

The Multidimensional Digital Inclusiveness Index Scoring Dashboard (Version 2.0): A Tool for Visualizing Digital Inclusiveness and Innovation Performance within the CGIAR Framework

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About the CGIAR Accelerator for Digital Transformation and the CGIAR Sustainable Farming Program

The CGIAR Accelerator for Digital Transformation and the CGIAR Sustainable Farming Program represent part of CGIAR's broader digital strategy under the 2025–2030 research portfolio. These programs focus on harnessing digital tools, data science, and advanced analytics to modernize agricultural advisory systems and promote sustainable farming practices at scale.

The goal of digital transformation in this context is to provide farmers, governments, and agricultural stakeholders with accurate, localized, and actionable information to improve productivity, resilience, and long-term sustainability. This includes digital and AI-enabled advisory services that deliver real-time agronomic guidance, climate risk insights, pest and disease alerts, and other farm-level intelligence tailored to smallholder needs.

Through these programs, CGIAR aims to accelerate the adoption of evidence-based digital interventions that strengthen preparedness and rapid response to emerging threats, enhance climate resilience, and unlock opportunities for transformation across farming systems. In doing so, it contributes to CGIAR's broader mission of building inclusive, efficient, and resilient agrifood systems that support farmers and food security goals around the world.

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Summary

The Multi-Dimensional Digital Inclusiveness Index (MDII) Scoring Dashboard 2.0 project presents a redesigned analytical platform for evaluating and visualizing digital inclusiveness and innovation performance across the Agriculture, Food, Water, and Land (AFWL) sectors within the CGIAR framework. The redesign builds upon Version 1.0 and responds directly to stakeholder feedback by improving usability, strengthening visualization capabilities, and enabling seamless web integration. The upgraded system enhances data-driven decision-making and continuous stakeholder engagement across digital innovation portfolios.

At its core, the enhanced dashboard operationalizes the MDII's seven dimensions: Accessibility, Beneficial Impact, Usage Effectiveness, Ethical and Responsible Innovation, Co-Creation and Governance, Risks and Harms, and Supportive Ecosystem, through structured survey data and hierarchical scoring outputs. Data are sourced from consolidated score repositories and KoboToolbox survey instruments capturing inputs from innovators, evaluators, users, and beneficiaries. These inputs are processed through the MDII Data API to generate dimension-, subdimension-, and indicator-level metrics, which function as key performance indicators (KPIs) for monitoring digital innovation inclusiveness. Developed in Microsoft Power BI, the dashboard serves as a portfolio-level monitoring and evaluation system, enabling stakeholders to assess performance across tools, countries, technologies, and project phases (including Ex-Ante and Regular assessments). Advanced radar, gauge, waffle, and decomposition charts, combined with interactive filters, support comparative analysis and evidence-based portfolio management.

A major advancement in this iteration is the introduction of Stakeholder Relationship Mapping and People & Impact modules. These components visualize collaboration patterns, co-creation intensity, and beneficiary-level outcomes, offering deeper insight into how digital tools interact with diverse user groups, including women, youth, rural communities, and other marginalized communities. By linking inclusiveness metrics to real-world demographic and impact indicators, the dashboard strengthens accountability and supports targeted improvement strategies.

Overall, MDII Scoring Dashboard 2.0 advances the CGIAR initiative's mission to institutionalize digital inclusiveness monitoring through transparent data systems, structured KPIs, and actionable performance insights embedded within a continuous learning and project management cycle.

1.0 Introduction

Web-based interactions have become a fundamental driver of digital experience, enabling active participation, continuous engagement, and user feedback integration. In view of this, the MDII Scoring Dashboard was developed under the CGIAR Digital Innovation Program by the International Water Management Institute (IWMI) as a decision-support system to strengthen accessibility, inclusiveness monitoring and visualization, and adoption of digital innovations within the Agriculture, Food, Water, and Land (AFWL) sectors.

The MDII Dashboard was developed as an interactive tool for assessing the inclusiveness of digital solutions across CGIAR's research and innovation portfolios (Opola et al., 2023; Martins et al., 2023). The system aimed to ensure that digital tools are accessible, usable, safe, and beneficial to all actors in the agricultural ecosystem, with particular emphasis on marginalized groups such as women, indigenous peoples, and rural youth (Martins et al., 2023). By integrating both quantitative and qualitative metrics, the dashboard enabled users to monitor inclusiveness trends, assess digital equity, and identify areas requiring targeted improvement. Beyond inclusiveness assessment, dashboards like MDII enhance institutional capacity by improving data accessibility, accelerating decision-making, and fostering a culture of evidence-based management (Eberhard, 2021; Paulsen & Lindsay, 2024; Masiello et al., 2024). Their intuitive interfaces reduce cognitive load, minimize human error, and support timely interventions through real-time monitoring (Frontiers, 2023).

The core objective of the dashboard is to support evidence-based decision-making by offering a structured, data-driven view of inclusiveness dimensions ranging from accessibility and participation to ethical practice and community impact. Stakeholders can use the dashboard to answer critical questions such as:

- How inclusive is a given innovation across key dimensions?
- What is the user experience and accessibility profile of innovations?
- How effectively are stakeholders and communities engaged?
- What are the tangible impacts of innovations on people and society?

Building on the initial design (version 1.0), MDII Dashboard Version 2.0 was developed as a major redesign and functional upgrade to enhance usability, interactivity, and integration within CGIAR's broader digital ecosystem. Developed by the IWMI, Version 2.0 integrates stakeholder feedback from Version 1.0 and introduces substantial improvements in data visualization, user experience, and system performance. The redesign represents a significant advancement in transforming raw stakeholder and survey data into actionable insights for evaluating innovation inclusiveness, which aligns with CGIAR's digital transformation goals: promoting equity, sustainability, and impact-driven innovation through data-centric design.

The dashboard developed in Microsoft Power BI serves as a decision-support and performance-monitoring system, enabling stakeholders to visualize, interpret, and assess inclusiveness across different innovation portfolios. It integrates quantitative and qualitative datasets derived from KoboToolbox forms and scores, calculated from survey reports, uniting responses from innovators, evaluators, users, and beneficiaries into a cohesive analytical environment. The interface now features simplified navigation, enhanced visual hierarchy, and a unified design system that improves clarity and aesthetic coherence while maintaining alignment with MDII's branding guidelines. The improved Power BI visualizations make use of modern data-driven design principles, employing gauge charts, radar charts, waffle charts, and decomposition trees to highlight inclusiveness dimensions in a clear, interactive format.

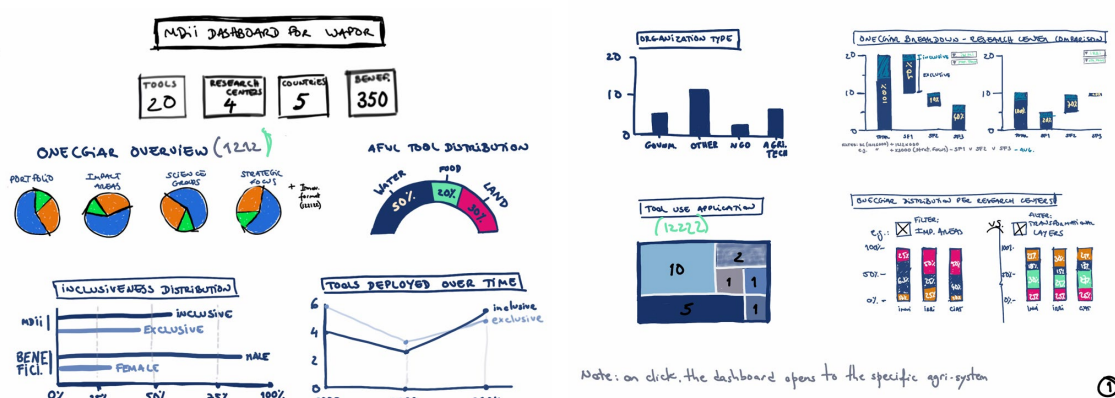
Several new capabilities distinguish the redesigned dashboard from its initial development, and these include:

- **Enhanced System Type Analysis:** Enables detailed classification of digital tools across food, water, and land domains.
- **Advanced Interactive Visuals:** Incorporates richer visualization formats for deeper exploration of inclusiveness indicators.
- **Stakeholder Relationship Mapping:** Introduces a novel module for visualizing the ecosystem of actors, collaborations, and feedback loops.
- **User-Centered Design:** Applies user research and stakeholder feedback to deliver an intuitive interface with efficient filters and customized reports.
- **Inclusiveness Impact Tracking:** Expands measurement frameworks to capture data on gender, youth, and other marginalized groups for more precise equity analysis.

In essence, MDII Version 2.0 advances beyond a visualization tool to become a comprehensive digital inclusive intelligence platform. By merging technical innovation with ethical, user-centered design, it strengthens CGIAR’s mission to promote inclusive digital transformation. It empowers portfolio managers, researchers, innovators, and policymakers with evidence-based insights, fostering a culture of continuous learning and improvement that bridges technology and equity in agricultural innovation.

2.0 Design and Development Process

The development process began with stakeholders’ and experts’ requirement-gathering and collaboration, during which stakeholders reviewed lessons from Version 1.0 and evaluated limitations such as limited interactivity, navigation complexity, and restricted integration with web systems. Insights from portfolio managers and innovators were consolidated into functional requirements that shaped the layout, color hierarchy, and key data components featured in the redesigned MDII Dashboard Layout. A conceptual layout of the dashboard was designed, serving as a prototype for the MDII Scoring Dashboard prior to the development, as illustrated in Figure 1 below.



assessment required both quantitative indicators and qualitative narratives. As a result, the redesigned layout incorporated sections such as Overview, Usage Experience, Stakeholder Relationships, People and Impact, and General Info & Method, allowing users to explore metrics while contextualizing them with qualitative insights. These structural changes were refined through several feedback iterations, with each cycle focusing on balancing analytical precision and ease of interpretation.

The technical development leveraged seven primary tables and multiple derived and reference datasets extracted from KoboToolbox submissions. Complex data transformations, including unpivoting, normalization, and hierarchical mapping, were conducted to ensure compatibility across all datasets. Over fifteen DAX (Data Analysis Expressions) measures were developed to compute aggregate inclusiveness scores, sub-dimension indices, and comparative performance benchmarks. The regular cross-team review sessions ensured that visual, functional, and technical elements evolved cohesively. The process also encouraged open communication through shared repositories, live testing links, and annotated prototypes, reinforcing transparency and co-ownership among all contributors.

Ultimately, the Version 2.0 development process exemplified the CGIAR Digital Accelerator's commitment to inclusive innovation, not only in the tools it produces but also in how they are co-created. The resulting dashboard layout captures this collective effort: an interface shaped by multidisciplinary collaboration, guided by end-user feedback, and optimized for accessibility, clarity, and adaptability. This collaborative design journey laid out a solid foundation for future iterations of the MDII Dashboard, where continuous feedback and participatory refinement remain central to sustaining usability and impact.

3.0 Navigating the Dashboard

The MDII Scoring Dashboard version 2.0 is designed to enhance easy navigation and accessibility. With clear menu structures, filters, and user-friendly flows, it reduces complexity and helps users find information quickly. The redesigned dashboard adopts a cleaner, more intuitive layout, divided into a fixed top-level navigation bar, a contextual filter ribbon, and a multi-panel visualization workspace. As illustrated in Figure 2, the navigation bar, positioned at the upper portion of the interface, anchors five main tabs: Overview, Usage Experience, Stakeholder Relationships, People and Impact, and General Info and Method, mirroring the logical flow of the MDII inclusiveness framework. Each tab acts as an independent analytical module, but all share the same interaction logic and design consistency.

Directly beneath the navigation bar lies the filter control strip, a newly refined feature allowing users to segment and interrogate data across multiple parameters: Tools/Innovation, Country, Dataset, and Technology. This design improvement addresses one of the major usability requests identified by stakeholders, with emphasis on the need for flexible data filtering without disrupting the analytical flow. By combining dropdown filters with responsive charts, Version 2.0 allows users to narrow their focus to specific innovation portfolios or geographical scopes while maintaining visibility of the aggregated results.

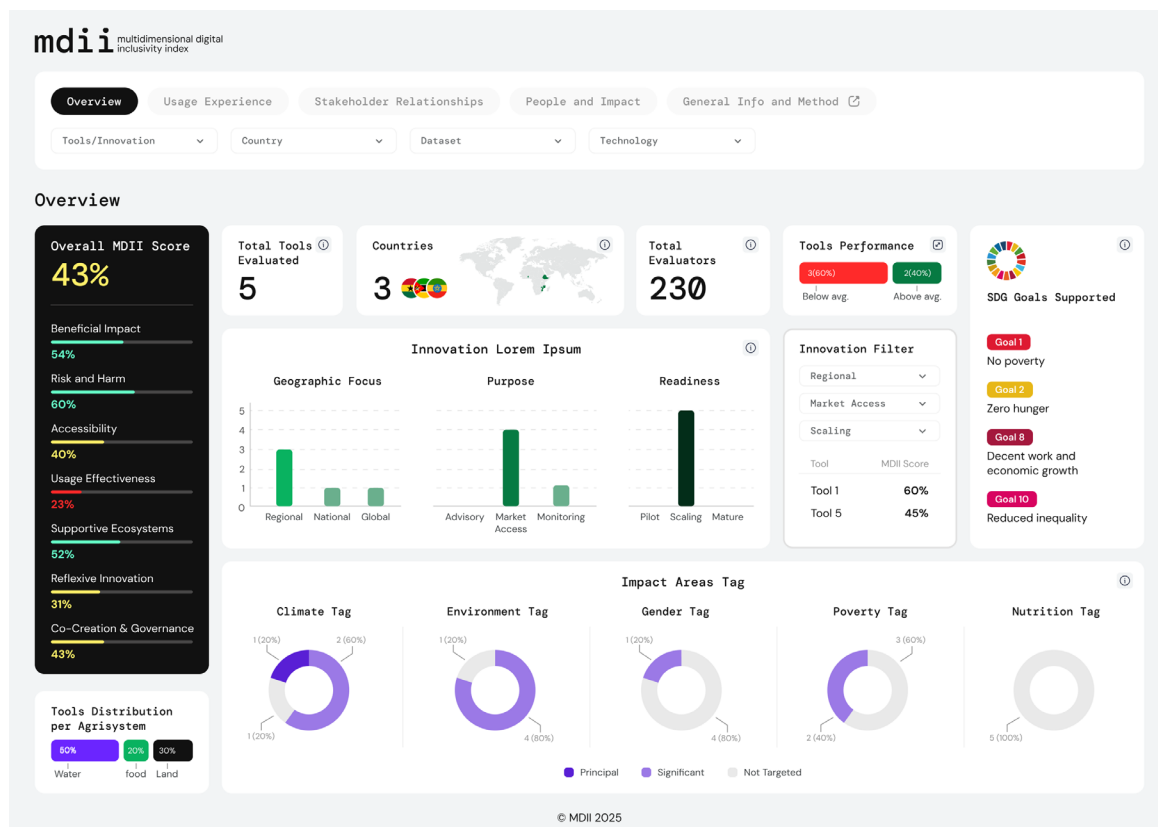


Figure 2: The MDII Scoring Dashboard Version 2.0 navigation bar, with menu tabs positioned at the upper portion of the dashboard. Source: Authors

Through its modular architecture, the “Inclusiveness Reporting Dashboard” offers stakeholders a unified analytical environment that integrates visual clarity with methodological rigor. It demonstrates how geospatial, demographic, and survey-derived data can converge into a dynamic platform that drives inclusiveness policy and innovation evaluation.

