

Community-based mapping with SmartLandMaps: versatile, simple and inclusive

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SUMMARY

Community-based mapping is a prominent method for fit-for-purpose (FFP) land tenure data collection. SmartLandMaps, an initiative of the University of Münster, Germany, provides local, national and international organizations with innovative geospatial tools and services for sketch-based documentation of land rights and land use. Communities interact, discuss and reach consensus on the ownership and land use rights of community members using high-resolution aerial or satellite imagery. A cloud-based digitization pipeline then converts the community-drawn paper maps into a standardized and digital format. Through three separate case studies, we highlight the mapping dynamics and digital outputs of community-based mapping with SmartLandMaps. Based on observations from Benin, Chad and Sierra Leone, three main characteristics stand out: versatility, simplicity and inclusivity. 1) Versatility refers to the ability to map a range of different tenure types. In addition, SmartLandMaps proved its versatility when used in conjunction with Trimble's Catalyst to verify boundaries in cases where the community had difficulty demarcating the boundaries. 2) The simplicity of the process was validated through several pilots. The main mapping activity required only a pen, a printed orthophoto, and a mobile device with a camera. 3) Finally, the SmartLandMaps approach is inclusive because it makes it easy for participants from different backgrounds (e.g. gender, social status, age groups and language backgrounds) to get involved. Cases from Benin, Chad and Sierra Leone will be compared to draw conclusions about the advantages and limitations of the SmartLandMaps community mapping process.

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1. INTRODUCTION

Community mapping is a process of visualizing and understanding the physical, social, and economic characteristics of a community through the creation of maps. It involves collecting and analyzing information about the people, places, and resources within a particular community, and then presenting that information in a spatial format. The goal of community mapping is to create a comprehensive understanding of a community's assets, needs, and resources, and to use this information to inform community development, planning, and decision-making processes. Among others, community mapping has the following key qualities:

- **Increased spatial knowledge:** Community members have a deep understanding of their local area and can provide valuable insights and information that may not be reflected in traditional maps.
- **Empowerment (Parker, 2006):** Community-based mapping empowers local residents to take ownership of their geographic information and to share their knowledge and perspectives with others.
- **Increased local engagement:** By involving local residents in the mapping process, community-based mapping can promote community engagement and strengthen local networks.
- **Improved decision-making:** Community-based maps can inform local decision-making and planning processes, ensuring that the perspectives and needs of local residents are considered.

Best practices in community engagement and various methods of participatory mapping have a long history in documenting land use and tenure and are used by various, mainly non-governmental organizations (e.g. Community Land Protection Facilitator Guide (Namati, 2016)). However, community mapping approaches have also gained importance in large-scale land projects (e.g. Rwanda) and are promoted as an FFP methodology (IFAD, 2023; Enemark et al., 2021). Different tools and approaches can be utilized depending on the context, resources and capacities (e.g. Eilola et al., 2019; Chipofya et al., 2020; Chipofya et al., 2021).

Drawing on paper maps and aerial photographs is an easy way to engage spatially with communities, but is sometimes seen as old-fashioned, low-tech and too complicated to digitize. In many cases, these hand-drawn maps remain analogue and eventually get forgotten in a drawer. SmartLandMaps has developed a process for community mapping with paper maps, combining low-tech mapping methods with high-tech digitisation processes. In this paper, we

highlight the mapping dynamics and digitisation outcomes of community-based mapping with SmartLandMaps. Evidence on the merits and limitations of this approach is drawn from three study sites in Benin, Chad and Sierra Leone.

2. METHODS

2.1 The SmartLandMaps process

SmartLandMaps is a startup initiative of the University of Münster in Germany that provides organizations with innovative tools and services for the digital documentation of land ownership and use (Degbelo et al, 2021). SmartLandMaps supports sketch-based community mapping activities and facilitates the digitization of sketch mapping results through tools that automatically extract drawn features from paper maps and translate them into geo-referenced data (Figure 1). The process itself is very simple, and SmartLandMaps ensures that everything drawn on a map can be digitized automatically, without the need for a large scanner or someone to perform time- and resource-intensive on-screen digitization. When the process is embedded in the actual collection of land tenure data, the digitization can be followed by a dissemination phase in which the data is verified and possibly edited or modified in consultation with the community. Once verified, the data can be easily integrated into existing cloud or GIS environments due to its standardized data formats.

