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LIBERIA

PARTICIPATORY MAPPING APPROACHES FOR LAND RIGHTS INVENTORY

LAND CONFLICT RESOLUTION PROJECT (LCRP)

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1.0 INTRODUCTION

"*A landscape is a medal struck in the image of its people*" – Elisee Reclus, 1870

Though more than a hundred years old, the quote above still holds true. The degree to which people associate themselves with a particular location is as strong as ever. This bond, though still present in urban communities, has been weakened through migration. However in locations where individuals are less likely to have arrived as opposed to being born, i.e. rural areas, the connection is as strong as ever. The process of identifying and extracting geospatial information through community mapping relies upon these connections and results in the community assuming ownership of any subsequent field activity.

Community mapping is a term that encompasses a multitude of different techniques. There is no single best practice and its application must be considered in light of local conditions and also the ultimate aim of the mapping to be conducted. That said, it is quite common for a modest community mapping exercise to blossom into something more extensive as participating citizens understand what can be achieved and embrace the tools provided to them. This enthusiasm, while contagious, should be tempered with setting expectations as to how the results will be incorporated into any existent para-statal frameworks associated with the data being collected. This is especially true in locations where government structures are weak or opaque. Irrespective of the method applied, there are three recognized stages in the application of community mapping tools which are;

- Stage 1 – Community Sensitization and Planning
- Stage 2 – Physical Mapping and Information Collection
- Stage 3 – Execution of Map Usage Depending Upon Guidelines Identified in Stage 1.

The following report has been written to achieve two separate aims. Firstly, to provide a reference document that delivers a description of available community mapping approaches to be considered and secondly, to identify case studies in various parts of the world that identify the advantages and possible disadvantages of these same methods. Many of the examples are born out of first-hand experience on the part of the GIS Unit at Tt-ARD that has extensive experience applying these methods in a range of projects around the world.

Finally, a chapter has been written that offers best practices based upon personal experience in light of the current land rights situation in Liberia, 2013. These are offered in good faith by the authors and may be considered by the relevant authorities and projects currently existing in the country.

2.0 DESCRIPTION OF TECHNICAL APPROACHES IN PARTICIPATORY GIS AND SUPPORTING EXAMPLES

2.1 HANDS-ON MAPPING

Hands-on mapping is a technical approach commonly employed in Participatory Rural Appraisal, Rapid Rural Appraisal and Participatory Learning and Action methodologies as a means of engaging community members in decision-making. The goal of this technical approach is not necessarily to make an accurate cartographic product, but to obtain information about local resources. Favored as a low-budget, low-training exercise, the approach is not commonly used by GIS specialists due to the fact that it does not produce data that can be easily incorporated into other mapping technologies.

The technical process for conducting hands-on mapping is not technologically intensive and does not require the assistance of a GIS specialist. Hands-on mapping often serves as a starting point for framing broad community based issues, in particular, land issues. This approach is helpful for acquainting non-expert users with maps.

Multiple scales can be mapped, ranging from detailed information such as village layout to larger areas such as traditional use areas for communities.

Though hands-on mapping requires little material preparation prior to engaging with the community, it is helpful to identify who will be involved in the mapping process and why. A suitable space where participants can easily engage in the activity should be identified. Appropriate, locally comprehensible materials should be collected for the activity, whether the map is to be drawn on the ground or assembled from rocks, leaves and other natural materials. Depending on the scope of information needed from the exercise, facilitators can take notes on the discussion.

Though hands-on mapping can serve as an effective participatory mapping tool, there are limitations to the approach. In ground mapping no “hard” data are collected from the exercise and the activity output does not have a consistent scale or measurements which makes the production of accurate maps difficult.

Summary

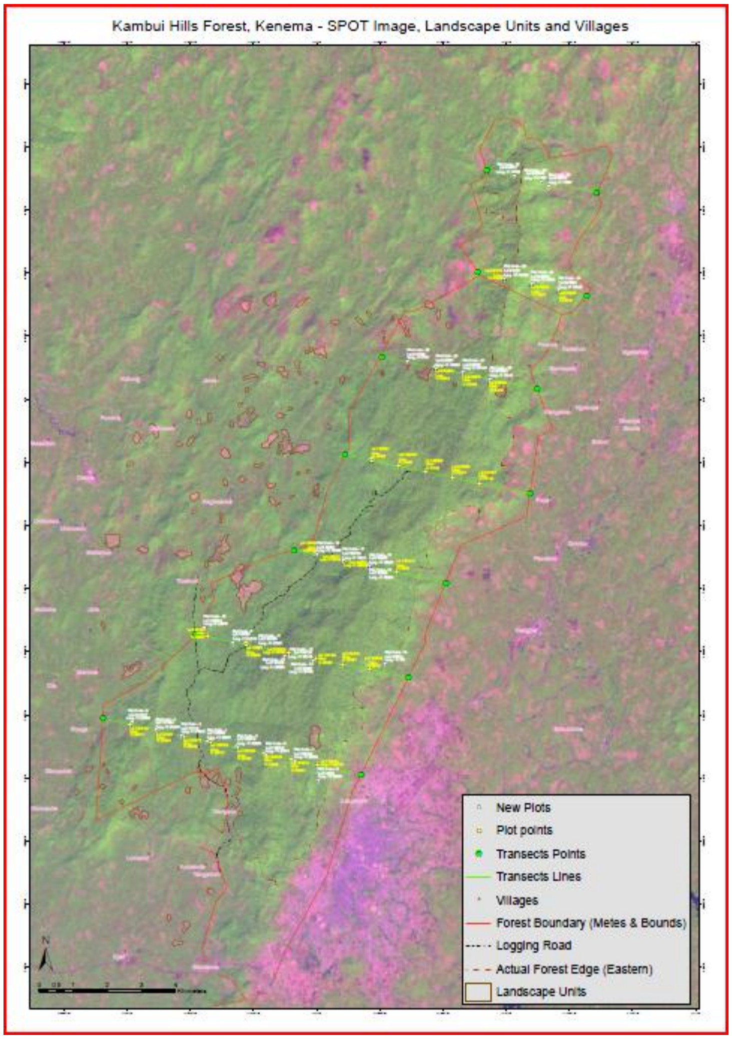
Hands-on mapping is best utilized as a sensitization technique to show relative size and position of community features and engage non-expert community members in mapping as a means of decision-making. Attractive because of its low cost and lack of intensive training required, the outputs of hands-on mapping cannot often be incorporated into formal cartographic processes. In addition, the approach often serves to provide outsiders with perspective on the community rather than providing long-term change and empowerment.

2.2 TRANSECT MAPPING

More of a traditional survey technique than a true participatory mapping tool, transect mapping has existed ever since the mid-1800’s as a way of sampling what physically exists in a geographic area. In a biodiversity survey for example, these samples are then extrapolated to statistically ascertain the flora and fauna of an area. The extent to which they can be considered a community mapping activity depends less on the actual methodology and more on how local communities can be engaged when conducting the transect surveys.

Before the survey is undertaken, the limits of the area to be sampled are frequently determined using satellite imagery. Then through discussions with the staff responsible for the transect itself, a series of linear transects are drawn through the area. The specific locations of these lines can then be loaded into handheld GPS units to support the correct navigation through an area by community participants.

Transects are then physically walked and survey points collected according to the instruction of the survey leader. The approach has less to do with local knowledge and more to do with executing a scientifically rigorous survey and so is considered a less important community mapping approach.



Summary

Information collected as part of transect mapping is community based only in the sense that local citizens may be invited to take part in the physical data collection. They do not normally take part in the preparations of the field visits and as the transect walk is planned to statistical standards, local knowledge beyond the location of the transects is not necessarily incorporated.

2.3 SCALE MAPPING – DRAWING INFORMATION ON EXISTING SCALE MAPS

Community members are able to very rapidly locate themselves within a landscape given certain pointers. This is particularly true when field staff wish to use more formal mapping aids such as topographic map sheets. Available for many countries from national mapping agencies or global map repositories, these map sheets are often the first exposure community members have to quantifiable descriptions of land cover and change dynamics.