Dashboard Structure and Tab Descriptions

The structural organization of the MDII Dashboard is summarized in Table 1. The table outlines the primary navigation tabs, global filtering controls, and footer components that collectively define the functional architecture of the dashboard, as visualized above in Figure 2.

Table 1: Structural Components of the MDII Scoring Dashboard (Version 2.0)

Navigation Element	Description and Functionality
Overview	Opens the main summary page showing inclusiveness scores, evaluator counts, readiness phases, SDG alignment, and impact tags. It is the default landing page and provides a consolidated performance snapshot across all innovations.
Usage Experience	Displays data on user demographics, accessibility, and satisfaction. Focuses on how end-users interact with innovations, highlighting barriers and enabling

conditions for inclusiveness. Interactive filters allow disaggregation by country, tool type, or portfolio.

Stakeholder Relationship	Presents an analysis of collaboration and engagement among innovators, evaluators, and partners. Includes visuals on co-creation, participation intensity, and consultation reach, emphasizing stakeholder inclusiveness.
People and Impact	Highlights beneficiary-level outcomes and community reach. Shows metrics on gender, poverty, nutrition, environment, and climate impact using charts and tag indicators, and integrates cross-filters with the Overview page.
General Info & Method	External button linking directly to the MDII (Multidimensional Digital Inclusivity Index) website. Opens the online methodological guide, data dictionary, and scoring framework for transparency and deeper interpretation.
Footer	Displays “© MDII 2025 - Designed & Developed by Spatialnode Inc.,” confirming the release year and developer. It serves as a reference point for documentation and dashboard authenticity.
Dashboard Title & Framework	MDII - Multidimensional Digital Inclusivity Index. This Power BI dashboard evaluates the inclusiveness of digital innovations across multiple dimensions, such as accessibility, ethics, impact, and stakeholder participation. It aligns with global SDG goals and is developed by <i>Spatialnode Inc.</i>
Tools/Innovation	Selects a specific digital tool or innovation under review.
Country	Filters data by country of implementation or assessment.
Technology Type	Filters by the underlying technology (e.g., digital platform, AI tool, extension service).
Project Portfolio	Segments tools into program portfolios (CGIAR, etc.)

3.1 Overview Section

The Overview page serves as the central gateway to the MDII Dashboard Version 2.0, as shown in Figure 2 above. It provides an at-a-glance summary of the inclusiveness performance across digital tools evaluated within the CGIAR framework. Building on the Version 1.0 architecture by Vinuri et al. (2024), the Version 2.0 interface consolidates multiple key indicators, visual summaries, and filters into a collected, highly interactive environment that empowers portfolio managers, innovators, and researchers to explore inclusiveness insights with greater precision and efficiency.

3.1.1 Left-Side Analytical Summary Panel

The left column of the dashboard, showing the “Overall MDII Score” as illustrated in Figure 3, presents a high-contrast summary panel that encapsulates the overall inclusiveness standing of all evaluated tools. In reference to the overview panel, the Overall MDII Score (43%) offers an aggregated performance index derived from the seven MDII dimensions. This score functions as the anchor metric, an immediate indicator of how digitally inclusive a portfolio of innovations is relative to established benchmarks.

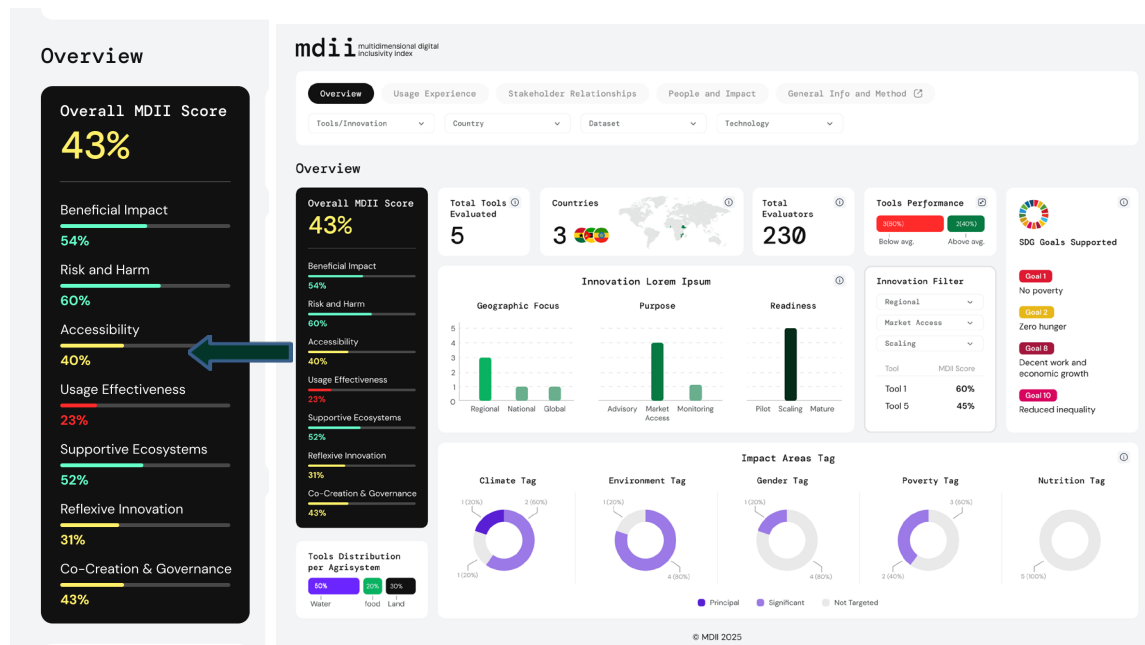


Figure 3: Overall MDII Score. Source: Authors

Beneath the main score, seven dimension-specific progress bars provide granular detail across the following categories:

- **Beneficial Impact:** Measures the extent to which digital tools generate positive, equitable outcomes for users.
- **Risk and Harm:** Captures how tools mitigate or exacerbate social, ethical, or digital access risks.
- **Accessibility:** Assesses the degree to which tools are available and usable by diverse user groups.
- **Usage Effectiveness:** Evaluates the adoption rate and functional performance in practice.
- **Supportive Ecosystems:** Reflects the enabling infrastructure and policy environment that sustains innovation use.
- **Reflexive Innovation:** Measures adaptive learning and the incorporation of feedback loops into design cycles.
- **Co-Creation and Governance:** Highlights inclusiveness in decision-making, partnership, and co-design processes.

These seven indicators collectively demonstrate MDII’s multidimensional character, offering a balanced mix of quantitative (numeric) and qualitative (perceptual) measures, a philosophy introduced in Version 1.0 and reaffirmed during the 2024 working session. The red bar indicates poor metrics, the yellow bar indicates fair metrics, while the green bar indicates metrics with good performance. By retaining this multidimensional structure,

Version 2.0 ensures comparability across time while enhancing interpretability through color-coded bars and responsive hover tooltips that display the underlying dataset.

3.1.2 Tools Distribution per Agrisystem (Bottom Left)

At the bottom of the overview panel is the “Tools Distribution per Agrisystem chart.” This chart (Figure 4) shows how different innovations are distributed across agricultural domains like food, land, and water systems. It is important because it helps stakeholders see which parts of the agrisystem receive the most innovation focus and which areas may need more attention or investment.

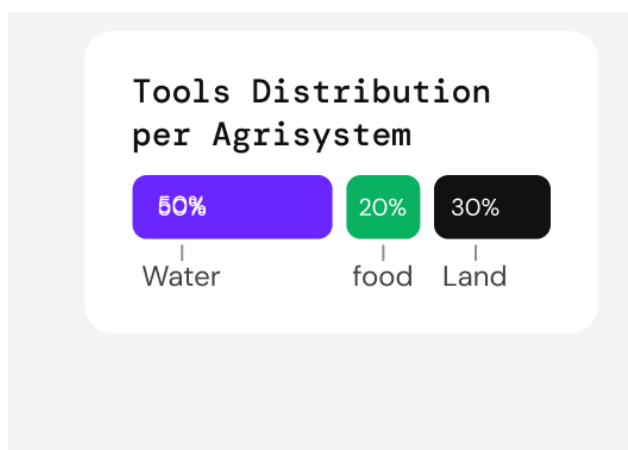


Figure 4: Tools Distribution per Agrisystem. Source: Authors

3.1.3 Top-Level Performance Indicators

The central workspace begins with a set of KPI cards summarizing essential statistics, as illustrated in Figure 5 below:

- **Total Tools Evaluated:** This counts the number of innovations assessed under the current filter.
- **Countries:** Displays the geographic spread through a world-map graphic annotated with country flags.
- **Total Evaluator:** Quantifies stakeholder participation, emphasizing the diversity and robustness of feedback.

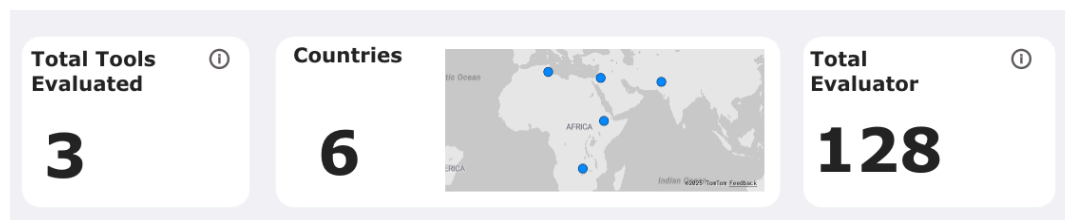


Figure 5: KPI cards summarizing essential statistics. Source: Authors

Together, these KPIs establish context for subsequent analyses. The visualization of the countries’ distribution via an embedded map embodies the redesign’s focus on interactive visualizations and geospatial context awareness, allowing users to hover for quick insights into regional coverage. Adjacent to these KPIs, two additional widgets, Tools Performance and SDG Goals Supported, extend interpretive capacity.

3.1.4 Tools Performance Table (Right Center)

The Tools Performance card, as shown in Figure 6, presents a concise comparative chart showing how many tools perform below or above average. In the sample view, three of five tools (60%) fall below average, while two (40%) exceed expectations. The color coding (red for below, green for above) provides immediate visual differentiation and improves situational awareness. This enhancement was a direct response to the stakeholder request for simplified performance categorization rather than detailed numeric tables.

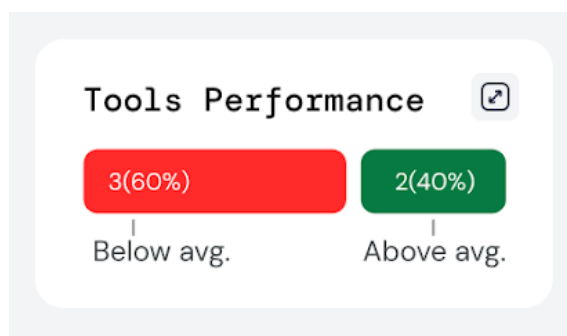


Figure 6: Tools Performance Indicator. Source: Authors

3.1.5 SDG Goals Supported (Right Sidebar)

The SDG Goals Supported card illustrated in Figure 7 aligns the MDII outcomes with global development objectives, linking each tool’s inclusiveness performance to relevant Sustainable Development Goals (SDGs), such as No Poverty (Goal 1), Zero Hunger (Goal 2), Decent Work and Economic Growth (Goal 8), Reduced Inequality (Goal 10), etc., and connects inclusiveness evaluation to the global development agenda, helping policymakers and donors see how innovations contribute to broader sustainability targets.



Figure 7: SDG Goals Supported card. Source: Authors

3.1.6 Middle-Tier Analytical Charts

Beneath the KPI row is a group of analytical visualizations (bar charts) that explore the “Tools Innovation Profile”. As shown in Figure 8, the chart displays the geographical focus, tool purpose, and readiness phase of the innovation.

- **Geographical Focus (Bar Chart):** This visual displays the scale or reach of each innovation, whether local, national, regional, or global. It is important because it highlights where inclusiveness efforts are geographically concentrated and identifies potential gaps in global or regional coverage.
- **Tool Purpose:** This chart distinguishes between types of innovation models, such as those developed for commercial profit versus those driven by social or developmental goals. It is important because it helps understand the underlying intent and sustainability of innovations in promoting inclusiveness.
- **Readiness Phase:** Categorizes innovations by their stage of maturity, from concept to deployment. It is important because it helps users identify which innovations are ready for scaling and which are still in development, guiding support and resource allocation.

