Royal Academy
of Engineering

Frontiers symposium

Digital tools for reversing environmental degradation

9 to 19 January 2023 | Virtual symposium

Royal Academy of Engineering

Introduction to the Frontiers symposia

The Frontiers symposia bring together around 70 of the best early- and mid-career researchers and practitioners from industry, academia, non-government organisations (NGOs), community groups, and the public sector in multidisciplinary workshops that address fundamental development challenges.

The symposia's objectives are to encourage collaborative work that addresses international development challenges and to promote cross-disciplinary thinking among the next generation of engineering leaders.

Competitively allocated seed funding is available to strengthen the collaborations developed at the symposia.

REVERSING ENVIRONMENTAL DEGRADATION

REDAA

IN AFRICA AND ASIA

UKaid
from the British people

iied International Institute for Environment and Development

Contents

Virtual symposium

Delegates met and worked together on the Frontiers' virtual platform, where they watched pre-recorded presentations, engaged in theme-related content, and networked with each other. This culminated in two days of live sessions where delegates workshopped the ideas being discussed on the platform.

Frontiers insights: digital tools for reversing environmental degradation

The Frontiers symposium took place online from 9 to 19 January 2023. Together with the Reversing Environmental Degradation in Africa and Asia (REDAA)[1] programme, the Frontiers team brought together 77 delegates from different disciplines, fields, and countries to discuss the many ways digital tools can be used to reverse environmental degradation. The event took place virtually through workshop-style sessions and networking and was co-chaired by Minnie Degawan and Edwin Macharia.

On the heels of several critical, multilateral meetings on environment and biodiversity – COP27[2], COP15[3], and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – environmental degradation and its impacts on people across the globe were top of mind for participants. With up to 40% of land degraded[4] globally and the world falling short of emissions targets[5], innovative and collaborative solutions are needed urgently.

Together, Frontiers symposium participants were tasked with identifying practical interventions to tackle environmental degradation while considering the wider impacts. For example, although technology can contribute to progress, researchers and innovators must consider other factors such as the ownership of technology and data and how it can empower and mobilise local changemakers.

At the same time, efforts to reverse environmental degradation must also support livelihoods and empower those most affected by their impacts – such as Indigenous peoples and women. Ensuring these groups and local communities are included, therefore, is critical and can help ensure the long-term success of collaborations. In addition,

incorporating their experience can build solutions that suit each community's needs and strengths. Underlining the urgency and complexity of the issue, event Chair Minnie Degawan said, "We have to come together with mutual respect and we must ensure that our solutions will not mean the loss of irreplaceable value systems."

The interdisciplinary symposium convened participants from academia, NGOs, indigenous people and local communities, business, and more to understand the ways digital tools can support efforts to prevent and reverse environmental degradation. Event Chair Edwin Macharia encouraged participants to take advantage of this unique occasion: "The lasting impact here is your own lightbulb moment when you understand and internalise a new perspective." The event was centred around three sub-themes: participatory research and decision-making; data access, visualisation, and analysis; and real-time monitoring and learning. This report captures the key points, insights, and expertise from the discussions and activities that took place.

The symposium partner, Reversing Environmental Degradation in Africa and Asia (REDAA)[6] is a programme that catalyses research, innovation and action at local, national and regional levels across Africa and Asia through a series of grant calls. Funded projects are interdisciplinary, often locally led and focus on solutions for ecosystem restoration and wildlife protection, enabling people and nature to thrive together in times of climate, resource and fiscal insecurity. REDAA is funded by UK Aid[7] from the Foreign, Commonwealth and Development Office and managed by IIED[8]. For more information, visit www.redaa.org.

[1] www.redaa.org

[2] cop27.eg/#/

[3] www.cbd.int/conferences/2021-2022

[4] www.unccd.int/sites/default/files/2022-04/GLO2_SDM_low-res_0.pdf

[5] www.unep.org/resources/emissions-gap-report-2022

[6] www.redaa.org

[7] www.ukaiddirect.org

[8] www.iied.org

Minnie Degawan, Conservation International

Minnie Degawan is an Indigenous Kankanaey-Igorot from the Cordillera, Philippines, and has been an activist for Indigenous people's rights since she was a student on national and global levels. She participated in drafting the UN Declaration on the Rights of Indigenous Peoples and helped form the International Alliance of Indigenous and Tribal Peoples of the Tropical Forests. Minnie became the project coordinator of a Global Environment Facility-funded project to enhance the participation of Indigenous peoples in biodiversity conservation. In 2016, she joined Conservation International as director of its Indigenous and Traditional Peoples Program.

