Innovate 4 Nature: Executive Summary

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Executive summary

Background and aims

Biodiversity is declining at an unprecedented rate, with global wildlife populations having declined by an estimated 73% on average, and over one million species at risk of extinction. This loss is not only an environmental crisis, but a social and economic one. Biodiversity underpins natural capital and supports livelihoods, food security, clean water, climate regulation, disaster risk reduction, and disease control, functions that are especially critical in Low- and Middle-Income Countries (LMICs), where dependence on natural resources is high.

As pressures from land-use change, climate change, over-exploitation, pollution, and invasive species intensify, robust biodiversity monitoring is essential. Monitoring provides the evidence needed to understand how ecosystems and species are changing, to evaluate the effectiveness of conservation actions, and to inform policy, planning, and investment decisions. It is also central to recognising and managing the economic value of nature, including its role in national accounting, development planning, and emerging nature-based finance mechanisms. Without reliable, trusted data, biodiversity cannot be effectively governed, valued, or protected.

Global frameworks such as the Convention on Biological Diversity (CBD) and the Kunming–Montreal Global Biodiversity Framework (GBF) place biodiversity monitoring at the centre of international commitments, requiring countries to track progress against agreed targets through standardised indicators and National Biodiversity Strategies and Action Plans (NBSAPs). Similar data demands arise from other global agreements, including the International Convention on Wetlands (Ramsar Convention), the Convention on Migratory Species (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Together, these frameworks make clear that biodiversity goals cannot be assessed or achieved without sustained, high-quality monitoring and data systems.

Despite this, biodiversity monitoring remains fragmented and uneven with significant taxonomic, geographic, and ecosystem-level gaps. Monitoring efforts are further constrained by limited standardisation, weak data governance, inadequate infrastructure, and insufficient capacity. As a result, much biodiversity data remains inaccessible, poorly integrated, or under-utilised in decision-making. A persistent disconnect between data producers and data users, exacerbated by weak science–policy interfaces, limited data literacy, and unclear governance, undermines the impact of monitoring investments.

Whilst emerging technologies offer substantial potential to address these challenges by improving the scale and coverage of data collection, they also introduce new challenges, such as the need for adequate infrastructure and capacity to store, process, and analyse large volumes of data, and the requirement that data outputs align with the needs of diverse end users. Moreover, technologies can exacerbate existing inequities in whose knowledge is valued and who participates in data-to-decision pathways, both locally, where communities and Indigenous Peoples may be excluded, and globally, where power imbalances between the Global North and South persist, highlighting the need to centre LMIC experiences in the application of biodiversity monitoring technologies.

Innovate 4 Nature (I4N) aims to gather evidence on the use of biodiversity monitoring technologies and data in low- and middle-income countries. The **I4N** project is led by the UK Centre for Ecology & Hydrology (UKCEH) and funded by Defra. Defra is the UK government's Department for Environment, Food and Rural Affairs. Defra is responsible for improving and protecting the environment and aims to grow a green economy and sustain thriving rural communities. Project partners for **I4N** are the Tropical Biology Association (TBA) (https://tropical-biology.org/).

The programme assesses current use of technology, identifies barriers to the effective use of biodiversity monitoring technologies and data across diverse actors and examines the needs required to overcome these constraints. It further explores the opportunities that emerging technologies could unlock and develops solutions to support scalable, context-appropriate, and inclusive uptake. Together, these efforts seek to ensure that biodiversity monitoring technologies translate into actionable insights, support sustainable livelihoods, reduce poverty, attract investment, and strengthen ecosystem protection and restoration. The technologies covered in the Innovate 4 Nature programme follow the WildLabs assessment of conservation technology (Speaker *et al.*, 2022), applied globally across all taxa and habitats, and utilised by a range of user groups.

Methods

We approached evidence gathering through a combination of four different methods: A rapid evidence assessment (REA) and questionnaire, focused across all LMICs, and a series of interviews and workshop, focused on East Africa. Across all evidence streams we addressed the following questions: 1) How are technologies currently being used in biodiversity monitoring across LMICs?, 2) What are the barriers to effective use of technologies and resulting data?, 3) What is needed to overcome these challenges?, and 4) What are the future opportunities that biodiversity monitoring technologies could unlock?

We adopted a Gender Equality, Disability, and Social Inclusion (GEDSI) approach, recognising that different social groups and identities experience technology, and biodiversity monitoring more broadly, in distinct ways.

Rapid evidence assessment
A rapid evidence assessment was conducted to examine how biodiversity monitoring technologies are used across LMICs and to identify key barriers to their adoption and impact. Guided by two main research questions and supporting sub-questions, the review covered all taxonomic groups, habitats, and a wide range of field-based and data-processing technologies across all Official Development Assistance (ODA) eligible countries. Peer-reviewed and grey literature were systematically searched between September and October 2025 using academic databases, organisational websites, and Google Scholar, using tailored search strategies. A two-stage screening process (title and abstract) applied defined inclusion criteria, focusing on empirical studies from 2010 onwards. Relevant data were extracted from 371 articles into a shared database, capturing technology type, application, and barriers or opportunities. Analysis was primarily descriptive, summarising patterns in technology use and synthesising evidence on technical, financial, institutional, and socio-political challenges affecting deployment and uptake.

