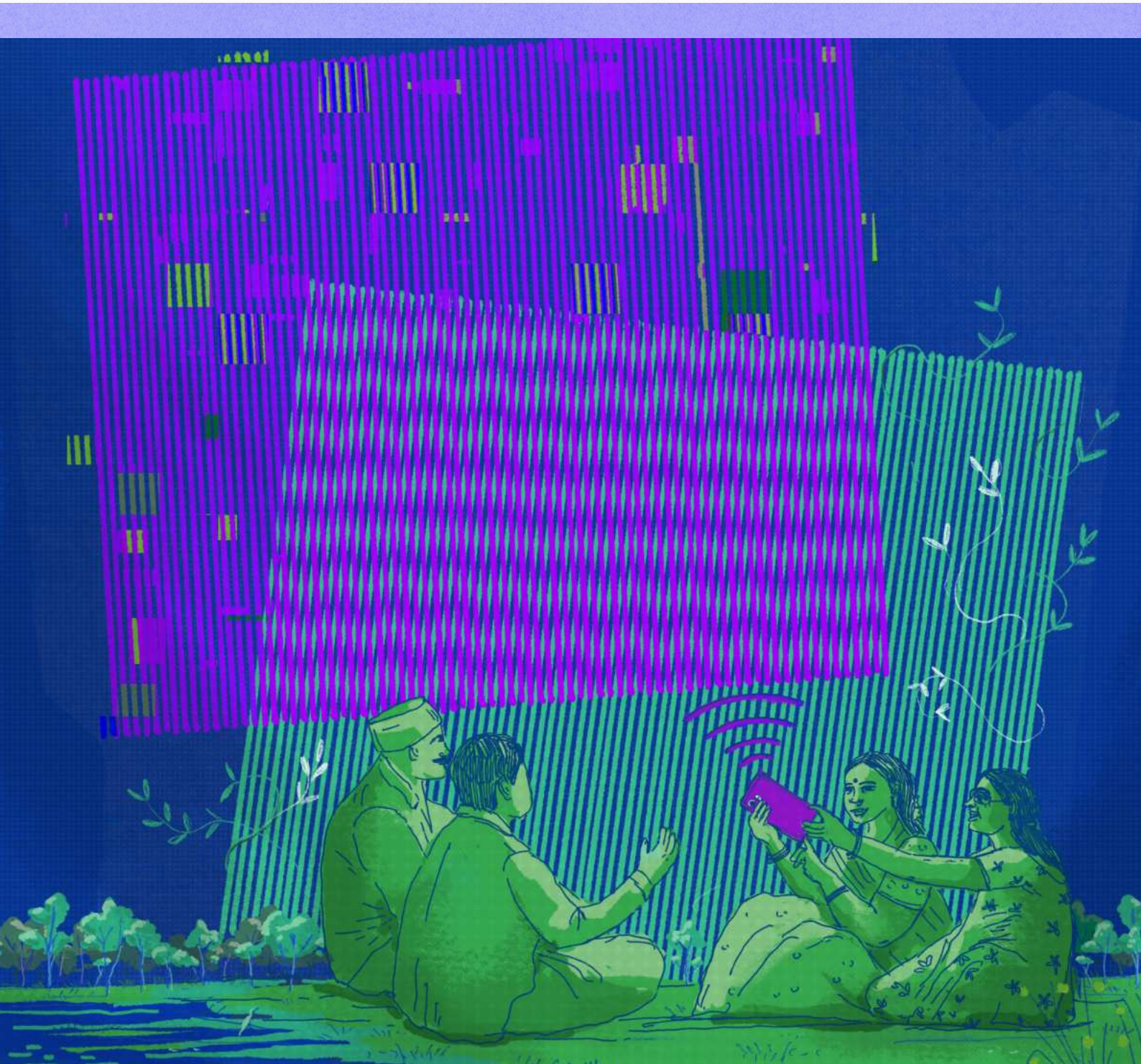
aapti institute

Common Ground

Reclaiming Digital Infrastructure for the Commons

Community Participation and Data Governance



This is a work of independent research, in collaboration with the **Common Ground Initiative** in 2026.

It was produced by **Aapti Institute**, a public research institute that works on the intersection of technology and society. Aapti examines the ways in which people interact and negotiate with technology both offline and online.

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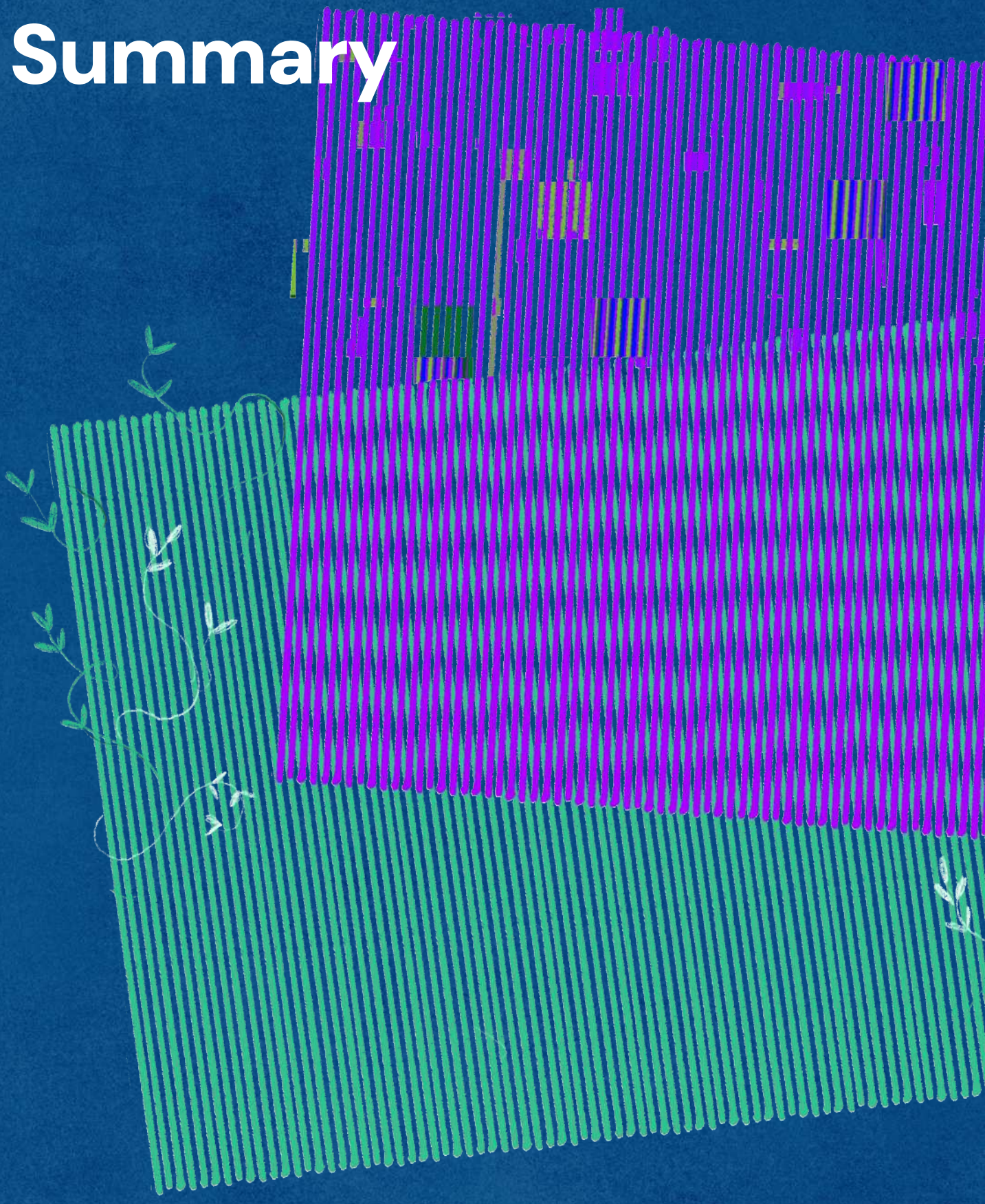

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Executive Summary

Problem Statement

Digital systems increasingly shape how land, livelihoods, welfare schemes, and natural resources are governed. Many of these systems are designed top-down, prioritising scale, interoperability, and administrative needs over community realities. This has led to fragmented data practices, limited local control over data, and weak feedback loops between communities, institutions, and technology builders. As digital infrastructures expand, the absence of community-centred data governance risks the deepening of exclusions and the undermining of trust in public interest technologies.

Objective of This Report

This report aims to examine how community-oriented digital infrastructures can be governed in ways that focus on participation, equity, and local relevance. Situated within the Common Ground Initiative, it brings together insights from participatory research, stakeholder interviews, and secondary literature to explore alternatives to dominant digital infrastructure models. The report focuses on identifying considerations and providing recommendations that can support decentralised data stewardship, collaborative engagement with vendors, and adaptable systems across contexts.

Limitations of This Report

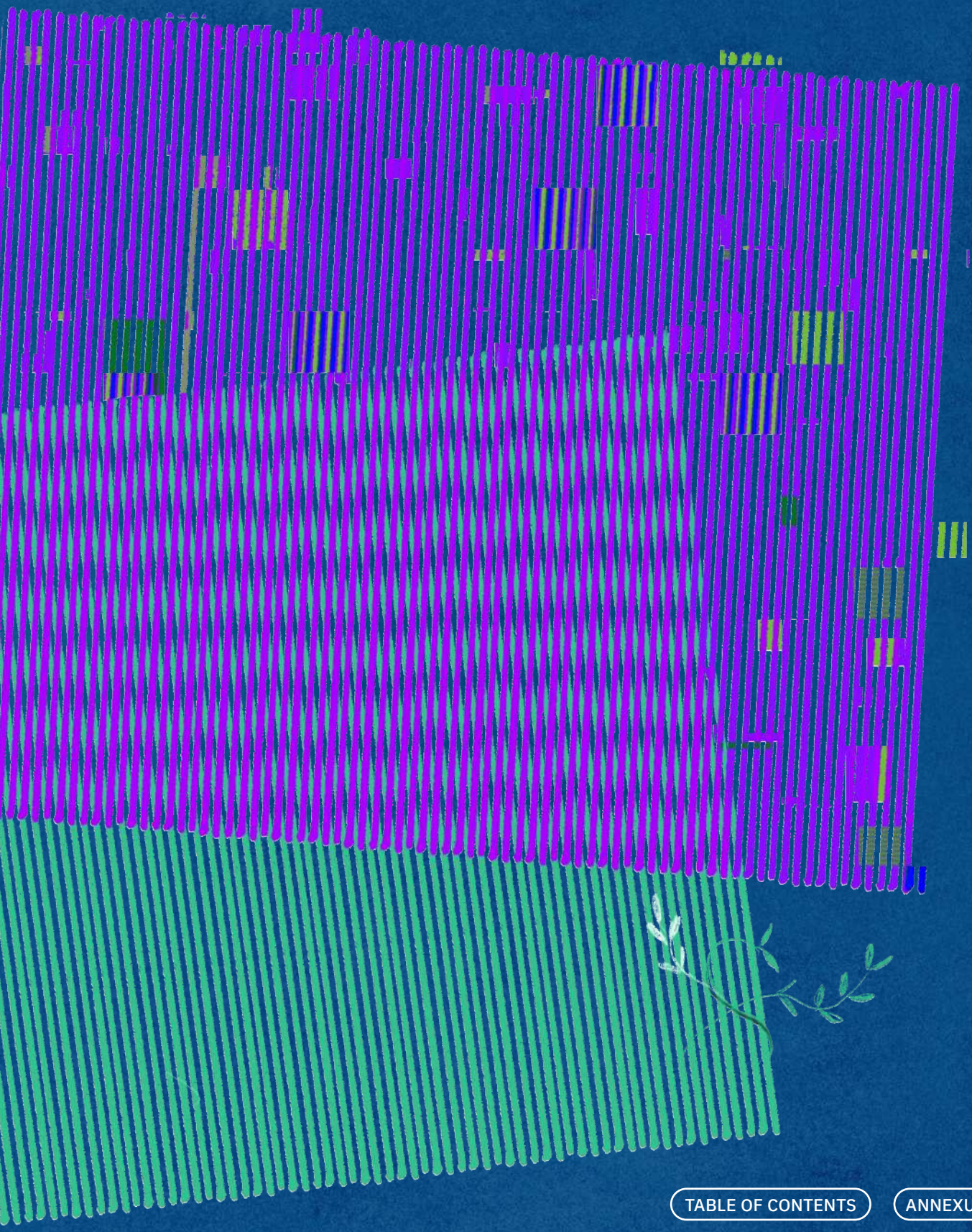
The report is based on qualitative research conducted primarily through online interviews. This limits sustained on-ground engagement and ethnographic depth. While it draws on perspectives from civil society organisations and experts, it does not claim to represent all community experiences or institutional contexts. The analysis focuses on governance and design frameworks rather than technical evaluation of specific tools, and should be read as exploratory and directional.

Next Steps

The findings of this report will inform the next phase of work under the Common Ground Initiative for Aapti Institute. The insights presented here will inform planned workshops that bring together community-facing organisations, technology builders, and ecosystem partners to explore practical questions regarding data sharing, stewardship, and accountability. These engagements are expected to translate the report's principles into concrete governance mechanisms and guide future Common Ground Initiative outcomes.

SECTION 1

Introduction



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SECTION 1

Introduction

> **Digital infrastructures are becoming increasingly central to the governance of land, livelihoods, welfare, and environmental resources in rural India. From digitised land records and agricultural databases to welfare delivery platforms and mobile-based monitoring systems, data-driven technologies are reshaping relationships between communities, the state, and markets. While these systems promise efficiency, transparency, and scale, they often repeat long-standing exclusions by prioritising centralised design, technical interoperability, and administrative convenience over local realities. As digital public infrastructures (DPIs) expand, questions of who controls data, whose knowledge is recognised, and how value is generated and distributed become critical to the future of equitable development.**

The Common Ground Initiative (CGI) is a collaborative systems change initiative in the domain of environmental governance and rural livelihoods in India, jointly led by over 90 organisations. Common Ground leverages the unique opportunity presented by the Commons to address three linked crises of our times – livelihoods, climate, and social equality – by bringing a socio-ecological narrative into mainstream development models. Through a collaborative action framework, Common Ground focuses on 'field setting', so that entrepreneurial action by multiple actors is accelerated and multiplied, seeding the ecosystem with institutional apparatus and a distributed network of change leaders, to set the stage for sustainable impact beyond the scope of any single initiative, or organisation.

Common Ground emerges within this context. It rethinks how public interest digital systems are conceived and governed. Rather than treating digital infrastructure as a neutral backend for service delivery, Common Ground approaches it as a socio-technical system embedded in commons governance, livelihood practices, and local institutions. Its focus on decentralised data governance, community participation, and collaborative engagement with technology builders reflects a growing recognition that sustainable digital systems must be shaped by the people and institutions they affect.

This report situates public interest digital systems like Common Ground within broader debates on DPI, open-source technologies, and community-led data governance. It also bases its analysis on the specific challenges faced by commons-dependent communities. Aapti Institute's role lies at the intersection of research, policy engagement, and participatory design — critically assessing dominant technology narratives and examining

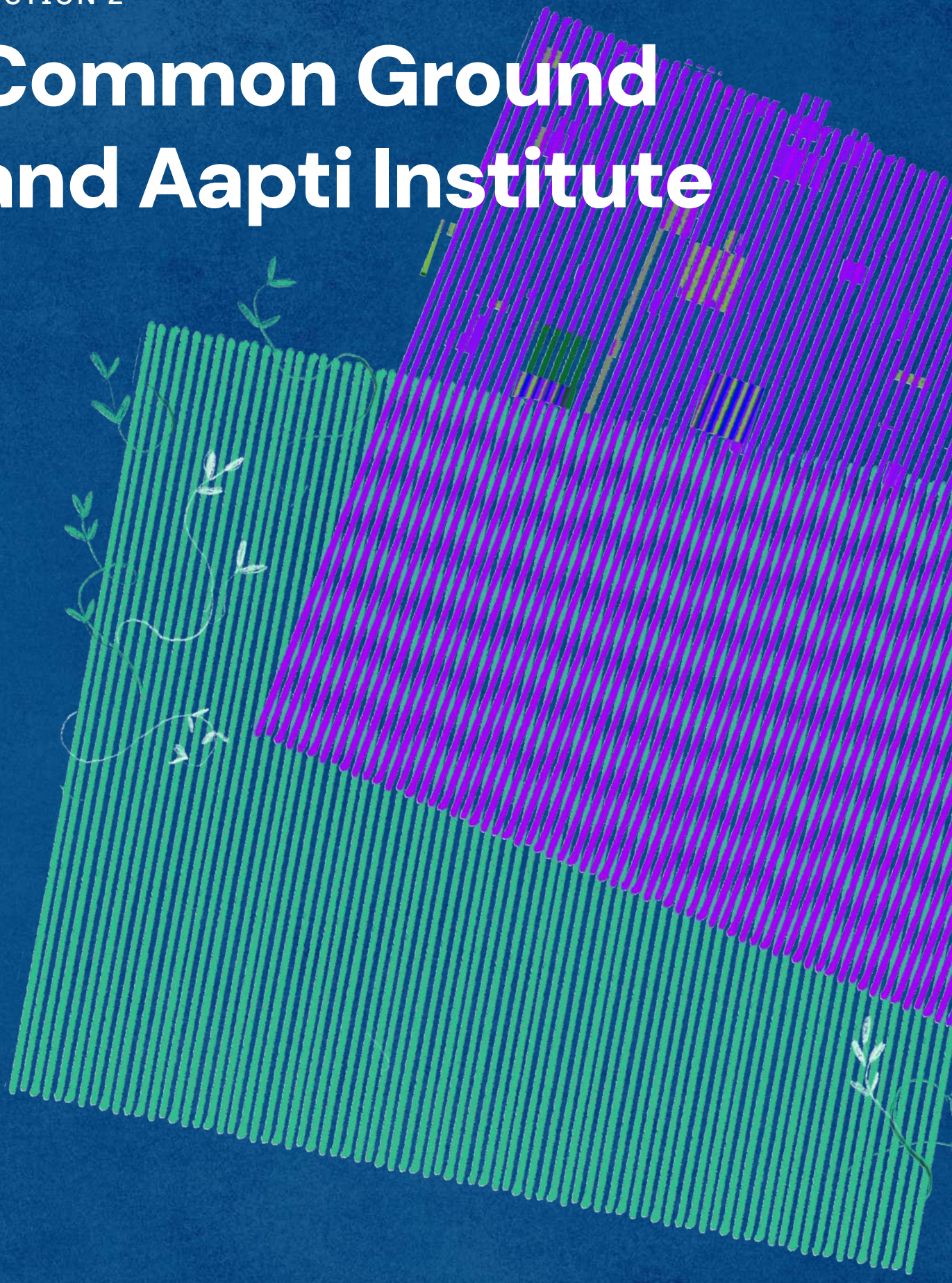
how questions of governance, power, and accountability are embedded within technical systems. The research presented in this report builds on Aapti Institute's ongoing work on data justice, public digital goods, and participatory methodologies, to develop grounded frameworks that inform policy and practice.

Methodologically, the report draws on a Participatory Action Research (PAR) orientation, combining qualitative interviews and secondary research. Key Informant Interviews (KIIs) with civil society organisations (CSOs) and domain experts provide insights into on-ground realities, institutional constraints, and emerging governance models. On the other hand, desk research situates these findings within wider academic and policy debates. This mixed approach enables the report to bridge empirical observations with conceptual analysis, ensuring that theoretical discussions remain anchored in lived experience.

The report aims to contribute to ongoing conversations on how digital systems can be designed and governed as public interest digital systems. By examining the limits of dominant digital infrastructure approaches and exploring alternative models rooted in infrastructural sovereignty, this report offers a nuanced understanding of what it means to build community-centred digital futures.

SECTION 2

Common Ground and Aapti Institute



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Common Ground and Aapti Institute

2.1 Common Ground as a Public Interest Digital System

The Digital Public Goods and Knowledge Commons workstream within the Common Ground Initiative represents a sustained, multi-partner effort to build the shared digital and knowledge infrastructure necessary for community-led landscape action across rural India. Rooted in the recognition that rural communities engaged in natural resource management and local governance consistently lack timely, contextually relevant, and trusted information, this workstream brings together a diverse coalition of CSOs, research institutions, and technology partners working toward a common purpose. Rather than developing isolated digital solutions, the initiative has pursued a deliberate strategy of convergence — creating the conditions under which tools, datasets, and knowledge resources built by different actors can draw from shared foundations, interoperate meaningfully, and collectively serve the information needs of communities, practitioners, and local governance actors at scale.

A central design challenge that has shaped this work is the fragmentation characteristic of the broader ecosystem: multiple organisations working on similar problems with similar tools, duplicating effort, operating in data silos, and unable to exchange information or functionality across platforms. In response, the workstream has invested in the architectural layer that makes interoperability possible — shared data standards, metadata frameworks, federated data repositories, and discovery infrastructure that allows different platforms to reference the same underlying data without depending on a single centralised system. This infrastructure work is understood not as a technical end in itself, but as the connective tissue that transforms a set of individual digital tools into a coherent, functioning knowledge commons — one in which data and knowledge move across institutional boundaries to reach the actors who need them, in forms they can act upon.

