Community Land Mapping in Tana River, Kenya

Supporting Namati and Kenya Land Alliance in Mapping Chara and Handaraku Community Lands

SPATIAL COLLECTIVE

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Acknowledgements

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About Spatial Collective

Spatial Collective is a Kenyan company specializing in community mapping. Spatial Collective supports communities and organizations in adopting available technologies to collect, store, analyze and own data on issues that are important to them and then help them use that information to improve development outcomes. We specialize in remote and difficult to access areas, work on topics such as community land rights, crime and insecurity, and access to services in informal settlements. Since 2012, our team has delivered projects in countries across Africa and worked with a range of the leading organizations in international development.

List of acronymns

API	Application Program Interface
DFID	Department for International Development, United Kingdom Government
GIS	Geographic Information Systems
GPS	Global Positioning System
GPX	Global Positioning System Exchange Format
KLA	Kenya Land Alliance
LRM	Land Rights Mobilizer
TARDA	Tana and Athi River Development Authority
QGIS	Quantum Geographic Information System

Executive summary

Pending the passing of the Community Lands Bill - anticipated in 2016 - Kenyan communities will be able to apply for title deeds that will allow them to secure, preserve and claim rights to their ancestral lands. One of the requirements to registering community land will be for communities to agree on and identify the community resources and boundaries to determine which entity deserves recognition for ownership. For this reason, there is an urgent need to build the most affordable and sustainable systems for mapping community lands.

Spatial Collective, with support from Omidyar Network and Oxfam, provided technical assistance to Namati and their partner Kenya Land Alliance on delineating community lands in two targeted communities - Chara and Handaraku - in Tana River County. This report provides a summary of activities and lessons learned during several weeks of training and fieldwork activities conducted by Spatial Collective.

To complete the task, Spatial Collective used a mixed-methods approach to mapping community lands, including, training of Namati and KLA staff on appropriate selection of tools and subsequent data collection; participatory map drawing with communities to determine the size, locations of boundary points and land use in the area; GPS data collection to capture locations of community land boundaries and land features; post-processing of data including digitization of satellite imagery; and finally, producing two maps depicting community lands of Chara and Handaraku communities in Tana River County.

There was a general consensus among the project partners and government officials that mapping of community land is a technically and politically sensitive undertaking. Spatial Collective recommends that the work of future and current land advocates is at least supported by GIS or surveying professions.

Due to the size of the terrain and its features, GPS mapping and post-processing using satellite imagery proved to be a viable solution to capturing community lands, however, the introduction of technology to the boundary harmonization increased existing tensions in the land reconciliation process. Spatial Collective therefore recommends that GPS mapping follow the boundary harmonization process as documented in Namati's Community Land Protection process.

Spatial Collective also recommends further research into the existing and proposed legal framework for community lands and determining how this framework relates to national mapping standards.

While the methods used fulfilled expectations from the partners and communities, they can be time consuming and likely too technically demanding for wide scale adoption. To scale-up the documentation of community lands, more focus is needed on finding low-cost and low-skill GPS and GIS technology for community land mapping, as well as on building appropriate land administration systems for managing spatial data.

> *"Community space is a contested space. Many actors want to use it for various purposes and communities and their community land often receive a beating."*
>
> **Lumumba, CEO, Kenya Land Alliance (KLA)**

Methodology

Between February and May 2016, Spatial Collective worked with Kenya Land Alliance (KLA), Namati, Oxfam on mapping community lands in Kenya. These three organizations were running an existing program in Kenya, focused on securing land rights in 15 communities in two counties: Tana River and Turkana. KLA is the implementing partner for the community work and Namati provides technical assistance based on their Community Land Protection Facilitators Guide. Oxfam is the funding partner with support from DFID.

Spatial Collective partnered with KLA and Namati 16 months into the boundary reconciliation process in two neighbouring communities in Tana River county: Chara and Handaraku. KLA and Namati chose these two communities (out of the 15) because the boundaries of the two communities were already consolidated and they were therefore ready for technical data collection and mapping. Omidyar Network, specifically the Property Rights Initiative, provided financial support to Spatial Collective this work.

We believe that using geospatial technology for community lands mapping will provide evidence to support land rights claims that will be accepted by the Kenyan government. In order to delineate community lands of the two targeted communities we used the following methods:

Step 1: Review existing information about target communities: Chara and Handaraku

Step 2: Select tools and methods to test and develop a tailored training programme

Step 3: Train land rights advocates on the basic GIS concepts and steps on community mapping project management and map creation

Step 4: Conduct fieldwork training on GPS data collection and logistics of mapping activities.

Step 5: Provide on-going support in data management to Namati and KLA, including an introduction to digitization of satellite imagery and map creation

Step 6: Create finalized maps of the two communities: Chara and Handaraku

Step 7: Document lessons learned, paying particular attention to goals of cost-effectiveness, accessibility, and scalability, including the most appropriate methods for data collection that could fit within Namati's current model

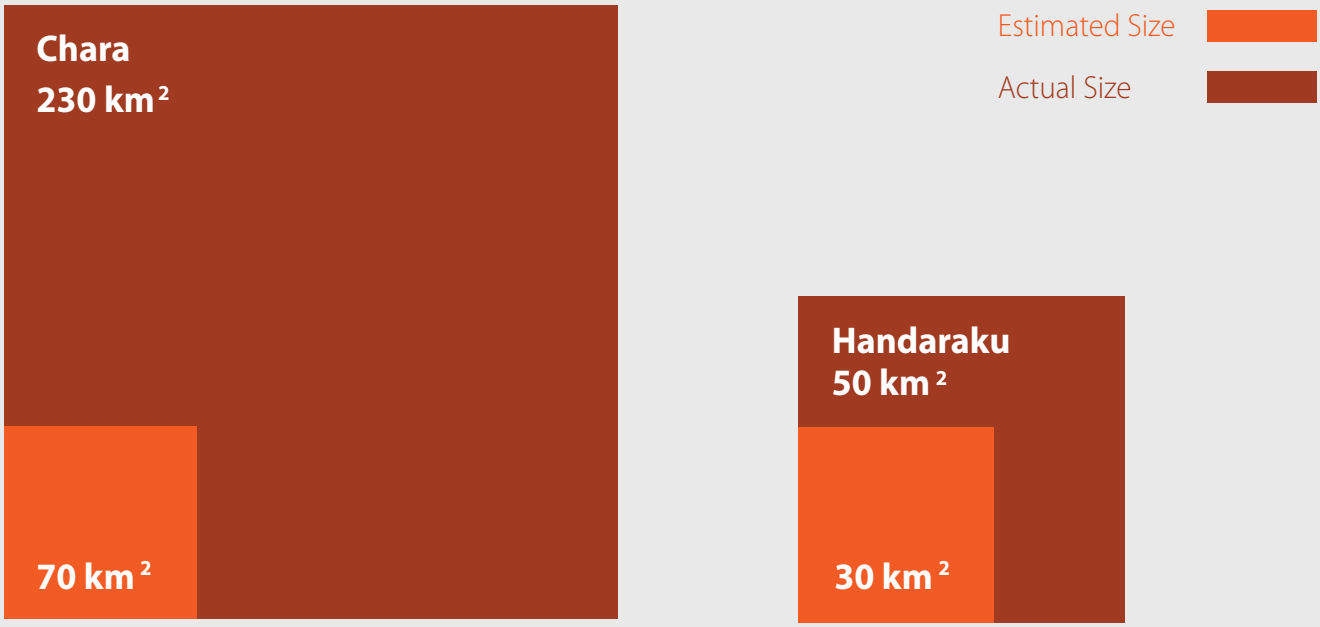
Review of existing information about target communities: Chara and Handaraku

To draft maps of communities in areas that lie at periphery of the country's development initiatives, we had to first determine what data were already available. We reviewed available open data, such as Kenya Open Data and OpenStreetMap (OSM) data, and quickly realized that there was very little data available on the area of operation. We assumed that this "lack of geospatial information about the area can mean that the area is inaccessible, lacks interest, is sensitive, or it may also mean that the state in the area is 'spatially challenged,' in that the projection of its governance is hardly enforceable in that particular geographic area and period of time." [1]

Additionally, we had limited time to acquire available datasets, such as Topographic Sheets (toposheets) or other government data. For this reason, we relied on our partners Namati and Kenya Land Alliance to provide us with the initial information regarding the two targeted communities. Namati and KLA estimated Chara community at 70 square kilometers and Handaraku at 30 square kilometers, however, through fieldwork, we learned that the actual size of Chara is 230 square kilometers and Handaraku 50 square kilometers. The reason for misrepresentation of the size of the two communities is likely because our partners only relied on sketch maps for estimates. While sketch maps are an excellent resource for understanding features and boundary points they are not to scale, thus making any accurate estimates regarding the size of a community rather difficult.