Edwin Macharia, Dalberg

In his current role at Dalberg, **Edwin Macharia** oversees activities across offices worldwide. Before that, Edwin served as the firm's Africa Regional Director. He was instrumental in building out the firm's footprint, talent, and capabilities in Africa. Also, he has played catalytic roles across the firm, including pioneering the Agriculture and Food Security practice. In his advisory capacity, Edwin supports clients on a range of issues including strategy, operational efficiency, and program implementation. He also serves as a member of The Nature Conservancy Africa Council and the Amref University Governing Council. He has been recognised as a Young Global Leader by the World Economic Forum and was listed by Forbes as one of the 10 Most Powerful Men in Africa in 2015.

Participatory research and decision-making

Session chairs

**James Rattling Leaf Sr,
GEO Indigenous Alliance**

**Dr Onesmus Mwabonje,
Imperial College London**

Kriti Chouhan, Busara Centre

Presentations

1. GEO Indigenous Alliance: advocating for Indigenous peoples to utilise earth observations to support Indigenous nation building

   James Rattling Leaf Sr

2. 2050 cCalculator: The role of 2050 calculators in building inclusive pathways to net-zero

   Dr Onesmus Mwabonje

3. Exploring behavioural barriers and opportunities to make technologies more accessible

   Kriti Chouhan

Key takeaways:

- Technology and innovation can support and help preserve Indigenous knowledge, especially relating to environmental conservation.

- Local communities must be properly informed about the use of and access to their data.

- Young people can be local champions for new solutions while also creating opportunities for professional growth.

- Tools must be adapted to different local contexts to address varying needs, resources, capacities, and goals.

- Researchers can introduce new tools, resources, and innovations through trusted networks to build relationships with local communities. This includes key community figures as well as highly-used channels such as WhatsApp.

Opening the symposium, the first session focused on the different approaches to local participation and decision-making for environmental preservation. Session chairs shared success stories of local involvement in innovative solutions, while also highlighting opportunities for the future. Communication, ownership, and involvement were central to their experiences. The breakout sessions allowed participants to discuss the ways local people can be more involved in solutions development.

Presentations

GEO Indigenous Alliance: advocating for Indigenous peoples to utilise earth observations to support Indigenous nation building

James Rattling Leaf Sr,
GEO Indigenous Alliance

In his presentation, James explained the work of the Group on Earth Observations (GEO) Indigenous Alliance and how technology can be used to support Indigenous communities and their environmental protection efforts. The GEO Indigenous Alliance was created to protect and sustain tribal and indigenous cultural heritage using science and technology. The group emphasises the use of technology as a tool for intergenerational knowledge transfer and cultural heritage to help build a knowledge base for more sustainable life on Earth.

James underlined the challenges related to Indigenous groups and technology use. In many cases, there have been gaps in delivering technology to Indigenous communities or a lack of technological literacy efforts. Data sovereignty is also a prevailing concern. While there has been an increased interest in the insights of traditional knowledge to address climate change and biodiversity loss, there must also be equitable collaborations that empower Indigenous groups.

Through his experience with the GEO Indigenous Alliance, James found that data and its collection must reflect the needs, ethics, perspectives, and protocols of the community it derives from – and that the communities themselves should have access to the data. To ensure data sovereignty for Indigenous groups, James highlighted how GEO Indigenous Alliance applies the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) principles to data initiatives. Emphasising this, James said: "Data sovereignty is key to any future development of tribal nations."

Working with Indigenous youth is also critical in the long term. It can help create opportunities while furthering efforts to preserve traditional knowledge through technology and data. GEO Indigenous Alliance, for example, has developed an ambassador programme for youth to gain funding, resources, and mentorship to address prevailing issues in their own communities.