Equally central to the workstream's approach is the imperative to address substantive data gaps that currently constrain evidence-based decision-making in landscape governance. Key thematic domains — including forest cover, water systems, biodiversity, livelihoods, and community entitlements — remain inadequately represented in open, accessible, and locally usable data infrastructure. The goal is not merely to make more data available, but to ensure that the information reaching local actors is contextually grounded, verifiable, and structured to support the specific decisions that communities and their partners are trying to make.

Underlying all dimensions of this work is a strong and explicit commitment to community agency — both in the adoption of digital tools and in the governance of data and knowledge systems. Experience over the first two years of the initiative has underscored that technology availability is a necessary but insufficient condition for meaningful adoption: communities, civil society organisations, and government actors each engage with digital tools and data on distinct terms, shaped by their existing capacities, institutional incentives, and lived contexts. The workstream has drawn from this learning to prioritise facilitated, co-created implementation pathways over deployment-led approaches, and to invest in the development of local stewards, community champions, and bridging capacities capable of connecting digital infrastructure to grassroots action. In parallel, dedicated work on data governance frameworks seeks to establish operational models through which communities exercise genuine rights over the data generated about and by them — determining what is collected, how it is used, and how they participate as informed and empowered actors in shared information systems, rather than as passive subjects of external documentation.

2.2 Aapti Institute's role in Common Ground's Digital Public Goods and Knowledge Commons workstream

Aapti Institute contributes to the Common Ground by bringing analytical, governance, and methodological expertise to support the creation of community-aligned digital systems. Within the Digital Public Goods and Knowledge Commons workstream, Aapti's ensures that digital components and governance arrangements remain attentive to inclusion, agency and fairness. This involves developing governance templates, documenting institutional processes, identifying risks, and grounding technical design in the realities of rural institutions and resource governance.

A key function for Aapti Institute in the workstream is to act as a convenor across stakeholders — linking partners, CSOs, technologists, and policy makers. Coordination is necessary because the evolution of public interest digital systems requires negotiation across diverse forms of expertise — technical, social, and institutional. Aapti Institute bridges these needs and helps create shared templates that multiple actors can agree upon and implement.

Finally, Aapti Institute focuses on producing knowledge products that encourage uptake and replication. Our playbooks, operational frameworks, and technical guidance translate learnings into usable steps. These products are intended for field practitioners and institutional actors. By packaging field-tested insights into practical guidance, Aapti Institute seeks to make the learnings accessible even to those who are not formally part of the Initiative.

2.3 The Research Questions

The research revolves around three interlinked questions that orient Aapti Institutes's inquiry in the initiative. Each question addresses one aspect of building community-centred digital systems — process and inclusion (participation), access and safeguards (data governance), and reach and sustainability (scalability).

1. **How can participatory action be deployed to ensure community voices are included in the design, validation and governance of local digital systems?**

   This question addresses process and power — who gets to set priorities, whose knowledge counts, and how decisions are made. We treat participation as an ongoing set of practices that embed communities in every stage of the system's development. This includes co-design, iterative validation, shared documentation and local stewardship. This means designing methods that surface varied perspectives, create simple feedback loops so communities can critique prototypes/tools and establish local roles (stewards, advisory groups).

2. **What data governance methodologies support fair and workable data practices in varied contexts?**

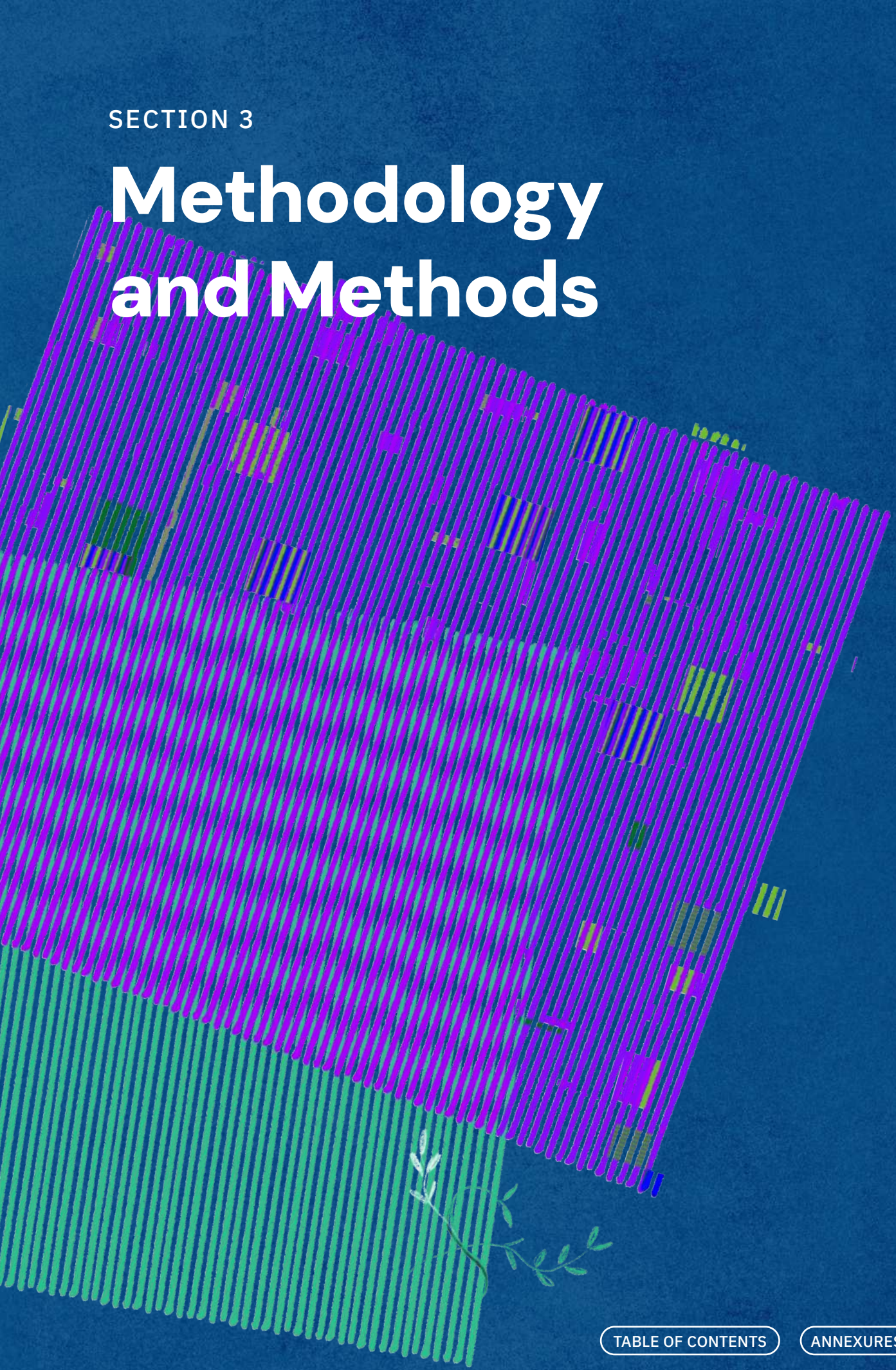
   The second question tackles data governance methods. It assesses appropriate methodologies in contexts where relationships to land, welfare, and resources are mediated by a mix of formal institutions and informal norms. It questions what gets collected, how it is verified, who controls access, how consent is organised, and how value generated from data use is shared. The research builds governance options that vendors, technologists and communities can adopt according to capacity and needs.

3. **How can community-oriented technologies be scaled, while staying grounded in local practice?**

   This question looks at the trade-offs between local specificity and wider applicability. We are seeking ways to combine modular technical design with governance mechanisms that accommodate local norms. Scalability is not just replication, but the capacity to re-use core components while allowing place-based variation in data fields, use cases, and stewarding arrangements. This involves institutionalising minimal common standards, documenting local needs and gaps, and assessing the cost and institutional support needed for wider adoption. The intended output is a set of design and implementation guidelines that make it possible to scale functions without erasing local realities.

SECTION 3

Methodology and Methods



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Methodology and Methods

3.1 PAR Framework

The project adopts a PAR framework because it aligns with the project's commitments — participation, reflection and action. PAR treats research as a cycle rather than a one-time exercise. Through PAR, communities help define questions, participate in data collection, co-analyse results, and co-decide subsequent steps. This cyclic approach deepens local relevance and creates continual opportunities to correct direction based on what is learned in the field.

Within PAR, we utilised Socio-Economic and Gender Analysis (SEAGA) to ensure that differences across gender, caste, age, and economic status were visible and informed the design. SEAGA provides insights into who benefits from the current data systems, and highlights barriers to participation. Embedding SEAGA within PAR ensures that the research intentionally seeks out marginalised voices, adjusts methods to make participation feasible, and prioritises outputs that address inequities.

PAR also focuses on co-creation as a governance mechanism. Instead of delivering finished specifications, the research process invites joint prototyping, validation, and refinement with communities and developers. This co-design posture reduces the chance that technical solutions will be rejected or unused, and it builds local ownership by involving community members in verification and governance experiments from an early stage. PAR serves as a methodology and as a means to test governance innovations in real-time.

Given the scope and timing, we did not undertake action or reflection cycles on the ground. Instead, we applied PAR principles to how we designed and conducted the research. Our questions for the CSOs were developed using SEAGA to centre local realities, the findings were interpreted with attention to community perspectives, and interim insights were kept open for validation rather than treated as fixed. Next, we intend to share the report with experts and where feasible, conduct follow-up conversations to incorporate critiques, clarifications, and reflections.

3.2 Key Methods

3.2.1 KIIS WITH CSOS AND EXPERTS

We conducted a series of online KIIs with two distinct, but complementary groups:

(a) **CSOs** within Common Ground, who work on the ground and provide detailed, place-based evidence of needs, gaps, and everyday practice; and

(b) **domain experts** who offer higher-level perspectives on governance models, technical architectures, and comparative case studies.

All interviews were carried out remotely and lasted between 60 and 90 minutes.

The CSO interviews followed a structured template. This template was designed using SEAGA to ensure the questions probed socio-economic differences, institutional relationships and the linkages between commons and livelihoods. Using a common template that ensured comparability across sites, we could identify recurring problems, cross-cutting data gaps, and existing data practices. The participants were chosen from Jharkhand and Odisha, and were informed beforehand that they could choose their medium of interview from Hindi, English, Bengali, Marathi, and Tamil, or a mixture of these languages.

Domain expert interviews were intentionally less scripted. Experts vary in the roles they play and the kind of knowledge they bring — technology developers, policy analysts, and community-tech practitioners. A rigid template would have constrained the conversation and would have missed important insights about governance trade-offs, interoperability experiments, or novel case studies. The semi-open format allowed us to follow leads, probe recent pilots or failures, and gather practical recommendations.

Interview notes and recordings were handled according to informed consent agreements. We anonymised transcripts and coded notes with an a priori codebook (Commons Ecology, Livelihood Challenges, Power Equity, Institutional Dynamics, and Data Tech) and refined the codes inductively as patterns emerged. The iterative coding allowed us to discover expected themes and unanticipated issues that became important for later design. The participants were offered a copy of the transcripts, if requested.

3.2.2 SECONDARY RESEARCH APPROACHES: LITERATURE AND TECHNICAL REVIEW

Our secondary research combined a broad literature review of academic papers, policy documents, and practitioner reports relevant to technology infrastructures, data governance, and community-led public interest digital systems. The goal was to build a well-grounded

analytical base before interpreting interview findings, and to ensure that our conceptual vocabulary for data governance, institutional design, and commons-oriented technologies was consistent and rigorous.

A significant part of the desk analysis examined how large public digital systems are typically designed, governed, and scaled. We paid particular attention to case studies that elaborated on their engagement with communities. This helped us identify ecosystem-level assumptions, gaps, and risks that any alternative community-centred model must be prepared to address. Alongside, we reviewed literature and documentation on free and open-source governance and community-managed technologies. This included studies of modular architectures, federated designs and long-standing open-source communities. It helped us understand how transparency, participatory governance, and local adaptability have been operationalised in practice, and drew out elements relevant for designing inclusive and accountable data-sharing systems.

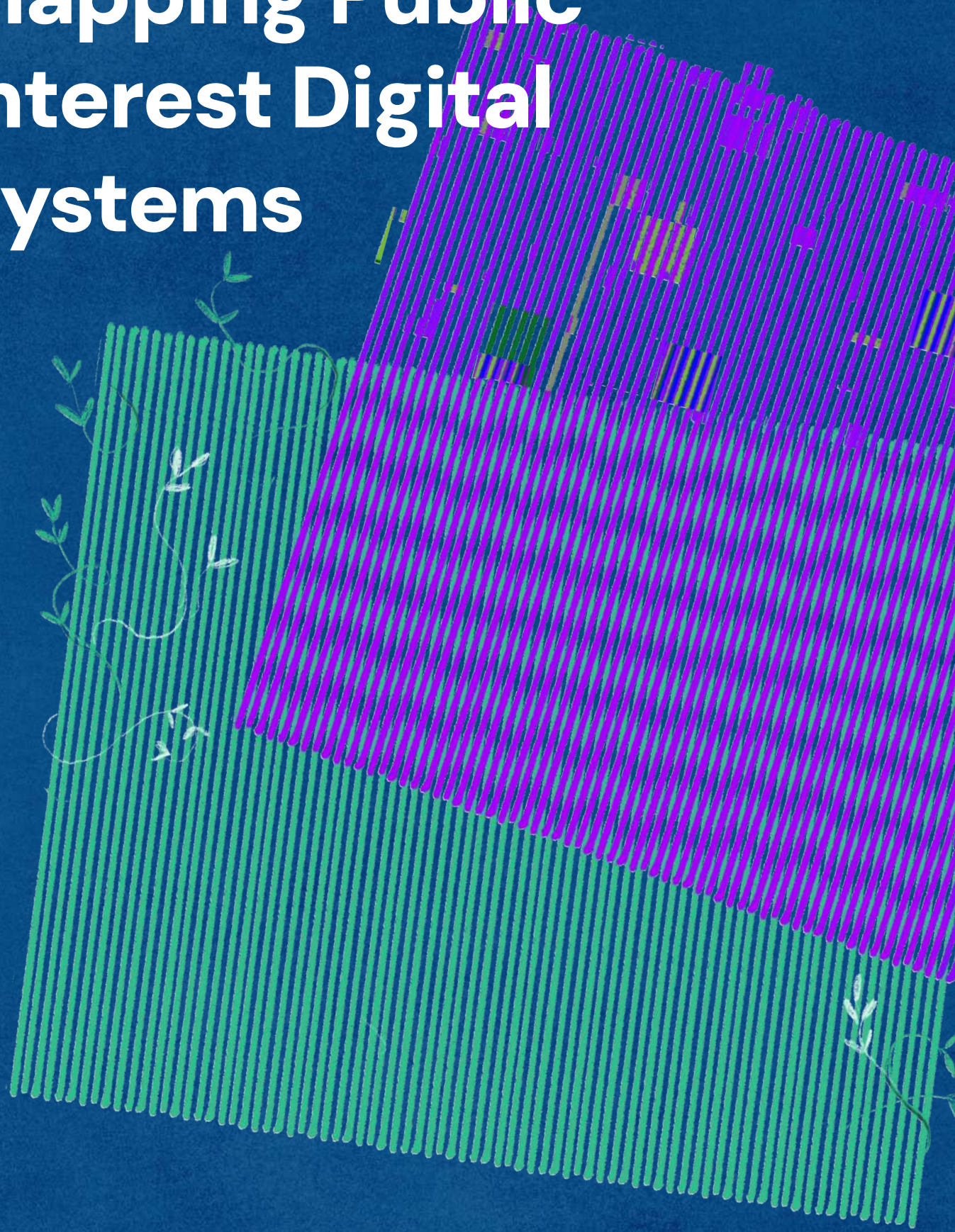
A third line of inquiry studied emerging work on data cooperatives, data collectives, and other bottom-up data governance experiments. These models encouraged practical questions around shared data ownership, verification mechanisms, benefit distribution, and the institutional arrangements required for collective decision-making. They also offered examples of how communities negotiate power, trust, and control in digital environments.

Across these elements, our approach was iterative. Insights from the literature informed interview guides, helped contextualise field-facing inputs, and provided a comparative frame to analyse what the CSOs and domain experts shared. The desk review ensured that the project was anchored in a wide body of evidence. It also positioned our primary research within ongoing debates about public technologies, governance, and community rights.

Data from KIIs and desk research were treated as complementary. We triangulated findings across partner accounts, expert perspectives, and documentary evidence to reduce the chance that a single viewpoint would dominate conclusions. Coding and analysis produced a set of thematic briefs that summarise common data gaps, verification practices, institutional blockages, practical consent and privacy concerns, while presenting promising technical approaches.

SECTION 4

Mapping Public Interest Digital Systems



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Mapping Public Interest Digital Systems

4.1 The DPI Approach

The DPI paradigm has emerged as a dominant framework for a state-led digital transformation and creation of public interest digital systems in the 21st century. Due to varying forms and adaptations globally, DPIs have no single conceptual definition. Despite the lack of a global standard, there have been variations of DPIs, led by state-backed and privately built innovations in countries such as India and Brazil. They have set the tone for the global adoption of this new form of public interest technology (Bandura et al., 2024). Conceptualised as a set of minimal, reusable, and interoperable digital building blocks, DPIs come with tall promises. They aim to catalyse innovation in private-public technologies, enhance state capacity by introducing digital layers for efficient governance, and accelerate service delivery through digital-first or digitalised welfare services offered by the state (Clark et al., 2025).

The DPI approach has several proponents, who argue that by providing foundational capabilities such as digital identity, payments, and data exchange, a level playing field is created for public and private actors, fostering inclusive growth. In India, Aadhaar and Unified Payments Interface (UPI) are frequently cited as successes of this model, measured by scale and adoption (D'Silva et al., 2019).

The core DPI narrative is one of technological efficiency, leveraging modular architecture and open standards. In the ideal DPI matrix, the modularity of the techno-social infrastructure was built to drive innovation while also preventing monopolisation to avoid vendor lock-in (Clark et al., 2025). However, private dependencies in the DPI ecosystems are key to regulation, smooth functioning, and adoption, despite the public nature of the system (Malik & Jain, 2025).

4.1.1 EMERGING DPIs IN THE INDIAN AND GLOBAL LANDSCAPE

Digital India Land Records Modernisation Programme

The Digital India Land Records Modernisation Programme (DILRMP) aims to create a unified, computerised land registry. While intending to reduce fraud in land transfer, purchase, and ownership, its implementation has often been criticised. It is said to superimpose a standardised formal system onto complex, pluralistic local tenure arrangements, potentially disenfranchising those with informal or customary claims.

DILRMP is an attempt to convert land tenure, determined by presumptive means, to conclusive titling. However, in this process, the risks of land "datafication" are not addressed, leaving small and marginal owners at the risk of profiling and exclusion by the state and private players (Gurumurthy et al., 2022).

AgriStack

This proposed data exchange, unlike the DILRMP (a data repository), comprises digital infrastructures for agriculture. It is centred around a farmer registry and unified data platforms that enable real-time market connectivity and discovery. However, this data exchange model has faced significant backlash from farmer unions and civil society over concerns of data exploitation, profiling, and the promotion of a private-interest-based agricultural model without adequate consultation or legal frameworks. Despite the backlash, AgriStack is in its pilot phase. With the help of MoUs with private agriculture and technology giants, it is creating key infrastructure (Jaiswal et al., 2024).

Agricultural Data Exchange

Positioned as a decentralised protocol for agricultural data, Agricultural Data Exchange (ADeX) is a flagship initiative of the Telangana Government. It aims to give farmers better access to markets, with a focus on credit. Similar to AgriStack, ADeX prioritises the discoverability of farmers' data by private players, with the addition of Web 3.0 tools such as Blockchain and Internet of Things (IoT). While still nascent, its principles may seem more user-centric and drive for interoperability (ADeX, 2025; Telangana Data Exchange, 2025).

European Data Spaces

The EU's strategy for data governance, exemplified by the Data Governance Act, emphasises data sovereignty and the creation of sectoral data spaces (e.g., health, energy). This model is more regulatory and federated, focusing on enabling data sharing while upholding strict privacy and fundamental rights standards through the General Data Protection Regulation (GDPR) (European Commission, 2025). It presents a more rights-based, though still largely top-down, approach to building data infrastructures. The European Data Spaces represents a highly regulated centralised model with various human-based checks and balances embedded within its system. It also stands out as a model that adapts to sectors and sectoral practices, making it a unique example of a data-exchange-based DPI (Ryan et al., 2024).

Open Network for Digital Commerce

The Open Network for Digital Commerce (ONDC) aims to democratise e-commerce by breaking down platform silos. It creates a common protocol that platforms can onboard on to, allowing discoverability across platforms and preventing lock-ins (Islam et al., 2024; the Aapti Institute, 2024). Its success hinges on its ability to genuinely empower small merchants and avoid being

captured by existing large players. However, the lack of mandatory practices and overarching regulation has made the ONDC unsuccessful, with platforms continuing to prefer their own vendors and sellers (Koshy, 2025).

4.1.2 LIMITATIONS OF THE DPI MODEL

Though the idea and concept of DPIs have experienced political and economic acceptance, a growing body of scholarly and community-oriented research shows that DPIs often obscure the socio-political choices embedded in their design and implementation. The prevailing DPI model is predominantly informed by the logic of "scale-at-all-costs", frequently sidelining questions of equity, justice, and public deliberation.

