Empowering Communities in the Global South
With Geospatial Technology for Sustainable Development
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SUMMARY
The past two decades have seen a revolution in the availability of geospatial technologies, internet connectivity, and innovative fit-for-purpose methodologies that are faster and more affordable for securing tenure rights. In addition to these advances, low-resource communities are increasingly adopting these technologies to document and manage their own land and resource rights. Furthermore, many governments are demonstrating increased political will toward working directly with communities and are taking the initiative to improve land administration systems to be more inclusive and accessible to vulnerable and marginalized communities. The convergence of these trends provides a unique window of opportunity to improve access to secure land tenure across the Global South at an unprecedented scale.

This paper details the role of communities as rights-holders and equal co-producers of knowledge in land administration processes and the need to strengthen the links between communities and governments to secure tenure. It highlights recent examples in which the Cadasta Foundation and its local partners took advantage of available fit-for-purpose approaches and technologies, government partnerships, and community empowerment strategies to access formal recognition of land and resource rights in Uganda, Kenya, and India.

1. INTRODUCTION

Cadasta Foundation is a leading global land technology and services platform. Its Esri-powered platform provides state-of-the-art software, tools, security, and services to support the documentation of land and resource rights to build stronger, more sustainable communities. To date, Cadasta and its partners have documented 6,379,371 people and 21,775,637 hectares in 46 countries. By 2040, Cadasta's ambitious goal is to catalyze land systems change, leading to inclusive land and resource rights for half the world's one billion tenure-insecure people.
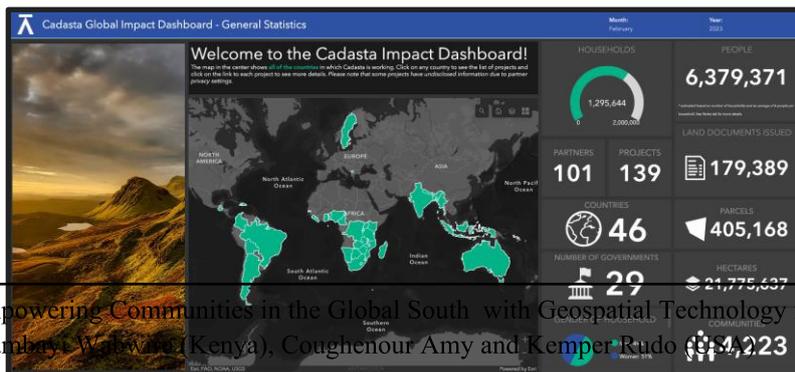
With advances in geospatial technologies, smartphone mapping applications, and growing connectivity, there has been a revolution in the democratization of technology

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that puts mapping tools in the hands of development organizations and local community members. At the backdrop of this revolution was the realization by industry experts of the need to innovate land administration practices in line with the joint 2014 FIG and World Bank Publication "Fit-for-purpose Land Administration" and the 2012 FAO Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests (VGGT). These guidelines called for the use of viable, practical solutions that are faster and more affordable in securing tenure rights while involving and recognizing communities as equal co-producers of knowledge in land administration, and more broadly, in sustainable development.

Although the land administration and development fields have recognized the importance of community buy-in to fit-for-purpose processes and shared power, there is more work to do to fully enable community members to take ownership of data creation and use—from mapping and documenting their own knowledge to better advocating for rights, to receiving titles for their lands, to managing community data for livelihoods, planning, land protection, and conflict reduction.

This paper highlights recent examples in which the Cadasta Foundation and its local partners took advantage of available it-for-purpose approaches and technologies, government partnerships, and community empowerment strategies to access formal recognition of land and resource rights in Uganda, Kenya, and India. Each case study summarizes the project overview and results, the technology approach, and how communities were engaged and empowered throughout the process.

1.1 The Global Democratization of Geospatial Technology for Local Communities

Historically, the implementation of geospatial technologies to conduct surveys or collect data for land administration was the domain of a select group of experts, typically trained in universities in the Global North. Although local users did not benefit from the same level of expert training, they are nevertheless a key player in the process—as experts in the local knowledge required for land demarcation and administration to successfully capture accurate customary land tenure of communities and avoid exacerbating conflict.

Low-resource communities are more able than ever to access data collection applications that capture geospatial coordinates from the device's built-in GPS. According to the 2022 Mobile Economy report by the mobile technology industry group, GSMA, 53% of the world subscribes to a mobile internet connection; in Sub-Saharan Africa, 50% of the population are mobile subscribers. In Latin America, this number increases to 69%. These adoption rates are poised to grow, and while there remain substantial gaps in access for the poorest sectors of the population, more and more communities across the Global South are connected.

