



Sociology & Cultural Research Review (SCRR)
Available Online: <https://scrrjournal.com>
Print ISSN: [3007-3103](#) **Online ISSN:** [3007-3111](#)
Platform & Workflow by: [Open Journal Systems](#)
<https://doi.org/10.5281/zenodo.22164873>



Agricultural Information Governance in the Digital Age: Ethical Challenges, Policy Frameworks and Future Directions in Developing Countries

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ABSTRACT

The rapid advancement of digital technologies has transformed agricultural, economic, social and institutional systems across developing countries. Digital platforms, artificial intelligence (AI), big data analytics, cloud computing, Internet of Things (IoT), remote sensing and mobile applications have created new opportunities for improving efficiency, decision making, transparency and service delivery. However, the increasing dependence on digital information systems has generated significant challenges related to information governance, ethical data management, privacy protection, security, ownership and accountability. Developing countries face unique difficulties because digital transformation is progressing faster than the development of appropriate governance structures, regulatory frameworks and institutional capacities. This descriptive literature review examines existing scholarly debates regarding information governance and ethical challenges in the digital age with particular emphasis on developing country contexts. The review synthesizes literature related to digital transformation, data

governance, responsible technology adoption, information security and ethical considerations in technology driven environments. The findings indicate that although digital technologies provide substantial benefits, weak governance mechanisms, limited regulatory capacity, inadequate digital literacy, unequal access and unclear data ownership arrangements remain major barriers to responsible digital transformation. In sectors such as agriculture, where large volumes of data are generated through smart farming technologies, ethical concerns regarding farmer data ownership, privacy, transparency and equitable access have become increasingly important. The review proposes that developing countries require integrated information governance approaches that combine technological innovation with ethical principles, stakeholder participation, regulatory frameworks and institutional accountability. The study contributes to the emerging discourse on responsible digital transformation by highlighting the need for inclusive governance models that ensure digital technologies serve social and economic development objectives.

Keywords: *Information Governance; Digital Transformation; Data Ethics; Developing Countries; Digital Agriculture; Data Privacy; Information Security; Responsible Innovation.*

1. Introduction

Digital transformation has become one of the most influential forces shaping contemporary societies. The rapid adoption of advanced digital technologies has changed how organizations collect, process, store, share and utilize information. Technologies including artificial intelligence, big data analytics, cloud computing, blockchain, Internet of Things (IoT) and digital platforms have enabled organizations and governments to improve operational efficiency, enhance decision making and develop innovative services. Unlike traditional information technology adoption, digital transformation represents a broader socio technical transition involving changes in organizational structures, institutional practices and societal interactions (Vial, 2019). Developing countries are increasingly embracing digital transformation as a pathway toward economic growth, improved public services, sustainable development and social inclusion. Governments and organizations have introduced digital initiatives in sectors such as healthcare, education, agriculture, finance and public administration. These initiatives aim to overcome traditional development challenges by improving access to information, increasing transparency and enabling data driven decision making. However, the expansion of digital systems has also introduced complex governance challenges concerning how information is collected, controlled, shared and protected.

Information has become a strategic resource in the digital era. Organizations that possess and control data can influence decision making processes, economic opportunities and social outcomes. Therefore, effective information governance has become essential to ensure that information assets are managed responsibly throughout their lifecycle. Information governance refers to the development of policies, processes, standards and accountability mechanisms that regulate information creation, access, use, storage and disposal (Smallwood, 2019). It extends beyond traditional data management by incorporating legal, ethical, organizational and social considerations. The importance of information governance has become particularly evident in developing countries, where digital transformation often occurs within environments characterized by limited institutional capacity, emerging regulatory systems, infrastructure constraints and unequal digital access. While digital technologies create opportunities for improving productivity and service delivery, weak governance mechanisms may increase risks

related to privacy violations, cybersecurity threats, misinformation, discrimination and unequal distribution of benefits.

Agriculture provides an important example of these opportunities and challenges. Digital agriculture has emerged as a major transformation area through the use of remote sensing, geographic information systems (GIS), mobile advisory platforms, artificial intelligence and precision farming technologies. These technologies generate large amounts of agricultural information related to soil conditions, weather patterns, crop performance, farm locations and production practices. Although such information can support sustainable farming and improve productivity, questions regarding ownership, access rights, privacy and control over agricultural data remain unresolved (Wolfert et al., 2017). Recent literature shows that agricultural data governance has become a growing research area because stakeholders increasingly require clear mechanisms for responsible data sharing and protection. In developing countries, these concerns are particularly significant because smallholder farmers and marginalized communities may have limited awareness, bargaining power and technological capacity. Digital systems developed without inclusive governance approaches may unintentionally increase inequalities by benefiting technologically advanced stakeholders while excluding vulnerable groups. Studies on digital agriculture adoption in low- and middle-income countries highlight that socioeconomic factors, institutional conditions, infrastructure availability and digital skills strongly influence whether communities can benefit from technological innovations (Manzoor et al., 2025).

Despite growing interest in digital transformation, existing literature has largely focused on technological benefits, adoption barriers and productivity improvements, while comparatively less attention has been given to ethical information governance issues. Questions concerning who owns digital information, which controls access, how data driven decisions are justified and how individual rights are protected remain insufficiently addressed, especially in developing country contexts. Therefore, this review examines information governance and ethical challenges associated with digital transformation in developing countries. It explores existing practices, policy approaches and emerging concerns while highlighting the need for responsible governance frameworks that balance technological innovation with ethical responsibility.

2. Literature Review

2.1 Digital Transformation and the Emergence of Data Driven Societies

Digital transformation represents a fundamental shift in how organizations, governments and societies create value through the integration of advanced digital technologies. Unlike conventional digitization, which mainly involves converting analogue information into digital formats, digital transformation involves broader organizational, institutional and social changes enabled by technologies such as artificial intelligence (AI), big data analytics, cloud computing, Internet of Things (IoT), blockchain and digital platforms (Vial, 2019). These technologies have reshaped decision making processes by allowing organizations to collect, analyze and utilize unprecedented volumes of information. In developing countries, digital transformation has become closely associated with economic development strategies, improved public service delivery and social inclusion. Governments increasingly view digital technologies as mechanisms for overcoming traditional development barriers, improving transparency and enhancing access to information. However, the rapid expansion of digital systems has also created new governance challenges because institutional and regulatory frameworks often develop more slowly than technological innovations (Heeks, 2022).