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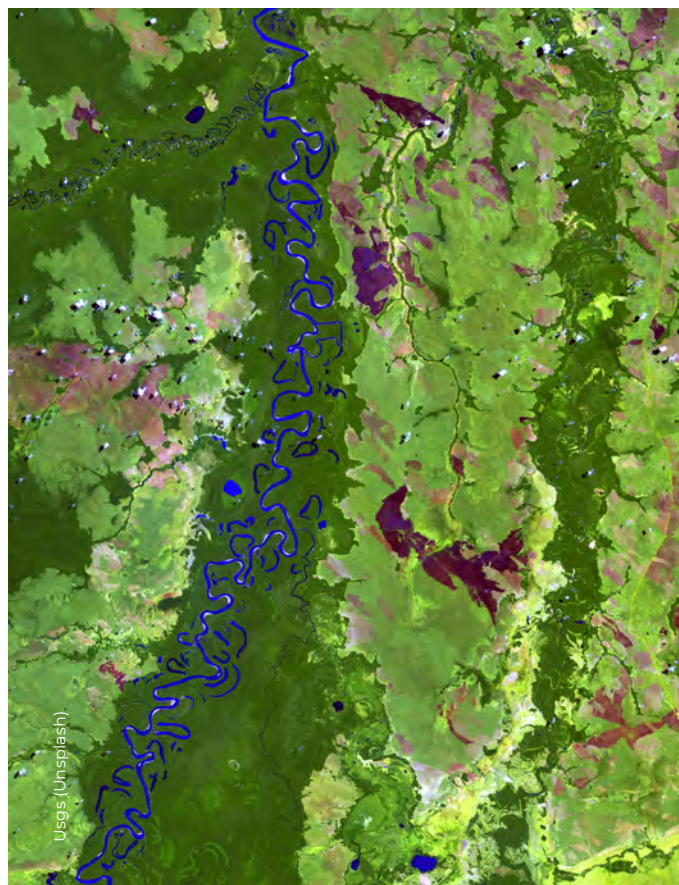
2050 Calculator: The role of 2050 calculators in building inclusive pathways to net zero

**Dr Onesmus Mwabonje,
Imperial College London**

Onesmus used his presentation to demonstrate how open-source climate information tools can help facilitate low-carbon transitions. Specifically, he has worked on the 2050 Calculator – an interactive, open-source energy model that is regionally-developed to provide evidence for governments and policymakers to make well-informed decisions on emissions and energy.

The tool was originally developed for the UK but has since been adapted in collaboration with other countries, including India, Colombia, Nigeria, and more, while also creating opportunities for South-South cooperation. Furthermore, the calculator now has several different interfaces for different audiences such as academia, the general public, and children.

To demonstrate how the 2050 Calculator has been applied outside of the UK, Onesmus explained the process for developing the tool for Kenya, where it was adapted by local researchers. The group held workshops tailored to different audiences to ensure its longevity, which also created buy-in from key stakeholders. Going forward, they hope to extend the calculator's use to more local populations.

In the breakout session, participants discussed how the 2050 Calculator can be used to engage citizens in different countries. They agreed that adapting and tailoring the tool for different contexts was highly important, including local cultures, needs, and goals. Jaya summarised this point: "When we engage the citizens and local communities, it will help us to know the proper insight of what is going on there and what is needed."

Annie Spratt (Unsplash)

To accomplish this, communities must be a part of the process from the core design to the implementation. This creates a need for capacity-building programmes that give people the required skills to understand and apply the calculator. In turn, local leaders must also be able to translate and distil the outputs to their communities.

Participants expanded the conversation to emphasise the need to include citizens in climate policymaking. Doing so can build transparency and trust for people. It also helps create permanence to policy because when people help create something, they become more invested in its success. The 2050 Calculator serves as an example of a tool that can help facilitate this process.

Exploring behavioural barriers and opportunities to make technologies more accessible

Kriti Chouhan, Busara Centre

Opening her presentation, Kriti posed a question: "Is creating the best data-driven solution for natural resource management enough to ensure its uptake? The answer is rarely." In other words, humans often do not do what is best for them, creating an intention-action gap. Considering this, Busara has been working with the Foundation for Ecological Security and the India Observatory to find ways to make technology for natural resource management more accessible. Both organisations seek to understand the behavioural, psychological, and social barriers to the adoption of tools, technology, and data for resource management.

