Smallholder-oriented Data Governance Principles

Fair & Smart Data

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ABSTRACT

Smallholder-oriented data governance defines the smallholder data ecosystem as comprising multiple stakeholders with asymmetric levels of power, knowledge and resource access. These stakeholders handle smallholder farmers' data responsibly and transparently to empower and avoid harm.

Smallholder-oriented data governance requires the more powerful and well-resourced stakeholders to commit to fair treatment and compensation of smallholder farmers.

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Content

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Sincerely,

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1. Motivation

Data yields significant social, economic, and political power in the current global economy. However, unequal access and control of data create a digital divide and inequality in many data ecosystems. This digital divide engenders obstacles to sustainable development, human agency, and individual and collective self-determination and well-being (Fisher & Streinz, 2021). Data-driven agriculture promises to boost sustainable development by improving the environment and livelihoods of smallholder farmers and their communities, making their farming practices more efficient and allowing them to access valuable information (Maru et al., 2018). However, the smallholder data ecosystem is subject to a significant power imbalance resulting from differently resourced, capable, and informed stakeholders (Ferris & Rahman, 2016).

In their data ecosystem, smallholders are stuck between two ends of a spectrum, both detrimental to their interests. One end has elements of what is called "capitalist accumulation by dispossession" (Thatcher et al., 2016, p.994), where smallholder farmers become unpaid data harvesters for multinational companies. These companies would then add "value" to their data to sell paid services, products, and advertisements to the same farmers. The other end of the spectrum is called "data nationalism," defined loosely as the effort by nation-states to ensure control over data for a range of normative and security-based reasons. With data localisation requirements enacted in Russia, India, China, and elsewhere, this trend is rising and can exclude farmers from global knowledge and services (Daskal & Sherman, 2020).

Moreover, there are no benchmarks regarding the fairness of smallholder data governance. This situation leaves smallholders vulnerable to unfair and unsustainable data collection and use (Fisher & Strains, 2021; Quayson et al., 2021). The critical question would be then whether the "fairness benchmark" should be a national law, international law under the UN system or a global multi-stakeholder voluntary standard. Each option has its own pros, cons, and challenges.

Another aspect highlighting the need for better data governance is the regulatory requirements related to supply chain due diligence and sustainability. For instance, the new EU Corporate Sustainability Reporting Directive (EU CSRD[1]) will require companies to provide information on the environmental impact of sourcing raw materials and their suppliers' social and welfare conditions. This will result in more data collection from and about farmers. With this increasing scope of data collection, the ramifications of these regulatory interventions on farmers' living conditions remain to be seen.

1 EU CSRD law requires all large companies and all listed companies (except listed micro-enterprises) to disclose information on what they see as the risks and opportunities arising from social and environmental issues, and on the impact of their activities on people and the environment. (Corporate Sustainability Reporting, 2023, European Commission)

In this report, we try to answer what principles a data governance system should have to ensure fair and sustainable benefit-sharing from smallholders' data. The report defines smallholder farmers, informed consent, and fair data ecosystem and presents five principles for smallholder-oriented data governance with their enabling conditions.

1.1 Who is the smallholder farmer?

From our literature review of different approaches to defining smallholder farmers, we synthesised six fundamental criteria:

Essential criteria	Smallholder farmers
Geographic	Located in rural areas of countries in the Global South
Social	Vulnerable community[2]
Economic	Limited financial resources
Reason of farming	A mixture of cash crops and subsistence farming
Farm size	Usually cultivating smaller fields (depending on the region but usually between 2 to 5 hectares)
Access to infrastructure, including education	Limited access to essential infrastructures such as education, electricity, telecom, and roadways.

This report adopts the following working definition of smallholder farmers, which we deem as the most comprehensive:

*"**Smallholders** are a vulnerable group of people cultivating small fields of land to feed their families and earn an income, mostly living in rural areas of countries in the Global South with limited access to financial resources and essential infrastructures."*

It should be noted that this report focuses on smallholders who engage in data-driven agricultural projects or interventions or are subject to data collection in the scope of the supply chains of their commodities. Gray et al. (2018, p.1) define data-driven agriculture as the "thoughtful use of data (...) to inform farmer decisions and actions. It means having the right data, at the right time, to make better decisions that improve long-term profitability." The data types could range from weather and soil data to real-time market pricing data. Moreover, this data could be captured and valorised for various applications by other stakeholders for purposes that are not directly related to the farmer's primary activities.