Questionnaire
A targeted sampling approach was used to recruit participants, drawing on a database of collaborators, researchers, and organisations, with invitations distributed via email and online platforms and expanded through snowball sampling. The questionnaire was open from 27 October to 8 December 2025 and collected anonymous responses following informed consent. The survey combined multiple-choice, Likert scale, and open-ended questions.

Respondents (n = 62) brought professional experience from across a wide range of LMICs, professional backgrounds, and technology applications, with expertise spanning 40 countries across eight geographical subregions. The greatest representation of respondents' expertise was in Sub-Saharan Africa (n = 32, 48%) and South-eastern Asia (n = 12, 19%), followed by Latin America and the Caribbean and Northern Africa (n = 9, 13% each). Most respondents were affiliated with universities or research institutes (n = 27, 44%), non-governmental organisations or charities (n = 15, 24%), and governmental or regulatory agencies (n = 11, 18%).

Interviews
Interviews were conducted in Kenya by trained researchers with 56 participants, comprising key informants from government (n = 4), research (n = 6), NGO (n = 5), and business/finance sectors (n = 4), alongside 37 community stakeholders. Interviews were recorded with informed consent, transcribed, reviewed, and summarised to ensure accuracy, with translation support provided where necessary. Data were analysed using an iterative coding process, with multiple researchers developing and applying a shared coding framework to identify themes and viewpoints. Findings reflect participants' perspectives, capturing both commonly shared and individual perspectives, however, they were not independently verified and should be interpreted with caution given the sample composition.

Workshop
A 2-day workshop in Nairobi, Kenya, was organised and led by project partners TBA. Participants attended from Kenya (n = 27), Tanzania (n = 4), Uganda (n = 4) and the Democratic Republic of Congo (n = 1). They represented a wide range of professional backgrounds, including technology experts, conservation scientists, practitioners, and policymakers, and diverse experiences of using biodiversity monitoring technologies. The workshop adopted a participatory format to explore technology and data use in biodiversity monitoring, combining plenary talks, group discussions and facilitated exercises (e.g. fishbone analysis and visual tools) supported active engagement and the generation of shared insights.

Figure 1 Summary of the evidence gathered through four methods that underpin the Innovate 4 Nature findings.

Headline findings

Our research uncovered the current landscape of technologies for biodiversity monitoring in LMICs, highlighting where they are being applied and the benefits they are bringing. We identified a range of interrelated barriers and needs affecting the effective use of biodiversity monitoring technologies and resulting data across LMICs. These challenges cut across all user groups and span the full monitoring pathway, from technology development and deployment through to data use in decision-making. We also investigated perspectives on the future opportunities for technology in biodiversity monitoring.

Current use of biodiversity monitoring technologies in LMICs

Technology use in LMICs has been increasing, with some tools more widely used than others. Established tools remain essential, while computational and molecular approaches are expanding quickly, but require development for wider and more effective uptake.

Key evidence:

- GIS and remote sensing the most commonly used technologies (41% literature reviewed, 46% questionnaire respondents, 30% interview respondents).
- Camera traps had strong representation in both published studies (21%) and practitioner use (46% in the questionnaire, 54% in interviews).
- Mobile applications were heavily used by community-based data collectors (54% of interviewees, 32% questionnaire respondents).
- AI/machine learning and eDNA/genomics both show fast recent growth in published studies, though used by fewer practitioners and ranked as least developed by questionnaire respondents.

Technologies are being applied across diverse taxa, habitats and monitoring purposes. Plants and land mammals consistently rank among the most monitored groups. Freshwater systems are also well represented, while grasslands, savannas, shrublands and deserts remain comparatively under-monitored with technology.

Key evidence:

- Forests are the most common habitat for technology-enabled monitoring (41% of studies; 70% of survey respondents).
- Species identification and population monitoring dominate in the literature (63% of articles).
- Habitat assessment and mapping are widely reported (49% of articles).
- Management and intervention decisions are a major focus for practitioners (66% of interviewees).

Technology is seen as valuable for improving the quality, efficiency, and usability of biodiversity data.
Emphasis on technologies ability to enhance data collection and integration but should complement rather than replace traditional methods.

Key evidence:

- 75% of interview participants referred to the ease and efficiency technology brings to data collection.
- Interview participants mentioned potential for a reduction in bias (27%, n=15), and the increased transparency and verification of measurements (32%, n=18).

- Technology as a tool to improve data integration and reporting was mentioned by almost half of interview participants (46%, n=26).

