# Community Land Registers for Internally Displaced Persons in South Darfur, Sudan: ICT solution

**Ahmed HEMOUDI, Malumbo CHIPOFYA and Dimo TODOROVSKI, Netherlands**

**Key words**: Community land, IDPs, user requirements, Fit-for-purpose land adminstration, ICT solution

## SUMMARY

In many countries, the land administration system (LA) is ineffective when it lacks innovative solutions to register all land tenure rights. Nevertheless, a well-functioning land administration system should capture even the customs and norms that govern land use management in the customary tenure system. In South Darfur, Sudan, it is claimed that the customary tenure system is most affected by the poor land administration system because there is no recognition of its different land rights among all Sudanese Land Acts. Additionally, land professionals believe that the Native Administration System as a social institution is considered a parallel land administration system that manages the community land. It acknowledges people's relation to their tribal land (Dar) and the returning Internally Displaced Persons (IDPs) with their Housh connection (extended family house). However, only 1% of the customary land in the Darfur region is believed to be registered. Furthermore, Darfur's region has experienced armed conflict since 2003; therefore, communities in Nyala and Eid El-Firsan, South Darfur, have received many IDPs from other states, such as western Darfur and returning IDPs.

The Native Administration System lacks innovative land registration technologies because it manages the customary land through a paper-based system and Aaraf. Therefore, It has been necessary to develop technical solutions that improve the Native Administration System's main work. This research distinguished an ICT solution for the community land register for IDPs in South Darfur. The information system requirements were identified after assessing the Native Administration system's main functions, practices, and processes in addressing the land claim of returning IDPs and the Juddiya's primary work as a local land resolution mechanism. Fieldwork, interviews, and a literature review were used to conduct this research.

The identification of the ICT solution was guided by the spatial and legal frameworks of the fit-for-purpose land administration approach. A selection of LA tools was analysed for alignment with the identified requirements. Furthermore, the capacity of the community to use the LA tools effectively was evaluated. The combination of functionalities provided by SmartSkeMa, the Field Survey App, and UAVs was found to be the best suite of ICT functionality for the Native Administration System in administrating the community land. The three tools provide complementary functionality that can be integrated into a solution that facilitates capturing different customary land use rights and their social restrictions through participatory mapping using affordable high-resolution UAV imagery and also allows for collecting information about land conflicts.

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## 1. INTRODUCTION

It is believed that the national land administration cannot be comprehensive without registering all land rights, especially rights within conflict areas and customary lands in general. Sudan is a country in the northeast of Africa, with an estimated population of 45.7 million. It is claimed that 99% of lands under customary tenure in Sudan are managed through the Native Administration system which is governed by tribal leaders and communities (GLTN, 2020). Under the national laws of the Republic of Sudan, the Native Administration system does not have a legal mandate to register customary rights over lands such as Hakora, Dar, Housh, and for individual' household rights as well. The Native Administration concept refers to local government or tribal leadership, which was given this name during the colonial government and has continued to be called Native Administration since that time. It has three main characteristics: to manage lands, make justice and represent the community, and it is totally connected to land tenure. Hence, the Native Administrative leaders are considered to be not the actual owners of the lands but rather managing and administering lands (Tubiana et al., 2012).

This issue can play a role in not protecting customary land rights for Darfur's communities precisely when land conflicts occur, which produce IDPs. Hence, land rights' issues should be considered after the end of land conflicts in the land resolution mechanism to ensure and protect rights for secondary occupancy of the land, such as that of IDPs (Todorovski et al., 2015). Another characteristic regarding land issues in Darfur is the lack of innovative land administration solutions to tackle the problem of recognising the customary land rights. Around 2.3 million IDPs are forced to be displaced and live in camps in Darfur (Augustinus & Tempra, 2021). It is conceivable that an ICT solution for the Native Administration system in Darfur could help deal with land disputes more effectively and provide security of tenure for returned IDPs and communities in customary areas in South Darfur in general.

Customary land ownership rights are different in the region of Darfur. Firstly, the Dar refers to each Sudanese tribal land in a customary area, which is managed by Sultan, who has a significant role in organising the land within the Dar and the Native Administration system. Secondly, the Hakora, another Sudanese terminology, refers to the land belonging to a small group of people. It is a piece of land that the Sultan assigns to a small group of people, a small family, and a person to be used for specific reasons or shared use.