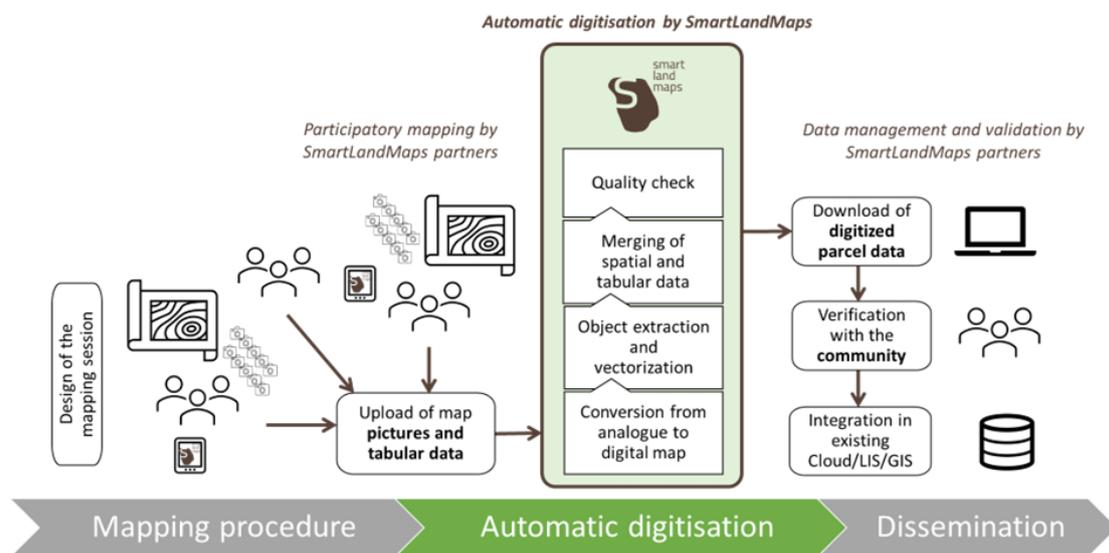


Figure 1: SmartLandMaps process. The mapping procedure including the design of the mapping session and the data collection is led by SmartLandMaps partners on-site.

2.2 Case study areas

As indicated in Figure 1, the mapping activity was carried out by organizations partnering with SmartLandMaps. These are typically CSOs or government organizations. Three countries, Benin, Chad, and Sierra Leone (Figure 2), each with their own unique history, culture and

challenges, were selected as case study sites where existing contacts with ongoing land projects or new initiatives made it possible to test SmartLandMaps in different settings.