The value of digital transformation depends not only on technological availability but also on the ability of institutions to manage information responsibly. Data has become a strategic asset, influencing economic activities, public policy decisions and social relationships. Consequently, effective information governance has become essential to ensure that digital transformation produces equitable benefits while minimizing risks associated with misuse, exclusion and loss of individual control over information. The agricultural sector represents one of the most significant examples of this transformation. Digital agriculture, often described as Agriculture 4.0, integrates technologies such as remote sensing, artificial intelligence, mobile applications, precision farming systems and IoT based monitoring tools to improve agricultural productivity and sustainability. These technologies generate extensive datasets related to climate conditions, soil characteristics, crop performance, farm management practices and market information (Wolfert et al., 2017). Recent reviews indicate that digital agriculture research has increasingly focused on agricultural information exchange, digital production systems and technology enabled decision making. However, the increasing dependence on data driven agricultural systems raises important questions regarding governance, control and ethical responsibility. Agricultural data is no longer simply technical information; it has become an economic and social resource that influences relationships between farmers, governments, technology companies, researchers and agribusiness organizations.

2.2 Concept of Information Governance

Information governance has emerged as a critical discipline for managing information assets throughout their lifecycle. It refers to the development of policies, procedures, standards and accountability mechanisms that ensure information is created, stored, accessed, shared and used appropriately (Smallwood, 2019). Unlike traditional information management, which focuses primarily on operational efficiency, information governance incorporates broader considerations including legal compliance, ethical responsibility, risk management and organizational accountability. According to Abraham et al. (2019), information governance requires coordinated decision-making structures that define responsibilities, authority and processes for managing information resources. Effective governance ensures that organizations maintain information quality, security, accessibility and reliability while reducing risks associated with inappropriate use. The importance of information governance has increased significantly due to the expansion of big data and artificial intelligence. Modern digital systems continuously generate large amounts of information from multiple sources, making traditional approaches to information management insufficient. Organizations must establish governance mechanisms that address questions such as:

- Who owns information?
- Who has the right to access and use information?
- How can information accuracy be ensured?
- How can privacy and security be protected?
- Who is accountable when information causes harm?

These questions become more complex in developing countries because digital ecosystems often involve multiple stakeholders operating under different levels of technological capability and regulatory maturity.

In agricultural systems, information governance involves managing the entire agricultural data lifecycle: **Data Collection → Data Storage → Data Processing → Data Sharing → Data Utilization**

Each stage creates governance requirements. For example, during data collection, issues arise regarding farmer consent and transparency. During storage and processing, cybersecurity and data quality become important. During sharing and utilization, questions of ownership, commercial use and equitable benefit distribution become central concerns.

2.3 Digital Agriculture and Agricultural Information Governance

Agriculture has traditionally depended on information related to weather patterns, soil conditions, crop cycles, market prices and farming practices. However, digital technologies have transformed agricultural information from locally generated knowledge into large scale digital datasets. Sensors, satellites, drones, mobile applications and artificial intelligence systems now generate continuous streams of agricultural information. Wolfert et al. (2017) argue that big data has become a fundamental component of smart farming because it enables predictive analysis, automated decision making and improved resource management. However, they also emphasize that digital agriculture creates new ethical and organizational challenges, particularly regarding data ownership, accessibility and power relationships among stakeholders. Agricultural data governance is especially important because data ownership is often unclear. Farmers may generate valuable information through their farming activities, but technology providers or agribusiness companies may control the platforms through which data is collected and processed. This creates potential power imbalances between farmers and large technology organizations.

The Organization for Economic Co operation and Development (OECD) highlights that agricultural data governance requires balancing two competing objectives: protecting farmers' privacy and economic interests while enabling data sharing that supports innovation and agricultural development. For developing countries, these challenges are intensified because many agricultural systems are dominated by smallholder farmers who may have limited digital literacy, weak negotiating capacity and restricted access to technological infrastructure. Research on digital agriculture adoption in low- and middle-income countries shows that technological benefits depend heavily on socioeconomic conditions, institutional support, infrastructure availability and user capabilities.

2.4 Ethical Challenges of Information Governance in the Digital Age

2.4.1 Data Ownership and Control

Data ownership is one of the most significant ethical concerns in digital agriculture. Traditional property concepts are difficult to apply to digital information because data can be copied, processed and shared repeatedly without physical limitations. A farmer may generate agricultural data through crop monitoring systems, but questions remain regarding whether ownership belongs to the farmer, technology provider, government agency, or research institution. Unclear ownership arrangements can reduce farmers' willingness to participate in digital platforms and create concerns about unequal economic benefits. Research on smart farming ethics identifies data ownership and access as central concerns because control over agricultural data can influence power relations within food systems (Bronson & Knezevic, 2016). The issue is particularly relevant in developing countries where farmers may have limited awareness of their rights regarding digital information.

2.4.2 Privacy and Confidentiality Concerns

Privacy represents another major ethical challenge. Agricultural information may reveal sensitive details about individuals and communities, including:

- Farm Locations
- Production Capacity
- Economic Conditions
- Land Characteristics
- Business Practices

Although agricultural data may appear less personal than healthcare or financial information, inappropriate disclosure can create economic disadvantages for farmers. For example, competitors may use production information to influence markets or commercial strategies. Therefore, ethical information governance requires clear privacy principles, including:

- Informed Consent
- Transparent Data Collection Practices
- Restricted Access
- Responsible Data Sharing

2.4.3 Data Security and Cybersecurity Risks

The increasing digitalization of agriculture creates new cybersecurity vulnerabilities. Connected agricultural systems depend on digital infrastructure, cloud platforms and communication networks, making them potential targets for unauthorized access or manipulation. Weak cybersecurity practices may affect:

- Agricultural Databases
- Farm Management Systems
- Digital Advisory Platforms
- Supply Chain Information Systems

Developing countries often face additional challenges because cybersecurity expertise, institutional capacity and regulatory enforcement mechanisms may be limited.

2.4.4 Transparency and Accountability

Transparency is essential for building trust in digital systems. Farmers and other stakeholders need to understand:

- What Information Is Collected
- Why It Is Collected
- How It Is Processed
- Who Benefits From Its Use

This issue becomes more significant when artificial intelligence systems are used for agricultural recommendations. If AI models provide decisions regarding crop selection, irrigation, or disease management, stakeholders need confidence that these decisions are understandable and fair. Responsible AI literature emphasizes that transparency and accountability are fundamental principles for ensuring that algorithmic systems operate ethically (Floridi et al., 2018).