The popular orientation of how DPIs are constructed lacks a fundamental public-centred approach. Without the framework of a public interest digital system, citizens are often framed as end users, versus co-creators of the infrastructure (Milan & Treré, 2019). Critiques of DPIs are explained below.

- **Lack of Specificity Affects Functionality:** A critical limitation of many DPIs lies in their generalised design. It emphasises universal applicability at the expense of context-specific functionality (Access Now, 2024). While the DPI framework promotes interoperability and modularity, these features can dilute sector-specific responsiveness. These include poor adaptation to localised health service delivery and informal sector economic activities, particularly in the context of commons governance (Pope, 2019).

  This universalising architecture assumes homogeneity in user needs and institutional capacity, leading to functional gaps directly determined by the DPI's design. The modularity of DPIs determined by universal principles does not meaningfully align with demands and gaps on the ground. It can perpetuate systems of discrimination and reaffirm them by establishing a regime of truth-making that is difficult to redress (van Toorn et al., 2024). Although centralised design frameworks are key to scale and adoption, the combined effect of privatisation of the DPI undermines nuances needed for local governance processes, resulting in systems that are present but underutilised (Sridharan et al., 2024). This is particularly true in the context of how DPIs are interpreted – as the "railroad infrastructures" of digital transformations. However, unlike railroads, DPIs are heavily overlaid and contextualised by private players in charge of the last-mile of these systems, where design and deployment decisions are determined less by governments and people, and more by vendors (Vaidya, 2023).

- **Lack of Governance and Accountability:** A fundamental challenge of the DPI approach is the governance and accountability deficits embedded within the design mandates of DPIs, affecting their legitimacy and sustainability. While these infrastructures centralise critical functions — identity verification, data sets, and data exchanges — they often operate

without centralised governance mandates, but with centralised architecture rules (Ngodup Massally et al., 2023). In many jurisdictions, the institutions responsible for DPI oversight lack clearly defined mandates. This is particularly true for the oversight authority for India's seminal UPI system. Their rules and functioning are determined by the National Payments Corporation of India (NPCI), run by a consortium of private and public banks and registered as a non-profit. Legal and legislative means of accountability, such as the Right to Information (RTI), only apply to publicly-owned bodies. The absence of enforceable accountability standards for NPCI and other bodies leaves users without recourse when the system fails, data is misused, or exclusionary outcomes emerge (Parsheera, 2024).

Partnerships with private actors introduce additional complexity. Without well-structured regulatory safeguards that address the privatisation of specific infrastructural elements within the larger DPI system, private entities gain disproportionate influence over public data, raising concerns about conflicts of interest, market power asymmetries, and data commodification (Sridharan et al., 2024; Malik & Jain, 2025).

- **Overshadow of Process Roadblocks:** The technology-first approach of many DPI initiatives inadvertently deprioritises organisational and administrative processes that encompass its adoption, integration, and deployment. This is particularly true for commons-related data and its governance. It contains several jurisdictional, legal, and regulatory considerations, along with the nature of data, its collection mechanism, and stakeholders who are closely involved (Sridharan et al., 2023; the Aapti Institute, 2023). The DPI deployment often assumes that digital technologies by themselves can streamline service delivery and institutional operations. Integrating DPI systems requires changes in workflow, staff competencies, institutional roles, and inter-agency coordination. In addition, subjects such as environment and livelihood require the cooperation of departments at various governance levels. This dynamic results in digital infrastructures that are formally adopted but functionally mismatched with on-ground realities, leading to partial implementation (Ngodup Massally et al., 2023; Pope, 2019). An effective DPI implementation must encompass the technological build and the organisational and legislative transformation necessary to embed these systems within evolving administrative practices.

4.1.3 HOW THE DPI APPROACH ADDS TO THE DATA COMMONS

While the DPI paradigm has primarily been state-led, its architectural principles offer significant advantages for nation-wide initiatives such as the Common Ground. When adapted to prioritise community sovereignty rather than administrative efficiency, the DPI approach can provide the following benefits:

- **Establishes institutional legitimacy:** Community-led initiatives often struggle to gain recognition from governments and access to official data streams. Embedding the DPI

design adheres to standards that government functionaries now increasingly understand, potentially easing integration with existing e-governance systems. The World Bank (2025) explicitly calls for "multistakeholder governance structures" in the DPI implementation, providing a conceptual space for community-led collectives within official digital ecosystems. This is reinforced in the Indian context, where recent policy documents – including the Economic Survey (2025–26) and NITI Aayog's India's Data Imperative (2025) – increasingly position Digital Public Infrastructure as core to governance and public service delivery, signalling growing institutional support for DPI-aligned approaches.

- **Enables modular architecture that accommodates local variation:** The DPI emphasises modular, extensible building blocks, addressing the tension between standardisation and contextual responsiveness. Its architecture enables a standardised core for interoperability, paired with configurable middle and interface layers for local adaptation. The protocol-based rather than platform-based design is particularly valuable, preventing vendor lock-in while enabling federated networks.

- **Reduces technical barriers and costs:** DPIs mandate the use of open standards, lowering technical and financial barriers to building interoperable systems (Digital Impact Alliance, 2024). This makes room for local developers to learn from publicly documented specifications rather than depending on proprietary knowledge controlled by individual vendors.

- **Prevents market-capture and encourages multi-actor innovation:** Protocol-based DPIs allow multiple implementations to co-exist, enabling diverse actors to compete and prevent single entities from dominating. It lets data remain distributed across autonomous nodes (communities, organisations, districts, etc.) while still being discoverable and exchangeable when authorised (United Nations Development Programme, 2024).

- **Facilitates compliance through 'obligations in code':** The DPI's techno-legal framework automatically embeds compliance into system design. Rather than relying solely on contracts and trust, community-defined rules, such as consent requirements, access restrictions, audit obligations, and benefit-sharing mechanisms, can be fed directly into technical protocols. This reduces enforcement burden on communities and creates automatic accountability. India's Data Empowerment and Protection Architecture (DEPA) demonstrates this principle through its Account Aggregator framework, which embeds consent protocols directly into data-sharing flows, giving individuals control over how their financial data is accessed (Digital Impact Alliance, 2024).

- **Enables cross-border and South-South knowledge sharing:** The DPI has a network of practitioners, policymakers, and technologists across the Global South. Initiatives such as the 50-in-5 campaign, the Global DPI Repository, and platforms such as Co-Develop facilitate the sharing of implementations, lessons learned, and technical components

(Maheshwari, 2024). This ecosystem provides resource access to collectively address community data governance, rural connectivity constraints, and multi-stakeholder coordination.

However, realising these benefits requires deliberately adapting the DPI principles to prioritise community sovereignty over administrative efficiency, ensuring that standardisation serves local needs rather than imposing uniformity. This also maintains vigilance against the centralisation and surveillance risks that have plagued state-led DPI implementations. India's legacy of community-led commons governance represents sophisticated, place-based socio-ecological infrastructures that have sustained resources through locally-evolved rules, monitoring systems, and conflict-resolution mechanisms. These systems can challenge and reformulate the DPI approach to strengthen existing environmental stewardship.

If they flow through and strengthen existing trusted institutions, such as the decentralised Panchayati system, community-led DPIs gain immediate legitimacy and adoption. In turn, DPIs can make local governance more accountable, particularly to marginalised groups. While DPIs often lack transparency, a community-managed digital ledger can record meeting minutes and fund allocations from local decisions. Local definitions and classifications of resources can be preserved, preventing the loss of external standardisation created by poor data provenance. Thus, we need to enable actors to tailor their own solutions to contextual problems while relying on the DPI's institutional legitimacy, technical standards, and multi-actor architecture.

4.2 Free and Open-Source Software

Free and Open Source Software (FOSS) refers to software that is licensed to give users the right to use, share, modify, and distribute. FOSS entails publicly available source code that allows users to exercise these rights, but not all source-available software is FOSS. Over the decades, FOSS has evolved into a profound socio-technological movement, philosophy, development methodology, and distribution model. It has fundamentally challenged the paradigmatic proprietary method of creating software, breaking open different collaborative models of software creation and ownership (Weber, 2004; CivicDataLab, 2021).

FOSS encompasses the overlapping, often complementary, terms of free software and open-source software. Borrowing from the hacker ethic (Himanen, 2001) and the public domain ecosystem, Richard Stillman wrote "The Free Software Definition", a policy document which was later adopted by the Free Software Foundation (FSF), thereby offering the following explanation of "free" (GNU, n.d.):

> **“Free software” means software that respects users' freedom and community. Roughly, it means that the users have the freedom to run, copy, distribute, study, change and improve the software. Thus, “free software” is a matter of liberty, not price. To understand the concept, you should think of “free” as in “free speech,” not as in “free beer.” We sometimes call it “libre software,” borrowing the French or Spanish word for “free” as in freedom, to show we do not mean the software is gratis. You may have paid money to get copies of a free program, or you may have obtained copies at no charge. But regardless of how you got your copies, you always have the freedom to copy and change the software, even to sell copies.**

The FSF espouses four fundamental freedoms within this concept:

- **Freedom 0:** The freedom to run the programme as you wish, for any purpose
- **Freedom 1:** The freedom to study how the programme works, and change it so it does your computing as you wish. Access to the source code is a precondition for this.
- **Freedom 2:** The freedom to redistribute copies so you can help others.
- **Freedom 3:** The freedom to distribute copies of your modified versions to others. By doing this, you enable the community to benefit from your changes. Access to the source code is a precondition for this.

On the other hand, the Open Source Initiative (OSI), emphasising the business-friendly development and use of code, produced the Open Source Definition. It captures ten criteria that qualify a code as open source (OSI, 2007):

- **Free redistribution:** The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programmes from several different sources. The license shall not require a royalty or other fee for such sale.

- **Source code:** The programme must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicised means of obtaining the source code for no more than a reasonable reproduction cost, preferably downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

- **Derived works:** The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

- **Integrity of the author's source code:** The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

- **No discrimination against persons or groups:** The license must not discriminate against any person or group of persons.

- **No discrimination against fields of endeavour:** The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

- **Distribution of license:** The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

- **License must not be specific to a product:** The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

- **License must not restrict other software:** The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open source software.

- **License must be technology-neutral:** No provision of the license may be predicated on any individual technology or style of interface.

4.2.1 FOSS LICENSES

Free and Open Source Software (FOSS) licenses constitute the legal and technical substrate of openness (Weber, 2004). They are the mechanisms through which the abstract ideals of software freedom are translated into enforceable rights, obligations, and interoperable systems. While there are some philosophical differences between "free software" and "open-source software", in terms of licenses, there is a sizable overlap between them (CivicDataLab, 2021).

There is a large compendium of FOSS licenses (OSI, n.d.; GNU, n.d.), and they can be categorised into four models of openness (CivicDataLab, 2021):

- **Strong Copyleft (Enforced Reciprocity):** Strong copyleft licenses, such as the GNU General Public License (GPL) and the Affero GPL (AGPL), require derivative works to be released under the same license, embedding reciprocity directly into the legal structure of the software. This design choice aims to prevent enclosure and ensure that collective contributions remain part of a shared commons, particularly in environments where private actors may otherwise extract value without contributing back. The AGPL was specifically written to close the cloud services loophole in the GPL licenses, as cloud-based Software-as-a-Service (SaaS) deployments bypass traditional GPL distribution triggers, allowing companies to use GPL code in proprietary offerings without releasing source code.

- **Weak Copyleft (Bounded Protection):** Weak copyleft licenses, such as the GNU Lesser General Public License (LGPL), Mozilla Public License (MPL), and Eclipse Public License (EPL), narrow this reciprocity to specific components or files, enabling integration with proprietary systems while still protecting core contributions.

- **Permissive Licenses (Adoption over Control):** Permissive licenses, such as MIT, BSD, and Apache License 2.0, impose minimal obligations, typically in the space of attribution and license preservation. They prioritise interoperability, adoption, and ecosystem growth over enforced sharing.

- **Public Domain (No Copyright/Copyleft):** It places software outside copyright altogether, allowing unrestricted use, modification, and redistribution without conditions. Instruments such as Creative Commons Zero (CC0) are often used where legal systems do not allow voluntary abandonment of copyright. While this model maximises freedom and reuse, it provides no structural safeguards against enclosure or misappropriation, making it the least protective of collective stewardship.

  License choice is not just a technical or legal framework but also a governance decision that shapes who participates, how value circulates, and whether cooperation is structurally required or voluntary (and to what degree). In the DPI conversation, permissive licenses are useful as they lower barriers for government adoption and multi-vendor implementation. Copyleft licenses are common in projects that conserve community leverage over dominant corporate actors. Accepting external code from vendors needs to be clarified through Contributor License Agreements (CLAs) or licensing models such as Apache License 2.0, which include inbound-outbound patent grants. These mechanisms reduce legal ambiguity, protect downstream users, and stabilise the commons against future disputes (Riss, 2025; Weber, 2004).

Yet, licenses remain subject to power imbalances in the market. In the past, cloud vendors captured large portions of revenue by offering open-source software "'as- a- service"' while the original software vendors had to bear the burden of development costs. Redis, for example, in 2024, shifted from a permissive BSD license to a restrictive dual license, sparking controversy. Open-source companies face increasing pressure from boards to adopt closed-source or restrictive licenses to compete with cloud giants such as Amazon Web Services (AWS), creating a "crisis of sustainability" in the FOSS ecosystem. These trade-offs directly affect sustainability, power asymmetries, and long-term control of critical digital assets (Argentieri, 2004).

Licenses are insufficient when operating within a contested political economy that battles unresolved tensions between community sustainability, corporate extraction, and limitations of traditional licensing models in cloud-dominated markets. Thus, successful FOSS systems are overseen by community norms and procedural rules using governance models. It is critical to meet the main operational responsibility of FOSS licenses: compliance. Failure to comply with license terms can expose organisations to legal risk, credibility damage, and undermine the collaborative norms on which FOSS depends (O'Mahony, 2003). Governance models specify who has access and how decisions are made, and codes of conduct establish expectations for respectful and inclusive collaboration. These community protocols operationalise openness, ensuring that legal freedoms translate into actual participation rather than symbolic access.

4.2.2 FOSS GOVERNANCE MODELS

Open-source governance refers to the rules, processes, and institutional structures through which authority is exercised in a FOSS project. This involves identifying five things (Berkus, 2020):

1. **What role do contributors play in the project?**
2. **What qualifications, duties, privileges, and authority are associated with each role?**
3. **How do people get assigned to (and removed from) roles?**
4. **How can role definitions be changed?**
5. **What are the project's collected policies and procedures?**

Governance is analytically distinct from licensing. While a license defines legal permissions and obligations, governance determines how those permissions are operationalised in practice. A project may adopt an OSI-approved permissive license such as Apache 2.0. This allows broad commercial reuse while simultaneously maintaining tightly controlled governance, where only a small group of trusted maintainers can merge code or set technical direction, a pattern common in corporate-backed projects.

Governance thus mediates participation, shaping whose contributions count, how legitimacy is established, and how power accumulates or disperses within open systems. Over time, a set of recognisable governance patterns emerges, each responding to different coordination problems such as scaling participation, resolving conflict, managing technical quality, and balancing community values with commercial interests. These governance types are not rigid templates. In fact, most large and long-lived FOSS projects evolve into hybrids as they scale and diversify (O'Mahony & Ferraro, 2017). Some of these include:

- **Do-ocracy:** A do-ocracy is a governance model in which authority accrues in those who actively contribute to the code. Decision-making power is exercised implicitly by contributors who "do the work", rather than through formal roles or elections. This model is commonly observed in small or early-stage open-source projects and is closely associated with the ethos articulated by Raymond (1998), where initiative and action are valued over formal permission. The principal advantage of do-ocracy is speed, as decisions are made quickly by those closest to the technical problem. However, at scale, authority remains informal and opaque, conflicts are difficult to resolve, and contributors with more time or resources can dominate decision-making (O'Mahony & Ferraro, 2017).

- **Benevolent Dictator for Life (BDFL):** This model centralises the final decision-making authority in a single individual, typically the project founder, who is trusted to act in the project's long-term interest. This model has historically provided strong technical coherence and clear leadership, as seen in Python before 2018 (van Rossum, 2018). Its strengths lie in decisiveness, reduced coordination costs, and the ability to resolve disputes quickly. However, the model relies heavily on personal legitimacy and goodwill, creating risks around succession, burnout, and concentration of power.

- **Meritocratic:** This governance model allocates authority based on sustained contribution, often measured through technical outputs such as code commits, reviews, or long-term maintenance. In this model, contributors may progress to committer and leadership roles based on demonstrated merit and peer recognition (Apache Software Foundation, 2023). The primary advantage of meritocracy is that the decision-making authority rests with those with deep technical knowledge and a proven commitment to the project. However, critics have noted that meritocratic systems often privilege visible technical labour while undervaluing non-code contributions (O'Neil, 2016; O'Mahony & Ferraro, 2017).

- **Self-appointing council or board:** In a self-appointing council or board model, governance authority rests with a small group that selects its own successors. This structure is commonly adopted by mature projects seeking stability and continuity without the risks of frequent elections. Its advantages include institutional memory, resistance to sudden capture, and relatively efficient decision-making (Weber, 2007). However, because this authority is not directly accountable to a broader constituency, such bodies can become insular or disconnected from community priorities if transparency and consultation mechanisms are weak.

- **Electoral:** Electoral governance assigns authority through voting by a defined electorate, such as contributors or project members, and is typically codified in formal constitutions or bylaws. The key strength of this model lies in democratic legitimacy and explicit accountability, as leaders derive authority from a collective mandate. However, electoral systems are slow, vulnerable to low participation, and susceptible to factionalism or popularity dynamics, particularly in technically complex projects (O'Mahony & Ferraro, 2017).

- **Corporate or Foundation-led:** This model arises when a single entity retains decisive control over a project's roadmap, maintainership, and strategic direction, even though the software is released under an open-source licence. This model is common in firm-originated or "open-core" projects (Weber, 2007). Its advantages include predictable funding, professional maintenance, and clear lines of responsibility. However, community contributions may be marginalised, and decisions may prioritise commercial or bureaucratic interests over public or community value (Engwall, 2020; Eghbal, 2020).

As FOSS projects scale, governance structures tend to formalise in response to coordination and sustainability challenges. A widely cited inflexion point occurred in July 2018, when Python's creator Guido van Rossum stepped down as BDFL (van Rossum, 2018). Python adopted the PEP 8016 model, replacing the singular BDFL model with a five-member steering council and delegated release authority, redistributing decision-making across core maintainers (Smith & Stufft, 2018).

In parallel, Open Source Program Offices (OSPOs) became ubiquitous in the FOSS ecosystem, present in over 70% of surveyed organisations in 2022. OSPOs were generally tasked with aligning internal development practices with external project governance, license compliance, and strategic contribution (Ruff, 2022). Boehm (2019) suggests that such formalised governance arrangements correlate with higher contributor retention, increased commit volumes, and longer project lifespans, as clear norms and roles reduce conflict in large, heterogeneous communities.

4.2.3 PROMINENT FOSS CASES IN THE INDIAN AND GLOBAL LANDSCAPE

Apache Software Foundation

Apache Software Foundation represents institutionalised meritocratic governance. Apache projects are governed by Project Management Committees (PMCs) whose members are selected based on demonstrated merit. Decision-making within PMCs follows a "lazy consensus" model, where proposals move forward unless substantial objections are raised. This approach balances efficiency with inclusiveness. Beyond the project, Apache has a Board of Directors for legal, financial, and infrastructural governance, but avoids technical direction. This separation between technical governance (PMCs) and institutional governance (the Board)

allows project autonomy while ensuring shared legal protection, brand management, community norms, sustainability, and neutrality (Apache Software Foundation, 2023).

The Document Foundation

The Document Foundation (TDF), which stewards LibreOffice, exemplifies foundation-backed community governance. TDF was created explicitly to ensure vendor neutrality and community control. The governance is structured around a Board of Trustees (membership oversight) and a Board of Directors (executive and strategic responsibility), with clear bylaws governing elections, terms, and responsibilities described in TDF statutes (Gamalielsson & Lundell, 2014).

The LibreOffice development remains meritocratic while the foundation provides legal and institutional continuity. Separating community-led technical work from formal organisational governance allows TDF to institutionalise independence without centralising technical authority. As a case study, it highlights how foundations can function as protective governance mechanisms rather than command-and-control bodies (Gamalielsson & Lundell, 2014; Engwall, 2020).

Mozilla

With the Mozilla Project being governed by the nonprofit Mozilla Foundation, separately from the commercial Mozilla Corporation, its governance model seeks to separate mission stewardship from revenue generation and shareholder pressure. Unlike Apache-style neutrality or Debian-style constitutionalism, Mozilla's governance is normative and value-driven. Decisions are evaluated against a public interest mission. Legitimacy, thus, flows from alignment with mission principles. As ethical commitments are formal governance constraints, Mozilla offers a case study in values-first FOSS governance (Benkler, 2006; O'Mahony & Ferraro, 2017).

DHIS2/HISP

DHIS2, developed and maintained in collaboration with the global HISP network, represents a networked governance model. Core technical decisions are made by a central team of maintainers, while requirements, feedback, and extensions emerge from national and regional HISP groups embedded in public health systems. Governance is therefore not purely volunteer-driven, nor purely centralised, but distributed across a global implementation network. Thus, the lived experience takes centre stage, demonstrating how useContext governance can coexist with centralised technical stewardship (Braa & Sahay, 2017).