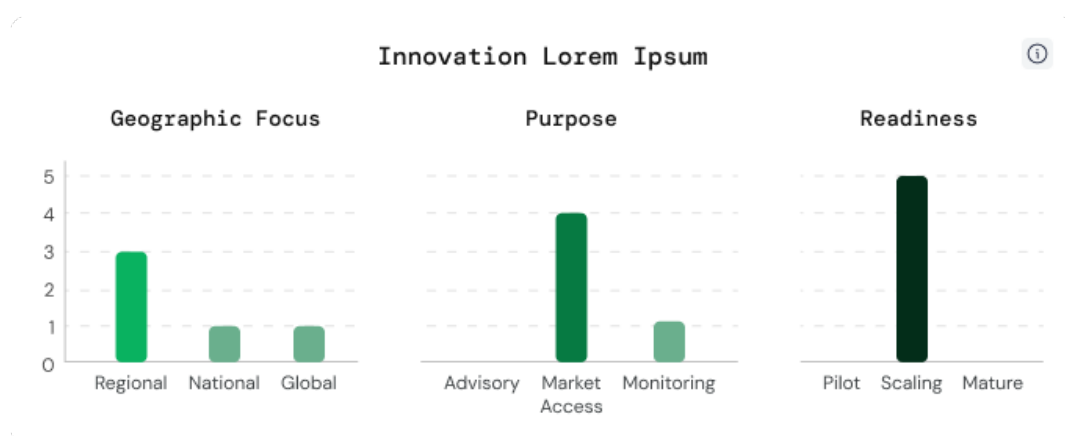


Figure 8: Analytical visualizations that explore innovation focus. Source: Authors

Each of these bar charts responds dynamically to filter selections, enabling comparative analysis across countries or innovation types. They collectively answer fundamental management questions: Where are our digital tools focused, what do they aim to achieve, and how mature are they in deployment?

These analytics draw directly from Version 1.0’s “Tool Profiles” section but integrate stronger color contrast and standardized axes for easier visual comparison. The unified labeling convention (“Tools Innovation Profile”) also reflects the new data schema standardization adopted in Version 2.0 to ensure consistent metadata classification across datasets.

3.1.7 Innovation Filter Panel

On the right side of the “Tools Innovation Profile” block is the Innovation Filter module. The innovation filter panel allows users to refine results by location, purpose, readiness, or specific innovation as displayed in Figure 9. It is important because it makes the dashboard dynamic and adaptable, letting users perform targeted analyses based on their area of interest and observe corresponding score updates across all charts.

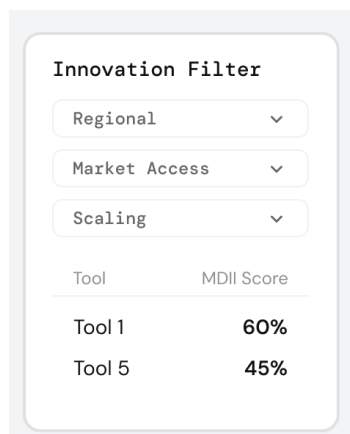


Figure 9: Innovation Filter Panel. Source: Authors

3.1.8 Impact Area Tags (Bottom Section)

The lower section of the “Overview” page hosts a collection of impact-area tag visuals, each represented by circular donut charts. These visual tags, as displayed in Figure 10, represent how innovations contribute to key thematic areas such as climate, environment, gender, poverty, and nutrition. It is important because it summarizes real-world outcomes and shows how inclusiveness translates into tangible community or environmental benefits.

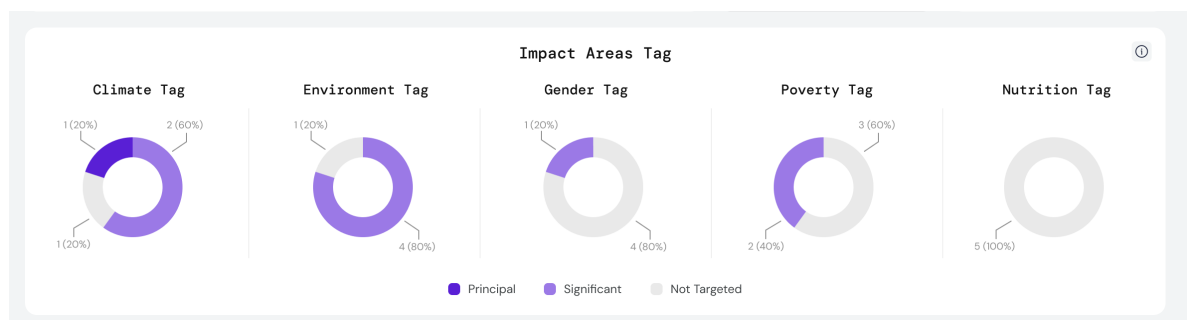


Figure 10: Impact Areas Tag. Source: Authors

This visualization is one of Version 2.0’s hallmark improvements. The new layout presents them separately to emphasize sectoral connections. For example, under the current dataset illustrated in Figure 10, one of five tools (20%) has significant alignment with Climate Impact, while only one (20%) shows a “Not Targeted” contribution to Climate Impact. This modular approach supports targeted interventions and resource prioritization within specific domains.

3.2 Usage Experience Section

The Usage Experience section of the MDII Scoring Dashboard redesign (Version 2.0) provides an in-depth visualization of how users interact with digital innovations, focusing on accessibility, affordability, inclusiveness, and engagement. Building upon the foundation of Version 1.0, this section introduces enhanced visualization tools and refined data categories that capture a multidimensional view of digital usage. The aim is to help portfolio managers and decision-makers assess not just the performance of innovations, but also their actual usability and inclusiveness across diverse user groups.

Version 1.0 laid down the groundwork by tracking user accessibility, tool performance, and connectivity. However, through stakeholder feedback sessions, users requested richer interaction insights, specifically around affordability, literacy alignment, support systems,

and user participation. Version 2.0 responds to these needs with an improved interface, advanced chart types, and comparative metrics as displayed in Figure 11. This visualizes how well digital innovations align with inclusiveness goals in real-world scenarios.

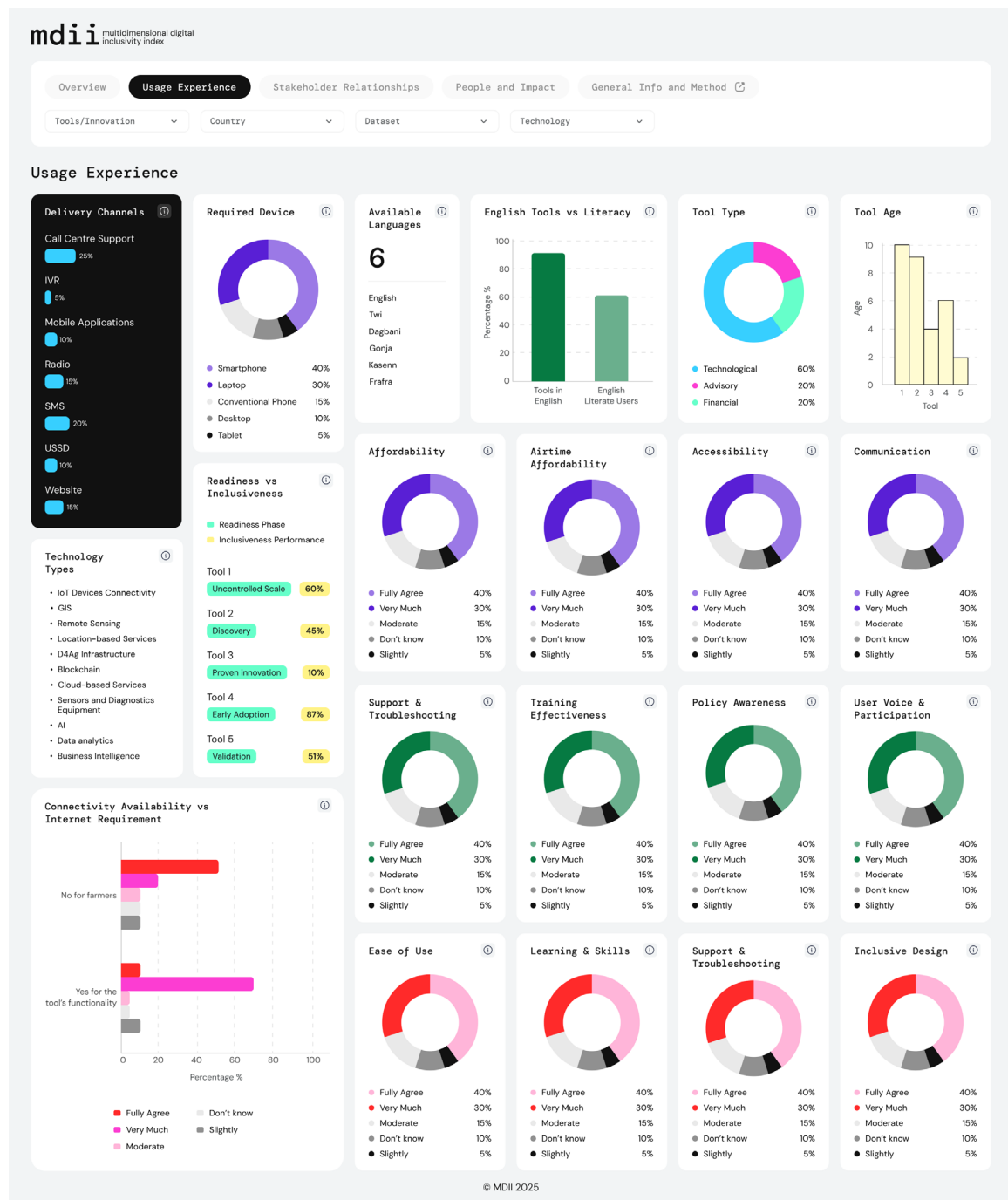


Figure 11: Usage Experience Scoring Dashboard. Source: Authors

3.2.1 Delivery Channels and Technology Types

The delivery channels' visualization as displayed in Figure 11 highlights the various channels through which users access digital tools, ranging from call centers, IVR, and mobile applications to radio, SMS, desktop, and web-based platforms. The design uses an interactive chart to visualize proportional usage, providing immediate insight into user preferences and accessibility constraints. It is important because it highlights accessibility

and diversity and reveals how inclusiveness depends on multi-channel delivery to reach different audiences.

The inclusion of technology types such as IoT devices, GIS, remote sensing, AI, and business intelligence tools, as displayed beneath the delivery channels in Figure 11, reflects the expanding scope of digital inclusiveness across diverse innovation ecosystems.

These features underscore MDII's commitment to understanding how technology types influence inclusiveness and accessibility, especially in low-connectivity environments.

3.2.2 Tool Type and Tool Age

The tool-type chart in Figure 12 categorizes the nature of innovation, such as capacity-building tools, technical solutions, advisory systems, or financial platforms. This feature helps assess the inclusiveness focus of different innovation types and their societal role.

The tool-age chart beside the tool type displayed in Figure 12 visualizes how long each digital innovation has been active. It reveals tool maturity and adoption potential, helping to distinguish between emerging solutions and established systems.

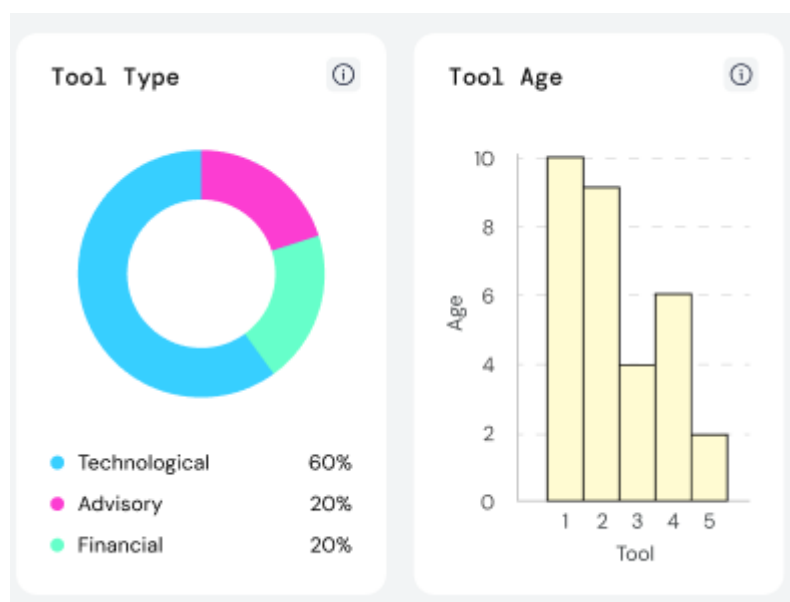


Figure 12: Tool type and tool age. Source: Authors

3.2.3 Required Device and Connectivity Availability

The required device illustrates the devices required to access digital tools, showing usage distribution across smartphones, laptops, conventional phones, desktops, and tablets. According to the sample chart in Figure 11, smartphones are the predominant access device, highlighting mobile-first inclusiveness but also revealing gaps in accessibility for users without advanced devices.

Complementing this, the Connectivity Availability vs. Internet Requirement graph offers a comparative view of internet dependency. This feature, newly refined in Version 2.0, visually links network requirements with user accessibility, distinguishing between “yes” (tools that function under existing infrastructure) and “no” (tools that exclude offline or low-bandwidth users). This metric supports digital equity assessment by illustrating whether innovations are realistically usable by target demographics, including rural farmers and smallholder users.

3.2.4 Language Accessibility and Literacy

The Available Languages and English Tools vs. Literacy visualizations reveal how linguistic inclusiveness affects tool usability. In the sample chart as displayed in Figure 13, six languages; English, Twi, Dagbani, Gonja, Kasem, and Frafra; are represented, showcasing efforts to localize digital tools. The literacy comparison chart provides a visual representation of the gap between the tools available in English and literacy rates among users, reinforcing the importance of language diversity for equitable access.