Proper use of topographic maps and satellite imagery can provide better estimates for planning of community mapping work, additionally, adequate time should be allowed for a reconnaissance mission and for collection of relevant secondary data (topographic sheets and satellite imagery).

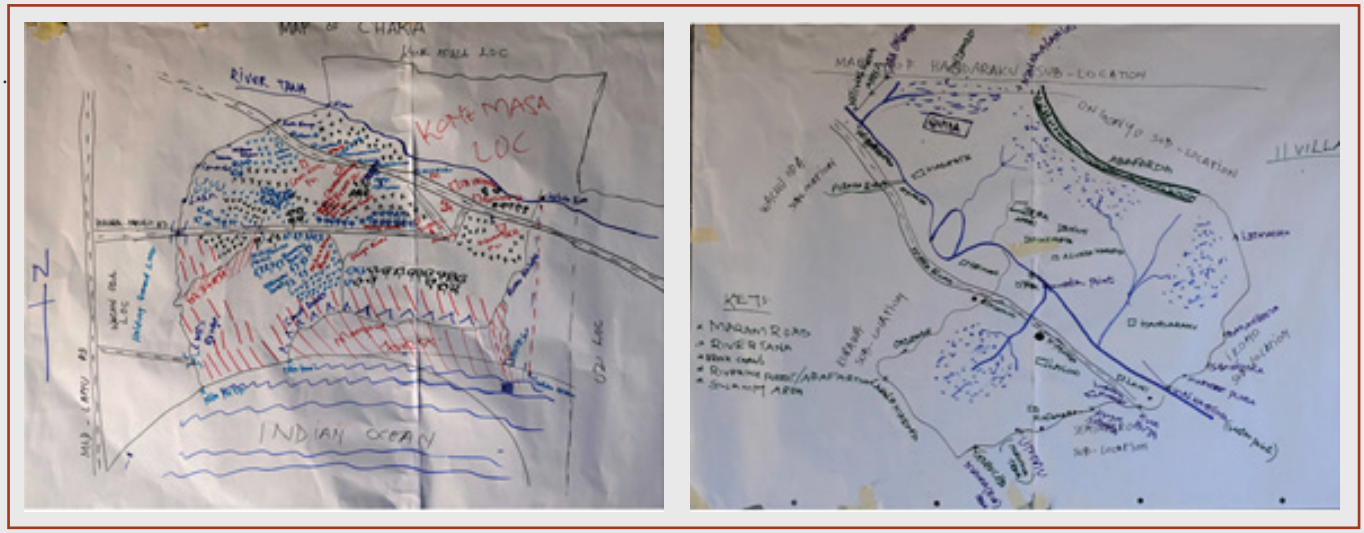
Some of the data available to us prior going to the field:



Size of the areas as estimated by Namati and KLA compared to actual size of the areas

[1] *Steven Livingston and Gregor Walter-Drop, "Information and Communication Technologies in the Areas of Limited Statehood," SFB-Governance Working Paper. Series 38, (2012): 1-26*

Points, lines and polygons in the area of operation available in OpenStreetMap



Chara and Handaraku sketch maps

A criteria for selection of tools and methods for mapping community land

Based on our previous experience conducting similar work in comparable terrains, we selected a mixed-methods approach to community lands mapping. We selected a variety of geospatial and participatory tools and methods that would be appropriate for the field conditions. Additionally, we developed a criteria for our partners to consider in future community lands mapping. We refined the criteria after the fieldwork. The fieldwork is described in subsequent sections.

Criteria	Considerations	Options: Technical tools and logistical considerations
Enabling environment	**Who are your allies?** **Who are your opponents?** **What are the risks to your staff and community members?** **Are community boundaries reconciled?**	**Consider socio-economic, political, cultural, historic, and ethnic history of the area** **Gather either evidence of the following: name of the community; community facilitator assigned to the community; names of the key coordinating committee members; brief summary of the activities conducted to date and any challenges experienced with boundary harmonisation; any expected challenges (e.g. no network coverage)** **Remote data analysis may be a preferred option - satellite or aerial imagery analysis - if there are risks from opponents** **If there is broad support for the work, fieldwork with GPS and/or mobile tools may be possible**
Size of the area	**What is the size of the area?** **What tools can you use to determine the size as you are planning your work?**	**Speak to local people to get an idea of how long it would take to walk, drive or bicycle around the area. This will help determine if the time and resources are available are adequate** **Map drawing is a good exercise to determine the size of the area and features within an area** **Use of topographic maps or internet platforms, such as OpenStreetMap or Google Maps or Google Earth to identify the area ahead of fieldwork, and begin to estimate size**

Criteria	Considerations	Options: Technical tools and logistical considerations
Terrain	What are the terrain types in the area of interest? Is there road access to all areas you want to map? How does the season affect possible data collection?	Use of satellite imagery, topographic maps or internet platforms, such as OpenStreetMap or Google Maps or Google Earth, to identify the area, terrain types and other features within the area Choosing the right season (rainy or dry) for mapping saves time, energy and spending
Existing data sources	Identify existing data sources (avoid duplicating efforts if data already exist)	Look at acquiring existing and available topographic maps from government agencies, open data portals (e.g. Kenya Open Data Portal, World Bank Open Data, OpenStreetMap)
Type and accuracy of data required	What data do you need? Is the information represented by points, lines or polygons? What degree of accuracy is required for the final output?	Community land has features that can be represented by points (e.g. villages), lines (e.g. rivers and roads) and polygons (e.g. forests, grazing areas). Methods and tools selected need to capture and represent all of these features For community lands, general boundaries are sufficient, meaning those whose position has not been precisely determined and which usually relate to some physical features. For mapping property rights in urban and peri-urban areas, fixed boundaries and sub-meter accuracy is required in Kenya
Available resources (budget)	What financial resources do you have available for the project? Resources should include both labour (e.g. staff time) and direct costs (e.g. transportation, equipment, software licenses, meeting costs)	Field data collection is resource intensive Remote data analysis may not be possible if you do not have enough reference data so resource mobilization may be required

Criteria	Considerations	Options: Technical tools and logistical considerations
Available human resources (staff) and skill level	**Who is available for the work?** **What is their skill level?**	**Consider having: a Project Manager to oversee the planning and implementation of activities; a GIS Field Manager(s) to plan and oversee field operations, Data Collectors with a field team structure to support organized data collection and coordination**
Mobile network coverage	**Is there mobile coverage in the area?**	**Use hand-held GPS devices for areas with limited mobile connectivity** **Develop a safety and communication plan for coordinating field activities in areas of limited mobile connectivity**

We assessed the information provided to us by KLA, Namati and Oxfam against the eight criteria, and made the following assumptions about Chara and Handaraku:

1 **Enabling environment -** the boundaries are harmonized and there is buy-in from the community and county government for the mapping process. The community has been mobilized and informed about the process. GPS mapping is a good option, as it allows us to become familiar with the area, train KLA staff and collect data on community features.

