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Research Article

Privacy Law Challenges in Environmental Data Sharing: A Phenomenological Study of Stakeholder Views

Sadikul Alam Ahad¹; Kazi Abdul Mannan²

¹ Department of Law, Department of Business Administration, Shanto-Mariam University of Creative Technology
Uttara, Dhaka-1230, Bangladesh.

Corresponding Author Sadikul Alam Ahad, Email: sadikulahad@gmail.com

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ABSTRACT

Environmental data sharing is essential for addressing global sustainability challenges; however, it raises complex privacy law concerns when datasets intersect with personal, geospatial, and socio-economic information. This study examines privacy law challenges in environmental data sharing through a qualitative phenomenological approach based on secondary data. Drawing on scholarly literature, policy reports, and documented stakeholder perspectives, the research explores how stakeholders perceive and navigate tensions between open data imperatives and privacy protection. The findings reveal that regulatory fragmentation, limitations of anonymisation, consent complexities, and technological constraints significantly hinder effective data sharing. Moreover, stakeholder experiences highlight the central role of trust, ethical considerations, and institutional capacity in shaping data governance practices. The study integrates Privacy Calculus Theory, Data Governance Theory, and phenomenology to provide a holistic understanding of these challenges. It concludes that achieving a balance between openness and privacy requires adaptive governance frameworks, investment in privacy-enhancing technologies, and inclusive stakeholder engagement. The research contributes to the growing discourse on data governance by offering interdisciplinary insights and practical recommendations for policymakers and researchers.

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1. Introduction

Environmental data sharing has emerged as a cornerstone of contemporary environmental governance, scientific collaboration, and sustainable development. In an era characterised by complex global challenges, such as climate change, biodiversity loss, and environmental degradation, the availability and accessibility of high-quality environmental data are critical for informed decision-making and policy formulation. Governments, research institutions, and international organisations increasingly advocate for open data practices to foster transparency, innovation, and interdisciplinary collaboration (Layode et al., 2024; U.S. National Research Council, 2014).

The proliferation of advanced technologies, including remote sensing, geographic information systems (GIS), and Internet of Things (IoT) devices, has significantly expanded the scope and scale of environmental data collection. These technologies enable real-time monitoring of environmental variables, such as air quality, water resources, and land use patterns. However, the integration of environmental data with socio-economic, demographic, and health-related datasets has blurred the boundaries between environmental and personal data, thereby introducing complex privacy concerns (Gruschka et al., 2018). For instance, geospatial datasets that track environmental exposure may inadvertently reveal sensitive information about individuals' locations, behaviours, and health conditions.

In response to these emerging risks, privacy laws and data protection regulations have become increasingly stringent. Legal frameworks such as the General Data Protection Regulation (GDPR) in the European Union establish comprehensive guidelines for the collection, processing, and sharing of personal data, emphasising principles such as data minimisation, purpose limitation, and accountability (Ghorashi et al., 2023). While these regulations play a crucial role in safeguarding individual rights, they also pose significant challenges for environmental data sharing initiatives. Researchers and policymakers often face difficulties in navigating complex regulatory requirements, particularly when dealing with cross-border data flows and interdisciplinary datasets.

One of the central tensions in environmental data governance lies in balancing the imperative for open data with the need to protect privacy. Open data initiatives are widely recognised for their potential to accelerate scientific discovery, enhance public participation, and improve environmental outcomes. However, the unrestricted sharing of data can expose individuals and communities to privacy risks, including unauthorised access, data misuse, and re-identification (Murtagh, 2018). These risks are particularly pronounced in contexts where environmental data intersect with vulnerable populations, such as indigenous communities or individuals affected by environmental hazards.

The challenge of data anonymisation further complicates this landscape. Although anonymisation techniques are commonly

employed to protect privacy, recent studies suggest that they may not be sufficient to prevent re-identification, especially when datasets are combined or analysed using advanced algorithms (Sivizaca Conde et al., 2024). This raises critical questions about the adequacy of existing privacy safeguards and the need for more robust privacy-enhancing technologies.

In addition to legal and technical challenges, environmental data sharing is shaped by organisational and cultural factors. Stakeholders, including researchers, data managers, policymakers, and legal experts, often have divergent priorities and perspectives regarding data sharing. For example, researchers may prioritise data accessibility to advance scientific knowledge, while legal experts emphasise compliance with privacy regulations. These differing perspectives can lead to conflicts and delays in data-sharing processes (Springer Nature, 2023).

