, sharing and archiving system within the country. Moreover, section 6 aims to foster the exchange of knowledge, information, and capacity-building initiatives in areas related to climate change. Furthermore, it aims to establish a national data portal to regularly update climate change-related data, and its sharing in GIS/remote sensing-based studies to evaluate and quantify current trends while predicting future changes across the country.

Pakistan Cloud First Policy

The Pakistan Cloud First policy (GOP, [2022](#)) highlights the concept of sharing services for data processing and making government data discoverable and accessible.

NIH Policy for Data Management and Sharing

The policy (GOP, [2023](#)) was issued in 2023 by the National Institutes of Health (NIH) even though work on the policy had started in 2020.

The policy coined the term/concept of sharing scientific data. According to the policy, scientific data refers to the factual information that the researchers' community agrees as important for confirming and reproducing research results.

Table 1

Summary of Pakistan's information-sharing related laws and policies

Year	Name	Description
1973	The Constitution of the Islamic Republic of Pakistan	Article 19A of the constitution guarantees that every citizen has the right to access information on all matters of public importance, subject to regulation and reasonable restrictions imposed by law. However, the constitution is silent about the mechanism to get information.

Year	Name	Description
1981	Pakistan Agricultural Research Council	<p>The ordinance is designed to simplify, aid, encourage and synchronize agricultural research activities while also generating, obtaining, and disseminating agricultural information. The ordinance does not specify the means to obtain and disseminate information.</p> <p>The e-services mentioned in the strategy include:</p> <ul style="list-style-type: none"> • A portal for information, the latest news and projects being implemented • Online application forms. For example, to obtain a driving license • Sharing of geospatial information related to agriculture (Ali, 2008). <p>The strategy specifies online portal as the means to share information.</p>
2005	E-Government Strategy Five Year Plan 2005	<p>The policy book highlights the significance of data and its sharing. For example, function 7 of the macro-economic section involves the upkeep of data related to the macroeconomic framework, while function 8 entails providing data to both national and international organizations. The handbook does not specify the means to share information.</p>
2008	Hand Book on Planning Commission	<p>The act underscores the need to share spatial information (Ali et al., 2023). The act does not specify the means to share information.</p>
2014	Surveying and Mapping Act 2014	<p>The document provides detailed information about geospatial data and its sharing via portal.</p>
2015	Surveying and Mapping Rules 2015	<p>Grants the public the right to access official information of the federal government and various agencies. The Act does not mention the mechanism to implement it.</p>
2017	Right of Access to Information Act, 2017	

Year	Name	Description
2018	Digital Pakistan Policy 2018	This policy encompasses a wide array of initiatives, among them a substantial overhaul of Geographical Information Systems (GIS) tailored specifically for Pakistan. The policy implementation mechanism is not included in the document.
2018	National Food Security Policy, 2018	The policy emphasizes the pressing nature of climate change and underscores the importance of utilizing IT-based information sharing to promptly adapt production plans. Like most policies in Pakistan, action plan to implement the policy is not mentioned.
2018	IT Policy and Action Plan 2018	Emphasizes the importance of enabling sharing of data. This is also generic policy lacking implementation strategy. One of the objectives of the policy is to create a mechanism for sharing information among various levels of the government to monitor, detect, safeguard and address threats to national information security systems. This is also a generic policy lacking an implementation strategy.
2021	National Cyber Security Policy 2021	This policy encourages the sharing of spatial information and its use in GIS/remote sensing-based studies to evaluate and quantify historical temporal trends while monitoring future changes across the country. The policy lacks an implementation strategy.
2021	National Climate Change Policy	The policy emphasizes the concept of service sharing for data processing and ensuring that government data is easily discoverable and accessible. The policy lacks an implementation strategy.
2022	Pakistan Cloud First Policy	The policy aims to promote the sharing of data. The policy lacks an implementation strategy.
2023	NIH Policy for Data Management and Sharing	

Literature Review

Geospatial data is pervasive and brings significant insight into solving key challenges in all sectors of society. The use of geospatial data and spatial analytical techniques is vital for policymaking (Organisation for Economic Co-operation and Development [OCED], [2021](#), [2022](#)) and socioeconomic development. It offers essential insights for urban planning and national security (Valachamy et al., [2019](#)).