4.2.4 CASES THAT HAVE DONE THINGS DIFFERENTLY

Beckn Protocol

The Beckn Protocol is an open protocol specification, making its governance model closer to Internet standard bodies, rather than traditional software projects. The governance is organised by a Core Working Group, area leads for API, Taxonomy, Certification, Architecture, Network Security, Policy and Missions, and open working groups that deliberate on protocol evolution, review proposals, and maintain compatibility (Beckn Protocol, 2025; Dittrich et al., 2026). Participation is open with transparent and documented processes. The authority lies in specification stewardship rather than code ownership, as decisions are made off-chain, through discussion and consensus. This model is particularly valuable for digital systems such as open commerce, where openness, interoperability, and trust need balancing without becoming a platform monopolist (the Aapti Institute, 2024).

Mastodon and the Fediverse

Mastodon and the broader "Fediverse" represent a covenant federation network governance emerging from protocol design. The governance is distributed across independently operated servers ("instances"), each with its own rules, moderation policies and community norms. Instances can choose whom to federate. This creates a form of governance-through-exit rather than governance-through-vote. It affords community contributions in development, implementation, users, and governance of the federation — allowing users to run, manage, and moderate their own instance (Gehl & Zulli, 2022).

4.2.5 LIMITATIONS OF THE FOSS APPROACH

While FOSS has been highly effective for collaborative software development, its governance models are not enough to achieve power-sharing across the data lifecycle. This limitation reflects deeper tensions between technical openness and meaningful democratic control. Early work on knowledge commons emphasised institutional arrangements, community-defined boundaries, and material embeddedness (Hess & Ostrom, 2005; Frischmann et al., 2014). However, contemporary "open" paradigms have increasingly privileged licensing and legal openness, sidelining broader questions of collective governance (Keller & Tarkowsky, 2021). Some of these concerns are as followed:

- **Conflation of access with governance:** As Schneider (2022) argues, FOSS prioritises technical openness over participatory decision-making, producing what Keller and Tarkowsky (2021) describe as the "paradox of open", where openness concentrates rather than disperses power. This shift eclipsed concerns around equity, inclusion, and value-sharing. FOSS-style licensing encourages widespread reuse but offers no mechanisms to collectively deliberation on how data is produced, governed, or used (Dulong de Rosnay &

Stalder, 2020). This gap is increasingly visible as corporations extract value from open data for AI development while contributing little to commons stewardship, reinforcing extractive political economies of openness. Kleiner (2010) calls for an alternative "copyfarleft" license that does not restrict commercial use but encourages use that is not based in the commons.

- **Reproduces exclusion:** Despite claims of horizontality, the lack of democracy and emphasis on meritocracy act as gatekeeping mechanisms favouring those with existing power, time, and technical capital (Schneider, 2022). In data commons, these barriers are amplified. Digital divides create "situated" inequalities in participation (Bezuidenhout et al., 2017), while Global South communities, often primary data subjects, remain marginal to data governance (Joshi & Singh, 2021). Feminist and decolonial scholarship demonstrate how such commons replicate systemic biases, masking epistemic and material asymmetries behind claims of universality (D'Ignazio & Klein, 2020; Dunbar-Hester, 2020).

- **Poorly equipped to address data justice:** Moving from openness to justice requires grappling with power, benefit-sharing, and structural inequality — issues that code-centric governance cannot resolve (Johnson, 2014). This has prompted calls for new licensing and governance models grounded in reciprocity and community benefit, particularly for data commons vulnerable to commercial capture (Benhamou & Dulong de Rosnay, 2025).

- **Sustainability crises undermine long-term stewardship:** Critical infrastructure depends on underpaid or invisible volunteer labour, creating fragile systems (Pennington, 2019; Curto-Millet & Corsín Jiménez, 2022). For data commons, which require ongoing curation and care, this model is especially inadequate. The dominant "open" imaginary also obscures the material and labour conditions underpinning digital infrastructures (Ensmenger, 2018; Fia & Maanen, 2025).

Taken together, these limits do not negate FOSS's contributions, but they illustrate why data commons demand governance frameworks that prioritise participation over access, justice over openness, and sustained collective care over voluntary contribution (Golumbia, 2024).

4.2.6 HOW THE FOSS APPROACH ADDS TO THE DATA COMMONS

During the COVID-19 pandemic, FOSS became the backbone on which several mission-critical digital tools were developed. It validated the numerous benefits of employing FOSS to generate inclusive, equitable, and sovereign digital designs that tackle societal challenges at scale (Wang et al., 2020; Dong et al., 2022). Adopting FOSS:

- **Encourages collaborative innovation, preventing vendor lock-in:** FOSS supports a multi-vendor ecosystem. It reduces dependence on single suppliers and allows systems to

evolve modularly over time, while lowering costs and encouraging innovation, even for newer players (Weber, 2004; OSI, 2007).

- **Drives inclusivity and equity:** By removing prohibitive licensing costs and disclosing the source code, FOSS adds to the public good mandate — increasing access, allowing deep localisation, and enabling language interoperability and context-specific workflows (Weber, 2004).

- **Builds trust through radical transparency:** The "many eyes" principle lets independent experts verify claims about privacy, security, fairness, and integrity. This is especially true for sensitive use cases such as welfare targeting, resource allocation, and service delivery. The openness of FOSS invites continuous peer review that quickly identifies and patches vulnerabilities, increasing accountability (Raymond, 1999).

- **Fosters a native innovation economy:** As it promotes a commons-based peer production of information (Benkler, 2006), the FOSS-based ecosystem becomes a public innovation platform that encourages local talent. It moves up the value chain from outsourced labour to experts with network outreach. Vendors can also develop extra proprietary value-added services around the open core.

- **Accelerates implementation and interoperability:** The FOSS architecture enables rapid forking and adaptation of existing digital resources. This composable nature ensures native interoperability. Ecosystems built on FOSS are designed to be open and interconnected from the ground up. Data portability and system-to-system communication become features, not expensive afterthoughts (Weber, 2004; Eghbal, 2020).

- **Builds institutional memory and capacity:** Undisclosed source codes obscure institutional knowledge, crippling negotiating power for many actors. FOSS reverses this. It cultivates long-term capacity and in-house talent, reducing over-reliance on external consultants (Eghbal, 2020).

- **Creates a global commons and soft power:** FOSS-based tools and ecosystems add to the global commons of technological solutions. This is strategic soft power that establishes a scalable digital architecture. It fosters international collaboration, which feeds back into the domestic ecosystem with new ideas, partnerships, and reinforced expertise (Weber, 2004).

- **Creates technical resilience:** FOSS creates antifragile systems where components can be swapped without dismantling the entire enterprise. As ownership and management are flexible, FOSS allows any enterprise to weather shocks. The community ensures its evolution, preventing technological dead-ends (Curto-Millet & Corsín Jiménez, 2022). This adds a critical aspect to digital sovereignty, ensuring that essential services are defined by the community. Thus, FOSS becomes a resilient ecosystem of collaborative data governance.

4.3 Data Cooperatives and Data Collectives

Girish & Avery (2023) define a data cooperative as:

> **A data cooperative is a voluntary member owned organisation with a common goal of pooling access to the data of its members and conferring them with other rights in relation to their data. The cooperative can also provide digital identity management to its membership. Members of the cooperative will have control of data access, data use, and the governance mechanisms will be transparent, uphold accountability, and trust.**

Data cooperatives represent a fundamental departure from the scale-obsessed logic of platform capitalism. They embrace federated, community-centric governance structures that prioritise collective agency over data. Unlike conventional data intermediaries that aggregate user data for corporate profit maximisation, data cooperatives function as member-owned organisations. Here, individuals voluntarily pool their data, control its usage collectively, and share resulting benefits equitably (the Aapti Institute, 2024). This model leverages the century-old tradition of cooperative enterprises, while adapting governance principles to address contemporary challenges of digital capitalism.

The defining characteristic of data cooperatives lies in their adherence to the seven core cooperative principles established by the International Cooperative Alliance (2020):

1. **Voluntary and open membership**
2. **Democratic member control**
3. **Economic participation by members**
4. **Autonomy and independence**
5. **Education and training**
6. **Cooperation among cooperatives**
7. **Concern for the community**

These principles distinguish data cooperatives from related models such as data trusts (where trustees make top-down decisions on behalf of contributors), data commons (that emphasise collective access but often lack structured individual rights), and data unions (that focus primarily on collective bargaining rather than ownership) (Mendonca et al., 2025).
Data cooperatives embody what might be termed "scaling out" rather than "scaling up". They grow through federated networks of autonomous nodes rather than centralised monopolies

(Girish & Avery, 2023). This architectural choice reflects the data's collective nature. This means that the most valuable data emerges from social interactions involving multiple parties, making individual property claims conceptually incoherent (Coyle & Manley, 2023). As Divya Siddarth argues in the Aspen Digital report (2023), "because the data we're creating is fundamentally shared, collective structures like data cooperatives are the appropriate vehicle to negotiate on behalf of data holders."

Data collectives encompass a broader category of community-led data governance initiatives (including but not limited to data cooperatives). These initiatives, which may not adopt formal cooperative legal structures, embody principles of collective stewardship and shared decision-making. Data collectives include indigenous data sovereignty networks, grassroots worker organisations, civil society-led data initiatives, and community mapping projects that collectively govern data as part of the wider social justice struggles (Kukutai & Taylor, 2016; Hsieh et al., 2024; The Royal Society, 2020; the Aapti Institute, 2023). While data cooperatives operate through formalised membership and voting mechanisms, data collectives often rely on consensus-based deliberation, emphasise relationship-building over transactional arrangements, and embed data governance within broader political economies of resistance against extraction (Joshi & Singh, 2021).

Both models respond to what scholars call the “inegalitarian harms of dataification”, i.e. the fundamental failure of individualised consent regimes to protect collective interests in circumstances, where the value of data derives from aggregation and harms manifest at group levels (Viljoen, 2020). As Viljoen (2020) argues, data is inherently relational. Its production involves multiple parties, its insights emerge through pattern recognition across populations, and its misuse impacts communities rather than isolated individuals. This relationality necessitates governance structures that transcend individual property claims and encourage collective deliberation, shared sovereignty, and communal benefit distribution (Ostrom, 2000; Benkler, 2006).

4.3.1 CASE STUDIES

Drivers Seat Cooperative

Drivers Seat Cooperative was an early and influential experiment in platform worker data governance that sought to address asymmetries in the gig economy. Founded in 2020, the cooperative enabled ride-hailing and delivery workers to pool work-related data, access analytics-based insights into earnings patterns, and collectively license aggregated datasets to researchers and public interest organisations (Labor of Change, 2019; Scholz & Schneider, 2017; Girish & Avery, 2023).

It operated on a lower commission model than major ride-hailing platforms, with the stated aim of redistributing value directly to worker-members. Data contributions were structured as

time-bound and purpose-specific arrangements rather than permanent transfers, allowing drivers to retain ongoing control over how their data could be used and limiting risks of downstream appropriation or enclosure (Delacroix & Lawrence, 2019). Due to revenue issues, the cooperative closed in 2023, and its technical infrastructure was transferred to the Princeton University's Workers' Algorithm Observatory, enabling continued worker access to tools for research and advocacy (Modhvadia & Reid, 2024).

Drivers Seat Cooperative combined formal democratic control with an elected drivers board. Governance authority rested formally with members through a "one-member–one-vote" mechanism (Labour of Change, 2019). However, participatory decision-making is time-intensive and dependent on volunteer labour, imposing disproportionate burdens on gig workers who are already time-poor and economically precarious. Limited organisational capacity can further restrict sustained and informed participation in complex data governance issues (Bunders, 2024; Mendonca et al., 2025).

Abalobi

Abalobi is a well-documented example of a digital data cooperative, supporting small-scale fishing communities in South Africa. It was established in 2014 through collaboration between fishers, researchers, and the University of Cape Town. Abalobi was developed to address the economic and informational marginalisation of small-scale fishers within seafood supply chains, particularly their dependence on intermediaries and lack of price transparency (Earthshot Prize, 2023).

Abalobi operates as an integrated digital system that enables fishers to record catches, access market information, and connect directly with buyers. Its tools support catch documentation, basic financial record-keeping, and supply-chain traceability, allowing fishers to use sustainable practices and negotiate improved market terms. These functions are explicitly designed to strengthen fishers' bargaining power and support compliance with small-scale fisheries governance frameworks (Petrik & Raemaekers, 2018).

Abalobi operates through a hybrid governance model that combines non-profit platform management with cooperative control by small-scale fishing groups. The non-profit organisation maintains the digital infrastructure and partnerships. The fishing cooperatives use it for catch documentation, collective accounting, and engagement with buyers and regulators, with data governance centred on fisher consent and collective ownership (Petrik & Raemaekers, 2018).

This model strengthens fisher agency over data and market participation and supports alignment between livelihood and sustainability objectives. However, reliance on donor funding and technical intermediaries, along with uneven digital access and literacy, poses challenges for long-term sustainability and inclusive participation (Nthane et al., 2020).

Te Mana Raraunga (Māori Indigenous Data Sovereignty)

Te Mana Raraunga, the Māori Data Sovereignty Network established in 2015, has advanced indigenous data governance through the Collective Benefit, Authority to Control, Responsibility, Ethics (CARE) principles. The CARE principles complement the Findable, Accessible, Interoperable, Reusable (FAIR) principles used in open science. The CARE principles assert that indigenous people hold inherent rights to data derived from them, their territories, and their knowledge systems, regardless of who physically holds the data (Carroll et al., 2020).

The Papa Reo, a natural language processing project, developed AI tools for Te Reo Māori (Māori language) while protecting linguistic data through indigenous data governance. It demonstrates how data collectives can advance community aspirations while preventing extractive appropriation. These indigenous data collective cases reveal governance operating through fundamentally different logic as compared to western property, where matters of obligations to land, relatives, future generations, and ancestors determine decision-making (Kukutai & Taylor, 2016).

Te Mana Raraunga operates as a network including Māori researchers, data practitioners, tribal representatives and community organisations. They employ Kaitiaki governance, wherein individuals or groups holding cultural authority exercise stewardship over their data and derived AI tools. Kaitiaki grants access permissions based on applicants' alignment with Māori values and power-sharing materialises through customary protocols. However, the Kaitiakitanga Licence, drafted by Te Hiku Media, legally enforces these cultural protocols (Taiuru, 2021).

Nevertheless, research shows that even the most prominent advocates are failing to uphold the crafted principles without strong Government and legal instruments backing them up. Emphasis on benefit sharing and Māori participation in the data economy has taken a backseat (Taiuru, 2025).

Experimenting with the Cooperative Design: Open Data Manchester

Open Data Manchester, a non-profit that uses “data for good”, worked with Carbon Co-op, a Manchester-based energy cooperative, to explore whether a data cooperative model could support ethical and trustworthy management of members’ energy data. The exploratory project was supported by the Data Infrastructure Stimulus Fund of the Open Data Institute (ODI). From 2020 to 2021, they conducted a series of co-design workshops with cooperative members and stakeholders to develop a proof-of-concept (ODI, 2021).

The workshop focused on three broad areas:

1. **Building member understanding of energy data and data sharing**
2. **Exploring consent mechanisms to collect and use member data**
3. **Considering governance approaches to manage data in alignment with cooperative values.**

The workshop findings indicated that members preferred granular, purpose-specific consent, particularly to allow participation in research while excluding commercial uses by default. Trust and transparency in technical systems and organisational processes were identified as prerequisites for participation (Open Data Manchester, 2021).

The co-design approach ensured that the voices of Open Data Manchester members shaped the model, building trust and ownership. Ethical rather than merely legal consent mechanisms enhanced member control. Identification of federated data flows controlled by a persona-based consent mechanism offered scaling possibilities without burdening each member, while respecting cooperative autonomy. However, concerns around sustainability, operationality, infrastructural costs, and scalability remain. The proof-of-concept remains unimplemented, highlighting challenges of translating cooperative principles into functioning data infrastructure without significant ongoing resources (Open Data Manchester, 2021).

4.3.2 LIMITATIONS OF DATA COOPERATIVES AND COLLECTIVES

Despite their transformative potential, data cooperatives and collectives face substantial structural limitations and documented operational challenges.

- **Scale:** Cooperatives struggle to achieve the scale required for viability when competing against platform monopolies. The 2023 closure of Drivers Seat Cooperative illustrates this difficulty. Despite achieving programmatic success, it failed to sustain operations against the entrenched market power (Modhvadia & Reid, 2024).

- Cooperatives and collectives often form with the support of public institutions, such as the Maori Data Sovereignty Collective. However, this engagement is fragile due to power imbalances (Taiuru, 2025). Similarly, Open Data Manchester revealed significant sustainability barriers, indicating that translating cooperative principles into functional infrastructure requires ongoing, substantial resources (Open Data Manchester, 2021).

- **Capital:** Grassroots initiatives particularly face the crunch in developing and sustaining a secure data infrastructure without significant investment. Many cooperatives rely on

donations and philanthropic/subsidiary support, especially in the beginning. Filling important positions without significant financial reimbursement is a challenge and relies on individual idealism (Lauer et al., 2024).

- **Participation costs:** Meaningful engagement in data governance requires time, digital literacy, and decision-making capacity. These resources are often scarce to those facing economic precarity (Milan & van der Velden, 2016). As observed in the Open Data Manchester's workshops, even motivated members found data governance technically complex and time-intensive, leading to governance fatigue despite capacity-building efforts. These dynamic risks replicate existing inequalities, while those with more time and education dominate proceedings (Open Data Manchester, 2021).

- **Technical complexity:** Developing algorithms, privacy-preserving infrastructure, or granular consent systems requires specialised skills, forcing cooperatives to either cultivate internal expertise or hire externally (Pasquale, 2015). This asymmetry leads to de facto technical hierarchies, where developers hold disproportionate influence over ostensibly democratic decisions. This tension is observed in projects like Abalobi, where disparities in digital literacy existed between NPO staff and fisher cooperative members. It can also lead to internal conflict and the failure to develop a defined identity (Lauer et al., 2024).

- **Regulatory uncertainty:** Most jurisdictions lack clear legal frameworks to support data cooperatives. Traditional cooperative law is ill-suited to data contexts and data protection regulations, like the GDPR, which is designed around individual, not collective rights-holders (Duncan, 2023). This ambiguity creates vulnerabilities around liability, compliance, and contract enforcement that well-resourced corporations navigate easily.

- **Other power dynamics:** Even well-intentioned participatory design allows dominant subgroups to define "collective benefit" in ways that marginalise others. Third parties such as researchers, policymakers, and corporations, despite barriers, still use the cooperative's aggregated data to stigmatise communities or extract value (Thatcher et al., 2016). Western frameworks and scientific/technological paradigms can conflict with indigenous knowledge systems and governance protocols (Rainie et al., 2019).

4.3.3 HOW THE DATA COOPERATIVES AND COLLECTIVES APPROACH ADDS TO THE COMMONS

Data cooperatives and collectives present distinct advantages over models based on individual consent, corporate intermediaries, or state control. This allows an alternative vision. By centering authority in data subjecthood, this model institutes consensus-based governance and creates explicit benefit-sharing mechanisms. Frameworks like the CARE principles formally articulate these commitments (Carroll et al., 2020).

DPIs often limit participation to service consumption and champion benevolent state stewardship and FOSS relies on concentrating power in skilled contributors. However, data cooperatives and collectives definitely assert deliberate redistribution of power and economic value (Mendonca et al., 2025). Data cooperatives and collectives also:

- **Establish democratic control:** This constitutes their foundational principle. Members exercise collective authority over data collection parameters, storage infrastructure, access permissions, and monetisation strategies (Hardjono & Pentland, 2019). This democratic ethos manifests through diverse mechanisms — from "one-member-one-vote" structures in formal cooperatives to consensus-based deliberation in indigenous data collectives. They consistently centre the principle that those who generate or are represented in data hold primary governance authority.

- **Impose fiduciary responsibility:** Cooperatives impose legal and ethical obligations to act in members' collective interests rather than maximising profit for external shareholders (Fink, 2024). This contrasts sharply with conventional data brokers whose fiduciary duties prioritise investors rather than data subjects.

  MiData, for example, operates under the Swiss cooperative law. It requires that all decisions prioritise member welfare, preventing scenarios where user data might be sold to pharmaceutical companies against members' wishes, even if it is financially lucrative (Hafen, 2018).

- **Enable contextual consent architectures:** Data cooperatives replace binary opt-in/opt-out mechanisms with granular, ongoing, and purpose-specific permissions (the Aapti Institute, 2024). Data cooperatives recognise that meaningful consent requires understanding context — who seeks access, for what purpose, under what safeguards — and that individuals' comfort with data sharing shifts over time.

  Open Data Manchester's Energy Data Cooperative workshops revealed that members wanted layered consent, enabling them to approve specific research partnerships while declining commercial uses, with default settings aligned to cooperative values rather than corporate preferences (Open Data Manchester, 2021).

- **Strengthen collective bargaining power:** Members gain a collective voice from data aggregation at scale. They can, for instance, command higher prices for data access than individuals could negotiate separately.

  Drivers Seat Cooperative leveraged aggregated ride-hail data to partner with transportation researchers and urban planners to demand that research outputs benefit workers through policy advocacy rather than solely advancing academic careers (Labour of Change, 2019). This collective leverage also enabled members to refuse exploitative partnerships, contrasting with individuals' weak negotiating positions vis-à-vis platform monopolies.

- **Embed solidarity economics:** Data cooperatives and collectives are framed within broader movements for economic democracy rather than merely technical innovation (International Cooperative Alliance, 2020). Cooperatives explicitly reject extractive capitalism, which is imperative to endless growth. Instead, they prioritise sustainable operations, fair labour practices, and concern for community welfare.