Accessing these maps often times involves two issues not previously encountered in the range of approaches described here. The first is cost. Many mapping agencies that have data available do charge for it and project staff must budget accordingly. However, in the majority of cases due to a lack of regulation related to intellectual property, the topographic data is available from extra-national sources at no cost. Either from international sources within or outside of the country, copies of digital topographic data can be acquired. The second issue is that by using topographic data in the participatory process, a new, higher level of technical capacity is assumed. Up until this point, all previous participatory methods can be undertaken without the need for an individual specifically skilled in Geographic Information Systems (GIS). Having said that, the necessary level of capacity is minimal and can often be found locally, especially if the topographic map sheets are pre-prepared by a national mapping agency and provided in hard copy.

The data scale required is very much dependent upon the scope of the participatory mapping. For county level planning in Liberia, maps of a scale no less than 1:250,000 are sufficient. When working with individual communities, for the topographic maps to have any use, they must be no smaller than 1:50,000 but 1:25,000 are preferable. The scale of the available data is critical. Maps with too much detail for the mapping exercise purpose lead to confusion among participants while those with too little detail or that cover too great an area provide insufficient information. The decision as to the optimal scale should be in the hands of the GIS specialist, who will need to carefully consider and define the expected results of the mapping and the available resources at hand.

The process by which scale mapping can be achieved is straightforward. Initial map products are printed (A1 or A0 – 24x26 inches) and laminated in preparation for the field work. Field teams then visit communities or other entities that will be involved with the mapping exercise. Before the visit is made, a sensitization process must be conducted to make the participants aware of the purpose of the exercise. A short presentation must be given that includes an explanation for the participants of the desired outcome of the work. As soon as possible the topographic map sheets must be shared with the participants to allow further familiarization. The majority of people involved will not have seen or worked with a topographic map sheet previously and so time must be allowed to explain what the different symbols present in each map represent. Once a level of familiarity with the maps is observed, the data collection component of the exercise can be started. Participants are asked to list those features in their landscape that they consider to be relevant and worthy of capturing in terms of location and associated attributes. These lists are then discussed to ensure that the required data will be collected. Once consensus has been achieved, individuals are assigned to draw on the map sheets with erasable markers the locations of features identified by several participants. In some cases, it is easier to divide the group into smaller teams and assign specific types of data to be collected by each team. During this stage, it may be required that non-community members leave the groups alone while they discuss amongst themselves. After a pre-determined time, perhaps up to 30 minutes, the teams present their work once again to the entire group to assure agreement on the locations is reached. Once achieved, any associated attribute information e.g. names and land use types, are collected. At this stage, the GIS specialist finalizes the maps by tracing over the features marked with a permanent marker. The results are then digitized by hand by the specialist and incorporated into a series of GIS data layers that can be used for analysis and reporting purposes.

Summary

This method offers both great advantages and some downsides based upon the type of data being collected and also the capacity of the participants to appreciate the information presented in topographic maps.

In cases where non-physical data is being collected e.g. customary boundaries that follow geographic features such as streams and relief, there are few better approaches for rapid data collection. For more physical data e.g., visible field boundaries or areas of particular land cover, the topographic map sheet may be less helpful. In either case, the role of the GIS specialist is key, ensuring that participants can interpret the information presented to them and assisting with the orientation of participants when conducting the data collection itself. The topographic map itself must be considered abstract for most participants as opposed to an alternative data type such as a satellite image and therefore sufficient time must be allowed for the community members to learn how to 'read' the map.

Difficulties can arise when the available map data is not of a sufficient scale rather than the data itself being perceived as too old. While the age of data can initially appear to be an issue, features such as villages, relief and major rivers can still be used even if the information was last updated more than 60 year before. Tetra Tech has proven this to be the case with work conducted in both Southern Sudan and Sierra Leone.

The quality of the data collected using this technique is generally sufficient for the purpose of the activity, but property boundaries for anything more detailed than customary claims would be suspect unless the map scale involved was around 1:5,000. This level of map detail would be nearly impossible to obtain in the developing world outside of the principal urban areas.

2.4 PARTICIPATORY 3-D MODELING (P3DM)

The creation of physical, three dimensional models of landscapes has been around for decades in many developing countries. Predominantly used to date by the civil engineering and to a lesser extent, tourism sectors, these 'maquettes' have often been created by professional model making companies that were tasked with creating an output which could convey a message or scenario to the general public. The use of 3D models for participatory mapping has been less extensive due to the perception that they are only useful for providing already existent information as opposed to capturing new data.

The application of 3D models for participatory mapping creates several challenges but also great opportunities not least of which in terms of community engagement. Many of the other methods described in this paper can appear exclusive i.e. the role of community members may be limited in favor of a professional consultant, but executed correctly, the use of 3D models can fully engage community participants throughout the entire process of creation and ultimate data capture.

To justify the additional work entailed with the use of 3D mapping exercises, the purpose of the participatory mapping must include a broader degree of communication than perhaps other methods can deliver. An example of this broader communication might include those cases where information needs to be regularly conveyed individuals from outside the immediate community. The ability to refer to a physical model of the immediate landscape greatly increases both the ability to ask intelligent questions about potential land use scenarios and explain existing conditions to those less familiar with an area. This second purpose is most frequently required when explaining and defending community or customary land rights to other groups and government departments.

The steps involved in successfully building a 3D model are multiple and involve inputs from a range of parties. The first stage involves defining the area to be modeled. This decision will most likely involve the project management team that has chartered the creation of the model based upon inputs from community members. Once defined, the area is identified by a GIS Specialist and a limit created. This limit is then used to subset any relevant digital data held in a GIS database. The two principle data layers needed are an elevation data layer, possibly a Digital Elevation Model or contour data and any available satellite imagery. All of the data to be used should seamlessly overlay and so a standard projection must be agreed upon from the outset. If the model is to be used to measure areas, then the recommended projection would be a Universal Transverse Mercator (UTM) while if areas are not likely to be measured, a standard geographic (Decimal degrees) would suffice.

Once the area to be modeled has been clearly defined, the GIS Specialist will make and print a series of paper maps at the required size (A0) that indicate various levels of elevation. This work is conducted before going to the field.

Prior to heading to a community, the following materials must be sourced. Large corrugated cardboard sheets (a minimum of 24x24 inches), box cutters, a wooden baseboard, flat head nails, flour, mixing bowls, painting materials including matt white paint, and permanent markers. Upon arrival at the community with whom the project is working, a brief presentation as to what is about to happen is given. In essence it will be the community members that after some initial support from the GIS specialist will build the model themselves. Depending upon the size of the model to be built, up to 20 people can be engaged in its creation. The work itself can be conducted inside or outside but will require plenty of space.

A first step involves using the paper maps to trace out on the cardboard sheets varying contour lines which are then cut out. When this cutting is done, it is important to keep track of the elevation contour that it represents. If possible, contours should be cut out sequentially, with the lowest point to be modeled to be cut first. If the relief being modeled is not steep and additional vertical exaggeration is required, a second identical cardboard contour interval can be cut. The intervals have to be decided on a case by case basis.

As each contour is cut it is attached to a base board and each consecutive level is attached on top of the previous. Using this method, very quickly the base of the 3D model is created. Cardboard layers can be fastened with glue or more likely pins driven down into the layers at an angle. Once the base model is finished, the relief is ready to be applied using *papier mache*. It is possible to create several models at the same time, each with a dedicated group and then combine them into a larger model by simply laying them next to each other. This approach of multiple models may help with the transportation and storage of the models especially if the area is large.

The newspapers will have been shredded into small pieces and combined with a flour and water based glue. Community members then simply drape the papier mache over the contour model to smooth the relief. This process should be moderated to ensure the model does not become overly wet as it will need to dry rapidly (within a day or two) before the next stage can be completed.

Once dried, the community will have a three dimensional model of their area bereft of any features other than relief. The entire model must now be painted using water based matte white. Again, after being left to dry completely, the model can now be annotated with the support of the GIS Specialist by the community itself. The process can be helped along by projecting onto the model any available satellite imagery of the area. Using this technique, visible features including roads, rivers, villages and forest boundaries can be traced onto the model to ensure maximum accuracy. Once these visible features are incorporated onto the model surface, the community can then add other features not visible in the imagery to complete the model. Experience shows that the spatial awareness of community members is more than sufficient to navigate such a 3D model and develop a truly useful and permanent tool for continued community engagement.

