Historical Layers as Added Value: Integrating Geo-Historical Archives into Digital Cadastres in the Global South

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Key words: land administration, digitisation, geo-historical archives, digital humanities, Global South

Abstract

Land administration in the Global South increasingly relies on digital cadastres and land information systems (LIS) to deliver secure, inclusive, and transparent land rights. Yet, many of these systems start from a fragmented or incomplete documentary base. This paper explores how historical geo-relevant archival material—maps, title deeds, survey records, and related documents—can serve as a critical, value-adding layer in building and improving digital land administration systems.

The research, conducted under Kadaster International, investigates the proposition that digitising and integrating such historical sources can accelerate land rights registration and enhance inclusivity, particularly where colonial and post-colonial records remain the only surviving evidence of ownership or tenure. Drawing on interviews with digital humanists, economic historians, and cadastral experts, and supported by case examples from Africa, Asia, and the Caribbean, the study situates this work within the broader "spatial turn" and emerging "historical turn" in land administration.

Collaboration between land administration authorities and digital humanities groups emerges as the missing link in current digitisation efforts. While digital humanists and cultural heritage institutions have advanced techniques in digitisation, metadata structuring, and visualisation, cadastral organisations bring expertise in spatial data management, quality control, and land governance frameworks. Bridging these domains could unlock new co-financing opportunities—from cultural heritage funds to development banks—while producing interoperable, context-rich digital archives that support both governance and research.

The paper outlines a conceptual and methodological framework for assessing, digitising, and integrating historical materials into modern cadastres. It stresses the need for critical source evaluation, especially of colonial records, and highlights the potential of AI and deep learning to extract structured spatial information from legacy maps.

By linking digital cadastres to digital humanities initiatives, the project envisions a fit-for-purpose, historically grounded digital land administration model that strengthens land rights, preserves cultural heritage, and contributes to the UN Sustainable Development Goals. The paper concludes by proposing a collaborative "toolbox" for institutions in the Global South to identify, assess, and digitise geo-historical materials—transforming archives from passive repositories into active instruments of land justice and development.

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1. INTRODUCTION

Land administration in the Global South increasingly relies on digital cadastres and land information systems (LIS) to deliver secure, inclusive, and transparent land rights. Yet many of these systems are built on a fragmented or incomplete documentary base. Kadaster International (KI), the international consultancy branch of the Dutch Land Registry, is investigating a new proposition: the systematic use of geo-relevant historical archive material as an additional source for setting up and improving digital land administration systems in countries where KI is active (Rodima-Taylor, 2021).

Relevant geo-historical archive material consists of cadastral maps, title deeds, survey records, and related documents pertaining to land rights. In many countries of the Global South, these sources remain undigitised, and in some cases the cadastral archive itself exists only on paper. Digitising both the organisation's own archives and supplementary historical sources from other repositories can contribute to faster and more inclusive land rights registration. However, achieving this requires interdisciplinary collaboration between cadastral organisations and the fields of history, digital humanities (DH), and digital cultural heritage—a collaboration that is currently almost non-existent (Zaagsma, 2023).

This paper presents the findings of an exploratory study that investigates to what extent digitisation and integration of geo-historical archive material can contribute to strengthening land administration. It addresses which types of archive material are relevant, where they can be found, what technical requirements exist for their digitisation, and what collaborations are desirable to make these sources accessible. The study is based on a literature review supplemented by interviews with researchers and curators from various disciplines, and it proposes a conceptual and methodological framework—a collaborative "toolbox"—for institutions in the Global South to identify, assess, and digitise geo-historical materials.

The Netherlands and the Dutch government are recognised by the OECD as pioneers in protecting and developing civil society in combination with embracing digital technology (OECD, 2025). This progressive stance, combined with Kadaster International's longstanding commitment to the motto "land rights for all" and the achievement of the Sustainable Development Goals (SDGs), provides a natural basis for the development of this new proposition (FIG Task Force on FIG and SDGs).

2. THEORETICAL FRAMEWORK: THE SPATIAL AND HISTORICAL TURN

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In recent decades, a "spatial turn" has been taking place within the humanities and social sciences. Geographical data is increasingly used to analyse social and historical phenomena, enabled by digital technology such as Geographic Information Systems (GIS). Simultaneously, the interdisciplinary field of digital humanities has emerged, applying digital technology to traditional research in the humanities, or conversely, using traditional humanistic inquiry to interrogate digital technologies (Zhang et al., 2024). A related sub-field, digital cultural heritage, focuses on digitising heritage materials to enable new research connections and to ensure preservation for future generations.