Similarly, substantial advances have been made to make these tools easy to use, configure, and integrate with external services like dashboards and other data visualization and reporting tools that aid community and stakeholder understanding and use of data. Both open-source tools, such as OpenDataKit and KoboToolbox, among others, as well as commercially available solutions, such as Esri ArcGIS, Survey123, and Field Maps, are used by communities across

the world to map their lands and resources, increasingly with less involvement of land administration or geospatial experts once initial capacity is built to train local users on their use.

In addition to these trends, many governments are demonstrating increased political will toward working directly with communities and are taking the initiative to inclusively improve land administration systems. This provides a unique window of opportunity to improve access to secure land tenure across the Global South at an unprecedented scale.

2. CHALLENGES TO COMMUNITY IMPLEMENTATION OF GEOSPATIAL TECHNOLOGIES

While the revolution in geospatial technology has undoubtedly introduced numerous benefits for local communities accessing land administration services and tenure, notably, a substantial increase of autonomy and ownership over the mapping process, there are nevertheless challenges that must be overcome. Some of these are new challenges associated with novel technologies; others are more familiar and persistent, regardless of the technology of our day.

2.1 Risks of data loss. One of the great advantages of community access to geospatial technologies is that anyone can be involved in collecting or creating data on a smartphone or laptop. However, considerable risks are associated with data being stored on personal devices, such as damage, loss, theft of the device or the data, or accidental data erasure or corruption. Stories abound of harrowing experiences in the field when a device was found to be malfunctioning, data was accidentally wiped. This is true of any digital device, but much less likely to happen in the case of expert surveyors collecting data in the field. A similar set of risks may apply to community-operated geospatial database servers. Without the suitable IT infrastructure to back it up, the data is at a higher risk of cybersecurity threats, downtime due to improper configuration, or loss if the costs are not covered in the long term.

2.2 Sustainability beyond the project lifecycle. A common issue is that protocols for proper data storage and governance are generally developed for the project duration and rarely consider how data will be stored and accessed after a project has ended. This is especially
true for community-led mapping projects with limited resources to afford the proper digital infrastructure for long-term data storage and access. This may result in data being stored on external hard drives that eventually are lost, forgotten, or damaged.

2.3 Data quality assurance. While the fit-for-purpose paradigm has helped to alleviate some of the most onerous data and process requirements, there are issues of data quality assurance when community members are not properly trained on data collection protocols. Surveys submitted by community mappers may lack required information or accurate coordinates, or may duplicate mapping data, resulting in a high level of data validation work by persons with insufficient knowledge of how to make informed decisions on data cleaning and validation.

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These challenges can be abated to some extent by proper training, but nevertheless can easily occur throughout the mapping cycle.

2.4 Growing abundance of tools. Creating a multi-platform smartphone or desktop application is easier than ever, resulting in a proliferation of tools on the market. The numerous open-source and proprietary solutions available make it difficult for community members to assess which will best serve their needs and to keep up with the latest changes. Multiple tools are often used in one project, resulting in confusion or frustration if they are not easily compatible. The high rate at which tools are being developed also results in the rapid obsolescence of existing tools. Communities can end up with data collected on a tool that has been deprecated, requiring a time-consuming and costly data migration to another tool or platform.

2.5 Connectivity. As the geospatial field increasingly moves towards cloud-based solutions, acquiring and sustaining connectivity becomes even more important. While fully offline open-source tools exist, these tools tend to only work for data collection. To perform analysis or create data products, such as land tenure claims, interactive maps, or dashboards for advocacy, communities need reliable internet access.

2.6 Cost. The costs for doing field mapping are lower than ever but remain a barrier for many low-resource communities or organizations, particularly where additional equipment is required, such as a satellite WiFi connection or GNSS antenna. In addition, it may be necessary to obtain a laptop for the aggregation, cleanup, validation, and analysis of data. For the use of commercial products such as ArcGIS, there are licensing fees to consider, and even for free and open-source solutions, there are often hidden costs, such as secure cloud storage of data or the need for ad-hoc contracting support to build, customize, or troubleshoot the tools.