However, it is claimed that there is a need to implement new land policies regarding hakora and decide whether it is an awarded tribal land or ownership type. Thirdly, the Housh, refers to traditional housing in the customary area where the extended family live. Housh is divided into several rooms occupied by small families and under joint ownership, as shown in Figure1. Finally, a right belonging to an individual has several conflicts within the community areas because of a lack of proof of ownership.

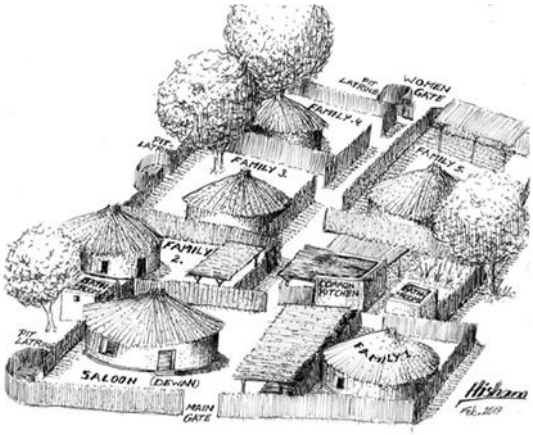


Figure 1. The Sudanese Customary Housh (extended family housing) (GLTN, 2020)

This research aims to identify the information system requirements for suggesting a possible ICT solution to the Native Administration System in South Darfur, Sudan and improve land management. An ICT solution can then support communities in recording and managing their land for hosting IDPs and returned IDPs. In Sudan, particularly the Darfur region, this cannot be done without assessing the Native Administration System and how it works and functions. The assessment will help to explore and understand how leaders such as Sultan/ Nazir, Omda, and Sheikh within the community traditionally manage the processes of securing lands for IDPs and maintaining their land records. Also, this research needs to understand and explore how the different levels of the Native Administration are involved, and other additional processes occur between them.

## 2. METHODOLOGY

### 2.1. Study Area

This research took place in Nyala, the capital of South Darfur state, in the southwest of Sudan. Nyala is 637 meters above sea level and is located 1200 kilometres away from the capital of Sudan, Khartoum. In continuation, this study area was selected because it is historically and currently considered a trade hub, and connecting with Chad, Central African Republic, South Sudan, and Khartoum via routes (UN-HABITAT, 2009). It is inhabitant by over sixty thousand IDPs living in Kalma camp in South Darfur (OCHA, 2022). Additionally, the lack of an adequate land registration system in the whole area and the country generally plays a crucial role in not providing security of tenure for returned IDPs (GLTN, 2020). The research was conducted in the Eid El Firsan locality and one of its administrative unit called Om

Ginaah, where the Bani Halba community is living. It is one of the Southern Darfur biggest tribes and Sudan's tribe as well.



Figure 2. The study area, Nyala, South Darfur

(Sudan Maps & Facts - World Atlas(Accessed on 15 January 2024))

### 2.2. Research Method

The main objective of this reserach is to identify a suitable ICT solution for land recordation processes for the Native Administration System, focusing on tenure relations of returned IDPs in South Darfur, Sudan. This involved assessing the Native Administration System's primary functions for providing returned IDPs access to land in South Darfur from the lens of the existing customary land tenure arrangements. This assessment enabled us to identify the information system requirements for implementing functionalities to support the Native Administration System and to perform a comparative analysis establish of some known land administration tools and their functionalities with respect to the information system requirements**.**
Primary data for this research was collected through a semi-structure interviews, focus-group discussions, and in-depth interviews. Respondents in our study included tribal leaders, citizens, and IDPs residing in the study area as well as national and local land professionals from the governmental sector. In addition, secondary data was obtained from the literature.

In terms of specifying the requirements we use UML activity diagrams to model the general workflow of certain land use management processes in the Native Administration System including how they address tenure security for returned IDPs. General system requirements have been expressed in terms of the goals of the different actors within the community.