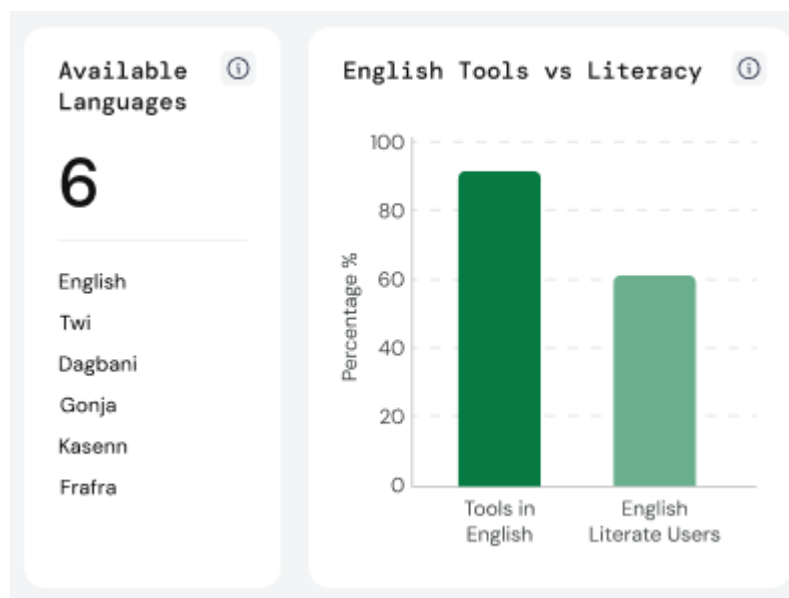


Figure 13: Language Accessibility and Literacy. Source: Authors

This dual-language visualization was introduced based on feedback from Version 1.0, where stakeholders emphasized that linguistic inclusiveness directly impacts engagement levels and adoption rates.

3.2.5 Affordability and Accessibility Indicators

Affordability remains a critical factor in determining the inclusiveness of digital tools. The redesigned dashboard introduces multiple interlinked donut charts, as shown in Figure 14; these include Affordability, Airtime Affordability, Accessibility, and Communication that visualize user responses ranging from “Fully Agree” to “Don’t Know.” These metrics allow evaluators to examine economic barriers influencing digital participation.

The Accessibility chart complements this by focusing on the physical and infrastructural ease of using tools. Collectively, these visuals (Figure 14) provide a snapshot of how

economic and environmental factors shape user experience, aligning with the MDII framework’s social equity goals.

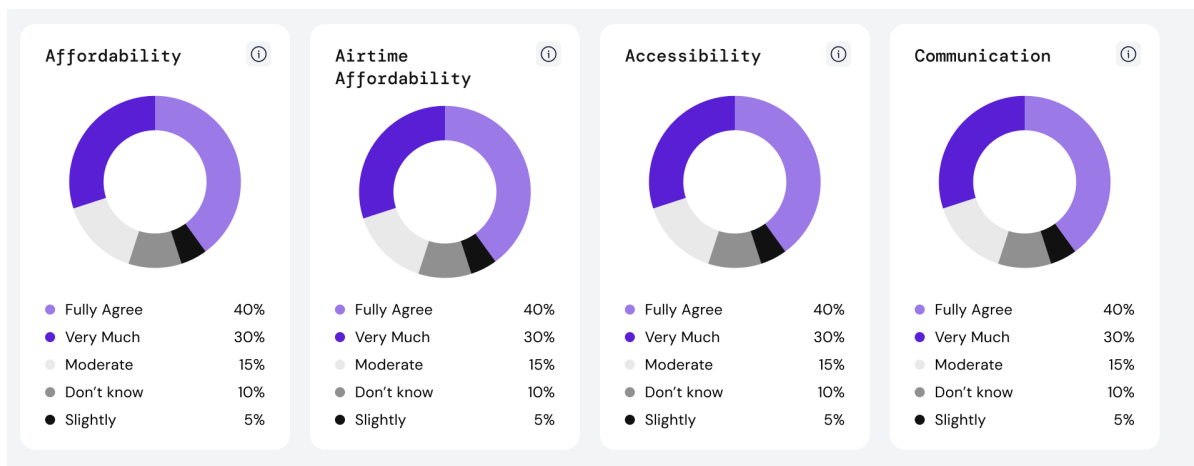


Figure 14: Affordability and Accessibility Indicators. Source: Authors

3.2.6 Communication, Support, and Training

The Communication, Support & Troubleshooting, Training Effectiveness, Policy Awareness, and User Voice & Participation charts (Figure 15) reflect user experience beyond technology, capturing responsiveness, learning facilitation, and problem resolution. The interactive nature of these visuals enables users to assess how well digital innovations maintain post-deployment engagement and support systems.

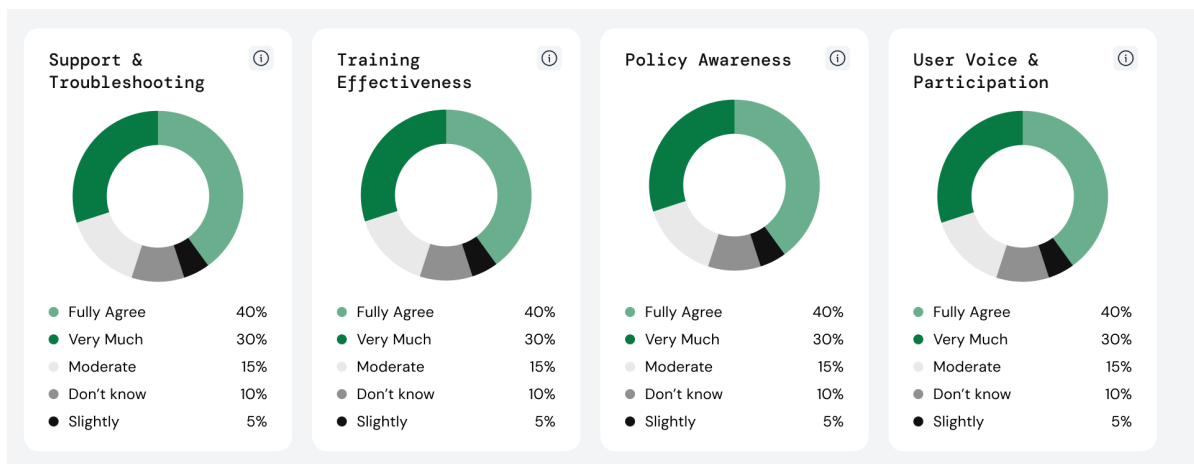


Figure 15: Support & Troubleshooting, Training Effectiveness, Policy Awareness, and User Voice & Participation charts. Source: Authors

This scoreboard integrates feedback from field testers who emphasized that consistent user support, follow-up communication, and hands-on training significantly enhance inclusiveness. As illustrated in Figure 15, these charts help decision-makers identify whether innovations sustain meaningful relationships with their user base.

Furthermore, the “Policy Awareness and User Voice & Participation” indicators measure the degree to which users understand the regulatory and governance framework of digital tools, as well as how actively they contribute feedback. The visual configuration shown in Figure 15 provides measurable insights into how user inclusiveness extends beyond access toward shared ownership and co-creation. The interactive representation of user participation underscores MDII’s participatory approach to innovation evaluation.

3.2.7 Ease of Use, Learning, and Inclusive Design

The bottom part of the “Usage Experience” dashboard are charts presenting the “Ease of Use, Learning Indicators, Support & Troubleshooting, and Inclusive Design” metrics (Figure 16). These assess how intuitive and educationally supportive digital tools are. The inclusion of inclusive design as a distinct metric in Version 2.0 demonstrates a stronger focus on user diversity, ensuring that innovations cater to different literacy levels, abilities, and socio-economic contexts.

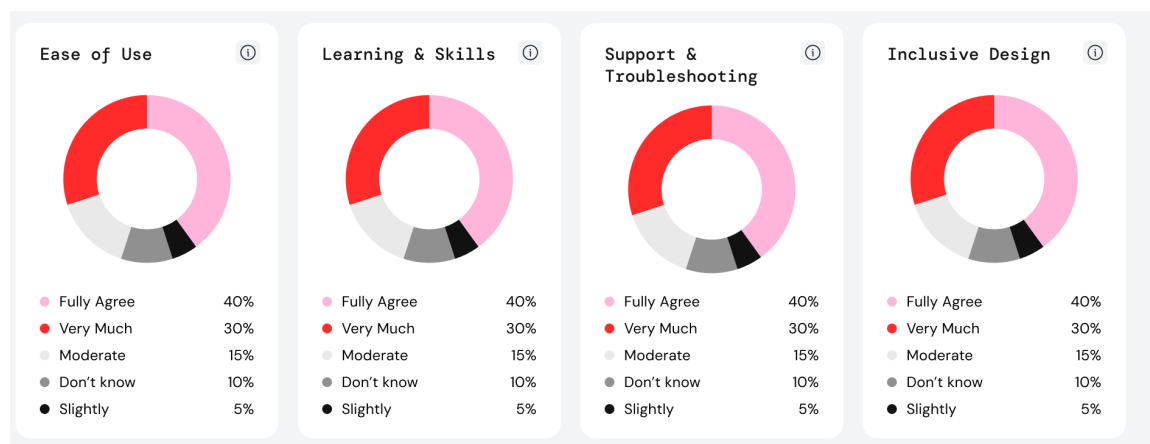


Figure 16: Ease of Use, Learning, and Inclusive Design. Source: Authors

As illustrated in Figure 16, the combined visualization of usability, skill development, and inclusiveness indicators enables a holistic assessment of user experience. These visuals integrate quantitative scoring outputs with qualitative feedback, providing actionable intelligence for improving tool design and accessibility. The user-centric interface directly aligns with the MDII’s human-centered evaluation framework, promoting equitable participation and sustained engagement.

3.2.8 Readiness and Inclusiveness Performance

The Readiness and Inclusiveness Performance visualization (Figure 17) connects the readiness phase of each innovation (ranging from “Uncontrolled Scale” to “Validation”) with inclusiveness performance scores. This comparative model allows evaluators to see how maturity levels affect inclusiveness outcomes. As illustrated in Figure 17, innovations in early validation or scaling phases tend to perform better when inclusiveness is prioritized from the design stage.

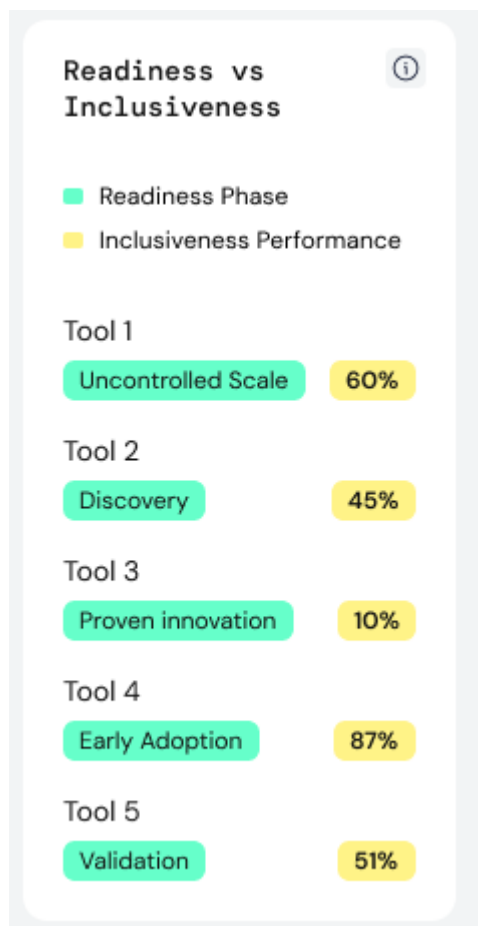


Figure 17: Readiness and Inclusiveness Performance. Source: Authors

This alignment between development readiness and inclusiveness is a new addition to (new design) Version 2.0, translating previously qualitative assessments from Version 1.0 into quantifiable performance metrics.

The “Usage Experience” section of the MDII Scoring Dashboard Version 2.0 demonstrates how digital inclusiveness extends beyond access to encompass usability, affordability, and user empowerment. Visualizing data on device access, connectivity, communication, training, and inclusive design provides a comprehensive overview of how end users interact with digital innovations across different contexts. The insights derived here serve as a foundation for understanding stakeholder interdependencies, as the way users experience tools often reflects how effectively innovators, developers, and partners collaborate to sustain inclusiveness. This natural progression sets the stage for the next section, Stakeholder Relationships, which explores the ecosystem of actors driving the performance, outreach, and long-term equity impact of these digital innovations.

3.3 Stakeholder Relationships

The Stakeholder Relationships section of the MDII Scoring Dashboard Version 2.0 (Figure 18) provides a detailed visualization of how inclusiveness and ethical innovation practices are embedded within the ecosystem of digital tool development. Building on the foundations laid in Version 1.0, this upgraded version expands the analysis by offering deeper insights into collaboration, governance, co-creation, partnership patterns, and feedback mechanisms, factors that are essential for achieving digital inclusiveness across diverse user groups.