Barriers and needs related to use of biodiversity monitoring hardware in LMICs

Cost remains a major barrier to the adoption of biodiversity monitoring technologies in LMICs, with affordable technology and sustained funding as key enabling factors.
High upfront costs, expensive repair and maintenance requirements, and a lack of sustained funding significantly restrict technology adoption and long-term use across all user groups. These financial constraints limit not only initial access to equipment but also the ability to maintain, repair, and scale monitoring systems over time.

Participants consistently emphasised the need for more affordable technologies and sustained funding models that support the full lifecycle of monitoring tools. Without long-term investment, even technically effective solutions fail to translate into durable monitoring programmes.

Key evidence:

- Costs related to equipment and supporting infrastructure were identified as a barrier in 16% of reviewed studies.
- Upfront costs constrained technology adoption for 60% (n = 14) of questionnaire respondents using technology for data collection, and 42% (n = 24) of interview participants.
- Repair and maintenance costs were a barrier for 35% (n = 8) of questionnaire respondents using monitoring technologies.
- Nearly half (48%, n = 11) of questionnaire respondents using technologies reported a need for cheaper technologies, while over two-thirds (68%, n = 38) stated that access to funding was required to enable adoption of biodiversity monitoring technologies.

Technologies designed and produced for higher income contexts are often inaccessible and poorly suited to LMIC needs, improved access and local co-production are key enablers.
Technologies are predominantly produced in High Income Countries (HIC), creating access barriers through high import costs, lengthy procurement delays, and limited local availability. Many tools are also poorly adapted to local ecological, cultural, infrastructural, and operational conditions, reducing their effectiveness and uptake in LMIC contexts.

Improved access to existing technologies, alongside local or regional production, adaptation, and repair, was consistently identified as critical. Participants emphasised the need for technologies to be designed *with* local users, and supported by locally available technical expertise, data analysis tools, and storage capacity.

Key evidence:

- 57% (n = 13) of questionnaire respondents reported lack of access to technology as a barrier, with widespread examples of high import fees and long delays.
- 22% (n = 5) of questionnaire respondents collecting data reported that available technologies were not well suited to local conditions.
- 20% (n = 12) of interview respondents stated that current technologies were ineffective for collecting the data they needed.

Users prioritise robust, easy-to-use technologies over complex or rapidly evolving tools. Frequent technological change, redundancy, and increasing complexity make it difficult to select appropriate tools and sustain their use. These challenges are particularly exacerbated where monitoring is carried out by rangers and local communities, for whom repeated changes in hardware or platforms undermine training, trust, and participation.

Participants consistently called for "frugal" technologies, tools that are durable, reliable, locally repairable, and usable with minimal training, designed to support decision-making rather than technological novelty.

Key evidence:

- 35% (n = 8) of questionnaire participants found monitoring technologies difficult to use.
- 27% (n = 15) of interview participants reported poor reliability as a key barrier.
- 23% (n = 13) of interview participants identified technological complexity as a major constraint.

Barriers and needs related to use of biodiversity data in LMICs

Biodiversity data are costly, fragmented, and often do not meet user needs, improved access and the collection of locally relevant data are key enabling factors.
Access to biodiversity data is limited by cost, fragmentation across multiple platforms, inaccessible formats, and gaps in availability. Even where data exists, it often lack the spatial, temporal, or taxonomic resolution required for decision-making, significantly limiting its usefulness.

Participants emphasised the need for improved access to existing data, collection of additional, locally relevant datasets, and better access to data management and analysis tools. The development of national data platforms with tiered access that maintain the ownership rights of data collectors was highlighted as a priority to improve integration and usability.

Key evidence:

- 40% (n = 21) of questionnaire respondents who use biodiversity data identified upfront data access costs as a barrier.
- Data were reported as unavailable by 31% (n = 15) and difficult to access by 29% (n = 15) of questionnaire respondents; 25% (n = 14) interview participants reported access challenges overall.
- 23% (n = 13) of interview participants stated that available data were in the wrong format or not fit for purpose.
- Data gaps were reported by questionnaire respondents for spatial coverage (27%), taxonomic coverage (25%), and temporal resolution (15%).
- 30% (n = 15) questionnaire respondents reported a need for improved data access, and 26% reported a need for data that does not currently exist.

Analytical infrastructure and skills lag behind data collection capacity, local investment in infrastructure and skill development is critical.
Although field-based data collection has grown, limited computing power, unreliable electricity and connectivity, and insufficient data storage continue to restrict local analysis. Data collection is already extractive, with information gathered in LMICs but analysed in high-income countries. Without investment in local infrastructure, new technologies risk deepening this pattern and undermining current efforts to amplify the voices of local communities, especially traditional and indigenous knowledge. Many analytical tools developed in HICs, including AI models, are poorly suited to local

species and contexts, leading to constrained use, biased outputs, reinforced skill gaps, and weaker data-to-decision pathways.

Investment is required in local analytical infrastructure, including computing resources, power and connectivity, data storage, and locally relevant analytical tools (e.g. classifiers and reference libraries), to enable contextually appropriate data processing and interpretation within LMIC institutions.