2.4.5 Digital Inequality and Inclusion Challenges

Although digital technologies can improve agricultural productivity, they may also increase inequalities if access is uneven. Smallholder farmers in developing countries frequently face barriers such as:

- Limited Internet Connectivity
- Lack Of Digital Skills
- Financial Constraints
- Inadequate Institutional Support

As a result, digital transformation may benefit large commercial farms more than resource constrained farmers. Inclusive information governance therefore requires stakeholder participation and policies that ensure vulnerable groups are not excluded from digital agricultural systems.

2.5 Policy and Governance Frameworks for Digital Information Management in Developing Countries

The effectiveness of digital transformation depends significantly on the existence of appropriate governance structures, regulatory frameworks and institutional capacities. Developing countries face a complex situation: while digital technologies are being rapidly adopted to accelerate economic and social development, governance systems required to regulate information flows are often still emerging. This creates a gap between technological advancement and institutional readiness. Information governance policies in developing countries generally address broader areas such as cybersecurity, digital identity, data protection and electronic transactions rather than sector specific information governance. As a result, sectors generating highly valuable datasets, such as agriculture, healthcare and finance, often lack specialized frameworks for responsible data management. According to the United Nations Conference on Trade and Development (UNCTAD, 2021), developing countries require comprehensive data governance approaches that balance innovation, economic development, individual rights and public interest. Effective governance requires not only legal regulations but also institutional coordination, technical capacity and stakeholder participation.

2.5.1 International Approaches to Data Governance

Several international organizations have developed principles and frameworks to guide responsible digital transformation. The Organization for Economic Cooperation and Development (OECD) emphasizes principles including:

- Transparency
- Accountability
- Data Quality
- Security Safeguards
- Stakeholder Participation

These principles highlight that data governance should not only focus on protecting information but also on ensuring that data contributes positively to society (OECD, 2020). Similarly, the European Union has developed comprehensive approaches to digital governance through regulations such as the General Data Protection Regulation (GDPR). Although GDPR primarily focuses on personal data protection, its principles regarding consent, transparency, accountability and individual rights have influenced global discussions about responsible data management (Voigt & von dem Bussche, 2017). However, direct adoption of developed country governance models may not always be suitable for developing countries. Differences in infrastructure, institutional capacity, cultural contexts and digital literacy require locally adaptable governance approaches.

2.5.2 Agricultural Data Governance in Developing Countries

Agriculture represents a particularly challenging area for information governance because agricultural information involves multiple stakeholders with different interests. Key stakeholders include:

- Farmers

- Government Agricultural Departments
- Research Institutions
- Technology Companies
- Financial Institutions
- Agricultural Extension Organizations

Each stakeholder generates, controls, or uses agricultural information. Without clear governance mechanisms, conflicts may emerge regarding:

- Data Ownership
- Access Rights
- Commercial Exploitation
- Benefit Sharing

The Food and Agriculture Organization (FAO) emphasizes that digital agricultural transformation should follow inclusive and farmer centered approaches to ensure that technological innovation contributes to sustainable food systems (FAO, 2022). In many developing countries, agricultural digitalization initiatives have focused mainly on increasing productivity through technology adoption. However, less attention has been given to ethical governance issues. This creates the need for frameworks that integrate technological innovation with farmer rights, transparency and accountability.

2.5.3 Information Governance Challenges in Pakistan and Similar Developing Economies

Pakistan provides an important example of a developing agricultural economy experiencing rapid digital transformation. Agriculture contributes significantly to employment and economic activity and digital technologies are increasingly being introduced through:

- Agricultural Mobile Applications
- Satellite Based Crop Monitoring
- Digital Advisory Services
- Electronic Market Platforms
- Climate Information Systems

However, challenges remain regarding digital infrastructure, institutional coordination, cybersecurity and data governance capacity. Similar issues are observed across developing countries. Digital agricultural systems often operate through multiple organizations, creating fragmented information environments where responsibilities for data management are unclear. Smallholder farmers may participate in digital platforms without fully understanding how their information is collected, stored, or utilized. Therefore, developing countries require governance models that recognize local conditions while incorporating international principles of responsible information management.

2.6 Recent Developments in Agricultural Information Governance in Developing Countries

Recent literature demonstrates that agricultural information governance has emerged as an important research domain due to the rapid expansion of digital agriculture platforms, artificial intelligence (AI) based applications, Internet of Things (IoT) devices, remote sensing technologies and data driven decision support systems. Earlier studies on digital agriculture primarily emphasized technology adoption, productivity enhancement and operational efficiency; however, recent scholarship has increasingly shifted attention toward questions related to agricultural data ownership, governance structures, farmer rights, ethical data utilization and responsible innovation (Klerkx & Rose, 2020; Wolfert et al., 2017). This transition reflects the

growing recognition that successful digital transformation in agriculture depends not only on technological capabilities but also on effective governance mechanisms that ensure transparency, accountability and equitable participation. The emergence of Agriculture 4.0 has transformed traditional agricultural systems into complex digital information ecosystems involving multiple stakeholders, including farmers, technology companies, government institutions, research organizations, financial service providers and agribusiness enterprises. These ecosystems continuously generate large volumes of agricultural information through satellite imagery, precision farming technologies, mobile advisory applications, automated sensors and artificial intelligence based analytical systems. Such data can support improved decision making, resource optimization, climate adaptation and sustainable agricultural practices (Wolfert et al., 2017). However, the increasing complexity of agricultural data ecosystems has also created significant governance challenges, particularly in developing countries where regulatory frameworks, institutional capacities and digital infrastructures remain insufficient (Klerkx & Rose, 2020).