2 **Size of the area -** the communities were estimated to be between 70 - 100 square kilometers and we would be able to walk on foot and use vehicles to collect the data within a day or two.

3 **Terrain -** we had limited information about the terrain, aside from learning that it was a grasslands environment, and thus wanted to use GPS data collection to familiarize ourselves with the area.

4 **Existing data sources -** in the time available, we were not able to obtain existing data sources. OpenStreetMap and Google Maps had limited data about the area - most roads and villages were missing. We had a centroid location for the two communities and the closest commercial centre, but one location was incorrect.

5 **Type and accuracy of data required -** for community land mapping, general boundaries are acceptable. An accuracy of 3 meters (as provided by the Garmin e-Trex 20 handheld GPS) is adequate for the final output. We were required to collect point and line data and thus needed a tool with long battery life and that could capture both feature types.

6 **Available resources -** funding for the work was adequate to cover training and fieldwork activities, including food, accommodation, air travel, vehicles, fuel, etc.

7 **Available human resources -** the staff and community members were mobilized by KLA and available to conduct fieldwork. The skill level of the staff was unknown ahead of the field visit and proved to be a challenge for fieldwork (discussed below).

8 **Mobile coverage -** we made an assumption that mobile network would be available during fieldwork. This proved to be incorrect and there was limited mobile connectivity in the two communities.

Using the available information and assumptions, the central piece of our methodological approach was GPS data collection supported by digitization of satellite imagery. Specifically, the tools we used were:

- Garmin e-Trex 20 handheld GPS
- QGIS for data management
- BRCK for wireless Internet in the field
- Digital Globe's Maps Application Program Interface (API)
- Android mobile phones for communication and Internet access

And the methods:

- Secondary data collection and review
- Assessing the environment (electricity and mobile connectivity, accessibility, etc.)
- Evaluating the capacity of Namati and KLA to conduct community mapping
- GPS and mapping training of KLA and Namati staff
- Sketch mapping with community members to design the field data capture
- GPS data collection of selected boundary points and community amenities
- Basic data management (data transfer and storage)
- Post fieldwork data management (digitization) and map creation
- Feedback support

Training for land-rights advocates in community mapping

The main goal of the training exercise was to support Namati and KLA staff on how to organize and implement community land mapping activities, specifically, how to select the right tools, collect data (GPS) on boundaries and other community resources in the field, and how to use basic GIS concepts to store and manage field data.

The first part of the training was held in Malindi with the following participants:

- 5 KLA community facilitators, 3 from Tana River County and 2 from Turkana County
- Two, more senior KLA staff, from the head office in Nakuru: a communications officer and a community land rights coordinator
- Program Officer from Namati, from the San Francisco office
- Oxfam's Land Rights Coordinator, who participated in 3 days of training

Name	Org	Role	Education Level	Yrs of Experience	Basic Computer	Relevant conceptual and practical skills
Marena Brinkhurst	Namati	Program Officer	Masters - Natural Resource Mngmt	4	Yes	Has good conceptual understand of GIS but no previous experience with GPS devices or GIS software
Rebecca Wangui	Oxfam	Land Rights Coordinator	Law Degree	5	Yes	Has basic conceptual understanding of GIS but no previous experience with GPS devices or GIS software. Did not participate in fieldwork
Odha Ilu Hiyesa (Sayd)	KLA - Tana River	Community Facilitator	Completed Secondary School	1	No	No computer skills but good understanding of GPS data collection after training
Yusuf Omar Uleta	KLA - Tana River	Community Facilitator	Completed Secondary School	1	No	No computer skills but good understanding of GPS data collection after training
Farhia O. Kuno	KLA - Tana River	Community Facilitator	Completed Secondary School	0	No	No computer skills but good understanding of GPS data collection after training
Charles Lokae	KLA - Turkana	Community Facilitator	College Certificate	3	Yes	Computer skills and good understanding of GPS data collection and data sharing

Sarah Adan	**KLA - Turkana**	**Community Facilitator**	**Completed Secondary School**	**0**	**No**	**No computer skills and basic understanding of GPS data collection after training**
Hillary Ogina	**KLA - HQ**	**Communicati-ons Officer**	**University (Bachelors)**	**6**	**Yes**	**Has good conceptual understand of GIS but no previous experience with GPS devices or GIS software**
Samson Maitha	**KLA - HQ**	**Community Land Rights Coordinator**	**Masters**	**14**	**Yes**	**Has basic conceptual understand of GIS but no previous experience with GPS devices or GIS software**

The initial training consisted of the following topics:

- Project design and implementation
- GPS data collection
- Basic data management in QGIS
- Introduction to communication strategies for technology, mapping and community land

The second part of the training is described in the next section. It was conducted in Chara and Handaraku communities in Tana River County with the same participants as above - with an exception of Oxfam's staff - and with the addition of a dozen (12) community land rights mobilizers and it included:

- A community forum to introduce the tools and methods, and plan the fieldwork
- Hands-on GPS mapping of the two communities' boundaries and amenities
- A forum with the 29 Land Rights Mobilizers from the 10 communities KLA and Namati work with in Tana River

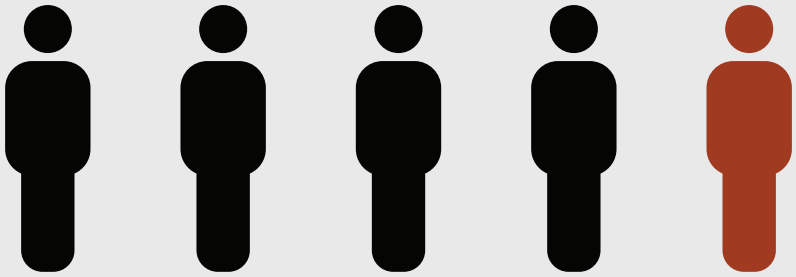
Outcomes and observations from the first part of the training held in Malindi

- All of the training participants - Namati, Oxfam and KLA staff and Land Rights Mobilizers - increased their understanding of how GPS mapping can be used to understand community land.

- None of the participants had any practical experience using GPS devices. After the training, they could describe a GPS device, the data file format (GPX) and transfer data from the Garmin e-Trex 20 device on to the computer and save the file. They could also identify the basic elements of a map: points, lines and polygons, and had a good conceptual understanding of how real-world features can be represented by either points, lines or polygons.

- We note that 4 of the 5 Community Facilitators who participated in the training had never used Microsoft Word or Excel before. This slowed down the training considerably, as we focused on concepts such as internal and external computer memory, how to use a mouse and how to copy and paste information from one folder to another. At the end of the 12 days of conceptual and hands-on training, the Community Facilitators all asked for more technical training and practice with transferring and editing data.

- The skills level of the Community Facilitators was not clearly understood by all partners. Community Facilitators are expected to send weekly reports to KLA (and Namati) and thus we assumed that they had basic computer skills. During the training, it became clear that only 1 of the 5 Community Facilitators had basic computer skills (Microsoft Word, Excel, Powerpoint, Internet usage, etc.).



Only 1/5 Community Facilitators has computer skills

Computer skills are a prerequisite for GPS and GIS data management. The lack of computer skills slowed down the training and will be a challenge to the scale-up of both Namati and KLA's community mapping work.

Land Rights Mobilizers during the forum

Hands-on training: fieldwork in rural Kenya

After the initial training of the land rights advocates in Malindi, we traveled with our partners to Tana River county for fieldwork.

Fieldwork initiated with a forum consisting of representatives from Chara and Handaraku communities; the two targeted communities. During the forum, Spatial Collective and the partners received updates on the work completed up to that point and took the opportunity to introduce geospatial technology, specifically Global Positioning Systems, to community based land rights mobilizers and other community members. In the forum, sketch mapping was facilitated for the purpose of planning logistics during the subsequent days of data collection.