Key evidence:

- 34% (n = 17) of questionnaire respondents reported a need for improved access to data management and processing tools, and 26% (n = 13) for better access to analytical tools.
- 22% of questionnaire respondents cited unreliable computing infrastructure and 12% reported data storage limitations.

Barriers and needs related to capacity for biodiversity monitoring in LMICs

Widespread skills shortages limit effective use of technology and data.
Capacity gaps span the full technology and data lifecycle, including deployment, maintenance, repair, data management, and analysis. A lack of training in data processing and interpretation is particularly evident, limiting the translation of data into actionable insights.

Participants identified the need for expanded, end-to-end training, extending beyond data collection to include analysis, interpretation, and decision-making, with emphasis on developing "data translators" rather than only data collectors.

Key evidence:

- Capacity-related challenges were identified as a major barrier in 24% of reviewed studies.
- 62.5% (n = 35) of interview respondents reported shortages in local technical capacity.
- Insufficient analytical capacity was reported by 39% (n = 9) of questionnaire respondents and 18% (n = 10) of interview respondents.
- Increased training was identified as a priority by 48% (n = 11) of questionnaire respondents and 66% (n = 37) of interview respondents.

Capacity is externally dependent and weakly embedded within local institutions.
Analytical expertise is often concentrated away from data collection locations, either in city-based central offices or out of country, usually in HICs, creating disconnects between data producers and data users. Training is heavily weighted towards data collection, with limited emphasis on synthesis or use, reducing local ownership, trust, and long-term sustainability. If technology becomes the default tool for monitoring, and access and capacity remain unequal, we risk deepening existing inequalities. This would narrow the range of actors and knowledge shaping conservation and further erode local ownership of data.

Embedding technical and analytical capacity within local and national institutions was identified as essential to ensure continuity of monitoring, reduce reliance on external actors, and strengthen data-to-decision pathways.

Key evidence:

- 36% (n = 16) of questionnaire respondents reported lack of capacity or expertise as a key barrier to using data in decisions.
- Respondents from or working with local communities reported reduced buy-in where data analysis occurs externally, and feedback is limited.

Practical infrastructure and funding constraints undermine capacity development, **investment in sustained infrastructure and personal is critical**.
Even where skills exist, limited staff time, computing resources, power supply, connectivity, and sustained funding prevent effective application of technology and data.

Participants stressed the need for investment in practical capacity, including staffing, computing services, data management systems, power, connectivity, and long-term funding models to support sustained monitoring.

Key evidence:

- 22% (n = 5) of questionnaire respondents reported inadequate computing infrastructure for technology use, and 15% (n = 8) for data use.
- 54% (n = 30) of interview participants identified power and network constraints as major barriers.
- 36% (n = 20) of interview participants cited lack of sustained funding as a key challenge.

Individual characteristics such as gender and Indigenous identity shape people's ability to access, use, and benefit from biodiversity monitoring technologies and data.
These characteristics influence confidence levels, training needs, perceived barriers, and the suitability of available tools. Limited sample size prevented detailed analysis on these aspects and indicate results should be interpreted with care, but these within LMIC individual differences warrant attention.

Key evidence:

- Women were nearly three times more likely to report that technology was not suitable for their needs (11% vs 4.35%).
- 0% of Indigenous questionnaire respondents rated themselves as "expert," and 50% identified as novice/beginner.
- Indigenous respondents were four times more likely to request more training or technical support (23.53% vs 6.67%).

Barriers and needs related to governance of biodiversity monitoring in LMICs

Current governance arrangements risk reinforcing inequities in biodiversity monitoring, clear data governance frameworks are critical and co-design with local communities.
Technologies can exacerbate inequities through Western-centric design, weak integration of Traditional and Indigenous Knowledge (TIK), unclear data ownership, and increased separation between data collectors and decision-makers. Complex technologies further limit community participation and relevance.

Participants highlighted the need for clear data governance frameworks, community co-design, equitable data ownership arrangements and technologies that complement rather than marginalise TIK and local priorities.

Key evidence:

- 43% of interview participants expressed uncertainty over who owns or controls biodiversity data.
- 24% of questionnaire respondents reported that TIK was not integrated or only slightly integrated.

- 20% (n = 12) of interview respondents cited limited understanding of technology value or lack of meaningful community involvement (11%, n = 6) as key barriers.

Lack of standardisation, frameworks and trust in data limit data use in decision-making, standardisation frameworks and transparency are critical across the collection and data lifecycle.
Weak standards, unclear policy frameworks and low trust in data quality result in fragmented systems and under-use of data. Many actors operate in silos, with limited coordination between data producers and decision-makers.

Participants emphasised the need for clear standards, policy frameworks and improved data quality and transparency across sectors

Key evidence:

- 37% (n = 21) of interview participants identified lack of frameworks or policies to guide data use as a barrier.
- Lack of standardisation was cited by 51% (n = 22) of questionnaire respondents, and lack of integration frameworks by 44% (n = 19).
- Data quality concerns were reported by 20% of questionnaire respondents, with 40% interview respondents participants identifying poor quality data as a key limitation for decision-making.