Geographic or geospatial information includes data and information on locations acquired through remote sensing, mapping and surveying technologies. Most of the information is generally collected by national mapping agencies and 80% of all information held by public institutions is geospatial (EU Monitor, [2005](#)).

Geospatial data sharing and NSDI are two sides of the same coin. The sharing of data particularly held by public sector organizations, presents significant legal challenges (Fan et al., [2014](#)). The legal framework is a crucial element in the development of an NSDI and geospatial data sharing (Dimova, [2018](#)). Maphanyane et al. ([2018](#)) also underscore the need to create an NSDI Act for geospatial data sharing in Botswana. Lance ([2003](#)) outlined 21 national spatial data infrastructure (SDI) initiatives currently underway across Africa. The authors find that many of these initiatives lack legal status or an enabling legislation, which hampers their implementation on the ground. A fundamental principle of spatial data infrastructure (SDI) development is the necessity of a strong legal foundation. This legal framework outlines the overarching objectives of the SDI and defines how it will operate, including the roles and responsibilities of key stakeholders (Masser & Cromptvoets, [2019](#)). The authors argue that barriers related to legal frameworks impede effective data sharing.

Due to an increasing demand for sharing geospatial data, Australian government released a geospatial data access and pricing policy in 2001 (Houghton, [2011](#)). The theme and related data are shown in Table 2.

Table 2
Some Key Datasets Made Available to The Public Through Policy in Australia

Theme	Datasets
Geographic Information	Cartographic information Cadastral data for land use information

Theme	Datasets
	Geographical coordinates Administrative boundaries Topographical data Elevation data
Meteorological and Environmental Information	Oceanographic data Hydrographic data Environmental (quality) data Atmospheric data Meteorological (weather) data
Economic and Business Information	Financial information Company information Economic and Statistics Industry and trade information
Social Information	Demographic information Attitude surveys Data on health/illness Education and labour statistics
Traffic and Transport Information	Transport network information Traffic information Transport statistics Vehicle registration data
Tourist and Leisure Information	Hotel information Tourism statistics Entertainment (local and national)
Agricultural, Farming, Forestry and Fisheries information	Cropping/land use data Farm incomes/use of resources Fish farming/harvest information Live stock data
Natural Resource Information	Biologic and ecologic information Energy resource/consumption information Geological and geophysical information
Scientific Information and Research Data	University research Publicly-funded research institutes Governmental research

Note. Source: OECD ([2006](#))

The main legal obstacle to data sharing is the lack of clear and relevant policies (Shepherd, [2015](#); Wirtz et al., [2016](#); Zuiderwijk & Janssen, [2014](#)). To enable the sharing of geospatial data, countries around the world have introduced several policies in their jurisdictions.

In India, the sharing of geospatial data is regulated by various laws and policies, including the national GIS policy, national data sharing and accessibility policy (Mishra et al., [2017](#)), the geospatial information regulation bill (2016), and geospatial data policy introduced in 2022 (Government of India, [2022](#)). These policies promote the accessibility and sharing of geospatial data.

In China, 35 regulations form a comprehensive legal framework for governing, surveying and mapping the geo-information activities in the country, ensuring the effective management, quality assurance and utilization of geospatial data and resources across various sectors and applications. These include regulation of the publication of government information, fundamental regulation of geospatial information framework, fundamental regulation of basic geospatial information database, and fundamental regulation of common geospatial information platforms (Zheng & He, [2009](#)).

According to Safarov ([2020](#)) in Azerbaijan, various laws and initiatives promote sharing and access to information. The Law on Access to Information, established in 2005, and the Law on Personal Information, introduced in 2010, lay the groundwork for information accessibility. Additionally, the State Program for the Implementation of the National Strategy for Information Society Development, created from 2016 to 2020, aims to advance the country's information society. Complementing these efforts, Azerbaijan's National Spatial Data Infrastructure (NSDI) ensures the sharing of geospatial data (Khanalibayli, [2020](#)).