A growing body of literature argues that agricultural data should not be considered merely as a technical resource but as a valuable socio-economic asset with implications for power relations, economic opportunities and farmers' rights. Agricultural data generated through digital platforms can influence decisions related to production planning, market access, financial services and resource allocation. However, farmers who contribute this information often have limited knowledge about how their data is collected, processed, shared, or commercialized. This creates concerns regarding unequal control over agricultural information and potential exploitation by technology providers or other powerful stakeholders (Janssen et al., 2020; Bronson & Knezevic, 2016). Therefore, responsible agricultural information governance requires mechanisms that ensure transparency, informed participation and fair distribution of benefits among all stakeholders. Recent studies further highlight that agricultural data governance challenges are multidimensional and extend beyond technical issues. Key concerns include unclear data ownership arrangements, fragmented information systems, limited interoperability between digital platforms, inadequate privacy protection, cybersecurity risks and weak institutional governance structures (Abraham et al., 2019; OECD, 2021). In many developing countries, agricultural digitalization initiatives have progressed faster than the development of appropriate governance frameworks, creating uncertainty regarding who controls agricultural information and how data driven decisions should be regulated. The OECD (2021) emphasizes that effective agricultural data governance requires balancing innovation and data sharing with the protection of farmers' interests, privacy and economic rights.

The issue of interoperability has also gained increasing attention in recent research. Digital agricultural systems often involve multiple platforms and organizations that collect and process agricultural information using different standards and technologies. Lack of interoperability can restrict efficient data exchange, reduce system effectiveness and limit opportunities for collaborative innovation (Wolfert et al., 2017). Developing countries face additional difficulties because agricultural information systems are frequently fragmented across government departments, research institutions and private sector platforms. Establishing common data standards and coordinated governance mechanisms is therefore essential for maximizing the benefits of digital agriculture. Another important development in agricultural information governance literature is the growing emphasis on farmer centered governance models. Research

focusing on smallholder agriculture in the Global South argues that digital transformation should not concentrate decision making power among technology companies, governments, or large agribusiness organizations while treating farmers merely as data providers. Instead, governance frameworks should actively involve farmers in decisions regarding data collection, access, ownership and utilization (Janssen et al., 2020). Farmer centered approaches emphasize participation, transparency, accountability and empowerment as essential components of ethical digital agriculture.

The importance of inclusive governance is particularly relevant in developing countries where smallholder farmers often face digital inequalities related to limited connectivity, financial constraints and inadequate digital literacy. Without appropriate governance mechanisms, digital agriculture may unintentionally reinforce existing inequalities by allowing technologically advanced stakeholders to capture greater benefits from agricultural data. Therefore, recent literature advocates for governance models that combine technological innovation with social inclusion, ethical responsibility and institutional accountability (FAO, 2022). Furthermore, responsible agricultural data governance requires stronger collaboration between policymakers, technology developers, researchers and farming communities. Governments play a critical role in developing regulatory frameworks, establishing data protection standards and ensuring that digital agricultural initiatives align with broader sustainability and development goals. Technology providers, meanwhile, must adopt responsible data practices by ensuring transparency, protecting user information and designing systems that address the needs of diverse agricultural stakeholders (OECD, 2021). Overall, recent developments indicate a shift from a technology centered understanding of digital agriculture toward a governance centered perspective. The future of agricultural digitalization, particularly in developing countries, depends on the ability to create information governance systems that protect farmer rights, encourage responsible data sharing, reduce inequalities and promote sustainable agricultural development. Consequently, agricultural information governance should be viewed as an essential component of responsible digital transformation rather than merely an administrative or technical function.

3. Research Objectives

1. To examine the role of digital transformation in changing information management practices across developing countries.
2. To identify major information governance challenges associated with digital transformation.
3. To analyze ethical challenges related to the collection, processing, sharing and utilization of digital information.
4. To evaluate existing policy approaches and identify gaps in information governance frameworks within developing countries.
5. To propose future directions for strengthening ethical information governance in developing countries.

4. Materials and Methods

4.1 Research Design

This study adopts a descriptive literature review approach to examine existing academic knowledge regarding information governance and ethical challenges in the digital age. Unlike systematic literature reviews that follow structured screening protocols, descriptive reviews aim

to interpret, synthesize and critically discuss existing theoretical and empirical contributions within a research area (Snyder, 2019). The descriptive review approach is appropriate because the topic is interdisciplinary, involving information systems, digital transformation, ethics, governance, agriculture and development studies. The objective is not only to summarize previous findings but also to identify conceptual relationships and develop future research directions.

4.2 Literature Search and Selection Approach

Relevant literature was identified from major academic databases and scholarly sources, including:

- Scopus
- Web of Science
- ScienceDirect
- SpringerLink
- IEEE Xplore
- Google Scholar

The review considered research articles, policy reports and conceptual studies related to:

- Information Governance
- Digital Transformation
- Digital Agriculture
- Agricultural Data Management
- Data Ethics
- Cybersecurity
- Responsible Innovation

Search terms included combinations of: "information governance," "digital transformation," "data ethics," "digital agriculture," "agricultural data governance," "developing countries," "data privacy," "responsible AI." Priority was given to peer reviewed publications and authoritative institutional reports published primarily between 2015 and 2026, while including foundational theoretical studies where necessary.

4.3 Analytical Approach

The selected literature was analyzed thematically. Major themes were identified and synthesized according to the following categories:

1. Digital transformation and information ecosystems
2. Principles of information governance
3. Ethical challenges of digital information management
4. Policy and regulatory approaches
5. Developing country challenges and opportunities

Thematic synthesis was used to identify relationships among technological development, governance mechanisms and ethical outcomes.

5. Results and Findings

The descriptive analysis of existing literature reveals that digital transformation has significantly changed the nature, volume and value of information generated across different sectors in developing countries. Although digital technologies have created substantial opportunities for improving efficiency, innovation and decision making, the literature indicates that inadequate

governance mechanisms often limit the sustainable and ethical use of digital information. The findings are organized into five major themes:

1. Transformation of information ecosystems through digital technologies
2. Importance of information governance in the digital era
3. Ethical challenges associated with digital information management
4. Policy and institutional gaps in developing countries
5. Need for inclusive and responsible governance frameworks

5.1 Transformation of Information Ecosystems Through Digital Technologies

The literature demonstrates that digital transformation has fundamentally altered how information is created, processed and utilized. Traditional information systems were generally characterized by limited data generation and centralized control. In contrast, contemporary digital ecosystems involve continuous information generation through interconnected technologies, platforms and users. Technologies such as artificial intelligence, Internet of Things (IoT), cloud computing, blockchain and big data analytics have enabled organizations to collect and analyze large scale datasets in real time (Vial, 2019). These capabilities have improved forecasting, decision making, automation and service delivery across multiple sectors. In agriculture, digital technologies have created new forms of agricultural information ecosystems. Smart farming systems collect information from:

- Satellite Imagery
- Sensors
- Drones
- Weather Monitoring Systems
- Mobile Applications
- Farm Management Platforms

According to Wolfert et al. (2017), big data driven agriculture provides opportunities for predictive analytics, precision farming and improved resource management. However, the same data driven systems create new governance challenges because information has become a valuable economic asset controlled by multiple actors. The literature indicates that digital transformation is therefore not only a technological process but also a governance challenge. The ability of societies to benefit from digital innovation depends on whether information systems are developed with appropriate ethical, legal and institutional safeguards.