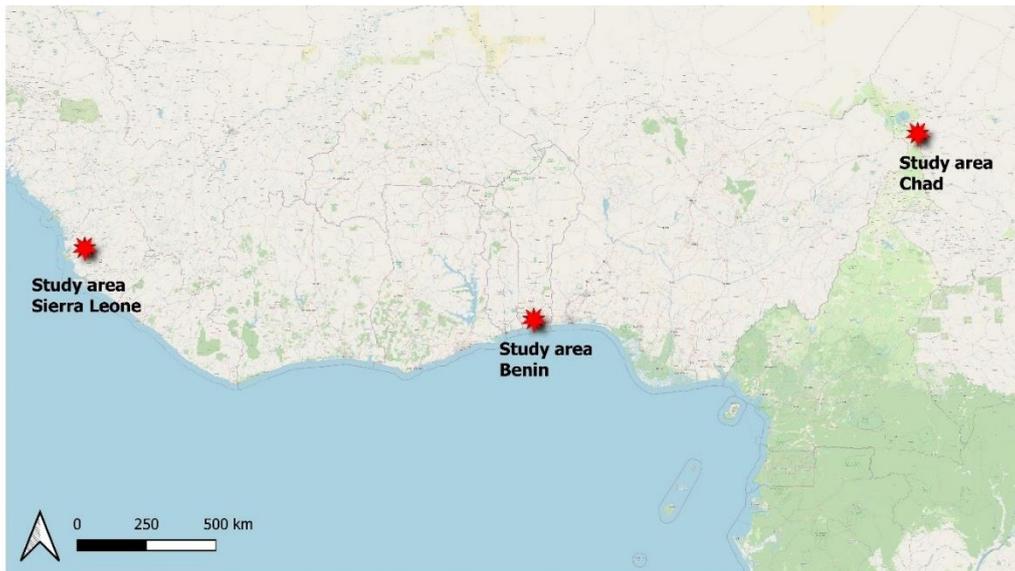


Figure 2: Overview of study area locations in Western Africa

Benin is a small West African country that gained independence from France in 1960 and became a democratic republic in 1991. The country covers an area of 114,763 km² and has a population of more than 12 million people. Benin has established a centralized land administration system with the objective of recording the entire national territory in one digital central land administration system. The legal foundation under the land administration is the 2013 Land Administration Law, which replaced previous land laws. The execution of the land administration is assigned to the National Land Registry and Agency, l'Agence Nationale du Domaine et du Foncier (ANDF), founded in 2016. However, the transition to a uniform land administration system that covers the entire country is progressing slower than expected. The Benin case study builds on the existing land tenure intervention funded by the Netherlands through the Land Administration Modernization Project (PMAF). VNG International, Kadaster International and YILAA facilitated the mapping activity on-site in January/February 2022 (Stöcker et al. 2022).

Sierra Leone is a country in West Africa with a population of more than 8 million, a large proportion of whom live in rural areas (FAO, 2021a). Known for its rich cultural heritage and natural resources, including diamonds and other minerals, Sierra Leone also faces significant challenges, including a brutal civil war in the 1990s and ongoing economic and social problems, including high poverty rates. Land grabbing is a major problem in Sierra Leone, with both local and foreign companies acquiring large tracts of land for commercial purposes. Due to weak land governance structures, these developments can lead to conflicts with local communities, particularly in areas where customary laws govern land tenure. For several years, Sierra Leone has been moving forward with its new Land Policy and Customary Land Rights Act to address the issue of land tenure security. The FIG Young Surveyors Network Volunteer Community

Surveying Program (VCSP) is working with Sierra Leone's Ministry of Lands, Housing and Country Planning to build the capacity of local surveyors and use appropriate technology to help Sierra Leone's land administration implement reforms and prevent land grabs and informal transfers. Together with Trimble, SmartLandMaps provide expertise and conducted a community-based mapping exercise.

Chad is a landlocked country in Central Africa with a population of more than 16 million, $\frac{3}{4}$ of whom live in rural areas (FAO, 2021b). Land administration in Chad is governed by various laws developed and adopted shortly after independence. Chad's land administration is facing numerous challenges including slow and expensive cadastral mapping and land registration, lack of qualified professionals, and inadequate land information leading to land conflicts, non-productivity of agricultural land, uncontrolled urban development, and hindering the country's socio-economic development. In 2019, the Dutch Ministry of Foreign Affairs launched the 'LAND-at-scale' program with the aim of contributing to the achievement of the United Nations Sustainable Development Goals (SDGs) by improving the institutionalization of land tenure and rights in developing countries. During a joint event with Kadaster International, esri North Africa, Trimble Land Administration and SmartLandMaps, community-based mapping activities were carried out in an urban area north of N'Djamena (Unger et al. 2023).

Table 1: Characteristics of study areas

	<i>Chad</i>	<i>Benin</i>		<i>Sierra Leone</i>
<i>Partners involved</i>	Kadaster International, esri North Africa, Trimble, ...	Kadaster International, VNG International, YILAA,		FIG YSN VCSP, Trimble, Ministry of Land, Housing and Country Planning
<i>Date</i>	11.-12.10.2022	1.-3.2.2022	7.-9.2.2022	24.-25.01.2023
<i>Orthophoto</i>	MAXAR, 50 cm	UAV-based orthophoto 1,8 cm 2,3 cm		MAXAR, 50 cm
<i>Land use class</i>	Peri-ruban residential	Urban residential	Rural residential	Rural agroforestry

2.3 Community-based mapping

The mapping activity was preceded by an extensive awareness-raising campaign. Local government representatives, leaders and village elders were informed about the data collection process by local partners. The schedule of activities was coordinated in detail with the community to ensure maximum resident participation. Market days, local commitments,

religious, and spiritual needs were taken into consideration. Sufficient time was planned to answer questions and address the concerns of residents.

All that is required for the SmartLandMaps community mapping approach is a pen, a printed aerial photograph, and printed stickers with unique identifiers to associate the collected attributes with the parcels. Any mobile device with a camera could be used to enter non-spatial information about land rights and land rights holders and to photograph the map after the mapping campaign. Base maps were obtained from the inventory of national aerial photographs, licensed satellite data or drone data (see Table 1). The printing of the base maps and the translation of the country profile data model into a digital questionnaire was supported by the SmartLandMaps team. The data collected with the SmartLandMaps ODK mobile app did not require an Internet connection. However, once back in the office, the non-spatial data and photographs of the sketched map were uploaded using the SmartLandMaps API as soon as an internet connection was established. Once the data was in the cloud, the digitization process was initiated (see Figure 3).