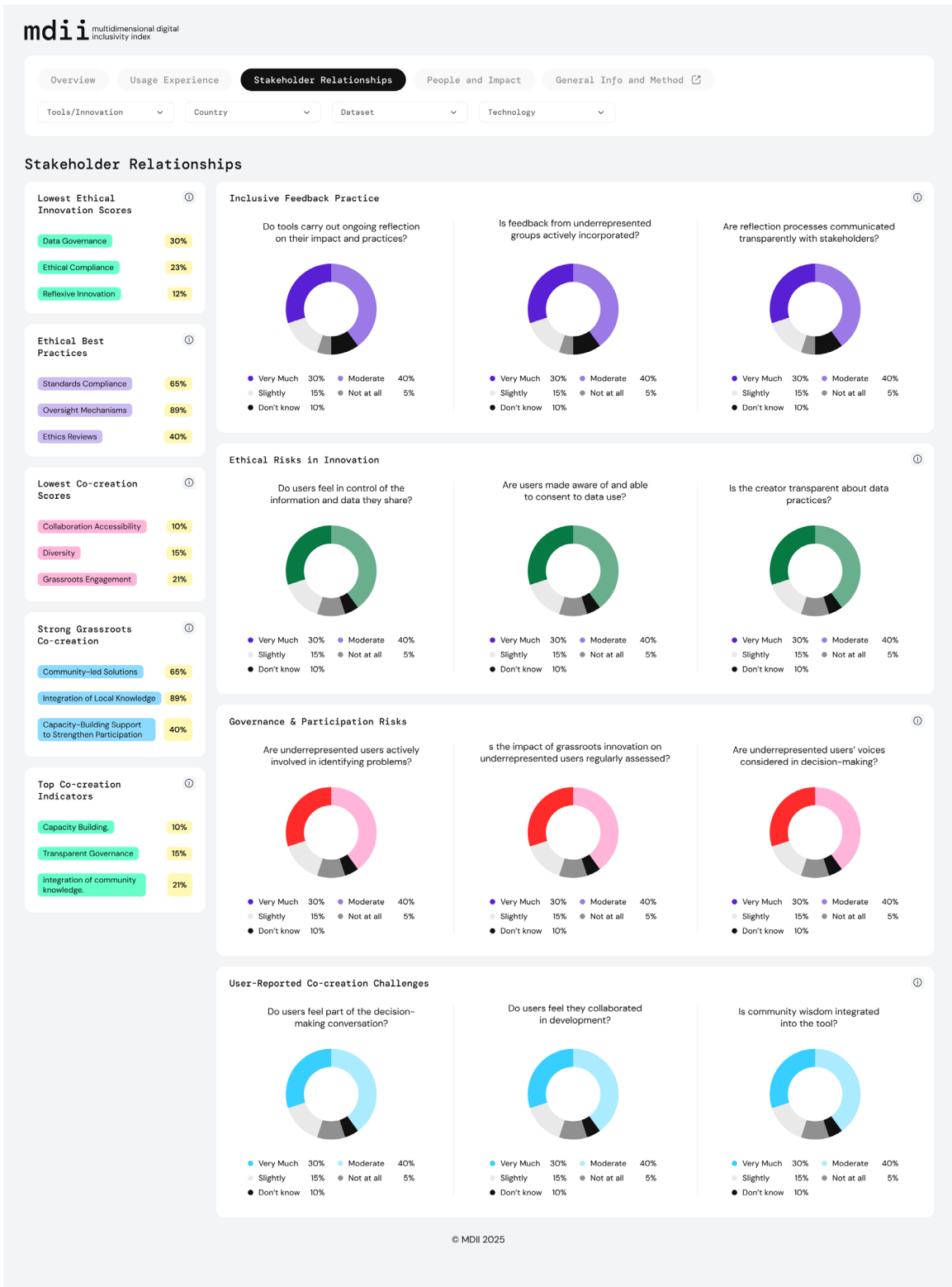


Figure 18: Stakeholder Relationships. Source: Authors

In Version 1.0, the stakeholder relationship visualization primarily focused on feedback collection and the assessment of ethical and participatory practices. However, Version 2.0, as shown in Figure 18, takes this further by integrating multi-dimensional stakeholder mapping and user interaction analytics. This enables users to not only assess the presence of stakeholder engagement but also measure the quality and depth of collaboration across the innovation lifecycle, from ideation to deployment.

3.3.1 Inclusive Feedback Practices

This section (Figure 19) visualizes how effectively feedback loops are maintained and integrated. The three donut charts track whether tools:

- Carry out ongoing reflection on their impact and practices,
- Incorporate feedback from underrepresented groups, and
- Communicate reflection outcomes transparently.

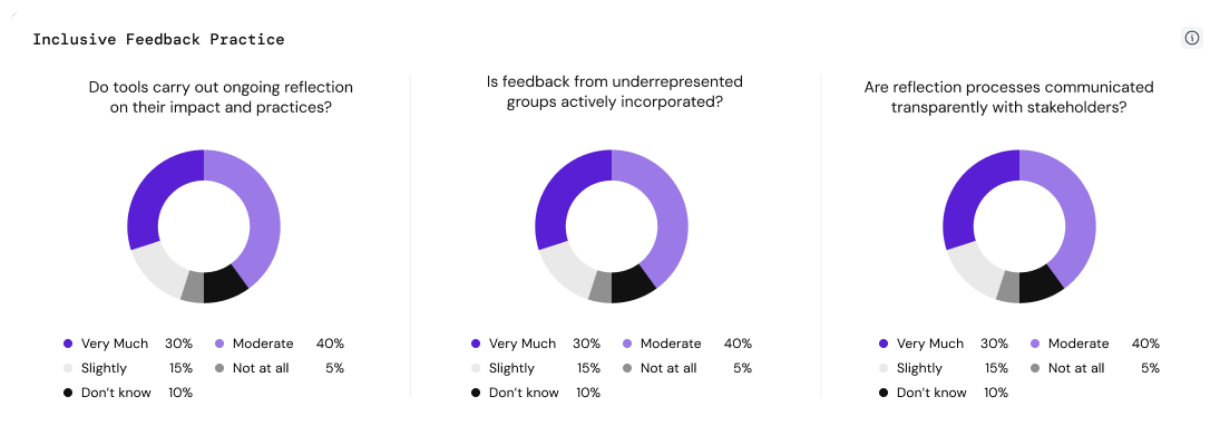


Figure 19: Inclusive feedback practices. Source: Authors

Each visual metric enables users to evaluate how participatory and reflexive digital innovations are. The balance between “Very Much,” “Moderate,” and “Slightly” responses reflect the inclusiveness and maturity of a tool’s feedback ecosystem.

3.3.2 Ethical Risks in Innovation

The Ethical Risks visualization (Figure 20) examines how digital innovations handle data, privacy, and user consent responsibly. Charts on user control, awareness of data sharing, and transparency in data practices help users identify potential ethical vulnerabilities. Compared to Version 1.0, this section integrates additional metadata filters, allowing evaluators to segment insights by region, tool type, or innovation phase, making ethical performance assessments more granular and actionable.

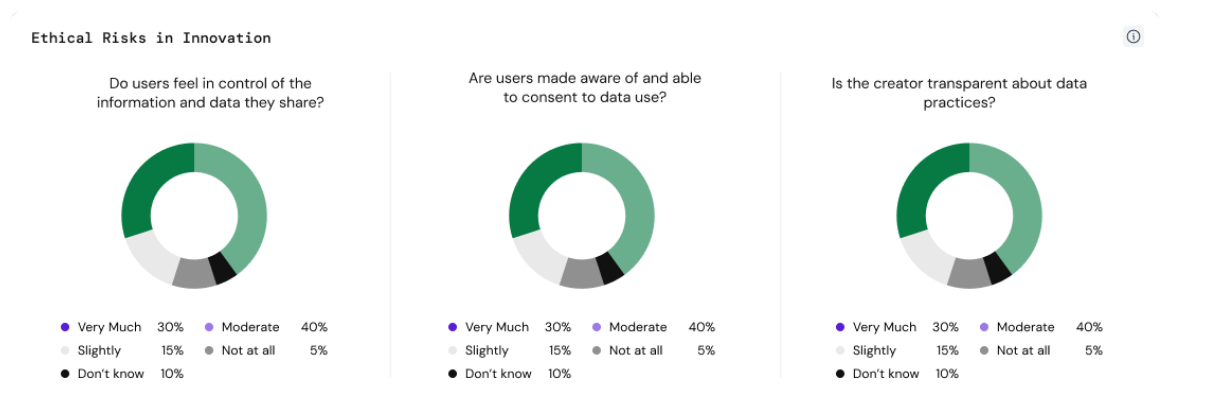


Figure 20: Ethical risks in innovation. Source: Authors

3.3.3 Governance and Participation Risks

The governance and participation metrics, as illustrated in Figure 21, measure how well tools empower underrepresented groups in the innovation process. The visuals highlight whether marginalized users are:

- Involved in problem identification,
- Regularly assessed for grassroots impact, and
- Included in decision-making processes.

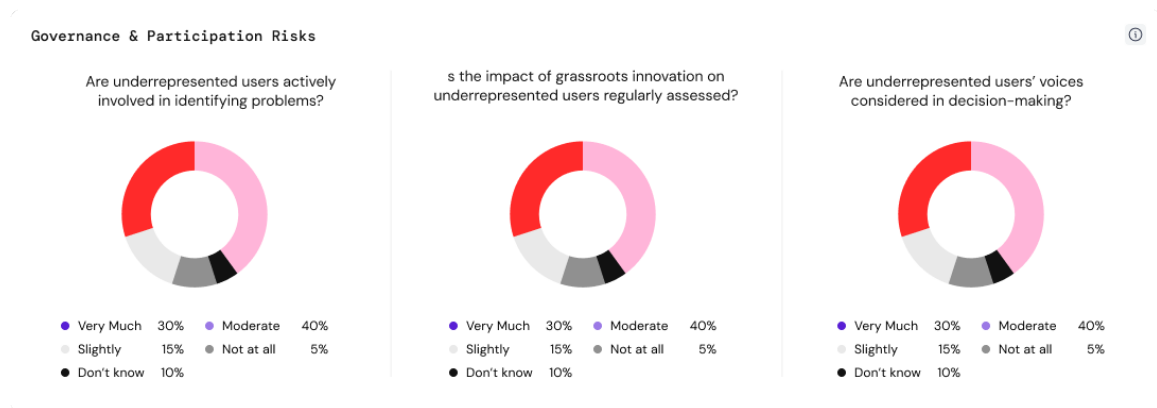


Figure 21: Governance and participation risks. Source: Authors

The redesign strengthens this section with cross-dimensional tagging, enabling correlation between participation scores and inclusiveness outcomes in other dashboard sections (e.g., “People and Impact”). This holistic linkage provides richer contextual insights into how inclusive governance affects overall innovation performance.

3.3.4 User-Reported Co-Creation Challenges

This subsection captures user-centered feedback on co-creation, focusing on collaboration and community integration. The visual charts as displayed in Figure 22 represent three core questions:

- Do users feel part of the decision-making conversation?
- Do they feel they collaborated during development?
- Is community wisdom integrated into the tool?

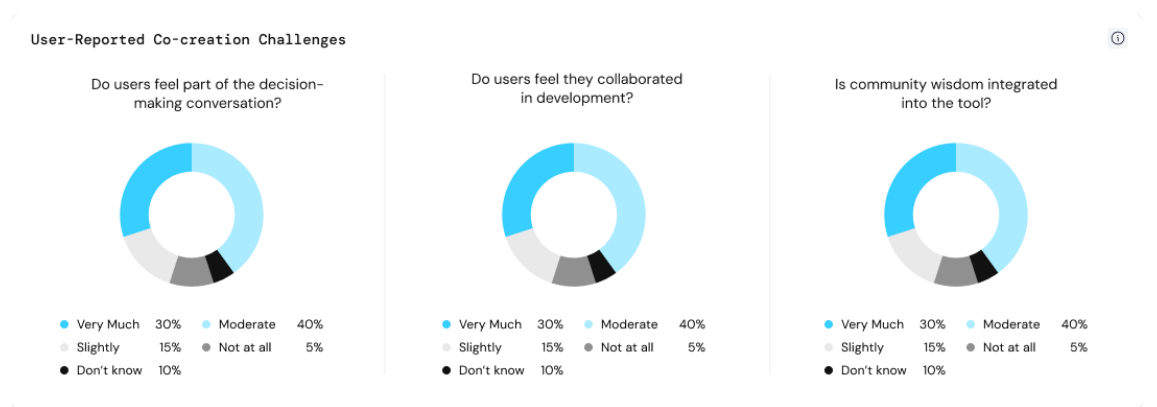



Figure 22: User-reported co-creation challenges. Source: Authors



These indicators, as illustrated in Figure 22, reveal how effectively digital innovators apply participatory design principles. For example, higher “Very Much” or “Moderate” responses indicate a more inclusive, user-driven innovation process.

3.3.5 Co-Creation and Ethical Performance Indicators

The sidebar features composite performance indicators, grouped into five clusters:

- Lowest Ethical Innovation Scores (Data Governance, Ethical Compliance, Reflexive Innovation)
- Ethical Best Practices (Standards Compliance, Oversight Mechanisms, Ethics Reviews)
- Lowest Co-Creation Scores (Collaboration Accessibility, Diversity, Grassroots Engagement)
- Strong Grassroots Co-Creation (Community-Led Solutions, Integration of Local Knowledge, Capacity-Building Support).
- Top co-creation indicators: This involves capacity building, transparent governance, and integration of community knowledge.

These scores, as shown in Figure 23, serve as quick diagnostic tools that help decision-makers identify strengths and weaknesses in the ethical and co-creation landscape.

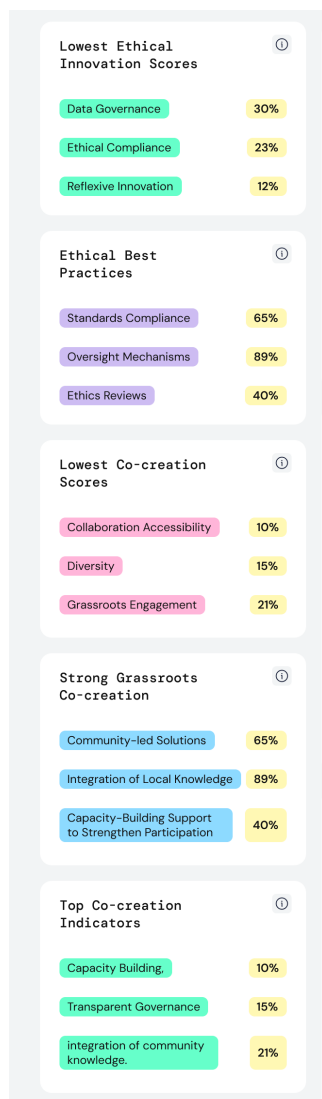


Figure 23: Stakeholder relationship scores. Source: Authors

Overall, the Stakeholder Relationships section of MDII Version 2.0 exemplifies the project's human-centered and participatory ethos. By combining ethical compliance, user feedback integration, and co-creation assessment into a unified visual interface, the dashboard empowers decision-makers to ensure digital innovations are inclusive, transparent, and community-driven.

The redesign, particularly the integration of interactive filters, metadata-driven insights, and cross-dimensional analysis, advances the MDII's mission to promote ethical, responsible, and socially aware digital transformation. This section serves as a bridge to the People and Impact section, where inclusiveness outcomes are analyzed from the user perspective, linking stakeholder behavior to measurable social and demographic impacts.