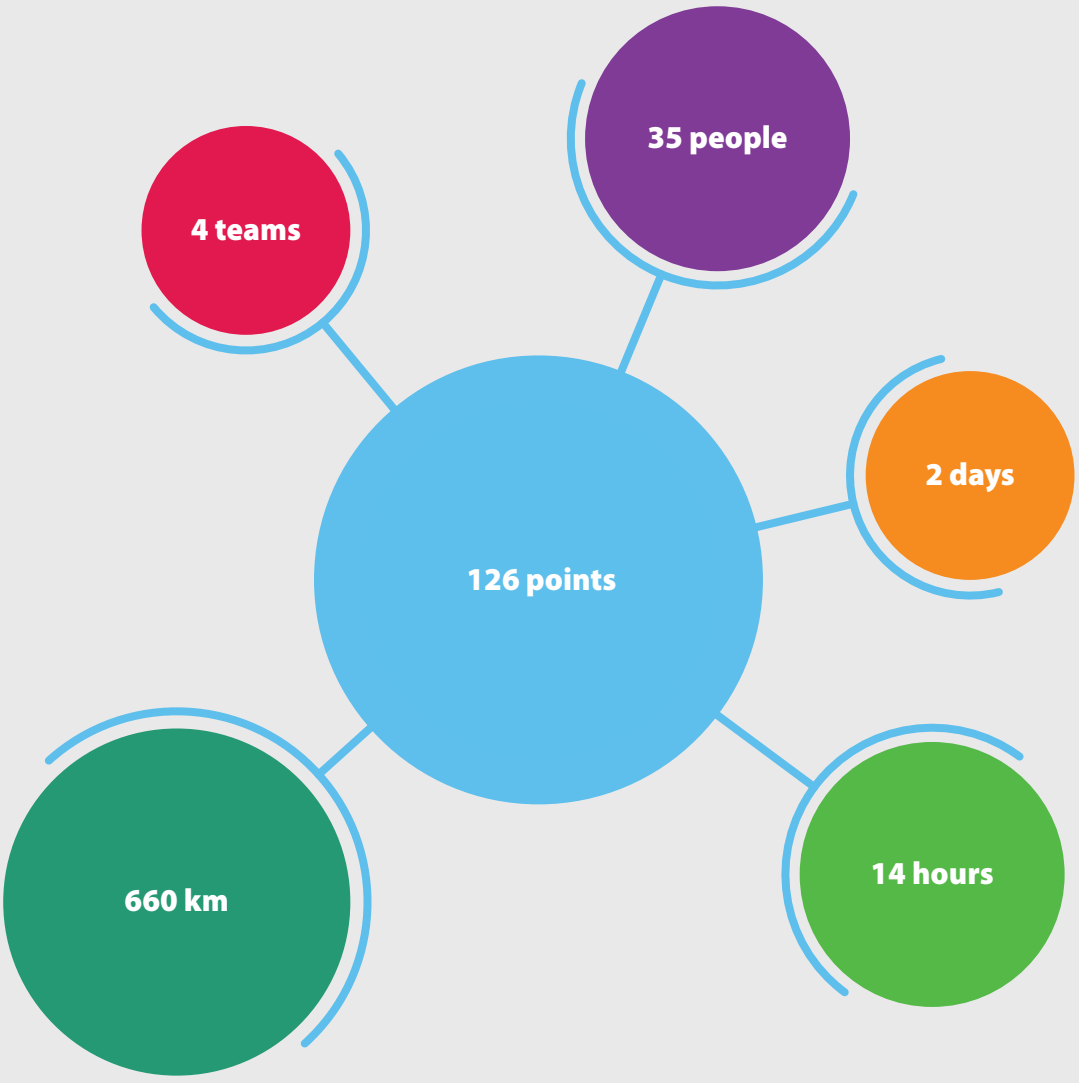
Some of the logistical challenges brought forth by the communities were:

- The communities specified that community lands are more than just boundary points and that the fieldwork should also include collecting locations of community resources.
- Four teams would be needed to cover the vast area in the allotted time.
- The teams would travel with four-wheel drives and use motorbikes or walking to capture all of the relevant features.
- Each team would consist of one Spatial Collective staff, one to two KLA representatives and two to three Land Rights Mobilizers (community members from Chara and Handaraku).

Elders from Handaraku community inspecting the GPS unit

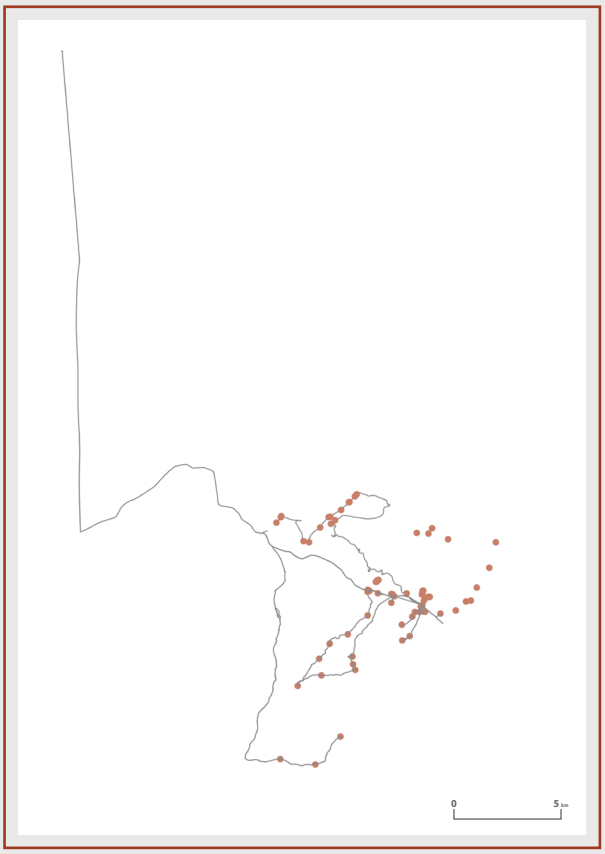
Some of the details of fieldwork were:

- Fieldwork was conducted over two days by four teams teams working between the hours of approximately 07:00 and 14:00.
- The fieldwork required the teams to drive approximately 1-1.5 hours each direction between Garsen town and the communities.
- In two days, Team 1 in Handaraku traversed approximately 120 km of terrain and Team 2 covered 100 kms (includes traveling back and forth from the base of operations in Garsen) using four-wheel drive vehicles, motorbikes and covering some areas on foot. In two days, Handaraku team collected 70 points.
- In two days, each team in Chara covered more than 220 km (440 kms in total) of terrain (back and forth from the base of operations) using four-wheel drive vehicles, motorbikes and on foot. In two days, Chara team collected 56 points.