2.7 Legal requirements. Despite land administration and geospatial data reforms in many countries, there are still outdated, overly rigid and onerous legal requirements for accuracy, outputs (such as hand- or CAD-drawn sketch maps), and bureaucratic processes. In these cases, current technologies can ameliorate some of the time-consuming manual steps, but does not streamline the work enough to reduce the costs and time that would be needed to take titling efforts to scale.

3. THE UNIQUENESS OF THE CADASTA APPROACH

Cadasta's approach globally is to provide tools and services that are accessible, affordable, flexible, and meet the needs of government and civil society to close the land services implementation gap that prevents communities from receiving
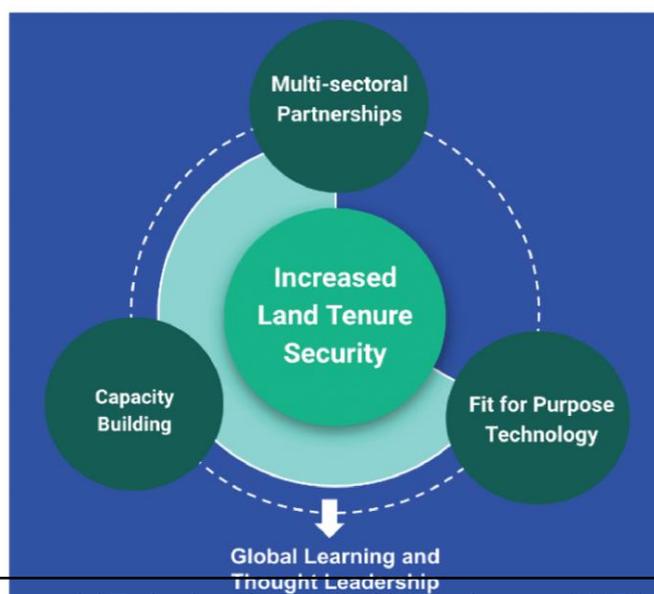
Figure 1: Cadasta's Approach to Increasing Land Tenure Security

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formal land tenure. Cadasta's interventions are tech-enabled, but they are not solely technology interventions. They also consider issues of social inclusion, technical quality, and sustainability. The approach integrates partnerships, technology, and capacity-building, leveraging Cadasta's expertise in fit-for-purpose land administration and the deployment of technologies to bridge the gap between community landholders and government land agencies and ensure both technical and community legitimacy. The following elements are central to Cadasta's approach:

3.1 Facilitating multi-sectoral partnerships. A core element of our strategy is to enable community engagement with the government to ensure that data collected by communities leads to increased tenure security. In Cadasta's experience, many governments across the Global South (local and national levels) are open to improving their land administration systems but often lack the human systems, or financial capacities to do so. Cadasta projects seek to maximize the impact of community-driven interventions by facilitating the technical processes, training, and joint collaboration that help ensure buy-in and capacity of the government to carry out their role.

3.2 Deploying Fit-for-Purpose Technology. Cadasta partners with stakeholders to select and deploy the technology tools most appropriate for the context and to design efficient and effective data models with workflows that speed up implementation and result in land document issuance. Cadasta works with tools that are easy to use and teach, economically viable, and sustainable. Activities directly reflect the community's objectives, requiring configuration for specific needs and tasks, including language localization, custom survey design, data models, and custom dashboards for communities to visualize data and monitor the impact communities want   to   achieve.

3.3 Building local capacity and participatory processes. Community members (as well as government stakeholders) are active participants in as much of the project cycle as possible, including awareness building, design, training, data collection, validation, and post-project data use. Training and technical support are critical to enabling stakeholders to take the lead before, during, and after the project. Cadasta utilizes a train-the-trainer approach that enables knowledge transfer so that partners and communities have the requisite skills to manage as many aspects of the technical solution as possible, decreasing dependence on Cadasta and enabling local stakeholders to use the technical infrastructure and data beyond the project cycle.

3.4 Fostering learning and thought leadership. Leveraging and sharing global best practices adds value to country-level efforts and strengthens knowledge-sharing across multiple disciplines and sectors.

4.   COUNTRY CASE STUDIES

4.1 Uganda Customary Land Registration. Cadasta started working in Uganda in 2018 under an agreement with the Ministry of Land, Housing, and Urban Development (MoLHUD) to provide fit-for-purpose technology and services to implement customary land regularization.