Christine Donaldson (Unsplash)

Kriti highlighted the CLART[9] tool, a mobile application that provides data on where groundwater is available and presents information in a consumable format using colour codes, as an example of this work. The key barriers to the uptake of the CLART tool were extensive, including a lack of awareness around common resources and the need to preserve them, diffusion of responsibility to others, misconceptions about ownership, lack of knowledge about the tools, high costs, and risk aversion towards technology. However, each of these barriers also presented opportunities for improving awareness and adoption. Increasing knowledge through trusted local governing bodies helped communities view natural resources as economic resources and build support systems, for example.

The presentation emphasised the importance of clear and streamlined communication to reduce friction – or different levels of barriers such as a lack of local language availability – to use the tool. Communications should clearly explain how resources are beneficial to a community specifically. Kriti also highlighted community mobilisation as key to long-term use: researchers

should leverage trusted sources, such as local governments, to use the tools and advocate for technology as a source of knowledge, while disseminating information through trusted channels such as WhatsApp and YouTube.

In the breakout session, participants were asked to develop solutions for a myriad of problems. They discussed how certain groups tend to be left behind by innovative digital solutions and how technology can be made more accessible and inclusive. Across the interdisciplinary group, there was a wide range of ideas proposed, such as the potential of youth as champions as well as facilitating linkages between communities experiencing similar challenges in different locations.

However, they also emphasised that the disconnect between local communities and national resources can derive from systemic issues that must be addressed, such as the political structures in place. Technology, though important, cannot solve all the world's problems alone, and thus researchers and innovators must understand wider contexts, putting people first.

[9] www.indiaobservatory.org.in/tool/clart

Data access, visualisation, and analysis

Session chairs

Bruce Jones, Allen Institute for Artificial Intelligence – EarthRanger

Aradhana Gurung, Viamo

Miroslawa Alunowska Figueroa and Lilian Nguracha, Samburu Adventure

Presentations

1. EarthRanger's role in reversing environmental degradation

   Bruce Jones

2. The role of localised and place-based approaches to use data in decision making

   Aradhana Gurung

3. 'Naapu Ntomonok App': Women empowerment and conservation

   Miroslawa Alunowska Figueroa and Lilian Nguracha

Key takeaways:

- Data collection does not require 'high-tech' solutions. Innovative approaches to 'low-tech' tools can help facilitate data collection in low-resource or remote settings.

- Data misuse is a serious problem that researchers must contend with from the onset of their projects. Ensuring that projects do not put local safety at risk is paramount.

- To build solutions that work for a community, innovators and researchers must understand the people – considering social dynamics, local resources, government, and more.

- Local communities must have ownership and leadership in a solution. Researchers should serve as facilitators for this process.

Focusing on innovative, locally-led approaches to data collection, the second session brought together chairs from an array of sectors. Through their presentations, they offered tools and lessons learned around data's use and application for environmental conservation, as well as other complex issues such as COVID-19, financial security, and climate change. They emphasised the importance of bottom-up approaches that allow local people to lead and tailor solutions for their community. Together with participants, session chairs underlined the importance of communication around data. People must understand how their data will be used, how it can benefit the community, and how they can access and own their information.

Presentations

EarthRanger's role in reversing environmental degradation

Bruce Jones, Allen Institute for Artificial Intelligence – EarthRanger

Bruce shared the EarthRanger[10] platform with symposium participants to illustrate how data tools can help reverse environmental degradation. The EarthRanger platform aids those working in wildlife protection, ecologists, and biologists to make more informed decisions for wildlife conservation. The tool works within different environments globally but is especially used in Africa. The platform provides a standardised view of a region and creates a database of real-time information from the field that tracks subjects such as wildlife, field observations, rangers, enforcement assets, and infrastructure like aircrafts. Live tracking comes from a range of devices: satellite trackers, remote GPS trackers, and more. Together, the different live tracking data feed into the application.

EarthRanger's database of information can then be translated into practical decisions. For instance, the application can show where there are forest fires or road issues, and managers can then direct rangers to alternative routes. By using the information on where animals are feeding or creating dens, they can also work to reduce human-animal conflicts.