Summary

This approach might be considered the most engaging for a broad range of community members including children if desired. It does require some initial work on the part of the GIS Specialist but this work is basic, low cost and the data required is freely available for just about anywhere in the world at this stage. The entire process will require at least two visits to a community but this should be seen as an advantage rather than a hindrance. The fact that a final annotated landscape model can be left with community elders is a huge benefit to the approach and in one fell swoop eliminates the risk that community members feel left out of the results or findings of participatory mapping exercises.

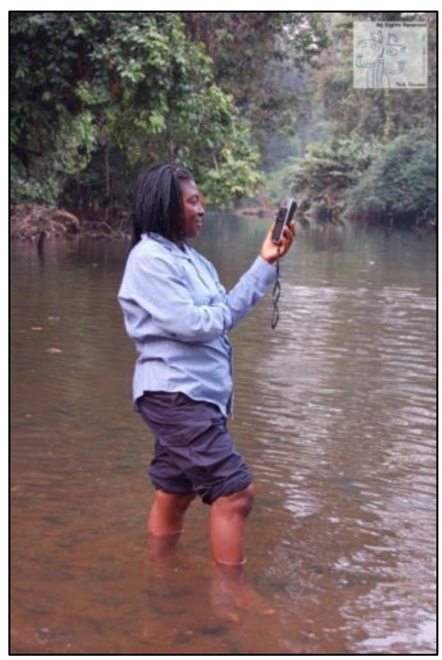
2.5 GPS MAPPING

A development of more traditional land surveying techniques, global positioning systems has revolutionized data collection capacity over the past 15 years and is the primary reason that GIS is accessible to so many. Providing the ability of anyone with a handheld receiver to locate their position on the surface of the earth to within three or four meters, an affordable, basic GPS unit is an indispensable field tool.

In terms of community mapping, the most common type of GPS receiver used is a fully portable handheld device that can be used by anyone after they have spent 15 minutes familiarizing themselves with it. This basic device will capture discrete locations and, when required, linear features, such as paths and boundaries that can then be transferred digitally into a project GIS. The GPS units themselves are durable and can withstand the challenging conditions of the field while the user interface has been designed to make operation as simple as possible. Field team training focuses on the timing and spacing of when new data points should be collected and how to fully document them rather than in the use of the unit itself.

Experiences gained from multiple projects indicate that the use of the actual GPS unit is never the cause of any issues that arise. Instead, possible pitfalls occur when staff are not clear as to when to take measurements, how to transfer field data onto an office computer or between offices and after unsanctioned changes have been made that differ from the established GPS unit setup. To prevent these situations from occurring, sufficient initial training followed by refresher courses must be provided.

Given that the field teams, often comprised of local community members, work independently of any technical oversight, a thorough training component is essential to ensure that any information collected is of a high quality. The training for a group of 10 takes a single day and starts with short lectures, continues with practical exercises and finally instruction on information transfer protocols.



There are many different manufacturers of GPS units but a unit must be selected that is adequate for the environment in which it will be used. To ensure an accurate location is collected, the unit will normally require at a minimum 12 channels to receive signals from 12 satellites simultaneously. In densely forested environments or areas with steep relief, this number of channels is essential.

Immediately after the training has been completed, two person field teams, begin operation in collaboration with at least one community member who acts as a guide and community liaison. These community members are often nominated by community leaders, a common situation in case of customary land rights work. To ensure that data collected is not lost, while one individual operates the GPS unit, the second manually records location data on a pre-prepared form. Upon return to the office, the digital data is downloaded from the GPS unit and used in conjunction with the written data to generate a visual representation of the data collected in a GIS. This in turn, can be used to publish maps that are then displayed and, whenever possible, provided to the community members that supported the field work. The step of returning to the field to demonstrate visual results is important when using GPS. If this is not done, zero evidence of community participation exists, which may in turn lead to fatigue on the part of community members.

Clear instruction from project management as to what needs to be collected is the key to success. Project management should expect that discrete location specific data, e.g. a single point that represents the location of a culturally important feature, be collected relatively quickly. Much of this sort of information can be collected by communities in a week of work. More complicated features, e.g. property boundaries, are more time intensive but with adequate planning, even these should be captured within a month or six weeks. Field work should be planned to be intensive. Experience has shown that data capture exercises which continue for longer periods can precipitate problems of lost data as well as general project disengagement on the part of community members.

Summary

GPS mapping provides a low cost technical solution for the collection of field data that is hard to beat in certain circumstances, specifically when features are not discernible in the field based upon physical appearance. Such features include cultural locations, sacred bushes and customary property boundaries, and socio-economic data including households being surveyed. The locational accuracy provided by the units is second only to very high resolution imagery and the ease with which community members can be trained in their use make them a very powerful participatory mapping technology.

However, their successful use depends as much on factors not directly associated with working in the field. A project that applies their use must have a robust data capture and management plan, a clearly identified path of data custody and resource investments made that provide adequate training and on-going technical oversight. Without these in place, results can be mixed at best and very poor at worst.

2.6 PHOTOMAPS

Providing poster sized print-outs of landscapes is one of the most efficient methods of collecting information from participating communities. The posters or in some cases, map books, allow direct annotation which is then ready referenced prior to digitization. The imagery can be considered expensive and some preparatory work is required by a GIS Specialist but that said, the benefits of allowing community members to rapidly orient themselves within the map and deliver information that is immediately useful far outweighs these issues.

The use of remotely sensed data including satellite imagery has greatly increased over the past 10 years. Access and availability has increased as private companies now sell imagery at a spatial resolution only dreamed off in the past. Images can be acquired that allow the easy identification by untrained individuals of houses and land use patterns. Of course this high resolution comes at a cost and not just monetary. Higher resolution images have smaller image footprints or swathes meaning that in some cases multiple images are required to cover an area of interest. For these reasons, when selecting the imagery for a mapping exercise it is critical to clearly understand both the size of the area in question and the principal type of data to be collected. The use of topographic map sheets or GPS units is common to delineate the area of interest while the type of data is must be determined by the project management before procurement is initiated.

Multiple companies sell imagery and there are also free resources available. However, as general rule, the more recent the image and the higher resolution, the more likely that the image will come with a cost. Once acquired, some basic image processing is required to convert the digital file into a series of usable maps most commonly created 24x36 inches in size. Processing can generate multiple data from a single image with land cover classifications and basic natural color maps being the most common. At this stage, available vector GIS data layers such as roads and villages can be superimposed to support user orientation in the field. All maps should also be taken to the field in digital format in case a decision is made to broaden the engagement of community members. Laminating the maps is recommended to provide protection against field conditions and all maps should contain a grid for reference purposes. When mapping smaller geographic areas, e.g. individual properties, creating a map book series that is bound into a folio is recommended to ensure that map scales are adequate for boundary delineation. A 2.5 meter resolution image will provide a useable map with a scale of 1:5,000.

Photomaps are most frequently used to collect large amounts of detailed information visible to participating community members but not visible to the naked eye. They can be used to collect more intangible features such as the locations of sacred bushes but other cheaper methods can be applied. The exception involves large areas of land use and it is in this example that the real value of photomaps is found. No other method can collect large area measurements through engagement with community members that are readily incorporated into a project GIS. This represents a large saving in time and resources.