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The goal was to provide more efficient, cost-effective, and sustainable spatial and social data collection methods for legal Certificates of Customary Ownership (CCOs) that could be scaled across the country. Cadasta selected and trained a local civil society partner, Ujamaa Tribe, to lead local processes and serve as trainers to train land officials and community members to use the Platform and ensure social inclusion. To date, the project has delivered tenure rights for more than 30,000 rural Ugandans.

4.1.1 Project Overview and Results. Starting in 2019 in Buliisa sub-county, the project trained and supported the Area Land Committee (ALC) to demarcate over 250 parcels. The effort expanded to Namutumba District in eastern Uganda, where over 700 parcels were demarcated in the sub-counties of Ivukula, Nabweyo, Kibaale, and Nangonde, resulting in the government issuing over 600 CCOs. MoLHUD requested Cadasta's support for another three Districts (Maracha, Apac, Agago) covering six sub-counties in northern Uganda and demarcating over 4,000 parcels. To date, a total of 5,228 CCOs have been issued to over 30,000 Ugandans, the latest of which were presented to landholders by the President of Uganda, Yoweri Museveni, in a ceremony in September 2022.

4.1.2 Technology and FFP Approach. Cadasta worked with MoLHUD staff to determine the technical requirements for data collection and submission of applications for CCOs. The team developed a data model aligned with the ISO-compliant Land Administration Domain Model while emphasizing ease of access and use by community and government users. MoLHUD wanted to replace manual processes and have the ability to load high-resolution imagery and ortho-photos, work offline, use XLS forms, capture images, and store and analyze data for stakeholder communication and decision making. Using Field Maps and Survey123 for data collection, ArcGIS Online for data storage and management, and Dashboards for the monitoring and sharing of data, the users were able to speed up workflows to capture and process field data and easily store and visualize it. Especially important was the ability to work in rural areas with no internet connectivity.

Once the parcel and attribute data was captured and automatically uploaded to the Cadasta Platform, it was reviewed for accuracy, completeness, parcel overlaps, legal requirements, and conformity to the International Terrestrial Reference Frame (ITRF) 2005 standard. Data was displayed through maps for the applicants to review for confirmation and/or requests for amendment for a period of 14 days. Any adjustments were recorded, reviewed, and acted upon. Parcels were digitized with orthophoto-enhanced accuracy, and the final digital version of the dataset and certificates were submitted for final approval and processing by the District Land Board. Cadasta ensured that technical backstopping was available to assist with any technological challenges both on-site and through remote support.

Cadasta built a software integration using Geocortex to provide the government the ability to design, configure, and print the CCOs directly from the Platform.The final CCO shape files and scanned PDFs were submitted to the MoLHUD's Commissioner for Surveys and Mapping for integration into the National Land Information System (NLIS). This last step addresses an

important gap, since none of the CCOs previously issued over the last decade have been integrated into the NLIS.

4.1.3 Stakeholder and Community Empowerment. The project team trained local stakeholders—both local land agency staff and communities—on participatory mapping, the basics of Uganda's land laws, regulations, and policies; field data collection methods; the importance of capturing the rights of women and youth; and using the field apps and aerial imagery for data collection. Women and youth were encouraged to participate at all levels of engagement—in sensitization sessions, as community mappers, and as members of the data collection and oversight teams. Trainees were led through simulated data collection exercises using real-world examples, such as overlapping land claims, boundary disputes, inheritance disputes, and discriminatory practices.

Sub-county demarcation teams represented the Physical Planning Committee, the District Land Office (DLO), and customary land owners. They used participatory boundary delimitation techniques to reduce the time needed to solve boundary disputes and ensure all stakeholders are represented. The project team worked with stakeholders to create dashboards with maps and data on community perception of tenure security, demographics, landholdings, CCOs issued, and other data points that allow all stakeholders to view the project's progress and make decisions. These tools create goodwill and buy-in from all parties, allowing data sharing with the public while protecting landholder data privacy and security.

The project has not only resulted in the issuance of secure land tenure documents, but has also begun to improve and transform the land system and its services to be more efficient, affordable, and sustainable. MoLHUD has improved its practices and processes and has designed future interventions based on this successful work.

