Risks and benefits of artificial intelligence in locally led nature restoration

Scoping study for the Reversing Environmental Degradation in Africa and Asia (REDAA) programme

REVERSING ENVIRONMENTAL DEGRADATION
REDAA
IN AFRICA AND ASIA

About the report

This report explores the potential applications, prospects, risks and barriers of artificial intelligence (AI) for the REDAA programme. It provides insights into how AI might support or hinder locally led nature restoration and conservation initiatives and identifies potential AI tools for REDAA partners to consider. Authors are Adrien Tofighi-Niaki (ATN), independent climate and environmental research consultant, Sanjukta Moorthy (SM), planning, monitoring, evaluation, and learning, and justice, equity, diversity, and inclusion expert, The SMC Group, and Ramin Soleymani (RS) independent consultant and research engineer, Barcelona Supercomputing Centre.

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About the REDAA programme

REDAA is a programme that supports research and action in sub-Saharan Africa and South and Southeast Asia by offering grants and facilitating mutual learning between partners.

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Disclaimer
The potential AI applications and recommendations in this study offer a pathway for REDAA to consider how AI could, if applied ethically, benefit the initiatives it supports. However, any AI tool or model that REDAA considers should undergo a unique and comprehensive evaluation. Such granular assessment was not within the scope of this study. As noted in the recommendations, the authors strongly recommend that REDAA develops an internal policy on the use of AI in the programme. This policy should include assessment protocols for technical, regulatory, social, economic and environmental risks prior to applying specific AI tools within REDAA-supported initiatives, so as to fully understand both the short-term and long-term risks.

Executive summary

Introduction

This scoping study explores the potential applications, prospects, risks and barriers of artificial intelligence (AI) in the context of the Reversing Environmental Degradation in Africa and Asia (REDAA) programme. It provides insights into how AI might support or hinder locally led nature restoration and conservation initiatives, and identifies potential AI tools for REDAA partners to consider. The study employed multiple research methods, including a literature review, stakeholder consultations and technical assessments. The literature review examined 126 documents, including 49 internal REDAA documents and 77 external academic articles. Stakeholder consultations involved interviews and surveys with 57 participants representing diverse sectors and hailing from 48 countries worldwide. The technical review consisted of assessing 68 AI models or tools for various factors such as function, use case, accessibility, cost, technical requirements and relevance to the REDAA programme.

AI prospects

Biodiversity monitoring, land use and modelling: Biodiversity monitoring can be significantly enhanced through AI-powered tools that analyse images and sounds to identify species and track ecosystem health. These can reduce the time and cost associated with manual monitoring processes. Remote sensing and satellite imagery also enable real-time analysis of environmental changes, such as deforestation and habitat degradation. Finally, AI's capacity for risk and predictive modelling can allow communities to forecast environmental hazards like floods and wildfires, enabling proactive measures.

Local research and participatory design: If integrated with local research systems or governance structures, AI tools can provide the benefits listed in the previous point at granular and contextually relevant scales, making restoration efforts more effective.

Business models: Local-level business models can benefit from AI tools like virtual assistants and chatbots that provide tailored training and support to smallholder farmers, for instance, in order to help them optimise yield or market access.

Financing and funding: AI-based chatbots or tools can also improve access to funding opportunities by streamlining grant management and assisting with grant proposal writing.

Inclusive governance systems: In terms of governance, AI tools have the potential to enhance transparency and accountability by generating real-time alerts or simplifying complex legal information, ultimately leading to stronger local governance systems if deployed ethically.

AI risks

The adoption of AI is not without significant risks. One of the primary concerns is the lack of transparency in AI models, which are often described as 'black boxes' due to the opaque nature of their decision-making processes. This lack of clarity makes it challenging to understand or replicate how AI systems arrive at specific conclusions, undermining trust and accountability.

Bias: AI bias is a significant risk in conservation, as it can prioritise certain species, ecosystems or regions over others due to developer assumptions or limited data. In data-poor regions, unvalidated AI systems may lead to flawed management recommendations with harmful ecological consequences.

Hallucinations: Open-ended AI models, including chatbots and computer vision tools, can sometimes produce nonsensical outputs due to training flaws or limited context, resulting in misleading but seemingly coherent responses. For biodiversity monitoring, open-ended species identification models trained in specific regions may mislabel species when applied elsewhere, leading to inaccurate data and poor decision making or recommendations.

Transparency and integrity: The AI 'black box' can limit understanding and reproducibility, forcing conservationists to depend on opaque outputs. This lack of clarity can undermine decision making and compromise ecological management. Without insight into how AI produces results, scrutiny and accountability can suffer, thereby weakening research integrity.

Privacy and security: Weak regulations or cybersecurity measures can lead to data breaches and exploitation of natural resources. Surveillance technologies, such as drones and remote sensing, can also be used to unlawfully monitor certain ecosystems and communities.

Exploitation and sovereignty: By adopting and inputting data into certain tools, Indigenous Peoples (IPs) or local communities (LCs) may increasingly provide valuable information via AI systems but lose more control over how that data is used or who profits from it, which can reinforce power imbalances. This can jeopardise data sovereignty and community rights, including control over sacred sites or traditional practices.

Dependency: Reliance on foreign AI systems may come with certain technical or social conditions from the tool developers that ultimately have the potential to reduce community agency. Long-term dependency on certain tools also risks undermining local wildlife management practices or weakening traditional monitoring skills.

Unequal access and benefit: AI tools may exacerbate existing inequalities. For example, in the context of local agricultural production systems, AI tools (eg precision farming or resource optimisation platforms) may be more cost effective, technically feasible or digitally accessible for middle- or large-scale producers than for smallholder farmers.

Misrepresentation of culture and knowledge systems: AI often simplifies socio-ecological relationships based on Western scientific approaches, overlooking equally important Indigenous or locally based research methods and cultural practices. This can lead to inappropriate or harmful solutions for IPs or LCs. As reliance on big AI grows, traditional ecological knowledge is increasingly at risk of being sidelined, devalued or erased, which can have grave environmental and social consequences.

Stakeholder opportunities

Technology: According to stakeholder feedback, the top opportunities for AI to meaningfully support projects are by reducing technical barriers to community members' participation (89%), empowering local data ownership (72.7%) and strengthening local data collection (70.9%). There was an interest in technical training to foster peer knowledge sharing rather than relying on external expertise. Advanced tools like drones and AI-powered monitoring systems were seen as valuable, with better adoption possible if solutions were affordable, accessible and linguistically inclusive. Ethical protocols for data collection and community-driven approaches were highlighted as essential for protecting community rights.

Cultural and epistemic: Stakeholders emphasised that broad community engagement would be needed to ensure inclusive participation in AI adoption. Language and cultural barriers were common concerns, with calls for tools tailored to local contexts and non-English speakers.

Some participants mentioned that many data repositories are developed by tech-focused conservationists rather than through community-driven approaches. Participants advocated for ethical, culturally grounded solutions rather than adopting AI for novelty's sake.

Stakeholder challenges

Technical and infrastructure: Participants emphasised that focusing on AI without addressing basic technical gaps is futile, as many of them still lack essential tools like laptops, phones and monitoring resources. Key challenges include high technology costs (83% of responses), difficulty integrating new tools (67.9% of responses) and limited technical awareness (62.3% of responses). Inconsistent hardware access, data privacy concerns and language barriers were also noted as issues. Outdated and inaccessible data further hinders strategic decision making, particularly among ethnic minority and non-English-speaking staff.

Organisational development and funding: A major barrier to REDAA projects adopting AI is that external decision makers often undervalue locally led approaches. Participants highlighted the importance of co-design and meaningful inclusion in partnerships, though this is not universally supported by international partners. Resource constraints, including limited access to funding and technology, prevent many community-based organisations from fully adopting AI solutions. Participants stressed the need for capability building such as organisational strengthening, and capital investments in hardware to support technological engagement.

Contextual: The survey revealed conflicting views regarding community interest in AI; some saw its potential to address various gaps, while others felt it conflicted with traditional values. Regulatory barriers, including weak data privacy laws and top-down governance, hinder local technology adoption. Political instability, corruption and social resistance also complicate project implementation.

AI tools in REDAA context

The study assessed 68 AI tools, classifying them into 23 overlapping use cases, including restoration, agriculture and food security, species identification, climate resilience, bioacoustics, language, grants and fundraising, and information access, to name a few.

REDAA themes: Most tools focus on conservation, monitoring and species identification, and climate resilience. Notably, 51 tools supported local research, 44 resource and land use, 16 business models, 13 inclusive governance systems, and 8 financing mechanisms, often spanning multiple REDAA themes.

Regional representation: Most of the AI tools assessed are available globally (71%), with several designed for specific regions: Africa (8.7%), South Asia (5.8%), North America (4.3%), Europe (2.9%), Polynesia (2.9%), Oceania (1.4%), Arctic (1.4%) and South America (1.4%).

Language diversity: Over 50 languages were represented across the AI tools. Tools across Africa included 40 languages, while South Asian tools featured 8 Indian languages.

Expertise requirements: Required expertise for using or deploying the AI tools varied, ranging from basic smartphone skills (9%) and basic computer skills (22%) to intermediate skills (38%), which require general understanding of digital platforms and data analysis, and expert skills (31%), which require some element of computer programming or machine learning skill.

Potential AI tools for REDAA initiatives: Ten AI tools were identified as potential applications for REDAA initiatives in South and Southeast Asia and sub-Saharan Africa. Among them, Ketos, a bioacoustic data analysis tool, could support coastal restoration efforts in Myanmar by enabling the monitoring of underwater ecosystems. The Raspberry Pi AI Kit, a hardware solution that enables real-time wildlife monitoring specifically in Vietnam, is also ideal as a portable and affordable tool for community-led conservation projects. Farmer Chat, a user-friendly AI chatbot, supports small-scale farmers by providing access to agricultural advice and overcoming the digital literacy barriers.

Actionable steps and recommendations

Priority One: Understand and prepare

REDAA Scientific Management Unit (SMU):

- **Close the technology gap:** Closing the technology gap is critical — ensuring access to basic technological resources such as mobile phones, laptops and data collection tools will lay the groundwork for AI adoption.

- **Develop a REDAA/IIED AI policy:** The development of an AI policy is essential. This policy should include clear protocols for responsible AI assessment, deployment and monitoring of impact. It should incorporate ethical guidelines laid out in this report and across other AI ethical frameworks, as well as from REDAA community partners.

- **Support stakeholder preparation:** Ongoing support should be offered, including webinars, materials and lessons-learned events, to prepare REDAA partners on AI deployment.

REDAA initiatives and community:

- **Collect good base data:** Collect high-quality data using regular community-based monitoring mechanisms, and apply local research protocols for data use and ownership. This can provide a foundation for AI applicability later.

- **Build long-term technical partnerships:** Collaborate with local universities, local social enterprises and local organisations to bridge the digital divide and ensure long-term resilience when facing AI-related challenges.

- **Understand AI ethical risks:** Develop informative community documentation and consent protocols to ensure collective understanding, control and oversight over AI systems.

- **Co-develop informational materials,** such as culturally relevant guides, a repository of best practices, reviews in AI tool deployment, and lessons learned.

Priority Two: Assess low-risk models

Once the steps in priority one have been achieved, the authors recommend gradual and scalable adoption of AI tools by first focusing on low-risk applications. Some examples of low-risk tools include those that prioritise minimal reliance on sensitive cultural or ecosystem data, are developed or successfully used by organisations experienced in working with IPs or LCs, have constrained and predictable outcomes (eg not open-ended or prone to hallucinations), and are affordable, contextually relevant, linguistically inclusive, user-friendly and interpretable in terms of decision-making logic. Long-term, iterative co-development will ensure that AI solutions remain meaningful and context-specific rather than superficial.

1. Introduction

1.1 Scope of study

This scoping study was conducted for the Reversing Environmental Degradation in Africa and Asia (REDAA) programme. REDAA Strategy is periodically revised in light of experience with the programme. One area in which experience is nascent but growing in the REDAA Community is artificial intelligence (AI). The REDAA Community expressed interest in understanding how AI and related technologies could help local organisations running REDAA-supported initiatives, or other initiatives focused on research-to-action for locally led nature restoration and conservation. This report therefore looks at the prospects, risks, issues and opportunities related to AI in this context.

The following questions guided our research: (1) How can AI help organisations practising or supporting research-to-action for locally led nature restoration to be as effective and positively impactful as possible? (2) What are the prospects and risks of AI in the context of locally led conservation and restoration? (3) What barriers or opportunities do supported initiatives and partners have with adopting AI or technology more broadly in their work? (4) What AI tools exist that could potentially support REDAA partners and its thematic pillars?

1.2 Methodology

Literature review

The study began with a literature review of 49 internal IIED/REDAA documents (see Annex 4) and 77 external academic articles or reports (see Annex 5). The main search engines we used were DuckDuckGo, Perplexity AI and Google Scholar. We developed a script in Python to extract information from several REDAA documents about the REDAA initiatives, namely the title, description, location, timeframe and outputs. This provided context for understanding REDAA, its supported initiatives, and the scope of this study. The insights emerging from the literature review guided the technical review and stakeholder consultations.

Stakeholder consultations and analysis

The stakeholder consultations started with two mixed-methods online surveys, which were sent to IIED staff, REDAA-supported initiatives and partners, and the REDAA Community of partners, peer organisations and external experts. We received 57 survey responses across large international nongovernmental organisations (INGOs), national nongovernmental organisations (NGOs), civil society organisations, public agencies and universities. The geographic distribution was also varied, with respondents representing 34 countries in Africa, 11 in Asia, two in Europe and one in North America. The analysis is, therefore, based on a strong and varied sample of relatively diverse organisations as well as IIED staff and external experts.

The surveys were supplemented by stakeholder interviews with three practitioners in the conservation and locally led restoration field, three REDAA partners and five REDAA staff members. Interviews were conducted online and recorded to facilitate the collection of notes. All participants in the surveys and interviews provided their informed consent to be included in this scoping study. This scoping study does not share the names of individuals, projects or organisations. Despite some interviewees requesting their organisations and names be shared with partners to support peer learning, the authors decided to follow the request of the majority of participants and REDAA, and have anonymised all data.

The internal literature review data and stakeholder consultations data were combined and triangulated for a two-tiered analysis. Participants validated the data through a detailed consent process. Each method was then triangulated across at least one other source – the surveys and interviews supported each other's triangulation, and the literature review was verified through staff interviews.