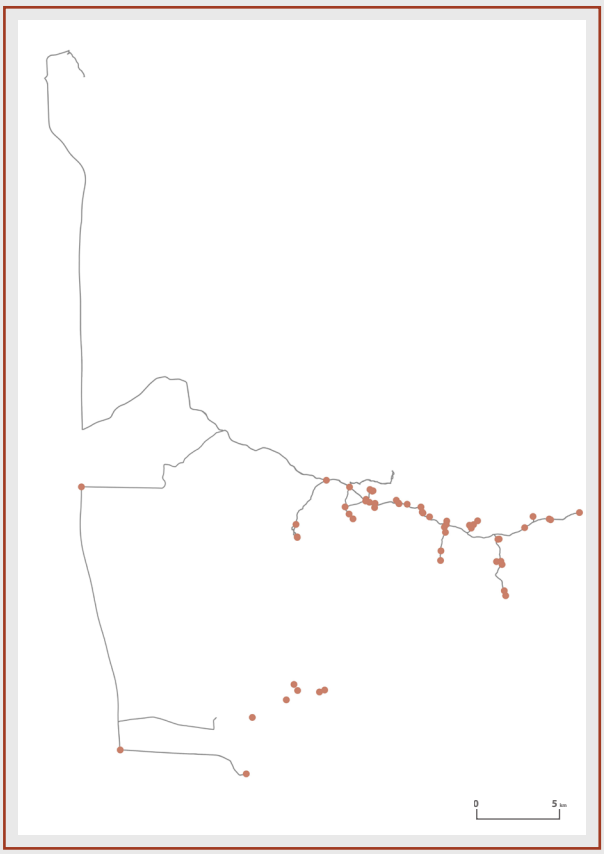


Fieldwork summary (2 days)

GPS points and tracks collected during fieldwork in Chara and Handaraku communities:



GPS tracks and points of Handaraku community



GPS tracks and points of Chara community

Furthest point accessible by vehicle

Outputs of the fieldwork:

- Sketch maps of natural resources and boundary points of two communities
- 126 community land GPS points captured, with corresponding field notes
- Several hundred kilometers of tracks captured
- Photographs

Challenges:

- Prior to going to the field, Spatial Collective received very little information about the area in terms of size, type of features, etc. This was due to limited time allowed for planning and poor communication from the partners; this made it more difficult to plan logistics and to coordinate activities.

- Another major issue was that it wasn't clear whether the boundaries were fully reconciled. As it turned out, not all of the boundary points seemed to be reconciled prior to fieldwork, putting field teams into difficult situation on more than one occasion. Improved communication from the partners can solve this issue.

- Despite the extensive work on budgeting, logistics were not properly planned by the partners (water, transport, food, etc.) The partners did not have previous experience with moving a group of 50 people around for fieldwork and did not understand how much work goes into mapping such vast areas.

- Tana River averaged about 40 degrees celsius during the day. Fieldwork in these conditions is not advisable, and in the evening there are security challenges which restrict movement; therefore fieldwork must start early (between 06:30 and 07:00 and finish before 13:00).

Costs associated with the fieldwork included:

- Vehicle rental at 200 USD per day, per vehicle (land cruiser or similar 4WD vehicle is required for the terrain), including a driver and fuel cost.

- Motorbike and driver hire varied depending on the amount of fieldwork done during the day. The teams found local motorbike drivers and hired them on the spot. A full day motorbike hire was about 25 USD but was not necessary as we switched between.

- 2 Litres of water per person, per day at about 2 USD per person, per day.

- Lunch for each person for the day at 3-5 USD per person, per day. Fieldwork is intensive and there were limited options for food for a large group moving around in the rural parts of Tana River.

- Reimbursement of community participants was not discussed and factored into the budget prior going to the field. This generated tension between KLA and community members. Given the nature and intensity of the work, we recommend that community members be reimbursed for their time for future mapping activities.

Community members discussing fieldwork

Post fieldwork data management and map creation

The final step in community land mapping in Tana River was to use the data from the field and design the two printed maps of Chara and Handaraku communities.

Data acquired during fieldwork were GPX files (points and tracks), maps drawn by the community members, notes and photographs. To process the data collected during the fieldwork, Spatial Collective and partners reviewed the GPX files, field notes and hand-drawn maps to identify boundary points. These data were overlaid on DigitalGlobe's satellite imagery for the purpose of digitization (turning GPX files and hand-drawn maps into shapefiles).

Specifically, post processing of data consisted of:

- Reviewing the data collected during fieldwork
- Managing GPX files (transforming them into shapefiles)
- Purchasing of relevant satellite imagery: Rapid Eye with 5 m resolution satellite imagery and Digital Globe's Maps API Subscription
- Digitization based on satellite imagery by using Digital Globe's Maps API
- Final map creation using QGIS

Additionally, Spatial Collective offered a follow-up training for five KLA staff, including three Community Facilitators from Tana River and one new Namati staff member:

- How to use QGIS, DigitalGlobe's Maps API (Satellite imagery) and GPS data from the field, to identify natural features with which the communities in Tana River identified during the GPS mapping
- Using GPS points from the field to locate natural and other features on the satellite imagery
- Digitization using QGIS and DigitalGlobe's Maps API

As a final step, maps that resemble toposheets found in Kenya were designed. The style was chosen because it offers a sense of familiarity to the citizens and the government agencies to whom they will be presented to support land rights claims.

Kenya Land Alliance and Namati plan to hold community meetings in Chara and Handaraku on June 8th and 9th, 2016. The purpose of the meetings is to present the maps back to the community participants and validate the data as presented on the draft maps. Spatial Collective will provide guidance to KLA and Namati in order to conduct these meetings and will update the maps to incorporate feedback from representatives from the two areas gathered during the meetings.

Post fieldwork data management and map creation

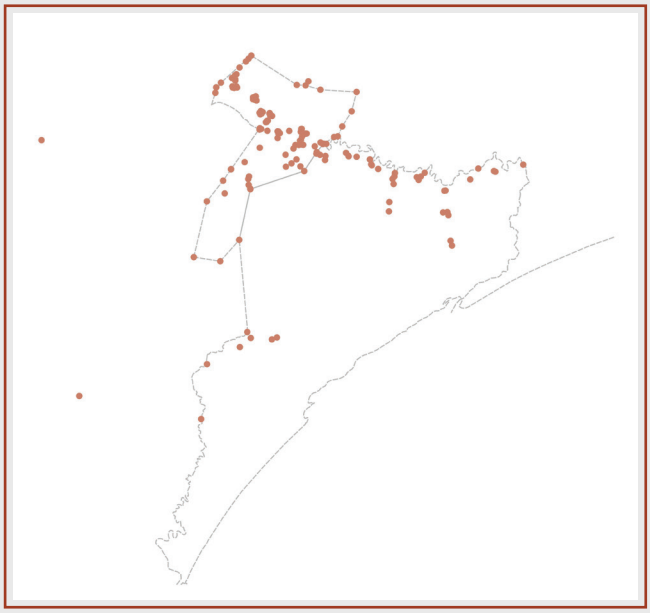
Natural Resources	Vector Feature	Amenities	Vector Feature
River/Brooks/Streams	Line	Villages	Point
Forests	Polygon	Schools	Point
Swamps	Polygon	Hospitals/Dispensaries	Point
Ocean	Polygon	Mosque/Churches	Point
Sand dunes	Polygon	Water Points	Point
Grazing Areas	Polygon	Roads	Line
Farm Lands	Polygon	Air strips	Point
Water pan (dam)	Polygon	Hotels	Point
		Footbridge	Point
		Cattle dip	Point

Natural resources and features mapped and digitized to complete community maps of Chara and Handaraku

To indicate the amount of data gathered by our field teams, we compared it to openly available OSM data in the same area of operation:

OpenStreetMap

Data Collected



Comparison between existing points in OpenStreetMap and points collected during fieldwork

Number of points in OSM	**6**
Number of points collected	**126**

A detailed comparison of some of the point data collected:

OpenStreetMap	Data Collected
6 Villages	*25 Villages*
0 Schools	*12 Schools*
0 Health facilities	*3 Health facilities*
0 boreholes	*11 boreholes*
0 police posts	*1 police posts*
0 religious institutions	*25 religious institutions*

OpenStreetMap

Data Collected

Comparison between existing rivers in OpenStreetMap and data generated through and post fieldwork

Length of rivers in OSM	**91** *km*
Length of rivers digitized	**381** *km*

OpenStreetMap

Data Collected

Comparison between existing roads in OpenStreetMap and data generated through and post fieldwork