## 3. FINDINGS

### 3.1. Land Tenure Institutions and Processes in South Darfur

**Land Tenure**

Land tenure in the Darfur region has largely continued to follow customary tenurial practices incorporating adaptations in response to socio-politico and environmental changes as necessary. El Amin (1990) studied some of these adaptations as made in response to the drought periods starting in the mid-1970s and culminating the devastating famine of 1984. El Amin (1990) found a striking difference in the customary land tenure practices before and after the droughts. Prior to the drought period the communal nature of customary land tenure had more influence over land relations as compared to individual control over land which became stronger in post the drought period.

Despite the tendency towards individual control over access and use of land many longstanding traditions and customs continue regulate tenure relations in South Darfur. El Amin notes 3 major factors influencing land tenure in the Darfur region, namely, local customs and traditions, Islamic law (Sharia) which lays down the laws of inheritance and of the distribution of land products, and political structures and (esp.) power.

As in most mixed agrarian and semi-nomadic pastoral economies, land tenure in South Darfur can be viewed from several different perspectives. For example, one must distinguish between the domestic and the economic spheres though they always overlap. It is also important to note that when speaking of access and use of land in such contexts one often refers to the individual household rather than the individual person. Especially when speaking of rights, rules and regulating customs, these invariably apply to households.

The most prevalent economic activities in South Darfur are the cultivation of Millet, Sorghum, and vegetables and rearing of sheep, camels, and cattle through traditional migratory pastoralism. In addition to cultivation of crops, sedentary communities in Darfur also often keep a small number of livestock including sheep and camels. Thus, the land of a community is separated into portions for cultivation, locally known as Sawani, and areas of pasture land, locally, Marahil. This separation aims in part to reduce conflicts between farmers and pastoralists.

**The Dar and the Hakura**

The Dar refers to each Sudanese tribal land in a customary area, which is managed by Sultan, who has a significant role in organising the land within the Dar and the Native Administration system. Secondly, the Hakora, another Sudanese terminology, refers to the land belonging to a small group of people. It is a piece of land that the Sultan assigns to a small group of people, a small family, and a person to be used for specific reasons or shared use.

**The Housh**

In the domestic sphere, the right to dwelling space in South Darfur is often exercised through occupation of a compound by extended families. Such compounds, called Housh, consist of several individual sub-compounds with dwelling quarters for each household, as well as one or more common kitchens, two or more common bathrooms, toilets, and a common meeting

house, called Dewan. As such kinship and membership to a family by descent or marriage determine an individual person's right to dwellings within a community.

**El Goz and Wadi Cultivation**

By tradition, a member of a tribe obtains the right of use on communal land after allocation by the local chief (locally called the Sheikh) of the village or community and their subsequent clearing of this land to make it arable. This right continues to hold provided that the land continues to be put under cultivation. El Amin (1990) found that on El Goz land the requirement of continuous cultivation allows for a fallow period of up to between 8 and 12 years depending on the tribe, clan or village. Wadi land can be leased out to third parties and the use rights can be inherited in accordance with Sharia law.

**Pastoralist Grazing**

While cultivation of crops requires continuous and exclusive use of a definite piece of land over an extended period of time, subsistence pastoralist activity is characterized by continuous movement over relatively large areas and long periods of time. Pastoralists generally migrate over tribal range lands in search of water and pasture for their livestock dictated primarily by climatic and environmental conditions.

Traditionally, individual access to grazing lands and to water resources for livestock extends to all land and resources so designated by the individual's tribe. Thus an individual member of the tribe or clan has virtually unlimited access to pasture and water. But of course the amount of these resources is finite and often, in any one place, not sufficient to carry the numbers of livestock required for the sustenance of an entire tribe or even village. Perhaps as a result of this, pastoralist communities make arrangements with other communities in their neighborhood to establish corridors for migration grazing.

Corridors in Darfur cover distances of many tens of kilometers often connecting many tribal lands and extend beyond tribal land boundaries and even the national borders of Sudan itself. From our fieldwork we learned that these corridors can be up to 5 km wide. Similar to other pastoralist communities across the African continent (e.g. the Maasai peoples of Kenya), special areas along the corridors are designated as resting areas during movement. In South Darfur these areas are called Siniya and are generally within 5 kilometers of a permanent human settlement.

