

The Contribution of ICTs to Securing Land Transactions and Reducing Land Conflicts: The Case of Cameroon

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Abstract

The administration responsible for land management often faces challenges such as land governance, land conflicts, the proliferation of slums, urban planning, insufficient resources, the lack of digitization of records, the absence of a clear land policy, insufficient information, and slow and complex procedures. This initial problem underscores the urgent need to modernize the administrative apparatus to restore user confidence. This article analyzes the contribution of Information and Communication Technologies (ICTs) to improving this sector. The methodological approach adopted is based on a mixed-methods analysis: a review of existing documentation combined with a qualitative survey of institutional stakeholders and users. The assessment reveals a gradual but difficult transition from an archaic manual system to a digitized land registry, often hampered by structural resistance and limited infrastructure. However, the results demonstrate that the integration of ICTs (land information systems, digital mapping, electronic archiving) allows for a significant reduction in processing times and improved traceability of land titles. The recommendations include the implementation of an integrated land information system, the digitization of land transactions, and the strengthening of the legal and institutional framework. The study concludes that while ICTs are undeniably a means of reducing conflicts, their effectiveness remains contingent on the reliability of input data and ongoing staff training.

Keywords

ICT, Land Tenure Security, GIS, Land Conflicts, E-Land

1. Introduction

The Cameroonian government, through the National Development Strategy 2030 [1] in Chapter 3, paragraph 202, concerning the structural transformation of the economy, intends to continue modernizing land and cadastral management. However, the Cameroonian land management system is marked by persistent challenges, notably insecurity in transactions and a high prevalence of land disputes. These problems are often exacerbated by cumbersome administrative procedures, a lack of transparency, and limited access to information. This leads to ineffective urban planning and development, hinders private investment, and causes economic and social disruption, among other things. Faced with these persistent challenges, Information and Communication Technologies (ICTs) are emerging as a potential lever for modernizing and improving land management. Their capacity to process, store, disseminate, and make information accessible quickly, transparently, and securely offers new perspectives. These perspectives make it possible to streamline land transaction processes and optimize mechanisms for preventing land disputes.

The central problem here is the insecurity of land transactions and the resurgence of land conflicts in Cameroon.

The question, therefore, is how the strategic and integrated application of ICTs can contribute to improving the security of land transactions and reducing the frequency and intensity of land conflicts in Cameroon?

The objective of this work is thus to evaluate the potential contribution of these ICTs to improving the security of land transactions and reducing land conflicts in Cameroon.

2. Land and ICTs Concepts

2.1. Land Concepts

This section explores the fundamental concepts of land, illustrated in **Table 1** below, in order to better understand the related issues.

Table 1. Land concepts.

N°	Designation	Definition
1.	Land Ownership	All property rights relating to a given piece of land [2]. In other words, it concerns the right to possess and enjoy, as well as the ability to dispose of, real estate, whether it be a house, an apartment, or simply a plot of land.
2.	Land Management	All the processes by which land rules and policies are implemented, applied, and managed in a way that promotes the efficient and equitable use of land [3].
3.	Land Conflicts	Disputes and litigation that arise between individuals, communities, businesses, or the State concerning the ownership, use, access, and management of land [4]. Managing these conflicts is crucial for ensuring the security of land transactions and preserving social cohesion.

Land conflict reduction refers to the set of strategies, mechanisms, and tools, including ICTs, aimed at decreasing the occurrence, intensity, and duration of disputes related to land ownership, use, and management [5]. Conflicts related to the commercial transaction of land rights in Cameroon have been recognized as potential sources of conflict between actors. Examples include double or multiple sales or leases of the same plot of land, opposition from rightful owners to the sale of family land, and disagreements over plot boundaries.

2.2. ICTs Concepts

This section explores the fundamental concepts underlying the study of the impact of ICTs on society and, more specifically, their potential application in land management. Understanding these theories is essential for analyzing how ICTs can influence the security of transactions and the reduction of land conflicts in Cameroon. **Table 2** below defines the ICT concepts applicable to land governance.

Table 2. ICTs concepts.

N°	Designation	Definition
1.	E-Governance or Electronic Governance	Refers to the integration of ICTs into a government's administrative processes. It aims to improve the efficiency and performance of public services by using these technologies to transform the internal processes of public organizations. E-governance thus enables a more integrated and continuous delivery of public services [6]. Applied to the land sector, it aims to modernize administration, improve access to information, simplify procedures, increase transparency, and strengthen stakeholder participation in land management.
2.	Digital Transformation	A strategic process that involves fully integrating digital technologies into all aspects of an organization. This includes modernizing processes, products, and operations to foster continuous, user-centered innovation. The digital transformation of the land sector in Cameroon involves the strategic use of ICTs to modernize land management, secure property rights, facilitate transactions, and improve conflict resolution.
3.	Securing Land Transactions	A process that aims to guarantee the security and transparency of land transactions [7].

2.3. Documentary Analysis

This involves reviewing existing land policies in Cameroon, case studies of ICT implementation in the land sector in other contexts (particularly African), and relevant academic literature on land management and ICT.

2.3.1. An Examination of Existing Land Policies in Cameroon Reveals Several Key Elements

- The legal framework: Cameroon has a legal framework governing land management, notably Ordinances No. 74-1 and No. 74-2 of July 6, 1974.
- Institutionalization: The institutions responsible for land management in Cam-

eroon include the Ministry of State Property, Surveys, and Land Affairs.

- Challenges: Major challenges include the complexity of procedures, corruption, and a lack of transparency in land management.

2.3.2. Case Studies of ICT Implementation in the Land Sector

Several African countries have implemented ICT solutions to improve land management, including [8]:

- Rwanda: Rwanda has implemented a digital land management system to improve land tenure security and reduce conflict [9].
- Ghana: Ghana has launched a land data digitization project to improve the transparency and efficiency of land management [10].
- Kenya: Kenya has developed an online land management platform, allowing citizens to view land information and submit applications online [11].

2.3.3. Relevant Academic Literature

The review of academic literature on land management and ICTs highlights several key points:

1) The importance of digitalization:

Studies highlight the importance of digitalization for improving the transparency, efficiency, and security of land management.