5.2 Information Governance as a Foundation for Responsible Digital Transformation

A major finding from the literature is that information governance has become a fundamental requirement for managing digital transformation responsibly. Organizations and governments increasingly recognize that effective information governance provides mechanisms for ensuring information quality, security, accessibility and accountability. The reviewed literature identifies six central dimensions of information governance:

5.2.1 Data Ownership

Data ownership concerns the rights and authority associated with information assets. In digital environments, ownership becomes complex because data is often generated collaboratively by multiple stakeholders. In agricultural systems, for example, farmers generate valuable information through their farming activities, but technology companies may collect and process this information through digital platforms. The absence of clear ownership rules may create unequal relationships between data producers and data controllers (Bronson & Knezevic, 2016).

Effective governance requires transparent agreements defining:

- Ownership Rights
- Usage Permissions
- Benefit Sharing Mechanisms
- Responsibilities Of Data Controllers

5.2.2 Data Access and Sharing

Data sharing is essential for innovation and collective problem solving. However, unrestricted data sharing may create risks related to privacy, commercial exploitation and security. The literature suggests that effective governance requires a balance between:

- Encouraging Responsible Data Sharing
- Protecting Stakeholder Interests

In agricultural contexts, data sharing can improve:

- Weather Forecasting
- Disease Prediction
- Market Intelligence
- Climate Adaptation Strategies

However, farmers and communities should maintain meaningful control over how their information is accessed and used.

5.2.3 Data Quality and Reliability

Digital decision making depends heavily on information accuracy. Poor quality data can result in incorrect decisions, ineffective policies and reduced trust in digital systems. Information governance frameworks therefore emphasize:

- Accuracy
- Completeness
- Consistency
- Reliability

This is particularly important in developing countries where data collection systems may be fragmented and institutional coordination may be limited.

5.2.4 Information Security

The literature consistently identifies cybersecurity as a major governance concern. Increased connectivity creates new vulnerabilities, including:

- Unauthorized Access
- Data Theft
- Manipulation of Digital Records
- Cyberattacks

Developing countries often face additional difficulties due to limited cybersecurity expertise, insufficient investment and weak enforcement mechanisms.

Strong information governance requires:

- Security Policies
- Access Controls
- Encryption Mechanisms
- Organizational Responsibility

5.2.5 Transparency and Accountability

Transparency is essential for establishing trust in digital systems. Stakeholders must understand how information is collected, processed and used. This becomes particularly important with artificial intelligence-based systems. AI driven decisions may affect individuals and communities, yet the decision-making processes behind algorithms are often difficult to understand. Floridi et al. (2018) argue that responsible AI requires principles of:

- Transparency
- Fairness
- Accountability
- Human Oversight

Therefore, digital governance frameworks must ensure that technology providers and institutions remain accountable for the consequences of digital decisions.

5.3 Ethical Challenges in Digital Information Management

The literature reveals several ethical challenges emerging from increased dependence on digital information systems.

5.3.1 Privacy and Protection of Personal Information

Privacy represents one of the most frequently discussed ethical concerns. Digital systems collect extensive information about individuals, organizations and communities. Without appropriate safeguards, this information may be misused or accessed without proper authorization. In developing countries, privacy challenges are intensified because:

- Data Protection Laws May Be Incomplete
- Awareness Among Users May Be Limited
- Consent Mechanisms May Be Poorly Developed

Responsible information governance requires privacy by design approaches where ethical considerations are incorporated during system development rather than addressed after problems occur.

5.3.2 Unequal Control Over Information

The literature highlights concern that digital transformation may create unequal power relationships between technology providers and information producers.

Large technology companies often possess:

- Advanced Analytical Capabilities
- Infrastructure
- Financial Resources

Meanwhile, individuals and small organizations may contribute data without receiving equivalent benefits. This concern is particularly visible in agriculture, where small farmers may provide valuable information but have limited influence over how data is commercialized or used.

5.3.3 Algorithmic Bias and Fairness

Artificial intelligence systems increasingly influence decision making processes. However, algorithms may reproduce existing social inequalities if trained on incomplete or biased datasets. In developing countries, algorithmic bias may emerge because:

- Local Datasets Are Limited
- Marginalized Communities Are Underrepresented
- Imported Technologies May Not Reflect Local Realities

Ethical digital governance therefore requires fairness assessment, inclusive datasets and continuous monitoring of AI systems

5.3.4 Digital Divide and Social Exclusion

Another important finding is that digital transformation does not automatically create equal benefits. Access to digital technologies depends on:

- Internet Availability
- Affordability
- Digital Skills
- Institutional Support

Developing countries frequently experience digital divides between urban and rural communities, large organizations and small enterprises and technologically skilled and disadvantaged groups.

Therefore, ethical information governance must include principles of inclusion and accessibility.

5.4 Policy and Institutional Gaps in Developing Countries

The literature identifies several policy challenges affecting responsible digital transformation.

Fragmented Regulatory Frameworks

Many developing countries have introduced digital policies; however, these policies often focus on technology expansion rather than comprehensive information governance. Common gaps include:

- Unclear Data Ownership Rules
- Weak Privacy Protection
- Limited Cybersecurity Regulation
- Insufficient Sector Specific Governance

Limited Institutional Capacity

Effective information governance requires:

- Skilled Professionals
- Regulatory Institutions
- Technical Infrastructure
- Monitoring Mechanisms

Many developing countries face shortages in these areas, limiting their ability to implement effective governance systems.