In Eastern and Southern Africa, game reserves are often not fenced, meaning that pastoralists and wildlife are co-existing in the same area. In this environment, technology like EarthRanger can be used to understand where carnivorous animals are, implement warning systems, and ultimately reduce potential risks to the people tending to pastoral animals. It has also been used to understand which areas are over-grazed, helping pastoralists make informed decisions about their movement.

Ian Macharia (Unsplash)

In the breakout session, participants discussed the flow of data from collection to its presentation in databases and its practical application. They highlighted the advantages of tools like EarthRanger that can be used in a complex, widespread way as well as 'low-tech', specific situations. Data does not necessarily need to be technologically collected to be useful in innovative solutions. In other words, it can be collected using simple tools like written notes or mobile phones and then be incorporated into technology later. This helps increase adaptability for different contexts. However, the group also examined the different ways data and technology can be misused. For instance, sensitive information can be released, putting people at risk. Potential impacts must be considered when developing technology for conservation.

[10] www.earthranger.com

The role of localised and place-based approaches to use data in decision-making
Aradhana Gurung, Viamo

Aradhana opened her presentation by giving background insight into Viamo and its work. Viamo is a social enterprise with roots in Ghana and a growing global presence. The platform provides mobile technology solutions for gathering and sharing critical information.

Aradhana underlined that there are still many challenges in aggregating, managing, and creating value from the 2.5 quintillion bytes of data created daily. This issue is compounded by the fact that 2.7 billion people still lack access to the internet. In many regions, the lack of infrastructure, affordability, digital literacy, and locally-generated content inhibit access to data. On a wider scale, data security and a growing need for expertise in big data management are also pressing issues.

Low-cost, bottom-up, and place-based approaches can address these problems by including marginalized groups in the data collection process. Aradhana provided several different practical examples of these approaches. For instance, community members that participate in data collection can have agency over how data is cultivated and used. They can update data sets long-term as well. The use of visually presented data, instead of spreadsheets or reports, can improve accessibility and evoke empathy, fostering buy-in. At Viamo, Aradhana and her colleagues have been collecting quantitative and qualitative data through mobile devices, such as surveys through calls, which allows for direct access to respondents in a language and location most convenient to them.

In the context of international development, innovative data collection technology is being used to understand complex global challenges such as financial security, COVID-19, and climate change. However, Aradhana underlined that data collected should complement human efforts and not replace them. It is important to remember that practitioners should draw on a wide range of evidence to make better-informed decisions and consider local people as end-users.

In the breakout session, participants worked to understand what place, space, and local data meant to them. To accomplish this, they completed a design sprint on a variety of problems, identifying what a problem statement is, which stakeholders they would collaborate with, their data points, and the use of local data sources. Participants shared their own experiences in understanding local perspectives. Some had spent time in local communities, which allowed them to reiterate their original designs from an empathetic perspective. The group agreed that getting detailed, localised data is as important as national-level data in many cases so regional needs, stories, and goals are not lost in the implementation of solutions.

However, the oversimplification of data can also present challenges. Participants emphasised the importance of accurately translating data into messaging that can be used in public-facing communication, and tailoring information for different target channels to be better understood.

Critically, they also discussed data ownership. In many cases, communities help build data sources but often do not have access to the data itself, nor are they informed on the benefits of their participation. In some cases, the information can bring about unwanted attention to a community and other negative impacts. Therefore, as researchers, it is important to integrate human rights into the development of solutions.

'Naapu Ntomonok App': Women empowerment and conservation
Miroslawa Alunowska Figueroa and Lilian Nguracha, Samburu Adventure

Together, Miroslawa and Lilian, two winners of the Indigenous FODD4G Hackathon 2021, shared insights from their work on the Naapu Ntomonok App. The application helps the Indigenous, traditionally nomadic Samburu women in Kenya efficiently locate local resources and markets. It maps out fertile land, for instance, where they can take their livestock to graze, as well as medical services, water, and wildlife routes. The app was developed with the local community and allows them to input information, giving them ownership of the technology. It is also helping them build stable livelihoods. Without the app's functionality, for example, women in the community learn through word-of-mouth where the markets are opening and sometimes travel for days to reach them, only to find that the market has already closed or moved to a new location. This leaves them both losing time and potential income. Critically, the app is available in local languages.