2 A vulnerable group or community can be defined as a "population within a country that has specific characteristics that make it at a higher risk of needing humanitarian assistance than others or being excluded from financial and social services. In a crisis such groups would need extra assistance, which appeals for additional measures, i.e., extra capacity, as a part of the emergency phase of disaster management" [1]: 34. (M. Marin-Ferrer, L. Vernaccini, K. Poljansek. Index for Risk Management Concept and Methodology Version 2017 JRC, European Commission, 2017)

1.2 What is data governance?

Data governance is used here to describe the process of governing the exchange of digital information[3] among stakeholders as part of the data economy[4] (Cohen & Wendehorst, 2022). In other words, data governance in smallholder agriculture can be seen as a collective effort by all the stakeholders to establish the necessary rules to deal with the risks and benefits associated with using digital technology and its essential resource: data. Therefore, data governance should describe clearly:

- What types of data are governed?
- How is data collected, stored, and processed?
- Who owns the data, and how does the ownership of data change within its ecosystem from the original data generator or collector to the end user?
- Who can access and control what kinds of data?
- What the value of data is, and how is it captured, shared, and delivered?

It is necessary to distinguish between the macro-level of data governance (institutional or collective norms, principles and rules governing several data types) and micro-level data governance (data management at the organisational level). This report focuses on the macro-level in the context of the smallholder agriculture data ecosystem within the scope of global supply chains and value networks. Nonetheless, macro-level data governance principles will also have implications on data management at the organisational level.

1.3 What does smallholder-oriented data governance mean?

Smallholder-oriented data governance defines the smallholder data ecosystem (SDE) as comprising multiple stakeholders with asymmetric levels of power, knowledge, and resource access. These stakeholders handle smallholder farmers' data responsibly and transparently to empower and avoid harm. Smallholder-oriented data governance requires the more powerful and well-resourced stakeholders to commit to **fair treatment and compensation** of smallholder farmers.

While difficult to define, **fairness** should be sought by establishing a baseline of mutually agreed-upon farmer benefits. These benefits could be obtained by:

- Employing a living income standard, transparent market pricing, etc.
- Implementing adequate privacy, data protection and data security measures.
- Ensuring that smallholder farmers and their representatives are involved in decision-making and bargaining.

This report does not define what constitutes "fair value" to smallholder farmers because that depends on many contextual and practical factors, and there is no one-size-fits-all approach to defining fairness.

However, one of the building blocks of establishing fairness in the SDE is **transparency**. For instance, as mentioned in the UM-DPCSR framework, "...by understanding the benefits of data processing activities for the organisation, the data subject or individual can understand if they genuinely want to agree to certain data processing, allowing them to demand fair in-kind value for the provision of their data" (Balboni & Francis, 2022, p.29).

3 Digital information generally comprises data that is created by, or prepared for, electronic systems and devices such as computers, screens, calculators, communication devices and so on, and can be stored on those devices or in the Cloud. (Digital Information, BIM- Wiki, 2021)

4 The data economy measures the overall impacts of the data market – i.e., the marketplace where digital data is exchanged as products or services derived from raw data – on the economy as a whole. It involves the generation, collection, storage, processing, distribution, analysis, elaboration, delivery, and exploitation of data enabled by digital technologies. (European Data Market study, SMART 2013/0063, IDC, 2016)

1.4 How to ensure the agency and involvement of smallholder farmers?

To ensure the agency and adequate involvement of smallholder farmers, they must be able to give **informed consent** when participating in data-driven projects.

According to the World Food Programme (WFP), the concept of informed consent can be summarised as: *"The freely given and informed permission granted by the data subject [smallholder] to collect and process their personal data. Before granting permission, the data subject must understand the intended purpose of this collection and processing; with whom this data may be shared; and any risks to their privacy that might stem from their data being collected and processed"* (WFP, 2016, p.5).