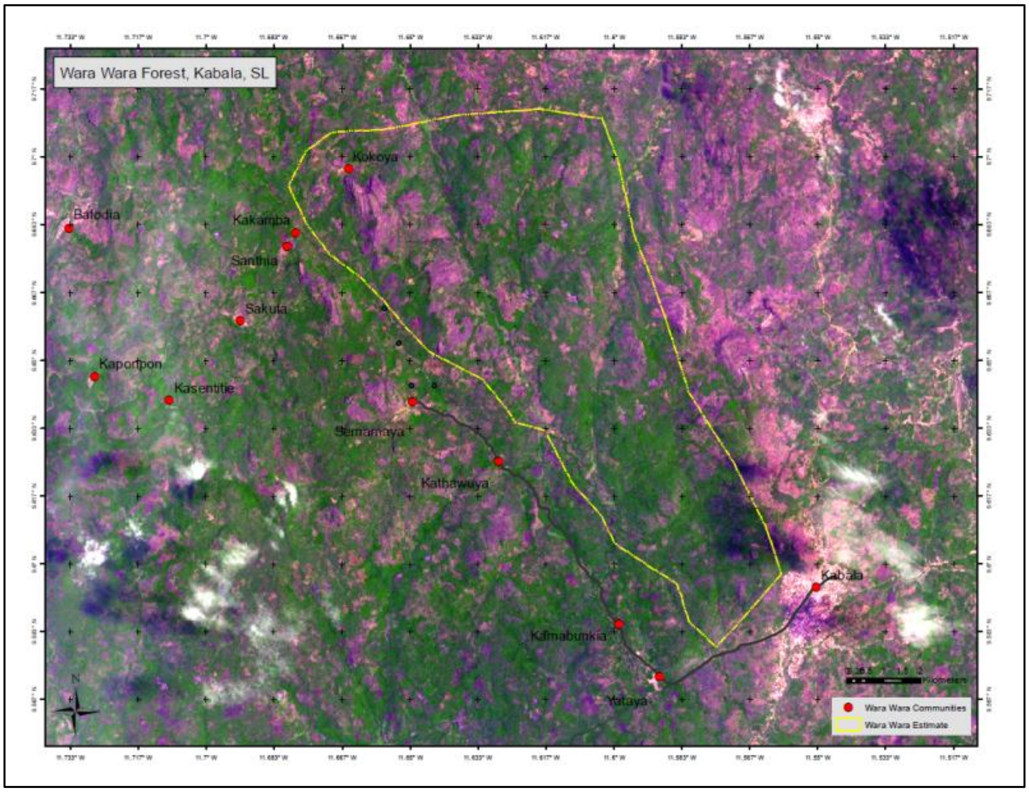
Once in the venue for community engagement, a brief presentation and description of the image maps is made that also clearly states the expected outputs of the next stage. The community members are then invited to review the maps to be used and can be oriented 'inside' the map by project team members. The result is that community members very quickly identify local landmarks to be used for reference purposes. Once complete, the community is invited to draw on the map with dry erase markers any features of interest. When this is done, they are invited to present their work to the entire community to ensure that there is agreement.   When this has been accomplished the features can be traced using a permanent marker ready for digitizing by a GIS specialist. In the case of identifying larger land use areas, the process is slightly different with the GIS specialist first defining an area based upon interpretation of the image map and then soliciting the land use from community members. There may be some discussion with the community ahead of this interpretative mapping to identify the locally described land cover or uses to ensure standards are maintained.

The final stage involves returning to the office and manually digitizing the limits and features captured on the image maps before including them in a GIS data layer of data base.

Summary

Photo or image maps are a commonly used tool to move from basic field sketches into a geo-referenced data environment where measurements can be made. Limited preparation prior to field work is required and investment costs can amount to several thousands of dollars depending upon the scope of the project. This however, should not detract from the proven value of these tools when working with communities. As stated before, the degree of spatial awareness of all communities engaged in these activities has been high and the image map has been proven to rapidly capture results and save money and resources that would have to be spent to achieve more questionable results.

Copies of all of the resultant data is easily produced by a GIS specialist and is often returned to the communities involved as a printed, laminated map to ensure that there are no feelings of data loss.



Stage 1 – Initial photomap produced

This map was produced from ASTER satellite imagery and shows an estimate of the Wara Wara forest boundary in yellow with nearby villages depicted as red dots.

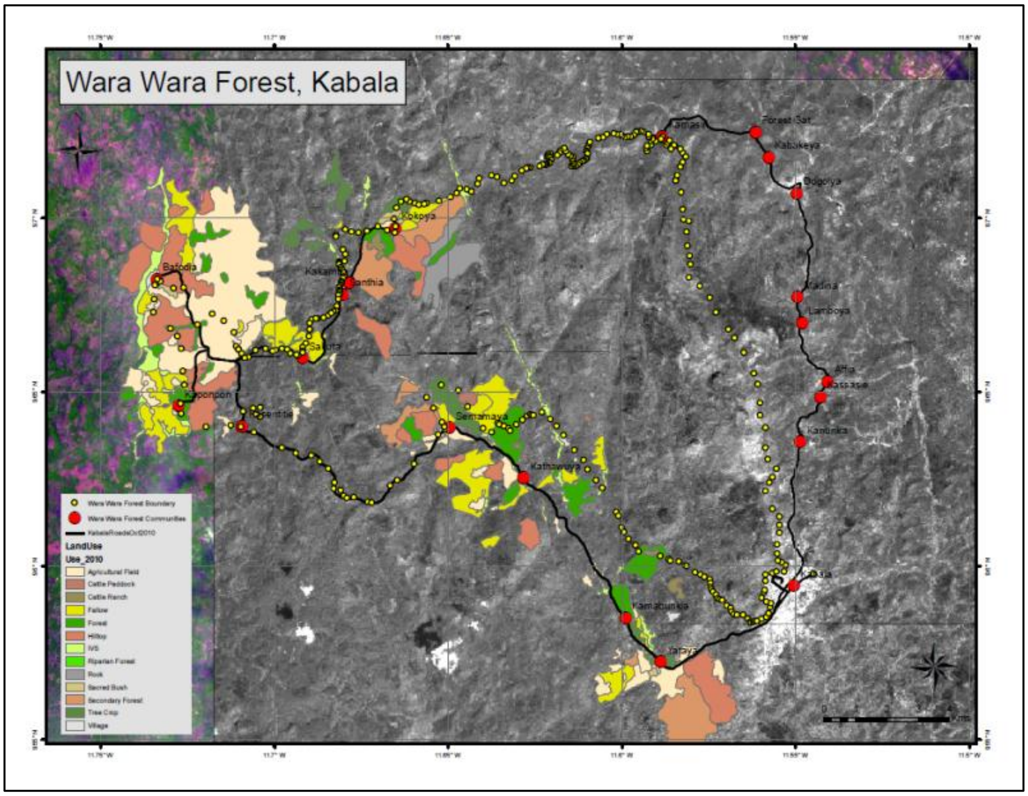
Stage 2 – Orientating Community Members

Stage 3 – Community members place geographic feature data on photomap

Stage 4 – Geographic features placed by community members are verified by GIS specialist

Stage 5 – Map including community information produced

This map again depicts the Wara Wara forest and includes data from both participatory GIS exercises as well as remote sensing techniques. Data from participatory GIS exercises using GPS mapping show the forest boundary in yellow dots. Remote sensing techniques were used to extract land use classifications (agricultural field, cattle ranch, tree crop, etc.) from the satellite imagery.



2.7 MOBILE DEVICE ENABLED MAPPING

Mobile devices can be defined for this section as electronics that offer more than an ability to locate a feature perhaps using a simple GPS unit. The controlling factor that has impacted the degree to which these have been applied is only in the past five years have suitable electronic hardware and software existed. This section describes an array of tools rather than a single approach for participatory mapping that while showing promise and being theoretically possible have yet to deliver entirely.

While there is now great variation to what is available, most mobile devices used for mapping provide the following capabilities. A GPS embedded seamlessly within the unit, an operating system that allows the installation of a specialized mapping or data collection software application, connectivity to the internet either via a mobile phone network or wireless connection, an embedded camera, and an interactive touchscreen through which the user accesses the necessary software. Smart cell phones can be considered mobile mapping devices although their application to date is still limited due in part to the small screen they offer for data collection.

Tablet devices show the greatest promise for legitimate participatory mapping work. That said, experience to date indicates that the degree of community participation possible is limited by the facts that the units are expensive, require significant set-up prior to use and must be operated by someone with formal training in geospatial technology. For these reasons, the participatory aspect of their use is limited to supportive input by community members rather than physically using the devices themselves.

The majority of tablet devices used for mapping have one of two operating systems, iOS (Apple) or Android (Google). The range of software applications that can support field mapping e.g. GIS Pro, GvSIG, GPS Kit, are useable on either one or the other. Rarely are available applications able to run on both operating systems. iOS is a proprietary system that relies upon Apple iTunes to copy information between the device and a standard computer. The Android OS allows the tablet device to be connected to a computer as any other external drive would be. The device appears in the computer file explorer window and data can be transferred easily from the device. This difference alone justifies the selection of an Android based tablet device over an iPad. The Apple alternative is overly cumbersome and causes difficulties in data management.