Lack of Stakeholder Participation

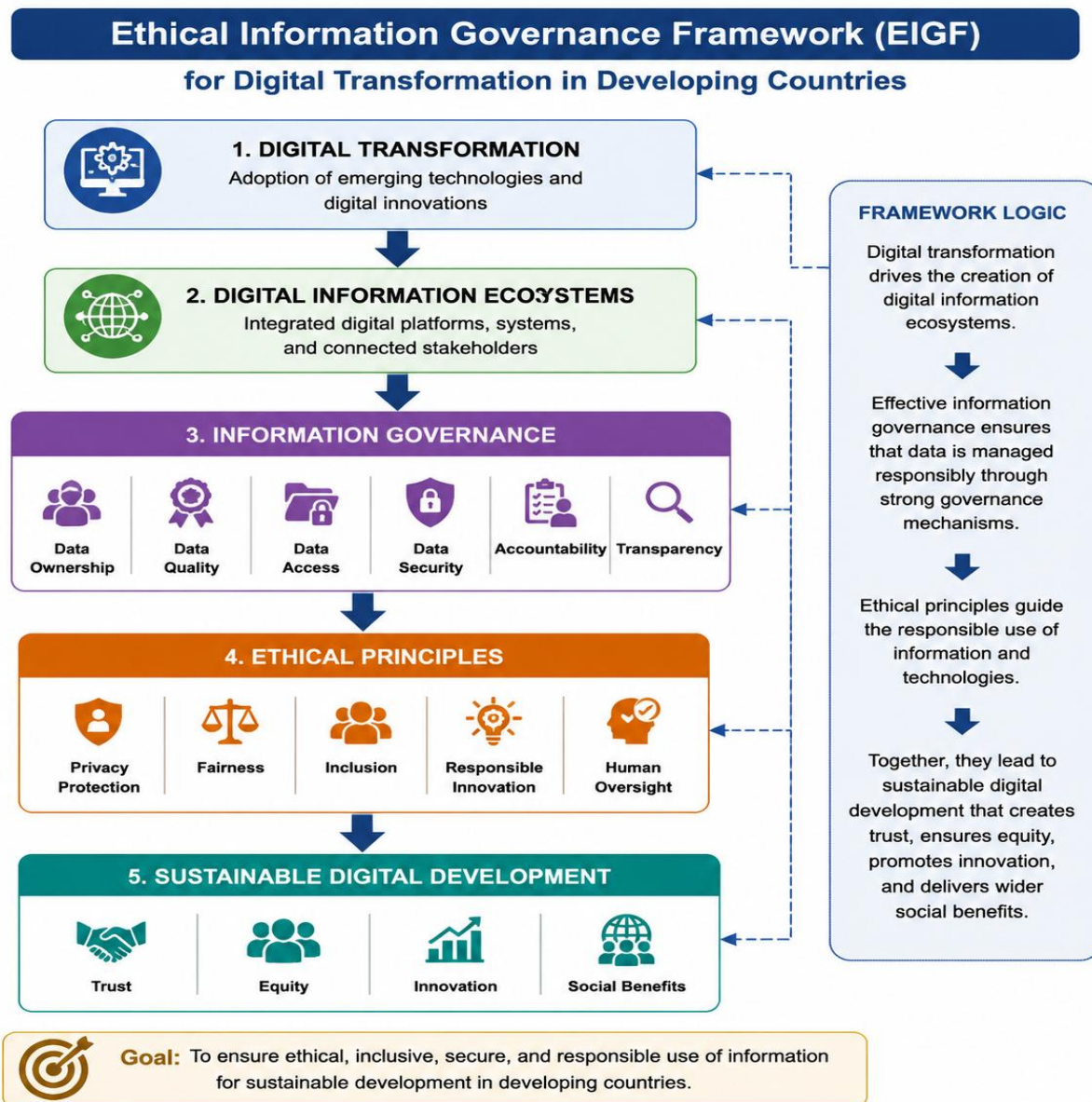
The literature emphasizes that governance approaches developed without stakeholder involvement may fail to address practical realities. Inclusive governance requires participation from:

- Citizens
- Farmers
- Businesses
- Researchers
- Policymakers
- Civil Society Organizations

5.5 Proposed Framework for Ethical Information Governance in Developing Countries

Based on the reviewed literature, this article proposes an Ethical Information Governance Framework for Digital Transformation in Developing Countries. The framework integrates technological, governance, ethical and social dimensions.

Ethical Information Governance Framework (EIGF)



The framework suggests that technological advancement alone is insufficient for successful digital transformation. Sustainable outcomes require integration between information governance mechanisms, ethical principles and stakeholder participation.

6. Discussion

The findings of this descriptive literature review demonstrate that digital transformation has created a new information landscape in developing countries where data has become a critical economic, social and institutional resource. While digital technologies provide significant opportunities for improving productivity, innovation, governance efficiency and service delivery, their long-term benefits depend on the establishment of effective information governance mechanisms. The literature indicates that many developing countries have focused primarily on technological adoption while giving comparatively less attention to governance structures, ethical principles and institutional capacity. This imbalance creates a situation where digital systems expand rapidly without adequate mechanisms to ensure responsible information

management. Therefore, the central challenge is no longer only how to introduce digital technologies, but how to govern the information generated through these technologies in an ethical, inclusive and sustainable manner.

6.1 Theoretical Implications

This review contributes to the emerging literature on digital transformation by integrating concepts from information governance, data ethics and responsible innovation. Previous studies have often examined digital transformation from a technological or economic perspective, emphasizing efficiency, productivity and innovation outcomes (Vial, 2019). However, this review highlights that digital transformation is also a governance and ethical challenge. The proposed framework extends existing information governance perspectives by incorporating ethical dimensions such as:

- Privacy Protection
- Fairness
- Transparency
- Inclusion
- Accountability

Traditional information governance models mainly focus on organizational control, compliance and information management processes (Smallwood, 2019). However, in modern digital ecosystems, governance must move beyond organizational boundaries because information flows across multiple actors, platforms and institutions.

The review therefore supports the argument that information governance should be understood as a socio technical system involving technology, institutions, individuals and societal values.