Article 7 and Recital 32 of the General Data Protection Regulation (GDPR) specify the basic requirements for the effectiveness of valid legal consent as follows: *"Consent must be freely given, specific, informed and unambiguous. In order to obtain freely given consent, it must be given on a voluntary basis. The element "free" implies a real choice by the data subject. Any element of inappropriate pressure or influence which could affect the outcome of that choice renders the consent invalid. In doing so, the legal text takes a certain imbalance between the controller and the data subject into consideration"* (GDPR website, Consent Section, 2021).

Five key criteria for identifying informed consent can be derived from these definitions. In the context of smallholder-oriented data governance, informed consent implies that

- smallholders must give their permission freely at the beginning of any data collection process and should be able to opt out of sharing their data and withdraw their consent,
- the language used to explain the purpose of data collection and processing, and consent provision and withdrawal must be clear, plain, and easily understood,
- smallholders must be informed about the specific purpose of data collection and processing; in case the purpose changes, a renewal of permission must be acquired,
- smallholders must be informed about which third parties can access and use their data,
- smallholders should be informed about all the benefits and risks associated with collecting and processing their data.

2. Smallholder Data Ecosystem: The Stakeholders and Their Roles

The **smallholder data ecosystem (SDE)** comprises stakeholders offering data-driven agricultural services, such as private companies and governmental and non-governmental organisations (NGOs). These entities offer their services directly to smallholders or as business-to-business (B2B) solutions to stakeholders participating in smallholder value chain decision-making processes, such as extension agencies, agribusinesses, financial institutions, or policymakers. Although data is the primary resource harnessed in the SDE, the system also relies on human agents who facilitate advisory services, market access, logistics, and access to financial services (Tstan et al., 2019).

2.1 Smallholder Data Ecosystem Structure

Developing principles for fair data governance in smallholder agriculture requires understanding the ecosystem's structure, roles, and functions. Clarity about how a data governance system is structured can help identify how some stakeholders could manipulate it to their benefit, potentially at the expense of sustainable development in smallholder agriculture (McDonald, 2021).

This report adopts the notion of a **data ecosystem** since the aim is a balanced, self-sustaining interplay of stakeholders who derive value from their interactions. Whether centralised or federated[5], the data ecosystem's architecture is not emphasised here. However, given the status quo of data collection from smallholder farmers, the analysis below recognises the asymmetry in data accessibility, control, and valorisation. The following analysis defines the distinct roles and attributes (well-resourced, data generators, data controllers or holders, data sources) of the ecosystem's stakeholders.

Figure 1 represents a simplified model of relevant stakeholders and their respective roles in the SDE. The model is derived from the works of Cohen and Wendehorst (2022), Ferris and Rahman (2016), and Gray et al. (2018) and intends to outline the underlying asymmetry of power among the stakeholders. However, the distribution of roles can differ in individual cases.

5 In the centralised architecture, each institution must upload its data to a centralised web server. In contrast, in the federated architecture, data stay at their respective institutions, but each institution must implement an interface to make the data findable but not necessarily accessible. Vesteghem, C. et al. (2019) 'Implementing the fair data principles in precision oncology: Review of Supporting Initiatives', Briefings in Bioinformatics, 21(3), pp. 936–945. doi:10.1093/bib/bbz044.

There are two main roles for stakeholders in data ecosystems: the **data generators** who handle data production[6] and the **data controllers** or **holders** who can access the data shared among the stakeholders and decide on the purposes and means of its processing and use (Cohen & Wendehorst, 2022).

Given the bidirectional data exchange, all SDE stakeholders can be **end-users**. However, in practice, the data controllers (usually private companies, governmental organisations, NGOs, and farmer organisations) tend to be the data end-users in most cases.