Reflecting on the development of the project, Miroslawa underlined the importance of tailoring solutions to local contexts. As researchers often come from outside of target communities, it is critical to realise what assumptions we have and to overcome them. She highlighted how differing access to Wi-Fi, technology, and financing can affect project development and longevity.

Lilian also emphasised the opportunity to empower women in conservation. In her work at the Sambari Women Conserve in Kenya, she equips women as conservationists, giving them access to education and tools to protect their animals and local environments as well as take charge as local leaders. They can uniquely communicate in different social circles, connecting

Lazarus Marson (Unsplash)

with other women, the elderly, young people, men in their networks and more, which can help magnify important messages and knowledge on conservation.

In the breakout session, the group discussed how digital solutions can help overcome issues like those the Samburu community is facing such as climate change and growing drought, access to water and sanitation, human and wildlife conflict, and more. The group agreed that to develop long-term solutions, engineers and innovators must deeply understand a community and its problems, while fostering trusting relationships, coining the term, 'brutal intentionality.' This also means understanding different social dynamics and tailoring language to suit different situations.

For instance, using language around 'women's empowerment' can sometimes cause concerns in communities where women and men have imbalanced power relations. One way to help address this is to utilise language and evidence that shows how empowering women is beneficial for everyone. The group also underlined that the role of external researchers and solutions developers is not to implement as much as it is to facilitate local communities to lead the way.

Real-time monitoring and learning

Session chairs

Titus Letaapo and Diana Mastracci Sanchez, GEO Indigenous Alliance

Professor Jeffrey A Tuhtan, Tallinn University of Technology

Anthony Vodacek, Rochester Institute of Technology

Presentations

1. Digital tools for reversing environmental degradation

   Titus Letaapo and Diana Mastracci Sanchez

2. A smart fish counter story: locals in the loop

   Professor Jeffrey A Tuhtan

3. Applying acoustic networks for monitoring the environment

   Anthony Vodacek

Key takeaways:

- Solutions must consider those who are less familiar with technology or communities with high illiteracy and be adapted for them.

- Citizen science can empower communities to be a part of the solution and data collection, while also providing insights into local environments.

- From the onset of a project, measurements to track impacts must be developed. This includes metrics that measure economic, social, and environmental benefits to a community.

- Machine learning can be a critical tool to support researchers, quickly processing large sources of information for people to interpret and apply.

In this session, speakers shared innovative tools used to advance environmental protection and monitoring. They included audio recording, applications that collect local stories, and more. As was often discussed throughout the symposium, participants and session chairs stressed the need to understand local contexts when developing technology or solutions for a problem.

Presentations

Digital tools for reversing environmental degradation
Titus Letaapo and Diana Mastracci Sanchez, GEO Indigenous Alliance

As highlighted by James in the first session, Diana and Titus underscored the work of the GEO Indigenous Alliance. The group was founded by Indigenous leaders to protect and sustain Indigenous cultural heritage by using earth observation science, data, and technology. Together, they shared their experiences using technology in Indigenous communities to address complex issues.

In the Ecuadorian Amazon, Indigenous communities such as the Shuar people are using technology to collect biomass estimates to understand the amount of carbon stored in trees. The Visibilidade Quilombola App[11] encourages local groups to share their stories and garner support from beyond their region. It then creates data visualisations of different challenges they are facing, making the needs and hopes of the community more visible.

Titus' community – the Samburu tribe – is facing the impacts of climate change such as persistent drought, shrinking grassland and forest, unpredictable weather, and loss of habitat and water sources. These all lead to fewer pastures for the largely pastoralist community, furthering land degradation as the animals are staying in fewer places for longer. Proposed solutions, however, bring about further challenges: there is little internet connectivity and access to data, a lack of funding for Indigenous projects, minimal relevant government services, and prejudices against Indigenous knowledge.

Azzedine Rouichi (Unsplash)

With this framing, Diana and Titus asked the breakout group participants to put themselves in the shoes of the Samburu tribe and consider what digital solutions can be created to benefit the community in different ways. Participants came up with a range of ideas, from monitoring water resource availability to the identification of medical and climate-resilient plants, while also considering how these could help tackle issues and what further challenges may arise. For example, monitoring water resources can help reduce conflict and improve resource management, but determining territorial areas for nomadic communities can be difficult. Also, all digital solutions would need to consider how to onboard older community members who may be less familiar with technological tools.