Louahem Redha and Touabti Imen Sourour [12] explicitly explore how the integration of new information and communication technologies (ICTs) into land management aims to achieve transparency in processes, particularly in the context of industrial land.

Hersperger, A. *et al.*, in a 2022 study, confirm this finding that the digital transformation of land administration is primarily driven by improving the efficiency of planning practices and increasing transparency. This provides a solid theoretical and empirical framework [13].

2) Implementation challenges:

The research identifies the challenges of implementing ICT solutions in land management, including issues of institutional capacity, financing and awareness.

The UN-Habitat (UN-Habitat) Handbook of Good Practices—Land Tenure Security and Access to Land provides operational guidelines for establishing cadastral systems in developing countries [3].

Hernando de Soto also explains why the absence of formal property titles hinders economic development [14]:

Étienne Le Roy, Alain Karsenty and Alain Bertrand (Ed. Karthala) [5] for their part, make a fine analysis which goes beyond the simple technique to understand why conflicts arise (customary law vs modern law).

3) The role of e-governance:

Studies show that e-governance can play a key role in improving land management by strengthening transparency, accountability and citizen participation.

Lemmen, C.H.J., van Oosterom, P.J.M., *et al.* explain the ISO 19152 standard,

which is the global standard for modelling a land database [15].

Shang, Q., & Price, A., meanwhile, analyzed in 2019 how blockchain is used in practice to prevent double selling and alteration of ledgers (examples in Georgia, Sweden, Ghana) [15].

The African Journal on Land Policy and Geospatial Sciences in 2023 remained focused on the application of these technologies in the African context, with the constraints of connectivity and governance [16].

4) Articles on Conflict Reduction and Governance

These works were necessary for the “Dispute Management” module of the architecture.

J. Zevenbergen & T. Burns, look at how to rebuild trust in the land registry after crises [17], while Philippe Lavigne Delville [18] makes a critical analysis of attempts at land registry in Africa.

5) Technical Standards and Norms (Essential for Architecture)

These standards are essential to prove the robustness of the solution:

- ISO 19152 (LADM): Regarding the data structure (Person-Right-Plot).
- OGC (Open Geospatial Consortium) Standards: For the exchange of map data (WMS, WFS) between the Surveyor module and the Citizen module.

3. Methodology and Tools

3.1. Presentation of the Proposed ICT Methodology

To facilitate understanding and analysis of the various ICT methodologies that can contribute to securing land transactions and reducing land conflicts in Cameroon, the following **Table 3** presents a summary of their main characteristics, potential advantages, and implementation challenges:

Table 3. Table of proposed ICT methodology.

N°	ICT Tool	Description	Advantages	Limitations	Examples of Use
1.	Geographic Information Systems (GIS)	Tools for mapping and spatial analysis for spatial management	Spatial visualization and analysis, informed decision-making	Technical skills required, high cost	Urban planning, natural resource management
2.	Online land management platforms	Online platforms for managing land data and transactions	Online access, transparency, data immutability	Data security and privacy, dependence on internet infrastructure	Property registration, land transaction management
3.	Blockchain technologies	Technology for secure and decentralized storage and transmission of information	Security, transparency, data immutability	Complexity, scalability, regulation	Secure property title registration, land transaction management

This table therefore allows for the analysis of the various ICT tools proposed for land management. Each tool has its own advantages and limitations and can be adapted to specific needs. GIS is useful for spatial visualization and analysis, online land management platforms offer online access and increased transparency, while blockchain technologies provide security and data immutability. However, an online land management platform can combine all these technologies.

3.2. Specifications for the Land Management Platform

As part of this work, we propose an online land management platform that could play a crucial role in securing land transactions and reducing land conflicts in Cameroon. To this end, we recommend integrating GIS and Blockchain according to the specifications we propose. These specifications aim to define the technical, operational, and security requirements and functionalities of a digital land management platform in Cameroon.

3.2.1. Context

Land management in Cameroon needs modernization to reduce conflicts and secure transactions. The online land management platform aims to improve transparency, efficiency, and security of land transactions.

3.2.2. Overall Objective

The main objective is to digitize land procedures, secure transactions, and reduce land-related conflicts.

3.2.3. Specific Objectives

- Securing land transactions: Establish a transparent and tamper-proof system for monitoring land transactions, from registration to transfer.
- Reduce land conflicts: Provide a single, accessible land database, thereby reducing disputes related to the double allocation of land titles or the lack of documentation.
- Modernize land administration: Simplify, speed up, and digitalize procedures for users and administration staff.
- Accessibility and transparency: Allow citizens to check the progress of their files and verify the authenticity of land titles online or in person.

3.2.4. Platform Features

a. Land Title Management Module

- Creation and registration: Module for registering new registration requests, with entry of land information (GPS coordinates, area), owner details, and legal documents (registration requisition, boundary survey, etc.).
- Transfer and change of ownership: Tool for tracking sales, donation, or inheritance transactions. The platform must automatically link the old property title to the new owner after the procedures are validated.
- Consultation and authentication: A search module allowing the verification of the existence and authenticity of a land title using its number or its geograph-

ical coordinates.

- Transaction history: Each land title must have an accessible history, tracing all previous transfers, mortgages, or disputes.

b. Dispute Management Module

- Conflict database: Module for recording complaints and land disputes, along with the associated supporting documents.
- Resolution tracking: Tool that allows the relevant services to monitor the progress of mediation or legal proceedings for each registered dispute.
- Conflict alerts: The system must be able to issue alerts if a transaction involves a land title that is under dispute.

c. User administration and management module

- Role and access management: Creation of user profiles with specific access levels (administrator, land officer, notary, surveyor, citizen, etc.).
- Dashboard: For each user, a dashboard displaying ongoing cases, notifications, and relevant statistics.
- Notifications and alerts: System for sending alerts via SMS or email to users at each stage of progress of their case.

To precisely meet the objectives of security and social peace, here are the detailed features of the platform, organized by module and target user. These features aim to address common problems: double selling, overlapping titles, administrative delays, and corruption.