Bodenhamer et al. (2010) refer to the intersection of these fields as "spatial humanities" and observe that concepts such as the spatial component and enriched databases are central subjects of research, with strong links to visualisation and image sharing. The spatial turn is confirmed in practice by researchers at various institutions. At the University of Groningen, the Geodienst supports spatial research across faculties, while researchers such as Ryan and Bolt are heavy users of digitised map material for research into gender equality and economic history, respectively.

These developments open opportunities for collaboration between academic institutions and implementing organisations such as land registry services. Digitised historical maps and deeds are, within such collaborations, obvious relevant sources for reconstructing land rights, provided they are carefully analysed and subject to rigorous source criticism. All faculties, departments, and scientific institutes that are putting the spatial turn into practice are potential discussion and collaboration partners for land registries around the world—land registries that may have a growing interest in the historical context: a possible "historical turn" in the world of land administration and cadastres. The spatial turn in the humanities can thus be deepened and broadened by this historical turn in the domain of land administration.

3. METHODOLOGY

This study adopted an exploratory, qualitative research design combining three complementary approaches. First, a comprehensive literature review was conducted, covering academic publications and grey literature on the digitisation of historical archive material, the spatial turn in the humanities, and the intersection of digital heritage with land administration. Second, semi-structured interviews were held with scientists, researchers, and curators from multiple disciplines, including digital humanities, economic history, international relations, archival science, and cadastral surveying. Interviewees included Professor Jaap Zevenbergen (University of Twente, ITC Faculty), Dr Caitlin Ryan and Professor Jutta Bolt (University of Groningen), Dr Marco van Egmond (Utrecht University), and Dr Wolfgang Göderle (University of Graz). Third, a technical review was conducted of the hardware, software, metadata standards, quality control protocols, and archiving structures currently available for digitising geo-relevant historical archive material.

The research focused explicitly on paper archival material, because its shelf life is under greater pressure due to the lack of ideal storage conditions in many countries of the Global South, creating a real risk that valuable information may be permanently lost. While the preservation of "digital born" archival material is also a relevant concern, the emphasis in this study lies on the far larger volume of paper-based sources that have not yet been digitised.

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4. FINDINGS

4.1 Availability and Location of Geo-Historical Archives

An immense volume of historical material is stored in archives around the world that can provide insight into previous ownership situations and plot boundaries. This material includes cadastral maps, title deeds, large-scale topographical maps, smaller-scale topographical maps, orally transmitted descriptions of ownership situations or legal constructions, and aerial photographs. Such material can supplement missing data in a new digital cadastre: it may contain boundaries that have remained stable, indicate previous ownership situations, or provide landmarks for geo-referencing. In some cases, it includes textual descriptions of plot boundaries and ownership data as they applied to indigenous populations.

Like the archives held by national mapping agencies, this material is subject to extreme conditions of heat and humidity, particularly in tropical regions. There is a real danger that valuable supplementary information will be lost. In the countries of the Global South, the vast majority of relevant information is still available only in paper archives, both older and more recent sources. In some places, only paper archives remain in use to this day. The European Union recognises the digitisation of cultural heritage, including archives, as economic activity that adds value—a position in sharp contrast to, for example, the African continent, where few funds are available and priorities for digitisation lie elsewhere (Zaagsma, 2023).

Much of the geo-relevant historical material is found in the archives of former colonial powers. The National Archives in The Netherlands and the British Library in Great Britain are prominent examples. In Indonesia, there is a wealth of material from the Dutch colonial period scattered across various archives. The same applies to India and British Africa, where local archives contain substantial material while British archives hold maps and deeds with valuable information about historical property rights and boundaries. In other parts of the world, including Asia and South America, hand-drawn maps with plot boundaries and deeds with property information are stored in archives spanning both the colonial and post-colonial periods. Until the 1960s, 1970s, and 1980s, maps and deeds were produced that are not available digitally; in some countries, paper archiving is still the norm. Together, these scattered sources form a network of invaluable information that is not yet accessible, visible, or connected. Rapid and efficient digitisation can partially unlock and connect this network, thereby contributing to more land rights for citizens, better insight into historical land use, and ultimately greater prosperity and equality.

4.2 Assessment of Usability and Relevance

Not all historical material is automatically suitable for inclusion in a database that underpins land rights. It is essential to determine suitability quickly and with authority. For many areas in the Global South, the colonial period was the first time that a wealth of map material was produced and preserved. Archival material from this period requires a critical approach. As Zevenbergen observed in an interview: colonial maps were, by definition, instruments intended to consolidate power. Ryan cautioned similarly that such material was not intended to protect the rights of indigenous populations, and pointed to the importance of the "silence of the archives"—the question of why material is absent and what gaps in the archive signify. She

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cited the example of Liberia, where entire sections of property rights archives were destroyed during the rise to power of dictator Charles Taylor.