2.4 Digitisation with SmartLandMaps Software as a Service



Figure 3: SmartLandMaps digitisation: 1) community mapping to create a sketch map on top of a base map, 2) automatic extraction of sketched lines based on machine learning and computer vision techniques, 3) georeferencing and conversion into GIS vector formats ready to be integrated into existing GIS platforms or land information systems

The digitization starts with processing all photos taken from the map with WebODM aiming at generating an orthophoto from the data input. The processing pipeline starts with structure from motion, multiview stereo, meshing, texturing and ends with the orthophoto generation (Toffanin, 2019). As the photos of the map do not have usable geotags, the generated output is georeferenced using pre-existing markers (small red crosses) on the printed map. The location of at least five equally distributed markers and corresponding coordinates in the target reference system are utilised to apply the Helmert transformation. Afterwards, a georeferenced quasi orthophoto of the annotated printed map is generated.

All further processing is automatised by running the SmartLandMaps software. The software is implemented in Python and can be run in the cloud utilising a Google Colab environment. The first module of the program extracts the boundaries from the georeferenced image as a binary raster. The second module creates polygons from the output of the first one and saves the result into a GeoJSON file. A third module detects the stickers and recognises the numbers

printed on them, which are then saved into a GeoJSON as well. Using the numbers as unique identifiers for joining the spatial and tabular data, the final output contains all collected data integrated into a single GeoJSON file.

The modules of the program use various open-source libraries, such as OpenCV, skimage and imutils for image manipulation, shapely for creating geometries, pyproj and gdal for coordinate transformation, and GrassGIS for generalization and vector post-processing. The detection of numbers is based on the Tesseract OCR Engine. To extract boundaries from the digitized paper map, the software reads the georeferenced image and after a white padding is added, the image is divided into small patches. Boundary extraction is performed on the patches using watershed segmentation based on the edges, with a mask applied to them. The mask is a binary image, resulting from the thresholding of the grayscale-converted original image, keeping only dark pixels that make up the boundaries. The results from the patches are then merged into a single image. This step is performed twice using a different padding to minimise possible gaps, and the combined results are written into a single raster file. Patches with 640×640 pixels were found to help achieve the quickest overall runtime, whereas the grayscale threshold may vary from dataset to dataset, mostly in the range of 45 to 90.

Vectorisation is done by first skeletonizing the boundary raster, and then using a contour approximation algorithm, based on which polygon geometries are created. The coordinates of the polygons are transformed into WGS84 and are saved into a GeoJSON file as raw polygons. Finally, post-processing is applied by deleting holes, generalising the polygons with the Douglas-Peucker algorithm, and cleaning sliver polygons, which is done by GrassGIS utilising the grass-session and PyGrass modules.

The sticker recognition module filters the image by the colour of the stickers, which is typically a bright colour, distinct from the background. Stickers are identified on the resulting binary image by contour detection. The contours are polygonised and approximated with rotated bounding rectangles, which are then horizontally aligned and cropped. The Tesseract OCR detects the text on these cropped images. As stickers could be upside down, all ID numbers end with a special character (asterisk), so that results can be evaluated and accordingly OCR can be performed again on the 180 degrees rotated image. The vector coordinates are derived from the centre of the bounding rectangles. The output is a GeoJSON file containing point geometries with the detected text (minus the asterisk) and the assumed successfulness as attributes. A module analyses the point and polygon data and compares the ID numbers with the data collected in the questionnaire. A report is written as feedback, on whether there are any issues. If the data is consistent, it is merged with the non-spatial data.

3. RESULTS

3.1 Observations from the preparation and mapping phase

Preparatory meetings with local representatives were held up to a month before the mapping campaigns. On the first day of mapping, detailed schedules with meeting points were developed together. Although all community mapping activities were facilitated and conducted in a similar

manner, there were large differences in the way community members interacted with the map. A snapshot of the community maps is shown in Figure 4. It is evident that the characteristics of the spatial units mapped, the mapping context, and the land use characteristics are heterogeneous across the study areas.