1) Citizen Module (Transparency & Access)

These features allow the general public to verify information and track their cases without a dubious intermediary.

- Land Registry Search (e-Cadastre): Interactive map allowing you to view a plot, see its approximate boundaries, and check its status (titled, untitled, state-owned).
- Property Verification (e-Search): By entering a land title number, the system shows who the current owner is and whether the land is “free of encumbrances” (no mortgage, no ongoing dispute).
- Real-Time Case Tracking (Tracking): Progress bar (like for a package): File submitted.

➤ Boundary validated → Notice signed → Title available.

- Land Alerts System: An owner can subscribe to SMS/Email notifications. If anyone tries to make changes to their land title, they are alerted immediately.
- Online Tax Payment: Payment of property taxes via Bank Card or banking wallet services (Campost Money, Mobile Money, Orange Money, etc.) to avoid handling cash and bribery.

2) Technical & Surveying Module (Precision & Overlap Prevention)

It is the technical core for preventing boundary disputes.

- Submission of Digital Plans: Upload of topographic surveys (DXF/Shapefile files).
 - directly by certified surveyors.

- Automatic Overlap Detection (Overlap Check): Critical feature. Upon upload, the system compares the new coordinates with the existing database. If there is any overlap, even 10 cm, the system rejects the file and flags the potential conflict.
 - Mandatory Georeferencing: Automatic conversion of local coordinates to the global system (WGS84) to ensure location uniqueness.
- 3) Notarial & Legal Module (Transaction Security)
For notaries, lawyers, and banks.
- Drafting and Electronic Signing of Deeds: Generation of standardized sale contracts and tamper-proof cryptographic signing.
 - Title Locking: During a sale process or credit application, the notary can temporarily “freeze” the title to prevent the owner from selling it to a second person during the proceedings.
 - Mortgage Management: Automatic registration and cancellation of mortgages by banks (to prevent selling land that is pledged as collateral to a bank).
- 4) Administrative Module (Validation & Archiving)
For the MINDCAF staff.
- Digitization of Archives (OCR): Scanning old paper files (“Land Registers”) to make them accessible and indestructible (fire/flood).
 - Secure Approval Workflow: Each validation step requires strong authentication (biometrics or cryptographic USB key) from the government officer. We know who approved what and when.
 - Dispute Management Dashboard: A dedicated interface to record objections. As long as an objection is not lifted by a judge or an amicable agreement, the system technically blocks any transfer (sale/division).
- 5) Trust Module (Blockchain & Audit)
The system’s “black box”.
- Timestamping: Each action is permanently time-stamped.
 - Immutable History (Audit Trail): Ability to see the entire ownership chain of a property from its first registration (who sold to whom, and on what date).
 - Biometric Verification: During the signing of the final sales deed, the seller’s fingerprint is compared with the one recorded on their ID card to prevent identity theft.
- d. Security and Privacy Aspects
- Strong authentication: Implementation of a two-factor authentication system for agents and industry professionals.
 - Data encryption: All sensitive data (personal information, documents) must be encrypted, both in transit and at rest.
 - Regular backups: A backup and disaster recovery plan must be implemented to ensure the platform’s resilience.
 - Legal compliance: The system must comply with Cameroonian legislation regarding data protection and land transactions.
- It should be noted that Artificial Intelligence could be used to analyze land

data, identify areas at risk of conflict, optimize cadastre management, and improve decision-making.

Table 4 below summarizes and illustrates how these features reduce conflicts.

Table 4. Summary.

Type of conflict	Feature solution
Double sale	Land Title Looking + SMS Alert to Owner + Blockchain History.
Overlapping Land	Automatic Overlap Detection (the computer rejects the overlapping plan).
False owner	Biometrics + Online Property Verification before purchase.
Backdating of Documents	Blockchain Timestamping (impossible to say “I bought this yesterday” if the system records today).
Loss of file	Digitization + Online Tracking

3.3. UML Diagram

3.3.1. List of Use Cases

To illustrate the interactions between the actors concretely, **Table 5** lists the main use cases.

Table 5. List of use case diagram.

ACTOR	USE CASE/ACTION	DESCRIPTION
Citizen/ Applicant	Create an account	Register on the platform to initiate and track a transaction.
	Submit a land title application	Complete the online form and upload the initial documents (ID card, deed of sale, etc.).
	Track the application status	View the progress of your application in real time through the different stages.
	Pay fees online	Make secure payment of the application fees via electronic payment methods.
	Receive notifications	Be alerted by email or SMS at each key stage (validation, site visit, etc.).
	View the site plan	View the plot in question on an interactive map integrated into the system.
	Report a dispute	Initiate a dispute or conflict reporting procedure for a plot.
Land Surveyor	Upload the technical file	Submit the boundary plans, the boundary survey report, and the technical reports.
	Respond to requests for clarification.	Provide additional information if requested by the land registry officer.
	Validate the GPS location.	Confirm the exact geographic coordinates of the parcel in the system.
	Transmit the file to the Land Registrar.	Send the complete file with its technical opinion to the Land Registrar for a decision.

Continued

Notary	Authenticate the deeds of sale.	Verify the identity of the parties and certify the authenticity of the transaction.
	Upload the authenticated deed.	Add the notarized deed of sale to the digital file for consultation by the authorities.
Land Registry Officer	Verify the admissibility of the file.	Ensure that all initial documents are present, complete, and compliant.
	Review the technical file.	Analyze the surveyor's documents to guarantee their accuracy and compliance.
	Schedule the site visit.	Organize and notify the parties of the date of the site visit (site inspection).
	Publish the boundary survey notice.	Make the boundary demarcation notice public to gather any objections.
Land Registrar	Process the final file	Examine all documents, reports, and opinions to make a final decision.
	Manage objections	Process disputes received following the publication of the boundary survey notice.
	Approve or reject the application.	Validate the creation of the land title or provide reasons for rejecting the application.
	Sign and issue the land title.	Generate and digitally sign the title deed, making it official and enforceable.
	Update the land register.	Enter the new title deed into the central and immutable cadastral database.
Judge/Mediator	Consult a disputed case.	Access all documents in a case that is the subject of a legal dispute in read-only mode.
	Record a court decision.	Upload the judgment or mediation agreement that resolves the land dispute.
System Administrator	Manage user accounts	Create, modify, and suspend access for various system users.
	Perform maintenance	Carry out software and hardware updates and ensure platform availability.
	Monitor security	Monitor access, detect intrusions, and guarantee data integrity and confidentiality.
	Manage profiles and permissions	Define specific access rights for each type of user.