In May 2007, the Japanese government passed NSDI Act to establish a legal framework for the development and sharing of geospatial information. This legislation aims to enhance the accessibility of geospatial data among various stakeholders, including government agencies, businesses and the public (Murakami, [2008](#)).

In 1994, the Clinton administration acknowledged the significance of geospatial data sharing and initiated the NSDI by issuing an executive order (Schade et al., [2020](#)). Therefore since then, in the United States, federal

agencies have been mandated by law to provide public access to the information they gather, ensuring it is available without copyright restrictions and at a cost that covers only the minimal expenses of distribution (Masser, [2019](#), [2005](#)).

The South African Spatial Data Infrastructure (SASDI) is governed by the Spatial Data Infrastructure Act No. 54 of 2003. It is based on principles that emphasize data sharing, accessibility, and the prevention of duplication in the collection of public geospatial information (Siebritz & Coetzee, [2022](#)). Indonesia's effort to establish its NSDI began with the Geospatial Information Act, enacted on April 21, 2011. A major goal of the act is to enhance the sharing of geospatial information among stakeholders (Nugroho & Supangkat, [2021](#)).

Malaysia Geospatial Data Infrastructure (MyGDI) was established by Circular Letter No. 1 of 2006 - Guidelines for the Implementation (MyGDI) (Subari, [2015](#)). The National Space Policy 2012 of the country has also come up with a related policy framework in support of SDI development in Malaysia.

Bangladesh started its National Spatial Data Infrastructure (NSDI) development in 2016, prioritizing it in recent years. A task force was established to create a roadmap for NSDI implementation, highlighting essential components such as data-sharing policies (Rahman & Szabo, [2023](#)).

Methodology

The methodology adopted for this research is content analysis as this study is focused on exploring laws and policies. For data collection, the websites of 27 out of 40 ministries dealing with geospatial data, maps, and digital data were visited. A total of 14 documents were selected and downloaded for detailed analysis. The documents comprised six policies, two acts, one constitution, one set of rules, one ordinance, one strategy, one action plan, and one handbook (Figure 3), covering a span of over 50 years, from 1973 to 2023. Accordingly, codes for these documents were developed and assigned (Table 3).