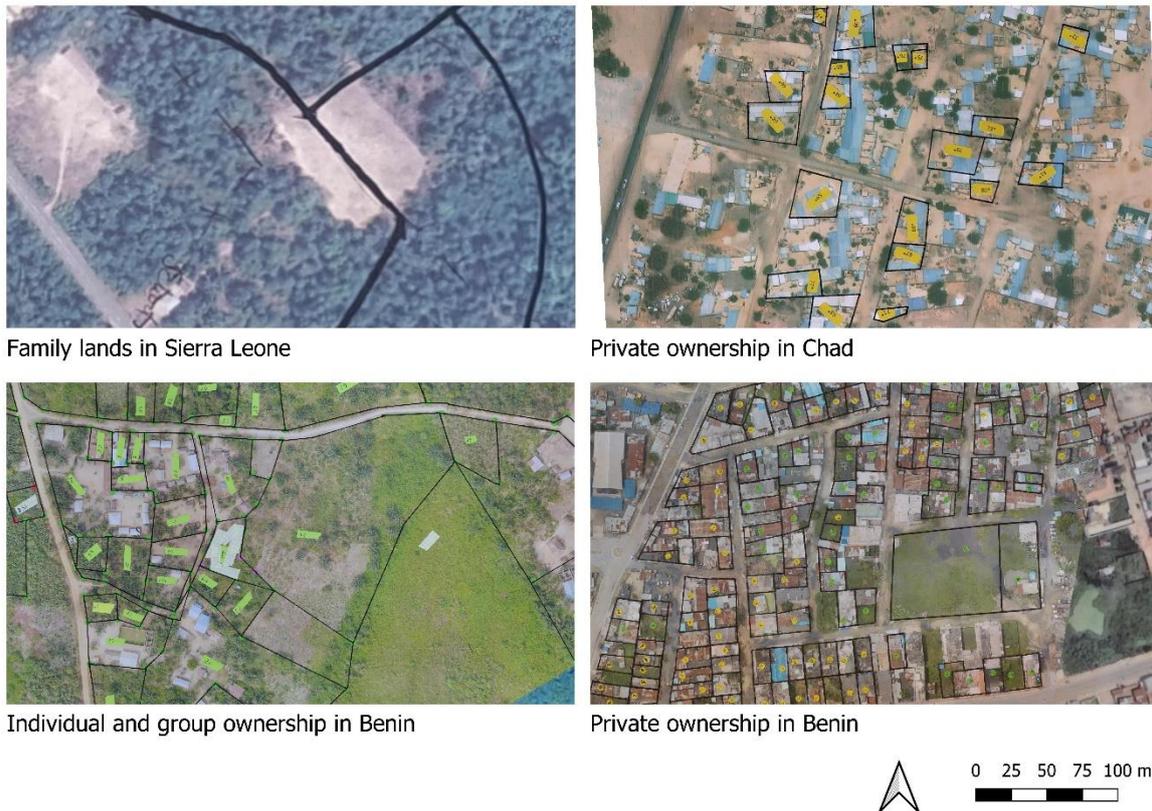


Figure 4: An excerpt of the community-mapping outputs. Note that the scale is the same for all maps.

Benin

In Benin, YILAA facilitated two people as mapping assistants. In particular, YILAA's knowledge of local languages and customs was critical for appropriate facilitation in the rural study area, as most community members spoke only the local language. A local task force consisting of a man, a woman, a young person, and an elderly person was formed to assist in mobilizing and sensitizing landowners. To take advantage of a large map, meeting places were arranged so that several people could gather around a large table to stimulate discussion. A call to action in the early morning informed community members about the mapping activity. In addition, the local task force spread out to ask neighbors to participate, so people showed up when it was convenient for them, which sometimes made it difficult to get all the neighbors together. In those cases, the local task force could assist as a trusted intermediary. It could be observed that the morning hours worked much better than the afternoon hours.

The mapping team worked with removable sticky dots and sticky notes to allow for dynamic consensus building on the location of boundary corner points. At the end of the mapping

session, lines were drawn using a black marker and a ruler. In the urban area, most boundaries consisted of physical objects that were easy to recognize. The high spatial resolution of the orthophoto allowed for a high level of granularity in the interpretation of the orthophoto. Small features such as garbage cans, bushes, or even piles of bricks or sand helped to orient in the map. On average, it only took 5-10 min for each resident to put the dots marking the boundary corners on the map and fill in the questionnaire. In total 202 parcels (urban environment) and 232 parcels (rural environment) were sketched within 6 mapping days, summing up to 50-80 parcels that could be mapped during one day.