  The SEWA Federation's exploration of data cooperatives for women agricultural workers exemplifies this solidarity orientation. Rather than maximising data revenues, SEWA centres workers' dignity and protection from predatory lenders and strengthens collective bargaining with agricultural supply chains (Kumar & Hiriyur, 2023).

- **Safeguard cultural sovereignty:** This proves especially salient for indigenous data collectives. The Cherokee Nation's 2024 AI Task Force grounded data governance in the Cherokee value "ᏕᏣᏓᎨᏳᏎᏍᏗ detsadageyusesdi", which translates to "be stingy with one another's existence, like a mother with a child." This association transformed data protection into a sacred obligation rather than property management (Bridge & Block, 2025). This cultural grounding means data governance cannot be reduced to privacy, but must honour relationships, reciprocity, and future generations' interests, i.e. principles fundamentally incompatible with commodification (Rainie et al., 2019).

- **Develop federated architectures:** Data cooperatives and collectives are enabled to scale through networks of autonomous nodes rather than centralised monopolies. Multiple cooperatives can coexist, each tailored to specific communities and contexts, while coordinating through shared protocols and interoperability standards. This "scaling out" rather than "scaling up" respects local self-determination while generating network effects necessary for collective power (Girish & Avery, 2023).

4.4 Learnings from the Approaches and Cases

The three approaches - DPI, FOSS, and data cooperatives and data collectives - represent distinct paradigms of organising digital systems, each embodying different relationships with scale, control, and value distribution. Understanding their compatibilities and contradictions is essential for design choices. *[Check Annex 3 for a detailed comparative look at the three approaches.]*

The DPI's centralised architecture is designed for scale and interoperability, prioritising system-level efficiency and rapid deployment. It treats citizens as end-users rather than co-creators. The "scale-at-all-costs" orientation deprioritises responsiveness, and its top-down infrastructure creates accountability deficits. By contrast, FOSS is based on technical meritocracy and collaborative development, enabling adaptive replication and forking. Governance is often an earned authority — dependent on contributions and commitment. While this creates robust software quality, it conflates code access with meaningful governance,

thereby marginalising non-code contributions. It also struggles to create sufficient community-centric guardrails around how data is produced, governed and used.

Data cooperatives and collectives fundamentally invert these power relations by centring democratic control. Governance derives from data subjecthood. This means that those who generate or are represented in data hold primary decision-making power. The model incorporates collective bargaining power to address power asymmetries. However, it reveals significant challenges in achieving replicability, as the model requires exceptional coordination and technical capacity, sustained donor funding, and decades-long commitment.

Each model addresses the weakness in the others. The DPI approach provides the interoperability standards and institutional legitimacy that fragmented, community-led initiatives struggle to achieve. The FOSS approach contributes technical transparency that the other two models require. Data cooperatives and collectives centre agency and benefit-sharing that DPIs and FOSS neglect.

Yet, none adequately address the infrastructural realities documented by CSOs within the Common Ground [*refer to Annex 1*]. Unreliable connectivity, limited hardware, uneven digital literacy, and resource constraints fundamentally shape what technologies are viable in rural contexts. DPIs assume infrastructure that doesn't exist, FOSS demands technical capacity beyond most communities, and cooperatives require time and resources that economically precarious populations cannot afford.

The challenge lies not in selecting one model but in synthesising insights across all three. From DPIs, the initiative can adopt institutional integration strategies while rejecting centralised control and scale-first logic. From FOSS, it can adopt open licensing, collaborative development, and technical modularity while deliberately designing governance mechanisms that transcend meritocracy. From data cooperatives and collectives, it can centre democratic control, benefit-sharing, and cultural sovereignty, while developing sustainability models that do not depend solely on member contributions.

There is a need, thus, for a hybrid architecture — standardised core protocols (the DPI logic), open collaborative development (FOSS logic), and federated community governance (cooperative logic).

Each case study's real-world strengths and weaknesses should be studied to create a technical governance framework that best fits considerations of scale, control, and value distribution. Moreover, this synthesis must be animated by an explicit commitment to infrastructural sovereignty — recognising that a true public interest digital system emerges not from any single governance model, but from sustained negotiation among communities, institutions, and technology builders. We look into infrastructural sovereignty more closely in the next section.

SECTION 5

Infrastructural Sovereignty

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SECTION 5

Infrastructural Sovereignty

5.1 How Public Interest Digital Systems Can Uphold Principles of Infrastructural Sovereignty

The report positions itself within an emerging understanding of infrastructural sovereignty, where control over digital infrastructures is treated as a collective self-determination rather than technical optimisation. Infrastructural sovereignty extends debates on data sovereignty by prioritising the ownership of data and authority over the systems, standards, protocols, and institutional arrangements through which data is produced, circulated, and acted upon (Plantin et al., 2018). In the context of uneven state capacity, market dominance by private technology vendors, and long-standing community governance of land and resources, infrastructural sovereignty provides a lens for rethinking how public interest digital systems are designed and governed.

This approach departs from dominant top-down models of DPIs. It treats communities not as passive data providers or end-users, but as co-governors of the digital systems that mediate their relationship to land, livelihoods, and welfare. This aligns with scholarship on commons governance – demonstrating that durable collective institutions emerge when rules, monitoring mechanisms, and benefit-sharing arrangements are locally negotiated rather than externally imposed (Ostrom, 2010). Infrastructural sovereignty extends this insight into the digital domain by emphasising decentralised data governance and negotiated interfaces between communities and technology vendors.

Rather than proposing a single technology architecture, infrastructural sovereignty proposes principles that are expressed differently across landscapes. These include community control over data flows, the ability to refuse or condition data sharing, and mechanisms for collective decision-making around how digital tools evolve over time. This approach resonates with work on participatory infrastructure, which argues that infrastructures are never neutral. They are embedded political choices about whose knowledge counts and whose interests are prioritised (Björgvinsson et al., 2012; Gurstein, 2011).

Importantly, infrastructural sovereignty is a practical design challenge rather than an abstract normative claim. Questions of interoperability, scalability, and vendor participation are addressed not by defaulting to openness as an unquestioned good, but by asking how technical modularity can coexist with local rule-making. This reflects concerns raised in critical

infrastructure studies that excessive emphasis on standardisation and scale erodes local autonomy and accountability (Plantin & Punathambekar, 2018).

This theoretical intervention contributes to a growing body of work that seeks to reclaim digital infrastructures as sites of democratic governance. By foregrounding collective agency, negotiated control, and contextual adaptability, the initiative situates itself within broader efforts to envision public interest digital systems that do not merely extend state or market power, but strengthen community capacities to govern shared resources in digitally mediated environments (Bria, 2019).

5.1.1 A COLLABORATIVE APPROACH TO INFRASTRUCTURAL SOVEREIGNTY IN RURAL INDIA

The vision of infrastructural sovereignty is relational. It rests on collaboration among multiple stakeholder groups rather than the assertion of unilateral control by any single actor. These stakeholders include community members and local institutions, CSOs working on livelihoods and commons, technology vendors and developers, and intermediaries engaged in capacity building. Each stakeholder shapes how digital systems are designed, governed, and sustained over time.

As the originators of data concerning land, livelihoods, and welfare – data that reflects their lived realities – communities are positioned as the primary stakeholders. Crucially, they are also the ones who must contend with the consequences stemming from the use of this data. Critiques of individualistic data governance models capture the collective harms and benefits arising from datafication (Taylor et al., 2017). By treating data as relational and embedded in social and ecological systems, infrastructural sovereignty recognises the legitimacy of collective decision-making over data access, reuse, and value generation.

CSOs act as crucial intermediaries, translating between community priorities and technical or policy domains. Their long-standing engagement with commons governance, welfare delivery, and local institutions enables them to articulate demands that are often invisible in centralised digital systems. At the same time, these organisations face capacity constraints and fragmented digital ecosystems, requiring infrastructural arrangements that reduce administrative burdens. Such organisations remain one step removed from the communities themselves; they often serve as proxies or interlocutors, even as the ultimate aim is to reach individuals directly without intermediaries.

Technology vendors and developers are framed here not merely as service providers but as co-participants in governance arrangements. This reflects a shift away from procurement-driven models to negotiated relationships, where vendors are accountable to community-defined rules around data use, privacy, and interoperability. Scholarship on governance-by-

design highlights the importance of embedding such constraints within technical systems, rather than relying solely on downstream regulation (De Filippi & Wright, 2018).

Public institutions, including local government bodies, remain important stakeholders, particularly where welfare schemes and regulatory mandates intersect with digital systems. This approach does not seek to bypass the state. It utilises the position of the Panchayati Raj Institutions and their members, to make the digital infrastructure engagement community-centric and enduring. This layered stakeholder arrangement demonstrates a shared and negotiated understanding.

This stakeholder model illustrates a collaborative pathway to infrastructural sovereignty, one that acknowledges asymmetries of power and capacity while seeking to redistribute decision-making authority. This aligns with participatory technology research that emphasises long-term engagement and mutual learning over one-off consultation (Björgvinsson et al., 2012).

5.1.2 CHALLENGES IN THE CURRENT LANDSCAPE

Operationalising infrastructural sovereignty in the context of public interest digital systems like Common Ground presents significant challenges. This is particularly because such approaches have limited precedent in India's digital governance ecosystem. One major constraint is the material conditions of digital infrastructure. Unreliable connectivity, limited access to hardware, and inconsistent power supply fundamentally shape the kinds of systems that are viable. These conditions necessitate offline-first, low-bandwidth designs, complicating assumptions about real-time data exchange and continuous platform connectivity that underpin many contemporary digital infrastructures (Kitchin, 2014).

A second challenge concerns data fragmentation and institutional overload. CSOs and community institutions often operate hybrid systems that combine manual records with multiple digital tools. This results in parallel data streams that are difficult to reconcile. While one seeks to enable data sharing and interoperability, doing so without increasing administrative burdens requires careful attention to workflow integration and maintenance responsibilities. This reflects broader critiques of DPIs that prioritise integration without adequately addressing institutional capacity (Plantin et al., 2018).

Governance capacity poses another challenge. Collective data governance assumes the existence of processes through which communities independently deliberate and make decisions. However, such capacities are unevenly distributed and require sustained external facilitation and capacity building. Capacity here includes shared digital literacy and effective community engagement. The risk is that governance responsibilities transferred to the local level without adequate support may reproduce existing exclusions. Research on participatory systems cautions against romanticising local governance without attending to internal power dynamics and resource constraints (Ostrom, 2010).

The relationship with technology vendors introduces additional tensions. While collaborative governance models promise greater accountability, they must contend with commercial incentives that favour scale, standardisation, and data extraction. Aligning vendor participation with community-defined rules on data use and benefit-sharing requires enforceable agreements and technical architectures that limit unilateral appropriation. Without these safeguards, openness and interoperability risk becoming counter-productive (De Filippi & Wright, 2018).

**[Check Annex 1 for a detailed look at challenges faced by on-ground CSOs, and Annex 2 for challenges identified by sector experts.]*

5.1.3 CONSIDERATIONS FOR INFRASTRUCTURAL SOVEREIGNTY

Drawing insights from commons governance, participatory technology design, and emerging debates on data sovereignty, a set of synthesised considerations for infrastructural sovereignty can be derived.

First, **control over data must be collective as well as individual,** recognising that data about shared resources produces shared risks and benefits. This challenges privacy regimes that focus narrowly on individual consent while neglecting group-level impacts (Taylor et al., 2017).

Second, **governance must be embedded within the infrastructure itself.** Rather than treating governance as an external layer, infrastructural sovereignty emphasises technical modularity, access controls, and licensing arrangements that operationalise local rules. This reflects a governance-by-design approach, where choices are materialised within systems and protocols (De Filippi & Wright, 2018).

Third, **scalability should be approached through federation rather than uniformity.** This approach emphasises adaptable, modular systems aligned with critiques of one-size-fits-all infrastructures that prioritise reach over responsiveness. Federations allow shared standards to coexist with local variations, preserving autonomy while enabling coordination across contexts (Plantin & Punathambekar, 2018).

Fourth, **infrastructural sovereignty requires sustained intermediary work.** CSOs and local institutions play a critical role in translating between community priorities, technical design, and policy constraints. Supporting these intermediaries prevents governance responsibilities from becoming symbolic or extractive (Gurstein, 2011), while also balancing sustained intermediation with direct engagement of the individuals who use the digital artefact.

Finally, **value generation from data must benefit the community.** This includes feedback loops that return analysed data to communities, mechanisms for collective bargaining with vendors, and safeguards against data-driven exclusion. By prioritising “use value” over

"extractive value", infrastructural sovereignty aligns with broader commitments to equity and justice in digital transformation (Bria, 2019).

Together, these considerations articulate a coherent framework to understand infrastructural sovereignty as an effort to reclaim digital infrastructures as shared, governable commons. They do not resolve the tensions inherent in building community-oriented systems at scale, but they provide a grounded basis for navigating them in practice.

5.2 Recommendations by Experts

Throughout the study, domain and research experts were consulted to help highlight priority areas that can help public interest digital systems like Common Ground achieve infrastructural sovereignty. This largely aligned with the findings derived from secondary literature and case studies that were also explored concurrently. The following recommendations were aggregated from such expert interactions and literature, creating a baseline roadmap that can allow for a more community-first approach in the digital domain.

5.2.1 PRIORITISE TRUST-BUILDING OVER TECHNICAL DEVELOPMENT

The evidence across all research strands converges on a fundamental insight – trust precedes technology. Before investing heavily in technical architecture, there must be an investment in relational infrastructure. This means spending adequate time in communities to understand existing governance practices, identifying and nurturing local champions to serve as intermediaries, and demonstrating tangible value through small, immediate interventions before scaling up ambitions. The success of initiatives like Abalobi demonstrates how long-term relationships build trust that enables fishing communities to perceive material benefits, transforming them from data subjects to active participants.

Operationally, this requires resisting funder-driven timelines that compress relationship-building into tokenistic consultations. Allocating at least six months for ethnographic engagement in pilot sites was recommended by an expert, during which technical teams can work alongside community institutions to understand workflows, anxieties, and power dynamics. This period should yield not only technical specifications but trust capital as well.

Trust-building must extend beyond communities to encompass the full stakeholder ecosystem. This includes cultivating bilateral trust between government functionaries and community members through transparent data validation processes. It also includes establishing credibility with technology vendors through clear protocols and fair terms, and building confidence in CSOs that participation reduces their administrative burdens. The DHIS2/HISP network exemplifies how trusted intermediaries bridge government and community, which mediates conflicts and fosters dialogue across institutional divides.

5.2.2 DESIGN FOR THE LOWEST COMMON DENOMINATOR, THEN LAYER COMPLEXITY

Technical architecture must begin with the constraints that define rural digital realities, such as unreliable connectivity, limited hardware, inconsistent power supply, and varied digital literacy. This demands an offline-first, sync-later approach, where core functionality operates entirely without internet access, with synchronisation occurring when connectivity permits.

The principle of data minimisation should guide initial implementations. Rather than collecting comprehensive datasets for hypothetical future uses, there is a need to identify three to five essential data points that enable immediate, tangible community benefits. This approach counters what an expert identified as the "Product Manager Temptation Trap", which involves collecting all conceivable data for future use, creating an unsustainable operational pressure. Additional data fields can be added incrementally as trust grows and value is demonstrated. However, the foundational architecture must work with minimal data to reduce collection burdens and privacy risks.

Due to smartphone ubiquity in the field, a mobile-first design is non-negotiable. Interfaces must accommodate basic devices with limited storage and processing capacity. This requires ruthless simplicity, including visual interfaces with minimal text, icon-based navigation that transcends literacy barriers, and workflows designed for intermittent engagement rather than sustained sessions. The temptation to create feature-rich platforms must be resisted in favour of focused tools that solve specific, pressing problems well.

5.2.3 BALANCE CONTEXTUAL RESPONSIVENESS WITH STRATEGIC REPLICABILITY

Public interest digital systems face a fundamental tension: the need for deep contextual adaptation versus the imperative to replicate across diverse geographies. The resolution lies in architectural decisions that enable both – combining all three approaches delineated in Section 4 (Mapping Public Interest Digital Systems). The recommended approach is a three-layer design:

Layer 1: Standardised Core

> Defines minimal data schemas, interoperability protocols, and security standards. This layer draws on the DPI's strength in creating "digital building blocks" while avoiding its centralised control mechanisms. Standards should align with global frameworks such as Beckn Protocol's specification governance model. This model separates protocol stewardship from implementation control, enabling openness without centralised platform power.

Layer 2: Configurable Middle Layer

> Allows customisation of data fields, workflows, and validation rules without code changes. This incorporates FOSS principles of modularity while making customisation accessible to non-developers. As successful open-source projects demonstrate, front-end customisation models can enable 90 to 95% of use cases through configuration rather than development, dramatically lowering technical barriers for local adaptation.

Layer 3: Modular Interface Layer

> Enables vendors and local teams to build context-specific applications that connect to the common backend. The Fediverse's distributed governance model, where autonomous instances maintain independence while enabling federation, demonstrates this approach's viability. This layer embodies the cooperative principle of "scaling out" rather than "up"—growing through federated networks that accommodate local variation rather than imposing uniform solutions. These local variations need auditing and governance with community voices, after the initiative matures.

Governance of this layered architecture requires clear authority boundaries. Core schema decisions should rest with a technical steering committee modelled on the Apache Software Foundation's approach. This approach includes domain experts and technology practitioners with decision-making based on demonstrated contribution and sustained engagement. However, unlike pure FOSS meritocracy, which can reproduce exclusions, this committee must explicitly reserve seats for community representatives.

Customisation governance decisions should be delegated to contributor groups and community data collectives at the district-level or block-level, embodying the cooperative principle that "those who generate or are represented in data hold primary decision-making power" (Carroll et al., 2020). This distributes decision-making authority while maintaining system coherence.

5.2.4 EVOLVE FROM CENTRALISED COORDINATION TO FEDERATED AUTONOMY

From the three approaches and suggestions from experts, a phased governance methodology emerges.

Phase 1: Centralised Coordination with Community Voice

> During foundation-building and initial pilots, maintaining centralised decision-making within the organising entity to prevent the project from expanding into manifold dimensions while achieving little. This can be limited to:

1. **Governance Coordinator:** Leads data governance, quality, and community engagement. It establishes baseline policies for data access and consent, and represents the initiative in external partnerships. This is a rotational position.

2. **Technical Coordinator:** Manages technical infrastructure and operations, focusing on creating an inclusive technical design that works effectively. They ensure security, maintain the minimal viable system, and translate community-defined rules into technical implementation.

3. **Community Advisory:** Comprises representatives from pilot sites, CSO partners and local institutions. They provide feedback on system design, validate data collection approaches, and raise concerns. Participation should be low-burden, conducted in local languages, and at their convenience, and should focus on solving concrete and immediate issues rather than abstract governance questions.

However, centralisation must be tempered with transparent decision-making processes. This is achieved using public documentation of choice and rationale, regular meetings where priorities are discussed and feedback incorporated, and explicit sunset clauses that require governance review every 18 months.

Phase 2: Layered Authority with Maintained Coordination

As pilots validate approaches and community capacity develops, governance formalises and distributes authority across functional domains:

1. **Technical Steering Committee:** Oversees core schema, security standards, and interoperability protocols. Combines technical and infrastructure leadership with community-reserved seats. Decisions made through lazy consensus, with earned membership through sustained contribution. Manages platform architecture, data pipelines, API standards, and operational security.

2. **Community Data Collectives (CDCs):** Handles customisation decisions, local validation rules, and contextual adaptations at district/block levels. They are community-led, with technical advisory support, operating through consensus-building similar to “gram sabha” traditions. The community stewards interface between CDCs and other governance bodies.

3. **Data Governance Council:** Establishes data licensing terms, consent protocols, benefit-sharing arrangements, and dispute resolution mechanisms. Ensuring majority community representation with CSO, vendor, and domain expert participation. Led by the Chief Data Officer (replacing Interim Governance Coordinator), the Council oversees data quality, metadata standards, vendor audits, and sector-specific compliance. They are inspired by cooperative boards but adapted to digital contexts.

4. **Formal Board (established when complexity warrants):** Provides overall strategic direction, financial sustainability, and institutional partnerships, with clear bylaws and accountability mechanisms.

By phasing governance complexity, one can maintain momentum while progressively deepening participation. The governance framework centres community agency by recording and implementing grievance redressal, escalation pathways, and feedback loops. Transparency is maintained, and processes are open to scrutiny. There are multiple participation pathways, with technical contribution, community facilitation, documentation, capacity-building, and user feedback – all recognised as valuable. Moreover, to prevent elite capture, term limits, mandatory rotation, prohibition on single-organisation dominance, and processes for removing captured leaders must be maintained.

5.2.5 EMBED GOVERNANCE IN INFRASTRUCTURE FROM THE OUTSET

Rather than treating governance as an external oversight layer, it must materialise directly in technical systems. Technical implementation should include access controls that enforce community-defined data-sharing rules, consent mechanisms that allow granular, purpose-specific permissions (moving beyond binary opt-in/opt-out), and audit trails that make all data transactions transparent and traceable. The European Data Spaces model, despite its regulatory complexity, demonstrates how technical architecture can embed rights-based protections directly into data exchange mechanisms. A leaner version of the same can be employed.

Licensing arrangements represent a critical governance tool that addresses software and data dimensions.