4.2 Forest People's Land Rights in Kenya. Cadasta started working on community land rights in Kenya starting in 2018 to support the work of local organizations in their documentation of customary lands. Cadasta supported communities through training and innovating a bottom-up approach for the documentation of community land claims in line with the laws of Kenya. Through training and offering simple-to-use technologies such as mobile phones installed with the Survey123 App supporting offline data collection, communities were empowered to document and make decisions about land rights. One such community was the Ogiek Community; The Ogiek People are a forest-dwelling, hunter-gatherer community that depends on the forest for its livelihood. They are spread across the expansive Mau Forest Complex in the Rift Valley and Mount Elgon in Kenya. Their history, from 1899 onwards, depicts systematic disenfranchisement of their land rights through a series of legal edifices aimed at "conserving the forest." The Ogiek people have often illegally been evicted from their homes in the forest, as explained in the Land Struggle Chronology documented by the Ogiek People Development Program.

A major milestone was winning the case against the government of Kenya at the African Court of Human and Peoples' Rights. in Arusha, Tanzania. The Court declared that the Ogiek People

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have the right to live in the Mau Complex as it is their ancestral land. At the height of the COVID-19 pandemic with government restrictions on movement, the Ogiek community living in Eastern Mau Forest Complex was evicted from their land under the government's guise of reclaiming the forest. Although they have won the Arusha case that ascertains their right to live and access forest resources—they had not demarcated their land or the full extent of their land knowledge. The uncertainty in the extent of the boundary opened them to conflict with the government and other communities encroaching in the forest. With the reduction of the forest due to human activities and climate change, the community claims were continuously shifting, and the extent of the forest could no longer be used as the boundary of their land.

With limited movement imposed by the government as the COVID-19 containment issues and a limited budget, the community needed to map their land claim for evidence and other purposes such as community registration. The mapping of the extent of the boundary offered an opportunity for the Ogiek people to build evidence on the extent of their land rights. It also marked the first step for them to register under the community land.

4.2.1 Project Overview and Results.
Cadasta tools and platform supported, cost-effective, quick deployment, documentation, and mapping of the Ogiek Community in East Mau within a month. A total area of 55,425 hectares was mapped and documented. The map produced was key evidence for Ogiek in laying their land claims at the historical land injustice workforce of the National Land Commission.

4.2.2 Technology and FFP Approach
The technology used by the community was required to be easily customizable, deployable, affordable to the community, and offer an accuracy of not less than five meters accuracy. Local community members used their mobile phones to collect the data, making the process affordable and easy to collect the data.

A key feature of the deployment of the geospatial technology was that community members were trained remotely to conduct the data collection. Community members owned the process from the start. The technology did not replace the established community processes of boundary identification but facilitated the community boundary identification process. The elders in the Ogiek community are the custodians of the boundaries. In deploying this technology, the youth data collectors relied on the local and institutional knowledge of the elders to mark their boundaries. The Platform offered a much faster and secure way to record and store the vital information by providing the capabilities of the communities to identify the georeferenced points for their land boundaries.

The technology also enabled the community to incorporate populations often neglected in community land documentation. The youth (male and female) offered the necessary skills needed to navigate through the technology, while the elders offered the much-needed local knowledge that is vital to the exercise.

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Because Cadasta focused on technology transfer and capacity-building, training and tools were delivered remotely, allowing the community to take full ownership of the data collection exercise. Youth data collectors were trained to use their mobile devices to collect boundary data, relying on village elders to identify the boundary points passed down through the generations.

Field Surveys

Field surveys were conducted using the Survey123 App installed on a mobile device and supported seamless and offline data collection. The form was designed to map the coordinates, capture the names of the places, and provide a digital picture of boundary points. To speed up the data collection exercise, the demarcation team divided themselves into groups consisting of youths and village elders for each village. Each demarcation team collected their respective village boundaries. This information was collected offline in the evening, and uploaded to the Cadasta platform once they were in a place with internet connectivity. To increase accuracy in data collection while offline, the imagery was prepared and shared in the device ahead of time, and the boundary data collected was overlaid in Google Earth imagery.

Map Creation and Export

The boundaries collected in the different villages were collated through the Cadasta Platform, creating a clear community map of the boundaries. A map was created and taken through a series of validation exercises at the village level to gather feedback and buy-in from the community on the map product.

4.2.3 Stakeholder and Community Empowerment

At the heart of the FFP implementation is the involvement and ownership of the community in the process and the products. Community members and other relevant stakeholders are equal producers and users of information, especially land rights data. The extent of the Ogiek land claims was known by the respective village elders who lived in different villages across the Eastern Mau. Training and technology offered to the data collectors, a critical element to enable

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community-led boundary collection. The map developed was taken through a validation process by the community and the Ogiek Council of Elders.