Chad

The purpose of the field work in Chad was to demonstrate different surveying and mapping approaches and to sensitize government representatives to the wide range of tools available. One day of the fieldwork was dedicated to community-based mapping with SmartLandMaps. We worked in two different sites that were very similar in terms of physical characteristics. Initially, a third mapping was planned, which was located outside the meeting site and was mainly characterized by industrial features surrounded by huge walls. During the first on-site meeting, it was decided to skip this area because it was too difficult for the residents to relate to these areas as they were not familiar with the objects behind the big walls as they had never entered these areas. Thus, the demonstration was carried out only in two peri-urban areas. In contrast to the mapping activities in Sierra Leone and Benin, this demonstration did not aim at a complete mapping of all land tenure arrangements, but rather at mapping the areas of people who showed up at the community mapping site.

It was found that map orientation was relatively straightforward, with some confusion caused by the temporal resolution of the MAXAR orthophoto, which was more than two years old. Some buildings were not represented on the orthophoto because they were not yet built (including the mosque as a very important element on the map). Although the resolution of the satellite image was not optimal, people were able to relate very well to their properties by seeing only rooftops, some walls, and trees. The visibility of boundary objects was sufficient. A total of 74 parcels were mapped in one day. In contrast to Benin, the residents were not mobilized during the mapping activity and only a large group of community elders, representatives and the like were involved in the demonstration activity, which is reflected in a rather scattered sketch of the respective properties.

Sierra Leone:

In Sierra Leone, two field mapping days were scheduled. The day began with introductions, small gifts for the chief, and prayer at a well-known community meeting place in the shade of a large tree. The first look at the map was not self-explanatory, and the mapping assistants were very helpful in orienting the map. After this initial hesitation, the community leaders, together with the VCSs, pointed out the first landmarks in the village, such as the Chinese brick area, the school, the mosque, the playground, and neighboring settlements. All the community members showed great interest in the map, but almost all of them had difficulty pointing out the boundaries of their family lands because the boundaries were hardly marked by visible objects. In addition to the problem of visibility of family land boundaries, not all family heads

were present during the initial mapping activity. It also turned out that few community members knew where the boundaries should be. In the field, no monuments or other physical objects are placed on the boundary. In summary, it was not an easy start for the community mapping exercise. However, as time went on, the understanding of the map was improved by guiding questions and explanations from the community mapping assistants. Relative locations such as left or right of the swamp, crossing of roads and trails, and naming of bordering families helped a lot to get a first rough overview of the family lands from those present. After 2.5 hours, 7 out of 11 family lands were roughly delineated on the map. On the second day, families not present on the first day were invited to participate in the mapping session. Especially in forested areas, the family landowners had great difficulty locating their boundaries. Additional GNSS measurements were taken with a local community representative using the Trimble Catalyst DA2 antenna and Penmap software. Sketches on the satellite image were corrected for locations where GNSS measurements showed discrepancies with the sketched lines. Due to time constraints, only 1 parcel and several boundary points of a second parcel could be surveyed. However, this approach seemed to be very promising for contexts with less visible boundaries, as it is not necessary to walk the entire boundary, but rather to cross-check those boundary points that could not be indicated on the map with a high degree of confidence.

3.2 Results of the digitization with SmartLandMaps

The success of digitisation depends largely on the distinction between the sketched lines as foreground and the orthophoto as background. Especially in contexts with strong contrasts and dark elements such as shadows or vegetation, a careful calibration of the parameters is essential. Two parameters are found to be most important: the threshold to derive the binary raster image and the generalisation parameter to simplify extracted polygons. The boundary threshold is applied to the grey-scale converted original image, and it functions as filtering the dark pixels in the image, which make up the boundaries. Choosing a low threshold might result in more gaps in the boundaries, and choosing a high value tends to lead to a noisier image. Therefore, it must be chosen according to the overall brightness of the boundary pixels. The generalisation parameter (maximal tolerance value) is a distance given in map units – arc degrees – which is applied by the Douglas-Peucker algorithm as a threshold to reduce the number of vertices. The higher this value is, the more details of the features are simplified, hence, it must be chosen in accordance with the desired level of detail and the map scale.

Results of the digitization are presented in the table below indicating selected parameters, as well as the error of omission and the error of commission as quality measures. Typically, those are used to assess the accuracy of classification results (Congalton, 1991). The error of omission refers to polygons (i.e. parcel) that were falsely left out in the digitization pipeline. The error of commission refers to wrong classification results, in this case to polygons needing manual editing as parts of the polygon are not correctly represented.