Length of roads in OSM	**103** *km*
Length of roads digitized	**110** *km*

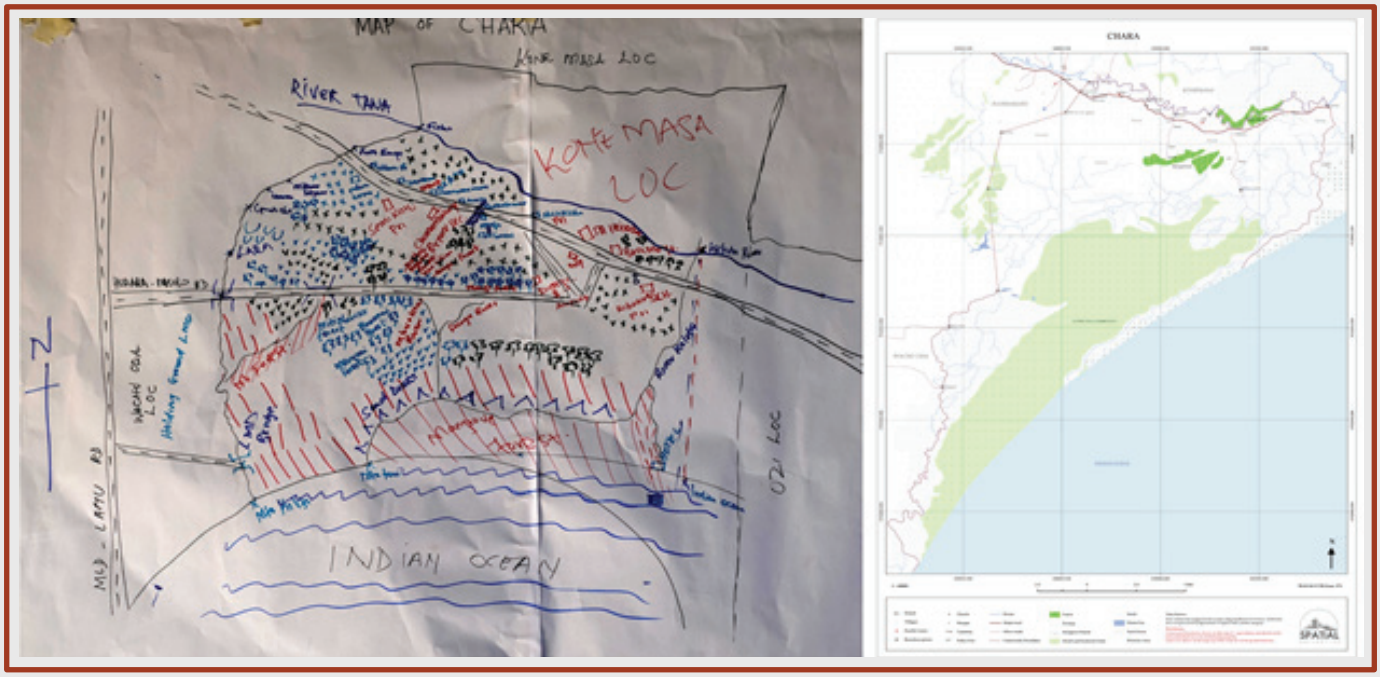
OpenStreetMap

Data Collected

Comparison between existing areas in OpenStreetMap and data generated through and post fieldwork

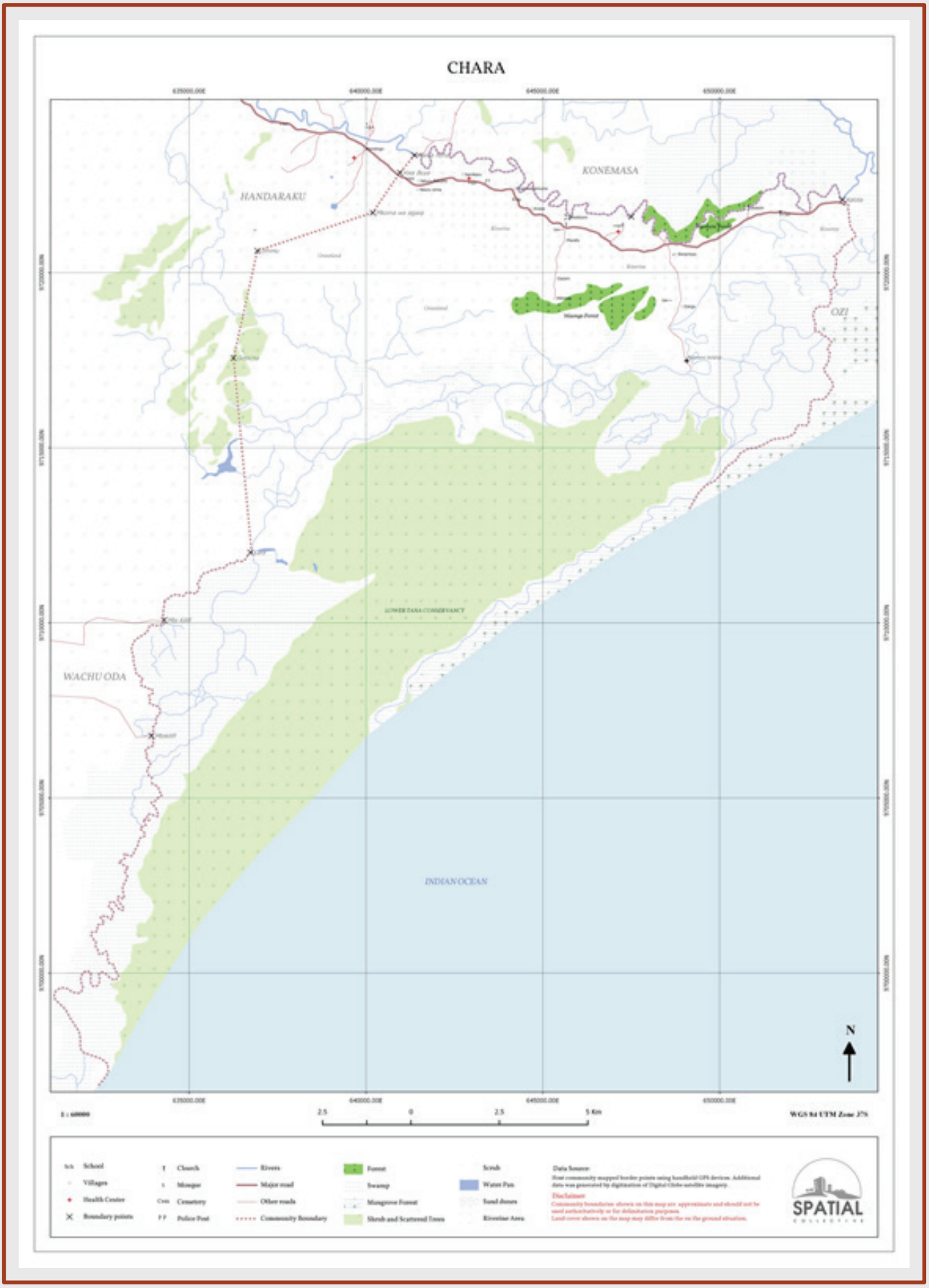
Areas in OSM	**17** km^2
Areas digitized	**590** km^2

After digitization, the maps that resemble toposheets found in Kenya were designed. Images below compare the initial dataset - sketch maps - and final georeferenced maps of the two communities: The following two pages contain the two drafted maps in detail.