4.3 Mapping Land and Forest Rights in India. Since 2016, Cadasta Foundation has worked with 25 Indian organizations to map and document the rights of over 1.9 million people in urban and rural communities left out of formal land systems. Cadasta saw early success by providing its Platform to the award-winning Odisha Liveable Habitat "JAGA Mission" and Tata Trusts to document and issue formal land rights to one million slum dwellers in 1,725 informal

OGIEK COMMUNITY ANCESTORAL CLAIM IN EASTERN MAU FOREST
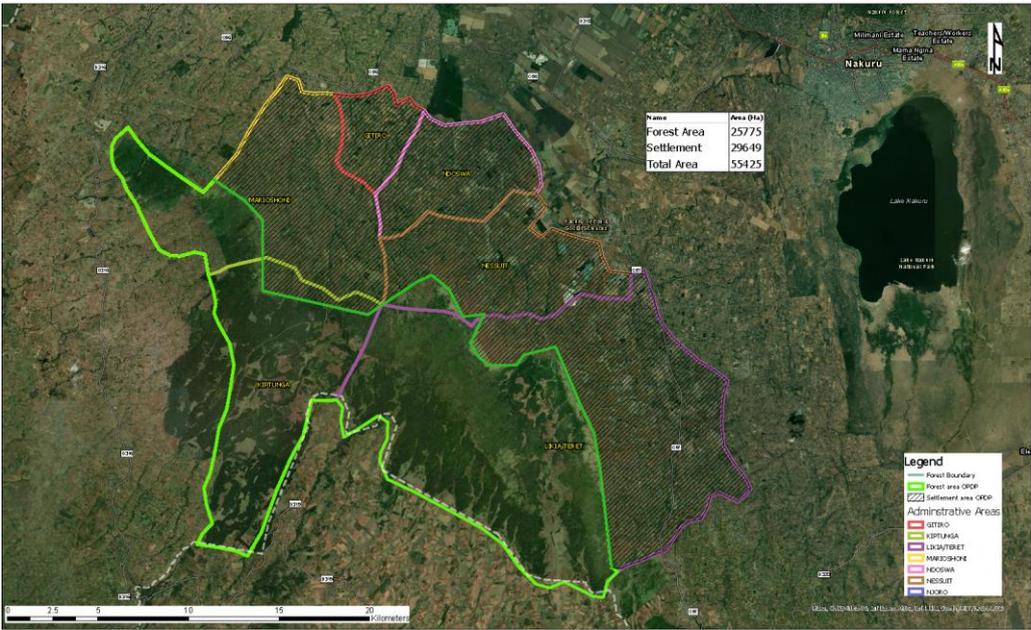
settlements across 30 districts. The project was awarded a Bronze World Habitat Award in 2019 and 2023 as one of the world's most "'innovative, outstanding and revolutionary ideas, projects, and programmes."

In the rural sector, the enactment of the Forest Rights Act (FRA) 2006 was a landmark legislation, opening a path toward the recognition of individual and community land rights of Scheduled Tribes and Other Traditional Dwellers (referred to as "Adivasi" communities) to receive Individual Forest Rights (IFRs) and Community Forest Rights (CFRs). However, implementation has been slow, with millions of communities still without entitlements to their traditional land holdings, contributing to high levels of tenure insecurity in rural India–71 percent, according to a 2019 Prindex study conducted by Gallup.

4.3.1 Project Overview and Results. Cadasta is working with three Indian nonprofit organizations—Pradan, ARCH Vahini, and Waatavaran—on projects to recognize and secure

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forest rights for tribal communities in Chhattisgarh, Gujarat, Jharkhand, Maharashtra, and Odisha states.

PRADAN: Starting in 2019, Cadasta partnered with the Indian NGO, Professional Assistance for Development Action (PRADAN) to conduct a pilot for data collection, mapping, and GIS analysis of approximately 1,400 forest-dwelling people in Jharkhand and Odisha States. Using the data collected with Cadasta's mobile tools and geospatial platform, two communities received government-recognized CFRs, allowing them to develop their own land use and management plans, governance processes, and local mechanisms for forest protection. Over 700 individuals received government-recognized IFRs, and with support from the International Fund for Agriculture Development, the effort was expanded to three additional villages in Odisha and Jharkhand, reaching 7,200 project participants.