The great advantage of mobile devices is that information is collected directly in a digital format and therefore reduces production times. Information can be collected and immediately combined with other data layers in a map view that is customizable according to the needs of the community or project staff member. This flexibility provides a fully interactive experience that can offset the apparent lack of engagement of community members when collecting the original data. Stored on the device, the information collected in the field can be managed and re-displayed for community meetings held to ensure consensus has been reached on the features mapped, in a matter of minutes with the help of a projector. Any issues or features reported previously that prove contentious can be remedied during the meeting. If a printer is available, then hard copies of the data collected in collaboration with the local community can be left behind.

In addition to the collection of mapped or geometric data e.g. boundaries and discrete point locations, the mobile device helps greatly when collecting both qualitative and quantitative survey data. An example might involve a household survey. The devices can run survey software that eliminate the need for paper forms, guarantee data quality by providing selectable response options in drop down lists and instantly locate the household, for display at a later date in a GIS using the embedded GPS facility.

Summary

As costs reduce and more robust software applications become available, the use of mobile devices holds great promise for participatory GIS. The advantages of immediate data digitization, access to all spatial data when in the field, easy interaction with the map interface and data management options that include wireless of mobile telephone connectivity with Cloud based GIS storage options, all mean that great time and cost savings will be realized in the future. As smart phones become more popular in the developing world, it is not unlikely that projects will be able to mobilise vast numbers of community members to collect spatial data using these devices and easily send the information to a central data repository for further processing. Unfortunately, this is not yet reality.

The hardware and software still responds in the majority of cases as prototypes might and so a participatory GIS activity based solely upon these devices would most likely fail. All is not lost however in the investments made to date, as they can already bring great advantages if used in a supplemental role to collect qualitative field data from communities in association with more tried technical mapping approaches and tools.

The software that is available for mapping as well as the data collection forms do require preparation that includes defining what is to be collected. While this is the same for all methods previously described, it is particularly important with mobile devices as the technical set-up of the devices has to happen before getting to the field, often before arriving in the country. These 'set-ups' need to be conducted by professional GIS specialists following instruction from project management and can take as little as two days or as long as two weeks depending upon the scope of the work at hand.

In terms of using mobile devices supporting group sessions where spatial data can be collected using a projector, if smart phones are discounted due to their size, much of the functionality of the tablet can be replicated by a stronger laptop computer running professional GIS software. Using this setup, a skilled operator can elicit from a community, location specific information after displaying a series of spatial data layers, including satellite imagery that can then be seamlessly added to an existing GIS database. Until a mobile device can offer more than this, their application will be limited to perfunctory uses such as taking 'geotagged' photographs and running digital forms as part of broader field questionnaires.

2.8 CROWDSOURCED MAPPING

The advent of cell phones, including the latest generation of smart devices, has precipitated the ability of members of the general public to provide a wide range of data through custom web applications. This information can range from simple text message (SMS) based delivery to web pages through which a multitude of digital data including video and photography, can be delivered. In either case, a central data management repository, now frequently located on a virtual server or cloud server, must exist and rigorous management of the information being received conducted.

If quantitative crowd sourced data via cellphones is a new approach, then examples of using the same technology and methods to capture geometric map coordinates that describe property claims are non-existent. This is case where a technical approach may appear promising and popular in development circles, the reality is that implementing such an approach would be next to impossible. Quality of data, ensuring equal access to all citizens, verification of claims and adjudication on data collected in a manner not recognized by the surveying profession are just some of the reasons. The picture does change somewhat if the crowd sourcing approach is applied only once the initial geometric data has been captured using an alternate method. Providing access to the public via cellphone technology could support the need to update citizens on the stage of land registration their particular claim has reached. However, even this is a complicated task and the accessibility advantage through which information may be exchanged would most likely be outweighed by the setup costs and maintenance of such a system.

Ushahidi is a commonly described success of crowd sourced data and has been applied in several countries including Liberia. Occasionally suggested as a model upon which a participatory mapping activity could be based, its original purpose was to document the location of political violence in Kenya. Subsequently used for situational data collection after a natural disaster (Haiti, January 2010), the collection model has always and continues to be entirely based upon a single point location as opposed to an area measurement. How this locational data is ascertained is dependent upon the individual providing it and so even here there is room for errors to be introduced unwittingly.

Internet mapping does hold realistic value for participatory GIS. Where crowd sourced data collection is a non-starter, using interactive maps on-line via a web page does hold real value for participatory GIS if only at the dissemination of information stage. Of course, access to a web connection and the necessary design and creation of a website that provides a straightforward user experience is a given requirement and by no means an easy task. Once established however, data access to many communities and even the provision of functionality that allows citizens to report land infractions is all possible. For these reasons alone, crowd sourced mapping does hold tremendous promise, but expectations must still be tempered by a pragmatic appreciation of the realities faced by communities in the field.

3.0 LAND TENURE RIGHTS INVENTORY PROJECTS

3.1 LIBERIAN EXAMPLES

3.1.1 Liberia - Land Rights and Community Forestry Program (LRCFP)

Project Description

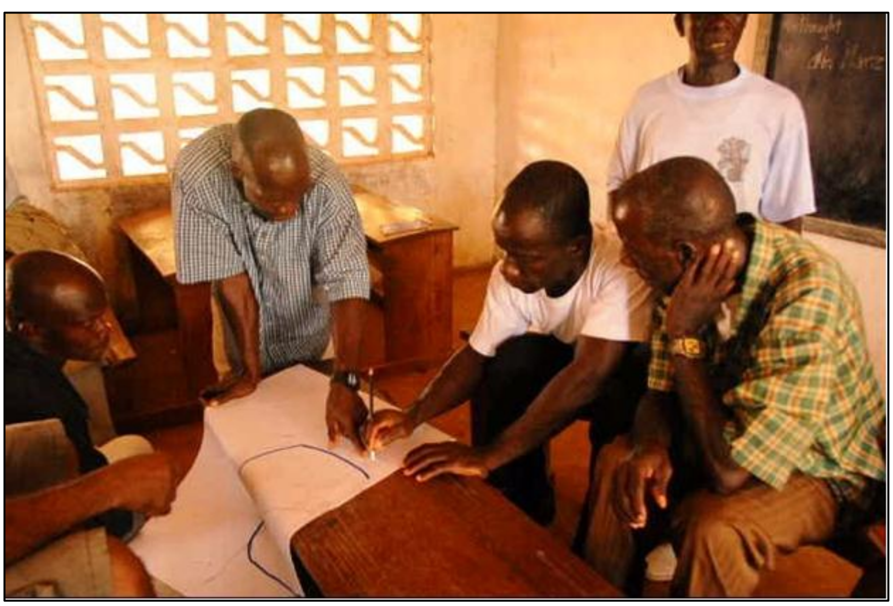
The LRCFP was a USAID project assisting the Forestry Development Authority (FDA) and forest-based communities to promote and foster community management of forest lands in Liberia. Policy and legal reforms in Liberia's forestry sector mandated that the FDA empower and assist Liberian communities to manage their forest resources sustainably. LRCFP worked with the FDA and other stakeholders to develop this capacity at the national, county, and community levels.

The LRCFP worked in four pilot communities, two each in Nimba and Sinoe Counties. In conjunction with FDA's support, the LRCFP worked to help communities establish representative forest management committees and provided training and resources for them to govern and carry out forest conservation and economic use of forest resources for improved livelihoods. The LRCFP used this community-based experience to help the FDA develop a national institutional framework for community forestry in Liberia.

Community Mapping Goal

In order for communities to assume rights and responsibilities for managing their forest resources, LRCFP assisted communities with forest management planning activities, including forest resource inventory and land use planning. These activities were undertaken using participatory mapping approaches including hands-on mapping, photomapping, and GPS mapping. In addition, remote sensing techniques were employed to assist with land use mapping and forest zoning. In order to determine community and community forest boundaries, a three-stage, participatory process was undertaken.