For the stakeholder consultations, AI tools were used to support validation and triangulation of emerging findings during the analysis. A fully anonymised mixed-methods analysis of the stakeholder consultations, surveys and REDAA literature review was prepared and NotebookLM was used to help identify any gaps in the research, including biases and limitations. Fireflies was used to help generate transcripts of stakeholder consultations, with the explicit consent of all participants, and transcripts were securely deleted after generation. Typeform was chosen as the survey platform. Quantitative analysis was done manually and triangulated against Typeform's built-in quantitative analysis, also to identify any gaps or emerging insights captured by AI. Throughout the data collection and analysis stages of this phase, mixed-methods manual notes and analysis were prepared separately and used to cross-check against the details provided through these platforms' AI functions. This included all qualitative analysis, and AI was used solely for cross-checking, one layer of triangulation, and to identify gaps or limitations.

Technical review and analysis

A technical review of 120 potential AI tools and services in the context of REDAA's work was also conducted. We identified these tools via Google Dorking, Google Scholar, Github, and civil society, technology and other conservation-related repositories, as well as from the stakeholder consultations. A first-round assessment was conducted to test their actual relevance to the scope of the study. As a result, 52 tools were omitted as they were either top-down or heavily corporate,[i] outdated,[ii] or not actually AI tools.[iii]

The 68 remaining tools (see Annex 1) were then assessed manually for the following criteria: (1) function and task-solving capacity (eg mobile app, chatbot, image-processing software, Python package for data processing); (2) use case (eg species identification, satellite imagery, agriculture and food security);[iv] (3) accessibility (language, cost, hardware and software needs, geographical relevance); (4) relevance to REDAA themes (local research, resource and land use, business models, financing mechanisms, and inclusive governance). Results from the stakeholder interviews, survey responses and REDAA grantee details were then assessed to determine the tools' relevance to specific existing tools by cross-referencing them with tool classifications such as REDAA themes, use cases and geographical relevance. This guided the potential applications and recommendations sections.

i These were tools that did not align with the scope of the study (eg high corporate rates/costs, low transparency over data control), or were designed specifically for multinational corporate operations (eg big agriculture supply chains, corporate marketing).

ii Some AI tools were either outdated or no longer active according to their GitHub page or interface.

iii Many tools that were included in this first review appeared to integrate AI but were in fact support tools (eg Timby), sometimes used in tandem with another AI tool. This happened in various references from the stakeholder consultations (eg Kobo toolbox). In other instances, an identical AI model was used as the backend to various front-facing tools or products, making those tools redundant.

iv Use cases include approaches as well as outputs, and in most cases more than one use case was assigned to a tool despite this distinction (eg 'restoration', 'aerials and drones', and 'forestry' could all be use-case classifications for tool X).

2. Artificial intelligence

2.1 Overview

Artificial intelligence (AI), machine learning (ML) and deep learning (DL) are computer science innovations with their own definitions. AI is often seen as a metaphor or umbrella term, encompassing digital systems that can perform tasks that typically require human intelligence, such as reasoning, decision-making or language understanding. Machine learning is a branch of AI in which those systems learn from data without being explicitly programmed.[1] Deep learning is a specialised branch of machine learning based on artificial neural networks that vaguely mimic human brain cells. Thanks to research breakthroughs in the mid-2010s, combined with the availability of powerful computing resources and massive amounts of training data, deep learning has become almost synonymous with modern AI applications.[2]

A key strength of these artificial neural networks is their universal representation of information, such as text, image or structured data, which enables interoperability of diverse data types and cross-modal applications, such as generating text descriptions from images or synthesising data from textual prompts.[3] By translating and generating across modalities, these systems bridge previously siloed data types. A common application of AI is via Large Language Models (LLM), which promise to revolutionise how we interact with information through natural language interfaces (eg ChatGPT, Claude). Natural language has become a universal interface, enabling both human–machine communication and machine-to-machine interaction. The ability to find patterns in large amounts of complex data and handle and query that data makes AI an incredibly transformative and powerful tool especially for tasks within research, analysis, decision making and creative work. Yet, as with all technology, enormous potential for groundbreaking progress comes with enormous potential for novel risks for people and planet alike.

2.2 Global risks

Today, large AI models have grown so complex that they operate as 'black boxes'. This means that while we might understand their inputs and outputs, their internal decision-making processes have become increasingly opaque. As models scale to billions or trillions of parameters, it becomes computationally unfeasible and practically impossible to fully analyse how they learn and make predictions. This creates a paradox in which our most capable AI systems are also our least understood, raising important questions about transparency, reliability and responsible development.

The field of AI ethics raises a number of critical concerns, ranging from algorithm bias and transparency, and the responsible deployment of AI technologies, to the existential risk posed to humanity by overly powerful and uncontrollable AI systems. The latter, a very real concern as expressed in a letter signed by hundreds of AI experts and scholars titled Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war,[4] should not be dismissed as extremist rhetoric. These concerns are amplified by the fact that in most countries, AI regulatory frameworks are largely under development.[5] Special attention needs to be paid to the increasing power of large tech companies over many aspects of daily life. Companies such as Google, Meta and Microsoft already have an unparalleled influence on global politics, economy and culture, but this influence will be exacerbated by AI as there is a risk that AI development will be concentrated in the hands of a few profit-driven companies.[6,7,8]

Furthermore, as with all rapidly evolving technology, it is common for small companies to be founded and then close down[9] (eg after data breaches, ending up on the wrong side of the law), leading to valuable data loss, since migrating data is often impossible. Early adoption of nascent technology also means that end users are often integrating unproven or even beta versions of products or decisions into their lives, which can have minimal or significant consequences depending on their use case.

The rise in energy and material demand to build and maintain AI systems, such as data centres, is also of significant concern. In some cases, data centre energy demand has already resulted in energy grid overload.[10] These centres are causing stresses on material and water supply as well, with a typical data centre requiring 3–5 million gallons of water per day.[11] In the United States, nearly half of data centre servers are fully or partially powered by power plants located within water-stressed regions.[12] At a global scale, this surge in material, energy and water demand is likely to leak to low- and lower-middle-income countries, thereby aggravating existing inequalities, while benefits from such developments flow to powerful elites or high-income countries.[13,14] Given the role of resource extraction in driving the climate and biodiversity crises, development of AI systems will exacerbate the existing disproportionate impacts of climate change and biodiversity loss for many global South communities, and may even do so under the guise of bold climate or environmental action.

3. AI in locally-led conservation and restoration

3.1 Prospects of AI in REDAA

In this section, we consider the prospects and promises of AI in the context of REDAA and its five themes: local research and capability for research, resource and land use, business models, financing mechanisms, and inclusive governance systems. The points below are applicable to more than one theme and collectively have the potential to advance REDAA's broader goals. However, we focus on prospects based on a combination of the tools and literature available, as well as the ethical implications highlighted in section 3.2. As a result, this section does not explore every possible facet of AI applicability in this field, and is restricted to what the authors considered most significant. We have not given specific case examples, but a searchable database of existing AI tools relating to the majority of these points is made available in Chapter 5, and potential applications for REDAA are considered in Chapter 6.

Biodiversity monitoring, land use assessments, and modelling for resilience

- **Image and sound recognition:** AI tools that integrate species identification such as image or acoustic recognition (eg using camera traps or recording devices) can streamline biodiversity assessments and enable communities to monitor ecosystem health, illegal activities, human–wildlife conflict incidents and population trends. In many cases, they do so at a fraction of the cost and time that manual interventions would take, thereby significantly improving both organisational resource optimisation and evidence generation.

- **Remote sensing, satellite imagery and aerial surveys:** The ability of AI to communicate across various language systems makes it possible to combine and integrate large datasets pulled from multi-layered sources (eg satellite imagery, drone images, aerial surveys) and quickly understand scenarios at various scales in real time, from broad landscape changes like deforestation to detailed local changes like habitat degradation. For agricultural or food security initiatives, these operations could also be combined with ground-level data such as soil health, water quality, moisture or crop types. Doing so, these models could theoretically support local farmers in making decisions on types of drought-tolerant crops or irrigation practices that best meet their needs and contexts. The speed at which many of these models work has resulted in significantly cheaper and faster operations. Local communities can then use these insights to evaluate habitat suitability or identify priority areas for interventions.

- **Risk and predictive modelling:** Perhaps one of AI's greatest strengths is its ability to process large amounts of information in real time at high speed. By combining historical or environmentally comparable data with real-time patterns (eg weather patterns, water levels, coastal conditions), AI-based tools can contribute to the early identification of risks and forecast floods, droughts, wildfires or human–wildlife conflicts. Additionally, models can be used to integrate these forecasts for rapid scenario planning to help communities best understand their options. By identifying such risks early on, communities could theoretically make proactive, adaptive decisions that meet local decision-making or governance protocols rather than reactive decisions often made under the pressure of emergency situations or the conditions of external NGOs/entities, thereby improving overall resilience.

Local research and participatory design

- **Local systems, devices and platforms:** There is increasing potential to run AI models locally, which would give communities control over their data and, ultimately, their research. However, while smaller, specialised models can run on local infrastructure and offer enhanced privacy, offline functionality and reduced latency, these generally require more specialised knowledge of AI. They also may not always work optimally since the performance and capability of an AI model depend on its size, architecture and computational requirements. But if these models are deployed ethically and successfully, there is potential to link existing phones, low-bandwidth or offline-first applications, and other community-based monitoring platforms to them so as to improve access to real-time insights and response options. Locally led data-driven decision making can also restore power to communities as evidence can demonstrate the impact or effectiveness of conservation or restoration efforts.

- **Participatory design:** Organisations are starting to co-design or build AI and technology policies alongside local communities (LCs) or Indigenous Peoples (IPs) in order to try and make these systems contextually relevant.[15] Thankfully, there are a growing number of methods that allow the development of specialised small AI models which outperform large general purpose LLMs.[16] Via dedicated workshops and careful planning, IPs and LCs can support traditional, local or Indigenous knowledge and practices with insights gathered from these models to align precise restoration goals with local and culturally or economically relevant needs and priorities. These tools could run on mobile phones or other simple devices,[17] which would facilitate participatory design and research.

Business models

- **Training and development:** Some of the most common applications for AI technology are through smart training, support chatbots, virtual mentorship or mobile app assistants. When these assistants or models are trained well on a specific field, commodity, process or context, they can offer workers guidance — on production-related uncertainties (eg which tree species are better suited for specific restoration efforts), or via short trainings where models learn and adapt to the user's skillset and speed. Applications that strengthen existing social relationships rather than replace them are key, for instance if an assistant is used to reduce technical barriers for smallholder farmers, it can increase their agency in social or economic structures, giving them a better chance of competing against large-scale agricultural production systems. Depending on the quality of the model, AI-based training simulations could also help workers foresee and understand long-term outcomes of certain practices.

- **Traceability and quality management:** Using image or pattern recognition, AI models can help verify the quality of goods or processes linked to local-level production systems, thereby improving a producer's market access. Such measures could also uphold intellectual property or community rights and autonomy. For example, AI-based tools can generate unique digital identifiers for goods or batches. This could help create a verified chain of custody for local commodities or traditional production methods, which in theory could not only safeguard rights but also build evidence and help shape the narrative around the value of traditional or local means of production.

Financing and funding[v]

- **Capacity development:** One of AI's few success stories so far is its ability to streamline repetitive functions that take time but don't require much brain power, while also generating new metrics or insights in that process. For example, under-resourced organisations or small enterprises could use accounting software to streamline internal financial procedures. Offloading these types of tasks could help organisations meet certain financial outputs and allow staff to focus their time and attention on programme-related activities instead, thereby increasing organisational capacity.

- **Grant management:** Other common AI-based applications for civil society funding are tailormade platforms, chatbots or mobile applications that facilitate access to funding opportunities and assist users in developing grant proposals. Not only can AI models regularly improve their search for opportunities based on user profiles and preferences, they can also provide guidance on eligibility and procedures, as well as generate tailormade proposals based on organisational values, contexts and needs. Natural Language Processing also helps break down language barriers, allowing individuals or communities in one country to access funding from sources they may have never previously been able to reach.

Inclusive governance systems

- **Accountability:** Many of the tools listed later in this report (in Chapters 5 and 6) could theoretically contribute to stronger governance systems if deployed responsibly. Monitoring platforms that improve transparency and understanding of resource management or ecosystems can be used to generate alerts when abnormal activities occur, thereby driving stronger local accountability. Furthermore, closed-ended chatbot or legal support tools have the potential to explain complex legal information in simple terminology across various language and cultural landscapes, giving communities the opportunity to be in charge of driving accountability measures. These same tools could also be set up to track and document governance processes and decisions that lead to stronger transparency.

- **Access to information:** From chatbots and personal assistants to training models and predictive insights, better access to (good) information, especially in the context of local or remote communities, can contribute to better decision making and ultimately stronger governance. This is especially the case for NLP, which may facilitate more context-specific and culturally relevant information.

3.2 Risks of AI in REDAA

In the context of REDAA's work in varying South Asia, Southeast Asia, and sub-Saharan African contexts, some direct risks include:

- Economic and livelihood risks[18] (eg agriculture supply chain job displacement due to AI automation of tasks)

- Security and privacy risks[19] (eg AI-powered surveillance and data collection via ecosystem monitoring agents)

v During our research we came across a few examples of AI and carbon markets, However, given the overwhelming evidence of flaws in global voluntary carbon markets (see www.nature.com/articles/s41467-024-53645-z), including the lack of systemic evidence that local communities actually benefit in the long run from participating in them (see https://carbonmarketwatch.org/publications/a-fair-share-of-the-voluntary-carbon-market/#:~:text=The%20study%20reveals%20that%20there,arrangements%E2%80%9D%20in%20their%20standard%20documents), we do not consider these to be effective tools and therefore did not include them in our study.

- Governance risks[20] (eg dependency on external AI services that lead to weaker community sovereignty)
- Legal risks[21] (eg lack of standards for AI safety and ethics resulting in a lack of accountability), and
- Environmental risks (eg geographic bias in predictive AI models, which overlook under-represented regions in climate mitigation or biodiversity conservation).

Here we focus on eight key risks that will impact locally led conservation and restoration efforts for IPs, LCs, and smallholder farmers, if they are not seriously considered.

1. **Bias:** In terms of reliability, AI bias is one of the most prominent risks. In conservation work, bias based on AI developer knowledge, positionality or data availability can result in certain species, ecosystems or regions receiving more attention, and therefore protection, than others. In the context of data-poor regions, AI systems that are developed without being validated or accompanied by local knowledge can result in incorrect management recommendations, which can have cascading negative effects. Similar to the controversial use of off-the-shelf climate models, which can lead to incorrect predictions,[22] off-the-shelf AI tools that haven't been custom-designed for the context in which they are applied can introduce all sorts of unknown biases.