Weak communication and collaboration significantly limit effective use of biodiversity data.
Poor coordination, siloed working practices, and weak communication between organisations and sectors constrain the translation of biodiversity data into decisions and action. Data sharing is particularly limited, with datasets dispersed across unlinked or inaccessible systems, leading to duplication and missed opportunities for synthesis. A critical disconnect exists between those collecting data and those making decisions, characterised by differing expectations, limited trust, and lack of clarity over data needs. These challenges are compounded by insufficient collaboration and limited co-design with local communities.

Participants emphasised the need for stronger collaboration mechanisms and clearer data-to-decision pathways, including regular dialogue between data producers and users, shared platforms for coordination and co-design of monitoring approaches with local communities. Improved communication was seen as essential to build trust, align data outputs with decision-making needs and ensure monitoring efforts lead to action.

Key evidence:

- 36% (n = 20) of interview participants identified siloed working as a major barrier to effective data use.
- 21% (n = 9) of questionnaire respondents reported difficulties related to communication and collaboration, and 18% highlighted challenges in coordinating with other groups or stakeholders.
- 38% of interview respondents identified fragmented or siloed working arrangements as significant constraints.
- 36% (n = 20) of interview participants expressed a need for stronger partnerships to improve monitoring outcomes, while 20% (n = 11) highlighted co-development as key to improving effectiveness.

Future opportunities for biodiversity monitoring technologies

Participants identified a wide range of future opportunities that emerging technologies could unlock:

- The greatest opportunity is not new technology but applying existing data and tools to real-world conservation decisions.
- Integrating multiple data types into unified, interoperable systems is seen as the most critical enabler of impact.
- Continuous and long-term monitoring can unlock early-warning systems, trend detection, and more adaptive management.
- Artificial intelligence offers major efficiency gains, but only where local reference data, infrastructure, and capacity exist.
- High-quality biodiversity data can support finance, investment, and livelihoods by linking conservation outcomes to economic incentives.
- Inclusive collaboration, by centring Traditional and Indigenous Knowledge and strengthening partnerships between different stakeholders, identified as essential to translate technology into lasting outcomes.