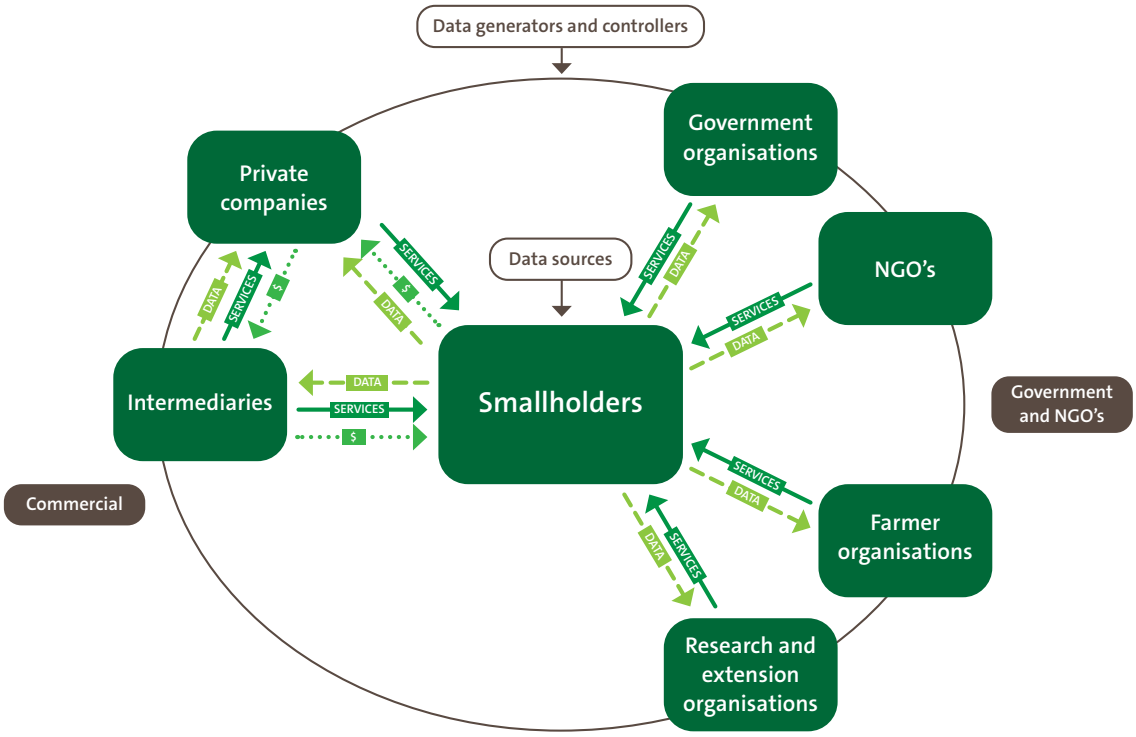

Figure 1. The smallholder data ecosystem.

The smallholders are positioned at the centre of the data ecosystem, and the more powerful and well-resourced stakeholders (the primary stakeholders collecting and valorising data in the SDE) are on the outer ring. The asymmetric access to resources and information between smallholders and the other stakeholders is also noticeable in the distribution of roles in the data value chain[7]. While smallholders often contribute to data production, they rarely collect data on their own initiative or refine it themselves. Hence, given their passive role, smallholders are described as **data sources**. Moreover, the other stakeholders can often occupy both essential roles of data generators and data controllers (Cohen & Wendehorst, 2022).

In the SDE, various stakeholders contribute to data production in distinctive ways. This process could be based on either **active** or **passive data collection**:

- Active data collection is direct because data collectors such as extension workers interview individual farmers.
- Passive data collection is performed by data collectors without the involvement of smallholders, using, for instance, remote sensing technologies.

6 Data production includes all activities involved in the collecting, processing, analysing and storing of data.

7 "Data value chain describes the full data lifecycle from collection to analysis and usage. In other words, it categorises all of the various steps required to transform raw data into useful insights." (Mixson, E. (2022), The data value chain explained, AI, Data & Analytics Network.)

While smallholders play a role in active data collection, passive data collection is mainly done by well-resourced stakeholders (Ferris & Rahman, 2016). It is important to note that in both cases, the data collectors should acquire the consent of farmers. Although acquiring consent for remote sensing and satellite imagery data is complex and still subject to legal and ethical debates (Coffer, 2020), any data collection involving or impacting smallholder farmers should require their knowledge and consent. For example, suppose the party collecting data from the farmers will eventually need remote sensing data collection about their lands. In that case, they should disclose this in the consent forms and declarations provided to these farmers.

In the SDE, some stakeholders do not contribute directly to data collection but participate in value exchange by refining data to be more beneficial to other stakeholders (Cohen & Wendehorst, 2022). This is a crucial role since the quality of the services provided depends on the quality of data, its relevance to smallholders, and its quantity and accuracy for the stakeholders valorising it (De Beer, 2016). It is primarily **intermediaries and third parties** who refine data to make it useful to all stakeholders in the SDE. Intermediaries usually facilitate the transactions between stakeholders, such as the parties producing the data and those controlling it (Cohen & Wendehorst, 2022; Ferris & Rahman, 2016).