Mapping Process



Stage 1: Community Preparation

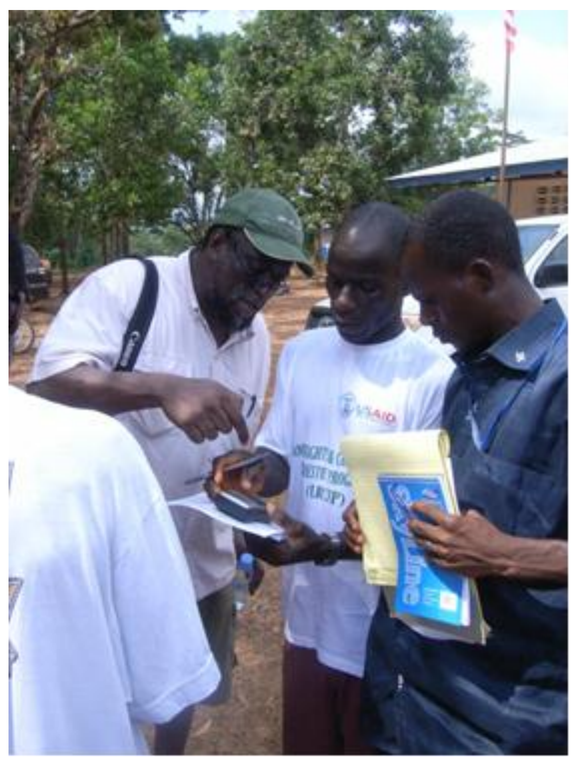
- Forest Management Committees (FMC) are formed with members of the local community.
- At community meetings, specialists in community forestry give presentations about the benefits and responsibilities

associated with the creation and implementation of a forest land use management plan.

- Facilitators repeat presentations as necessary so the community becomes familiarized with the process.
- Community meetings also involve the presentation of hard copy printouts of satellite imagery to familiarize community members. Facilitators point out locally recognized features such as rivers, roads and settlements surrounding the community forest.

Stage 2: Mapping

- Hands-on mapping exercises are conducted as part of community outreach and awareness.
- Community members draw forest boundaries and resources on photomaps.
- GPS data are collected by trained LRCFP program staff accompanied by local community members. The GPS teams record GPS tracks along forest boundary lines to demarcate the community forest boundary. Transects are also be recorded to assist with forest resource inventory.
- At the community mapping meeting, participants are presented with a photomap of the area.
  - Facilitators point out locally recognized features such as rivers, roads and settlements surrounding the community forest to orient community members to the map.
  - Participants draw the community forest boundary on the photomap and also depict agricultural and forest features.
  - In LRCFP communities, males and females were divided into separate mapping activities.



Stage 3: Data Processing and Analysis

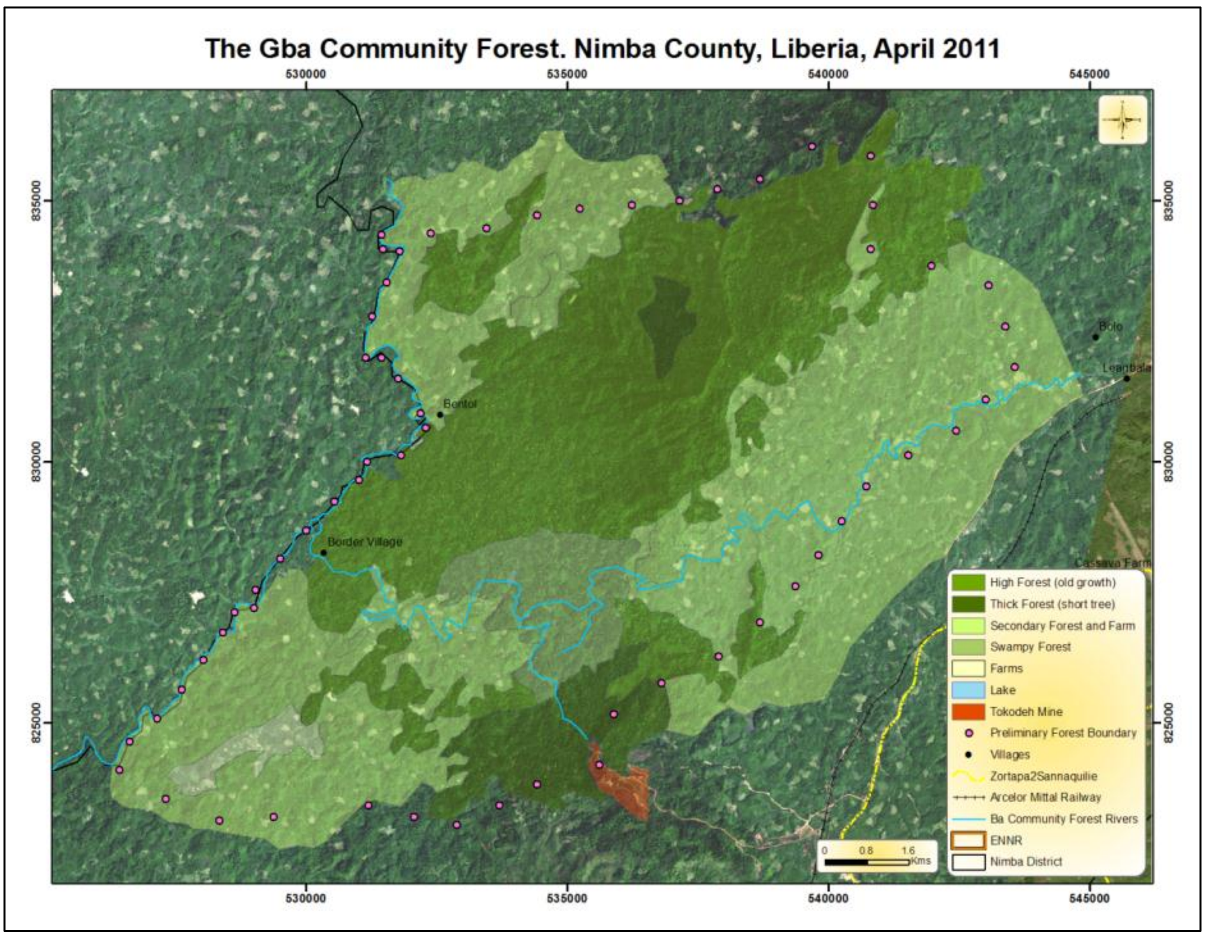
- Following community mapping exercises, the GIS specialist loads GPS data and features from photomapping exercise into a GIS.
- Using remote sensing techniques the GIS specialist extracts discrete forest units and types, rivers, villages, roads and features of interest such as mine workings and lakes.

- The GIS specialist calculates areas of each forest type or land use unit.
- Finally, maps are created showing forest types as well as threats to the forest.

Stage 4: Maps are distributed to communities

Lessons Learned

- The cartographic accuracy of any hands-on map is questionable once the immediate area around the central community is passed. Therefore, community boundaries are the most troublesome for participants to define.
- Approximately 80% of the participatory mapping activity was spent defining community boundaries while the remaining 20% was spent describing agricultural and forest features.
- Boundary definition is always a sensitive issue and as such it is better to have multiple single community working meetings rather than a single large group. Contradictory results can always be verified with the Forest Management Committee at a later date.
- Low spatial resolution imagery is better than nothing. If introduced as early as the first community awareness meeting, these satellite maps can be very useful to broadly explain the purpose and geographic area of the project. Subsequently, a trained image analyst can use this information in discussion with community members to extract important forest type data.