**Security of Tenure**

Where communal control over land is stronger than individual prerogatives in exclusive access and use of land tenure security is guaranteed by mechanisms that ensure that every individual (household) has access to land required for their self-sustenance. Because land is allocated according to need and reverts back to the community when not in use, subject to the availability of land, it is (theoretically) always possible to accommodate new people in the community. Indeed, historically foreigners have been absorbed by the different communities in Darfur following existing customary norms and procedures. While land and resources have become scarce, this historical precedence still forms the basis on which IDPs are received and settled by communities.

All these mechanisms are implemented by the Native Administration. The Native Administration is a hierarchical, decentralized structure with the Sheikh providing leadership at the smallest spatial unit of administration. We elaborate the leadership structure within the

Native Administration in the next section and section 3.3 outlines some of the land information needs for land administration processes implemented by the Native Administration, in one case in conjunction with the state.

### 3.2. Governance Institutions and Structures

The hierarchy of each Native Administration in South Darfur is headed by a Nazir or Shartay who is the tribal head. As we discuss below, in our study area in Nyala, there are two additional levels of leadership under the Nazir which decentralize certain aspects of administration including some land related administrative. As such it is understood that the Native Administration is the governance structure of a particular tribe, a Nazara or Shartaya. These designations date back to the period of the British colonial period (1916-1956) and to the Fur Sultanate starting around 1650, respectively. In some parts of Darfur, there is also a Magdum.

Abdul-Jalil (2006) reports, based on O'Fahey (1980), that the second ruler of the Keira dynasty of Darfur, Sultan Musa Ibn Suleiman, introduced a system of land grants called Hakura, which entitled the hakura title holder to collect taxes of different kinds depending on the type of hakura title conferred. Among them were hakura land grants apparently intended to encourage religious teachers (Fuqura), as well as merchants to settle in the territory.

The type of hakura title which persists most prevalently today is that granted to chiefs of the different tribal groups occupying significant territories in Darfur. It is these hakura estates that came to be known as the dars (meaning homeland; singular, dar) of the tribes. To be sure, the dar of a given tribe is not necessarily occupied exclusively by members of that one tribe. The dar is simply named after the most populous and therefore dominant tribes in the territory.

After defeating and killing Sultan Ali Dinar in 1916 the British colonial administration in Sudan introduced several new titles to the hierarchy set up by Darfur Sultanate as part of their reorganization of the state while maintaining much of the political strata in place (Abudl-Jalil/El Amin). Among these new titles were that of the Nazir and the Omda. The Nazir, as noted above is a leader of a tribe, equivalent in rank to the native Shartay title, and leads a Nazara (people and land) over the dar (hakura) of the tribe. The Nazir execut0es his administrative duties through the offices of the Omdas. An Omda is a second level office in the Native Administration structures and reports directly to the Nazir.

Each Omda is responsible for a part of the territory of the dar, often delineated on tribal, clan, or family lineages. During the field work we learned that a Nazara, during the time of the stablishment of the Native Administration system can be registered if a Nazir has at least 15 Omdas under his authority.

The last significant office in the Native administration is that of the Sheikh or local chief. The Sheikh reports to the Omda and there will be at least as many Sheikhs under an Omda's authority as there are distinct villages or settlements. The Sheikh is responsible for the day-to-day management of communal affairs in his local community including allocation of land within the area under communal control of their community and resolving land disputes.

The different levels of the Native administration each deal with land related concerns corresponding to their working context. That is to say, the Nazir is concerned primarily with strategic land matters, particularly, land use planning and regulations, the Omda coordinates land use and access for different groups and villages within his domain, and the Sheikh facilitates customary land tenure processes at the local level involving individual land users.

### 3.3. Land governance processes and land information

We are now in position to focus on the concrete case of the state of land tenure in the Om Ginaah and Nyala, where Beni Helba tribe lives, prior to the breakout of conflict in 2023. In this analysis we focus on land governance processes at the local level involving the Sheikh in the first place and to some extent the Omda. Another important structure within the customary legal system is the Judiyya, or traditional court, which also becomes involved with land dispute resolution especially those involving different groups or villages. There are many activities that the Sheikh does because he is more realted to the custaomry land management processes. the Sheikh has another role in collecting particular kinds of traditional taxes for the Nazir. Shiekh collects part of the land products (Kharag) and gives them to the Omda. Every householder has a specific area within his tribal land allocated by the Omda through a Shiekh. This land is used for different purposes, such as agriculture and grazing.