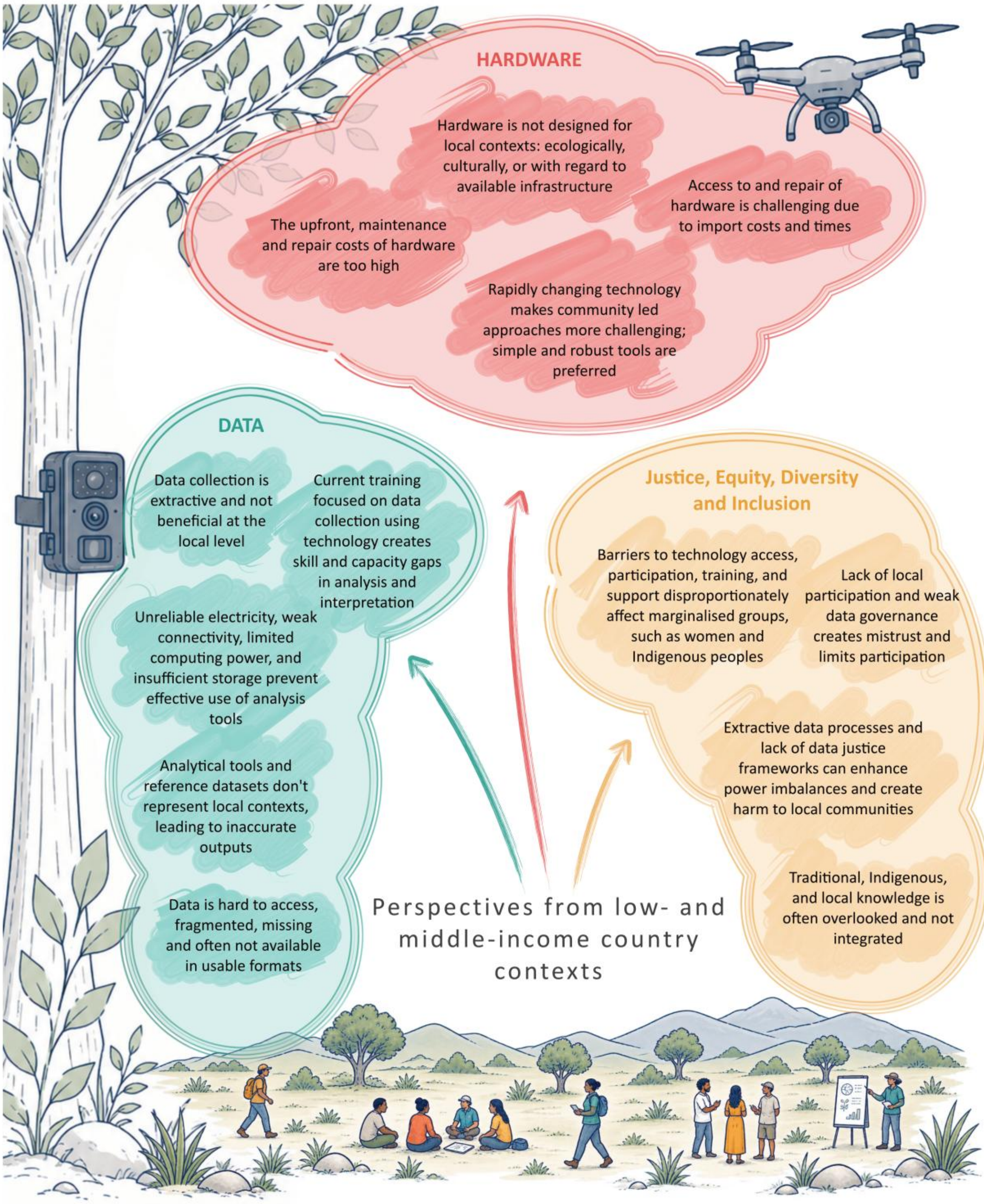

Figure 2 Headline findings from the Innovate 4 Nature project on experiences of accessing and using biodiversity monitoring technologies in low- and middle-income countries.

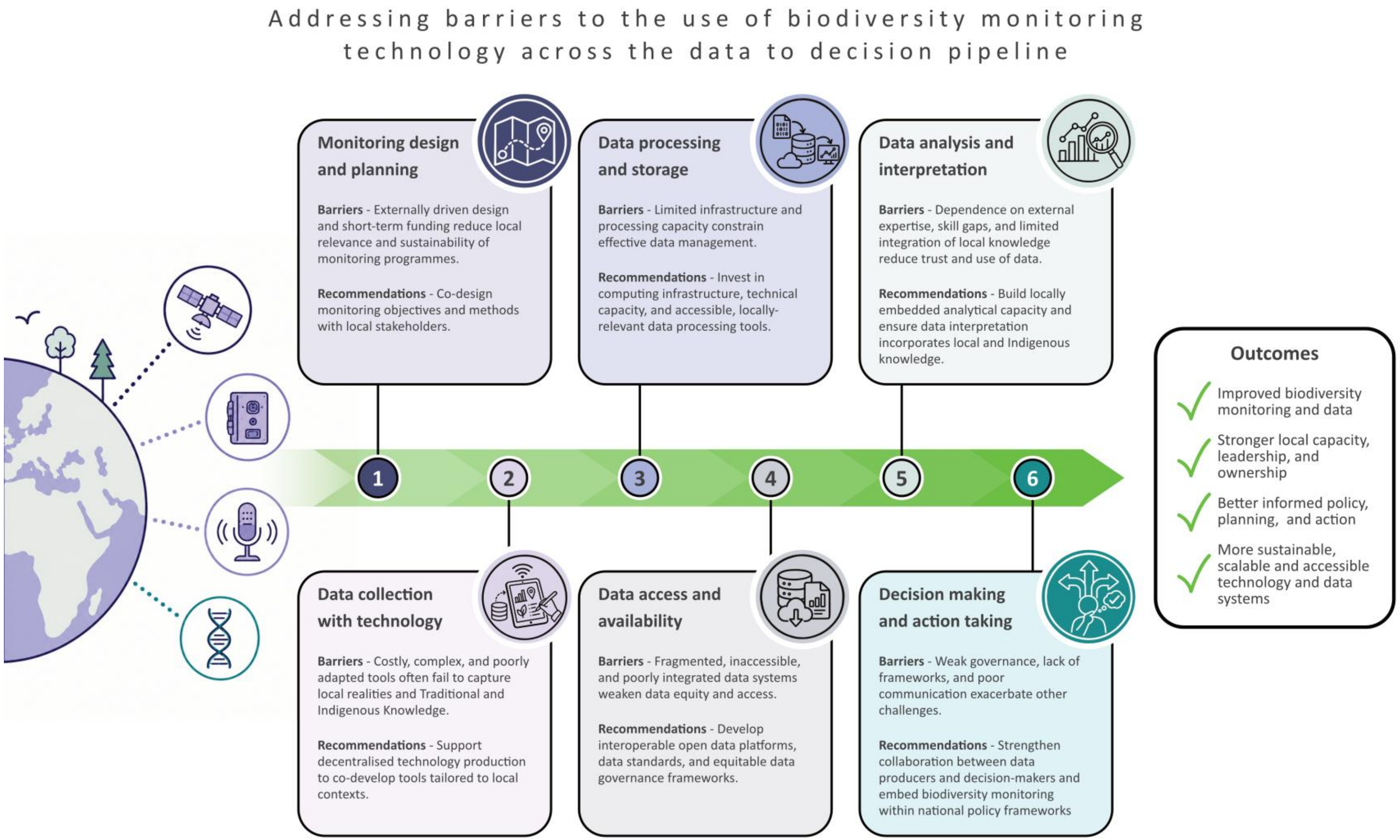

Figure 3 The key barriers along the data capture to decision making pipeline, as identified during the Innovate 4 Nature programme, and recommendations to overcome these challenges.