Figure 3

Type of Documents Examined in the Study

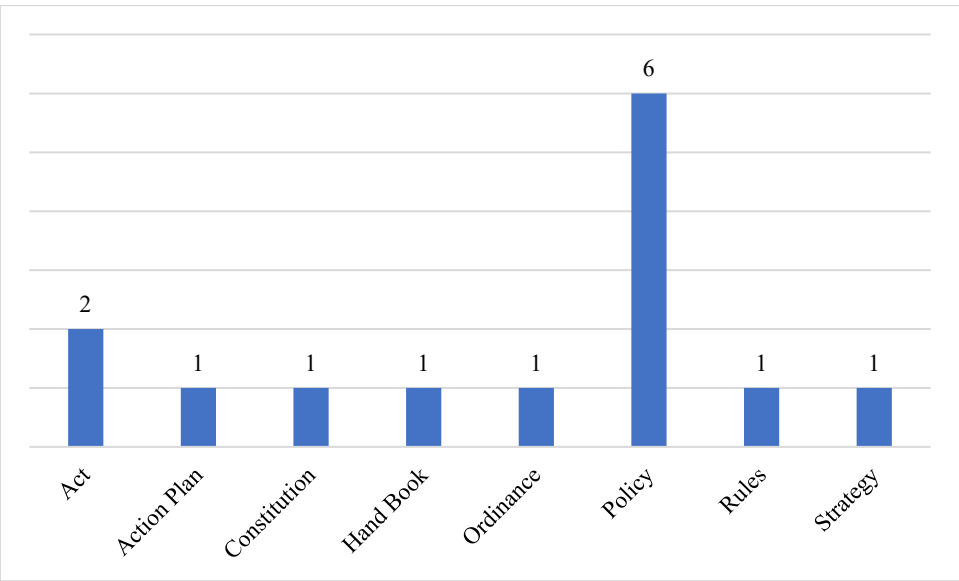


Table 3

Codes Developed for Document Types

Document Type	Code	Document Name	Running Code
Act	A	Surveying and Mapping Act	A1
		Right of Access to Information Act	A2
Action Plan	AP	IT Policy and Action Plan	AP1
Constitution	C	Constitution of Pakistan	C1
Hand Book	H	Planning Commission Hand Book	H1
Ordinance	O	PARC Ordinance	O1
		Digital Pakistan Policy	P1
Policy	P	National Food Security Policy	P2
		National Cyber Security Policy	P3
		National Climate Change Policy	P4
		Pakistan Cloud First Policy	P5
		NIH Policy for Data Management and Sharing	P6
		Surveying and Mapping Rules	R1
		E-Government Strategy	S1
Rules	R		
Strategy	S		

The keywords search included ‘geospatial’; ‘spatial’; ‘geographic’; ‘data’; ‘information’; ‘sharing’; ‘accesses’; ‘obtain’; ‘provide’; ‘portal’ and ‘right’. Microsoft Excel was employed to prepare data of keywords (Table 4).

Table 4

Number of Keywords Found in the Documents

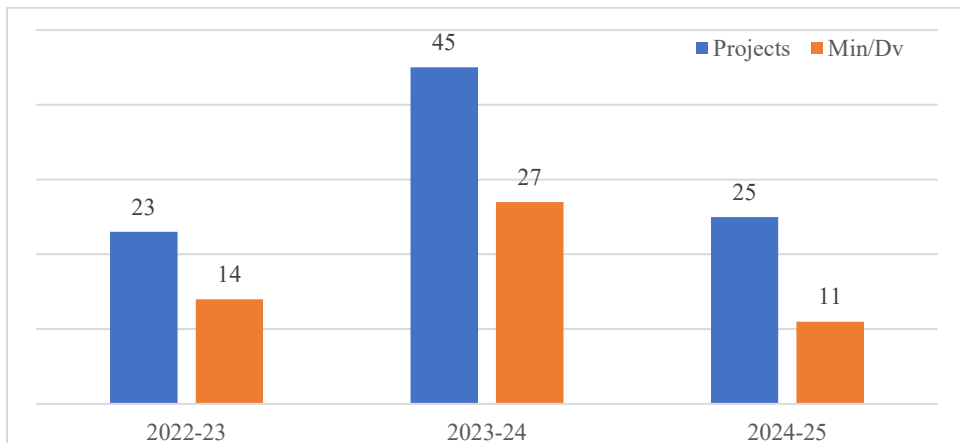
Running Code	Keywords Found	No. of Keywords
R1	geospatial, spatial, geographic, data, information, sharing, access, portal	8
A1	geospatial, data, information, sharing, access, obtain	5
C1	information, access, right	3
A2	information, right, access	3
P4	geospatial, information, sharing	3
O1	information, obtain	2
S1	information, sharing	2
H1	data, provide	2
P1	geographical, Information	2
P2	information, sharing	2
AP1	data, sharing	2
P3	information, sharing	2
P5	data, sharing	2
P6	data, sharing	2

Results

In Pakistan, although fourteen types of legislation (Figure 3) regarding data and information sharing exist, it is a pity to note that only three of them i.e., Surveying and Mapping Act 2014, Surveying and Mapping Rules 2015, and National Climate Change Policy specifically mention geospatial data/information sharing (Table 3 & 4). The digital Pakistan policy, although describes geographical information, but is silent about the need to share it for the collective good. It reveals the lack of awareness about geospatial information and the benefits of its sharing among the concerned quarters. The constitution, 1973 guarantees all citizens’ right to access information on public matters. As discussed in the introduction and literature review section, geospatial information is also a type of

information that is used to inform, implement, and monitor policies of public interest. Therefore, it is argued that the constitution of Pakistan provides a legal cover to geospatial information sharing. The Pakistan Agricultural Research Council Ordinance promotes the dissemination and sharing of agricultural geospatial information. However, the ordinance lacks important details including the access of information by users (Table 2) (GOP, [1981](#)).