3.4 People and Impact

The People and Impact section of the MDII Scoring Dashboard Version 2.0 (Figure 24) visualizes how digital inclusiveness translates into measurable social and demographic outcomes. Like the other tools, it also builds on the Version 1.0 framework by providing deeper insights into the diversity of users, inclusiveness of participation, and the real-world effects of digital innovations across gender, age, education, and other vulnerable demographics. This section, as displayed in Figure 24 acts as a bridge between the

stakeholder engagement dynamics explored earlier and the practical inclusiveness outcomes they produce.

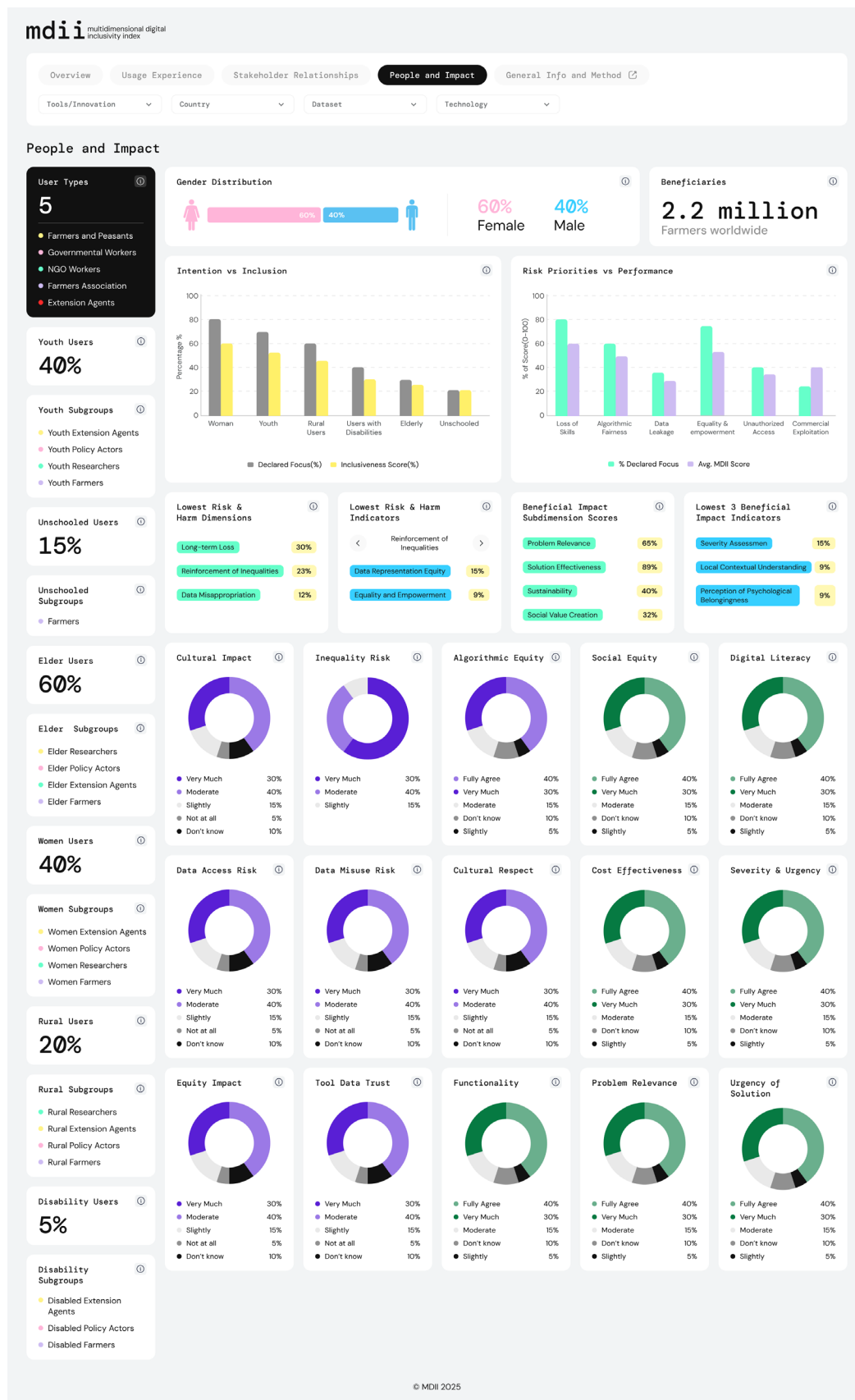


Figure 24: People and Impact. Source: Authors

3.4.1 User Demographics and Representation

At the top left of the dashboard (Figure 24), the User Types panel categorizes participants into five primary groups: Farmers and Peasants, Governmental Workers, NGO Workers, Farmers Associations, and Extension Agents. This classification, as illustrated in Figure 24, highlights the range of digital tool beneficiaries and ensures that inclusiveness assessments extend beyond end users to intermediaries who facilitate innovation adoption.

Subcategories further refine this view, such as Youth Users, Unschooled Users, Elder Users, Women Users, Rural Users, and Disability Users, each accompanied by detailed subgroups. These subgroup breakdowns (e.g., Youth Researchers, Elder Policy Actors, and Disabled Farmers) illustrate how inclusiveness is distributed across both demographic and professional strata, capturing multidimensional representation within the innovation ecosystem.

3.4.2 Gender Distribution and Inclusiveness

The Gender Distribution Bar chart (Figure 25) presents a visual comparison of the percentage of female and male participation across assessed digital innovations. The sample visualization signifies strong engagement of women in digital innovation contexts. As illustrated in Figure 25, this distribution underscores the MDII’s mission to promote gender inclusivity by ensuring that digital tools not only reach women but also empower them through training, access, and equitable participation.

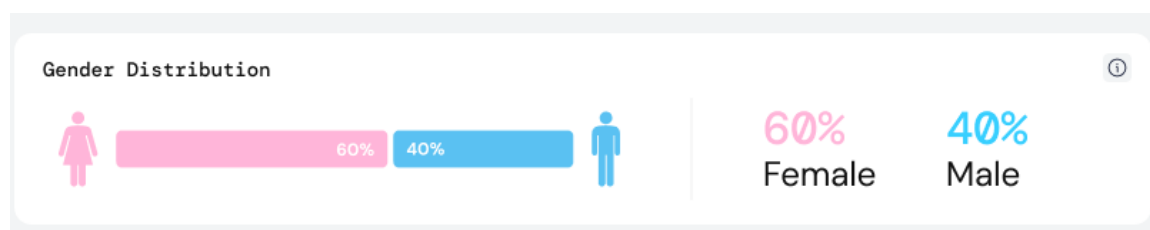


Figure 25: Gender distribution impact. Source: Authors

3.4.3 Intention vs Inclusion

The Intention vs. Inclusion chart (Figure 26) compares the declared focus of innovators with actual inclusiveness scores across different demographic groups: women, youth, rural users, users with disabilities, the elderly, and unschooled individuals. This comparative metric, as shown in Figure 26, provides a tangible measure of the “inclusiveness gap,” how intentions stated in project goals align (or fail to align) with on-the-ground inclusivity outcomes. The redesigned version’s upgraded bar visualization makes this comparison more intuitive, supporting data-driven evaluation of inclusiveness performance.

Intention vs Inclusion

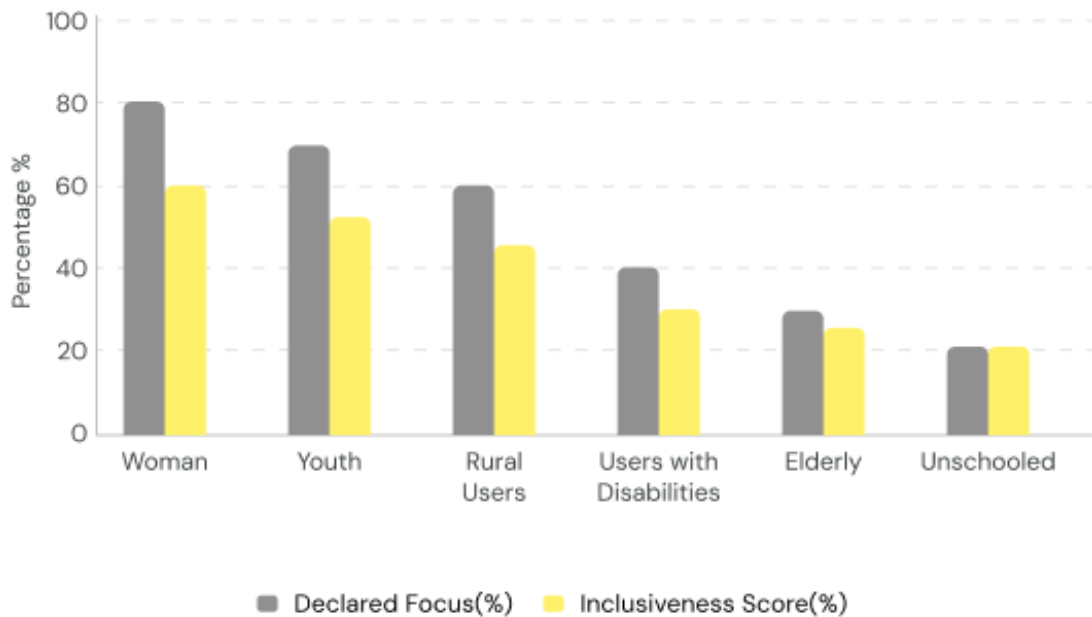


Figure 26: Intention vs. Inclusion Chart. Source: Authors

3.4.4 Risk Priorities vs Performance

The Risk Priorities vs. Performance section, as displayed in Figure 27, explores how tools address key ethical and operational risks such as loss of skills, algorithmic fairness, data leakage, equality in governance, unauthorized access, and commercial exploitation. This chart juxtaposes innovators' declared focus areas with their average MDII scores, revealing discrepancies between risk recognition and mitigation outcomes. By integrating both declared focus and actual performance, this visualization enhances accountability and strategic planning.

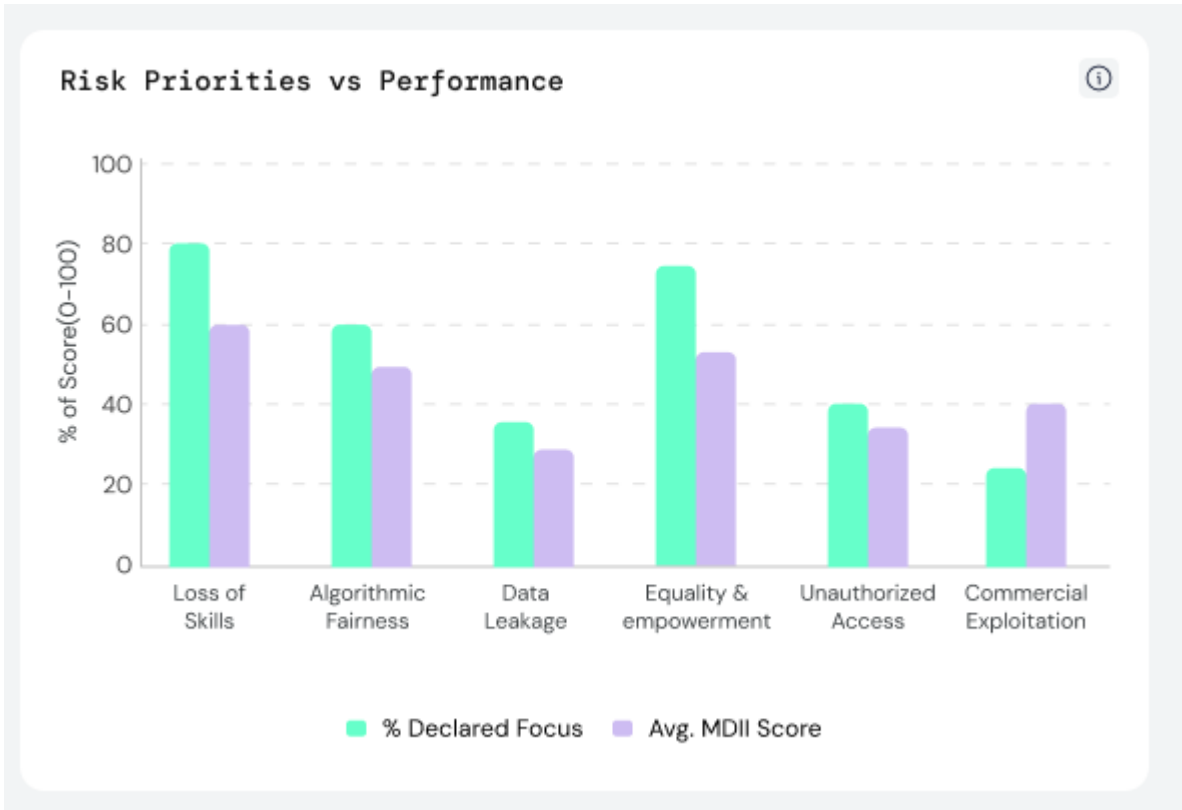


Figure 27: Risk priorities vs. performance. Source: Authors

3.4.5 Risk and Harm Indicators

The Risk and Harm Dimension module (Figure 28) identifies the lowest risk and harm dimensions, including long-term loss, reinforcement of inequalities, and data misrepresentation, metrics that highlight where digital innovations may inadvertently perpetuate exclusion. Complementing these are Lowest Risk and Harm Indicators, focusing on Data Representation Equity and Equality and Empowerment, which guide users toward priority areas for ethical improvement.