6.2 Digital Agriculture as an Example of Ethical Information Governance Challenges

Although digital transformation affects all sectors, agriculture provides a particularly important context for understanding information governance challenges in developing countries. Agriculture is increasingly becoming data intensive through:

- Artificial Intelligence Based Crop Prediction
- Satellite Monitoring
- Mobile Agricultural Advisory Systems
- Precision Farming Technologies
- Automated Irrigation Systems

These technologies create opportunities for improving food security, climate resilience and resource efficiency. However, they also raise important ethical questions regarding ownership, control and distribution of benefits. A central concern is that farmers, especially smallholder farmers, may become producers of valuable agricultural data without having sufficient control over how this information is used. Technology companies and agribusiness organizations may possess greater technical capacity to analyze and commercialize agricultural data, potentially creating unequal relationships. This issue reflects a broader challenge in developing countries: digital transformation may increase efficiency while simultaneously reinforcing existing economic inequalities if governance mechanisms are not designed to protect vulnerable stakeholders. Therefore, agricultural information governance should adopt farmer centered approaches that recognize farmers not merely as data providers but as important owners and participants within digital agricultural ecosystems.

6.3 Ethical Governance and Trust in Digital Systems

Trust emerges as a fundamental factor influencing digital technology adoption. The literature suggests that individuals and organizations are more likely to participate in digital systems when they believe that information will be managed responsibly. Lack of trust may result from concerns regarding:

- Unauthorized Data Use
- Insufficient Transparency
- Unclear Ownership Arrangements
- Cybersecurity Risks

In agricultural contexts, farmers may hesitate to adopt digital platforms if they believe their data could be used against their economic interests. For example, concerns about commercial exploitation of production information may discourage participation in digital advisory or market platforms. Therefore, ethical information governance is not only a regulatory requirement but also a foundation for building trust among stakeholders. Transparent policies, clear consent mechanisms and accountable institutions can improve confidence in digital systems.

6.4 Policy Implications for Developing Countries

The findings highlight several important policy implications.

6.4.1 Development of Comprehensive Data Governance Policies

Developing countries require information governance policies that move beyond general digital strategies and address sector specific challenges. Policies should define:

- Ownership Rights
- Data Access Conditions
- Responsibilities Of Technology Providers
- Mechanisms For Dispute Resolution

Agricultural sectors, healthcare systems and financial services require specialized governance approaches because they generate sensitive and strategically important information.

6.4.2 Strengthening Data Protection and Privacy Regulations

Many developing countries lack comprehensive data protection frameworks or face challenges in implementing existing regulations. Effective privacy governance requires:

- Clear Consent Procedures
- User Control Over Personal Information
- Restrictions On Unauthorized Data Sharing
- Institutional Monitoring

The adoption of international principles, such as transparency and accountability, can help countries develop stronger governance mechanisms while adapting them to local conditions.

6.4.3 Enhancing Cybersecurity Capacity

Digital transformation increases dependency on information systems, making cybersecurity an essential governance priority.

Developing countries should invest in:

- Cybersecurity Infrastructure
- Professional Training
- Institutional Awareness
- Incident Response Mechanisms

Without adequate security measures, digital transformation initiatives may expose organizations and communities to significant risks.

6.4.4 Promoting Inclusive Digital Transformation

The literature emphasizes that digital transformation should not only focus on technological availability but also on accessibility and inclusion. Governments and organizations should address:

- Rural Connectivity Gaps
- Digital Literacy Limitations
- Affordability Barriers
- Unequal Access to Digital Services

In agriculture, policies should ensure that smallholder farmers benefit from digital innovations rather than becoming excluded from emerging digital ecosystems.

6.5 Role of Stakeholders in Ethical Information Governance

Effective information governance requires collaboration among multiple stakeholders. Governments should:

- Establish Regulatory Frameworks
- Develop National Data Strategies
- Ensure Accountability Mechanisms
- Support Digital Inclusion

Technology Companies

Technology providers should:

- Adopt Responsible Data Practices
- Provide Transparent Information Policies
- Protect User Data
- Design Inclusive Digital Platforms

Research Institutions

Universities and research organizations should:

- study ethical implications
- develop governance models
- provide evidence-based policy recommendations

Farmers and Communities

Users of digital systems should be empowered through:

- Digital Literacy Programs
- Awareness Of Data Rights
- Participation In Governance Decisions

6.6 Future Direction: Towards Responsible Digital Ecosystems

The literature suggests that future digital transformation strategies should move from a technology centered approach toward a human centered governance approach. A responsible digital ecosystem should combine: **Technological Capability** with **Ethical Responsibility** and **Social Inclusion**. Future governance models should recognize that information is not merely a technical resource but also a social asset connected with rights, responsibilities and power relationships. Developing countries therefore require governance approaches that are flexible enough to encourage innovation while strong enough to protect individuals, communities and organizations.

7. Conclusion

Digital transformation has fundamentally changed how information is generated, managed and utilized across developing countries. Technologies such as artificial intelligence, big data analytics, Internet of Things and digital platforms have created unprecedented opportunities for improving economic development, public services and sectoral performance. However, the increasing dependence on digital information systems has also introduced complex governance and ethical challenges. This descriptive literature review demonstrates that information governance has become a critical requirement for ensuring responsible digital transformation. Issues related to data ownership, privacy, cybersecurity, transparency, accountability and digital inclusion represent major challenges that must be addressed to maximize the benefits of digital technologies. The review highlights that developing countries face particular difficulties because digital adoption is often progressing faster than regulatory development and institutional capacity building. Weak governance structures may create risks of information misuse, unequal benefit distribution and exclusion of vulnerable groups. The agricultural sector illustrates these challenges clearly. While digital agriculture provides opportunities for improved productivity, climate resilience and sustainable resource management, unresolved questions regarding agricultural data ownership, farmer rights and ethical data sharing remain significant concerns. This study argues that successful digital transformation requires a shift from technology driven approaches toward responsible information governance models. Such models should integrate technological innovation with ethical principles, stakeholder participation, regulatory frameworks and institutional accountability. The proposed Ethical Information Governance Framework emphasizes that responsible digital transformation requires alignment between information governance mechanisms and societal values. Developing countries should therefore prioritize governance strategies that protect information rights while enabling innovation and inclusive development. Ultimately, the future of digital transformation depends not only on technological advancement but also on the ability of societies to govern information responsibly, ethically and equitably.

8. Recommendations and Implications

Based on the findings of this descriptive literature review, several recommendations can be developed for policymakers, organizations, technology providers and researchers to strengthen information governance and address ethical challenges associated with digital transformation in developing countries.

8.1 Development of Comprehensive Information Governance Frameworks

Developing countries should establish comprehensive information governance frameworks that address the complete lifecycle of digital information, including:

- Data Collection
- Storage
- Processing
- Sharing
- Utilization
- Disposal

Many existing digital transformation policies focus primarily on technology adoption and infrastructure development, while insufficient attention is given to governance principles. Future policies should incorporate clear guidelines regarding:

- Data Ownership

- Access Rights
- Accountability Mechanisms
- Ethical Responsibilities

Such frameworks should be adaptable to different sectors because information governance requirements vary across agriculture, healthcare, education, finance and public administration.