Understanding these complexities requires a nuanced and context-sensitive approach. Traditional quantitative methods may not fully capture the subjective experiences and perceptions of stakeholders involved in environmental data sharing. Therefore, this study adopts a phenomenological perspective, focusing on the lived experiences of stakeholders to explore how they perceive and navigate privacy law challenges. Phenomenology is particularly well-suited for this purpose, as it emphasises the interpretation of human experiences and the meanings individuals attach to them.

By synthesising qualitative insights from secondary data sources, this research aims to

provide a comprehensive understanding of privacy law challenges in environmental data sharing. The study addresses the following research questions:

- How do stakeholders perceive privacy law challenges in environmental data sharing?
- What are the key legal, ethical, and technological barriers to effective data sharing?
- How can data governance frameworks be improved to balance openness and privacy?

The significance of this study lies in its interdisciplinary approach, integrating legal, ethical, and experiential perspectives. By examining stakeholder views, the research contributes to the development of more effective and inclusive data governance strategies. Furthermore, the findings have practical implications for policymakers, researchers, and organisations seeking to navigate the complex landscape of environmental data sharing.

2. Literature Review

Environmental data sharing is a fundamental component of the open science movement, which seeks to make scientific research more transparent, accessible, and collaborative. Open science initiatives encourage the dissemination of data, methodologies, and findings to facilitate knowledge exchange and innovation. In the context of environmental research, data sharing enables the integration of diverse datasets, supporting comprehensive analyses of complex

environmental systems (U.S. National Research Council, 2014).

The importance of environmental data sharing is particularly evident in addressing global challenges such as climate change. Large-scale environmental datasets, including satellite imagery and climate models, are essential for monitoring environmental trends and informing policy decisions. However, the increasing reliance on integrated datasets has also raised concerns about data quality, interoperability, and privacy (Layode et al., 2024).

Despite its benefits, open data sharing is not without challenges. Researchers often face barriers related to data standardisation, intellectual property rights, and resource constraints. Additionally, the inclusion of human-related data in environmental research introduces ethical considerations that must be carefully managed.

2.1 Privacy Laws and Regulatory Frameworks

Privacy laws play a critical role in regulating data sharing practices. The GDPR is widely regarded as one of the most comprehensive data protection frameworks, establishing strict requirements for data processing and emphasising individual rights (Ghorashi et al., 2023). Key principles of GDPR include:

- **Data minimisation:** Collecting only the data necessary for a specific purpose
- **Purpose limitation:** Using data only for the intended purpose

- **Transparency and accountability:** Ensuring that data processing activities are clearly documented

While these principles enhance data protection, they also create challenges for environmental data sharing. For example, the requirement for informed consent may be difficult to implement in large-scale environmental studies, where data are collected from diverse sources and reused for multiple purposes (Gruschka et al., 2018).

Furthermore, regulatory fragmentation across jurisdictions complicates international data sharing. Different countries have varying data protection laws, creating legal uncertainties and increasing compliance costs. Organisations must navigate these complexities to ensure that their data-sharing practices comply with multiple regulatory frameworks.

2.2 Privacy Risks in Environmental Data

Environmental data often contains sensitive information that can pose privacy risks. Geospatial data, for instance, can reveal precise locations of individuals or communities, while environmental health data may expose personal health conditions. Even when data are anonymised, the risk of re-identification remains a significant concern (Murtagh, 2018).

Advances in data analytics have exacerbated these risks. Techniques such as data linkage and machine learning enable the combination of multiple datasets, increasing the likelihood of identifying individuals. This has led to growing concerns about the adequacy of

traditional anonymisation methods (Sivizaca Conde et al., 2024).

Moreover, privacy risks are not limited to individuals. Environmental data may also reveal sensitive information about ecosystems, endangered species, or natural resources, raising concerns about environmental security and conservation.

2.3 Data Anonymisation and Privacy-Enhancing Technologies

Anonymisation is a widely used strategy for protecting privacy in data sharing. However, its effectiveness is increasingly questioned due to the risk of re-identification. Researchers have proposed various privacy-enhancing technologies (PETs), such as differential privacy, secure multi-party computation, and data encryption, to address these challenges (Sivizaca Conde et al., 2024).