   For example, the ChatGPT chatbot has already reinforced the adoption of North American and European sources to inform the expertise on restoration efforts worldwide.[23] It did this by neglecting low- and lower-middle-income countries as well as countries with strong restoration pledges such as the Democratic Republic of the Congo and Tanzania, instead citing high-income countries without official restoration pledges. What's more, only 2% of the mentions in the assessment on international NGOs in this field considered Indigenous and community restoration perspectives. This bias can lead to skewed AI-led research and decision-making processes.

2. **Hallucinations:** As part of the broader risk of reliability, hallucinations can also occur in large language models such as chatbots or computer vision tools that generate incorrect conclusions due to their poor understanding of the world (eg because they have been poorly trained, or overly trained on one specific field). When this is applied to text-based interactions, a hallucinating chatbot can produce entirely nonsensical text that may seem coherent. This can have serious repercussions if humans using these systems are not vigilant or skilled enough to spot them. In the context of biodiversity monitoring, a species identification model trained on one regional context may incorrectly label species if it is deployed in a completely different regional context that it was not trained on, thereby misleading users by providing erroneous data.

3. **Transparency and integrity:** The low transparency 'black box' nature of AI systems also means that learning from them for the reproducibility of results is nearly impossible.[24] In predictive modelling, this could result in conservationists or researchers having no alternative but to repeatedly depend on an AI system's output without fully understanding how it got there. This lack of understanding in rationale for conservation or restoration management decisions can have significant ecological impacts if the rationale is off. It also makes it difficult to scrutinise a resource management decision, thereby lowering the threshold for research integrity in general. This not only reduces the quality of conservation and restoration work but also has major accountability implications.

4. **Privacy and security:** The lack of regulations and safeguards in many countries, combined with the potential for massive data breaches (eg due to poor data collection, storage or management decisions) and cybersecurity issues, means that these tools can be used for economic gain or as surveillance mechanisms over behavioural or economic activity, or over natural resources and ecosystems. For example, in 2019 a former Monsanto employee was indicted with economic espionage after planning to illegally sell data to a foreign government from an agricultural predictive algorithm that had collected, stored and visualised farming data.[25] If that data belonged to IPs and LCs who did not agree to it being sold, or contained important natural resource-related findings, this could directly harm communities. Furthermore, hyper-surveillance of natural ecosystems, species or regions by combining mixed methods such as drones, cameras traps and remote sensing for better AI outputs can lead to invasive practices or insights that can jeopardise the rights of communities living in these areas.

5. **Exploitation and sovereignty:** Institutions are already using AI systems to exploit global South actors as data sources, thereby reinforcing existing power hierarchies.[26,27,28] By adopting and inputting data into certain tools, IPs and LCs may increasingly provide valuable information via AI systems but lose more control over how that data is used or who profits from it. Indeed, harvesting data from the global South to train AI systems (such as for understanding crop yield or species behaviour) already represents a new form of resource extraction.[29,30]

   Given the slow evolution of the AI regulatory landscape in contrast with its rapid deployment, AI adoption with Indigenous communities runs the risk of occurring without proper free, prior, and informed consent, thereby violating IP rights.[31] Collecting environmental and community data through such negligent AI systems raises questions about data sovereignty and governance, and IPs risk losing control over sensitive information about sacred sites, traditional practices, resources, and ultimately rights to their land.

   Communities that regularly rely on external AI systems to make decisions may also ultimately become dependent on these technologies for management decisions, thereby undermining their own sovereignty and traditional management agency. All of this reduces a community's ability to manage its natural resources. While local communities do not have the same legal safeguards as Indigenous Peoples, these negative implications of losing control, agency or autonomy can also apply to them.

6. **Dependency:** If an AI system is not developed locally and depends on foreign companies or institutions, the use of such tools by communities may come with additional social or environmental conditions, which can tie a community down to one tool or system in exchange for the novel benefits it provides. Relying too heavily on a system can make conservation or restoration efforts vulnerable to technological failures. In the long term, this dependency also has the ability to decrease traditional wildlife monitoring or restoration skills among local community members.

7. **Unequal access and benefit:** Similar to other technological advances, unequal access to AI tools leads to unequal benefits. For example, while smallholder farmers in low- and lower-middle-income countries account for a large proportion of those countries' food production, unequal access to crop yield optimisation, precision farming or resource efficiency tools can lead to an uneven distribution of economic benefits between them, or with large-scale producers.[32] These non-AI technologies are already unaffordable or require a certain level of digital literacy, and these inequalities will be exacerbated with AI.

8. **Misrepresentation of culture and knowledge systems:** AI models are generally good at reducing complex socio-ecological relationships to quantifiable metrics, but the models tend to be embedded in Western views of science and taxonomy. These views are likely to misrepresent or ignore local environmental conditions, perspectives, languages, and cultural practices, leading to technological solutions that are culturally and environmentally inappropriate or even harmful.[33,34] Oversimplifying the nuanced interactions between communities and their environments can lead to management decisions that ultimately ignore crucial cultural and ecological complexities.

   Reliance on technology is one of the most prominent threats to traditional ecological knowledge, and is already a widespread problem.[35] Making decisions based on systems that sideline entire knowledge systems could lead to further devaluation or even erasure of those knowledge systems and, consequently, the people and cultures that embody them. Aside from the more important social and cultural implications of such losses, a more utilitarian risk is that such losses could result in the loss of generations' worth of unique local understandings regarding local ecosystem management practices or relationships, which itself has massive environmental consequences.

4. REDAA stakeholder perspectives

Stakeholder consultations began with an online survey that asked about: organisational needs, challenges, gaps and opportunities; access, familiarity and skill in using technology and AI; potential or desired impacts of their application; and community involvement.

These were supplemented by interviews with staff, partners and external experts to help ground emerging insights in wider contextual trends, organisational challenges and the landscape analysis conducted through the literature review. Both the surveys and interviews discussed strategies and approaches to locally led conservation and restoration, lessons learned, best practices, the ethical applications of AI, and the requirements for a process that could meaningfully contribute to project outcomes.

Although we asked about or alluded to gender and social inclusion in the stakeholder consultations (interviews and surveys), these issues were not mentioned significantly in the responses. They were also not mainstreamed in the documents reviewed. It was therefore not possible to include a meaningful discussion of these issues in this scoping study. Instead, all insights and findings focused on a localisation approach, which can be seen to tangentially include gender and other marginalised groups as well. Responses from the consultations are presented below grouped as challenges and barriers, and opportunities.

4.1 Challenges and barriers

Partners, the broader community and REDAA staff were asked about key organisational challenges, gaps and barriers with regards to the application of AI. These included hindrances to locally led and community-driven projects, wider contextual threats and organisational needs, and obstacles to meaningfully using technology and AI platforms.

The surveys reported that top organisational barriers include technology access (mentioned by 61.8% of participants), financial constraints (60%), skills gaps in proposal writing (52.7%) and technology use (47.3%). Resource dependency, particularly access, funding and technology were the top cross-cutting themes emerging. Here, partners did not share the names of specific AI tools that they would like to use, but referred broadly to platforms, software or online/offline tools that could support their work programmatically. In some responses, general capital needs such as computers were cited, highlighting the foundational stage of understanding regarding how technology can be leveraged to support initiatives.

Technical and infrastructure

- It was evident across all responses that focusing on AI solutions without first addressing basic technical and infrastructural gaps would be futile as the majority of participants still felt the need for better access to basic technology such as data collection tools, laptops and mobiles phones, and ecosystem monitoring resources.
- Major technical challenges include the high costs associated with technology (mentioned by 83% of participants), difficulty in integrating technology with existing processes (67.9%), limited awareness of available tools or resources (62.3%) and a lack of technical training or knowledge. Additionally, inconsistent access to hardware or software, data privacy concerns and language barriers were also rated as key challenges.

- Technological and infrastructure challenges, including the digital divide, limited access and poor connectivity restricts the potential take-up of new tools and technologies.

- Key barriers preventing participants from finding and selecting the most relevant tools for their restoration work are limited technical expertise (mentioned by 87.3% of participants), a lack of infrastructure (85.5%) and the high cost of AI tools (70.9%).

- Low AI adoption could be due to lack of understanding and tailored training (mentioned by 61.8% of participants) on its benefits, risks and application potentials.

- Additional challenges include outdated, fragmented, or inaccessible data that hamper locally led decision making and strategic planning, especially among ethnic minority and non-English-speaking staff.

Organisational development and funding

- At the organisational level, a main barrier is that not all external decision makers value locally led approaches to design and implementation of initiatives. Participants shared that a commitment to co-design and meaningful inclusion should be universal across external power holders. While the partners consulted remain committed to local organisations and communities, there were allusions that this was not the case for their international partners and funders, despite a partnership model being a key requirement for initiatives to receive REDAA funding.

- All participants mentioned the need for capability building overall, including organisational strengthening. There are opportunities for technology to support organisational development beyond supporting individual programmes or initiatives, through easing capacity and resource burdens, and for funders to provide access to a broad range of technology, including hardware and software resources.

- Securing funding is complex due to organisational barriers, which prevent many community-based organisations from accessing support. Partners mentioned that REDAA's role connecting them with larger INGOs and facilitating a community of practice is valuable as peer learning and knowledge exchange can support them to secure funding.

Contextual

- The survey revealed some conflicting beliefs about community interest in engaging with AI. While some agreed that this technology can help tackle epistemic gaps, including access gaps, others shared that traditional values may conflict with AI's innovation. Participants shared that there may be an opportunity to involve the community in using AI tools, but did not share the specific ways in which this could be done.

- Regulatory hurdles, including weak enforcement of data privacy laws and top-down governance approaches excluding local voices, were also cited as common barriers to meaningfully embedding technology in restoration and conservation.

- At a wider level, political instability, policy shifts and corruption threaten project implementation, particularly for vulnerable communities and climate-vulnerable regions.

- In this context, social threats, such as community resistance, may exacerbate the cultural misalignment of AI and technology with local traditions and values.

- However, compared to the challenges shared in the above two sections, these were seen as medium-level challenges. This could demonstrate some level of expertise in navigating these challenges or indicate that participants chose to focus more on how technology can support their organisational and programmatic growth rather than external threats to their projects.

4.2 Opportunities

This section treats opportunities as potential strategies to mitigate some of the challenges shared above. There is therefore a natural overlap between these two sections. Supported partners were asked about potential ways to solve the context- and organisational-level challenges they shared and were invited to share ideas emerging from their observation or experiences.

Participants were asked about the potential opportunities for AI and technology to support their organisational growth, programmes and community engagement. They were also asked to rank the various uses, including potential uses, and describe the ideal ways in which processes could be streamlined.

According to stakeholder feedback, the top opportunities for AI to meaningfully support projects are by reducing barriers to community members' participation (mentioned by 89% of participants), empowering local data ownership (72.7%) and strengthening local data collection (70.9%). This demonstrates the level of significance given to co-designing and community ownership of projects, which also guided the technical reviews and the current and potential applications discussed in Chapter 5. Partners also identified real-time feedback from data, building technical skillsets, reducing resource burdens and improving decision making as additional opportunities.

Technology

- All participants reported a strong level of community engagement, including between different organisations in a project. Mobile applications and citizen science platforms are already being used to a moderate extent, with a good level of knowledge sharing, and cohesion between community priorities and needs and organisational goals.
- However, additional courses and learning opportunities in technical training and understanding can support partners to build connections with each other and share knowledge horizontally, as opposed to depending on external expertise.
- Participants expressed a strong interest in better understanding advanced tools such as remote sensing, drones and AI-powered biodiversity monitoring systems.
- Partners also pointed to greater possible adoption if technical solutions were subsidised or affordable, easily accessible, user-friendly and linguistically inclusive.
- Developing clear, ethical protocols for data collection, usage and ownership was identified as an opportunity to help protect community rights, which may be further strengthened by community-driven approaches to technology that centre their privacy.

Cultural and epistemic

- Some participants highlighted that any software selected for a project should be used by all partners of that project. They cautioned that broad engagement is important to ensure community participation. Using AI itself could be an opportunity to bridge cultural and epistemic gaps between organisations, while also ensuring the meaningful integration of technology.
- Language and cultural barriers came up consistently, including the need for more tools to be designed with communities and non-English speakers in mind. Both survey respondents and interviewees spoke of tools such as the Labeled Information Library of Alexandria (LILA) — a repository for data sets related to biology and conservation for machine learning — largely developed in the 'Global North' by top-down tech-savvy conservationists rather than via community-based bottom-up approaches.
- An undercurrent of concern and caution was noted throughout the surveys about finding culturally grounded and relevant approaches. Some participants alluded to the need to take considered steps towards finding the most appropriate, ethical and inclusive approaches to bringing AI tools to their projects rather than experimenting with new ideas for the sake of innovation.

5. Current AI tools in the REDAA context

5.1 Overview

The 68 relevant AI tools that were assessed in-depth were classified into 23 use-case themes, many with more than one use case. There were no initiatives or tools found in this study that took on a gender-based lens or emphasised gender equity. Please note that this list is based on current findings, and not a representation of the entire AI innovation landscape in this field. And as new AI tools are emerging every week, this dataset may lose relevance rapidly given how fast the industry is evolving, and would benefit from quarterly updates. A limited version of this dataset is available in Annex 1.