8.2 Establishment of Clear Data Ownership and Rights Mechanisms

One of the most significant challenges identified in the literature is uncertainty regarding data ownership. Developing countries should establish legal and institutional mechanisms that clearly define:

- Who Owns Digitally Generated Information
- Who Can Access and Process Data
- How Benefits Derived from Data Use Should Be Distributed

In sectors such as agriculture, farmers should have greater recognition as important contributors and stakeholders in agricultural data ecosystems. Policies should ensure that individuals and communities maintain meaningful control over information generated through their activities. Clear ownership mechanisms can increase trust and encourage greater participation in digital platforms.

8.3 Strengthening Data Protection and Privacy Policies

Governments should strengthen data protection regulations to address emerging digital challenges. Effective privacy frameworks should include:

- Informed Consent Requirements
- Transparency Obligations
- Restrictions On Unauthorized Data Sharing
- Mechanisms For Individuals To Control Their Information

Developing countries can learn from international approaches such as the European Union's General Data Protection Regulation (GDPR), while adapting principles according to local institutional and socioeconomic conditions (Voigt & von dem Bussche, 2017).

Privacy protection should not be considered only a legal issue but also an ethical responsibility associated with respecting individual autonomy and rights.

8.4 Promoting Responsible Artificial Intelligence and Algorithmic Transparency

As artificial intelligence becomes increasingly integrated into decision making processes, developing countries should promote responsible AI governance. Organizations implementing AI systems should ensure:

- Transparency Of Algorithmic Processes
- Fairness In Decision Outcomes
- Monitoring Of Potential Biases
- Human Oversight Of Automated Decisions

This is particularly important in sectors such as agriculture, where AI recommendations may influence decisions regarding crop selection, resource allocation and farm management.

Responsible AI approaches can help ensure that technological innovation contributes to equitable development rather than reinforcing existing inequalities.

8.5 Enhancing Cybersecurity Infrastructure and Institutional Capacity

Digital transformation requires strong cybersecurity capabilities. Developing countries should invest in:

- Cybersecurity Education
- Technical Expertise
- Secure Digital Infrastructure
- Institutional Response Mechanisms

Organizations should develop information security policies that include:

- Access Control
- Encryption
- Monitoring Systems
- Risk Assessment Procedures

Cybersecurity should become an integral component of digital development strategies rather than an issue addressed only after security incidents occur.

8.6 Improving Digital Literacy and Stakeholder Awareness

The benefits of digital transformation depend significantly on users' ability to understand and participate in digital systems. Therefore, developing countries should invest in digital literacy programs targeting:

- Farmers
- Rural Communities
- Small Businesses
- Public Sector Employees

Digital literacy initiatives should not only teach technology usage but also educate users about:

- Data Rights
- Privacy Risks
- Ethical Information Sharing
- Cybersecurity Practices

In agricultural contexts, empowering farmers with knowledge about agricultural data governance can help create more balanced relationships between farmers and technology providers.

8.7 Encouraging Multi Stakeholder Governance Approaches

Information governance should not be developed solely by governments or technology companies. Effective governance requires collaboration among:

- Policymakers
- Researchers
- Technology Developers
- Communities
- End Users

Multi stakeholder approaches can improve governance outcomes by ensuring that different perspectives and interests are considered. For developing countries, participatory governance models are particularly important because they can help address the needs of marginalized groups that may otherwise be excluded from digital transformation processes.

8.8 Implications for the Agriculture Sector

The agriculture sector requires special attention because digital agricultural systems generate valuable information with economic and social implications.

Future agricultural information governance policies should focus on:

- Farmer Data Ownership
- Ethical Agricultural Data Sharing

- Transparent Digital Platforms
- Equitable Access to Technology
- Protection Of Smallholder Farmers

Governments and agricultural organizations should develop farmer centered digital strategies that recognize farmers as active participants rather than passive users of digital technologies.

Responsible agricultural information governance can contribute to:

- Sustainable Farming Practices
- Improved Food Security
- Climate Resilience
- Inclusive Rural Development

9. Limitations and Future Research Directions

Although this descriptive literature review provides important insights into information governance and ethical challenges in developing countries, several limitations should be acknowledged.

- First, this study adopts a narrative literature review approach rather than a systematic review methodology. Although descriptive reviews are valuable for conceptual understanding and theory development, they may not capture all available studies or provide statistical assessment of research trends.
- Second, the literature on information governance in developing countries remains relatively fragmented. Many existing studies focus on developed economies, while research from low- and middle-income countries is comparatively limited. Therefore, future research should increase empirical investigation within developing country contexts.
- Third, this review examines information governance broadly across digital transformation contexts. Future studies may focus on specific sectors, such as agriculture, healthcare, education, or financial services, to identify sector specific governance challenges.

Future research directions include:

9.1 Empirical Investigation of Stakeholder Perspectives

Future studies should examine how different stakeholders perceive information governance challenges. Research involving:

- Farmers
- Government Officials
- Technology Companies
- Researchers

can provide deeper understanding of practical governance issues.

9.2 Development of Sector Specific Governance Models

Different sectors have unique information requirements and ethical challenges. Future research should develop specialized governance frameworks for:

- Digital Agriculture
- Healthcare Information Systems
- Smart Cities
- Financial Technologies

9.3 Examination of Artificial Intelligence Ethics in Developing Countries

As AI adoption increases, research should investigate:

- Algorithmic Fairness
- Explainability
- Bias Reduction
- Accountability Mechanisms

Particular attention should be given to whether AI systems developed in advanced economies are appropriate for developing country contexts.

9.4 Comparative Studies between Countries

Comparative research can examine how different developing countries address information governance challenges. Potential comparisons include:

- South Asia
- Africa
- Latin America

Such studies can identify successful governance models and transferable policy approaches.

9.5 Development of Measurement Frameworks

Future studies should develop quantitative indicators to measure:

- Information Governance Maturity
- Ethical Digital Transformation
- Stakeholder Trust
- Data Protection Effectiveness

Such measurement frameworks can help policymakers evaluate progress and identify weaknesses.

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