3.3.2. Interaction Sequence Diagram

Figure 1 presents the interaction sequence diagram of the Use Cases, detailing the exchange of messages between the actors.

3.4. The Tools Used

This section will describe the technological tools used in the context of this work.

Modelio: allowed us to model our UML analysis. It is an open-source modeling tool that specializes in model-based software and system development.

Vs Code: Visual Studio Code, more commonly known as VS Code, is a very popular and powerful source code editor developed by Microsoft. We chose this IDE (Integrated Development Environment) because it is lightweight and fast.

Node.js: It is an open-source, cross-platform JavaScript runtime environment.

React.js: It is an open-source, cross-platform JavaScript runtime environment.

Next.js: It is an open-source web development framework based on React.js, created by Vercel. It is designed to extend the capabilities of React by adding key features that make it easier to build production web applications, including improving performance, SEO, and the development experience.

Tailwind CSS: It is a CSS (Cascading Style Sheets) framework focused on utilities.

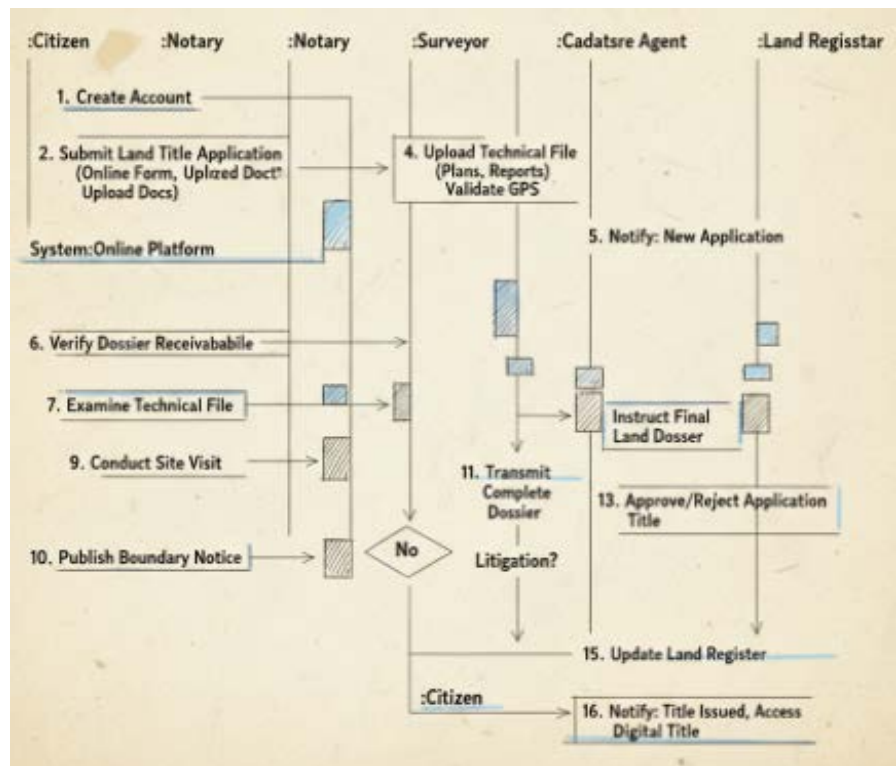


Figure 1. Sequence diagram.

3.5. Logical Architecture

For such a platform to be effective (real security and reduction of disputes), its logical architecture must be based on transparency, immutability (the inability to fraudulently alter the past), and interoperability (link between card and rights). We therefore propose a logical architecture structured in 5 layers (N-Tier), incorporating modern technologies like Blockchain for trust.

1) Presentation Layer (Access Channels)

It is the interface between the users and the system. It must be suited to the

different stakeholders.

- Public Web Portal: For citizens (checking the status of a plot of land, applying for a title, property verification).
- Professional Portal (Notaries/Lawyers): For registering sale deeds, mortgages, and legal checks.
- Mobile Application (Land):
 - For surveyors: GPS coordinate surveys, uploading photos of the site.
 - For government officials: Reports and inspections.
- Administration Interface: For MINDCAF agents (validation, archiving).

2) Security & Identity Layer (Gateway)

It's the "guardian". Before accessing the data, everyone must be formally identified.

- IAM (Identity and Access Management): Role management (Citizen vs Notary vs Admin).
- Strong Authentication (2FA): Biometrics or SMS to validate a transaction.
- Electronic Signature Service: So that contracts and plans have legal digital validity.

3) Business Layer (Application Services)

It is the "brain" of the system. It is divided into functional modules.

A. Cadastral Module (Technical & Geographical)

- GIS Server (Geographic Information System): Management of maps, terminals, and overlays.
- Overlap Detection: Critical algorithm. If a surveyor submits a plan that encroaches on an already titled plot, the system automatically blocks it (reducing conflicts).

B. Transactional Module (Legal)

- Validation workflow: Step by step (Request → Boundary marking → Public notice → Approval → Title).
- Mortgage management: Link with banks to block the sale of mortgaged land.
- Smart Contracts: Automation of property transfer once payment and approval are completed.

C. Dispute Management Module

- Objections' register: Allows a plot of land to be "frozen" in the event of a complaint being filed.
- History of mediations: Traceability of court decisions relating to this area.

4) Data Layer & Trust (Persistence)

This is where the added value for security lies. We use a hybrid approach.

- Relational Database (SQL): For user profiles, simple logs, legal texts.
- Spatial Database (PostGIS): To store land polygons (geographical coordinates).
- Blockchain (or Distributed Ledger—DLT):
 - Role: It is the "Digital Land Register".
 - Function: Each land title is a unique "token." Once registered, it is impossible to alter the history (remove a previous owner) without leaving a trace. This

prevents internal corruption (double selling).