Table 1: AI tools and services by use case

AI tool/service use case	Number of tools per use case
Conservation	28
Monitoring and species identification	23
General purpose	16
Climate resilience	10
Restoration	10
Agriculture and food security	9
Admin and operations	9
Information access	8
Marine/coastal	8
Grants and fundraising	7
Governance and decisions	6
Satellite and remote sensing	6
Aerial and drone	5
Bioacoustics	5
Forecasting and early warning	4
Forestry	3
Indigenous Peoples	3
Language	3
Rivers	2
Pest management	2
Illegal activity	2
Ethics	1
Pollution/waste	1

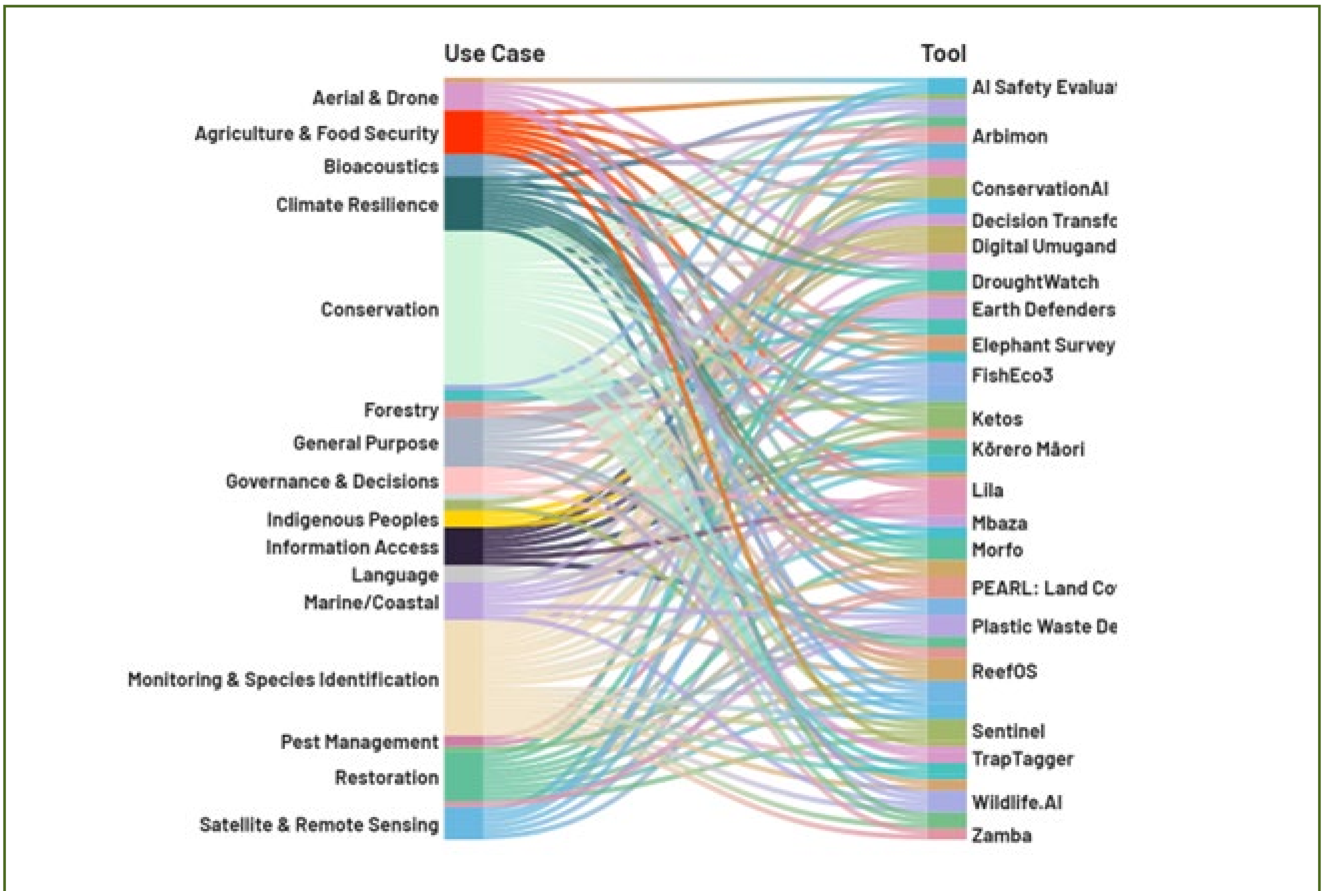
Each item was then assessed against various criteria, including the software, hardware or expertise required to use the tool, language availability, cost, the region in which the tool is applied or available, and its relevance to REDAA-related thematic priorities.

5.2 Classifications

REDAA-specific themes

The vast majority of the AI tools and services in this study focus on programme-specific initiatives such as conservation, monitoring and species identification, or climate resilience. As evidenced in Table 1 above, tools designed specifically to improve financing mechanisms or inclusive governance systems are lagging. Specifically, 51 tools were linked to local research, 44 to resource and land use, 16 to business models, 13 to inclusive governance systems, and 8 to financing mechanisms, with tools often linked to more than one theme.

Figure 1: Snapshot of AI tools aligned with REDAA's 'local research' theme.[vi] See Annex 1 for the other REDAA themes and full interactive web versions.



Regional focus

The regions where the AI tools were available were: global (71%), Africa (8.7%)[vii], South Asia (5.8%), North America (4.3%), Europe (2.9%), Polynesia (2.9%), Oceania (1.4%), Arctic (1.4%), and South America (1.4%). Global representation means the tools have the capacity to operate globally. This means they were either designed as open-source initiatives that are available worldwide or their applications were not restricted to any particular region. However, this does not mean that they were necessarily trained or built using globally available data or models.

Certain regions such as the Middle East or East Asia are not represented in this dataset. This does not imply that region-specific tools don't exist there, but only that the study did not

vi Full and interactive version available https://public.flourish.studio/visualisation/21118848/
vii One of the tools is available in 38 African languages across various African countries and does not specify which. For this reason, it is not possible to determine sub-regions for Africa.

find any. This may be due to language barriers if the initiatives are truly designed for local or regional applications. Some unique examples to highlight the regional diversity of this study include the following tools:

🛠 **FishEco3**	
First-of-its-kind ecosystem-based fisheries management tool to provide real-time data insights and actionable recommendations to forecast climate change impacts on fish stocks and maintain healthy populations.	
REDAA applicability: Local research, resource and land use (climate resilience, marine/coastal, forecasting and early warning, Indigenous Peoples)	
Geographic focus: Canada/Arctic	**Cost:** Unknown

🛠 **DroughtWatch**	
Deep learning open collaborative community benchmark for climate adaptation to predict drought conditions from satellite images.	
REDAA applicability: Local research, resource and land use (agriculture and food security, satellite and remote sensing, climate resilience, restoration)	
Geographic focus: Kenya	**Cost:** Free

🛠 **ReefOS**	
ReefOS is designed to become the most advanced AI platform for coral reef conservation and restoration via a network of reefs with connected cameras and sensors collecting crucial data.	
REDAA applicability: Resource and land use, local research (conservation, marine/coastal, restoration, climate resilience)	
Geographic focus: Fiji, French Polynesia	**Cost:** Free

Languages

Over 50 languages were represented across the tools, with English making up the vast majority. Out of six AI-based tools or services catered to African countries, three incorporated nearly 40 African languages (Kinyarwanda, Amharic, Kiswahili, Somali, and 38 unnamed African languages), with their use cases including agriculture and food security, governance and decisions, and information access. Furthermore, two AI tools/services catered to South Asian countries incorporated eight primarily Indian languages (Hindi, Marathi, Gujarati, Telugu, Kannada, Tamil, Odia and Punjabi). A few unique examples of language diversity of these tools include:

🛠 **CottonAce**	
An AI-powered early warning system that is available as an app on Android smart-phones. It guides smallholder cotton farmers on the optimal time to take preventive action and protect their farm against avoidable crop losses.	
REDAA applicability: Resource and land use, business models, local research (agriculture and food security, pest management, information access)	
Geographic focus: India. Language: English, Hindi, Marathi, Gujarati, Telugu, Kannada, Tamil, Odia, Punjabi	**Cost:** Free

🛠 **Kōrero Māori**	
An open-source app designed to collect oral recordings in Indigenous languages, and to train computers to understand spoken languages through machine learning.	
REDAA applicability: Inclusive governance, local research (Indigenous Peoples, information access, language)	**Language:** Māori, Hawai'ian, Cook Islands Māori, English
Geographic focus: Aerotrea (New Zealand)	**Cost:** Free

Expertise

The varying skills that were classified in the dataset relate to how technically capable AI-tool end users would need to be to use the tool. These were: (1) basic smartphone: The user must be able to perform basic smartphone tasks; (2) basic computer: The user must be able to perform basic computer tasks; (3) intermediate: The user requires an understanding of generic digital platform interfaces, some data analysis skills, and the ability to troubleshoot issues; (4) expert: The user requires at least coding or programming skills and ideally a knowledge of machine learning functions. The breakdown of AI tool availability by technical knowledge requirement is: basic smartphone: 6 (9%); basic computer: 15 (22%); intermediate: 26 (38%); and expert: 21 (31%) (see Annex 2 for a detailed breakdown). Some examples of tools categorised by the varying skillsets include:

Basic smartphone

🛠 **Plantix**	
A mobile app crop doctor with which small-scale farmers can accurately detect pests and diseases on crops within seconds. The application covers 30 major crops and detects 780+ plant damages.	
REDAA applicability: Business models, resource and land use, local research (agriculture and food security, information access, climate resilience)	
Geographic focus: India	**Cost:** Free

Intermediate

🛠 **Zamba**	
A tool that uses machine learning and computer vision to detect and classify animals in camera trap videos. The tool is created for conservation and wildlife researchers who aren't familiar with using a programming interface.	
REDAA applicability: Resource and land use, local research (monitoring and species identification, conservation)	
Geographic focus: Over 10 countries in Africa and Europe	**Cost:** Free

Expert

🛠 **Open Soundscape**	
An open-source Python utility library for analysing bioacoustic data, which includes utilities that can be strung together to create data analysis pipelines with versatile functions.	
REDAA applicability: Resource and land use, local research (bioacoustics, monitoring and species identification, conservation)	
Geographic focus: Global	**Cost:** Free

6. Potential AI tools for REDAA initiatives

In this section, we identify ten REDAA initiatives that could consider using AI tools from this study, if the tools are properly assessed first, as proposed in the recommendations in Chapter 7. The initiatives were selected based on the information provided in the REDAA documentation. Criteria for selection included project objectives, outputs and geographical contexts. The tools selected are only a sample of the larger 68-tool dataset, and in several instances could be considered for other projects in other regions as well.[viii] These tools have demonstrated the potential for local application, in most cases affordability, REDAA relevance, a range of use-case themes, and a range of skill requirements. Further details such as hardware or skill requirements are available in the dataset provided separately. All of the tools in this list are already being used by an organisation, institution or community.[ix]

6.1 South and Southeast Asia

🛠 Ketos	**Level of expertise:** Expert
Provides a unified, high-level interface for working with acoustic data and deep neural networks. Its main purpose is to support the development of deep learning models for solving detection and classification problems in underwater acoustics.	
REDAA applicability: Local research, resource and land use (conservation, monitoring and species identification, bioacoustics, marine/coastal)	
Geographic focus: Global	**Cost:** Free
Myanmar: Community-led research incentivize actions to enhance climate resilience in Myanmar's Ayeyarwady Delta: Researchers could consider this tool to work with officials from the Ayeyarwady Delta Key Biodiversity Area to better assess and understand the impact of mangrove deforestation and restoration efforts on marine or aquatic species.	

🛠 Lila	**Level of expertise:** Intermediate
A digital tool to simplify land use planning and restoration for climate change mitigation practices. It offers customisable and comprehensive data insights for informed decision making, and rapid assessment of sustainable lands for best environmental use case scenarios.	
REDAA applicability: Local research, resource and land use (agriculture and food security, climate resilience, satellite and remote sensing, restoration)	
Geographic focus: India	**Cost:** Unknown
India: Community-based ecological restoration of degraded grasslands, dry and wet forests in partnership with Indigenous Peoples of the Nilgiri Biosphere Reserve, Western Ghats: a global Biodiversity Hotspot: The project's efforts to map exotic and invasive species as an indicator for ecosystem degradation could be optimised by Lila depending on the tool's data policy and conditions. The tool's geographic focus on India also makes it an ideal option for context-specific species identification and locally relevant restoration efforts.	

viii It was not within the scope of this study to conduct a deeper feasibility assessment of each tool (eg existing experiences from other organisations using these tools, legal and technical implications of deploying the tool, community-level sentiment toward the tool, etc.). However, the authors strongly recommend REDAA to do so, and have indicated this in the recommendations.

ix The text summarising the platforms is italicised as it paraphrases the developer's language.

🛠 **Raspberry Pi AI Kit**	**Level of expertise:** Expert
This hardware device provides local, real-time, low-latency inferencing performance for object detection, image segmentation and pose estimation, which can be used as an AI-powered wildlife camera.	
REDAA applicability: Local research, resource and land use (conservation, monitoring and species identification, general purpose)	
Geographic focus: Vietnam, India, USA	**Cost:** €80 one-off cost
Vietnam: Supporting forest restoration in Quang Ninh district, Quang Binh: The project's efforts to develop innovative and evidence-based approaches for wildlife monitoring and forest management could be supported by this AI kit, which is available specifically for Vietnam.	

🛠 **Sentinel**	**Level of expertise:** Intermediate
Upgrades wildlife monitoring tools — like trail cameras and acoustic recorders — with intuitive AI technology, processing environmental data in real time as it's collected. It can monitor for invasive species, poaching and wildlife trafficking, zoonotic diseases, and changing animal behaviour.	
REDAA applicability: Local research, resource and land use (conservation, monitoring and species identification, illegal activity, restoration)	
Geographic focus: Global	**Cost:** US$100–1,000 one-off cost
Philippines: Engaging Indigenous Peoples and local communities in ensuring environmental and social safeguards for the Aklan River Watershed Forest Reserve: If deployed responsibly and with IPs and LCs at the centre of its deployment, Sentinel could support this project's objectives to work with citizen scientists and forest patrol guards in order to ensure that conflicting development plans and unsustainable practices are minimised.	

🛠 **Arbimon**	**Level of expertise:** Intermediate
An ecoacoustic analysis platform that empowers scientists and conservationists by efficiently uploading, storing and analysing large amounts of acoustic data. This enables them to derive insights about the ecosystem at scale.	
REDAA applicability: Resource and land use, local research (conservation, monitoring and species identification, bioacoustics)	
Geographic focus: Global	**Cost:** Free
Nepal: Promoting ecologically sound and socially just forest landscape restoration through co-production of knowledge and local capacity building: This project's aim to better inform place-based restoration efforts via empirically grounded techniques could be amplified by Arbimon. For example, the ecoacoustic tool could be used to understand project-related threats such as forest fires and dwindling biodiversity.	

6.2 Sub-Saharan Africa

🛠 **Farmer Chat**	**Level of expertise:** Basic computer
Tailored assistance to extension workers providing advice to tens of millions of small-scale farmers around the world, enabling them to ask conversational questions in their local language using voice, text or images to overcome digital literacy barriers and encourage gender equity. Limited features are available on smartphones.	
REDAA applicability: Business models, local research, inclusive governance (agriculture and food security, information access)	
Geographic focus: Global	**Cost:** Free
Zimbabwe: Community-led adaptation of Farming with Alternative Pollinators (FAP) as an approach for ecosystem restoration, improved household nutrition outcomes and climate resilience: If contextually relevant enough, Farmer Chat could be integrated to meet the project's objective of strengthening the capacities of smallholder farmers, communities and agriculture extension agents, as the tool is designed specifically for extension workers.	