2.2 Data Ownership in the Ecosystem

Data ownership is the subject of many academic debates. According to Fisher and Streinz (2021), the underlying legal uncertainty around data ownership constitutes a significant challenge in assessing legitimate data collection. Data generators in data ecosystems often assume an intellectual property-like character of data which incentivises them to generate data through collection or refinement. However, this assumption ignores that, in practice, some stakeholders perceive data as res nullius: "things that belong to no one but can be claimed by whoever catches them first" (Fisher & Streinz, 2021, p.36). This misleading appraisal of data as intellectual property is likely due to data being intangible as other things subject to intellectual property protection by law.

Although the GDPR clearly defines personal data[8], it does not stipulate a catch-all definition of data ownership. Instead, the GDPR rules refer to a list of rights for data subjects that could prevent misuse and misappropriation of their data, such as the right to be informed, the right to rectification, the right to erasure, the right to restrict processing, the right to data portability, the right to object, and rights concerning automated decision-making and profiling (GDPR, Chapter 3 – Rights of the Data Subject, 2018).

This report does not look at data ownership as the appropriation of a tangible or intangible asset by the farmer, the data generator, or the data controller but rather as a timed exchange of value based on informed consent, a clear understanding of the use, mutual benefit and assurance of privacy and security. In other words, farmers have the right to know why, for how long and to what extent their data will be collected, processed, and used. Moreover, they must understand and agree to the value they are receiving and be able to opt out of the data collection process when they see fit. The data generators and controllers should also ensure farmers' data privacy and security.

8 Personal data means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Art. 4 GDPR – definitions. General Data Protection Regulation (GDPR). (2018, March 29). https://gdpr-info.eu/art-4-gdpr/

3. FSD Smallholder-oriented Data Governance Principles

The principles were developed based on exploratory research from a master's thesis[9] at Maastricht University. Through these principles, Fair & Smart Data (FSD) Spearhead wants to contribute to adopting farmer-oriented data governance in the global agricultural value chains. The principles are meant to appeal to researchers and practitioners and should be interpreted to be consistent with sustainable development. Based on a literature review, the following criteria were central to developing the principles of smallholder-oriented data governance:

- The principles should account for the thematic areas identified in the data governance of SDE, such as digital sovereignty, informed consent, fairness, and resource asymmetry.
- The principles are practical and relevant for the stakeholders in the SDE.
- The principles are consistent with the related Sustainable Development Goals (SDGs), such as reducing poverty (SDG1), contributing to food and nutrition security (SDG2), and improving smallholders' position in global agricultural value chains (SDG8, SDG10).

Additionally, the principles must also address the following four essential concepts associated with fair and responsible data governance:

- Accountability
- Transparency
- Empowerment
- Harm avoidance

The consistency and substance of the proposed smallholder-oriented data governance principles were later verified by submitting a draft for review by some SDE stakeholders, researchers, and practitioners. In the future, case studies will be incorporated into this research to fine-tune the principles and disseminate them more widely.

3.1 The Principles and Their Enabling Conditions

The principles should not be interpreted as fixed policies or commandments because their formulations are deliberately broad. Instead, different stakeholders in the SDE should be able to use these principles when designing smallholder-oriented data-value policies. In addition, the stated enabling conditions can be used as a practical tool to create a check-and-balance system in smallholder-oriented data governance. The principles can also be helpful for actors who are not directly involved in data-value exchanges with smallholders, such as consumers and journalists.

9 Nico Beranek (2022), "When is data governance in data-driven smallholder agriculture fair? Developing a framework for sustainable data governance in smallholder farming." Master thesis Sustainability Science, Policy and Society, Maastricht University

3.1.1 Principle #1: Ethical Responsibility and Accountability

The first principle aims to establish equitable relationships among all the stakeholders in the smallholder data ecosystem based on ethical responsibility and accountability, which are the basis for trust in fair data governance. To enact the principle of ethical responsibility and accountability, three enabling conditions should be fulfilled:

In a fair data governance system, the powerful and well-resourced stakeholders should recognise that they are subject to ethical responsibility and accountability.