[11] www.earthobservations.org/geo_blog_obs.php?id=489

A smart fish counter story: locals in the loop

Professor Jeffrey A Tuhtan, Tallinn University of Technology

In his presentation, Jeffrey discussed his work developing technology to monitor endangered fish in Europe. Freshwater fish stocks are in decline globally, despite their importance to biodiversity and the environment. Lakes, rivers, and wetlands make up less than 1% of the Earth's surface but comprise 25% of vertebrate species. Of these, roughly half are fish species and one-third of them are at risk of extinction.

Across different sectors, however, work can be done to improve freshwater resources, including ensuring water quality, protecting and restoring habitats, preventing overfishing, and controlling non-native species invasions. To undertake any of these actions, digital monitoring technology is key. For example, some tools allow local fishers to submit photos of fish for researchers to identify. This helps them to better track the status of different fish populations.

Jeffrey then provided further examples of digital monitoring tools for water resources and wildlife. The Amber Barrier Atlas[12] tracks more than one million locations of freshwater fish species as they migrate. Citizens can contribute to the platform, which creates opportunities for real-time data generation. This information can then be used to prioritise and inform management and policy decisions to support and maintain connectivity between European rivers.

Emphasising the importance of local knowledge, Jeffrey outlined a concept he calls "locals in the loop." In other words, ensuring that the community members closest to the issue are included in the implementation and development of monitoring technology can help improve the outcomes. For instance, local fishers can better inform where cameras should be placed or help navigate difficult environments. In turn, solutions should be tailored to meet their needs and be communicated in local languages.

Machine learning can help process incoming data more efficiently. Across different freshwater preservation projects, machine learning can prevent human researchers from needing to watch hours of video monitoring underwater life. The tool – informed by local expertise – can immediately classify information, count migrating swarms of fish, and enable researchers to use the information more quickly.

In the subsequent breakout session, participants considered what 'real-time' means. Two definitions emerged from the discussion. First, real-time is seen as how fast data is available and the second refers to the decision made when receiving data – when a person determines if data must be used immediately or not.

Participants then engaged in a role-playing scenario in which a billionaire offers 10 million dollars over 10 years to build a water-related piece of revolutionary technology. It must provably reduce or address water degradation and must have key performance indicators to show that an improvement was made as a result of the innovation. The final caveat was that the participants needed to provide methods to measure positive community impacts.

Together, the group emerged with a collaborative idea: a solar-powered, real-time microplastic detection and removal system. The tool would work similarly to a vacuum for water sources. Tracking impacts could include regular measurements of the number of microplastics in the water as well as the economic impacts of improved water resources on the local community. To help show the more holistic ways the tool could benefit local communities, participants suggested involving local community members in the tool's implementation and tracking use over time. Through this collaborative exercise, participants more deeply understood that as technological solutions are developed, markers for tracking impacts on environments, economies, and communities must be incorporated and considered.

[12] amber.international/european-barrier-atlas/

Applying acoustic networks for monitoring the environment

**Anthony Vodacek,**
Rochester Institute of Technology

Anthony's presentation delved into the innovative use of sound for environmental monitoring. New low-cost and open-source projects are being developed that are enabling the creation of digital networks for sharing and tracking the environment. One such project is the Audiomoth[13], which records audio using the same microphone technology that is used in phones. It is sensitive to a wide range of frequencies, including those that humans cannot hear. An accompanying software helps track the device remotely, schedule recordings, and choose which specific frequencies to capture, giving researchers control over the data outputs.

The use of sound monitoring is being used for a variety of applications in environmental work and conservation efforts. For example, it can help inform the understanding of illegal activities such as logging and poaching. It is also being used in biodiversity assessments to track different animals that make unique sounds, as well as for the total combination of sounds in an environment.

In the breakout session, participants identified innovative applications for sound monitoring. They highlighted how it could be used in agricultural processes as well as tracking ice and glacier movement for climate change monitoring.