Another example for allocating land is for IDPs, as part of the community, are only allowed to use the land temporarily until the situation on their lands is stable. This temporary permission is called (kol, and goom), which means eat and go. So, the IDP is not allowed to own the land under the customary tenure system within the land of their hosting tribe. Thus, the Sheikh has a biger role in assigning a land for those valunerable group based on the community's traditionl law. The following acitivity diagram explans how this process executed, as shown in Figure 3, below.

The Sheikh is responsible for admitting that land is free of conflicts, especially when an individual is eager to register their land into the governmental system. The Omda confirms no

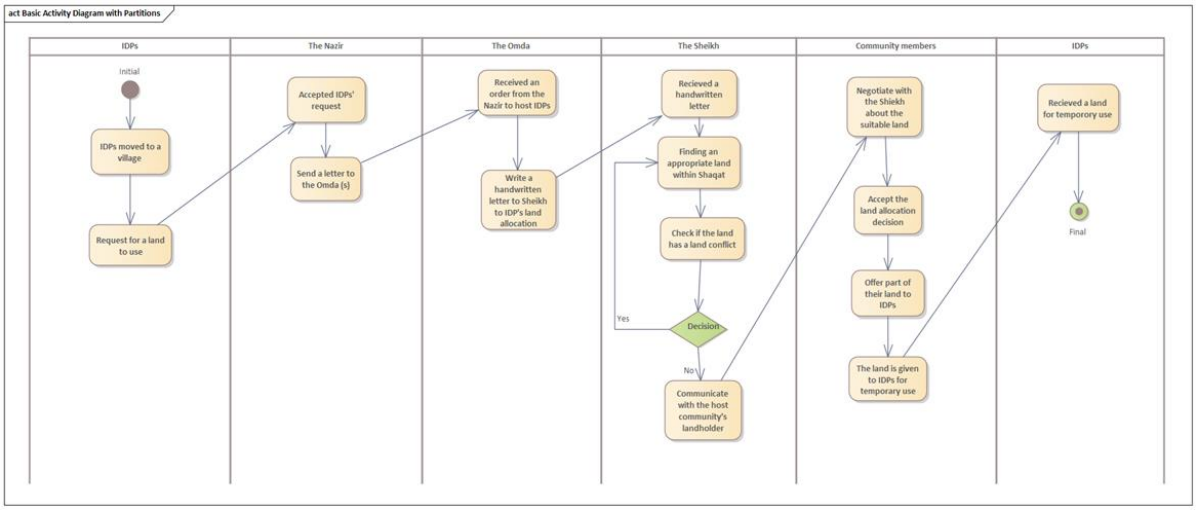


Figure 3. The activity diagram for allocating a land for IDPs

conflict status of parcel for registration in Government system. The other community memebers, especially the niegbours of the households will be interviewed by the Sheickh and Omda for checking if the land land has no historcial land disputes. They also confirm if the land belongs to the community member who intends to register it.
The following activity diagram shown below in Figure 4, illustrates the processes needed for community member to register his land. Howevre, this process starts by the Shiekh's check, the Omda and Nazir' approval, and other stakeholders from different governamental office.