The significant underlying asymmetries of information, financial resources, and expertise between smallholder farmers and the well-resourced stakeholders in controlling positions must be addressed when developing the rules for smallholder-oriented data governance. In other words, powerful and well-resourced stakeholders such as private companies, governmental organisations, and NGOs are subject to greater responsibility and higher standards of integrity and stewardship in smallholder-oriented data governance.

Data collection and processing should be legitimate and necessary.

The legitimacy of data collection is central to the fairness of smallholder-oriented data governance. Although balancing different interests can be costly and cause conflicts among stakeholders, legitimate data collection must account for the interests of smallholders. That implies establishing ways for the meaningful participation of smallholder farmers in decision-making processes. In this context, it is crucial to put in place transparent rules and measures to avoid exploitative data collection practices where smallholders are unable to provide informed consent and do not derive a benefit from the provision of their data.

Furthermore, besides the legitimacy of the data collection, its necessity should also be considered. Before starting a data collection process, data collectors and handlers should ask themselves: Is it necessary to collect the data? Are there other ways of collecting the data without interfering with the lives of farmers? Is this data collection the most suitable way to achieve the end goal of the project or intervention? Unnecessary data collection could overburden smallholders as many organisations repeatedly ask them to share the same data. This situation can lead to a decline in trust and participation among farmers in data-driven developmental projects, while many donor organisations, NGOs, and governments are already sitting on heaps of siloed data.

Well-resourced stakeholders in controlling positions should account for the socioeconomic conditions under which they are operating.

The willingness of well-resourced stakeholders in controlling positions to take responsibility for their data handling is a prerequisite for engaging in fair data governance with smallholders. Therefore, these more powerful stakeholders must understand the socio-economic context in which they operate to bridge the power and resource gap between them and the smallholders. That involves understanding the political and cultural environment and aligning with existing technological, legal, and regulatory policies. In some contexts, it is possible that the legal and regulatory frameworks do not address the issues of data and technology use in smallholder agriculture. For instance, if data privacy and security standards are not appropriately enacted in the context of a country, data controllers should apply the highest existing standards according to the common consensus (e.g., GDPR).

3.1.2 Principle # 2: Sustainable Benefit-sharing

The principle of sustainable benefit-sharing is based on the premise that when data is being valorised in the SDE, all stakeholders should derive sustainable and tangible value, especially smallholders since they are the ecosystem's data source. To implement this principle, the following two enabling conditions should be met:

All stakeholders should receive consistent benefits when adhering to the data governance system.

Generally, smallholder farmers do not get to determine the value of their data and how it will be used. Therefore, the stakeholders overseeing data valorisation should ensure a fair and agreed-on value for smallholder farmers. Moreover, the extent and duration of the benefits should be clarified to the farmers based on realistic calculations and projections. For instance, value to smallholders can be offered in cash payment, improved yield, a more powerful position in the value chain, or financial incentives for their data provision. Furthermore, sustainability implies the establishment of long-term business models and infrastructures that are socially, environmentally, and economically oriented. However, the absence of benefit sharing could be a clear indicator of "digital colonialism," or in other words, the extraction and use of data without any subsequent benefit received by the smallholder farmer (Ferris & Rahman, 2016, p.6).

An information feedback loop should be established for the smallholder farmers to benefit from their data-sharing.

In addition to guaranteeing sustainable benefits to smallholder farmers, a data feedback loop should be established. In the data value chain, smallholders are the source of the collected data, and the other stakeholders process, enrich and use this data. A feedback loop will ensure that any time data is cleaned, enriched, and coupled with real-life applications, its subsequent analysis and knowledge will be returned to smallholders without restrictions. For example, suppose a smallholder collects and shares data on their farm's input and yield. Then this data gets integrated with climate and market data to generate a recommendation for a new seed variety. In that case, the smallholder should be provided with this information to make well-informed decisions regarding seed purchasing.

3.1.3 Principle #3: Legitimate Expectations of Privacy and Security

The principle of legitimate expectations of privacy and security is based on the idea that in the SDE, throughout the data value chain, smallholders expect other stakeholders to protect their data privacy and security and establish all necessary means to fulfil this expectation. This principle is vital, especially when existing legal frameworks do not protect smallholder data. This principle has the following three enabling conditions:

Clear rules for data collection and processing should be established, including a monitoring mechanism to identify and protect the sensitive data of smallholder farmers.