- Proof storage: It stores the hash of the signed documents.

5) Interoperability Layer (API)

The system must not operate in isolation.

- Banking API: To verify tax or purchase payments.
- Civil Status API: To check that the seller is alive and is who they claim to be.
- Justice API: So that a judge can automatically record a decision (seizure, cancellation of a title).

6) Summary of the logical flow (Transaction example)

- Initiation: The notary initiates a sale through the Pro Portal.
- Auto Verification: The system checks the Blockchain to ensure the seller is the current owner and the Spatial Database to verify that there are no boundary disputes.
- Signing: The Seller and Buyer sign via the Security Module.
- Validation: The Land Registrar validates through the Admin Interface.
- Recording: The transaction is written into the Blockchain (immutable) and the new title is generated.

The synthesis of the components is illustrated in **Table 6** below.

Table 6. Summary of components.

Layer	Key Components	Objective: “Conflict Reduction”
Presentation	Mobile App, Web	Transparency: The citizen can check their land themselves.
Business	GIS, Overlap Algorithm	Technically prevents selling the same space twice (overlapping).
Data	blockchain Blockchain/DLT	Prevents tampering with historical records (backdating a title).
Integration	API Civil Status/ Justice	Verifies the real identity to avoid impersonation.

4. Proposed Solution and Recommendations

4.1. Platform for Securing Land Transactions and Reducing Land Conflicts

To design a credible platform, it is essential to rely on references that validate both our technological choice (Blockchain, GIS) and our sociological approach (conflict reduction).

4.1.1. Application Architecture

The solution is based on a modular and centralized architecture, structured around a secure application path, as described below in **Figure 2**.

4.1.2. Land Dispute Management Diagram

Figure 3 below illustrates an example of a class diagram: the case of land dispute management.

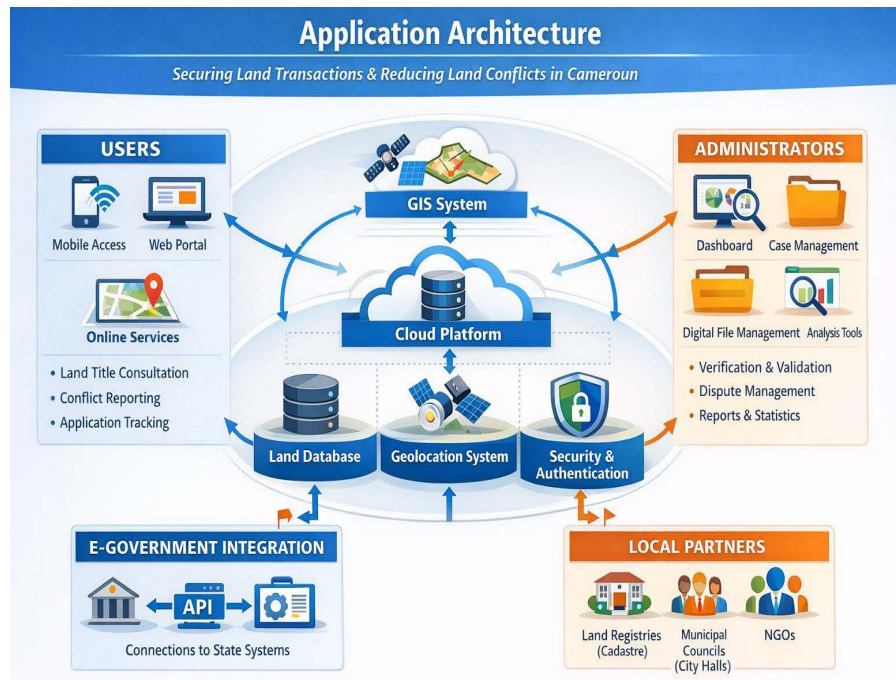


Figure 2. Application architecture.

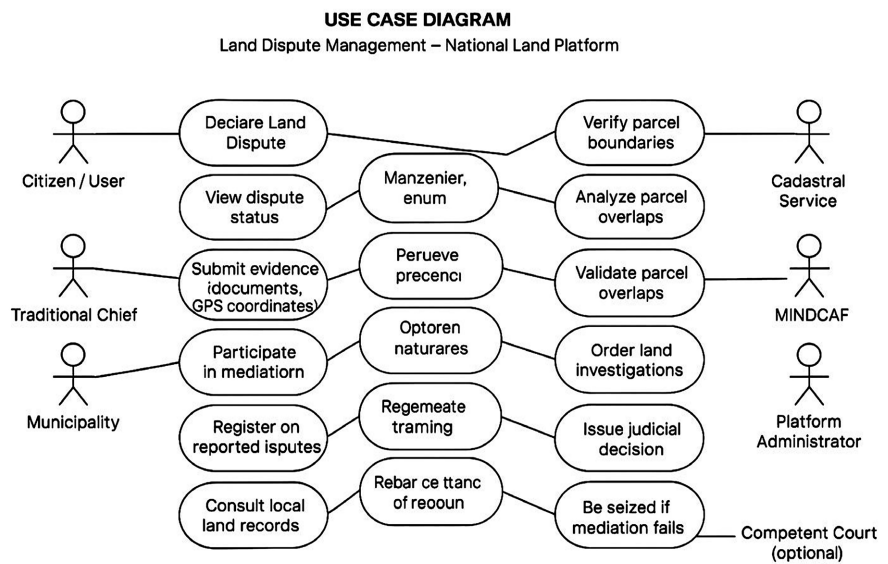


Figure 3. Use case diagram dispute management.

4.1.3. UML Class Diagram: Land Dispute Management

Figure 4 below illustrates an example of a class diagram: the case of land dispute management.

4.1.4. Some Screenshots of the Platform

Figure 5 below presents the SecureLand platform’s citizen dashboard, designed to offer users simple, fast, and transparent access to land services. This interface brings together key features such as consulting the electronic land registry, verifying ownership, tracking cases in real time, paying taxes online, and the land alert

system. It thus allows citizens to monitor their land transactions and stay informed about the progress of their cases securely.