🛠 **Kuzi**	**Level of expertise:** Basic smartphone
An AI-based early warning tool helping farmers across Africa to control locust plagues.	
REDAA applicability: Business models, resource and land use, local research (agriculture and food security, pest management)	
Geographic focus: Uganda, Kenya, Somalia, Ethiopia, Eritrea, Sudan, Djibouti	**Cost:** Free
Uganda: Restoring degraded environments for improved livelihoods in refugee settlements and host communities: Although the project region may not be at the centre of Uganda's locust pest outbreak, its rapid propagation combined with climate change could become increasingly concerning for the project's communities. Efforts to develop disease-tolerant crop varieties, improve farmer livelihoods, and reduce desertification could be improved by implementing this early-warning region-specific tool.	

🛠 **Earth Defenders Assistant**	**Level of expertise:** Basic smartphone
Harnesses offline-first technology to preserve languages, protect territories and ensure data sovereignty for communities on the front lines of climate justice. This AI chatbot is currently being developed to serve as a grant management assistant and information support.	
REDAA applicability: Inclusive governance, financing mechanisms, local research (general purpose, grants and fundraising, information access, Indigenous Peoples)	
Geographic focus: Global	**Cost:** Free
Congo and Democratic Republic of Congo: Advancing recognition and implementation of Indigenous Peoples' rights to improve land and resource governance and reverse environmental degradation: The project's objective to strengthen community governance and rights related to land and resources could be supported by this tool. The tool developers, Awana Digital, are also known for their work that upholds local community autonomy, and may align with the project's lead organisation on ethical deployment approaches and principles.	

🛠 **Digital Umuganda**	**Level of expertise:** Basic smartphone
An AI and open data company with a mission to enable access to information in local African languages. It creates open-source datasets, models and tools that make it possible for LLMs to work for marginalised communities that speak under-resourced languages.	
REDAA applicability: Inclusive governance, business models, local research (language, information access, governance and decisions)	
Geographic focus: Rwanda	**Cost:** Free
Rwanda: Strengthening systems: analysing policy implementation and building local capacity to reverse environmental degradation in Rwanda's Southern Province: Given its expertise in the Rwandan context, Digital Umuganda could be instrumental in supporting the lead organisation's efforts to improve community engagement and access to climate-related information.	

🛠 **Masakhane**	**Level of expertise:** Expert
A living collection of Natural Language Processing projects with the aim to improve representation of African languages in technology	
REDAA applicability: Inclusive governance, business models (governance and decisions, language, information access)	
Geographic focus: Tanzania, Uganda, Kenya	**Cost:** Free
Tanzania: NATURE FUNDI (Nature and Agriculture Transformation by Unlocking Resources to Ensure Funding for UNbanked and Deepening Inclusion): The project's objectives to engage local smallholder farmers and stakeholders in a credit-based incentive mechanism could be optimised by ensuring that local language resource names, concepts or terminology are properly represented. The tool developer's focus on promoting local-level sovereignty, and its expertise in the Tanzanian context, could also contribute to the project's success.	

7. Actionable steps and recommendations

The principal question guiding this scoping study is: How can AI help organisations practising or supporting research-to-action for locally led nature restoration to be as effective and positively impactful as possible? The authors of this study would like to emphasise 'as effective and positively impactful as possible' in making the following recommendations.

These actionable steps and recommendations are split into two parts. This highlights the need to focus first on a foundational phase to properly understand and address the risks that AI may pose to REDAA, its partners, the communities it works with, and the ecosystems they depend on. Indeed, the current AI hype could become a classic case of 'everything looks like a nail when you have a hammer'. The first and most important recommendation is not to rush AI adoption and deployment, but instead to quickly understand the full extent of its risks.

Much like blockchain technology did not revolutionise our ability to increase planetary resilience, AI will not resolve the biodiversity crisis, climate change or environmental degradation. After all, these remain issues that depend on political will. While technology definitely has a role in supporting these efforts, techno-solutionism remains a superficial approach to much deeper systemic issues.

7.1 Priority One: Understand and prepare

REDAA Scientific Management Unit (SMU)

1. **Close the technology gap:** In terms of technology and resources, it was evident from stakeholder consultations that technology basics should be addressed first. While tools should always be co-developed and locally led, it is unrealistic to engage IPs and LCs, or their respective organisations or customary institutions, in adopting AI technology without ensuring access to basic technology know-how or resources such as good primary data, hardware resources such as GPS devices, mobile phones, laptops and non-AI applications (eg data collection tools, mapping applications), or even data management plans. The SMU should prioritise REDAA grant calls that address these basic technical challenges first. Given the lack of tools with a gender-based approach, it is also important that grant calls have a strong gender-based lens, to ensure a more meaningful and deeper technical inclusion of gender diversity across the supported initiatives and REDAA's approach.

2. **Develop a REDAA/IIED AI policy:** At the same time, the SMU should engage IIED in developing an AI policy at the organisational level. The policy should include organisational protocols on how to properly assess AI models prior to and during deployment and continuously monitor their impacts. It should also make clear the type of AI that REDAA is interested in engaging with.

   Given the conflicting beliefs across the REDAA community about the prospects of AI, we strongly recommend including REDAA/IIED local community partners in the development of the policy, so that this is not a purely SMU-led process. A human rights-based approach to the use of AI in conservation and restoration work will ensure that community interests and rights are at the centre of these efforts. As a starting point, the SMU can use the list of guidelines, policies and methodologies for the development of an ethical AI policy and responsible AI assessment protocols in Annex 6.

3. **Support stakeholder preparation:** Once an understanding of AI implications is in place, the SMU can support the broader REDAA community in its preparation. Long-term support, rather than project-based funding, will help sustain relationships and systems of operation that will be as effective and positively impactful as possible for partners to engage with AI. This includes hosting informative webinars, developing informative materials and facilitating 'lessons learned' events with organisations that have deployed AI in this context.

REDAA initiatives

1. **Engage in good data collection:** Good AI models require good quality data. But partners don't require AI tools to collect high-quality data regarding their ecosystems or natural resources. Collecting data via regular community-based monitoring tools (offline-first applications, mobile apps, mapping tools, etc.) can not only contribute to better AI applicability later on, it can also improve local skillsets around use of technology. These data-collection processes will also give partners a better idea of the contextual, infrastructural, language and cultural components that need to be addressed when using these tools. During this phase, initiatives should focus on developing clear, ethical protocols for data collection, usage and ownership that can help protect community rights.

2. **Build long-term technical partnerships:** AI models will undoubtedly be present in nearly every facet of society. REDAA-supported initiatives should focus on building long-term technical partnerships, whether with local universities, social enterprises, or other local civil society organisations or institutions. These types of collaboration will help bridge the digital divide and provide a safety net to communities in the event of the myriad of potential technical issues that could occur (eg technical bugs, data loss).

3. **Understand AI ethical risks and implications:** Many communities have their own autonomous protocols around consent, benefit sharing, decision making and research, which establish rules of procedure to ensure that local or customary institutions and principles are respected. Community organisations should undertake exercises to inform community members on AI benefits and risks, ensuring that they understand the implications of this technology in their consent protocols, or within customary institutions. It is strongly recommended that these protocols or procedures include mechanisms for control and community oversight of the AI systems. IIED and REDAA's SMU should play a key role in co-developing AI informative and training resources in the context of conservation and restoration. Whether at a local or regional level, community members should be able to access and understand guidelines or documentation on responsible AI adoption and deployment. A key component of this is understanding the legislative AI landscape for each region or country.

REDAA community

Co-develop informational materials

- **Culturally relevant documentation:** Guides and how-to documentation that are linguistically inclusive are essential. A good starting point might be to turn segments of this scoping study into accessible terminology and language, as guidance documents for local organisations to use when presented with the opportunity to deploy AI in their work.

- **Repository of best practices:** Developing a repository of standards, best practices, tools, models and processes that are technically and culturally accessible for community-led initiatives will be essential. The repository can start with the 68 tools analysed in this report (see Annex 1), and can help partners find new technologies that others have already applied.

- **Lessons learned:** A series of learning sessions involving six to eight of the locally led AI-based conservation or restoration initiatives listed in this study could greatly benefit the community. The learning sessions, or presentations, could focus on the following insights: Who developed the tool and for what purpose? How was it deployed and how were local organisations or communities involved? What aspect of conservation or restoration did the tool address? Did the tool reinforce or replace local community knowledge or initiatives? What have been the risks associated with each tool and how were these mitigated? What have been the lessons learned so far?

7.2 Priority Two: Assess low-risk models

SMU, REDAA initiatives and community

Assess potential low-risk AI tools: Once all the steps in priority one have been achieved, the SMU can then, alongside REDAA's community and partners, engage in assessing potential low-risk AI models that might serve the needs of its programmes and partners. These assessments should analyse both short-term and long-term technical, regulatory, social, economic and environmental risks, on systems that are robust and have been tested. This process should be cyclical, and regular AI model assessments should be part of a broader technical monitoring and evaluation programme. To begin, low-risk models include but are not limited to those that:

- Do not require a heavy amount of community data.

- Are not at the centre of community operations and will not determine the success of conservation or restoration efforts. For example, a community should already have contingency plans in place for allocating emergency resources to mitigate against biodiversity threats. These plans can then be supplemented by AI-based systems, as opposed to depending on them.

- Do not hand control of valuable data (financial, ecological, etc.) to external entities, but instead empower local data ownership and strengthen local data collection.

- Come from organisations or institutions that are experienced in implementing technology in partnership with IPs, marginalised peoples, remote or local communities.

- Are closed-ended, where the possible outcomes from the AI are constrained (eg they use structured learning models trained to recognise patterns or make pre-defined predictions), as opposed to models that generate entirely new content. One way to test AI tools that you intend to work with is by asking questions or prompting them to complete tasks for which you know the answers to (such as, prompt for specifics, ask in native language, use local terminology for species, etc.).

- Are affordable, contextually relevant, linguistically inclusive, and technically user-friendly.

- Keep humans accountable (more of a governance feature than a technical one).

- Have interpretable, transparent models and/or contain clear documentation of methodologies used to understand decision-making logic.
- Have been successfully developed by civil society or groups with strong ethical values.
- Have been trained or developed by in-country organisations or companies and therefore are more contextually relevant.
- For integrated solutions, have long-term dedicated iterative processes, ensuring co-development is meaningful and not a box-ticking exercise.

8. Positionality statement and biases

This study is not without its biases. In the stakeholder consultations, while the sample of partners and staff was wide, and though the response rates for the surveys were above expectations, our staff survey had only three respondents, skewing the research significantly in favour of partners and the wider community.

There is also a bias in the profile of respondents, in that they were likely those with an interest in contributing to this research and an understanding of the role of locally led restoration in their projects. The reader should treat these results as indicative of some organisations working on restoration projects, not all. All of the survey respondents work in close partnership with local organisations and communities, so the sample does not represent projects with one lead organisation, or without the meaningful involvement of localised voices. This also skewed the bias of respondents towards those who value co-design and a community-led focus in projects. The sample of respondents came mostly from Africa, with significantly less representation from Asia. The resulting insights may, therefore, be less directly applicable to other regions.

As mentioned in the methodology, AI tools used for the stakeholder consultations analysis supported the triangulation of anonymised data prepared and analysed manually. They were used to validate emerging quantitative findings, minimising potential areas for individual bias from participants and researchers. These individual biases were partially mitigated by multiple rounds of sensemaking and validation to ensure the robustness of our findings.

The technical review was conducted based on the languages spoken by the authors, and though these included English, French, Spanish and conversational Tamil, we were likely unable to capture important AI developments in other languages. This skews the results towards regions where these languages are spoken.

While the authors of this report have Asian backgrounds, our team of researchers does not represent Africa. We are also all based in global North countries, which has a significant influence on how we perceive the prospects and risks of AI. Finally, we did not conduct fieldwork for this research. The isolated nature of desk-based work means that there may be important nuances from the stakeholder consultations that were missed in text, data or video feedback. The findings from the scoping study should therefore be read with this bias in mind.

Annex 1: Dataset of REDAA-relevant AI tools and services

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
Agri1	Agriculture & Food Security	Information Access		English	Free (Limited), 9$/ month (Full)	Computer	None	Basic computer	Global	Global
AI Safety Evaluation	Ethics	Governance & Decisions	Admin & Operations	English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Amini	Conservation	Restoration	Climate Resilience	English; French; Other	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Animl	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Arbimon	Conservation	Monitoring & Species Identification	Bioacoustics	English	Free	Computer; Recording Device	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Awesome Forests	Forestry	Satellite & Remote Sensing	Conservation	English	Multiple products	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
BirdNET Sound ID App	Conservation	Monitoring & Species Identification	Bioacoustics	English	Free	Smartphone; Computer	None	Basic computer	Global	Global
ChatGPT	General purpose			Global (more than 3 continents represented)	Free (Limited), $20/month (Plus), $200/month (Pro)	Computer	None	Basic computer	Global	Global
Claude	General purpose			Global (more than 3 continents represented)	Free (Limited), $18/month (Pro), $25/month (Team)	Computer	None	Basic computer	Global	Global
ConservationAI	Conservation	Monitoring & Species Identification	Illegal Activity	English	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
CottonAce	Agriculture & Food Security	Pest Management	Information Access	English; Hind; Marathi; Gujarati; Telugu; Kannada; Tamil; Odia; Punjabi	Free	Smartphone	None	Basic smartphone	India	South Asia
Decision and Process Automation	General purpose	Governance & Decisions		English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Decision Transformers	General purpose	Governance & Decisions		English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Dendra	Restoration	Monitoring & Species Identification		Global (more than 3 continents represented)	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Detectron2	General purpose			English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Digital Umuganda	Information Access	Language	Governance & Decisions	English; Kinyarwanda	Free	Smartphone	None	Basic smartphone	Rwanda	Africa
DonorSearchAI	Grants & Fundraising	Admin & Operations		English	N/A	Computer	None	Basic Computer	Global	Global
Drone wild	Conservation	Monitoring & Species Identification	Aerial & Drone	English	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	United Kingdom	Europe
DroughtWatch	Agriculture & Food Security	Satellite & Remote Sensing	Climate Resilience	English	Free	Computer	Python	Expert (Coding, ML)	Kenya	Africa
Earth Defenders Assistant	General purpose	Grants & Fundraising	Information Access	Global (more than 3 continents represented)	Free	Smartphone	None	Basic smartphone	Global	Global