3.1.2 Liberia - Property Rights and Artisanal Diamond Development (PRADD)

Project Context and Description

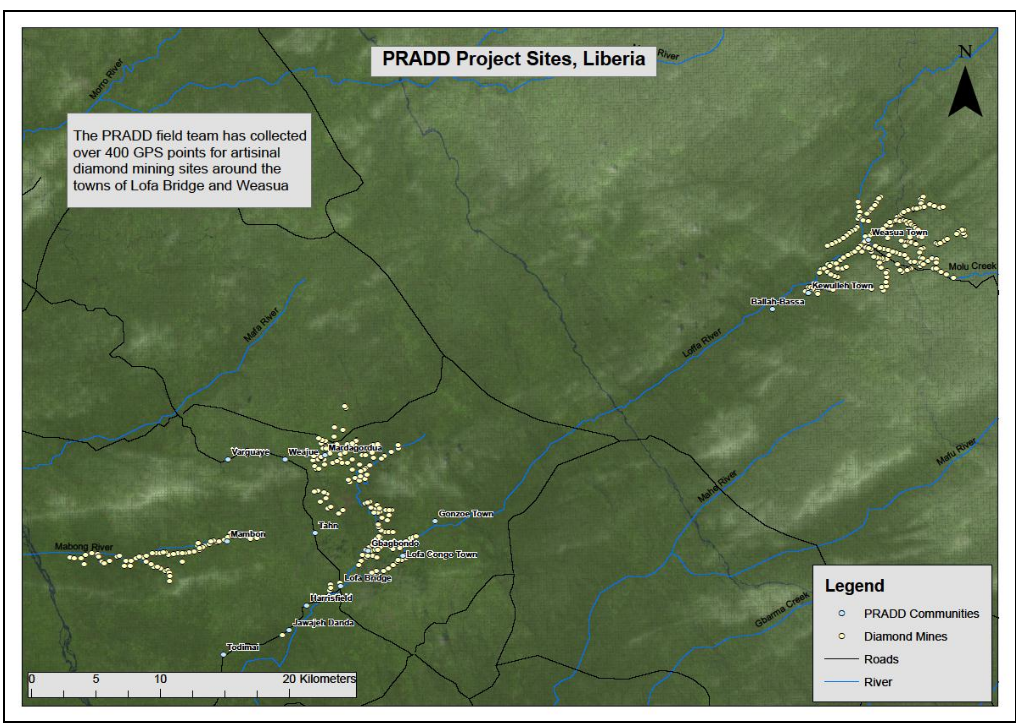
The PRADD project was a joint USAID/Department of State program to assist the Central African Republic (CAR) and Liberia in their compliance with the Kimberley Process Certification Scheme (KPCS). Launched in CAR in 2007 as a pilot and in Liberia in mid-2010, PRADD aimed to increase the amount of alluvial diamonds entering the formal chain of custody and to improve the lives of artisanal diamond miners through strengthening their property rights. Formalizing land ownership diamond prospecting rights encourages miners to enter their production into the formal chain of custody. The project also worked to enable the CAR and Liberia to better track artisanal diamonds from their point of extraction to market, and thereby help meet the requirements of the KPCS.

Mapping

Geospatial technologies, including GPS and GIS, have been cite by the PRADD project as a technology type that helped to assist in the securing and linking of data or information relationships found in traditional property management. By linking geographic data to demographic and property ownership data, a more complete picture of mining activities can be developed, particularly through the creation of map products. Representations of mining claims on a map helped provide initial information on location and volume of mined material, and help move Liberia towards compliance with the KPCS.

Mapping Process

Though participatory mapping approaches are not used by PRADD/Liberia, GPS mapping was used. The project collected a single point in the center of each mining claim mapped. In addition, use of mobile device enabled mapping was tested with an Apple iPad as a means of taking a photographic record of individual miners' claims and also measuring the distance of each individual claims. Photomapping was proposed as a means of more accurately mapping miners' claims, but was not implemented before the close of the project.



3.1.3 Liberia Municipal Water Project (LMWP)

Project Context

During and since the end of the civil conflict (1989-2003), the Government of Liberia (GOL) and a variety of donors have achieved incremental improvements in water supply access in urban Liberia. The bulk of these improvements have been via the provision of improved hand dug wells with hand pumps. These improvements have largely been led by non-governmental organizations (NGOs), coordinated through GOL representatives, including environmental health officers in County Health Departments. However, responsibility for water service provision in urban areas (>5,000 population) and county capitals rests with the Liberia Water and Sewer Corporation (LWSC). Since the end of the civil conflict, LWSC has undertaken partial rehabilitation of piped water systems in Monrovia, Kakata, and Zwedru with the support of the African Development Bank. Funding for the rehabilitation of the pre-existing piped water systems in the cities of Robertsport, Sanniquellie, and Voinjama has not yet been available and the systems are currently not functioning. The GOL identified these three as priority cities for USAID assistance and USAID/Liberia has committed to supporting the GOL in improving water supply service in these three towns.

While LWSC has the legal obligation to provide water and sanitation services in urban areas, their ability to do so was disrupted during civil conflict. To fill the gap, NGOs have contributed toward improving some critical services—primarily via hand pump wells and latrine construction and promotion of community-based management of these improvements. However, with humanitarian assistance slowly declining and GOL capacity improving, the time is right to transition toward more sustainable Liberian-led interventions including the re-establishment of piped water supply systems that can be sustainably maintained and operated, possibly through the private sector or local authorities.

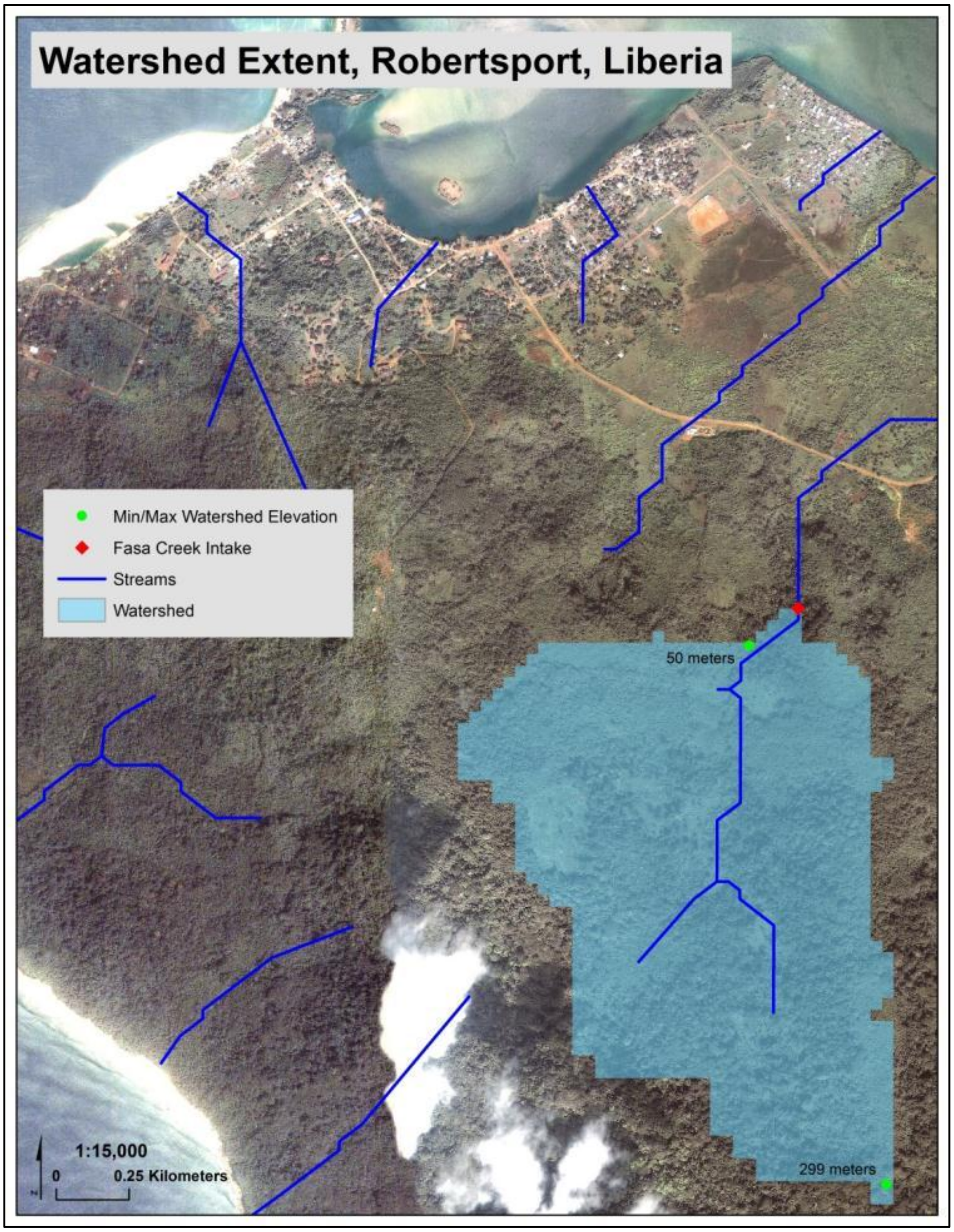
Project Description

The Liberia Municipal Water Project (LMWP) is assisting local and national authorities in developing plans for urban water supply and sanitation improvements, implementing short- and medium-term water supply infrastructure improvements, and re-establishing local capability to sustainably operate and maintain the water supply improvements. During the four-year project base period, it is the goal of LMWP to help establish improved water supply access in each city, with infrastructure managed by locally-based entities capable of financially and technically sustaining the service. The project coordinates with GOL entities including the Ministry of Lands, Mines and Energy (MLME) and the LWSC and county and local authorities. The improved water systems will provide public health and economic development benefits in the three target cities.