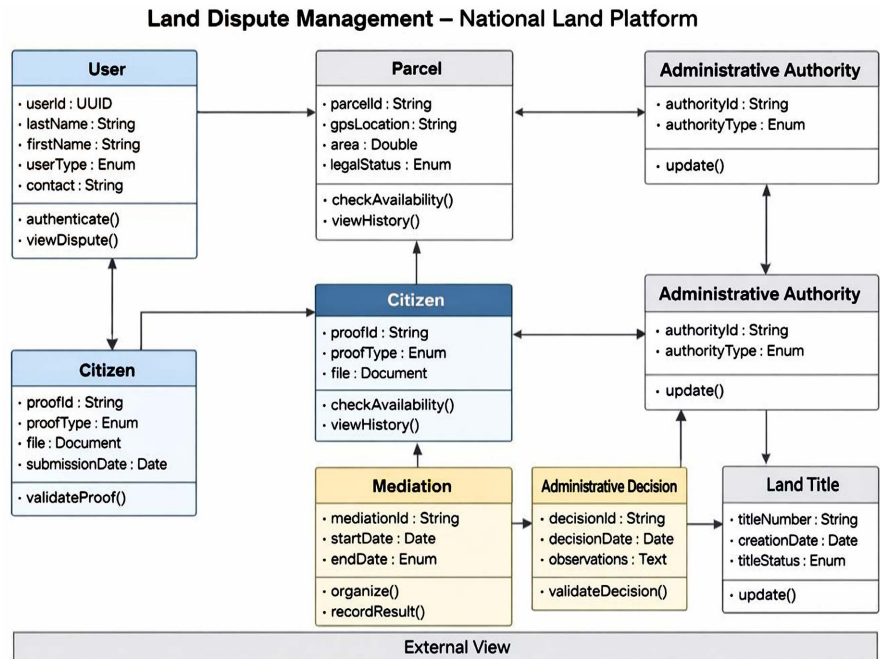


Figure 4. UML class diagram: Land dispute management.

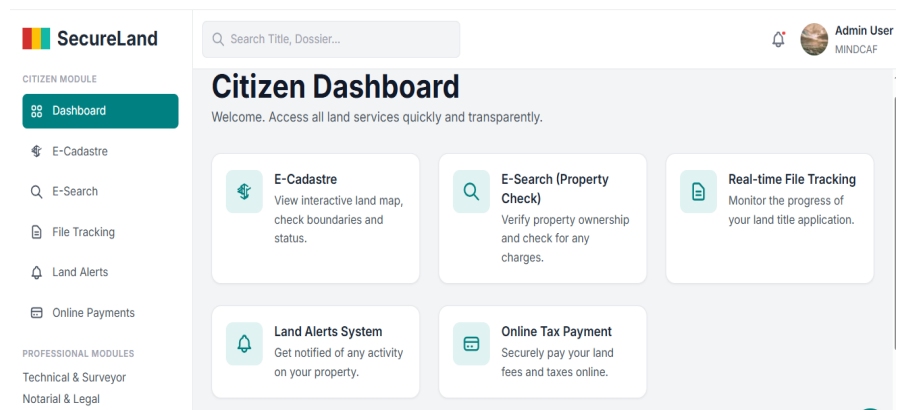


Figure 5. Dashboard.

Figure 6 below illustrates the E-Cadastre—Interactive Map module of the SecureLand platform, dedicated to consulting and visualizing land information. This interface allows users to search for a parcel by its identifier or location, explore the different cadastral layers (titled parcels, state-owned land, parcels undergoing processing), and interact with the map using the navigation tools. This module is an essential tool for transparent, secure, and structured access to land data.

Figure 7 below illustrates the user interface of the case tracking module. This page allows users to view the real-time progress of their property title application simply by entering their reference number.

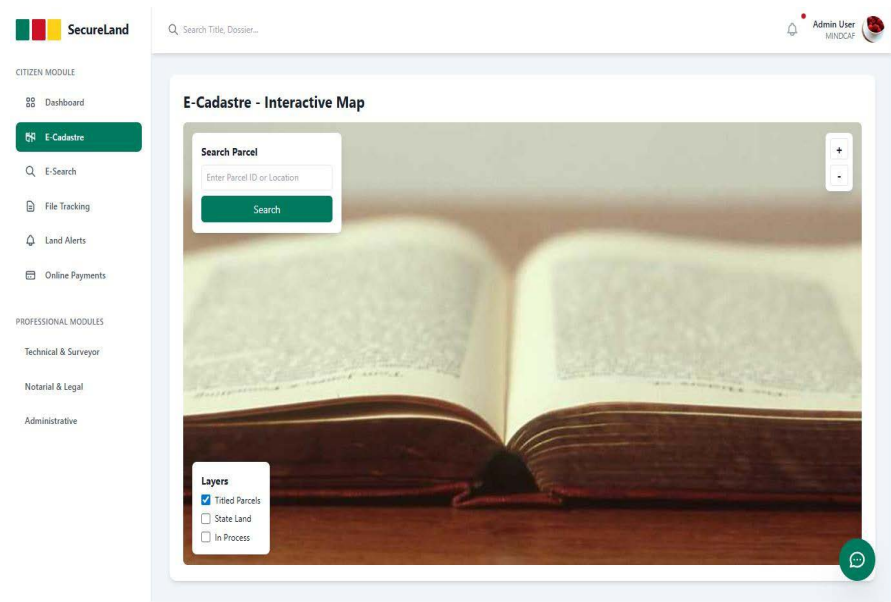


Figure 6. Cadastre management.