Since this initial project, Pradan has expanded its coverage, adding Chhattisgarh state and reaching a total of 4,094 villages, in which 13,181 IFRs and 1,452 CFRs have been filed. Of these, 1,745 titles have been approved and 1,281 have been distributed, with 126,376 hectares of forest lands now secured for legitimate landholders.

An evaluation of the early Pradan pilot with Cadasta was conducted in 2020 by 60 Decibels to assess the impacts on landholders and data collectors based on user and landholder survey data. Cadasta performed well in reaching beneficiaries who live in poverty (91% of the participants) and positively impacting their lives: 83% of beneficiaries reported an improved quality of life; 85% reported an increased ability to protect rights; 82% said they feel more confident defending themselves if rights are challenged; 74% were less worried overall; and 58% felt they're less likely to lose their land now that it has been mapped and documented. Based on this successful work, Odisha State announced a bold expansion of forest rights in early 2023 called "Mo Jungle

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Jami Yojana," (forest land scheme), naming Pradan as one of three Indian NGOs able to implement these statewide efforts.

ARCH VAHINI: Action Research in Community Health (ARCH Vahini) is a nonprofit organization working in Gujarat. Starting in 2005, ARCH Vahini used Google Maps and a handheld GPS device to survey the land and mark the coordinates to establish community presence on the land in 2005, a requirement for rights recognition under the law. Starting in 2019, ARCH Vahini started partnering with Cadasta to improve the speed and efficiency of capturing and processing data for applications for IFRs and CFRs. Cadasta trained ARCH-Vahini team members on how to leverage its Platform, including the integration of satellite imagery, managing mapping operations, and creating dashboards and maps to share data with the communities. ARCH-Vahini trained forest rights committee members and village youth on the use of Cadasta's data collection tools, including Survey123 and Fieldmaps, who collected surveys of claimed lands which were then superimposed on 2005 satellite imagery to establish occupancy. These efforts led to the approval of 90% of land claims in the region. Based on this success, the state government has decided to adopt this method to examine 80,000 pending claims for the remaining 13 districts.

WAATAVARAN AND VIKAS SAHYOG PRATISHTHAN: Waatavaran is a social venture based in Mumbai, Maharashtra state, where 10 million tribal people live and earn their livelihood from forest-based activities, yet do not have the rights to their land. The Adivasis for Forests project secures land and forest rights for tribal communities in Raigad district, Maharashtra, with support from the Canada Funds for Local Initiatives (CFLI), NGO Vikas Sahyog Pratishthan (VSP), and Cadasta Foundation. The project documented 2,219 tribal families from 73 villages and applied for land ownership for 11,475 people supporting their livelihoods and the well-being of their families now and in the future.

4.3.2 Technology and FFP Approach. One of the common threads in these three efforts was the demand for a fully-integrated geographic information system (GIS) for offline, participatory mapping of community and individual forest rights, with clear data models and workflows to meet government requirements. This required in-person and remote training on data collection techniques and methodologies for their core staff and project teams, and support on effective training for community mappers. Cadasta's training included sessions on how to use the Platform tools for survey design, data collection, data visual
ization, map creation, and reporting. Cadasta provided data collection back-end support, a data repository, and ongoing remote technical support during field work and back-office data processing. The specific tools included the following:

Field Surveys: The first step of the process was to collect the geographical and demographic data of the land and its claimants using Survey123. Cadasta configured the tools and workflows to address the specific project needs. Creation of this data collection system goes through

multiple iterations to make it efficient, and easy to use by the community. Once the tools are deployed, training is conducted with the field team.

Data Management: Cadasta trained the partners on managing and understanding the data using dashboards and ArcGIS Online. This included **data monitoring** skills to use the Platform capabilities to conduct quality checks, periodic tracking, and progress validation and **data cleaning** to review the visible boundaries on satellite imagery in order to validate the mapped land parcels and make needed adjustments. Teams were taught the use of ArcGIS Pro and ArcGIS online depending on the project's needs.

Map Creation and Export: Cadasta trained the partners to use ArcGIS Pro to generate and export maps required for land claim submissions. This included importing historical maps, creating layouts, and inserting key information like coordinates and claimant details. The output generated through this exercise helped create a document with strong evidence of landholdings, which ensured smooth validation of the claims.

An external study of the Pradan case conducted by 60 Decibels assessed Cadasta's Platform through user surveys. The research found that 95% of data collectors reported that they could not find a good alternative to Cadasta, validating market demand, and that the tools were easy to learn and use and improved their work efficiency (95% of respondents) and their workflow processes (90%).