Bolt, however, offered a more nuanced perspective. Her research on the stability of borders in British Africa, conducted in collaboration with the London School of Economics, concluded that boundaries at the national and municipal levels have remained surprisingly stable over the years—despite having been created to consolidate colonial power. This suggests that much of the material, down to the plot level, can be useful. The silence of the archives also extends to the absence of women, indigenous peoples, and farming communities from official records—precisely the groups for whom land rights registration is now most critical.

Critical source assessment—evaluating both the gaps in the archives and the available material—must always precede the digitisation process. In addition to assessing intrinsic value, factors such as collective memory, customary law, continuity in governance, official language, and border stability play a role. Old cadastral maps, even if no longer in use, remain valuable sources for understanding social and economic changes in land use and ownership, particularly when digitised, geo-referenced, and combined with topographical maps (Femenia-Ribera et al., 2022). Only after this assessment phase can the available information be properly integrated into a land administration system that can develop towards maturity.

4.3 Digitisation Practices and Project Examples

Multiple academic researchers confirmed extensive project experience with the digitisation of historical archive material. Ryan and Bolt have both been involved in projects digitising maps and other material from Africa, sourced from the British Library and local archives. Van Egmond is involved in projects such as OldMaps Online and Allmaps and has worked extensively with the David Rumsey Historical Map Collection. These digitisation projects range from individual scholarly initiatives to departmental projects in the context of research into gender equality or economic history, and were not established with the intention of improving a land registry.

A notable finding is the absence of international repositories that connect these disparate efforts. Projects are rarely linked, and scientists often independently develop methods for using stored spatial information, with minimal knowledge of the world of land registries. The technology used in both environments is similar, however: both academic and cadastral digitisation projects employ the same hardware and software. At the Dutch Land Registry, Hagemans and Florijn are global leaders in digitisation and the use of artificial intelligence as part of the Cadastral Map Next project (Hagemans et al., 2022). Kadaster International has extensive experience with projects in Armenia, Jordan, and Bangladesh in which digitisation of paper registries was a component of strengthening land rights.

Two case examples illustrate the potential for cross-domain collaboration. Sengupta et al. (2012) digitised a set of colonial maps around Haldia in West Bengal, India, to establish a Land Information System, supplementing the digitised maps with satellite images and GPS measurements. In Austria, Göderle et al. (2024) trained deep learning models on the nineteenth-century Habsburg Franciscan cadastre to extract large-scale data, enabling researchers to identify building locations in historical Styria and assisting government agencies in identifying culturally sensitive regions. These examples illustrate the mutual benefits of collaboration

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between digital humanities and land administration, as Bolt observed: digital humanists wish to use digitised cadastral material for research, while cadastral authorities in the Global South need knowledge and assistance with digitisation—an excellent basis for exchange.

5. TOWARDS A COLLABORATIVE TOOLBOX

Building on the findings, this study proposes a conceptual framework for a collaborative "toolbox"—designated the Historical Geo-Information Integration Method (HGIIM)—designed to support institutions in the Global South in identifying, assessing, and digitising geo-historical materials for integration into digital land administration systems. The toolbox is structured in four phases.

Phase 1: Research, Assessment and Planning

The first phase involves systematic research into available historical source material, including historical cadastral maps, surveying registers, field books, sketches, and current valuable source material such as existing GIS datasets, topographical maps, and aerial photographs. Inventories are conducted on location and at external institutions using established archival research methods. Assessment of the material employs standardised assessment forms covering provenance and dating, physical condition, format, content relevance for cadastral purposes, and juridical and contextual value. A project scope calculator assists in estimating time, costs, and capacity based on archive volume, physical state, and required processing steps.

Phase 2: Partnership and Funding

The second phase focuses on establishing partnerships with national archival services, universities and research institutes, international organisations such as UNESCO and the World Bank, and specialised heritage organisations. Funding sources include international heritage funds, EU programmes, development banks, and national government programmes. Crucially, bridging the domains of land administration and digital cultural heritage opens access to co-financing opportunities from donors that support digital heritage preservation—funds that would otherwise not be available for cadastral purposes.

Phase 3: Digitisation and Processing

The third phase encompasses the actual digitisation and data processing workflow. A digitisation hardware package may include mobile document scanners for fragile paper, large-format camera systems for oversized material, multispectral imaging technology for faded or damaged documents, and calibration tools. A GIS-ready software suite supports historical geo-referencing, extraction of potential cadastral ownership boundaries through AI-based solutions, OCR and handwriting text recognition, and document management. AI processing modules for handwriting recognition, boundary detection, metadata extraction, and data validation are integral components of this phase. The processing sequence follows three steps: digitisation, processing and analysis (OCR/AI), and GIS visualisation and integration.