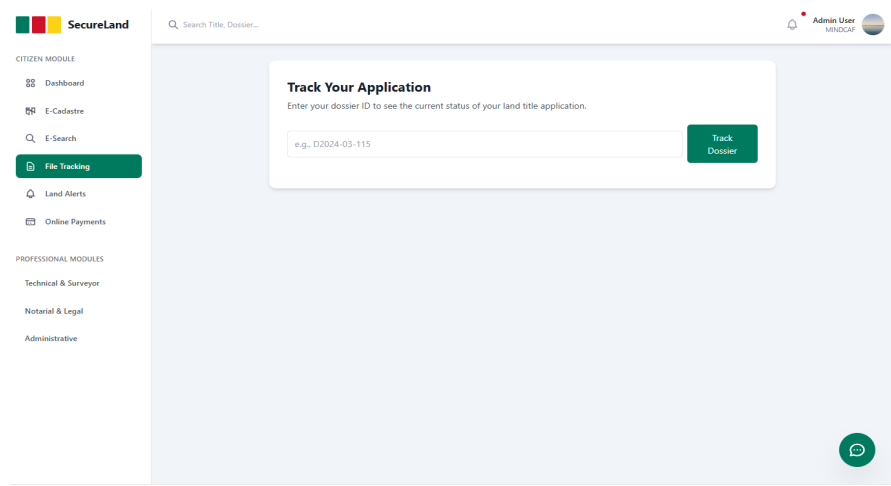


Figure 7. Case tracking.

To secure real estate transactions, the platform integrates a verification module called “E-Search”. As illustrated below in **Figure 8**, this tool confirms the identity of an owner and the legal status of a plot of land based on its title deed number.

In addition to consultation, the Secure-Land platform includes a critical dispute management component. As shown in the interface in **Figure 9** below, the “Land Dispute Management” module centralizes filed complaints, allowing for rigorous monitoring of the status of each dispute, whether it is open or in mediation.

Once logged in, the user accesses the alert system as illustrated in **Figure 10** below. This interface centralizes access to key services such as the E-Cadastre, case tracking, and online tax payment.

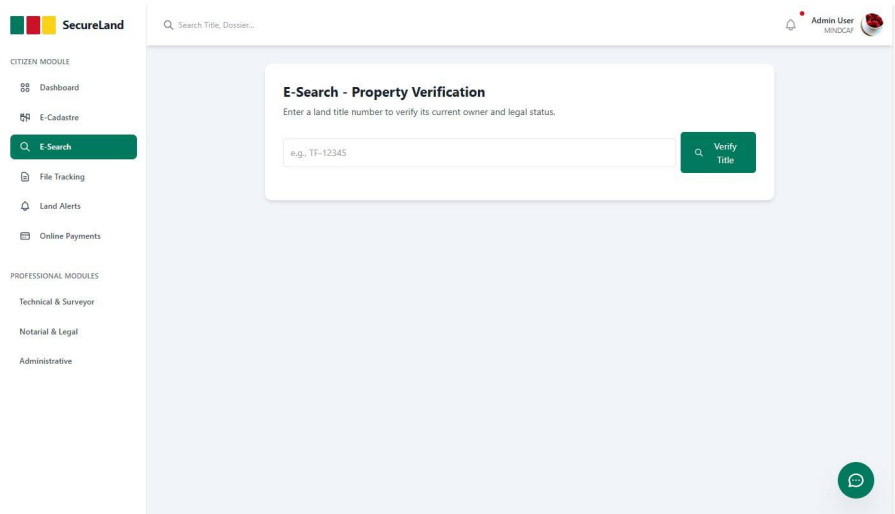


Figure 8. Search.

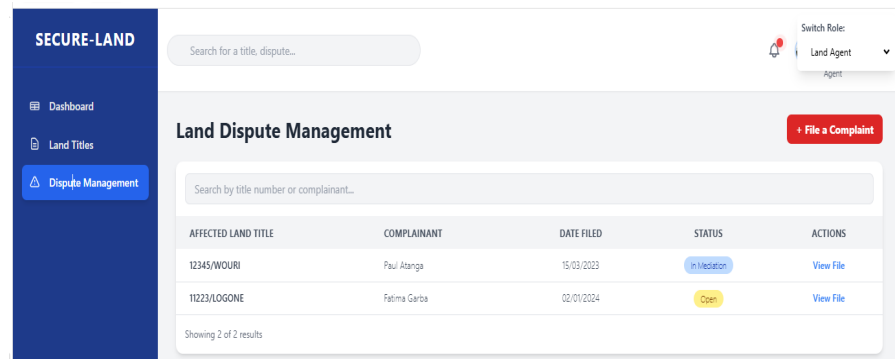


Figure 9. Land dispute management.

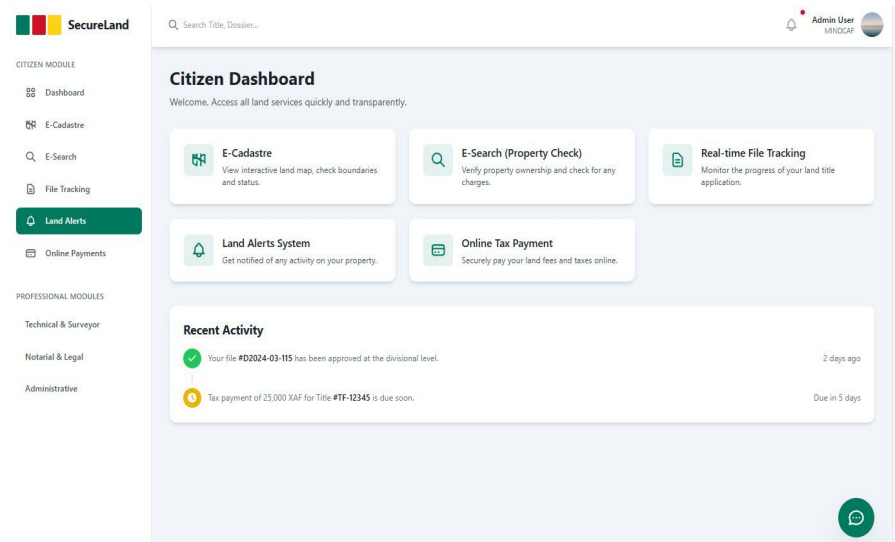


Figure 10. Alerts.

For administrative services, the platform offers a consolidated view of the land database. As illustrated in **Figure 11** in the following screenshot, the management

interface allows users to track the history of each plot, identify titles currently in dispute, and monitor registration dates.