4.3.3 Stakeholder and Community Empowerment. Any effort to formalize community forest and land rights needs participatory community-level processes to verify and legitimize data and to link with government systems that formally recognize land and property rights. In all three cases, the partner organizations conducted systematic outreach with local communities to create

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awareness about forest protection and sustainable cultivation practices, their rights under the law, and the formalization process using technology.

Community members meet to discuss and make decisions about their forest rights in Raigad district, Maharashtra, India. Credit: Waatavaran

Each partner conducted visits to the villages to understand the community's needs and develop trust. This included personal interactions, focus group discussions, and Gram Sabha (Village Council) meetings. They provided extensive support to community governance, such as establishing or strengthening forest rights committees, forest or biodiversity management committees. Community capacity-building sessions covered the roles and responsibilities each committee plays and included women's voice and participation in all activities. They ensured that women's names were included on the forest rights titles as equal landholders–a life-changing measure that not only empowers a woman's decision-making over the land, but also supports her livelihood potential and improved health and educational outcomes for the entire family.

Source:waatavaran.in/for_adivasis/

All the partners developed and nurtured strong partnership with local authorities, including Gram Panchayat (local decision-making bodies), revenue and forest department offices, and sub divisional and district offices. In each case, Cadasta provided relevant, customized project support,

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technical assistance, training, and the GIS platform, including the use of multiple regional languages and the potential to replicate and scale the efforts. Project teams trained community members to use the offline mapping tools, satellite imagery, and survey methods to gather household and parcel data needed to claim land entitlements. The Platform also served to analyze, store and share critical land and resource rights information.

CONCLUSION

The past two decades have seen major advances in the democratization of geospatial technologies, internet connectivity, and land administration methodologies to reach vulnerable, low-resource populations with more secure tenure rights. Governments are opening the doors to more inclusive and accessible land administration systems that acknowledge rights-holders as equal co-producers of knowledge and partners in the wide scale formalization of land tenure. Examples from the experiences of Cadasta Foundation and its partners in Uganda, Kenya, and India demonstrate that by deploying partnerships, fit-for-purpose technologies, and building community leadership and capacity, there is an unprecedented opportunity to scale formal recognition of more equitable and sustainable land rights across the Global South.

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BIOGRAPHICAL NOTES

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Wambayi is a land administration professional providing support to Cadasta partners in East Africa in the documentation of land rights using Cadasta technology and approaches. Prior to joining Cadasta, he worked with governments, multinationals, and civil society groups in Kenya and South Sudan to secure land rights for pastoral communities, women, and youth. Wambayi holds a BSc in Land Administration from the Technical University of Kenya.

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Rudo develops, leads, and manages Cadasta's program strategy and implementation. He is a geographer and technologist with over a decade of experience supporting Indigenous communities in mapping and monitoring their lands, and building digital tools that increase community self-determination, access to land rights, and land management capabilities. His experience includes work with Indigenous and other local communities throughout the Amazon, Caribbean, North America, and East Africa. Prior to joining Cadasta, Rudo worked as Senior Programmatic Lead at Digital Democracy and as Mapping and Programs Support Manager at the Amazon Conservation Team. He serves on the board of directors of Native Land Digital, the International Society for Participatory Mapping, Terrastories, and on the circle of advisors for the Seeds of Wisdom Foundation. He holds a graduate degree in anthropology from the University of North Carolina at Chapel Hill and a graduate degree in international administration from the University of Miami.

Amy Coughenour Betancourt, Chief Executive Officer, Cadasta Foundation
Amy is a transformational social sector leader who has led Cadasta's strategy and organizational growth since June 2018. She is a frequent global speaker and writer on the use of geospatial technology to achieve the Sustainable Development Goals; women's land rights and sustainable food systems; community land tenure and climate; and community data empowerment to address development challenges. Prior to Cadasta, Amy was the Chief Operating Officer of International Programs at the National Cooperative Business Association (NCBA CLUSA); the Deputy Executive Director of the Pan American Development Foundation; the Deputy Director and Adjunct Fellow of the Americas Program at the Center for Strategic and International Studies. She holds an M.A. in International Policy Studies from the Middlebury Institute of International Studies and a B.A. in German from Central College. Amy serves on the Executive Board of How Women Lead's Washington Capital Area; and Manna Food Center; and previously served on the Board of Interaction, the largest U.S. coalition of humanitarian and development NGOs.

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