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
EcoAssist	Conservation	Monitoring & Species Identification	Forecasting & Early Warning	English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Elephant Survey System	Conservation	Monitoring & Species Identification	Aerial & Drone	English	N/A	Computer; Aerial Equipment	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	South Africa; Botswana; Namibia	Africa
EO Learn	Satellite & Remote Sensing			English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Farmer Chat	Agriculture & Food Security	Information Access		Global (more than 3 continents represented)	Free	Smartphone; Computer	None	Basic computer	Global	Global
Fireflies	General purpose	Admin & Operations		English	Free (limited), $10/ month (Pro), $19/ month (Business)	Computer	None	Basic Computer	Global	Global
FishEco3	Climate Resilience	Marine/ Coastal	Forecasting & Early Warning	English	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Canada	Arctic
Flood Forecasting API	Forecasting & Early Warning	Marine/ Coastal	Climate Resilience	English	Free	Computer	None	Expert (Coding, ML)	Global	Global
ForestNet	Forestry	Satellite & Remote Sensing	Conservation	English	Free	Computer	None	Expert (Coding, ML)	Global	Global
GPT4All	General purpose	Information Access		Global (more than 3 continents represented)	Free	Computer	None	Basic computer	Global	Global
Grammarly	General purpose	Admin & Operations		English	Free (limited), EUR12/month (Pro)	Computer	None	Basic Computer	Global	Global

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
Grantable	Grants & Fundraising	Admin & Operations		Global (more than 3 continents represented)	Free (Limited), $24/month (Starter), $89/ month (Pro)	Computer	None	Basic computer	Global	Global
GrantAssistant	Grants & Fundraising	Admin & Operations		English	N/A	Computer	None	Basic computer	Global	Global
GrantBoost	Grants & Fundraising	Admin & Operations		English	Free (Limited), $19.99/month (Pro), $29.99/ month (Teams)	Computer	None	Basic computer	Global	Global
Grantorb	Grants & Fundraising	Admin & Operations		English	$119/year (Learning), $499/ year (Starter), $1650/year (Growth), $2640/ year (Impact)	Computer	None	Basic computer	Global	Global
Kaggle	General Purpose	Data Repository		English	Free	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Ketos	Conservation	Bioacoustics	Marine/ Coastal	English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Kōrero Māori	Indigenous Peoples	Information Access	Language	Māori; Hawai'ian; Cook Islands Māori; English	Free	Smartphone	None	Basic smartphone	New Zealand; Cook Islands; United States	Polynesia
Kuzi	Agriculture & Food Security	Pest Management		English; Amharic; Kiswahili, Somali	Free	Smartphone	None	Basic smartphone	Kenya; Somalia; Uganda; Ethiopia; Eritrea; Sudan; Djibouti	Africa

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
Lila	Agriculture & Food Security	Climate Resilience	Satellite & Remote Sensing	English; Tamil; Hindi	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	India	South Asia
LILA BC	Conservation	Monitoring & Species Identification	Marine/ Coastal	English	Free	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
LM Studio	General Purpose			English	Free	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Masakhane	Governance & Decisions	Information Access	Language	38 African languages	Free	Computer	Lua; Python	Expert (Coding, ML)	Over 10 countries	Africa
Mbaza	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
MegaDetector	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	None	Expert (Coding, ML)	Global	Global
Microsoft Premonition	Monitoring & Species Identification	Forecasting & Early Warning	Agriculture & Food Security	English	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Momentum	Grants & Fundraising	Admin & Operations		English	N/A	Computer	None	Basic Computer	Global	Global
Morfo	Restoration	Aerial & Drone	Climate Resilience	English; French; Portuguese	N/A	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Brazil	South America
Ollama	General Purpose			English	Free	Computer	None	Expert (Coding, ML)	Global	Global
OpenSoundscape	Conservation	Monitoring & Species Identification	Bioacoustics	English	Free	Computer	Python	Expert (Coding, ML)	Global	Global

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
"PEARL: Land Cover Mapping "	Satellite & Remote Sensing	Climate Resilience	Conservation	English	Free	Computer	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	United States	North America
Plantix	Agriculture & Food Security	Information Access	Climate Resilience	Global (more than 3 continents represented)	Free	Smartphone; Computer	None	Basic Smartphone	India	South Asia
"Plastic Waste Detection in Rivers YOLOv8 model "	Pollution/ Waste	Marine/ Coastal	Rivers	English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Platypus-Opt	General Purpose	Governance & Decisions		English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Raspberry Pi AI Kit	Conservation	General Purpose	Monitoring & Species Identification	English	€80	Computer; Camera	None	Expert (Coding, ML)	United States; China; Vietnam; India	North America; South Asia
ReefOS	Conservation	Marine/ Coastal	Restoration	English; French	Free	Computer	None	Basic Computer	Fiji; French Polynesia	Polynesia
SAM	General Purpose			English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Scout	Conservation	Monitoring & Species Identification	Aerial & Drone	English	Free, or $6000 for online support and remote system servicing.	Computer; Aerial Equipment	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Scoutbot	Conservation	Monitoring & Species Identification	Aerial & Drone	English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Sentinel	Conservation	Monitoring & Species Identification	Illegal Activity	Global (more than 3 continents represented)	$100 - $1000	Smartphone; Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global

Title	Use case 1	Use case 2	Use case 3	Languages	Cost/plan	Hardware needs	Other software/ app/language needs	Tech skills needs	Countries	Region/ continent
Soil analysis system for sustainable agriculture	Agriculture & Food Security			English	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Spacy	General Purpose			Global (more than 3 continents represented)	Free	Computer	Python	Expert (Coding, ML)	Global	Global
Trapper	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	Python	Expert (Coding, ML)	Global	Global
TrapTagger	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Wildbook	Conservation			English	Free	Computer; Camera; Aerial Equipment	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Wildlife Insights	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Global	Global
Wildlife.AI	Conservation	Monitoring & Species Identification	Marine/ Coastal	English	Free	Computer; Camera	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	New Zealand	Oceania
Wildtrax	Conservation	Monitoring & Species Identification	Bioacoustics	English	N/A	Computer; Camera; Recording Device	None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Canada	North America
Zamba	Conservation	Monitoring & Species Identification		English	Free	Computer; Camera	Python; None	Intermediate (Digital Platforms, Data Analysis, Troubleshooting, etc)	Over 10 countries	Africa; Europe

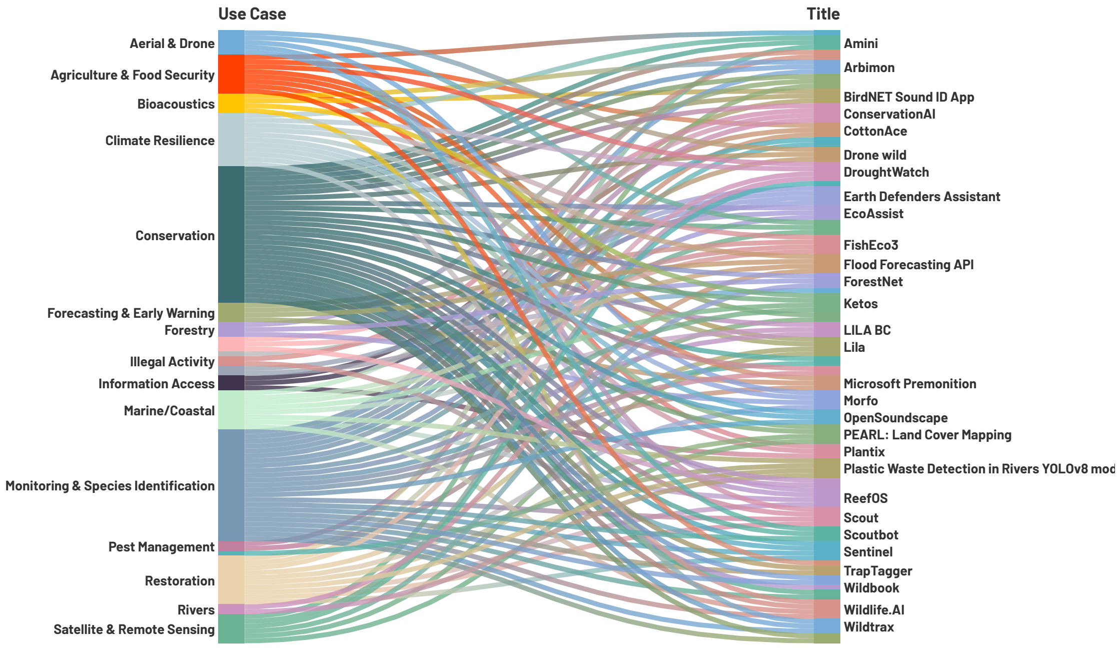
Annex 2: AI tools and services by expertise

Use case	Number of tools
Basic smartphone	**6 tools (9%)**
Information access	5
Agriculture and food security	3
Indigenous Peoples	2
Language	2
Pest management	2
Climate resilience	1
General purpose	1
Governance and decisions	1
Grants and fundraising	1
Basic computer	**15 tools (22%)**
Admin and operations	8
Grants and fundraising	6
General purpose	5
Agriculture and food security	2
Conservation	2
Information access	2
Monitoring and species identification	1
Climate resilience	1
Restoration	1
Bioacoustics	1
Marine/coastal	1
Intermediate	**26 tools (38%)**
Conservation	19
Monitoring and species identification	17
Restoration	7
Climate resilience	6
Aerial and drone	4
Marine/coastal	4
Forecasting and early warning	3
Satellite and remote Sensing	3
Agriculture and food security	2
Forestry	2
Bioacoustics	2
Illegal activity	2
General purpose	1
Indigenous Peoples	1

Use case	Number of tools
Expert	**21 tools (31%)**
General purpose	9
Conservation	7
Monitoring and species identification	5
Governance and decisions	5
Satellite and remote sensing	3
Marine/coastal	3
Agriculture and food security	2
Climate resilience	2
Restoration	2
Bioacoustics	2
Rivers	2
Ethics	1
Forecasting and early warning	1
Forestry	1
Information access	1
Pollution/waste	1
Admin and operations	1
Aerial and drone	1
Language	1

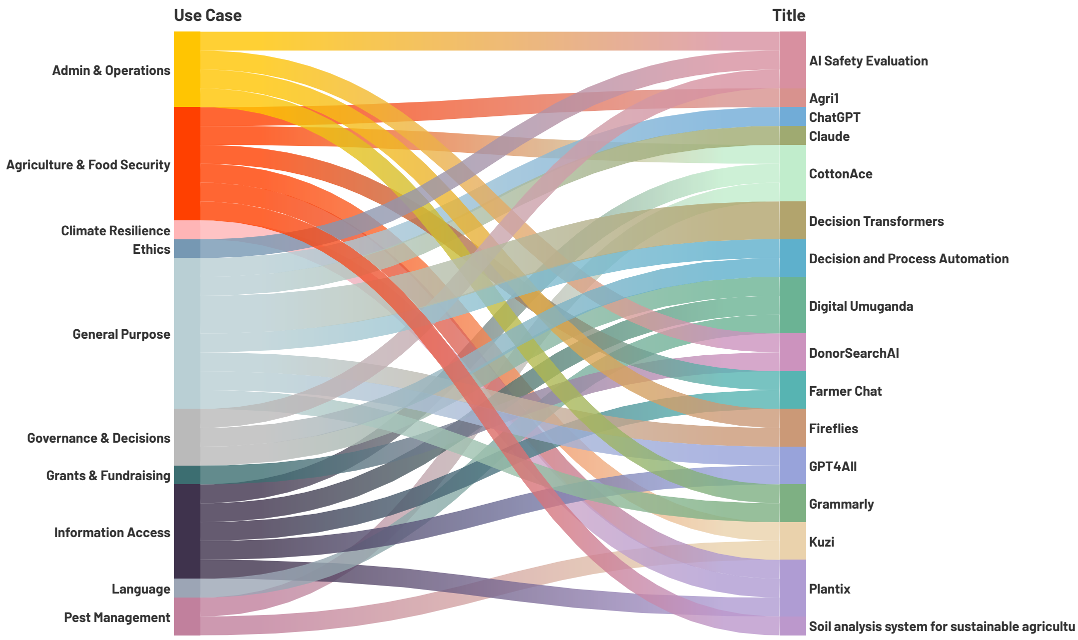
Annex 3: AI tools and use case by REDAA themes

Resource and land use



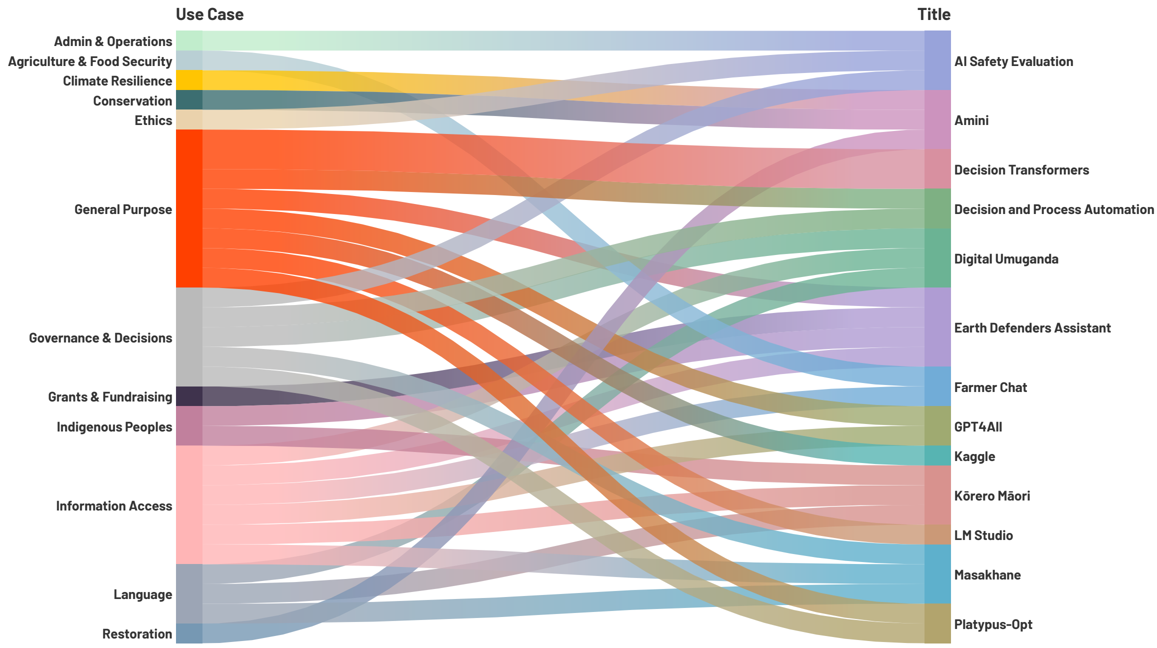
Interactive version: https://public.flourish.studio/visualisation/21119680/