While PETs offer promising solutions, their implementation is often complex and resource-intensive. Organisations may lack the technical expertise and infrastructure required to deploy these technologies effectively. Additionally, there is a trade-off between data utility and privacy protection, as stronger privacy measures may reduce the usability of data.

2.4 Ethical Considerations in Data Sharing

Ethical considerations are central to environmental data sharing. Issues such as informed consent, data ownership, and equity must be addressed to ensure that data-sharing practices are fair and inclusive. For example, indigenous communities may have specific

concerns about the use of environmental data related to their lands and resources.

The concept of “data justice” has gained prominence in recent years, emphasising the need to address power imbalances and ensure equitable access to data (Springer Nature, 2023). Ethical frameworks must consider the interests of all stakeholders, including marginalised communities.

2.5 Stakeholder Perspectives and Challenges

Stakeholder perspectives provide valuable insights into the practical challenges of data sharing. Qualitative studies reveal that stakeholders often face competing priorities, such as balancing legal compliance with research objectives. Common challenges include:

- Uncertainty about legal requirements
- Delays in data access due to compliance processes
- Limited resources for data management
- Lack of standardised protocols

Stakeholders also emphasise the importance of trust in data sharing. Public privacy concerns can influence participation in environmental research, highlighting the need for transparent and accountable practices (Springer Nature, 2023).

2.6 Research Gaps

Despite extensive research on data privacy and environmental data sharing, several gaps remain. First, there is a lack of studies that integrate legal, technical, and experiential perspectives. Second, limited research has

focused on the lived experiences of stakeholders, particularly in the context of privacy law challenges. Third, there is a need for practical frameworks that address the complexities of data governance in environmental contexts.

This study seeks to address these gaps by adopting a phenomenological approach, providing a holistic understanding of stakeholder experiences and identifying strategies for improving data governance.

3. Theoretical Framework

Understanding privacy law challenges in environmental data sharing requires a multidimensional theoretical lens that captures legal, behavioural, and experiential dimensions. This study integrates Privacy Calculus Theory, Data Governance Theory, and Phenomenology to provide a comprehensive analytical framework. These perspectives collectively explain how stakeholders evaluate risks, operate within institutional structures, and interpret their lived experiences in data-sharing environments.

3.1 Privacy Calculus Theory

Privacy Calculus Theory posits that individuals and organisations engage in a rational cost–benefit analysis when deciding whether to disclose or share data. The theory suggests that stakeholders weigh the perceived benefits of data sharing, such as scientific advancement, policy development, and societal welfare, against potential risks, including privacy breaches, reputational damage, and legal liability (Dinev & Hart, 2006).

In the context of environmental data sharing, this calculus becomes particularly complex. Environmental datasets often produce significant public benefits, such as improved climate modelling, disaster preparedness, and environmental health monitoring. However, these benefits may come at the cost of exposing sensitive personal or community-level information. For example, geospatial data used in environmental monitoring may inadvertently reveal individuals' locations or behavioural patterns, thereby increasing privacy risks (Gruschka et al., 2018).

Stakeholders such as researchers and policymakers must navigate these trade-offs within the constraints of legal frameworks like the General Data Protection Regulation (GDPR). The theory helps explain why stakeholders may adopt cautious or restrictive data-sharing practices, even when the potential benefits are substantial. It also highlights the importance of trust and perceived control in influencing data-sharing decisions. When stakeholders perceive that adequate safeguards are in place, they are more likely to engage in data sharing (Kehr et al., 2015).

Thus, Privacy Calculus Theory provides a behavioural foundation for understanding stakeholder decision-making processes in environmental data governance.

3.2 Data Governance Theory

Data Governance Theory focuses on the structures, policies, and processes that regulate data management within organisations and across systems. It emphasises the need for clear accountability, standardised procedures, and alignment

between legal, technical, and organisational dimensions (Khatri & Brown, 2010).

In environmental data sharing, data governance plays a critical role in ensuring compliance with privacy laws while enabling effective data utilisation. Governance frameworks typically include policies on data access, data quality, security measures, and ethical considerations. However, the increasing complexity of environmental datasets, often involving multiple stakeholders and cross-border data flows, poses significant challenges to traditional governance models.

One key issue is regulatory fragmentation, where different jurisdictions impose varying data protection requirements. This creates uncertainty and increases the burden on organisations engaged in international data sharing (Ghorashi et al., 2023). Additionally, the lack of standardised protocols for data anonymisation and sharing further complicates governance efforts.