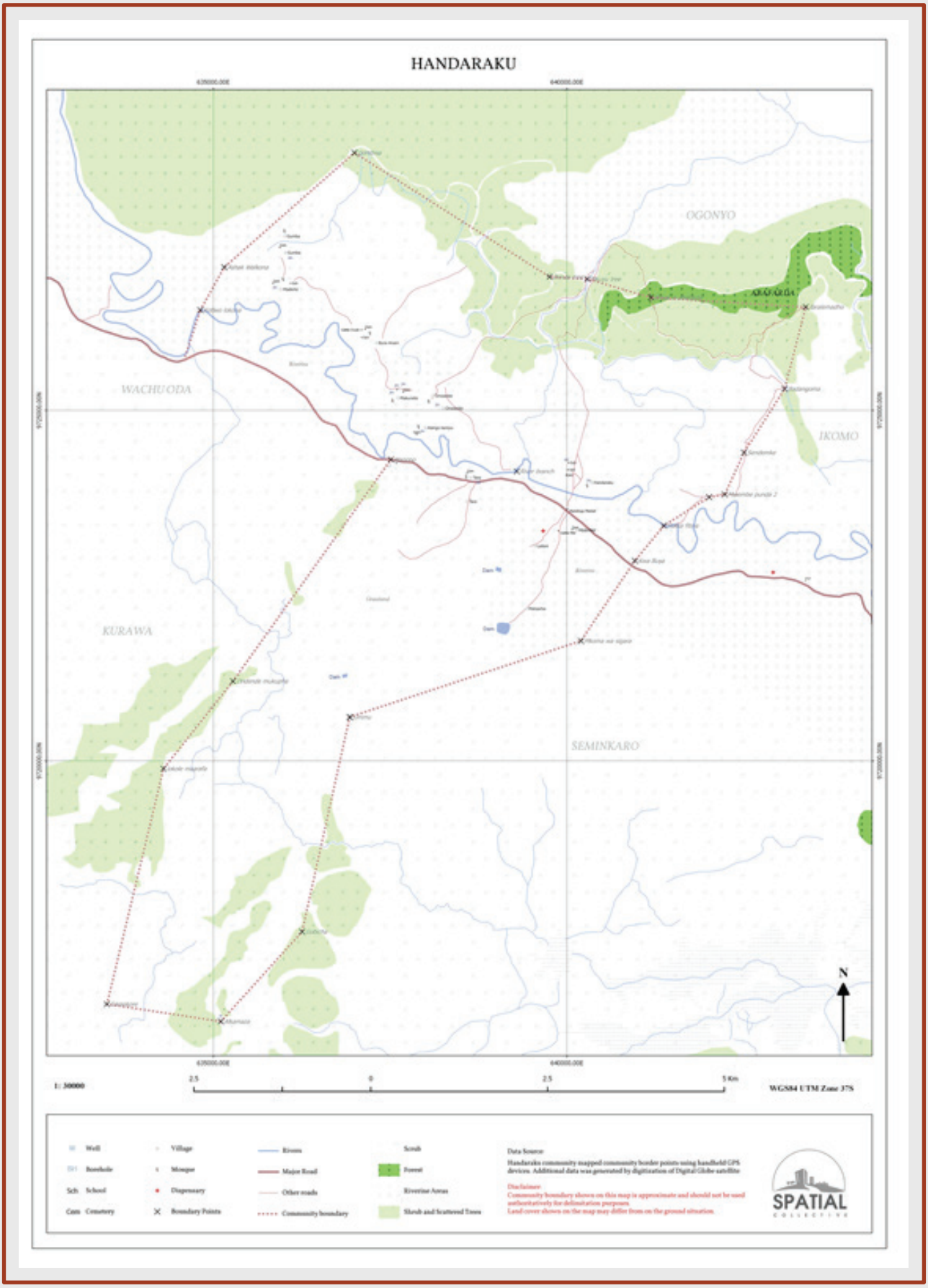


Chara drawn map (left) and georeferenced map (right)

Handaraku drawn map (left) and georeferenced map (right)



Chara Community Map - draft



Handaraku Community Map - draft

Key observations and recommendations

Spatial Collective joined KLA and Namati in the field in February 2016, to produce two community land maps of Chara and Handaraku communities in Tana River county. Below are some of the key observations and recommendations from the field.

The environment:

- Tana River Delta is an area lush with various types of land cover, including shrubs, savanna, marshes, forests, sand dunes, rivers, farmlands, grasslands, natural reserves and areas safeguarded for development by the national and county government. Due to the varying environmental conditions, the field team had to constantly adapt the mode of transportation, including four-wheel drive SUVs, motorbikes, and walking on foot.

- The area has low mobile connectivity and limited electricity supply. There are few spots with mobile network connection within the two communities. Low connectivity presented logistical problems during fieldwork, as communication between teams was not possible during most of the day.

Recommendations:

- Future field activities should be preceded by a reconnaissance mission undertaken by a GIS professional. This will allow the team to understand the size of the area, develop a more accurate estimate of time and resources required and develop a communication and safety plan to conduct fieldwork.

- Alternative communication options in low connectivity areas are satellite phones and VHF radio. The field team could establish a central communications point, such as a market with mobile connectivity, to facilitate communications outside of the field (in case of emergency such as a stuck vehicle, an injury or a conflict).

Land conflicts:

- There are on-going land conflicts between communities and TARDA (Tana and Athi River Development Authority) over land seized by the government but left unutilized by the development authority. Mapping TARDA lands was not possible because of the dangers posed by the conflict.

- Due to the size and features of the terrain, GPS mapping proved to be a viable solution to capturing community lands; however, the introduction of technology to the boundary harmonization increased existing tensions in the land reconciliation process.

Recommendations:

- It is important to talk about the areas of existing conflict and to indicate them for the purpose of documentation and to prepare a safety plan for fieldwork. Existing topographic maps or satellite imagery can be used to indicate the areas in question.

- Community land mapping is a technical and politically sensitive undertaking and should be supported by GIS and surveying professionals. GIS and surveying professionals can explain the different tools and methods used in community mapping, mitigate risks and liaise with other stakeholders to ensure the benefits of the exercise outweigh these risks.

- We recommend that GPS mapping does not proceed before boundaries between communities are agreed upon both within the community and with its neighbours.

Available data:

- There were very little data available on the area of operation and we had limited time to acquire available datasets, such as Topographic Sheets (toposheets), so we relied on local knowledge of the area.

- Namati and KLA estimated Chara at 70 and Handaraku at 30 square kilometers while the actual size is approximately 230 and 50 square kilometers respectively.

- Digital Globe Maps API was the superior option, in comparison to Rapid Eye satellite imagery, for digitization.

Recommendations:

- Sketch maps are an excellent resource for understanding features and boundary points, however, as they are not to scale, it is difficult to accurately estimate the size of a community. Proper use of topographic maps and satellite imagery can provide better estimates for planning of community mapping work. Adequate time should be allocated for a reconnaissance mission and collection of relevant secondary data (topographic sheets and satellite imagery).

- Access to toposheets can be advantageous during fieldwork planning and during map creation. Instead of digitizing every single feature from the satellite imagery, toposheets could be used to check against the newer satellite imagery for possible landscape and landuse changes and to use them as a base for community maps.

- Use of DigitalGlobe Maps API proved to be a better option for subsequent post-processing (digitization) of land features, rather than other commercial satellite imagery. The imagery had less cloud cover, better resolution and the product was cheaper for the task at hand. However, we used the Startup monthly license for 79 USD which allowed us to digitize online by using QGIS plugin. The service did not allow the user to download imagery. If the initiative was to scale, other licensing options are available, including a more costly Enterprise license that allows users to download imagery.

Data collection by communities

- According to interviews with the county government officials, including the Deputy County Commissioner, the Member of County Assembly and the Tana River County Surveyor, the county government is in favour of communities taking charge of demarcating their land as registration of community land is not possible without good geographic data. The Tana River County surveyor highlighted that "good geographic data collected by communities or maps can help surveyors faster identify community boundaries." With limited resources, it is possible that georeferenced maps will help speed up the process of land registration once the Community Land Bill is passed; however, this is yet to be tested.