The group also discussed how machine learning can process vast volumes of data generated by sound monitoring. The only effective way to process this audio data is through machine learning, using pattern recognition and unique sound identification. Participants asked if this could be done in real-time, and it was noted that with a carefully designed network, it should be possible to get real-time knowledge of sounds occurring.

They also underlined the value of Indigenous knowledge in this context as local communities can better identify sounds in their environment. This, in turn, can inform the machine learning that processes the sound recordings for researchers. Furthermore, the low-cost and open-source tools presented can be adapted and used in different contexts, allowing local communities to have ownership over the data.

Kiyoshi (Unsplash)

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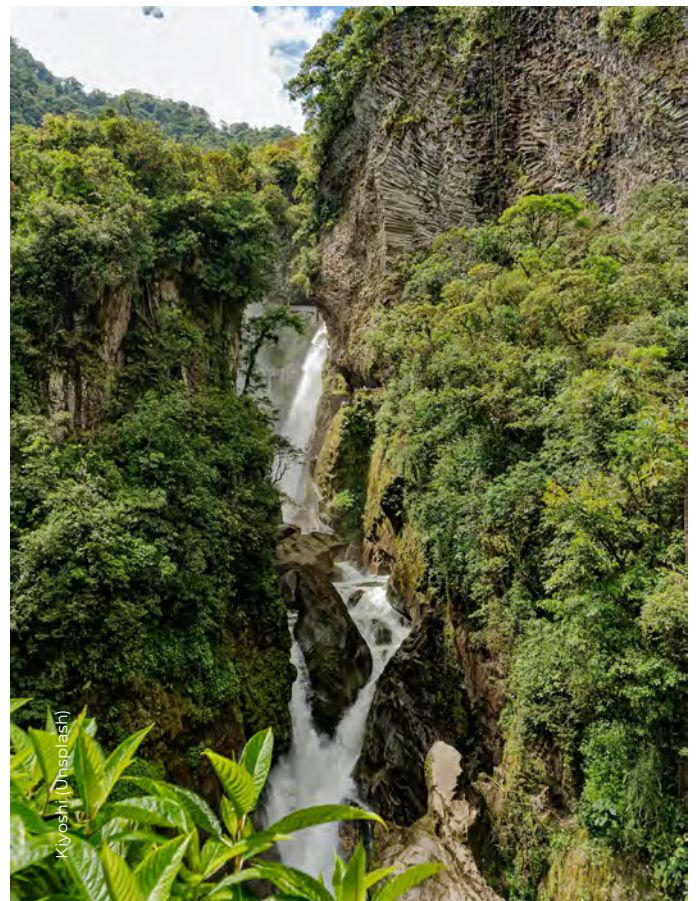
[13] www.openacousticdevices.info/audiomoth

Exploring barriers and incentives to digital solutions in natural resource management (NRM)

Leila Guici, GSMA

"What role do digital solutions play in natural resource management? How do we navigate the power dynamics of using such technology?"

Digital technology has the potential to enhance the efficiency of NRM in low- and middle-income countries, enabling real-time monitoring and data collection, supporting community engagement, and allowing organisations to store, analyse, and visualise data. In her work as a part of GSMA's Mobile for Development team, Leila has conducted research, local market development, and advocacy to drive innovation in digital technology. The goal of this work is to help reduce inequalities across the world.

For NRM, however, local involvement is key to progressing the responsible and fair use and updating of digital solutions. To better ensure the success of innovations in the field, Leila and her team have researched the barriers and incentives that often exist for local engagement. While the research is still ongoing, her team has

found that numerous structural, informational, and behavioural barriers persist. For instance, poor internet and confusing or misleading information on the technology can reduce usage. They also identified gender differences – young males tended to have the most access to and use of mobile phones.

By better understanding these barriers, more adaptable solutions can – and are – being developed. Leila identified several traits for successful implementations. They were usually co-created with local communities and tailored to local contexts. For instance, the tools were available in local languages or using symbols where illiteracy was prevalent. Successful solutions were also introduced through existing, trusted systems such as local governments or service providers, for example digital mobile money applications. Critically, these tools empowered local leaders to communicate and advocate for the technology while sharing the benefits with the communities.

Adeboro Odunlami (Unsplash)

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**For more information, including eligibility,
please visit raeng.org.uk/frontiers and follow 🐦@RAEngGlobal**

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