Data Governance Theory also highlights the importance of institutional trust and accountability. Effective governance requires transparency in data processing activities and mechanisms for monitoring compliance. Stakeholders must be confident that data-sharing practices adhere to legal and ethical standards, which in turn fosters trust and collaboration (Janssen et al., 2020).

Moreover, the theory underscores the role of adaptive governance in responding to emerging challenges. As technological advancements introduce new privacy risks, governance frameworks must evolve to incorporate innovative solutions, such as

privacy-enhancing technologies and dynamic consent models.

3.3 Phenomenological Perspective

Phenomenology is a qualitative research philosophy that seeks to understand individuals' lived experiences and the meanings they assign to those experiences. Rooted in the works of Husserl and Heidegger, phenomenology emphasises subjective perception and interpretation as central to understanding social phenomena (Creswell & Poth, 2018).

In this study, phenomenology is employed to explore how stakeholders experience and interpret privacy law challenges in environmental data sharing. Unlike purely legal or technical analyses, a phenomenological approach captures the nuanced and context-dependent nature of these challenges. Stakeholders do not merely respond to legal requirements; they interpret and negotiate them within their specific organisational and cultural contexts.

For instance, a data manager may experience privacy regulations as bureaucratic constraints, while a legal expert may view them as essential safeguards. Similarly, researchers may perceive anonymisation requirements as barriers to data usability. These differing perspectives highlight the importance of understanding the subjective dimensions of data governance.

Phenomenology also facilitates the identification of common themes and shared experiences across stakeholders. By analysing qualitative data from secondary sources, this study seeks to uncover the

essence of stakeholder experiences, including perceptions of risk, trust, and responsibility.

3.4 Integration of Theoretical Perspectives

The integration of these three theoretical perspectives provides a robust framework for analysing privacy law challenges in environmental data sharing. Privacy Calculus Theory explains the decision-making processes of stakeholders, Data Governance Theory addresses the structural and institutional dimensions, and Phenomenology captures the experiential aspects.

Together, these frameworks enable a holistic understanding of the research problem. They highlight the interplay between individual perceptions, organisational practices, and regulatory environments, offering valuable insights into the complexities of environmental data governance.

4. Methodology

This study adopts a qualitative phenomenological research design to explore stakeholder perceptions of privacy law challenges in environmental data sharing. Phenomenology is particularly suitable for this research because it focuses on understanding lived experiences and the meanings individuals attach to them (Creswell & Poth, 2018).

Given the complexity of privacy laws and the subjective nature of stakeholder experiences, a qualitative approach allows for an in-depth exploration of these issues. The study employs a secondary data-based phenomenological analysis, synthesising

insights from existing qualitative studies, policy documents, and scholarly literature.

4.1 Research Approach: Secondary Data Utilisation

The use of secondary data is justified by the availability of rich qualitative sources that document stakeholder experiences in environmental data sharing contexts. These sources include:

- Peer-reviewed journal articles
- Case studies and qualitative research reports
- Policy documents and legal analyses
- Reports from international organisations

Secondary data analysis offers several advantages. It enables the researcher to access a wide range of perspectives across different contexts and reduces the time and resource constraints associated with primary data collection (Johnston, 2017). Additionally, it allows for the synthesis of findings from multiple studies, enhancing the generalizability of the results.

However, the use of secondary data also presents challenges, such as variability in data quality and potential biases in the original studies. To address these issues, the study employs rigorous selection criteria and critical evaluation of sources.

4.2 Data Selection Criteria

The selection of data sources was guided by the following criteria:

- **Relevance:** Sources must address environmental data sharing, privacy laws, or stakeholder perspectives.

- **Credibility:** Sources must be peer-reviewed or published by reputable organisations.
- **Recency:** Preference was given to studies published within the last 10 years to ensure contemporary relevance.
- **Richness of Data:** Sources must provide detailed qualitative insights into stakeholder experiences.

These criteria ensure that the data used in the analysis are both reliable and relevant to the research objectives.

4.3 Data Analysis Method

The study employs thematic analysis, a widely used method for analysing qualitative data. Thematic analysis involves identifying, analysing, and interpreting patterns or themes within the data (Braun & Clarke, 2006).