### 3.4. The Information system requirement for the Native Administration System

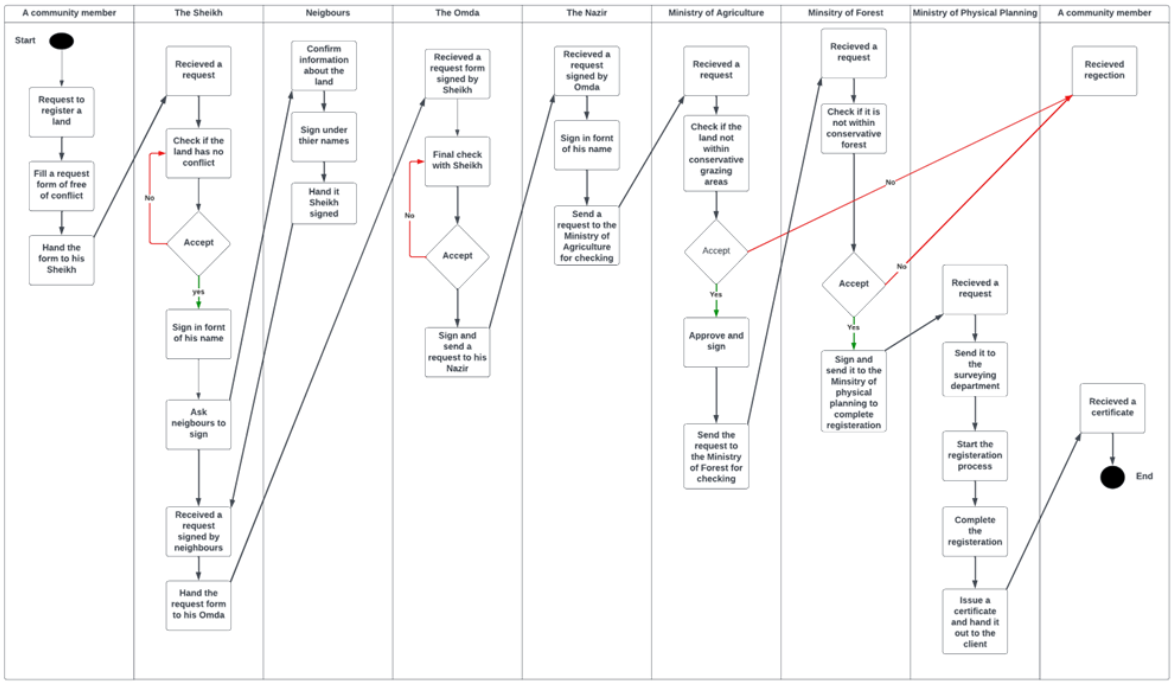


Figure 4. The activity diagram for registering land through the native administration system

This section presents the results synthesizing the information system requirements derived from focus group discussions and in-depth and semi-structured interviews with tribal leaders and community members in Nyala, South Darfur. The outcomes identified the functional requirements, non-functional requirements, collected information requirements, and stakeholders' collected information agreement. These requirements were obtained from the findings about the Native Administration System's analysis.

#### 3.4.1 Functional Requirements

The results of the functional requirements obtained from assessing the Native Administration System's main functions, practices and process regarding addressing the land relation of return IDPs, as explained in section 4.1. These functional requirements would determine the capabilities of the suggested ICT solution and how the system should work.

1. **Land recordation**

In this sub-functional requirement, the proposed system should allow the Native Administration System to capture both different customary land tenure and use rights, map different customary land rights, and record the approximate location of land disputes between community members. In addition, the system will record the new land allocation for IDPs and returning IDPs, map the tribal land boundary, and record different community land use restrictions. Also, the system will capture verbal stories and descriptions about land, social information about the tribal land relation, social obligations of using the land, and record individual and communal rights.

2. **Land management**

In this sub-functional requirement, the proposed system should allow the community to manage different customary land rights' information, maintain land use requests of community members, keep records of historical land agreements, and maintain conflict resolution decisions' records (Juddiya). Moreover, the system will allow keeping information about conservative land, support to have own community maps, keep records of new maps, and record the community's land claims.

3. **Solutions for conflict resolution (Juddiya)**

The proposed system is supposed to allow the retrieval of the approximate location of land disputes between community members, minimize conflict between the host community and IDPs, support Omda and Shiekh to implement customary law in their decisions, and codify the Aaraf, norms, and customs in their decisions. In addition, it should allow visualising of land disputes, resolved land disputes land disputes regarding pastoralists' routes with other tribes, enable the creation of a report of historical land records, and support Dar's conflict with other tribal boundaries.

4. **Technical and Operational**

In this sub-requirement, the proposed system should have a list of different custoamry land tenure rights, such as the Dar (tribal land), the Hokora (small group of people's land), and the Housh (extended family house). Also, it should include a list of options to select different land uses, such as: living, farming, temporory land for IDPs (kol, and goom), grazing, pastorlist routes, agropastroal, and women kitchen garden. Additionally, it should support capturing non-spatial information like, the name, age, martial status, family members' names, neighbours' names, and description of land's location.