In some instances, smallholders qualify as a vulnerable community because of their limited access to resources and the lack of fundamental rights (Quayson et al., 2021); mishandling smallholders' data can expose them to severe harm (Gray et al., 2018) such as political and social persecution. Therefore, smallholder-oriented data governance relies on establishing precise data collection and processing rules, including agreements on who can access and edit smallholder data. Furthermore, jointly agreed-on monitoring and enforcement mechanisms for the established rules can identify and protect the sensitive data of smallholder farmers.

Explicit mechanisms for risk management and compensation should be implemented.

Security for smallholders' data means understanding the risks associated with collecting and processing their data. Just because data can be used in a certain way does not mean it should be. All stakeholders should understand how data will be used and for what purpose it was generated in the first place. If smallholders are not transparently informed, the stakeholders collecting or refining their data would be solely accountable for any harm resulting from security and privacy breaches. Data breaches or misappropriation can cause severe damage to smallholders. Therefore, the SDE's powerful stakeholders, namely the data handlers, should establish mechanisms for risk management and compensation for potential damages to smallholders due to harmful unintended consequences of data collection, analysis, or selling (McDonald, 2019).

Data privacy rules should take local contexts into account.

Privacy in smallholder-oriented data governance is context-sensitive. Interpretations of privacy should therefore reflect not only the conceptual or legal tradition of well-resourced stakeholders or only focus on the individual nature of rights (United Nations, 2018) but also draw from frameworks, interpretations, and traditions that smallholders are more familiar with in their local context (Gehl et al., 2022). For example, in the African context, this could mean that the importance of connections in communities should be considered, such as the concept of Ubuntu[10] (Gehl et al., 2022; Olinger et al., 2007). In this regard, data privacy rules should encompass both individual privacy, as commonly addressed, and group privacy, particularly when it comes to passive data collection.

3.1.4 Principle #4: Provision of Practical Necessities

Smallholder farmers face many practical challenges that obstruct their ability to govern their data, such as digital illiteracy and lack of information in their native languages (Miller et al., 2013). The availability of data technology infrastructures and tools does not guarantee accessibility and understanding (Msengezi, 2019). However, operability and access to infrastructure are prerequisites to participating in fair data governance. Therefore, in smallholder-oriented data governance, well-resourced stakeholders should contribute to providing the practical necessities for the farmers' participation. To enact the principle of provision of practical necessities, the following two conditions should be met:

Smallholder farmers should be provided access to essential infrastructures to actively participate in the data ecosystem.

Smallholder-oriented data governance should aim to arrange the necessary practical conditions that allow smallholders to have meaningful participation in the ecosystem and empower them to become data controllers. Hence, access to essential infrastructures such as electricity and ICTs is necessary to support vulnerable communities to participate in the digital transformation process of the agricultural sector in the Global South and gain sovereignty over their data (Couture & Toupin, 2019).

Smallholder farmers should have meaningful access to relevant information, education, and continuous learning.

Digital illiteracy is one of the biggest challenges to data governance in rural areas where frustration and reduced enthusiasm about new technologies can spread quickly (World Bank, 2017). As many smallholders will become new users in the near future, providing them with the appropriate education and training will increase their access to and confidence in data-driven tools. Moreover, this will allow them to critically reflect

10 Ubuntu is "(...) an ancient African worldview based on the values of intense humanness, caring, respect, compassion, and associated values ensuring a happy and qualitative human community life in a spirit of family" (Olinger et al., 2007 p.33)

on their role as a data source, generator, or controller and demand that their interests be met. For all these reasons, education and training are keys to empowerment in smallholder-oriented data governance.

The education and training should also involve understanding the risks and benefits of participating in data-driven agricultural projects and raising their awareness of data as a tradable commodity. Knowledge facilitation is an essential building block for the genuine self-determination of smallholders. However, since smallholders do not have the resources to lead the process themselves, well-resourced stakeholders should provide the essential means for them to obtain relevant information, training, and access to essential infrastructures.