The analysis was conducted in the following stages:

Data Familiarisation: The researcher reviewed all selected sources to gain a comprehensive understanding of the content. Key ideas and recurring concepts were noted.

Coding: Relevant data segments were coded based on themes related to privacy law challenges, such as regulatory complexity, anonymisation, consent, and trust.

Theme Development: Codes were grouped into broader themes that capture the essence of stakeholder experiences. These themes were refined through iterative analysis.

Interpretation: The identified themes were interpreted in relation to the theoretical framework, providing insights into the

underlying dynamics of privacy law challenges.

4.4 Ensuring Research Rigour

To enhance the credibility and reliability of the study, several strategies were employed:

- **Triangulation:** Data from multiple sources were compared to identify consistent patterns.
- **Transparency:** The research process, including data selection and analysis procedures, was clearly documented.
- **Reflexivity:** The researcher critically reflected on potential biases and their influence on the analysis.

These measures ensure that the findings are robust and trustworthy.

4.5 Ethical Considerations

The study relies exclusively on publicly available secondary data, thereby minimising ethical concerns related to data collection. However, ethical considerations were still addressed by:

- Ensuring proper citation and acknowledgement of sources
- Avoiding misrepresentation of original findings
- Maintaining academic integrity throughout the research process

Additionally, the study adheres to ethical guidelines for qualitative research, emphasising respect for the original context and meaning of the data (Mannan & Farhana, 2026).

4.6 Limitations of the Methodology

While the chosen methodology offers several advantages, it also has limitations. The reliance on secondary data means that the analysis is constrained by the scope and quality of existing studies. The absence of primary data collection may limit the ability to capture context-specific insights.

Furthermore, phenomenological analysis typically involves direct engagement with participants. In this study, the use of secondary data may reduce the depth of experiential understanding. However, this limitation is mitigated by the inclusion of diverse and rich qualitative sources.

4.7 Justification of Methodological Choices

Despite its limitations, the chosen methodology is well-suited to the research objectives. The combination of phenomenology and secondary data analysis allows for a comprehensive exploration of stakeholder experiences across different contexts. It also aligns with the interdisciplinary nature of the research, integrating legal, technical, and social perspectives.

7. Conclusion

This study has explored the multifaceted challenges associated with privacy law in environmental data sharing through a phenomenological lens, emphasising stakeholder perceptions and experiences. The findings demonstrate that environmental data sharing operates within a complex and often conflicting landscape, where the imperative

for open data and scientific collaboration must be carefully balanced against the need to protect individual privacy and comply with regulatory frameworks.

A key conclusion of this research is that privacy law challenges are not merely legal or technical issues but are deeply embedded in organisational practices, ethical considerations, and stakeholder relationships. Regulatory complexity and fragmentation significantly hinder cross-border data sharing, creating uncertainty and increasing compliance burdens. At the same time, traditional approaches to privacy protection, such as data anonymisation, are increasingly inadequate in the face of advanced data analytics and re-identification risks.

The study also highlights the limitations of conventional consent mechanisms, particularly in environmental research contexts where data are often collected indirectly and reused for multiple purposes. These challenges underscore the need for more flexible and context-sensitive approaches, such as dynamic consent and community-based governance models, which can better address ethical concerns and enhance stakeholder participation.

Furthermore, the findings emphasise the critical role of trust in enabling effective data sharing. Trust is shaped by transparency, accountability, and the perceived legitimacy of data governance practices. Without trust, stakeholders are less likely to engage in data sharing, thereby limiting the potential benefits of environmental research.

From a theoretical perspective, the integration of Privacy Calculus Theory, Data Governance Theory, and phenomenology provides a comprehensive framework for understanding the interplay between individual decision-making, institutional structures, and lived experiences. This interdisciplinary approach offers valuable insights into the complexities of data governance and highlights the need for holistic solutions.

In practical terms, the study suggests several key recommendations. These include the harmonisation of privacy regulations across jurisdictions, increased investment in privacy-enhancing technologies, and the development of adaptive governance frameworks that can respond to evolving challenges. Additionally, fostering collaboration among legal, technical, and environmental experts is essential for addressing the interdisciplinary nature of these issues.

In conclusion, achieving a sustainable balance between environmental data sharing and privacy protection requires a nuanced and integrated approach that considers legal, technological, ethical, and experiential dimensions. Future research should focus on empirical case studies and the development of practical tools to support stakeholders in navigating this complex landscape.

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