TITLE NUMBER	OWNER	AREA	REGISTRATION DATE	STATUS	ACTIONS
12345/WOURI	Jean Dupont	500 m ²	12/01/2010	Dispute	Details Transfer
67890/FOUNDI	Maria Claire	1,200 m ²	05/06/2015	Valid	Details Transfer
11223/LOGONE	Aboubakar Sidiki	850 m ²	23/09/2018	Valid	Details Transfer
44556/FIMBO	Ether Bija	2,500 m ²	11/11/2005	Valid	Details Transfer

Figure 11. Land title management.

4.2. Recommendations

Based on the findings and analyses presented in the previous sections, it appears imperative to adopt a strategic and coordinated approach to maximize the potential of ICT in securing land transactions and reducing conflicts in Cameroon. The following recommendations aim to address the identified challenges and propose concrete courses of action for a sustainable transformation of the land sector.

4.2.1. Strengthening the Legal and Institutional Framework

Regarding the strengthening of the legal and institutional framework, we recommend the following measures:

1) Updating and Harmonizing Legislative Texts

It is crucial to adapt and harmonize existing land laws and regulations to fully incorporate the opportunities offered by ICT. This includes:

- The legal recognition of digital documents and signatures;
- The clarification of online transaction procedures;
- The definition of the responsibilities of different stakeholders in a digital environment.

2) Establishment of a Regulatory Framework for the Management of Digital Land Data

Establish clear standards for the collection, storage, protection, and accessibility of digital land data. This involves defining:

- Security protocols;
- System interoperability arrangements;
- Information privacy safeguards.

3) Clarification of the Legal Status of Information from Digital Systems

Clearly define the evidentiary value of digital land information and documents before administrative and judicial bodies.

4.2.2. Development and Deployment of Integrated and Secure Digital Platforms

For the design and implementation of a National Land Information System (NLIS),

the following measures should be taken:

- **Interoperable System:** Develop a centralized and interoperable digital platform, integrating cadastral data, land titles, transaction information, and relevant socio-economic data. This platform should ensure the security, integrity, and traceability of information.
- **Use of Secure Technologies:** Explore and adopt advanced technologies to guarantee the immutability and transparency of land records and transactions.
- **Development of Intuitive and Accessible User Interfaces:** Design user-friendly interfaces suitable for different levels of digital literacy, including rural populations.
- **Mobile applications and web platforms accessible via various devices are essential.**
- **Implementation of Strong Authentication Systems:** Implement robust authentication mechanisms to secure access to platforms and prevent identity theft.

4.2.3. Capacity Building and Awareness

The following activities are necessary as part of capacity building and raising citizens' awareness:

1) Training for Land Sector Stakeholders

The aim here is to organize training programs for the staff of the Ministry of Lands, Cadastre and Property Affairs (MINDCAF), the Ministry of Housing and Urban Development (MINH DU), the Ministry of Territorial Administration (MINAT), notaries, surveyors, magistrates, traditional authorities, and decentralized local authorities (CTD) on the use of digital tools and online transaction procedures.

2) Awareness and Education of Citizens

This involves conducting information and awareness campaigns among the population about the benefits of digital land registration, the procedures to follow, and the security measures to adopt. The focus should be on making information accessible and simplifying digital tools.

3) Support for Digital Literacy

The government will need to develop initiatives to reduce the digital divide and improve people's digital skills, especially in rural areas.

4.2.4. Promotion of Transparency and Participation

Promoting transparency and participation involves publishing Non-Confidential Land Information online. This will require:

- **Making certain land information accessible to the public,** such as: plot status, cadastral maps, and procedures via the digital platform, while respecting privacy and security.
- **Establishing online consultation and complaint mechanisms:** Integrate tools that allow citizens to check the status of their files, report anomalies or disputes, and track the processing of their complaints transparently.
- **Using ICT for Mediation and Conflict Resolution:** Explore the use of online

platforms to facilitate communication, mediation, and amicable resolution of land conflicts.

4.2.5. Collaboration and Strategic Partnerships

Collaboration and strategic partnerships should include the strengthening of Inter-Ministerial Collaboration. It will be necessary to ensure:

- Effective coordination between MINDCAF, the Ministry of Posts and Telecommunications (MINPOSTEL), the Ministry of Justice (MINJUSTICE), and other relevant ministries for the coherent implementation of digital initiatives.
- Partnerships with the Private Sector and Civil Society: Encourage collaboration with technology companies, civil society organizations, and land experts to benefit from their expertise and innovations.
- International Cooperation: Draw inspiration from the best international practices and collaborate with international organizations and countries that have successfully carried out digital transformation in the land sector.

5. Conclusions and Perspectives

Ultimately, this analysis highlighted the fundamental role that Information and Communication Technologies (ICT) are expected to play in the transformation of the Cameroonian land sector. In the face of persistent challenges such as administrative complexity and the proliferation of land disputes, the strategic integration of digital tools appears not only as an opportunity but also as an imperative necessity.

We have demonstrated that ICT, through the implementation of efficient information systems, the dematerialization of procedures, the improvement of transparency, and the facilitation of access to information, offers considerable potential to secure land transactions. The digital registration of plots, the traceability of deeds, the simplification of administrative procedures, and the dissemination of reliable information are all levers to strengthen the security of land transactions and reduce the risks of fraud and disputes.

However, it is crucial to recognize that achieving these ambitious goals is not automatic. It requires strong political commitment, effective interinstitutional coordination, substantial investments in infrastructure and skills, and full and wholehearted support from the population. Challenges related to the digital divide, data protection, cybersecurity, and resistance to change must be addressed with determination and pragmatism.

The future of the Cameroonian land sector, in the digital age, looks full of potential. Several avenues deserve to be explored and further developed:

1) Integration of Precise Geolocation and Drones: The use of high-precision geolocation technologies and drones could revolutionize land mapping, providing more accurate data and facilitating the monitoring of territorial changes.

2) Growth of Land “Fintech”: The emergence of digital financial solutions dedicated to land could simplify transactions, improve access to land credit, and promote financial inclusion.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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