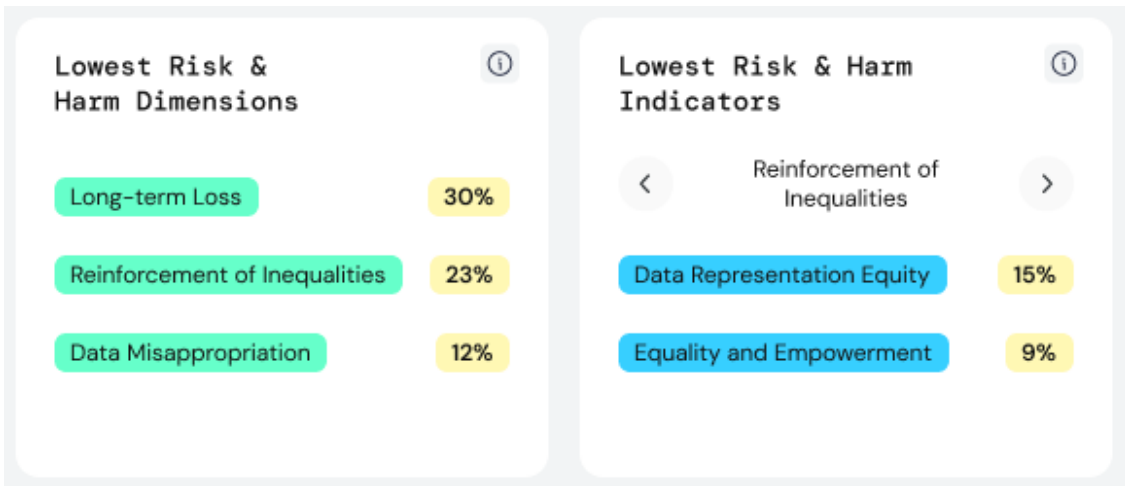


Figure 28: Risk & harm dimensions and indicators. Source: Authors

3.4.6 Beneficial Impact and Social Value Creation

The Beneficial Impact Subdimension Scores chart tracks key indicators such as “problem relevance, solution effectiveness, sustainability, and social value creation.” These measures, as illustrated in Figure 29, collectively evaluate how innovations translate inclusiveness principles into tangible socio-economic benefits. Alongside, the lowest 3 beneficial impact indicators (severity assessment, local contextual understanding, and perception of psychological belongingness) identify gaps in understanding user contexts, reinforcing the need for continuous co-design and contextual adaptation.

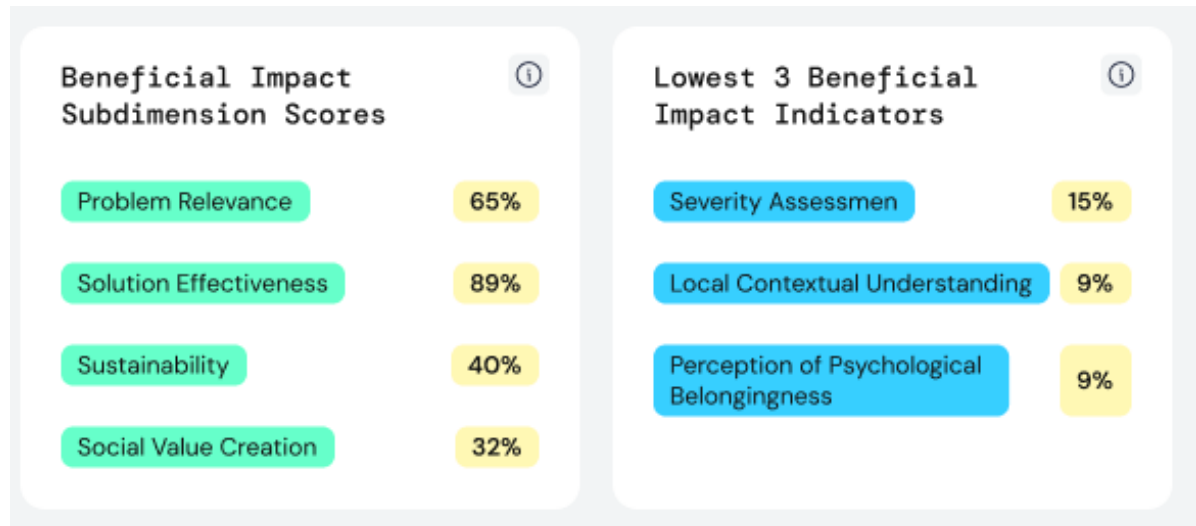


Figure 29: Beneficial impact subdimension scores and indicators. Source: Authors

3.4.7 Ethical and Cultural Dimensions

The bottom portion of the dashboard contains donut charts analyzing “Cultural Impact, Inequality Risk, Algorithmic Equity, Social Equity, and Digital Literacy.” These visualizations assess the social fairness and cultural responsiveness of digital tools. As illustrated in Figure 30, higher percentages in response categories such as “Fully Agree” or “Very Much” for algorithmic equity and social equity indicate stronger ethical alignment and fairness in system design. Conversely, lower scores in cultural respect or digital literacy signal areas requiring targeted capacity building and contextual adaptation.

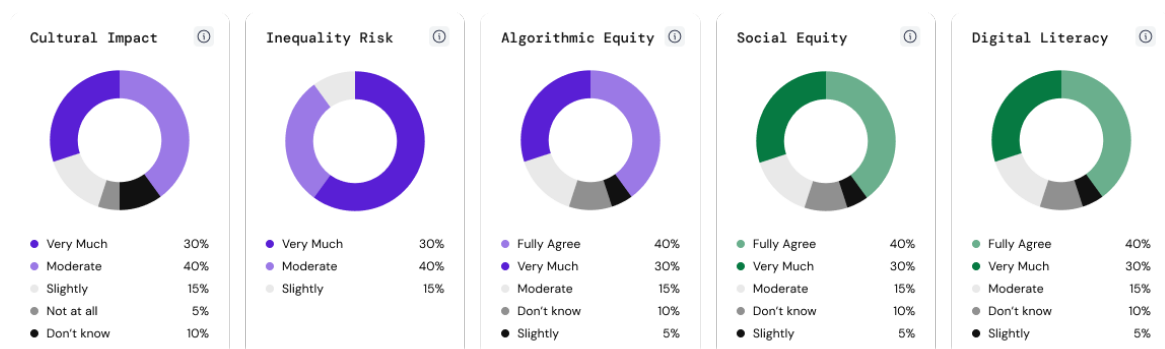


Figure 30: Cultural Impact, Inequality Risk, Algorithmic Equity, Social Equity, and Digital Literacy. Source: Authors.

3.4.8 Data Governance and Functionality

The complementary indicators, such as “Data Access Risk, Data Misuse Risk, and Tool Data Trust,” as displayed in Figure 31, evaluate users’ confidence in how their information is managed. Paired with functionality and problem-relevance visuals, these provide a

holistic understanding of how user trust and usability contribute to perceived value and sustained adoption.

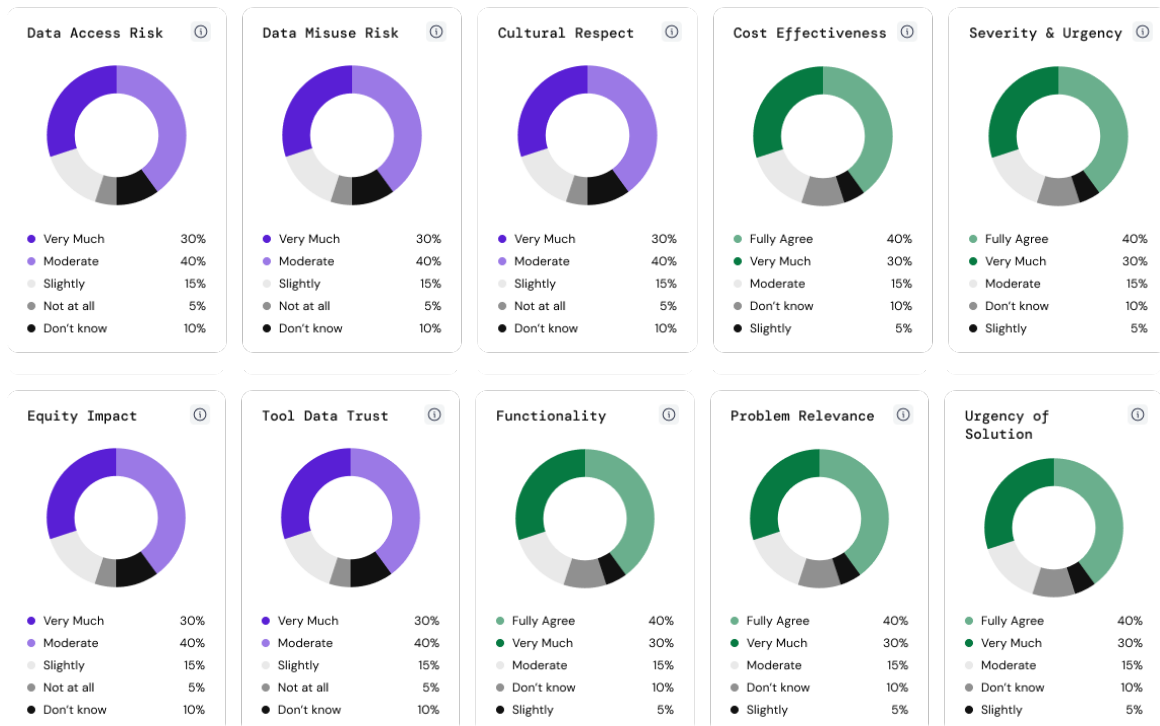


Figure 31: Data governance and functionality. Source: Authors

3.4.9 Inclusiveness Insights and Impact Summary

The cumulative insights from the People and Impact section establish Version 2.0 as a powerful diagnostic tool for understanding digital inclusiveness at scale. By combining demographic representation, inclusiveness performance, risk evaluation, and social value indicators, the dashboard enables stakeholders to monitor not just who is being reached but how and to what extent they benefit. This illustrates how inclusiveness metrics translate into measurable, human-centered outcomes. By offering granular data on user diversity, inclusiveness intent, and ethical performance, Version 2.0 reinforces the MDII’s vision of ensuring that digital innovation delivers equitable and sustainable benefits across all societal groups.

3.5 General Info & Method

The “General Info & Method” navigation button was embedded in the dashboard header. It connects directly to the MDII (Monitoring Digital Innovation Inclusiveness) website, providing transparent access to the methodological framework, data dictionary, indicator definitions, and scoring logic documentation.

3.6 Dynamic Filtering and Dropdown Navigation

A key enhancement introduced in the MDII Dashboard redesign is the integration of dynamic dropdown filters, strategically positioned beneath the main navigation bar across all sections (Figure 32): Overview, Usage Experience, Stakeholder Relationships, People and Impact, and General Info and Method. These dropdowns, Tools/Innovation, Country, Dataset, and Technology, enable users to interactively explore the inclusiveness data based on specific contextual parameters, making the dashboard highly adaptive and insight driven.

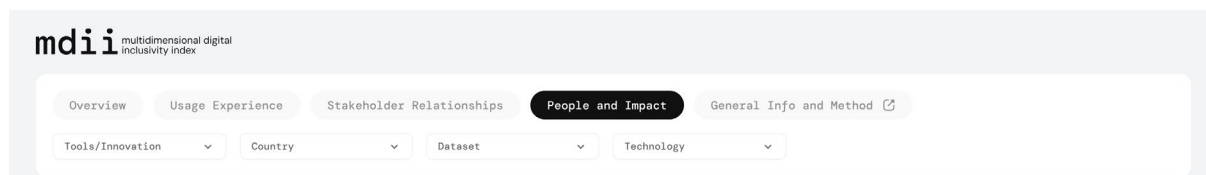


Figure 32: Dynamic filtering and dropdown navigation. Source: Authors

3.6.1 Tools/Innovation

The tools/innovation dropdown, as shown in Figure 32, allows users to filter and compare specific digital tools within the MDII portfolio. By selecting individual innovations, users can observe variations in inclusiveness performance, risk mitigation, and user engagement metrics. This feature supports granular analysis, helping portfolio managers and researchers identify which tools perform best across dimensions like Beneficial Impact, Accessibility, or Usage Effectiveness.

3.6.2 Country Dropdown

The Country filter customizes the view to display inclusiveness results for innovations deployed within specific nations or regions. This functionality is particularly valuable for cross-country comparison, enabling decision-makers to assess contextual factors influencing inclusiveness, such as local governance structures, digital literacy levels, or socio-economic environments. It also aids in evaluating how regional adaptations contribute to equitable technology adoption.

3.6.3 Dataset Dropdown

Through the Dataset filter, users can switch between different evaluation datasets, such as baseline data, pilot studies, or full-scale assessments. This feature provides flexibility for longitudinal analysis, allowing stakeholders to track progress over time and monitor the impact of interventions. It enhances transparency and supports evidence-based decision-making by displaying evolving inclusiveness scores tied to real data updates.

3.6.4 Technology Dropdown

The Technology dropdown enables filtering based on the underlying technological approach of the digital innovations, such as GIS, AI, IoT, mobile applications, or remote sensing tools. By selecting specific technology categories, users can investigate patterns in inclusiveness, assessing whether certain technologies inherently foster or hinder accessibility and participation among marginalized users.

3.6.7 Functional Value of the Dropdown System

Together, these four filters transform the dashboard from a static reporting interface into an interactive analytical environment. The dropdowns facilitate multidimensional exploration, allowing users to cross-reference variables, for example, analyzing AI-based tools deployed in Kenya or comparing GIS innovations across multiple datasets. This multi-filter capability provides both macro- and micro-level insights, enhancing the interpretive power of the MDII framework.

Furthermore, the consistent placement and intuitive design of the dropdowns align with MDII's user-centered design philosophy, ensuring that both technical and non-technical users can navigate seamlessly. By empowering users to explore inclusiveness data dynamically, the dropdown system contributes directly to MDII's core objectives: transparency, accessibility, and data-driven inclusiveness monitoring.

In essence, this filter framework exemplifies the adaptive intelligence of Version 2.0, reinforcing its commitment to flexibility, personalization, and user empowerment, key components in transforming digital inclusiveness assessments into actionable, context-aware insights.

4.0 Power BI Data Model Architecture

4.1 Model Overview

The Power BI model follows a star schema approach to ensure performance efficiency, modularity, and analytical clarity. The schema is composed of fact tables and supporting dimension tables, with a combination of connected and disconnected references to facilitate flexible data slicing.