Software Licensing Strategy: The Apache 2.0's permissive terms facilitate government adoption and multi-vendor participation (addressing DPI integration needs), while including explicit patent grants that protect downstream users and stabilise the commons. Strong copyleft licences, such as AGPL, while ensuring reciprocity, create barriers to government and commercial participation that could potentially be necessary for sustainability. However, the initiative should include clear contributor agreements to prevent extraction.

Data Licensing Innovation: For data contributions, restrictive arrangements are essential. Standard FOSS licences prove inadequate for data governance as they prioritise technical openness over participatory decision-making. Instead, public interest digital systems should develop data licensing agreements that:

- Specify permitted uses with explicit exclusions for exploitative commercial applications
- Require attribution to community sources, acknowledging data subjecthood
- Prohibit commercial exploitation without benefit-sharing arrangements
- Establish clear dispute resolution mechanisms
- Incorporate time-bound, purpose-specific permissions inspired by cooperative consent models

The Kaitiakitanga Licence, developed by the Te Hiku Media for Māori language data, provides a valuable precedent. It demonstrates how cultural protocols are legally enforced while maintaining data sovereignty. Similar context-relevant data licensing frameworks, that can embed community governance protocols directly into legal instruments, should be developed.

Contributor Agreements: Following the example of Apache 2.0's Contributor License Agreement, agreements should clarify the terms under which vendors, researchers, and external actors access and contribute to the ecosystem. These should explicitly address:

- Data ownership, which remains with communities
- Liability allocation across the multi-actor network
- Intellectual property rights for derived works
- Benefit-sharing mechanisms when commercial value is generated
- Mechanisms to revoke access if terms are violated
- Inbound-outbound patent grants to prevent future disputes

5.2.6 DESIGN INCENTIVE STRUCTURES THAT ALIGN MULTI-ACTOR INTERESTS

Sustainable participation requires that every stakeholder derive value exceeding their costs. Too many initiatives have failed because each actor's basic needs were not met.

For Communities: Immediate, tangible benefits are non-negotiable. This includes simplified access to welfare entitlements, improved documentation of land claims, better market information for NTFPs, or enhanced bargaining power with vendors. Generic promises of future empowerment do not sustain engagement. The Abalobi platform's success in increasing fisher incomes by 100-300% in a year demonstrates how material benefits drive sustained participation. Crucially, communities must benefit from data feedback loops, receiving analysed insights that support local decision-making, transforming them from data sources to data users.

For CSOs: Demonstrable reduction in administrative burden is essential. It requires careful workflow integration, where data entered once is reusable for multiple purposes. In the DHIS2 model, national HISP groups embedded in public health systems shape

requirements, while core maintainers handle technical development and demonstrate a sustainable division of labour. Organisations also benefit from network effects — access to aggregated insights, collaboration opportunities, and enhanced credibility with funders through participation in recognised digital infrastructure.

For Technology Vendors: Incentives include access to a structured market of CSO and government clients, credibility through association with public institutions, and technical support for integration. However, vendor participation must be structured to prevent the extractive dynamics that have plagued DPIs (where private dependencies undermine public cores) and FOSS projects (where cloud vendors capture revenue). This involves:

- Tiered models where vendors pay modest fees for commercial use while receiving free access for public interest applications
- Revenue-sharing arrangements where a portion of vendor income supports commons maintenance
- Open APIs and modular architecture that prevent vendor lock-in while enabling value-added services
- Clear protocols preventing "open-washing" where vendors extract value while contributing minimally

For Government Functionaries: Engagement occurs when digital systems improve decision-making or service delivery. This requires designing feedback mechanisms that produce actionable insights for administrators, integrate with existing workflows rather than creating parallel systems, and align with political incentives around visible governance improvements. However, there is a deep need to resist the tendency to prioritise administrative convenience over community needs, maintaining community control even when government priorities differ.

Sustainability Models: Eventually, initiatives must move beyond dependence on philanthropic funding without compromising public interest commitments. Options include:

- Multi-donor funding where large contributors (corporates, foundations) bear disproportionate costs, following models where single actors fund 80% of the ecosystem expenses
- Transaction fees for high-volume commercial uses, structured to avoid excluding small-ticket transactions
- Public-social partnerships where government contracts support infrastructure while communities retain governance authority
- Data stewardship training, open innovation fellowships, and community data clubs that build capacity while generating modest revenue
- Performance-linked data service agreements where value circulates within the ecosystem

Learning from cooperative failures, economic viability must be addressed from inception. As experts emphasised, organisations act primarily for revenue generation, cost savings, or regulatory compliance — "everything else becomes weekend volunteer work." Financial models, thus, must be grounded in this reality, ensuring the offerings deliver at least one of these three clear benefits to sustain participation beyond philanthropic phases.

5.2.7 PILOT STRATEGICALLY TO BUILD LEGITIMACY BEFORE SCALING

Initial implementations should prioritise best case scenarios. This includes geographies with relatively strong infrastructure, supportive local institutions, existing community mobilisation, and receptive government functionaries. The Document Foundation's deliberate creation as a vendor-neutral entity before attempting to scale LibreOffice, and DHIS2's decades-long relationship-building before expanding beyond pilot countries, demonstrate the value of establishing legitimacy before pursuing scale. This is not about avoiding problems, but establishing proof of concept under favourable conditions, before tackling challenging contexts.

Pilots should focus on a single, high-value use case that benefits at least 50 to 60% of the target population. This "killer use case", as referred to by an expert, anchors the system in immediate utility rather than abstract potential.

Multiple small pilot sites are preferable to a single large implementation, as this creates resilience when political or institutional conditions shift. Sites should be selected to represent diversity in ecological conditions, governance arrangements, and community demographics. Thus, allowing the initiative to test adaptability while maintaining a manageable scope. The FAO's Digital Village initiative offers guidance on integrating varied digital tools into existing ecosystems across contexts.

Critically, pilots must be designed for learning rather than performance. Success metrics should emphasise user adoption, data quality, and sustained engagement rather than vanity indicators such as downloads or registered users. Regular reflection cycles with all stakeholders should identify what is working, what is failing, and what unanticipated challenges have emerged — embracing what experts call "happy accidents" that reveal unique contextual value. This learning orientation aligns with the PAR methodology's iterative cycles, ensuring communities remain co-researchers rather than passive subjects.

5.3 Critical Questions for Governance Design

As public interest digital systems evolve, foundational questions must be continually revisited:

On Authority and Decision-Making:

- How will the decision-making authority be distributed between centralised technical direction and decentralised implementation? At what points in the system's maturity should authority shift?
- What mechanisms will ensure community voices carry real weight in technical decisions, beyond tokenistic consultation?
- How will conflicts between community preferences and technical constraints be resolved? Who adjudicates when communities want features that threaten security, or reject interoperability that enables wider benefits?
- How can governance structures accommodate the reality that contributors with more time often have less expertise, while those with expertise have limited time? FOSS's earned authority addresses this partly, but risks excluding those who cannot afford unpaid contributions.

On Data Sovereignty and Control:

- What does meaningful data sovereignty look like in practice, especially when data is co-produced by communities, CSOs, vendors, and government functionaries? How can collective data rights be operationalised?
- Under what conditions, if any, can community data be accessed by external actors? Who decides whether a use case is legitimate, and through what process is this decision made?
- How will the system prevent mission creep where initially consensual data collection expands into surveillance or control mechanisms? The DPIs' documented drift from welfare delivery to profiling and exclusion demonstrates this risk. What technical and governance safeguards can prevent similar trajectories?
- How can data licensing agreements be enforced when communities lack legal resources to pursue violations? Cooperative models typically assume members collectively hire legal support, but this may not be feasible in resource-constrained contexts.

On Value Creation and Distribution:

- How will economic value generated from community data be captured and redistributed? What mechanisms ensure benefits flow back to data contributors?
- Should benefit-sharing be direct (e.g., payments to data contributors) or indirect (e.g., improved services, enhanced infrastructure)?

- How can the system create meaningful value for all stakeholders without exploiting any?
- What happens when the interests of different stakeholder groups conflict? For example, if vendors want to monetise insights that communities prefer to keep restricted, or if government efficiency gains come at the cost of community privacy.
- What business models can sustain the infrastructure in long-term without compromising public interest commitments?

On Inclusion and Representation:

- How will governance structures ensure participation by marginalised groups — women, lower castes, linguistic minorities, and non-literate populations — who are often excluded from technical spaces?
- How can decision-making processes accommodate different forms of knowledge, including traditional ecological knowledge that may not conform to scientific data formats?
- What mechanisms prevent elite capture, where educated, digitally-literate community members dominate governance to the exclusion of others?
- Should representation be individual (one-person-one-vote cooperative model), institutional (representatives of community organisations), or hybrid? How do caste, gender, and economic hierarchies within communities shape who can meaningfully participate?
- How can governance be accessible to those with limited time, intermittent connectivity, and competing livelihood pressures? Cooperative models often assume members can attend meetings and deliberate extensively, which may not be realistic.

On Accountability and Redress:

- What accountability mechanisms ensure the initiative remains responsive to the community needs rather than the funder or institutional priorities?
- How will harms be addressed when they occur — data breaches, exclusion from benefits, and misuse by vendors or government functionaries? What recourse do communities have?
- Who bears liability when shared data systems cause harm? If aggregated community data enables discriminatory credit scoring, for example, how is responsibility allocated across technology providers, data contributors, and system operators?
- How can governance arrangements be changed when they prove inadequate? Who has the authority to initiate such a change?

On Sustainability and Evolution:

- At what point should the initiative transition from donor-funded experimentation to self-sustaining operations? What financial models make this viable without creating dependence on actors whose interests may diverge from the public good?
- How will the system evolve, as technologies, community needs, and political contexts change? What governance flexibility is required?
- When should the initiative declare success and step back, versus when should it continue active involvement? The Mozilla Corporation's permanent operation contrasts with the Apache project's graduation model — which approach fits?
- What happens if the government mandates conflict with infrastructural sovereignty goals? If state authorities demand data access or system modifications that communities oppose, whose authority prevails?

On Technology and Power:

- How can technical architecture prevent the accumulation of infrastructural power — situations where control over core systems grants disproportionate influence? DPIs demonstrate how infrastructure control becomes political power; FOSS maintainer authority illustrates technical power; cooperative member voting is dominated by organised factions.
- What prevents the emergence of "benevolent dictators" who, despite good intentions, concentrate decision-making authority?
- What responsibility does the architecture have toward non-participants — communities who are affected by aggregated insights or system design decisions but choose not to participate? Data cooperatives typically address only members, but the data's relational nature means that its impact extends beyond membership.

These questions do not have definitive answers. They establish a framework for ongoing deliberation as one moves from concept to operational reality. The initiative's governance arrangements must be designed for continuous learning and adaptation, with built-in mechanisms that encourage hard questions and course corrections when evidence demands it.

5.4 Conclusion

The path towards infrastructural sovereignty is neither quick nor straightforward. It requires patience with messy realities, tolerance for setbacks and pivots, and sustained commitment to values that may seem inefficient in the short term but prove essential for long-term legitimacy. Success will ultimately be measured not by the sophistication of technology or the scale of reach, but by whether there are genuine shifts of power towards communities. Will it enable them to govern their data, benefit from digital systems, and shape the technologies that increasingly mediate their relationship to land, livelihoods, and the state?

The recommendations outlined here provide a roadmap grounded in evidence from CSOs, expert practitioners, and comparative analysis of alternative models. They emphasise incremental progress over grand ambitions, relationship-building over technical optimisation, and sustained learning over premature scaling. By embracing these principles and rigorously engaging with the critical governance questions identified, the concept of infrastructural sovereignty contributes meaningfully to reimagining what a public interest digital system looks like when designed from the ground up with and for communities.

This reimagining requires acknowledging that infrastructural sovereignty is not a technical achievement but a political one. It is a continuous practice of negotiating power, distributing benefits, and ensuring that those whose data, knowledge, and labour sustain digital systems retain authority over their design and evolution. The architecture, licensing, and governance structure matter. Ultimately, what matters most is whether public interest digital systems like Common Ground enable communities to say "no" as well as "yes", to set terms rather than accept them, and to shape digital futures that serve their success rather than merely extracting their data.

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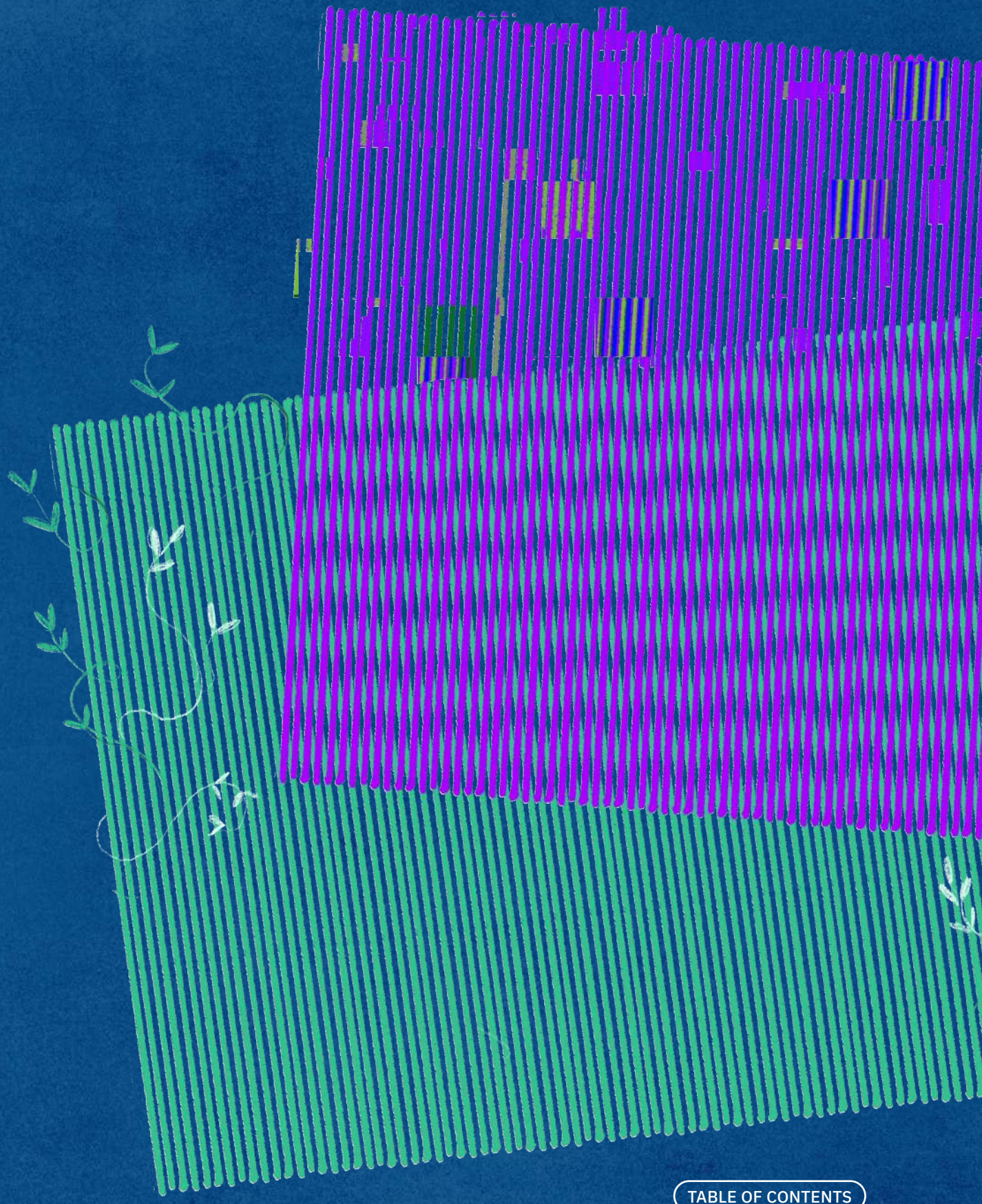
Annexures



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ANNEX 1

Insights from on-ground CSOs within Common Ground

1 Ecological Commons and Livelihood Systems

1.1 Environmental Monitoring Challenges

The degradation of natural commons - forests, water bodies, and grazing lands - is extensively documented across all seven organisations, but current digital systems fail to adequately capture these changes. Ground-level ecological data remains trapped in manual records or fragmented digital systems, limiting the ability to track deforestation, water table decline, and biodiversity loss systematically. As one CSO notes, the transition from satellite imagery to ground-truthing represents a significant data gap that current tools cannot efficiently address.

1.2 Livelihood Vulnerability and Data Gaps

The "diversified portfolio of subsistence activity" that characterises rural livelihoods creates complex data requirements that existing digital systems struggle to accommodate. Seasonal income patterns, NTFP collection cycles, and distress migration flows remain poorly documented in digital formats. A CSO observes that traditional livelihood tracking methods, while comprehensive, are extremely time-consuming, taking 6-7 days per village for proper data collection and verification. Gaps in data use, data access and data infrastructure have led to significant difficulties in availing and tracking livelihood entitlements as well.

1.3 Traditional Knowledge and Digital Exclusion

The sophisticated traditional governance systems documented by two organisations, including family-based tree allocation and rotational forest protection, represent valuable institutional knowledge that remains largely excluded from digital platforms. This indigenous knowledge gap in digital systems undermines the potential for governance models that combine traditional wisdom with modern technology.

2 Current Digital Infrastructure

2.1 Fragmented Tool Ecosystem

Organisations operate with a disjointed array of digital tools that reflect their transitional phase in technology adoption. One organisation that we spoke to employs mobile data collection platforms like mWater alongside GIS systems and is developing a centralised Management Information System to integrate disparate data sources. Most organisations rely heavily on basic MS Office software, with Excel serving as the primary data management tool across multiple organisations.

2.2 Communication Infrastructure

Accessible platforms like WhatsApp have become essential for coordination, with one organisation using WhatsApp groups for daily planning and online review meetings. However, this dependence on consumer-grade applications creates security and reliability concerns, particularly given the sensitivity of forest rights and community mobilisation work.

2.3 Hybrid Data Collection Approaches

Most organisations employ mixed-method approaches where digital tools coexist with traditional practices. For example, one organisation uses ODK for mobile data collection while maintaining extensive manual surveys, creating parallel data streams that are difficult to integrate. This hybrid approach, while practical, exacerbates data fragmentation and increases the administrative burden on field staff.

3 Systemic Digital Barriers

3.1 Infrastructure as Primary Constraint

The most fundamental barrier across all organisations is the absence of reliable connectivity in remote operational areas. One CSO reports that in many villages, mobile networks are completely absent, forcing complete reliance on manual data collection with subsequent digitisation. Another organisation explicitly notes the absence of reliable internet in their operational areas, making real-time digital work impossible. One CSO notes the need for physical infrastructure to provide any access to public digital systems, preferably at the block level. They illustrated this with examples in which providing and maintaining on-ground infrastructure, held together by local actors like block-level SHG federations, allowed for successful implementation of disbursal of entitlements.

3.2 Hardware and Power Supply Limitations

Basic technology infrastructure remains scarce, with organisations facing challenges related to device availability, maintenance, and power supply. Field staff often lack dedicated devices, and power outages further constrain the limited connectivity

windows. These basic infrastructure gaps fundamentally shape all technology interactions and implementation strategies.

3.3 Government Digital Systems

Organisations face significant challenges with government digital systems that are often cumbersome, poorly designed for field conditions, and unreliable. One organisation remarks on the inconsistencies in data tags in government datasets as well as on how long they take to update new data. Other organisations report difficulties with the National Mobile Monitoring System and struggles with inaccessible government portals that require manual compilation of already-digital data. This creates a paradoxical situation where organisations must maintain parallel digital and manual systems to meet reporting requirements.

4 Capacity and Usability

4.1 Technical Skill Gaps

Digital literacy varies significantly across organisations and between different levels of staff. Field coordinators and community mobilisers often lack confidence with even basic digital tools, while management staff may struggle with data analysis and interpretation. One CSO notes that technical capacity limitations affect staff across organisational hierarchies, from field coordinators to management, while another has identified gaps in technical skills and digital literacy in government stakeholders as well, and has attempted at addressing the same.

4.2 Training and Adoption Challenges

Current digital training approaches show limited effectiveness. One CSO reports that online training delivery through platforms like Google Meet results in unequal participation, while field staff struggle with practical implementation of tools learned in training sessions. The gap between theoretical knowledge and practical application remains significant, particularly for complex tools like GIS. Another organisation's most successful capacity building module included training 85 matriculation-level women in collecting and maintaining nutrition datasets. However, digitising them was still a struggle. So there is still a need for occasional technical support on ground.

4.3 Staff Turnover and Knowledge Loss

Organisations face persistent challenges with staff turnover and the consequent loss of digital knowledge. This creates a cycle where training investments are partially lost, and systems must be designed to accommodate frequent retraining. The need for solutions that are intuitive enough to survive staff transitions emerges as a critical design consideration.

5 Strategic Digital Needs and Opportunities

5.1 Offline-First, Sync-Later Solutions

The most consistently expressed need across all organisations is for robust offline functionality. One organisation explicitly calls for applications that can function entirely without the internet and synchronise when connectivity is available. This represents the single most important design requirement for any digital intervention in these contexts.

5.2 Unified Platform Architecture

Organisations consistently express frustration with maintaining multiple disconnected systems for commons, livelihood, and other program areas. There is strong demand for integrated platforms that can handle multiple data types and program areas within a single coherent system, reducing duplication and improving data utility.