Figure 4
Geospatial Data Collection



Note. Source: Ministry of planning, development and special initiatives

The E-Government Strategy underscores the need to develop GIS applications for various sectors such as agriculture, as well as developing a portal to share information but it does not mention that all GIS applications require different types of geospatial information and therefore ignores the importance of geospatial information sharing (GOP, 2005; as cited in Shahzad & Sandhu, [2007](#)). The planning commission of Pakistan a vital and integral part of the ministry of planning, development and special initiatives. It is the apex body responsible for development planning including public sector development programme (PSDP) that is a critical policy instrument to achieve balanced regional development, promote harmony and national integration through public investment. The commission is responsible for providing required resources as well. Geospatial information is also a strategic resource that is used for policy planning and almost all PSDP projects. As per PSDP 2022-203, 2023-24

and 2024-25 details available on the website of the ministry of planning, development and special initiatives (<https://www.pc.gov.pk/>), geospatial data is being collected by several ministries, and divisions but no organization exists for providing and sharing this data in an integrated form (Figure 4). The Hand Book on Planning Commission emphasizes the need for data management for macro-economic planning but does not provide detailed guidelines to manage the data including its sharing and the mode of data sharing i.e., data portal (GOP, [2008](#)).

The Surveying and Mapping Act ([2014](#)) aims for the establishment of National Spatial Data Infrastructure (NSDI) for Pakistan by the Survey of Pakistan (SoP) and key stakeholders, to streamline geospatial data management and its sharing. The Surveying and Mapping Rules 2015 underscore the need to share geospatial data collected by all public and private sector organization through NSDI portal. This study finds (Table 4) that almost all search keywords are present in the Surveying and Mapping Rules 2015 along with some guidelines about the data sharing. The Right of Access to Information Act ([2017](#)) enhances government transparency by facilitating public access to official records. The Digital Pakistan Policy ([2018a](#)) overhauls GIS systems, particularly for agriculture, addressing data integration challenges.

The National Food Security Policy ([2018b](#)) focuses on improving data sharing related to food security and climate adaptation. The IT Policy and Action Plan ([2000](#)) supports data sharing infrastructure and educational IT resources. The National Cyber Security Policy ([2012](#)) aims to protect information systems through enhanced security measures. The National Climate Change Policy ([2021a](#)) improves data collection and sharing related to climate change. The Pakistan Cloud First Policy ([2022](#)) advocates for cloud-based data management. Lastly, the NIH Policy for Data Management and Sharing ([2023](#)) defines and promotes the sharing of scientific data for research validation and reproducibility.

The comparative analysis between Pakistan and ten other developed and developing countries namely the United States, Australia, China, Japan, India, Bangladesh, Azerbaijan, Indonesia, Malaysia, and South Africa reveals that Pakistan significantly lags in establishing a legal framework for geospatial data sharing. The countries examined in this study have dedicated laws and policies in place for the sharing of geospatial information, with their governments and policymakers prioritizing the

development of NSDI for geospatial data sharing as well as supportive relevant regulations. In contrast, Pakistan has not made similar advancements.

In addition to significant legislation challenges, a number of technical issues also hamper data sharing in the country. The key technical issues include:

Lack of data standards: The lack of data standards contributes to the non-sharing of data. Geospatial data is accompanied by metadata, which plays a crucial role in facilitating the discovery, assessment and use of geographic information beyond its original organization or project (Global Spatial Data Infrastructure Association [GSDI], [2012](#)). Metadata is the information about the data such as the year of data collection, purpose of data collection, accuracy of the data as well information about data collecting department. Metadata helps to determine which organization is producing what kind of datasets, and the suitability of the dataset for the intended purpose and data integration. Currently, the Survey of Pakistan (SoP) is the only public sector organization in the country that generates standardized metadata. SoP has adopted the ISO 19115:2003 Geographic Information as metadata standards (Ali & Ahmad, [2013](#)).

Varying spatial reference system: A spatial reference system is a framework that defines the positions of objects on the Earth's surface (Shelton & McNamara, [2001](#)), encompassing both the coordinate system (like latitude and longitude) and the datum (a mathematical model of the Earth). Various spatial reference systems such as World Geodetic System 1984 (WGS 84) and Universal Transverse Mercator (UTM) can represent the same location, but they may utilize different coordinate systems or datums, potentially impacting the accuracy of the location. Unfortunately, various spatial reference systems being used in the country also hamper the sharing and integration of the data.