The system should support drawing sketchs of different customary tenure rights by the community and mapping fuzzy boundaries such as tribal land's boundary, small farms, grazing areas, and reserved forest. Also, it should identify who is using the land (indvidual/group). The system should have a list of various social restriction assosiated of using a land. In addition, it should capture histrocal verbal stories, allow viewing the status of thier land uses, and connect with internet data.

### 3.4.2 Non-Functional Requirements

The sub-section presents the analysis results of the non-functional requirements obtained from assessing the Native Administration System's main functions, practices and process regarding addressing the land relation of return IDPs, as explained in subsection 4.1. These non-functional requirements would determine the quality of the suggested ICT solution of the Native Administration System in Nyala, South Darfur.

1. **Security**

In this sub-non-functional requirement, the proposed system should be accessible by tribal leaders and their assistants from the community. It should also protect personal information about vulnerable groups such as IDPs. It should specify who grants the rights to use land within the tribal leaders. Finally, it should have restrictions regarding accessing the data agreed by the community members.

2. **Performance**

The proposed system should support mapping of land at different levels and precision, capturing various land use rights fast, and displaying a map on mobile screens or tablets. It should allow different sizes of data, run on computers or mobile phones (Android), and provide updates maps for newly allocated land.

### 3.4.3 Verification of collected information

The collected information is checked and agreed upon by different stakeholders within the community in Nyala to address IDPs' claimed land. It was found that representatives from the community, neighbors of an IDP, vulnerable groups, and tribal leaders, especially the Omda and the Sheikh, always set community meetings to investigate and discuss the land claim issue. After that, they will check all information gathered through discussion and consultation. Consequently, information will be agreed upon based on the decision made by all stakeholders. However, in case of disagreement, tribal leaders will find another land to allocate those vulnerable groups. Also, land dispute issues are managed and solved by Juddiya.

## 3.5. Fit-for-purpose land administration

### 3.5.1 Evaluation of some land administration tools

The comparison of some existing and available land administration tools currently used in the land administration field was made based on the findings from subsections 3.1 and 3.2. The selected LA tools were chosen through a literature review and because they have been experimented before in the customary land tenure within similar contests. The selected LA tools are STDM, UAV, the SmartLandMaps, SmartSkeMa, Cadasta, Smartphone, Esri collector, and Field survey app. The analysis of these tools were based on certain parameters that ensure the spatial framework of fit-for-purpose land administration as a guideline

principle, which are: functions, target users, previous implementation, the accuracy of data, time performance, ease of use, spatial and non-spatial and availability in the market.

### 3.5.2 The alignment between system requirements with some selected LA tools

Concerning identifying a land administration tool, the findings of the information system requirements of the Native Administration System presented in subsections 3.1 and also in Tables 1 and 2 are used to figure out what land administration tool can meet these identified requirements from all stakeholders in our study area.

A scoring system was used in this research to determine which land administration tools can meet the identified information system requirements of the Native Administration System. The following scoring scheme was used to rank the tools for each of the requirement types listed in Table 1:

1. High (H) - the tool meets at least two thirds of the requirements.
2. Medium (M) - the tool meets between one third and two thirds of the requirements.
3. Low (L) - the tool meets less than one third of the requirements.

Table (1) below presents the scoring table based on the information system requirements aligned with some land administration tools.

| **Functional and functional requirements** / **LA tools** | Functional requirement (Land recordation) | Functional requirement (Land management) | Functional requirement (conflict resolutions) | Functional requirement Technical and operational | Non-functional requirement (Performance) | Non-functional requirement (Security) | Number of higher alignment |
|---|---|---|---|---|---|---|---|
| STDM | H | M | M | M | H | H | 3 |
| UAV | M | M | M | M | H | L | 1 |
| SmartLandMaps | H | M | H | H | H | H | 5 |
| SmartSkeMa | H | M | H | H | H | H | 5 |
| Cadasta | H | M | M | M | H | H | 3 |
| Smartphone Esri collector | M | M | M | L | H | L | 1 |
| Field survey app | M | H | H | M | H | H | 4 |

Table 1. A score table based on the information system requirements aligned with some LA tools

### 3.5.3 The alignment with the capacity of the community

Regarding the capacity of the community in Nyala, South Darfur, three elements can play a role in identifying a suitable tool, which are the information system requirement, the assessed LA tools, and the capacity of actors in the Native Administration System. It was evident that the community lacks maps of their customary land, weak land recordation system, using paper-based system for land management, verbal agreements for Juddiya's decision, differentiate different customary land use rights within a better system, lack of trained land professionals, and there is a need for better recognizing the social land restrictions.