Business models



Interactive version: https://public.flourish.studio/visualisation/21119696/

Inclusive governance



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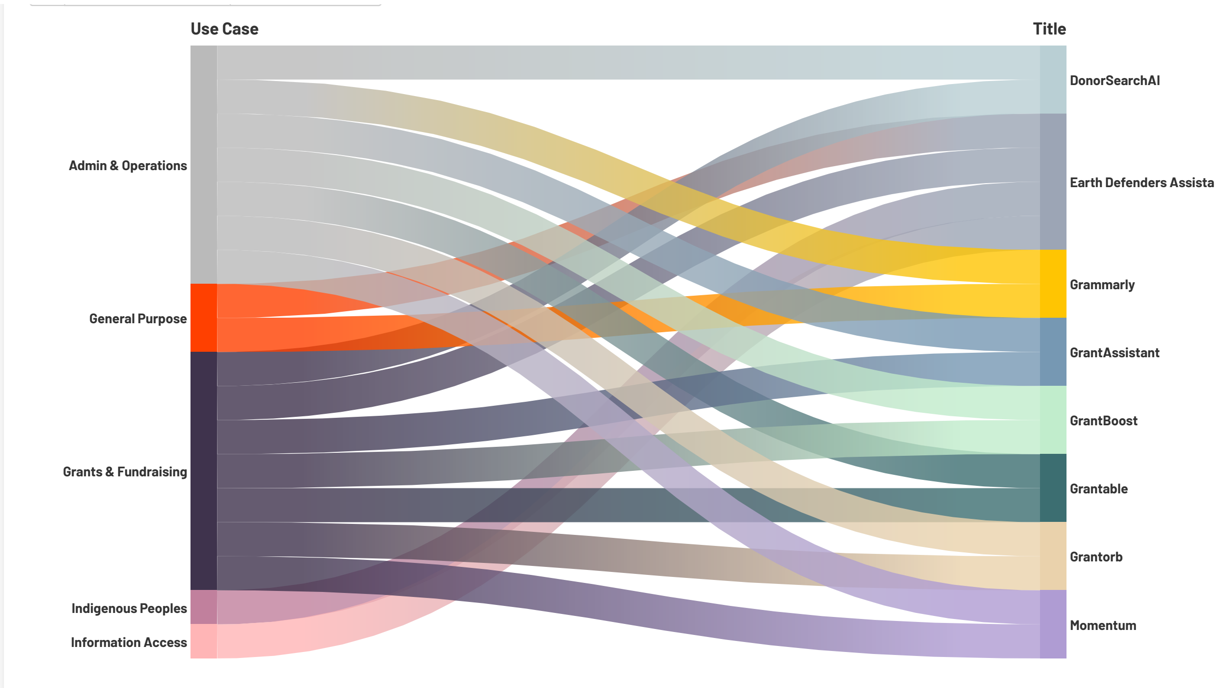
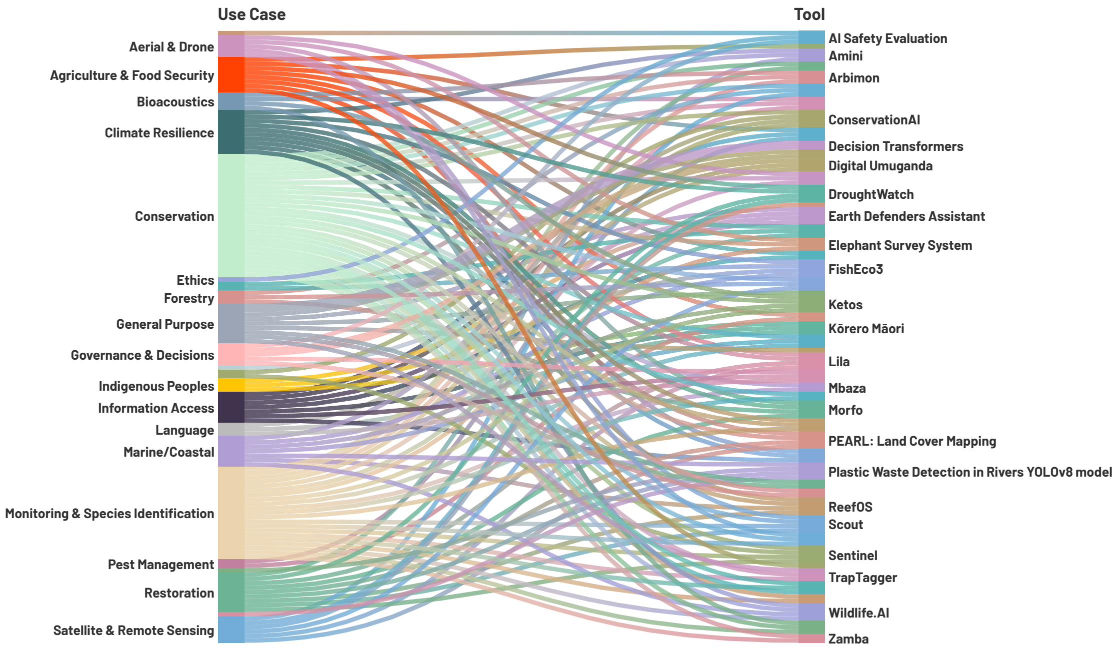
Financing mechanisms



Interactive version: https://public.flourish.studio/visualisation/21119708/

Local research



Interactive version: https://public.flourish.studio/visualisation/21118848/

Annex 4: Internal (REDAA) literature review

The following sources of secondary data were consulted during the preparatory stages of the scoping study:

1. IIED Strategy
2. REDAA Strategy
3. REDAA Theory of Change
4. REDAA Governance Plan
5. Various REDAA scoping studies
6. Co-designing REDAA in sub-Saharan Africa: report of regional consultation and implications for REDAA
7. Scoping study of research-to-action priorities for the REDAA programme: Central Africa
8. Scoping study of research-to-action priorities for the REDAA programme: West Africa
9. Co-designing REDAA in South Asia: Regional consultation workshop report
10. Co-designing REDAA in Southeast Asia: Regional consultation workshop report
11. Potential priority issues for REDAA in sub-Saharan Africa: A rapid literature review to inform the research-to-action programme REDAA
12. Turning the tide on environmental degradation in South Asia: Scoping study of research-to-action priorities for the REDAA programme
13. Scoping study of research-to-action priorities for the REDAA programme in Southeast Asia
14. Exploring barriers and incentives to digital solutions in Natural Resource Management
15. How research influences government action for nature
16. What is environmental degradation, what are its causes, and how to respond?
17. GESI Considerations Across REDAA
18. Nairobi Learning Event Documents
19. GC1 and GC2 Knowledge Products
20. REDAA Logframe
21. Business Case for REDAA
22. Annual REVIEWS
23. Project Proposals for Cohort 1
24. Project Proposals for Cohort 2 (30 documents across both)

Annex 5: External literature review

Title	Link
A Blueprint for Equity and Inclusion in Artificial Intelligence	www3.weforum.org/docs/WEF_A_Blueprint_for_Equity_and_Inclusion_in_Artificial_Intelligence_2022.pdf
A low-cost TinyML model for Mosquito Detection in Resource-Constrained Environments	https://dl.acm.org/doi/10.1145/3582515.3609514
Advancing accountability in AI	www.oecd.org/en/publications/advancing-accountability-in-ai_2448f04b-en.html
AI chatbots contribute to global conservation injustices	www.nature.com/articles/s41599-024-02720-3
AI Empire: Unraveling the interlocking systems of oppression in generative AI's global order	https://journals.sagepub.com/doi/10.1177/20539517231219241
AI for Conservation Office Hours: 2023 Review	https://wildlabs.net/article/ai-conservation-office-hours-2023-review
AI for Good Global Summit 2024 Workshop Summary Report	https://s41721.pcdn.co/wp-content/uploads/2021/06/AI4Good-Summit-2024-EW4All-Workshop-Summary-Report.pdf
AI for Impact: Strengthening AI Ecosystems for Social Innovation	www3.weforum.org/docs/WEF_AI_for_Impact_2024.pdf
AI for social good: Improving lives and protecting the plane	www.mckinsey.com/capabilities/quantumblack/our-insights/ai-for-social-good#/
AI for social good: unlocking the opportunity: for positive impact	www.nature.com/articles/s41467-020-15871-z.pdf
AI Governance Project Ideas	https://aisafetyfundamentals.com/blog/ai-governance-project-ideas/
AI Governance Tools	https://intothecommerce.com/software/artificial-intelligence/ai-governance-tools/
AI in the developing world: how 'tiny machine learning' can have a big impact	https://theconversation.com/ai-in-the-developing-world-how-tiny-machine-learning-can-have-a-big-impact-220025
AI in the Global South: Opportunities and challenges towards more inclusive governance	www.brookings.edu/articles/ai-in-the-global-south-opportunities-and-challenges-towards-more-inclusive-governance/
AI power: Expanding data center capacity to meet growing demand	www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand
AI tool helps people with opposing views find common ground	www.nature.com/articles/d41586-024-03424-z

Title	Link
AI-Driven Decision Support Systems	https://medium.com/@singularitynetambassadors/ai-driven-decision-support-systems-d75b3c544f7a
AI-enabled strategies for climate change adaptation: protecting communities, infrastructure, and businesses from the impacts of climate change	https://link.springer.com/article/10.1007/s43762-023-00100-2
AI: A New Weapon in the Fight Against Desertification	https://datafort.com/ai-a-new-weapon-in-the-fight-against-desertification/
Algorithmic Colonization of Africa	https://script-ed.org/article/algorithmic-colonization-of-africa/
Animal Detection and Classification from Camera Trap Images Using Different Mainstream Object Detection Architectures	https://pmc.ncbi.nlm.nih.gov/articles/PMC9367452/
Artificial intelligence (AI) and human rights: Using AI as a weapon of repression and its impact on human rights	www.europarl.europa.eu/thinktank/en/document/EXPO_IDA(2024)754450
Artificial Intelligence and Conservation	www.worldwildlife.org/pages/artificial-intelligence-and-conservation
Artificial intelligence is already helping improve fisheries, but the trick is in training the tech	www.globalseafood.org/advocate/artificial-intelligence-is-already-helping-improve-fisheries-but-the-trick-is-in-training-the-tech/
Artificial intelligence, systemic risks, and sustainability	www.sciencedirect.com/science/article/pii/S0160791X21002165#sec3
Biodiversity and Artificial Intelligence	https://gpai.ai/projects/responsible-ai/environment/biodiversity-and-AI-opportunities-recommendations-for-action.pdf
Biodiversity and Artificial Intelligence Opportunities & Recommendations for Action	https://gpai.ai/projects/responsible-ai/environment/biodiversity-and-AI-opportunities-recommendations-for-action.pdf
Case Studies of AI Policy Development in Africa	https://arxiv.org/html/2403.14662v1
Citizen-Centric Governance: Enhancing Citizen Engagement through Artificial Intelligence Tools	www.mdpi.com/2071-1050/16/7/2686#:~:text=Through%20AI%2Dbased%20platforms%20and,their%20concerns%2C%20provide%20feedback%20and
Comparing Specialised Small and General Large Language Models on Text Classification: 100 Labelled Samples to Achieve Break-Even Performance	https://arxiv.org/html/2402.12819v2

Title	Link
Comparing Specialised Small and General Large Language Models on Text Classification: 100 Labelled Samples to Achieve Break-Even Performance	https://arxiv.org/html/2402.12819v2
Continental Artificial Intelligence Strategy	https://au.int/sites/default/files/documents/44004-doc-EN-_Continental_AI_Strategy_July_2024.pdf
Developing AI for development	https://accountability.worldbank.org/en/news/2024/Developing-AI-for-development
Developing healthcare Artificial Intelligence for developing countries	http://essay.utwente.nl/95507/1/Aidarova_BA_BMS.pdf
Domain-Adaptive TinyML Model for Efficient Pest and Disease Detection in Domestic Crops: A Practical Approach for Developing Countries	https://dl.acm.org/doi/10.1145/3677525.3678639
Earth for AI: A Political Ecology of Data-Driven Climate Initiatives	www.sciencedirect.com/science/article/abs/pii/S0016718522000240?via%3Dihub
Ecological restoration and artificial intelligence: Whose values inform a project?	https://onlinelibrary.wiley.com/doi/10.1111/rec.14128
Exclusive: OpenAI Used Kenyan Workers on Less Than $2 Per Hour to Make ChatGPT Less Toxic	https://time.com/6247678/openai-chatgpt-kenya-workers/
Explainable Artificial Intelligence-Based Decision Support Systems: A Recent Review	www.mdpi.com/2079-9292/13/14/2842
Farms of the future: How can AI accelerate regenerative agriculture?	www.weforum.org/stories/2024/09/farms-ai-accelerate-regenerative-agriculture/
Governing AI in Southeast Asia: ASEAN's way forward	www.frontiersin.org/journals/artificial-intelligence/articles/10.3389/frai.2024.1411838/full
Governing with Artificial Intelligence	www.oecd.org/en/publications/governing-with-artificial-intelligence_26324bc2-en.html
Harnessing Emerging Technologies for Disaster Risk Reduction (WMO)	https://wmo.int/media/magazine-article/harnessing-emerging-technologies-disaster-risk-reduction
Harnessing human and machine intelligence for planetary-level climate action	www.nature.com/articles/s44168-023-00056-3
Harnessing large language models for coding, teaching and inclusion to empower research in ecology and evolution	https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.14325