Technical infrastructure: Technical infrastructure is a prerequisite to facilitate data sharing and is therefore, the backbone of an NSDI (Crompvoets et al., [2008](#)). It includes computers, data storage systems, servers, and network hardware, along with the geoportal and associated software. In Pakistan, technical infrastructure for data sharing has not been developed so far.

Discussion

The concept of National Spatial Data Infrastructure (NSDI) was first introduced through an executive order by U.S. President Bill Clinton in 1994 (Schade et al., [2020](#)). Since then, most developed countries have successfully implemented NSDIs within their jurisdictions (Masser, [2005](#)), and nearly all developing countries have either established NSDIs or are in the process of developing one. Unfortunately, Pakistan was not among the early adopters of NSDI due to a lack of awareness among policymakers regarding the economic potential of geospatial data (Ali, [2008](#)). As a result, dedicated relevant laws have not been framed (Ali & de Vries, [2023](#)).

Numerous studies worldwide have explored the barriers to NSDI implementation for sharing geospatial information. For example, Bajaj and Ram ([2008](#)) in their study conclude that lack of data storage mechanism hampers the implementation of NSDIs. Ballantyne ([2009](#)) argues that restricted access to public data contributes to NSDI implementation challenges, while the lack of coordination among government departments is the root cause of the non-sharing of geospatial information (Lance et al., [2009](#)). Poor data management by data-producing organizations also hampers information sharing (OECD, [2023](#)). Furthermore, lack of funding obstructs the implementation of public infrastructure projects, such as NSDI (Torrise, [2009](#)). Additionally, NSDI implementations often fail due to exclusion of private sector (Ali, [2008](#); Williamson et al., [2006](#)).

One key requirement for implementing NSDI is legal frameworks (Casolari et al., [2023](#); UN-GGIM, [2023](#)). Some studies in Pakistan explored barriers to NSDI in the country. For example, Bulbul et al. ([2019](#)) underscore the importance of developing NSDI for sustainable e-governance in Pakistan but focuses on challenges related to data standards. Khurshid et al. ([2022](#)) emphasize the significant value of making government data accessible for effective policymaking. The authors specifically focus on the social dimensions of open government data, highlighting how transparency can enhance public engagement and foster informed decision-making. Ahmad et al. ([2024](#)) evaluate the progress of Pakistan's NSDI implementation over the past 15 years. The authors identify key challenges and favourable factors including legal framework, in general, affecting NSDI development by utilizing multiple assessment frameworks.

This study thoroughly examines the status of the legal framework for developing NSDI and sharing geospatial data, a topic that has not been intricately explored previously. By addressing this gap, the research contributes valuable insights to an under-researched area, enhancing the understanding of the legal aspects essential for effective NSDI implementation in Pakistan. Moreover, this study has mentioned in depth some key technical issues impeding data sharing in the country.

Our findings reveal that multiple ministries and departments in Pakistan are generating geospatial data (Figure 4). However, there is no central authority to manage and synthesize this data for distribution to other departments that may require it. This lack of coordination hampers effective data sharing and utilization across various sectors.

The non-implementation of NSDI in Pakistan might lead to the collection of potentially non-standardized and duplicated datasets, which in turn would result in a significant waste of public resources. Without a cohesive framework for geospatial data management, different government agencies and organizations may develop their datasets independently, leading to inconsistencies and inefficiencies. This fragmentation not only hinders effective decision-making but also compromises the quality of public services.

Given these challenges, there is an urgent need for legal and policy reforms to advance geospatial information sharing in Pakistan. Such reforms should aim to establish clear guidelines for data standardization, interoperability, and sharing protocols among various stakeholders. By creating a robust legal framework that encourages collaboration and data sharing, Pakistan can optimize its geospatial resources, ensuring that public funds are utilized efficiently and effectively.