Phase 4: Evaluation and Adjustment

The final phase involves evaluation of quality, completeness, and applicability of the results. Where necessary, processes are adjusted for subsequent projects. The toolbox is accompanied

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by a handbook covering implementation guidelines, case studies, contextual research templates, stakeholder engagement, juridical frameworks, and training and knowledge transfer modules including technical training, historical context modules, and sustainable management guidelines.

6. ANALYSIS AND DISCUSSION

Linking digitised archive material to modern cadastral data can lead to faster development of a Land Information System (LIS), better historical substantiation of land rights, and a more inclusive land administration that takes into account the rights of indigenous groups and women. At the same time, geo-relevant historical archive material must be handled with care when the aim is to use it for land rights registration. Certain groups lack representation in official sources; colonial data are inherently biased; gaps in the archives require careful interpretation; and periods of data overload have their own contextual background. These considerations must always be taken into account in the assessment process.

Collaboration between land administration authorities and digital humanities groups emerges as the missing link in current digitisation efforts. While digital humanists and cultural heritage institutions have developed advanced techniques in digitisation, metadata structuring, and visualisation, cadastral organisations bring expertise in spatial data management, quality control, and land governance frameworks. Bridging these domains could unlock new co-financing opportunities—from cultural heritage funds to development banks—while producing interoperable, context-rich digital archives that serve both governance and research objectives. The Lindner et al. (2023) SmartLandMaps approach for participatory land rights mapping further demonstrates that innovative, technology-driven methods can complement historical source integration in inclusive land administration frameworks.

The potential of AI and deep learning to extract structured spatial information from legacy maps, as demonstrated by Göderle et al. (2024), suggests that technological advances are making the large-scale processing of historical materials increasingly feasible. Combined with a fit-for-purpose approach—as Zevenbergen emphasised: when only limited material is available, it is better than nothing—the integration of historical layers into digital cadastres can significantly accelerate land rights registration in the Global South.

7. CONCLUSIONS AND RECOMMENDATIONS

The preliminary conclusion of this research is that carefully selected and critically assessed geo-relevant archive material can contribute to accelerating the establishment of land registries and land administrations in the Global South. However, simply including any available data in a LIS is not sufficient—not even when funds or donors are available. A thorough assessment of the data must first be conducted, and this assessment must be embedded in the methodology so that a clear process is followed and no steps are omitted.

It is strongly recommended to seek and deepen cooperation beyond the boundaries of one's own field and region. Faculties, departments, and institutes in the Global North seek data for historical, economic, and social science research, while land registries in the Global South seek

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to expand their digital base to guarantee more land rights for citizens. This is where the win-win opportunity lies—an opportunity that can contribute to faster registration of land rights, economic development, and the preservation of cultural heritage. Through collaborations, funds can be tapped and donors identified who are willing to co-finance digitisation projects that would otherwise not receive support, enabling projects in the Global South to benefit from donors who support the conservation of digital heritage (Zaagsma, 2023).

By linking digital cadastres to digital humanities initiatives, this project envisions a fit-for-purpose, historically grounded digital land administration model that strengthens land rights, preserves cultural heritage, and contributes to the UN Sustainable Development Goals. The proposed collaborative toolbox—the Historical Geo-Information Integration Method—aims to transform archives from passive repositories into active instruments of land justice and development. In the next phases, the method will be further developed through partnerships between universities and archives, identification of suitable funds and development banks, and the development of a central, accessible repository for geo-historical cadastral material. It is also recommended that pilot projects be initiated to test the toolbox in practice.

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BIOGRAPHICAL NOTES

Durk Haarsma is The Historical Insights Architect, providing strategic historical policy advice. He works at the intersection of digital humanities, land administration, and specialised media. His research focuses on the digitisation of geo-relevant historical archives and their integration into modern cadastral systems in the Global South.

Paula Dijkstra As Director of Kadaster International, Paula collaborates globally to help secure land rights, empower communities, and support sustainable development through reliable geo-information. With a background in Social Geography and expertise in GIS and cadastre and land management, she is passionate about turning knowledge into impact. She currently serves as Co-Chair of the UN-GGIM Expert Group on Land Administration and as Chair of the FIG Task Force on the SDGs—roles that allow me to help shape global frameworks and foster meaningful change.

Claudia Lindner is Land Administration Advisor at Kadaster International with expertise in participatory land rights mapping and geospatial technologies for land administration. She has published on the SmartLandMaps approach for participatory land rights mapping and contributes expertise in spatial data management and inclusive land governance frameworks.

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