5.3 Community-Centred Data Ecosystems

A promising opportunity lies in developing tools that facilitate data feedback to communities, enabling local institutions to analyse information and drive decision-making. One CSO also notes that local organisations like FPOs try to maintain manual logs of their own datasets, and could use help in creating better data practices. Another organisation's approach of presenting analysed data back to Cluster Level Federations represents a best-practice model that could be enhanced through appropriate digital tools. This transforms communities from data subjects to active data users.

5.4 Mobile-First, Low-Bandwidth Design

Given the connectivity constraints and the primacy of mobile devices in field work, solutions must prioritise mobile-friendly interfaces designed for low-bandwidth environments. Tools must be usable on affordable smartphones with limited storage and processing capacity, with interfaces designed for non-technical users.

6 Emerging Technological Frontiers

6.1 Spatial Analysis and Mapping

Several organisations demonstrate interest in spatial tools, such as Google Earth and GIS mapping, despite implementation challenges. There is significant potential for simplified spatial tools that can support resource mapping and landscape planning without requiring advanced technical expertise.

6.2 Predictive Analytics for Agriculture

One CSO's work with PVTG communities reveals opportunities for predictive tools that can support agricultural planning and climate adaptation. Simple analytics based on historical patterns and climate data could significantly enhance livelihood security, though such tools must be designed for extremely user-friendly interaction.

6.3 AI and Advanced Applications

One organisation's successful AI training initiatives indicate growing awareness of advanced technologies, while another notes staff requirements for AI expertise. However, these applications must be approached cautiously, with focus on practical problem-solving rather than technological sophistication for its own sake.

7 Implementation Framework for Digital Solutions

7.1 Phased Adoption Strategy

Successful digital implementation requires acknowledging the gradual nature of technology adoption in resource-constrained environments. A phased approach that begins with solving the most critical pain points (e.g., offline data collection) and progressively adds functionality would likely prove more sustainable than comprehensive system overhaul. Critical pain points for the initial phase need to be studied extensively to avoid a tech-first approach and align the strategy to focus on providing direct benefits to the people on ground.

7.2 Collaborative Infrastructure Development

The expressed willingness of multiple organisations to participate in shared digital infrastructure suggests significant potential for collective approaches. One organisation discusses efforts to create systems where all partner data can come together, indicating readiness for standardised tools across partner organisations. Gaining buy-in and developing collaborative opportunities with active institutional stakeholders will be valuable in the long run.

7.3 Capacity-Building Ecosystem

Digital solutions must be accompanied by robust capacity-building that addresses multiple learning styles and technical starting points. This includes:

- Practical, hands-on training with immediate application to daily work
- Peer learning networks for ongoing support and knowledge sharing
- Local language resources and visual training materials
- Gradual skill progression from basic digital literacy to advanced analysis

7.4 Sustainability and Maintenance Models

Solutions must be designed for long-term sustainability without dedicated technical staff. One CSO suggested that NGOs, panchayati members, and local groups like SHG federations would prove crucial to this process. In particular, SHG members could ensure regular meetings, maintenance of livelihood data, gender-sensitive capacity building and on-ground coordination efforts. Long-term sustainable models require:

- Minimal maintenance requirements and easy troubleshooting
- Local ownership and clear support protocols
- Cost-effective licensing and update models
- Scalable architecture that can grow with organisational needs

ANNEX 2

Insights from Experts

1 The tension between contextualisation and replicability

1.1 Importance of contextual design

Multiple experts emphasised the importance of ensuring contextual modularity within the technical architecture, availed through participation on ground. One expert insisted that it, along with end-user trust, should be treated as more important than technological sophistication. Some data that is crucial for on-ground tools, such as tags for hyperlocal varieties of crops, makes not only community participation invaluable but also necessitates a technical architecture that can allow for such specific and contextual participation.

1.2 Importance of replicable design

Additionally, the experts also noted the value of instilling replicability from the beginning stages of the technical design. One expert, who has worked on building community technology from the ground up, suggested that scale itself is a value that can be attractive for product developers — it can allow for better reach, service delivery and sustainability for their products. Experts emphasised that global standards alignment can enhance legitimacy and replicability, although alignment must be balanced with India's preference for homegrown solutions that reflect local governance norms. Achieving this balance is necessary as over-standardisation can lead to loss of local application while over-customisation sacrifices interoperability.

1.3 Challenge of replicable, contextual design

Contextual design has proven to be difficult in the past, particularly in the Indian context. An expert attributed the success of UPI to two factors — the fact that the entire architecture is purely digital, and that it is mandated by the government. On the other hand, integrating real-world offline elements that are attached to the context, especially without a mandate, becomes problematic for any digital system. Standardised practices can conflict with sovereignty preferences and need to be managed. Moreover, in the process of creating operational design for establishing these sovereignty preferences, tensions can arise in trying to achieve genuine community participation and power-sharing mechanisms.

1.4 Lowest common denominator

It was strongly advised to keep the offerings simple, requiring minimal data collection. In general, the principle of data minimisation was championed. An expert advised to not collect data even for possible future uses, but to restrict data collection and management processes to essential data necessary for immediate use-cases. Aadhaar's success with just four core data points demonstrates that the Product Manager Temptation Trap — collecting all conceivable data "for future use" — creates unsustainable operational pressure. Experts also suggested that having too many use cases means excelling at none.

Some factors in deciding the immediate use-case should meet the following criteria: it should meet the most pressing and general community need, it should work at scale, it should be physically possible, it should require low time investment from all stakeholders, and it should be less resource intensive.

1.5 The generic-customisable balance

Experts attributed the success of their most successful open-source designs to creating an ecosystem that has centralised and governed core standards that allow for modular front-end options and contextual extensions for vendors to build alternatives. An expert noted that their Front-End Customisation Model enables 90-95% of use cases through configuration rather than development. This also addressed the limited availability of talent in low-income countries, while making it possible to be flexible across contexts in terms of levels of literacy, digitalisation, and capacities. Another expert stressed on understanding each context's unique resources, local dynamics, and existing institutional engagement. It would help generate an extensive needs-based analysis to tailor capacity-building programmes, co-create solutions and tap into existing pathways for engagement rather than imposing new ones.

2 Trust as foundational infrastructure

2.1 Trust precedes technology

A critical emphasis was on building trust across stakeholders before any technical considerations. Data is not a static artefact. Thus, to ensure long-term maturity for any digital initiative, communities must perceive that it embodies material benefits for them. Their involvement, both as contributors and end-users, hinge on developing robust feedback loops across the data lifecycle. Involving the community as co-designers not only ensure the relevance of the final output toward real-world community needs but also help break open the trust barrier, making your co-designers your first evangelists. Technology builders shared their experience of how data validation and ground-truthing in the first phases of their initiatives was slow and time-consuming. However, it helped build trust among community members, granting them local networks to ease several permission processes. If funder-driven timelines

allow a slower rollout, experts across the board suggested spending time in trust- and capacity-building approaches over technical sophistication.

2.2 Institutional embedding

Trust begins when leadership on ground, for instance, government departments, PRI members, and community leaders see real value in a digital initiative. Multiple experts insisted that platforms only gain momentum once they are embedded into existing institutional routines, and thus, local trust can be developed if local institutional workers are targeted. Use-cases within sectors like health and land use require government collaboration, despite the possibility of mistrust. While one expert suggested taking up government contracts from the get go, another gave an example of how state and district actors using their tool for real decision-making lead to real expansion of their service, empowering the community through local anchors and continuous system updates. Leadership buy-in, particularly from senior bureaucratic actors, sets the tone for adoption and mitigates the risk of midstream abandonment when personnel change.

2.3 Gaining buy-in from partners and vendors

Vendors often hesitate to join digital networks due to perceived costs, technical overheads, or fears of failure. Trust is strengthened when partners encounter transparency. Clear articulation of scope, limits, timelines, and examples allows stakeholders to calibrate expectations. Lowering entry barriers, such as (1) simplified onboarding, (2) initial handholding, (3) pro bono technical support, and (4) defined protocols for their participation, help vendors feel less burdened to participate. Rejecting vanity metrics, like downloads or user counts, in favour of genuine adoption helps signal integrity.

2.4 Building bilateral trust across the ecosystem

Trust must be cultivated horizontally across actors like vendors, institutions, partner organisations and community members. This is important to empower community data ownership as well because, for instance, in sectors like health, fisheries, and natural resource management, government mistrust of community-generated data is common. Experts emphasised the role of a trusted intermediary — an actor who can translate needs, mediate conflicts, foster dialogue, and build bilateral trust between government and community. This role is especially crucial in India, where plural governance systems, caste dynamics, and bureaucratic hierarchies shape who is considered legitimate.

3 Incentive structures

3.1 Multilayered incentive design

In a multi-actor system, it is imperative that every actor has an incentive to exist in the system, otherwise the system destabilises. It is possible to work with actors that may have neutral positions, but no actor should be losing and benefits must always outweigh the costs. This can be tricky, as open and commercial models have their own patterns of governance. Mapping interactions across different actors through defined protocols that ensures everyone is sufficiently incentivised then becomes a priority.

An expert explained that in their experience, a community-oriented platform thrives when each actor derives both tangible and emotional value. For communities, incentives should be direct — it could include visibility, recognition, monetary benefits, or the ability to demand entitlements using data. For CSOs, incentives could include lower costs of evidence through shared data backbones, networking effects and better collaboration opportunities. For third party service providers, granting open APIs and trusted data could grant them greater service delivery, market access and better credibility. Providing spaces for co-creation and modular frontend development while acting as the interlocutor could address deep silos in product development, allowing for a unique value-add for third-party vendors.

3.2 Networks as incentive

Sustainable ecosystems rely on cyclical exchange. For example, when a farmer updates their address or landholding information, they should directly experience benefits such as corrected entitlements or improved service delivery. These loops reinforce participation, prevent data decay, and help communities see data as an asset rather than an extractive burden.

For a lot of partners, being part of a structured network in and of itself is a big incentive, granted their priorities and tensions are sufficiently addressed. Interoperability and ecosystem partnerships are valued by most. These should ideally align with global standards to gain greater scope of partnerships as well as international credibility, creating greater possibilities for replicability. If there are reduced requirements to join the network and robust feedback loops where each actor's participation strengthens others, then there is room for real and continuous participation.

3.3 Alternative motivation systems

Beyond financial incentives, alternative motivation systems for participation can be explored. One would be to create an informal career pathway for youth, students, and early-career professionals. Young educated youth in rural areas that want to explore career paths in technology would be willing to participate in data collection and management. Students across India could want to participate directly into the

ecosystem, seeking to work closer to the action to generate social impact. Granting them skills and certifications will help them build their professional profiles.

In general, where monetary compensation is unavailable, models like gamification, playful community audits, leaderboards, open-source certifications, recognition platforms, and social competition create motivation through reputation and belonging. Such mechanisms help maintain momentum in voluntary or low-resource environments.

3.4 Economic realism

According to experts, participation in cooperative or data-sharing ecosystems struggle when they rely solely on goodwill. Voluntary commitments are inherently volatile because "doing something positive" works only when participants are not losing time, money, or resources. Once the activity becomes loss-making, even the most altruistic actors disengage. For organisational partnerships especially, participation must either avoid imposing financial or operational losses or compensate those losses with equivalent gains so that the relationship is 'not lossful'. When building communities of organisations rather than individuals, the focus must shift to understanding why organisations would not join and removing loss barriers, since adoption often hinges on eliminating friction rather than offering abstract benefits.

An expert pointed out that organisations act only for (1) revenue generation, (2) cost savings, or (3) regulatory compliance with consequences — everything else becomes weekend volunteer work. Voluntary adoption through open protocols frequently fails without any regulatory mandate, as seen with ONDC. Infrastructure, enforcement, and explicit incentives are three prongs necessary to bring partners to the table. Interoperability with proprietary systems adds further complications, making sustainability even more dependent on stable incentive structures. For-profit organisations face additional constraints because low margins make it difficult to justify investments in social-impact initiatives, and attempts to assign a hard valuation to social impact remain largely unworkable or impossible. Together, these realities highlight that sustainable participation requires articulation of clear, non-loss-making incentive structures rather than moral framing.

3.5 The self-sustainability imperative

In the initial phases, philanthropic funding might be imperative, especially since the primary early value exchanged, i.e. data, is non-monetary. However, an expert insisted that the economic viability of the governance model needs to be figured out from the very beginning. This financial plan can structure the platform and product design, for instance, systems could be built for high-volume, low-value transactions where flat fees or subscription models replace percentage-based commissions that otherwise incentivise excluding small-ticket transactions. Value creation cannot depend on new

burdens placed on participants. Instead, it should focus on identifying and redistributing surplus value already present in the ecosystem so that gains circulate rather than concentrate. Additionally, aligning open digital ecosystems to donor/corporate priorities to allow for a small set of contributors to bear disproportionate costs can also be another alternative. An expert gave an example of how a big for-profit was currently funding 80% of a digital ecosystem's expenses, despite all other monetisation avenues.

The offering must deliver at least one of three clear benefits of revenue generation, cost savings or compliance advantages. This includes designing supply-demand incentive loops—such as users updating their addresses because it improves access to benefits transfers — and establishing transparent mechanisms for crowdfunded data contributions. Donations can be a viable model when the benefits flow directly to vendors, but even then, contributors must understand the long-term value proposition. Ultimately, sustainability hinges on clearly articulating what intrinsic value remains after philanthropic funding ends and ensuring that the ongoing costs are justified by tangible, continuing benefit to participants.

4 Governance

4.1 Evolution from centralised to federated models

The shift from centralised to federated models is gradual and requires the deliberate removal of boundaries as systems mature, allowing cross-collaboration across groups and across different types of data. Although decentralisation is the long-term objective, the early phases must retain centralised decision-making within the organising entity to prevent the project from expanding into "10 different dimensions" and achieving very little. Business Requirement Documents (BRDs) therefore need to originate from the organising entity rather than the community, as allowing everyone to have their own opinion results in directionless chaos. Over time, greater maturity enables a move from centralised planning to decentralised implementation, supported by modular metadata and data-sharing structures that allow each entity to define its own governance mechanisms, user management, and access control. However, voluntary protocols without government regulation usually fail due to the absence of infrastructure, enforcement, and incentives, and even shifting from mandatory to merely encouraged adoption can delay progress by years or even decades. Federated models also create considerable overhead for communities, making it essential to assess whether splitting a product will reduce its value — if splitting dilutes value, governance needs to remain centralised, but if it does not, federated governance becomes feasible. Ultimately, federation must be intentional and clearly articulated, recognising that it can grow (moving in a defined direction towards success) or shrink (allowing forks that do not dilute value), depending on what best preserves system integrity.

4.2 Structured governance with layered authority

A well-structured governance system requires clearly defined layers of authority, such as the three-layer governance model that includes a national layer for core schema compliance, a block layer for contextualisation and validation, and a community layer for feedback and consent, captured in the phrase, “standardisation builds highways, and federation ensures each village can still choose its destination.” This layered structure helps navigate the tension between contributors wanting their voices heard and the impracticality of giving everyone decision-making power in every area. Contributors should have visibility across the system, but decision-making authority must be confined to specific, bounded domains to avoid overwhelming coordination challenges. Effective governance structures often include a larger steering committee supported by smaller sub-committees, with structured communication and explicit inclusion of CSOs, tech vendors, and gender considerations. Public calls and open houses offer further avenues for engagement while maintaining orderly participation pathways. The model recognises that the transition from organisational control to a formal board structure, comprising internal, external, organisational, and community members, should occur only once the depth and complexity of the system justify the demands of maintaining a board. Within this structure, governance must also ensure strict handling of personally identifiable information (PII), acknowledging that storing such data significantly increases security costs, and that working with aggregated data may often be the safer and more efficient option.

4.3 Power sharing and earned authority

Power sharing in federated ecosystems requires authority to be earned rather than granted automatically. Democratic equal-vote models are rejected because newcomers and long-term contributors cannot reasonably hold the same decision weight, and allowing “anybody to say anything anywhere” should not be allowed to influence strategic direction. Instead, the principle mirrors models like Apache, where contributors work towards membership, demonstrating sustained commitment and value over time. This is particularly important because contributors want their voices heard, yet giving everyone full authority results in cumbersome and unworkable governance structures. A system based on earned authority ensures that influence corresponds to actual contribution and investment, balancing transparency with practical governance. Federated governance also demands technical capacity within the community, working particularly well when anchored in academic institutions and non-profits that can sustain long-term involvement. Across these dynamics, federation does not imply unbounded autonomy; it requires clearly defined regions of authority and structured processes so that power is shared effectively without leading to organisational paralysis.

4.4 Adapting to existing institutions

Adapting governance models to existing institutions requires aligning decision-making structures with prevailing hierarchies rather than attempting to overhaul them. This includes ensuring compatibility with existing government systems, which is essential for demonstrating value in government contracts and avoiding institutional resistance. As the system evolves, it must retain alignment with established norms while supporting cross-group collaboration and enabling meaningful roles for CSOs and tech vendors within governance. Although federated governance empowers communities, it also imposes additional overhead, making it important to tailor the model to institutional capabilities and constraints. Federated structures therefore need to accommodate existing hierarchies, enabling decentralisation in implementation while retaining sufficient central coordination to prevent fragmentation, ensuring strict governance around PII, and allowing institutions to work safely at an aggregated-data level where required. By respecting established systems while introducing modular, flexible governance mechanisms, federated approaches become more practical, more stable, and far less disruptive.

5 Operations

5.1 Operational clarity and organisational alignment

Operational clarity requires a strong emphasis on ‘doing’: what exactly needs to be done, how it will be executed, and by when. This must be paired with a limited initial offering and scoped operational strategy, especially at the district level, ensuring ambitions match actual capacity. A clear understanding of (1) who the actors are, (2) which actions generate data, and (3) what incentives drive their participation is essential for designing realistic workflows. It is equally important to distinguish between organisational alignment, which is often easier to achieve through institutional relationships, and individual people alignment, which is more complex and demands deeper engagement. Using corporate terminology like “capacity planning” in community contexts can unintentionally signal transactional thinking, making contributors feel like “headcounts” rather than valued collaborators.

Effective alignment also requires recognising that contributors exist along a spectrum—from technically inclined participants to those who simply want structured, straightforward tasks like “fix this bug”—and therefore creating tailored pathways for different forms of engagement. Strategies must also account for the universal pattern in open communities where highly skilled individuals have little time, while less experienced contributors have more time but require direction. This must be balanced through approaches such as privately reaching out (“almost hiring”) to known, reliable individuals and organisations rather than relying solely on public recruitment, and creating implicit assessment processes during public outreach to guide volunteers into appropriate roles and avoid self-selection chaos.

5.2 Infrastructure and capacity

Infrastructure and capacity-building must be grounded in practical realities, even when this involves investments in physical infrastructure. This includes ensuring smartphone access, reliable charging, and suitable devices, as digital platforms cannot function if users lack the means to engage. There must be a realistic evaluation of digital literacy, ideally carried out with community partners who understand existing digital experience levels. DPGs often demand more sophisticated technology, yet they are expected to serve communities with poor hardware, accessibility challenges, and compatibility issues, creating a mismatch that must be addressed through thoughtful engineering.

Capacity-building also requires recognising essential personas within any technical community: engineering roles that build the systems, programme managers who coordinate, and product managers who design user journeys. Product requirement documents must come from experts with domain knowledge in comparable DPGs rather than from general enthusiasm, as this prevents technically unsound decisions by well-meaning novices. Some domain experts must be included, even if their availability is limited, because their guidance is essential for sound, context-aware decisions. In addition, domain expertise must be matched with correct technological abilities, as uncertainty typically impacts social impact projects first, making robust capacity indispensable for long-term resilience.

5.3 Inclusive interface and human-centred design

Human-centred design requires acknowledging that the burden of data reporting should not fall on the community, and that non-essential data must be made optional to allow gradual enhancement of participation. Inclusive interfaces must also come from a grounded understanding of how different demographics interact with technology. An expert observed that a common oversight in open-source and DPG communities is the neglect of UX roles, both visual design (how an interface looks) and interaction design (how people actually use it). Something may look visually appealing yet be entirely unusable for populations unfamiliar with certain UI patterns. Therefore, targeted design is essential, accounting for community realities, user constraints, and the diversity of digital familiarity. Public recruitment for design contributors often attracts individuals with more time but less experience, making it necessary to structure organisational processes that channel their enthusiasm into expert-guided design directions. Continuous engagement must be designed into the interface. For example, in systems like carbon credit programmes where constant data updates are essential, interfaces must support consistent and sustained participation.

5.4 Sustainability mechanisms

Sustainability depends on ensuring that the ecosystem supports long-term engagement, technically, institutionally, and emotionally. An expert noted that when state governments or CSOs derive real decision-making value from community-

generated data, they are naturally more willing to invest in maintaining and evolving the ecosystem. Sustainable models may include public–social partnerships, performance-linked data service agreements, and softer mechanisms like data stewardship training, open innovation fellowships, and community data clubs. Importantly, revenue must circulate within the ecosystem to improve data quality and support local institutions. Sustainability also requires mapping all potential users of datasets and distributing collection costs to those who gain the most value, reducing financial burdens on communities. An expert noted that in their organisation, communities currently do not have raw-data access and instead receive products like printed maps and analytical reports. They have also acknowledged the challenge of recognising ownership over collective traditional knowledge, while prioritising the involvement of community members, especially local staff and community resource persons, in data analysis and project design. These practices reinforce the need for sustainability models that balance operational feasibility, ethical considerations, and shared long-term value.