Table 2: *Quality assessment of the automatic digitization process*

Boundary threshold	Generalisation parameter	TP	FP	FN	ME	Error of Omission	Error of Commission
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Benin Rural 1	60	5,00E-06	73	0	1	5	1%	7%
Benin Rural 2	45	5,00E-06	36	0	0	1	0%	3%
Benin Rural 3	60	5,00E-06	62	1	1	4	2%	6%
Benin Rural 4	60	2,00E-05	43	0	2	1	4%	2%
Benin Urban	55	2,00E-05	193	0	9	10	4%	5%
Chad North	45	5,00E-06	50	0	2	0	4%	0%
Chad South	60	2,00E-05	24	0	0	1	0%	4%
Sierra Leone	75	2,00E-05	10	0	2	0	17%	0%

TP: True Positive, FP: False Positive, FN: False Negative, ME: Manual Editing Needed (values indicate the number of polygons/parcels)

A total of 491 plots were successfully digitized across all study sites (see Table 2). The boundary threshold varies slightly across the datasets, with 60 being the optimal value in 4 out of 8 datasets. Optimal values were assessed with the highest value for true positives and the lowest value for false negatives. The comparatively large difference between Chad Northern and Chad Southern can be explained by different lighting conditions during the process of photographing the map, as land use and map objects are very similar in both areas. The error of omission is related to the threshold, as polygons are only correctly vectorized (=true positives) if the sketched line is classified without gaps when creating the binary raster. False positives refer to polygons created in places where there are no sketched lines and seem to be less of a problem since they only occur in one instance. In contrast, false negatives refer to polygons that were not reconstructed even though a sketched parcel was present. The highest number of misses can be observed with the Benin Urban dataset and can be explained by the presence of dark shadows on walls and houses, which required a low threshold to avoid over-classifying the binary image. As a consequence, some black lines also showed some gaps and were not correctly vectorized as a consequence. Nevertheless, the error of omission is below 5% for seven of eight datasets. 17% for Sierra Leone is very high compared to the others. However, this value can be explained by the low total number of parcels (only 11), causing a high weight of individual errors. More data from this context would be needed to assess whether the high error of omission for Sierra Leone is systematic.

In five out of eight cases, the commission error is slightly higher, as indicated by a higher number of polygons that require manual editing because they could not be reconstructed correctly. The cause of this error has two dimensions: 1) truncation of edges due to oversimplification (see Figure 5, A), 2) creation of discontinuities due to dark map features that cannot be sufficiently distinguished from the black line (see Figure 5, C and D).