Title	Link
How Artificial Intelligence is Revolutionizing Environmental Conservation: A Comprehensive Guide	www.quarktwin.com/blogs/other/how-artificial-intelligence-is-revolutionizing-environmental-conservation-a-comprehensive-guide/514
How do I use conservation tech ethically?	https://wildlabs.net/event/how-do-i-use-conservation-tech-ethically
How to Involve Communities in AI-Driven Conservation Efforts	https://hivo.co/blog/how-to-involve-communities-in-ai-driven-conservation-efforts
How To Use AI in Decision Making	www.upwork.com/resources/ai-in-decision-making
Improving public services using artificial intelligence: possibilities, pitfalls, governance	www.tandfonline.com/doi/full/10.1080/23276665.2020.1816188
Indigenous-Led AI: How Indigenous Knowledge Systems Could Push AI to be More Inclusive	www.sshrc-crsh.gc.ca/funding-financement/nfrf-fnfr/stories-histoires/2023/inclusive_artificial_intelligence-intelligence_artificielle_inclusive-eng.aspx
Innovation and Adaptation in the Climate Crisis: Technology for the New Normal	www3.weforum.org/docs/WEF_Innovation_and_Adaptation_in_the_Climate_Crisis_2024.pdf
Large language model applications for evaluation: Opportunities and ethical implications	https://onlinelibrary.wiley.com/doi/10.1002/ev.20556
New report and guidelines for indigenous data sovereignty in artificial intelligence developments	www.unesco.org/en/articles/new-report-and-guidelines-indigenous-data-sovereignty-artificial-intelligence-developments
OECD AI Papers	www.oecd.org/en/publications/oecd-artificial-intelligence-papers_dee339a8-en.html
OECD AI Principles	www.oecd.org/en/topics/sub-issues/ai-principles.html
OECD Digital Economy Outlook 2024 (Volume 1)	www.oecd.org/en/publications/2024/05/oecd-digital-economy-outlook-2024-volume-1_d30a04c9.html#ai
Open Platforms for Artificial Intelligence for Social Good: Common Patterns as a Pathway to True Impact	https://aiforsocialgood.github.io/icml2019/accepted/track1/pdfs/39_aisg_icml2019.pdf
Perspectives in machine learning for wildlife conservation	www.nature.com/articles/s41467-022-27980-y
Point-of-use sensors and machine learning enable low-cost determination of soil nitrogen	www.guderesearch.com/wp-content/uploads/2022/10/Grell.et_.al_.Nature-Food.pdf
Raising Standards: Ethical AI	https://asiasociety.org/policy-institute/raising-standards-data-ai-southeast-asia

Title	Link
Rethinking AI for Good Governance	https://direct.mit.edu/daed/article/151/2/360/110613/Rethinking-AI-for-Good-Governance
SAT: A Software for Assessing the Risk of Desertification in Spain	https://onlinelibrary.wiley.com/doi/10.1155/2020/7563928
Smart Oceans: Artificial intelligence and marine protected area governance	www.sciencedirect.com/science/article/pii/S2589811622000106
Thailand's AI Governance Guideline for Executive	www.etda.or.th/getattachment/Our-Service/AIGC/Research-and-Recommendation/Thailand%E2%80%99s-AI-Governance-Guideline-for-Executive_2023.pdf.aspx?lang=th-TH
The 'AI divide' between the Global North and the Global South	www.weforum.org/stories/2023/01/davos23-ai-divide-global-north-global-south/
The AI governance gaps in developing countries	www.lesswrong.com/posts/cM7sR7seBRwtxctGY/the-ai-governance-gaps-in-developing-countries
The AI Revolution: Opportunities and Challenges for the Finance Sector	www.turing.ac.uk/sites/default/files/2024-11/the_ai_revolution_-_opportunities_and_challenges_for_the_finance_sector_-_report_1.pdf
The AI tool that aims to make bottom trawling smarter and prevent bycatch and discards	www.globalseafood.org/advocate/the-ai-tool-that-aims-to-make-bottom-trawling-smarter-and-prevent-bycatch-and-discards/
The Limits of Global Inclusion in AI Development	https://arxiv.org/abs/2102.01265
The Rise of AI in Water and Wastewater Management: Ensuring a Sustainable Future	www.nacwa.org/news-publications/news-detail/2023/11/16/the-rise-of-ai-in-water-and-wastewater-management-ensuring-a-sustainable-future
The State of Artificial Intelligence in the Pacific Islands	https://aiasiapacific.org/wp-content/uploads/2024/08/The-State-of-Artificial-Intelligence-in-the-Pacific-Islands.pdf
Trustworthy Artificial Intelligence in the Asia-Pacific Region	https://aiasiapacific.org/wp-content/uploads/2021/07/2021-Trustworthy-Artificial-Intelligence-in-the-Asia-Pacific-Region.pdf
UNESCO Readiness assessment methodology: a tool of the Recommendation on the Ethics of Artificial Intelligence	www.unesco.org/en/articles/readiness-assessment-methodology-tool-recommendation-ethics-artificial-intelligence
Worldwide AI ethics: A review of 200 guidelines and recommendations for AI governance	www.sciencedirect.com/science/article/pii/S2666389923002416

Annex 6: Guidelines, policies and methodologies for the development of an ethical AI policy and responsible AI assessment protocols

1. AI and Data Sovereignty. https://libguides.wintec.ac.nz/ai-literacy-toolbox/data-sovereignty
2. AI Safety Evaluation. https://github.com/allenai/safety-eval
3. An Overview of Catastrophic AI Risks. www.safe.ai/ai-risk
4. BBQ: A Hand-Built Bias Benchmark for Question Answering. https://arxiv.org/abs/2110.08193
5. Envisioning Communities: A Participatory Approach Towards AI for Social Good. https://arxiv.org/abs/2105.01774
6. EU Ethics Guidelines for Trustworthy AI. https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai
7. Guidelines for Indigenous-Centred AI Design. www.indigenous-ai.net/position-paper/
8. Guidelines on the responsible use of generative AI in research developed by the European Research Area Forum. https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/guidelines-responsible-use-generative-ai-research-developed-european-research-area-forum-2024-03-20_en
9. Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework. www.ohchr.org/en/publications/reference-publications/guiding-principles-business-and-human-rights
10. Readiness assessment methodology: a tool of the Recommendation on the Ethics of Artificial Intelligence. www.unesco.org/en/articles/readiness-assessment-methodology-tool-recommendation-ethics-artificial-intelligence
11. Indigenous Protocol and Artificial Intelligence Working Group. https://spectrum.library.concordia.ca/id/eprint/986506/
12. IPBES Data and Knowledge Management Policy. https://www.ipbes.net/resource-file/105683
13. LLM Safety Evaluation. https://github.com/allenai/safety-eval
14. OECD AI Principles. www.oecd.org/en/topics/sub-issues/ai-principles.html
15. Principles for the Ethical Use of Artificial Intelligence in the United Nations System. https://unsceb.org/principles-ethical-use-artificial-intelligence-united-nations-system
16. Principles on AI for Biodiversity Conservation. https://ai-for-sdgs.academy/principles-on-ai-for-biodiversity-conservation
17. Principles on AI for Climate Action. https://ai-for-sdgs.academy/principles-on-ai-for-climate-action

18. The ASEAN Guide on AI Governance and Ethics. https://asean.org/wp-content/uploads/2024/02/ASEAN-Guide-on-AI-Governance-and-Ethics_beautified_201223_v2.pdf

19. UNESCO Readiness assessment methodology: a tool of the Recommendation on the Ethics of Artificial Intelligence. www.unesco.org/en/articles/readiness-assessment-methodology-tool-recommendation-ethics-artificial-intelligence

20. Worldwide AI ethics: A review of 200 guidelines and recommendations for AI governance. www.sciencedirect.com/science/article/pii/S2666389923002416

Endnotes

1 CU-CAI (n.d.) Artificial Intelligence (AI) vs. Machine Learning. https://ai.engineering.columbia.edu/ai-vs-machine-learning/

2 MIT Technology Review (n.d.) We analyzed 16,625 papers to figure out where AI is headed next. www.technologyreview.com/2019/01/25/1436/we-analyzed-16625-papers-to-figure-out-where-ai-is-headed-next/

3 GeeksforGeeks (n.d.) What is a Neural Network? www.geeksforgeeks.org/neural-networks-a-beginners-guide/

4 https://www.safe.ai/work/statement-on-ai-risk

5 White & Case LLP (n.d.) AI Watch: Global regulatory tracker. www.whitecase.com/insight-our-thinking/ai-watch-global-regulatory-tracker

6 Mohsin, S (2024) Inside Project Maven, the US Military's AI Project. Bloomberg. www.bloomberg.com/news/newsletters/2024-02-29/inside-project-maven-the-us-military-s-ai-project

7 Kleinman, Z (2024) Microsoft to re-launch 'privacy nightmare' AI screenshot tool. BBC News. www.bbc.com/news/articles/c869glx8endo

8 AP News (2023) Is Bing too belligerent? Microsoft looks to tame AI chatbot. https://apnews.com/article/technology-science-microsoft-corp-business-software-fb49e5d625bf37be0527e5173116bef3

9 Johnson, R (2019) 60 Percent of Small Companies Close Within 6 Months of Being Hacked. Cybercrime Magazine. https://cybersecurityventures.com/60-percent-of-small-companies-close-within-6-months-of-being-hacked/

10 Baraniuk, C (2024) Electricity grids creak as AI demands soar. www.bbc.com/news/articles/cj5ll89dy2mo

11 Solon, O (2021) Do water-intensive data centers need to be built in the desert? NBC News. www.nbcnews.com/tech/internet/drought-stricken-communities-push-back-against-data-centers-n1271344

12 Siddik, MAB, Shehabi, A and Marston, L (2021) The environmental footprint of data centers in the United States. *Environmental Research Letters* 16 064017. https://energyanalysis.lbl.gov/publications/environmental-footprint-data-centers

13 Spencer, T and Singh, S (2024) What the data centre and AI boom could mean for the energy sector – Analysis. IEA. www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector

14 Jacobs, J and Tasin, F (2024) How the global South may pay the cost of AI development. OMFIF. www.omfif.org/2024/07/how-the-global-south-may-pay-the-cost-of-ai-development/

15 Government of Canada (2023) Indigenous-Led AI: How Indigenous Knowledge Systems Could Push AI to be More Inclusive. www.sshrc-crsh.gc.ca/funding-financement/nfrf-fnfr/stories-histoires/2023/inclusive_artificial_intelligence-intelligence_artificielle_inclusive-eng.aspx

16 Pecher, B, Srba, I and Bielikova, M (2024) Comparing Specialised Small and General Large Language Models on Text Classification: 100 Labelled Samples to Achieve Break-Even Performance. https://arxiv.org/abshtml/2402.12819v2

17 IBM (2023) What Is Edge AI? www.ibm.com/topics/edge-ai

18 Comunale, M and Manera, A (2024) The Economic Impacts and the Regulation of AI: A Review of the Academic Literature and Policy Actions. IMF Working Papers. https://doi.org/10.5089/9798400268588.001.A001

19 European Parliament (2024) Artificial intelligence (AI) and human rights: Using AI as a weapon of repression and its impact on human rights. www.europarl.europa.eu/thinktank/en/document/EXPO_IDA(2024)754450

20 Chakravorti, B (2024) AI's Trust Problem. Harvard Business Review. https://hbr.org/2024/05/ais-trust-problem

21 OECD (2023) Advancing accountability in AI. www.oecd.org/en/publications/advancing-accountability-in-ai_2448f04b-en.html

22 Galaz, V, Centeno, MA, Callahan, PW, Causevic, A, Patterson, T, Brass, I, Baum, S, Farber, D, Fischer, J, Garcia, D, McPhearson, T, Jimenez, D, King, B, Larcey, P and Levy, K. Artificial intelligence, systemic risks, and sustainability. *Technology in Society* 67 101741. www.sciencedirect.com/science/article/pii/S0160791X21002165

23 Urzedo, D, Sworna, ZT, Hoskins, AJ and Robinson, CJ (2024) AI chatbots contribute to global conservation injustices. *Humanities and Social Science Communications* 11 204. https://doi.org/10.1057/s41599-024-02720-3

24 Campo Ruid, I (2024) Controlling the environment with Artificial Intelligence risks intensifying social inequalities and colonization. https://open-research-europe.ec.europa.eu/articles/4-16

25 Galaz, V, Centeno, MA, Callahan, PW, Causevic, A, Patterson, T, Brass, I, Baum, S, Farber, D, Fischer, J, Garcia, D, McPhearson, T, Jimenez, D, King, B, Larcey, P and Levy, K. Artificial intelligence, systemic risks, and sustainability. *Technology in Society* 67 101741. www.sciencedirect.com/science/article/pii/S0160791X21002165

26 Falajiki, C (2023) The Political Economy of AI Ethics and Governance in Africa in the Rise of the US-China Geopolitics. www.africanobservatory.ai/social/the-political-economy-of-ai-ethics-and-governance-in-africa-in-the-rise-of-the-us-china-geopolitics

27 Nost, E and Colven, E (2022) Earth for AI: A Political Ecology of Data-Driven Climate Initiatives. *Geoforum* 130 23–34. https://doi.org/10.1016/j.geoforum.2022.01.016

28 Tacheva, J and Ramasubramanian, S (2023) AI Empire: Unraveling the interlocking systems of oppression in generative AI's global order. *Big Data & Society* 10. https://doi.org/10.1177/20539517231219241

29 Wintec (n.d.) AI and Data Sovereignty. https://libguides.wintec.ac.nz/ai-literacy-toolbox/data-sovereignty#s-lg-box-wrapper-26688807

30 Faculty of Arts (2024) Indigenous data stewardship stands against extractivist AI. University of British Columbia. www.arts.ubc.ca/news/indigenous-data-stewardship-stands-against-extractivist-ai/

31 UNESCO (2023) New report and guidelines for indigenous data sovereignty in artificial intelligence developments. www.unesco.org/en/articles/new-report-and-guidelines-indigenous-data-sovereignty-artificial-intelligence-developments

32 Galaz, V, Centeno, MA, Callahan, PW, Causevic, A, Patterson, T, Brass, I, Baum, S, Farber, D, Fischer, J, Garcia, D, McPhearson, T, Jimenez, D, King, B, Larcey, P and Levy, K. Artificial intelligence, systemic risks, and sustainability. *Technology in Society* 67 101741. www.sciencedirect.com/science/article/pii/S0160791X21002165

33 Nost, E and Colven, E (2022) Earth for AI: A Political Ecology of Data-Driven Climate Initiatives. *Geoforum* 130, 23–34. https://doi.org/10.1016/j.geoforum.2022.01.016

34 Ceccaroni, L, Bibby, J, Roger, E, Flemons, P, Michael, K, Fagan, L and Oliver, JL (2019) Opportunities and Risks for Citizen Science in the Age of Artificial Intelligence. *Citizen Science: Theory and Practice* 4. https://doi.org/10.5334/cstp.241

35 Tang, R and Gavin, MC (2016) A Classification of Threats to Traditional Ecological Knowledge and Conservation Responses. *Conservation and Society* 14, 57–70. https://www.jstor.org/stable/26393228?seq=1