Table 2 below shows the score table for the capacity of the community with some land administration tools A binary scoring system is used to classify the LA tools into those that meet the capacity of community to apply them in the Native Administration processes. A tick mark (✓) means that the LA tool meets the community's capacity and an x-cross mark (×) means that it does not. The table below also shows that the capacity of the community has different categories based on the findings from subsection 3.1, and 3.2.

| **The capacity of the community** / **LA tools** | Land management (paper-based) | Customary land tenure rights | Different customary land use rights | Customary land law (Araf) | Land disputes (neighbours, farmers, shepherds) | Land agreements (unrecorded) | Lack of maps | Social land use restrictions | Lack of technical support | Lack of trained land specialist | Number of checked boxes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STDM | ✓ | ✓ | × | × | × | × | × | ✓ | × | × | **3** |
| UAV technology | × | ✓ | ✓ | × | ✓ | × | ✓ | ✓ | ✓ | × | **6** |
| SmartLandMaps | × | ✓ | ✓ | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | **7** |
| SmartSkeMa | × | ✓ | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | **8** |
| Cadasta | ✓ | ✓ | × | × | × | ✓ | × | ✓ | × | × | **4** |
| Smartphone-Esri collector | × | ✓ | ✓ | × | × | × | × | ✓ | ✓ | ✓ | **5** |
| Field survey app | × | ✓ | ✓ | × | × | × | × | ✓ | ✓ | ✓ | **5** |

Table 2. The score table for the capacity of the community with some land administration tools

## 4. Conclusion

the identification of suitable LA tools for the Native Administration System was analysed and discussed based on the alignment with the distinguished functional and non-functional requirements and the capacity of the Native Administration System. Some selected LA tools were compared based on the spatial and legal framework of the FFPLA approach. LA tools such as SmartSkeMA, the Field Survey App, and UAV were found suitable for the Native Administration System in South Darfur. They could capture customary land rights, customary land use rights, Aaraf, and social land use restrictions as an ICT solution.

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## BIOGRAPHICAL NOTES

**Ahmed Hemoudi** is a land administration specialist currently working as an independent consultant with a background in Surveying Engineering. He is also a member of Sudan Engineering Society. He also acts as a land administration consultant with ISTIDAMA, for Land and Environmental Governance, Sudan. He specializes in land information system solutions for customary tenure systems, applications of fit-for-purpose land administration, geoinformation solution for land information, and for land conflict.

**Malumbo Chipofya** is Assistant Professor of Land Informatics at the Faculty of Geoinformation Science and Earth Observation of the University of Twente. His research interests broadly cover modelling customary land tenure systems, applications of distributed and decentralized systems in Land Administration, and sketch based geodata creation and use in Land Information Systems.

**Dimo Todorovski** is a senior lecturer in land administration and land governance, and a member of the management team of the PGM department at the Faculty of Geo-information Sciences and Earth Observations - ITC as a Portfolio Holder Education. He obtained an MSc degree in Geo-Information Science and Earth Observation at ITC in 2006 and holds a PhD from the University of Twente since 2016. In 1992 started a professional career at the Republic Geodetic Authority in the Republic of North Macedonia. Over the 19 years of professional engagement (1992-2011) in the Agency for Real Estate Cadastre (same authority new name), the last 12 years were in different managerial positions (Digitizing cadastral maps, GIS and Geo-ICT departments), and the final year he was Head of the Department for International Cooperation and European Integrations. Since 2011, firstly Dimo worked on his PhD research project (until 2016) and then continued as a lecturer and master's specialization coordinator of Land Administration (since 2020 new name: Geo-information Management for Land Administration - GIMLA) until today. His research interest focuses on professional education, land administration and land governance, and on land administration in post-conflict contexts. Dimo is a Chair of FIG Commission 2 – Professional education (2023-2026).

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