Incorporating these reforms will not only facilitate better data management but also enhance the overall effectiveness of public policy implementation. With a unified approach to geospatial information, government agencies can work together more effectively, leading to improved outcomes in areas such as urban planning, disaster management, and environmental monitoring. Ultimately, the advancement of geospatial information sharing through comprehensive legal and policy reforms is essential for fostering sustainable development and enhancing governance in Pakistan.

Conclusion

This article examined in detail the legal obstacles hindering the sharing of geospatial information and implementation of national spatial data infrastructure (NSDI) in Pakistan. The study adopted a content analysis approach to explore this issue. Data was gathered through comprehensive reviews of policy documents, and minutes of meetings. The study finds that several ministries, and divisions are collecting geospatial information (Figure 4) without sharing the data. Some very conducive laws and acts are in place such as Survey and Mapping Act 2014, Surveying and Mapping Rules 2015 and National Climate Change Policy. However, implementation of these laws and policies on the ground is not visible, which is a big question mark as well as a challenge especially for public policy practitioners. It is also concluded that policymakers and practitioners in Pakistan are still not well aware of the potential of geospatial information and its sharing for informing and implementing public policies and service delivery. By examining these sources, the article highlighted the inadequacy of current legal provisions in addressing the evolving landscape of NSDI for geospatial data sharing. The study found significant gaps in existing laws regarding the sharing of geospatial data. The fragmented and outdated laws serve as a clear indication that both real and perceived legal challenges pose substantial barriers to endeavours aimed at harnessing data from various sectors to advance socio-economic development in the country.

In contrast to the other ten countries examined in this study, only three out of fourteen pieces of legislation in Pakistan support the establishment of NSDI. Moreover, these laws fail to clearly define institutional roles and responsibilities, as highlighted in Table 4. This gap hinders the effective implementation and management of the NSDI in the country.

Some significant technical barriers such as lack of data standards, varying spatial reference systems, interoperability and lack of technical infrastructure also impede data sharing in the country.

It is imperative to raise awareness among policymakers in Pakistan regarding the potential of geospatial information and its sharing for informing and implementing public policies and enhancing service delivery. For this purpose, it is crucial to organize seminars and workshops at all levels of the government to serve as platforms for education and

dialogue, helping stakeholders understand the significant benefits of geospatial data in decision-making processes.

For the enabling of sharing geospatial information through National Spatial Data Infrastructure (NSDI), it is imperative to establish a comprehensive legal and policy framework. An NSDI act is recommended as the legal framework for paving the path to data sharing among all stakeholders and end users. The act should address various aspects related to geospatial information development, innovation, security, licensing agreements, cooperation among working groups, data dissemination, individual privacy protection, intellectual property rights (IPR), liability, and compliance strategies. To do that there is a need for amending and updating existing laws and policies to better facilitate the establishment and functioning of an effective NSDI in Pakistan.

Finally, this study recommends incorporating NSDI into the training materials of public policy institutions to civil servants in the country. As key implementers of national policies, the officers must understand the economic value of geospatial data and its sharing through NSDI. This knowledge is essential for effectively carrying out policy formulation and implementation across tactical, operational and strategic levels. By equipping civil servants with a solid understanding of NSDI, the government can enhance decision-making processes and promote better outcomes in public administration. It is recommended as future work to investigate the amount of public money allocated in Pakistan for the collection of geospatial data.

Limitations of the study

The study relies on document analysis, which may not capture the full range of factors influencing data-sharing practices, such as informal power dynamics within government institutions.

Conflict of Interest

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data will be provided by corresponding author on reasonable request.

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Appendix-1

Some Key NSDI Stakeholders in Pakistan

Sl.	Organization
1.	Survey of Pakistan (Lead Role)
2.	Space & Upper Atmosphere Research Commission (SUPARCO)
3.	National Disaster Management Authority (NDMA)
4.	Pakistan Agricultural Research Council (PARC)
5.	Pakistan Meteorological Department (PMD)
6.	Pakistan Bureau of Statistics (PBS)
7.	Geological Survey of Pakistan (GSP)
8.	Water and Power Development Authority (WAPDA)
9.	National Highway Authority (NHA)
10.	NESPAK (Representative of private sector)
11.	COMSATS University, Islamabad (Representative of academia)