Recommendations

For technology developers:

1. **Design technologies for local realities:** Prioritise robust, affordable, and context-appropriate tools that operate under constrained conditions (e.g. limited power and connectivity). Technologies should be co-designed with local scientists, practitioners, and communities to ensure relevance, usability, and sustained adoption.

2. **Decentralise technology production, maintenance, and support:** Reduce reliance on external production and repair by supporting local or regional manufacturing, adaptation, and maintenance. Where this is not feasible, technologies should be designed to be repairable locally, with streamlined procurement, permitting, and access to spare parts and technical support. National or regional centres, such as the Subregional Technical and Scientific Cooperation (TSC) Support Centres (https://www.cbd.int/tsc/tscm/subregionalcentres) could be utilised for support.

3. **Develop locally relevant analytical tools and reference libraries:** Support the development of local taxonomic reference collections, species classifiers, and analytical tools required for emerging technologies such as AI and eDNA. Locally relevant tools will improve accuracy, usability, trust in data and use of data in decision making.

For the research, NGO, and practitioner community

1. **Build local ownership and end-to-end capacity:** Expand capacity development beyond data collection to include data management, analysis, interpretation, and decision-making. Training should focus on developing "data translators" and embed technical and analytical expertise within local and national institutions to support long-term resilience. This could be supported through regional workshops and training events co-ordinated by local stakeholders, such as Subregional TSC Centres.

2. **Strengthen data systems through integration and standardisation:** Establish standardised national or regional biodiversity data platforms to consolidate datasets, improve access, and enable interoperability. Standardise data collection, formats, metadata, and analytical workflows to ensure comparability, integration, and trust in data outputs. Existing infrastructure, such as the Global Biodiversity Inventory Facility (GBIF; https://www.gbif.org/) and Group on Earth Observations' Biodiversity Observation Network in a BOX (BON in a BOX; https://boninabox.geobon.org/), can facilitate this process, but support and investment in local digital infrastructure is needed across many LMICs.

3. **Prioritise inclusive and participatory monitoring:** Ensure monitoring programmes are co-designed with communities and Indigenous Peoples from the outset, with clear benefit-sharing, feedback, and ownership mechanisms. To ensure equitable access to data, easy-to-use shared data platforms with informative and meaningful data visualisation is needed. Technologies should complement Traditional and Indigenous Knowledge and integrate biodiversity, socio-economic, and cultural values to support inclusive and equitable outcomes.

For policy actors

1. **Improve data-to-decision pathways and policy integration:** Strengthen communication between data producers and decision makers through dedicated platforms, embedded scientific expertise in decision-making bodies, and clear requirements for how data informs policy. The Convention on Biological Diversity National Biodiversity Strategies and Action Plans (NBSAPs) should provide a good framework for this, but more support is needed on how to integrate these into national policies.

2. **Strengthen data governance, ownership, and trust**: Establish clear, transparent data governance frameworks that define data ownership, custodianship, sharing, and ethical use. Governance arrangements should safeguard community and Indigenous data sovereignty while enabling appropriate access and reuse.

3. **Enable decentralised technology ecosystems:** Policy actors can incentivise local manufacturing, reduce import barriers for components, streamline permitting for sensors and drones, and support regional repair hubs.

For funders

1. **Invest in enabling infrastructure and long-term funding**: Move beyond short-term pilots by investing in power, connectivity, computing capacity, data storage, and long-term monitoring programmes. Sustained funding is essential to ensure technologies remain functional and data are usable over time.

2. **Ensure funding is diverse**: Funders should avoid concentrating resources solely on high-tech solutions and instead support a diversity of monitoring approaches, or risk excluding organisations without advanced infrastructure, narrowing who can participate in conservation, and weakening local ownership of data and decisions.

3. **Support local ownership and capacity building:** Funding should target local institutions, not only international partners. This includes training, institutional strengthening, and long-term support for local data collectors, technicians and analysts.

4. **Fund development of local analytical tools and reference libraries:** Funders can accelerate the creation of regional eDNA libraries, AI training datasets and taxonomic collections, which are essential for accurate biodiversity assessments.

5. **Incentivise inclusive and participatory monitoring**: Funders should require projects to demonstrate co-design with communities, benefit-sharing mechanisms, and integration of TIK as conditions for support.