3.1.5 Principle #5: Transparent and Deliberate Decision-making and Conflict-resolution

When establishing smallholder-oriented data governance, the stakeholders must anticipate challenges and acknowledge possible conflicting interests due to their varying capabilities and limitations (McDonald, 2021) and the differences in sociocultural and institutional norms, values, and motivations. Consequently, it is essential to establish transparent and deliberate mechanisms for decision-making and conflict resolution to prevent exploitative behaviours and mitigate unintended negative consequences of the asymmetric distribution of power and access to resources within the data ecosystem. The following enabling condition ensures the presence of this principle in smallholder-oriented data governance:

Smallholder-oriented data governance should establish transparent and deliberate decision-making and conflict-resolution mechanisms.

Sometimes, smallholders are not informed about the data collected from their farms. Even when they know about it, they do not always comprehend the extent of its use (Ferris & Rahman, 2016). Therefore, all the essential information regarding the purpose of data collection, intended use, and which stakeholders will have access to their data should be made available and accessible to smallholders to build trust through transparency. In addition, smallholders should be given sufficient time and opportunity to make a deliberate decision whether to opt in or out of the data collection and valorisation processes.

Impartiality and openness of decision-making processes are crucial to transparency in fair data governance. Thus, smallholders should have access to decision-making processes that establish rules for the stakeholders in the SDE at all stages. Participation of smallholders in decision-making can ensure that the privileged position of well-resourced stakeholders in the SDE does not lead to an unbalanced representation of their own interests. Meaningful participation of smallholders and consensus-oriented decision-making can be a tool to resolve potential conflicts (Gehl et al., 2022; Girard, 2019). As mentioned in the previous sections, this meaningful participation could be facilitated by providing the necessary infrastructure, education, and training.

4. Future Research and Development

We aim to follow up this report with case studies on the applicability and implementation of these principles for smallholder-oriented data governance in different regional and technical contexts, such as remote sensing and satellite imagery data. Future research will focus on the following goals:

- Developing implementation mechanisms for the data governance principles that incorporate the perspectives of smallholder farmers.
- Developing effective methodologies for monitoring adherence to these principles.
- Creating a criteria list to distinguish between fair and unfair data ecosystems while highlighting the potential benefits, implications, and challenges.
- Exploring fair and global price discovery mechanisms for farmers' data.
- Developing fair and transparent price-sharing formulas for farmers' data.

5. Recap Table

Principles	Ethical Responsibility and Accountability	Sustainable Benefit-sharing	Legitimate Expectations of Privacy and Security	Provision of Practical Necessities	Transparent and Deliberate Decision-making and Conflict-resolution
Enabling conditions	1. In a fair data governance system, the powerful and well-resourced stakeholders should recognise that they are subject to ethical responsibility and accountability. 2. Data collection and processing should be legitimate and necessary. 3. Well-resourced stakeholders in controlling positions should account for the socioeconomic conditions under which they are operating.	4. All stakeholders should receive consistent benefits when adhering to the data governance system. 5. An information feedback loop should be established for the smallholder farmers to benefit from their data-sharing.	6. Clear rules for data collection and processing should be established, including a monitoring mechanism to identify and protect the sensitive data of smallholder farmers. 7. Explicit mechanisms for risk management and compensation should be implemented. 8. Data privacy rules should take local contexts into account.	9. Smallholder farmers should be provided access to essential infrastructures to actively participate in the data ecosystem. 10. Smallholder farmers should have meaningful access to relevant information, education, and continuous learning.	11. Smallholder-oriented data governance should establish transparent and deliberate decision-making and conflict-resolution mechanisms.
Stakeholders involved	Private companies, Governmental organisations, NGOs, Research organisations, Extension agencies, Farmer organisations, and Intermediaries.	Smallholder farmers, Private companies, Governmental organisations, NGOs, Research organisations, Extension agencies, Farmer organisations, and Intermediaries.	Private companies, Governmental organisations, NGOs, Research organisations, Extension agencies, Farmer organisations, and Intermediaries.	Private companies, Governmental organisations, NGOs, Research organisations, Extension agencies, Farmer organisations, and Intermediaries.	Smallholder farmers, Private companies, Governmental organisations, NGOs, Research organisations, Extension agencies, Farmer organisations, and Intermediaries.

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