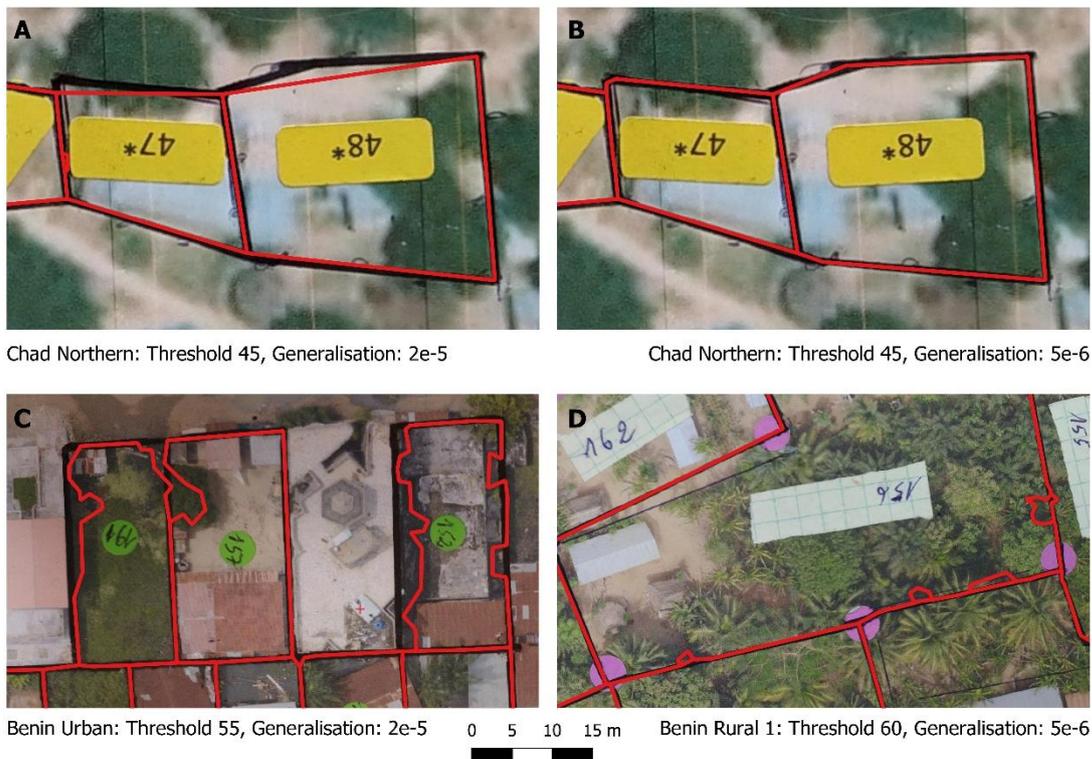


Figure 5: Examples of the error of commission: A: Generalisation too high, B: Generalisation performs well, C and D: Discontinuities due to dark shadows of walls/vegetation in the vicinity of sketched lines.

After line detection and polygon extraction, label extraction is performed to align the non-spatial data with the spatial data. Here, results can only be reported from the Chad North and Chad South and Sierra Leone datasets, as these specific yellow labels (as visible in Figure 5) were not used in Benin. While label recognition and interpretation worked 100% for the Sierra Leone dataset, two misses (74 out of 76 labels) are reported from the Chad dataset. On closer inspection, it becomes clear that the label size in these two cases is very small. The parcel was so small that the label had to be cut off to fit inside the parcel. Since the automatic extraction includes a size threshold for filtering candidate labels, these two labels were excluded from further processing.

4. DISCUSSION AND CONCLUSION

From the results presented above, it could be shown that with proper calibration of the parameters, the automatic digitization software is robust with an average detection rate of 96%, which could be demonstrated in rural, peri-urban and urban contexts. Label extraction also works reliably for standardized labels such as those used in Sierra Leone and Chad. Calibration of the parameters may require some human interaction with the SmartLandMaps software. However, it is likely that similar sets of parameters will be used as efforts are scaled up. Looking

to the future, loops can be programmed to test different parameter constellations. By evaluating the results, the optimal parameter settings can be automatically derived.

The participatory mapping process went well in all three cases, although there were differences in map-reading skills and the time needed to complete the data collection of a spatial unit. Situation-sensitive and well-trained mapping assistants are essential to facilitate communication, discussion and consensus building. Especially where the physical objects defining the boundary are less visible, mapping facilitation by mapping assistants is critical. Key characteristics of these individuals should include appropriate communication skills, a deep understanding of the map and a sense of orientation, as well as the ability to empower the community and allow them sufficient time and support to understand the map.

Last but not least, careful sketching and appropriate photography of the annotated map are critical to the success of the digitization process. If the photographs are taken under unfavorable conditions (e.g. poor lighting), there is a high risk that a lot of noise will be included in the binary raster, which is supposed to show mainly candidates for sketched lines. In addition, if the traced lines are not complete, the software will not be able to create a closed polygon of the spatial unit.

Based on those conclusions, the following statements can be derived with regard to the introduced characteristics of the SmartLandMaps process.

4.1 Versatility

It was shown that SmartLandMaps can be applied in different contexts with an adopted community mapping process, depending on different tenure systems, community structures and visibility of boundaries. Where boundaries are poorly visible and the participatory mapping process alone cannot produce reliable sketches on the orthophoto, a combination with additional ground measurements where necessary can be considered. Easily identifiable labels allow merging of non-spatial data with spatial units. In the future, different colors for the labels can even allow for different layers of information on one map.

4.2 Simplicity

The simplicity of the process was validated through several pilots. The main mapping activity required only a pen, a printed orthophoto, and a mobile device with a camera. Because SmartLandMaps allows for an almost completely automated digitization workflow, mapping assistants need only very basic skills to facilitate the mapping activity, but also to initiate the digitization. Simplicity applies not only to the mapping process, but also to the ease with which community members engage with the map as an accessible and easy-to-understand method of collecting spatial information.

4.3 Inclusivity

Inclusiveness can refer to the diversity of tenure systems or to the dimension of the people participating. In the three study sites, SmartLandMaps was demonstrated to include legal tenure as well as customary tenure. As for the dimension of inclusiveness of the mapping process, we

observed all kinds of participants in the mapping session, including women and men, old and young, people with disabilities, educated and literate people, as well as illiterate and less educated people. It seemed to us that no one felt excluded.

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