Table 2: Core Data Tables

Table Name	Description	Usage in Dashboard
Innovator	It captures information about each innovation, including Tool ID, organization name, and innovation category.	Central linking table; used for slicers, summaries, and drill-through filters.
Evaluator	Contains evaluator responses and scoring on various inclusiveness dimensions.	Primary source for inclusiveness and evaluation results metrics.
Users	Stores demographic details and user feedback data.	Supports Usage Experience tab visuals (e.g., demographics, satisfaction).
Beneficiary	Represents indirect beneficiaries and their relationship to each innovation.	Feeds People & Impact tab.
Dimension	Defines inclusiveness dimensions such as Accessibility, Participation, and Risk.	Used for score aggregation.
Subdimension	Further categorizes dimensions into specific measurable indicators.	Supports subdimension-level comparison visuals.
Indicator	Lists all measurable indicators.	Supports detailed indicator performance cards.

4.2 Supporting and Derived Tables

- **Reference Tables:** This includes SDG alignments, innovation typologies, and classification lookups. These are unconnected but feed dynamic slicers.
- **Derived Tables:** The table was created via Power Query for data reshaping, such as unpivoting indicator responses, splitting categorical attributes, and generating helper datasets for DAX measures.

- Data table with Measures: A centralized table containing reusable DAX expressions for composite scoring, ranking, and index computation.

4.3 Relationships

Relationships were defined as one-to-many (single direction) from dimension tables to fact tables as displayed in Figure 33. This design prevents ambiguity and enhances calculation speed. The Innovator table anchors the relationships, acting as the bridge among evaluator, user, and beneficiary datasets.



Figure 33: Power BI Data Model Schema. Source: Authors

5.0 Data Processing and Transformation

5.1 Data Cleaning and Integration

Data for the MDII Dashboard were aggregated from multiple KoboToolbox survey instruments and consolidated score repositories, representing responses from innovators, evaluators, users, and beneficiaries. Given the heterogeneity of these data sources, including variations across Regular and Ex-Ante assessment forms, extensive harmonization procedures were undertaken to ensure structural consistency and analytical reliability.

The data cleaning process began with schema alignment across Kobo form versions. Because forms evolved iteratively during implementation, discrepancies in field naming conventions, response encoding structures, and categorical options were identified and standardized. Question identifiers were mapped to a master metadata dictionary to ensure uniformity across stakeholder groups. Coded response values (e.g., numeric or abbreviated categorical labels) were programmatically converted into human-readable

formats using schema-based label dictionaries, ensuring semantic clarity and eliminating interpretation bias during analysis.

Data type normalization was then applied to enforce consistent formatting across datasets. Numeric fields were cast into appropriate data types for aggregation and scoring, while categorical variables were harmonized to eliminate inconsistent capitalization, spelling variations, and null-value artifacts. Multilingual entries were parsed to extract English-language labels, removing language delimiters and formatting artifacts to produce a standardized output suitable for integration into Power BI dashboards.

Tool_IDs were employed as the primary relational keys across all datasets. These identifiers enabled deterministic merging of stakeholder responses with consolidated scoring data and facilitated cross-table integration within a star-schema data model architecture. One-to-many relationships were defined between dimension tables and fact tables, ensuring referential integrity and preventing ambiguity during DAX-based measure computation.

To support hierarchical score analysis, indicator-level responses were unpivoted and restructured into a long format prior to aggregation. Hierarchical reconstruction logic was applied to map indicators to their respective subdimensions and dimensions using numeric ID conventions, thereby preserving the analytical structure of the MDII framework. This restructuring enabled the computation of dimension-level averages, weighted inclusiveness indices, and stakeholder-specific performance metrics.

Quality assurance procedures included validation of Tool_IDs against an authorized whitelist of approved digital innovations, removal of internal Kobo metadata fields (_id, submission timestamps), trimming of whitespace artifacts, and consistency checks across Regular and Ex-Ante assessments. Cross-verification was conducted to confirm that aggregated dashboard outputs aligned with manually reviewed benchmark values. Through this multi-stage cleaning and integration pipeline, raw heterogeneous survey responses were transformed into a unified, analysis-ready dataset optimized for real-time dashboard visualization and hierarchical performance monitoring. This process ensured that all inclusiveness metrics displayed within the MDII Dashboard are traceable, standardized, and methodologically robust.

5.2 Unpivoting and Splitting Operations

To support hierarchical inclusiveness analysis and dynamic dashboard interactivity, extensive data reshaping procedures were applied during preprocessing. A central transformation step involved unpivoting wide-format indicator datasets into a normalized long format structure. In the original consolidated score repository, each row contained multiple dimension-, subdimension-, and indicator-level score columns (prefixed by structured ID conventions). While suitable for static reporting, this format limited granular analysis and cross-dimensional aggregation.

Unpivoting converted these multiple score columns into attribute-value pairs, thereby restructuring the dataset so that each row represented a single Tool_ID-Indicator combination. This normalization enabled flexible aggregation across hierarchical levels and supported dynamic DAX-based calculations within Power BI. By transforming the data into a long analytical format prior to model integration, the dashboard could compute averages, weighted indices, ranking measures, and comparative benchmarks without redundancy or structural ambiguity.

In addition to unpivoting, several compound and concatenated fields were systematically decomposed into categorical components. For example, innovation typologies and agrisystem classifications embedded within single columns were parsed and split into discrete variables (e.g., innovation category, risk classification, technology type, readiness phase, and user cluster). This separation enhanced analytical granularity and enabled multi-dimensional slicing across dashboard visuals. Multi-select survey responses were also cleaned and tokenized to preserve categorical integrity. Delimited string values were parsed to ensure accurate representation in slicers and visual filters, preventing aggregation distortion. Where necessary, derived helper tables were created in Power Query to support lookups, reference mappings, and relationship enforcement within the star schema architecture.

These transformation procedures significantly improved the analytical flexibility of the MDII Dashboard. By enabling cross-tabulation of inclusiveness scores with innovation maturity, stakeholder type, geographic distribution, and technology classification, the system supports complex comparative analysis and portfolio-level monitoring. The unpivoting and categorical decomposition logic therefore serve as foundational mechanisms that translate raw survey outputs into structured, decision-ready intelligence.

5.3 Computation and Measure Development

To operationalize the MDII framework within an interactive analytical environment, over fifteen Data Analysis Expressions (DAX) measures were developed in Microsoft Power BI. These measures transform cleaned and structured datasets into composite inclusiveness indices, hierarchical performance metrics, and stakeholder-specific key performance indicators (KPIs).

The computation layer was designed to reflect the three-tiered MDII scoring hierarchy Indicator, Subdimension, and Dimension, allowing inclusiveness performance to be evaluated at granular, intermediate, and strategic levels. Indicator-level values were first aggregated to compute Subdimension averages, which were subsequently rolled up into Dimension-level scores. This hierarchical aggregation preserved structural alignment with the MDII framework while ensuring analytical traceability

Key DAX measures include:

- **Average Inclusiveness Score:** Calculates the mean inclusiveness performance across selected indicators or dimensions within applied filters.
- **Beneficial Impact Index:** Aggregates impact-related indicators to quantify positive social, environmental, and economic contributions.
- **Co-Creation Strength Score:** Measures stakeholder participation intensity, collaboration depth, and feedback integration across innovation lifecycles.
- **Ethical Innovation Indicator:** Assesses compliance with responsible innovation principles, including algorithmic fairness, data governance, and risk mitigation.
- **Dimension Average Score:** Computes average performance for each of the seven MDII core dimensions.
- **Overall Weighted Inclusiveness Index:** Applies proportional weighting across dimensions to produce a composite inclusiveness benchmark for cross-tool comparison.
- **Stakeholder Relationship Index:** Synthesizes engagement metrics across innovators, evaluators, users, and beneficiaries.
- **User Satisfaction Index:** Integrates usability, accessibility, and support metrics derived from stakeholder survey responses.

The Overall Weighted Inclusiveness Index was particularly critical for portfolio-level benchmarking. Weighting logic was embedded within DAX calculations to ensure that dimension contributions were proportionally represented without distortion from uneven indicator counts. This prevented aggregation bias and ensured that composite scores remained methodologically robust.

Context-aware filtering was implemented using DAX's evaluation context model, allowing measures to dynamically recalculate based on selected Tool_ID, country, readiness phase, stakeholder type, or technology classification. This functionality enables comparative benchmarking across innovation portfolios, lifecycle stages (e.g., Ex-Ante vs. Regular assessments), and geographic deployments

To ensure computational integrity, validation routines were conducted by cross-verifying DAX-generated outputs against manually computed benchmarks and API-delivered score datasets. This quality assurance step confirmed alignment between the Power BI analytical layer and the backend score transformation logic.

Collectively, these DAX measures transform static survey responses into dynamic performance intelligence. By embedding hierarchical aggregation, weighting mechanisms, and contextual recalculation within the computation layer, the MDII Dashboard supports structured monitoring, strategic comparison, and evidence-based decision-making across digital innovation ecosystems.

5.4 Validation and Consistency Checks

To ensure analytical reliability and computational integrity, a multi-layered validation framework was implemented across the data processing, transformation, and visualization stages of the MDII Dashboard. Validation procedures were designed to verify measurement accuracy, hierarchical aggregation logic, and relational consistency within the data model.

First, cross-verification was performed between the Power BI DAX outputs and the source score datasets delivered via the MDII Data API. Indicator-, subdimension-, and dimension-level aggregates were recalculated independently using controlled manual computations and compared against automated outputs to confirm consistency in hierarchical roll-up logic. Any discrepancies were traced back to transformation rules, filter context settings, or weighting configurations and corrected prior to deployment.

Second, relational integrity within the star schema data model was tested to prevent ambiguity or circular dependencies. One-to-many relationships between dimension tables and fact tables were examined to ensure that filter propagation behaved as expected across Innovator, Evaluator, User, and Beneficiary datasets. Referential checks confirmed that all Tool_IDs aligned with the authorized whitelist and that no orphan records existed within the model.

Third, cross-version testing was conducted across Regular and Ex-Ante Kobo form submissions to ensure structural harmonization. Field mappings, categorical encodings, and response scales were compared across form iterations to verify that schema evolution did not introduce aggregation bias or misalignment in scoring calculations. Where schema discrepancies were identified, harmonization rules were applied prior to integration.

Fourth, benchmark validation was carried out against stakeholder-supplied reference values. Selected tools were manually reviewed to confirm that computed inclusiveness

indices reflected expected performance patterns based on qualitative assessments and previously validated reporting outputs. This step served as a practical sanity check to ensure that dashboard metrics corresponded to real-world evaluation insights.

Additional consistency checks included:

- Verification of null-value handling and missing data treatment.
- Inspection of weighted index calculations to prevent disproportionate influence from uneven indicator counts.
- Confirmation that dynamic filters (Tool_ID, country, readiness phase, stakeholder type) triggered correct recalculation under varying evaluation contexts.
- Review of multilingual label extraction to ensure semantic consistency in categorical variables.

Through this layered validation process, the MDII Dashboard achieved methodological robustness, traceability, and internal coherence. These procedures ensure that all inclusiveness metrics displayed in Version 2.0 are computationally sound, relationally consistent, and aligned with the MDII framework's hierarchical logic.

Conclusion

The MDII Scoring Dashboard Version 2.0 represents a comprehensive advancement in digital inclusiveness monitoring, analytical rigor, and interactive performance evaluation. While retaining the foundational multidimensional framework introduced in Version 1.0, this redesigned system significantly strengthens methodological robustness, data integration architecture, and portfolio-level benchmarking capabilities.

Beyond visual refinement, Version 2.0 institutionalizes a structured monitoring framework that integrates hierarchical scoring (Indicator → Subdimension → Dimension), automated API-driven data processing, and dynamic DAX-based computation. By connecting consolidated score repositories with real-time KoboToolbox survey data across innovators, evaluators, users, and beneficiaries, the system transforms heterogeneous stakeholder inputs into standardized, traceable, and analysis-ready performance metrics. The star schema data model and relational architecture implemented in Power BI ensure referential integrity, contextual filtering, and scalable performance analytics across authorized digital innovation portfolios.

Through its computation layer, Version 2.0 operationalizes inclusiveness as a measurable construct via composite indices, weighted performance scores, stakeholder engagement metrics, and lifecycle-based readiness analysis. This shift from descriptive reporting to KPI-driven evaluation enables comparative benchmarking across tools, countries, technologies, and innovation maturity stages. The integration of Ex-Ante and Regular assessments further embeds inclusiveness within a continuous learning and project management cycle, strengthening accountability and adaptive improvement.

From a design perspective, the dashboard introduces a refined visual hierarchy characterized by strategic white space, defined card boundaries, and balanced color contrast to enhance cognitive clarity. A unified MDII color system; green for strengths, red for areas of concern, and purple for thematic classifications, reinforces intuitive interpretation while maintaining consistency with the established design system. Interactive features allow users to hover for detailed labels, apply dynamic cross-filters, drill into stakeholder segments, and export datasets for external analysis, addressing earlier usability limitations identified in Version 1.0.


This dashboard also advances inclusiveness analysis beyond access and usability by embedding ethical, cultural, and social equity dimensions into the analytical framework. Modules such as Stakeholder Relationships and People & Impact translate qualitative governance and participation principles into quantifiable indicators, strengthening transparency and evidence-based oversight.

Importantly, the system's backend infrastructure ensures scalability and sustainability. The MDII Data API automates data ingestion, label harmonization, multilingual parsing, hierarchical reconstruction, and CSV generation, eliminating manual bottlenecks and ensuring real-time analytical readiness. Validation protocols, including cross-version schema harmonization, whitelist enforcement, hierarchical roll-up verification, and stakeholder benchmark testing, ensure computational integrity and methodological coherence.

In summary, the MDII Scoring Dashboard Version 2.0 is not just a visualization upgrade but a fully integrated digital monitoring ecosystem. It combines data engineering, statistical computation, UI/UX optimization, and governance-aligned evaluation into a unified platform. By embedding inclusiveness within structured KPIs, relational data models, and interactive analytics, Version 2.0 strengthens MDII's mission to promote transparency, equity, and evidence-based decision-making across global agri-food and digital innovation systems.

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