6 Overcoming exclusion and knowledge barriers

6.1 Structural inequities

Several experts emphasised that many digital and data initiatives fail because they overlook deeper structural issues rooted in the political economy. There is often an inadequate understanding of how caste, class, gender, language, and land-based privileges shape people's ability to participate in data systems. When technologies are built on the assumption that "users will figure it out," they end up reinforcing the very inequities they intend to solve.

One expert noted that digitalisation tends to reproduce pre-existing hierarchies unless designers explicitly recognise systemic injustices and build mitigation into the design from the beginning. This includes acknowledging who is excluded—non-literate people, women with limited digital exposure, communities without connectivity—and who benefits from centralised data systems.

The discussion also highlighted that data validation is inherently political. Different age groups, genders, and social positions hold different forms of knowledge about the commons. Deciding whose knowledge is formalised in data systems is not a neutral or technical choice, but a question deeply entangled with power.

6.2 Institutional asymmetries in data

Speakers pointed to the deep institutional asymmetries that shape data ecosystems. In India, the centralisation of data flows means that information produced by community members or local staff often receives less legitimacy than research generated by national institutions. As one expert explained, this creates a structural imbalance: communities remain data providers, but decision-making authority sits elsewhere.

Experts stressed the need for strong and trust-based relationships with government bodies, as regulatory enforcement often depends on institutional goodwill. Yet, the centralisation of data infrastructure frequently sidelines community knowledge, undermining data sovereignty.

To counter this, the conversation called for frameworks that empower communities to question, challenge, and validate information shared by external entities. This is not simply a matter of interoperability across systems, but of shifting power so that communities become authorities on their own realities and custodians of their data rights.

6.3 Epistemological challenges

A recurring theme was the epistemological gap between scientific and traditional knowledge systems. One expert described their efforts to establish scientific backing for traditional knowledge without allowing scientific frameworks to dominate or dilute local epistemologies. This requires practitioners who can translate across systems sensitively — neither romanticising tradition nor imposing scientific hierarchies.

The dialogue underscored that communities should not be treated as passive data sources but as holders of sophisticated, place-based knowledge. For example, only local people can accurately tag hyperlocal crop varieties grown across three neighbouring villages — something external experts simply cannot identify. This makes community participation irreplaceable and ensures that their knowledge retains its integrity and authority.

6.4 Inclusive design methodologies

Experts recommended a combination of human-centred design and systems thinking to address hidden assumptions embedded in digital tools. This includes designing for language diversity, non-literate users, low-connectivity regions, and groups historically excluded from technological spaces.

One expert demonstrated how they bridge data literacy gaps through visual stories, icon-based user interfaces, and locally meaningful representations that allow communities to interpret and verify complex datasets. Their experience showed that when validation tools are accessible, communities can meaningfully engage with data, correcting inaccuracies and ensuring that external entities cannot override local realities.

One practitioner shared examples from their work on an EWR chatbot, which tackled language exclusion through multilingual and voice-based interfaces, addressed connectivity issues via an offline AI chatbot, and worked to close the data literacy gap through intuitive visual materials. They described the importance of decentralising upload rights to prevent elite capture and organising women-only onboarding sessions to build comfort, confidence, and agency.

Inclusive design, they argued, must go beyond simplifying interfaces. It must reshape participation by involving community members—including local staff—in analysis, decision-making, and project design, not merely data collection. This shifts the model from extraction to genuine co-production of knowledge, strengthening both legitimacy and impact.

7 Piloting strategies

7.1 Begin with belief and prepare for uncertainty

A pilot only succeeds when the team genuinely believes in the product being tested. Experts reminded that piloting a Digital Public Good (DPG) is inherently challenging, and one must learn to celebrate the "happy accidents" that emerge in the middle of struggles. These unintended insights often reveal what works in a specific context and what unique value the product offers.

Pilots must be designed with the understanding that people's priorities evolve, and shifts in local politics, staffing, or institutional interest can derail timelines. Therefore, contingencies are essential, not just in activities, but also relationships. Avoid depending on a single point of contact or a lone champion; instead, build two-to-three complementary networks that can sustain the pilot even when individuals or conditions change.

7.2 Choose the right starting conditions

Experts emphasised beginning with a "best-case scenario" for initial implementation — strong local actors, reliable infrastructure, and existing datasets. Starting with a supportive environment helps clarify what enables the system to work and exposes gaps more clearly before expanding to a complex or large geography.

Similarly, pilots should not rely on just one geography. Multiple sites, even small ones, create resilience when political or administrative contexts shift. Namita Singh noted that FAO's Digital Village initiative offers useful guidance on integrating varied digital tools into existing ecosystems, highlighting how good starting conditions can strengthen the foundation for scale.

7.3 Build trust locally and ground the pilot in ethnographic learning

Experts advised starting small in a context where there is diversity, trust, and a supportive ecosystem. This provides a fertile ground for experimentation while still enabling feedback from more challenging contexts to test robustness. Pilots work best when teams spend enough time in the field to understand concerns, observe workflows, and pick up subtle infrastructural or cultural constraints.

An ethnographic approach, i.e. deep listening, contextual immersion, identifying local champions, understanding anxieties, helps teams adapt quickly and avoid costly delays. A strong frontline team is critical for ensuring that concerns are addressed in real time and that the pilot remains socially anchored rather than extractive.

7.4 Design for early wins and genuine user value

A pilot is considered truly successful when end-users themselves express a desire to continue using the platform because it has made a tangible difference. To create this early win, experts stressed the importance of choosing a location with adequate connectivity and infrastructural readiness.

Pilots should centre around a "killer use case": one that benefits at least 50–60% of the target users, such as BRC users in one example. This anchors the pilot in real, immediate value rather than abstract potential. Involving future champions in the design process ensures that they feel ownership and later advocate for the solution organically.

7.5 Start with the problem, not the technology

A common caution was to avoid starting with available tools or engineers, as this often produces solutions that do not address core user problems. Instead, the first step should be the creation of a Business Requirement Document (BRD) that focuses entirely on the problem statement, user impact, and different use cases.

Only after the BRD is clear should product teams, UX designers, and technology teams map out user journeys and system requirements. This sequencing prevents premature technical decisions and ensures the pilot is user-centred rather than tool-centred.

7.6 Co-create data ecosystems and build legitimacy before scaling

Pilots must build legitimacy within the local ecosystem before attempting to scale or perfect the model. Early stages should focus on demonstrable improvements in local decision-making or processes, even if confined to a limited geography.

Experts recommended beginning with a clearly defined thematic area and co-creating a micro data commons with a consortium of local institutions. This allows teams to safely test data flows, governance protocols, sharing norms, and validation processes. Translating complex datasets into meaningful local insights, through storytelling, visuals, or simplified dashboards, helps communities understand value and stay engaged.

Strengthening basic data capacities, ensuring feedback loops on the ground, and showing the local impact of the work back to the community are essential for sustained participation and long-term legitimacy.

ANNEX 3

A Comparative Matrix of All Mapped Initiatives

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
Digital Public Infrastructure							
DILRMP	Central Government (Dept. of Land Resources), state revenue departments, district/tehsil officials, landowners, farmers	**Three tiers:** 1. Central funding/ coordination/ policy and standards 2. State execution/ data management 3. District/tehsil data collection	• Reduces fraud in land transfer • Improves transparency • Enables digital land records access • Facilitates credit through documentation	**Analysis suggests it:** • Excludes customary/ informal tenure • Legitimises erroneous records • Lacks datafication risks (profiling, surveillance) • Has inadequate data security • Excludes heterogeneity across states • Has no grievance mechanisms for marginalised groups	• Central Government funding • Dependency on state capacity	**Weak:** Top-down implementation without citizen participation or effective redress mechanisms.	**Low:** Excludes customary tenure holders, women with informal claims, and tenant farmers.
AgriStack	Central Ministry of Agriculture, State Governments, farmers, private agritech companies, financial service providers, tech partners	• Centre provides policy/standards/ funding • States maintain registries and implementation • Public-private partnership model • Consent-based data sharing framework (weakly implemented)	• Potential for improved credit access, market linkages, precision agriculture advisories, and insurance products • Authenticated farmer demographics • Interoperability across states	• Privacy violations without a robust data protection law • Exploitation by private companies • Exclusion of tenant/ informal farmers • Digital literacy barriers • Surveillance risks • Lack of democratic consultation	• Government funding (major part of ₹2,817 crore allotted for Digital Agriculture Mission approved September, 2024)[4] • Dependency on private sector partnerships	**Weak:** No farmer representation, inadequate consent mechanisms.	**Low:** Excludes tenant farmers, those with informal land arrangements, and digitally illiterate populations.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
ADeX	Telangana Government, IISc Bangalore, World Economic Forum, farmers, private agritech developers, financial institutions	**Multi-stakeholder partnership:** • State policy direction, IISc technical architecture, WEF industry engagement • Agriculture Data Management Framework (ADMF) oversight via inter-departmental committee	• Consent-based framework • Open-source architecture • Services include market advisory, pest prediction, simplified credit • Phased deployment allows iteration	• Consent mechanisms are inadequate given digital literacy gaps • Technical complexity distances farmers from oversight	• State Government funding • Unclear long-term financial sustainability	**Weak:** The inter-departmental committee lacks farmer accountability and unclear enforcement mechanisms.	**Low to Moderate:** ADMF provides stronger protections than AgriStack but similar farmer exclusion from governance and technical barriers persist.
European Data Spaces	European Commission, Member State Governments, Data Protection Authorities, sectoral bodies, data intermediaries, businesses, citizens, civil society	• EU-level policy/ coordination (Commission, Data Innovation Board), national implementation (Member States, competent authorities), and sectoral bodies evaluate access requests • GDPR compliance	• Stringent privacy protections (GDPR) • Rights-based approach • Sector-specific safeguards (EHDS prohibits discriminatory uses) • Regulated data intermediaries • Data altruism recognition • Robust accountability mechanisms	• Regulatory complexity creates barriers (evidence suggests 10 Member States were non-compliant as of Dec 2024) • Technocratic governance • Cross-border coordination difficulties • Analysis suggests economic value is prioritised over social solidarity	• Government funding (Digital Europe, Horizon Europe programmes) • Regulatory enforcement • Commercial data intermediary services	**Strong:** Legislative frameworks, Data Protection Authority oversight, transparency requirements, but limited citizen governance participation.	**Moderate to high:** Citizens have rights (access, portability, deletion) under GDPR; multi-stakeholder governance includes civil society, but corporate/state actors dominate.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
ONDC	DPIIT (Government), ONDC (Section 8 non-profit), buyer app platforms, seller apps, logistics partners, small merchants, MSMEs, consumers, legacy e-commerce platforms	• DPIIT policy guidance • Multistakeholder ONDC steering committee with Government/ industry/tech experts • Quality Council of India facilitation	• Interoperability through Beckn protocol • Reduces platform monopoly power theoretically • Enables rural e-commerce • Supports MSMEs	• Lack of mandatory anti-self-preferencing rules enables legacy platform dominance • Inadequate grievance mechanisms • Transaction fees introduced in 2025 may burden small sellers • Lack of personal data safeguards	• Initially subsidised • Transitioning to a platform fee structure • Sustainability depends on Government support and public-private partnerships	**Weak:** No legislation defining ONDC authority/ responsibility in preventing harm.	**Low to Moderate:** Small sellers and consumers benefit, but limited representation in governance; board privileges established corporate and Government actors.
Free and Open-Source Software							
Apache Software Foundation	ASF Members, Project Management Committee (PMC) members, committers, developers, users, Board of Directors, Officers	• Elected Board of Directors for foundation-level management, PMCs (autonomous project governance), and community contributors • Separation of institutional oversight from technical decisions • Lazy consensus for decisions	• Scales collaborative development effectively • Legal protection/brand management • Lazy consensus balances efficiency with inclusiveness • Project autonomy preserved • Welcoming to newcomers	• Analysis suggests meritocracy reproduces exclusions (requires English fluency, leisure time, technical skills) • Informal authority structures favour long-term contributors • Non-coding contributions undervalued	• Volunteer labour • Corporate sponsorships • Infrastructure donations • Foundation donations • Sustainable for 25+ years	**Moderate:** Annual Member elections for Board; transparent processes; but limited accountability for harm reduction on project-level	**Moderate to high:** Meritocratic progression (user → developer → committer → PMC member); transparent processes; mailing list participation, but informal barriers persist around gender, geography, language, and education.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
The Document Foundation	Members (voting body), Board of Directors, Engineering Steering Committee (ESC), developers and contributors, users, Advisory Board members, and corporate sponsors	**Formal multi-body structure defined in statutes:** • Members oversee membership and elect the Board • The Board of Directors manages executive and strategic affairs • The ESC coordinates technical matters • A Membership Committee reviews membership applications	• Vendor neutrality is explicitly codified in foundation statutes • Clear separation between institutional governance and technical coordination • Formal bylaws and election rules • Advisory Board provides a channel for corporate engagement without direct governing authority	• Governance requires volunteer time and organisational capacity • Participation may be limited to established contributors • Legal and administrative complexity • Occasional tensions between elected bodies and contributors	• Combination of paid staff and volunteer contributors funded through corporate sponsorships • Advisory Board participation, and individual donations • Continuous operation since 2010	**Strong:** Statutory elections, transparent processes, impeachment mechanisms, and clear bylaws.	**Moderate:** Formal democratic structures create pathways, but demographic skew persists. Also, the membership requirements create barriers.
Mozilla	Mozilla Foundation, Mozilla Corporation, community contributors, Firefox users, corporate partners like Google, donators	**Dual:** • Non-profit Foundation Board sets strategy, ensures mission alignment, and enables taxability • Corporation Board manages operations, products and community input advisory	• Institutionalises ethical commitments • Possibly separates mission from revenue pressures • Can make privacy-focused decisions	• Concentrates authority without robust community accountability • Evidence suggests revenue dependence on Google (~80% of revenue) invites vulnerability • 2024 layoffs suggest financial pressures • Normative governance demands value-alignment	• Corporation revenue • Foundation receives a portion of the corporation's revenues, in addition to separate philanthropy • Sustainable but vulnerable to partner shifts	**Moderate:** Foundation Board not elected by community; mission-based legitimacy but limited community recourse when decisions diverge from principles.	**Moderate:** Technical contributions welcome but governance concentrated; mission-driven approach can prioritise marginalised users (privacy, accessibility) but without their direct voice.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
DHIS2/ HISP Network	HISP Centre UiO (core developers), national/regional HISP groups, HISP Hubs (Africa, Asia), Government health ministries, implementing country health systems, global health funders	**Networked/ federated:** • HISP Centre UiO (core architecture, global coordination, platform development), • Autonomous HISP groups (implementation support, customisation) with Governments, • HISP Hubs (continental coordination), consensus-building between technical leadership and action research relationships	• Combines global technical excellence with local contextual adaptation • Long-term relationships build trust • Data sovereignty (countries' own instances) • Responsive to field needs • Sustainable funding from multiple global health partners	• Depends on sustained donor funding • Resource gaps between UiO and Global South HISP groups • Requires exceptional coordination capacity and decades-long commitment • Difficult to replicate and remain context-specific	• Multi-donor funding (Norad, PEPFAR, Global Fund, Gates Foundation, etc) • Implementation services by HISP groups • Diversified funding reduces single-donor dependency	**Strong:** Consensus-building processes; Governments hold data sovereignty; accountability through long-term implementation relationships.	**Moderate to High:** Field implementation focus centres useContext; but Global South HISP groups face resource constraints.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
Beckn Protocol (open protocol, not platform)	Core Working Group (CWG), Area Directors, working group members, FIDE (Beckn Foundation), developers implementing protocol, businesses using Beckn, Governments (ONDC integration), merchants, consumers	**Specification governance:** • Core Working Group (protocol specification authority) • Domain-specific working groups (area evolution) • Area Directors (domain coordination) • Beckn Foundation (adoption coordination, stakeholder engagement)	• Encourages openness • Enables domain-specific evolution while maintaining interoperability • Transparent processes (public meetings, documented principles) • Separates specification from implementation, preserves flexibility • Real-world impact through ONDC	• Working group participation requires sustained engagement and technical fluency • Power dynamics favour well-resourced organisations • Consensus-building time-intensive • Nascent implementation in many domains	• Beckn Foundation coordination • Voluntary contributions • Dependent on ecosystem adoption	**Moderate:** Transparent processes enable scrutiny, but no formal elections.	**Moderate:** Open participation in Discord and GitHub discussions; influence derives from technical contribution; transparent processes; protocol decentralisation alone cannot overcome structural power asymmetries.
Mastodon and the Fediverse	Mastodon gGmbH/ European non-profit (software development), instance administrators (8,500+ instances), moderators, users across Fediverse, ActivityPub protocol standardisers (W3C)	• Layered/ federated: Mastodon non-profit (software development) • Autonomous instance administrators (independent governance, federation decisions) • Protocol coordination (W3C ActivityPub standard) • #fediblock community inputs	• Enables diverse community-driven spaces • Instance autonomy allows experimentation with moderation/ policies • Meaningful exit options empower users • Reduces single points of failure • No centralised platform control	• Instance administration requires technical/ financial/ moderation resources • Power asymmetries between well-resourced and volunteer instances • Moderation challenges multiply • Harmful actors exploit protocol openness • No mechanisms for ecosystem-wide coordination	• Crowdfunding, paid hosting services, and merchandise • Instance-level sustainability varies (donations, volunteers)	**Moderate:** The maintainer model for software governance is public. Instance accountability varies by local governance. No ecosystem- level accountability mechanisms.	**Moderate to High:** Radical decentralisation; instance-level governance varies (benevolent dictatorships to democratic collectives); users exercise voice and exit; enables safe spaces, but technical/resource barriers skew demographics among users (men from the Global North).

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
Data Cooperatives and Data Collectives							
Drivers Seat Cooperative	Gig worker-members, Board of Directors (driver representatives, external advisors), technical staff, research partners, advocacy organisations (Rideshare Drivers United, Los Deliveristas Unidos)	**Multi-stakeholder cooperative:** • Democratic member control (one-member-one-vote) • Board comprising elected driver representatives and external advisors, regular member assemblies, and working groups for policy/product development	• Worker empowerment through collective data control • Fairer conditions and profit sharing • Democratic governance • Supported academic and policy research	• Could not achieve scale to compete with platform monopolies • Democratic processes are time-intensive, creating operational tensions • Volunteer governance labour risks burnout	• Commission on services • Data licensing to researchers • Transitioned technology to Princeton's Workers' Algorithm Observatory 2023 • Failing to compete with platform monopolies	**Strong:** "One-member-one-vote", transparent reporting, elected representatives, and member assemblies.	**High:** Explicitly centred around marginalised gig workers. Worker-members voting rights; but participation demands on time-poor workers created barriers.
Abalobi (Platform supporting coopera-tives)	Small-scale fisher members (across multiple countries), fishing cooperatives, Abalobi NPO board (fisher representatives, academic partners, development specialists), community co-management, buyers (restaurants, consumers), funders (development organisations)	• Abalobi NPO (technical infrastructure management, strategic partnerships) • Individual fishing cooperatives retain data sovereignty • Co-management agreements • Regional cooperation and collective negotiation with external stakeholders	• Triple-bottom-line success (ecological, economic, social) • Revenue increases of fisher communities by 100-300% within a year of platform adoption, and catch composition of 93% ecologically-resilient fish stocks • Data sovereignty • Transparent and fair supply chain	• NPO dependency on external funding could create sustainability vulnerabilities • Requires diverse and resilient market support across the supply chain • Capacity remains a challenge • Scaling strains governance	• Non-profit with development partner funding, Government partnerships, and earned income from marketplace transactions.	**Strong:** Fisher cooperatives are democratically controlled. The NPO board includes fisher representatives. Co-management agreements embed accountability.	**High:** Explicitly addresses marginalised fishers (apartheid-era exclusions). However, smartphone/ literacy requirements create barriers for some marginalised users.

NAME	STAKEHOLDERS	DECISION MAKING	KEY ADVANTAGES	KEY CHALLENGES	SUSTAINABILITY	ACCOUNTABILITY	INCLUSIVITY
Maori Te Raraunga (Data sovereignty movement)	Te Mana Raraunga network (Māori researchers, data practitioners, iwi/hapū representatives, community organisations), Kaitiaki (guardians), iwi (tribes), hapū (subtribes), potential data users seeking access	• Network organisation • Kaitiakitanga (guardianship) governance wherein designated Kaitiaki exercise stewardship • Tikanga Māori protocols guide decisions • Kaitiakitanga Licence enforces cultural protocols	• CARE Principles provide an indigenous data sovereignty framework • Kaitiakitanga Licence legally enforces cultural protocols, protects against extractive appropriation, advances community aspirations (te reo revitalisation), and grants visibility in the data economy	• Principles are insufficient to adapt to the current data economy landscape • Lack of implementation • Governance needs to be dynamic • Need for enforced benefit-sharing • Need for better political recognition	• Volunteer contributions • Research grants • As a social movement, operational costs are not comparable	**Moderate:** Kaitiaki accountable through tikanga and iwi/hapū consultation. Network structure enables diverse participation, but traditional authority structures may not align with Western democratic concepts.	**High:** Network structure enables diverse Māori voices. Tikanga-based processes ensure cultural grounding. Iwi/hapū consultation required. Principle-based governance.

aapti institute

Aapti is a public research institute that works at the intersection of technology and society. Aapti examines the ways in which people interact and negotiate with technology both offline and online.

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