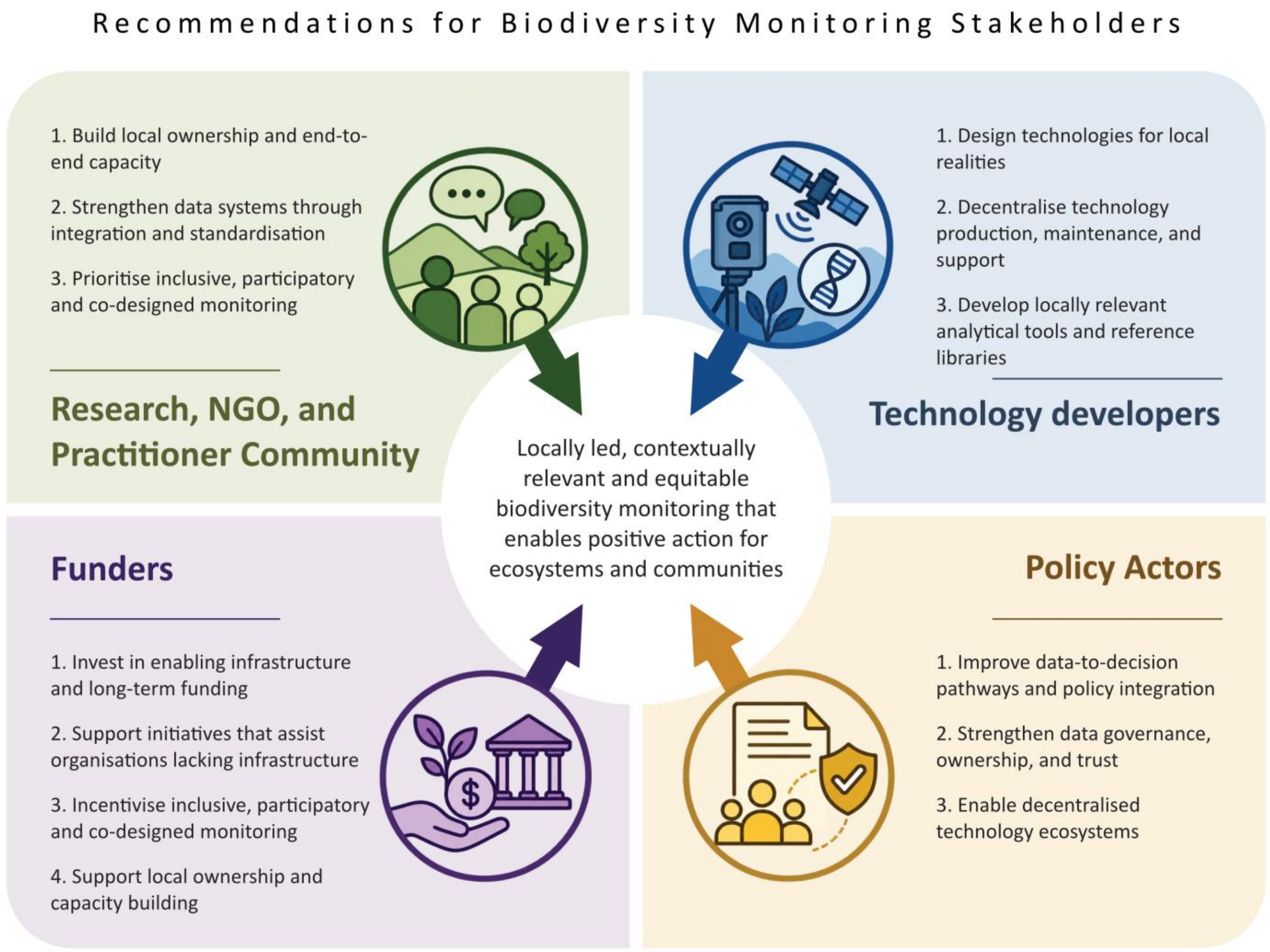

Figure 4 The key recommendations to increase effective and equitable technology use for biodiversity monitoring for each group of stakeholders considered in the Innovate 4 Nature programme.

Conclusion

There is great scope for technologies to enable the monitoring that is required to meet local, national, and global objectives. Participants highlighted the opportunities that technologies can bring to landscape-scale monitoring, to long-term continuous monitoring and early-warning systems for threat detection. Technologies are already being applied across multiple taxonomic groups and habitats, and being used to inform actions and decisions at scale. Participants widely reported that technology has enhanced their capacity to collect and use data, improved data quality, and delivered resource efficiencies in biodiversity monitoring. While a range of barriers and needs were identified, it is important to note that many of these, such as power imbalances between monitoring actors, siloed working practices, and weak links between data, practice, and policy, are systemic challenges that also occur in the absence of technology. At the same time, there is a risk that technology could exacerbate these existing challenges if it is poorly designed or implemented. It is therefore vital for targeted interventions that ensure biodiversity monitoring follows a more robust and equitable trajectory. As countries work towards their 2030 global biodiversity goals, there is a narrow window to ensure technologies are deployed in inclusive, integrated ways that respond to on-the-ground needs. Realising their full potential will depend not only on technological innovation, but on strong governance, collaboration across sectors, and a clear commitment to bridging the gap between data and action.