> *"We really appreciate what you are doing with communities. This is supposed to be done by government, but we have limited capacity and resources, so we greatly appreciate the work…"*
>
> **Director of Lands, Tana River County Government**

- According to the local Tana River government surveyor, if mapping is done by communities, and if the community members both within the community and from the bordering communities agree on the boundaries (i.e. there is evidence of the agreement and there are no disputes), it can be used as an initial instrument for delimitation of boundaries and could potentially be recognized by the surveyor's office.

Recommendations:

- County government surveyors were supportive of the community lands process. Interviews with Tana River surveyors indicate that the GIS mapping will make land registration easier and reduce the time required for surveyors to verify community boundaries, putting them into "a more managerial role in relation to managing and using the land data." However, we did not engage surveyors in other counties and the proposed Bill has not been passed. Further research into the existing and proposed legal framework for community lands is needed, as well as testing the framework as related to national mapping standards once the Bill is passed.

- GPS mapping is a viable solution to capturing border points and community amenities, however, in order to adequately capture community land - including land use and locations of historical and cultural significance - satellite imagery and satellite imagery processing is required. Use of satellite imagery is also necessary because many areas are not accessible by vehicle or by foot.

Process of boundary reconciliation and technical mapping

- One of the most important requirements for recognition of community land maps by the county surveyor's office, is that both people from within and outside the community agree on the boundaries. For this reason the process of community mapping and boundary harmonization needs to occur within and outside the targeted community and with participation of all of the neighbouring communities. Furthermore, boundary harmonization proceedings need to be recorded (for example: signed meeting minutes, pictures, videos) for proof of the agreement.

- Methods need to be adjusted to the local realities. Prior to data collection, adequate time needs to be devoted to community participation in, for example, initial project planning, managing expectations about the work required and compensation, organizing logistics, documenting the process, etc.

- Boundary points are insufficient to document community land. In accordance with the proposed Community Land Bill, community resources and land use such as water points, grazing areas, migratory routes, villages, etc. must be documented in order to adequately capture community's claim to their indigenous land.

- Introduction of technology completely shifts the power dynamics between the facilitating organization and the community, as well as within the community itself.

Recommendations:

- To operationalize and record boundary reconciliation proceedings, it is important to set up proper monitoring systems, such as video recordings of meetings (a suggestion put forth by the county surveyor in Tana River); signed meeting minutes; formal invitations to boundary harmonization meetings, chief barazas, etc. An information management system is required to enable storing and easy access to data.

- To fit the local realities, a participatory and inclusive approach to community mapping should be implemented, including, training, participatory planning and project implementation.

- Through sketch maps, communities identified boundary points of their community lands and other features associated with that land. To adequately document community land, land use and other land features need to be documented. The most appropriate way to document land use is through the use of satellite imagery.

- Introduction of technology changes power dynamics within and outside the community, hence, it is important that a technical specialist is attached to the project from the beginning in order to explain issues, such as, how technology works and how it fits into land registration process; what are the benefits of mapping; what demarcation is; and to manage expectations of community members.

Capacity of partners

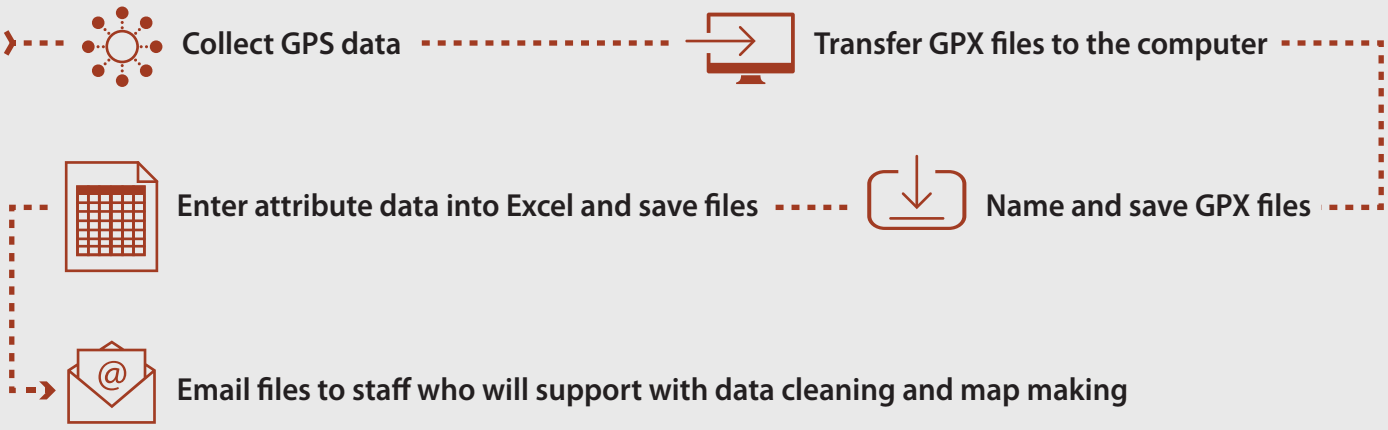
- Technical capacity of the selected KLA staff (Community facilitators) to take on the task of data management was not well understood by the partners. KLA and Namati should prioritize additional capacity building for field staff (i.e the Community Facilitators). We emphasize that basic computer skills are a requirement for GPS and GIS data collection and management. Four of the five Community Facilitators do not currently have even basic computer skills, yet, they were expected to be the point people in data collection and sharing.

- Some of the KLA and Namati staff are new to community work. All steps in the Namati process should be led by community facilitation experts who take into account local customs and context.

- A lack of computer literacy amongst field staff will be a challenge for scaling community mapping within Namati's existing model for Community Land Protection.

Recommendations:

- Basic computer skills, such as Microsoft Word, Excel and internet search, are a requirement for individuals who will be involved in data management. An example of the workflow piloted in this project is that Community Facilitator would complete the following steps:



- KLA and Namati could invest in basic computer training for all Community Facilitators.
- To scale-up the documentation of community lands, more focus is also needed on low-cost GPS and GIS technology community land mapping. We also recommend a review of tools available for community staff with limited computer skills.
- A mobile solution could prove efficient for collecting feedback from the field and even during initial data collection. Due to the size of these areas, an interactive tablet-based solution that enables viewing of satellite imagery or topographic maps, location selection, feature identification, note taking and project planning would be preferable.

Conclusions

Community land mapping often occurs in remote and hard to access areas which are removed from government resources, such as adequate communication or road networks and access to information. Often, there is very little data available on these areas. For this reason, prior to fieldwork, a great deal of effort should focus on understanding the size of the area, on developing accurate estimates of time and resources required and on developing a communication and safety plan to conduct fieldwork.

The introduction of technology to community lands mapping shifts the power dynamics within and between communities. It is important that a technical specialist is attached to the project from the beginning to address concerns touching on the role and benefits of technology in the land registration process.

Due to the changing environmental conditions, the size of the areas, the government requirements and community expectations, a mixed-method approach, including, sketch map drawing, GPS data collection and digitization of satellite imagery, is appropriate for field data collection. For example, during fieldwork alone, the Spatial Collective team relied on the following equipment to plan and execute the work in the proposed timeframe:

- Hand-held GPS units for data collection
- Mobile phones for communication
- Satellite imagery for orientation and digitization
- BRCK for wireless internet
- A projector for sketch mapping
- Several computers and external flash drives for data storage
- QGIS for data management
- Paper and pencil for note taking and data collection
- Digital camera for documentation
- Voice recorders (not used in Phase I but useful for providing evidence on
- boundary harmonization process as recommended by the County Surveyor)

As practitioners, we see the need for simplification and streamlining of some of the functionality of the various hardware and software used for documentation of community lands. More focus is needed on finding low-cost and low-skill GPS and GIS technology for community land mapping, as well as on building appropriate land administration systems for managing spatial data.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