While each city has unique characteristics that require a tailored approach, common institutional, technical, and socioeconomic challenges and opportunities exist. As such the project is focused on public information and awareness programs to engage communities early and often to participate in the planning process.

Mapping Process

Mapping activities support a broad range of LMWP's tasks. LMWP staff members have used handheld GPS units to collect field data about existing water services infrastructure. More in-depth spatial analysis has provided a situational awareness of local watersheds, physical infrastructure and resources, and socioeconomic context. Data from the Liberian census gives socioeconomic context to the planning of water systems delivery. Land use classifications, preliminary pump test and bacteria results, elevation data, municipal pipe systems and results from a community survey have all been mapped in support of project planning, providing planners with cartographic decision-making tools.



3.1.4 Liberia – Community Land Titling Initiative

Project Context and Description

To assist communities in Liberia with claiming and protecting customary land rights, the International Development Law Organization (IDLO), in conjunction with the Sustainable Development Institute (SDI), implemented a project designed to investigate the best type and level of support that communities need to assure that customary land rights could be successfully claimed, protected and leveraged for local prosperity (Kaba, 2011). This project had a broad range of activities that largely focused on legal and local governance concerns related to community land titling.

The mapping component of this work had a strong emphasis on conflict resolution at intra- and inter-community levels. In fact, Knight et al. (2012) notes that community land documentation (mapping the meta-unit of the ‘community’) may be a more efficient method of land protection than individual titling, especially in the short term. Community land documentation is not only just a mapping and registration exercise, but also includes conflict resolution and the establishment of good governance at a local level. The authors argue that community land titling efforts that lack mechanisms to improve local governance may result in more unjust land dealings. As such, communities should be trained in open, non-violent communication, compromise strategies and mediation/dispute resolution tactics. The boundary harmonization exercises undertaken by this project unearthed every unresolved land conflict, even in communities that reported no disputes. Though boundary harmonization has the potential to actively create conflicts where before none existed, the authors cite a desire for “papers” as the impetus many communities needed to resolve long-standing disputes.

Mapping Process

Stage 1: Creation of coordinating committee

Stage 2: Intra-community participatory hands-on mapping

- Community members divided into groups of women, youth and elders.
- Each group draws a map identifying:
  - all borders and landmarks (roads, rivers, hills, trees),
  - neighboring communities, towns and major roads,
  - all man-made infrastructure (schools, clinics, churches),
  - all natural resources (forests, rivers, springs, lakes, caves, areas for gathering thatch, medicinal plants),
  - forestry concession areas,
  - sacred/religious sites.
- Each group’s map is integrated into a larger comprehensive map.

Stage 3: Inter-community boundary negotiation

- Boundary harmonization teams, delegations of trusted community members, are elected to negotiate boundaries with representatives of neighboring communities.
- After working with other communities’ boundary harmonization teams, the team presents the agreed boundaries to their home community, seeking community approval.
- When agreement cannot be reached, conflict resolution and mediation techniques are employed.

Stage 4: Boundary demarcation

- Once boundaries are agreed upon the communities document the agreed boundaries by planting boundary trees in the presence of representatives of neighboring communities. ‘Soap trees’ which have extensive roots and are fire-resistant have been planted in Liberia.
- The communities have formal gatherings that bring together representatives of neighboring communities to sign permanent MOUs attesting to the agreed boundaries.

Stage 5: Establish by-laws for community land administration

Stage 6: Draft land and natural resources management plan

Stage 7: Elect permanent governing body

Lessons Learned (Knight et al., 2012)

- Boundary harmonization teams that included both elders and youth were the most effective in negotiating boundaries due to their complimentary negotiation techniques and viewpoints.
- A community's willingness to compromise greatly impacted its abilities to move through the boundary harmonization process. The desire to maintain good relations with neighbors and document land claims contributed to a faster process.
- Towns with split allegiances between clans tended to result in less successful negotiations due to the complexity of these allegiances.
- Changes to previously approved boundary markers created additional challenges for community negotiations. In instances where a tree which served as a boundary marker was removed or a new road was installed previously accepted boundary lines were more likely to be challenged.
- Confusion between customary and state-drawn boundaries led to additional boundary harmonization disagreements between communities.
- The suspected or known presence of natural resources along a boundary line created an additional flashpoint for boundary harmonization.
- Community land documentation is not only an exercise in demarcation; it is also a conflict-resolution activity. Facilitators should be ready to support resolution of land conflicts and should craft curricula and trainings designed to support open, non-violent communication, compromise strategies and mediation/dispute resolution tactics.
- Mapping has the potential to expose intra-community conflict. To mitigate conflict, the entire community should be convened for all boundary mapping , resolution of land conflicts and planting of boundary markers.
- The goal of securing documentation is a strong motivating factor for communities to resolve their disputes over land.
- Boundary harmonization resolved many more conflicts than it created.

3.1.5 Liberia - Community Mapping in Nimba and Grand Bassa Counties, February 2013

Introduction

The Big Gio Forest in Nimba County is surrounded by multiple villages that all need land for farming purposes. As part of efforts to sustainably manage the area for future generations, the PROSPER project needs to know where the customary clan boundaries lie in the area, both around and within the forest itself. Once the boundaries are identified and the various villages apportioned to them, the project will support these same communities with the development of community forest plans. The following describes the stages involved in obtaining this information from groups ranging in size from 15 to 40 individuals.

Preparation

All of the communities visited, Gbotuo, Marley and Bah Town, were informed of the community mapping exercise in advance through a series of sensitization meetings that raised the profile of the project as a whole. Then, they were invited to attend a daylong event at which the mapping of the boundaries would be conducted. In all of these communities, a rapid participatory map exercise or 'mind map' had been completed.

The mapping specialist prepared for these meetings by procuring recent satellite imagery for the Big Gio Forest area and making two distinct maps for use at the event. One, which was laminated as it will be used again in the future, provided a general view of the area. The second map was printed on plain white bond paper and provided more visible detail for the participants to use. Additionally, markers and flipcharts were brought along for use at the meeting.

First Stage – Introduction and Familiarization with Materials

Before the meeting started, the laminated map and two sheets of paper from the flipchart were attached to the wall of the meeting hut with masking tape. After the meeting started with prayers and round of introductions, the primary purpose of the meeting was reiterated to all attendees by the local office manager. It is worthwhile to note that a translator was needed in most of the venues where the exercise was conducted to translate English into the local language. This was particularly requested by the village elders and chiefs.

The mapping specialist then took charge of the meeting by explaining that success depended upon both inputs from himself and the attendees. Part of this was achieved by highlighting the fact that only they knew where the clan or district boundaries lay in their communities.

The original participatory 'mind maps' were then shown to the attendees. It was explained that while a relatively useful tool to quickly identify local features, the method used did not produce robust data that can be assimilated into a professional map. At this point, the laminated satellite image map was introduced and a general briefing given (Figure 4). This included an explanation that the image was acquired from up in the sky and identified the major geographic features that were immediately visible.

Figure 4 – Introduction of the Satellite Image Map to Community Members

In the case of the area in Nimba County, these included the main road between Ganta and Tappita, the Cesto River bordering Ivory Coast, the Big Geo Forest boundaries as defined by FDA in 1952 and various villages and settlements. After the general description, all attendees were invited in groups of four to receive a personal explanation from the mapping specialist. This process took up to 20 minutes. Once completed, it was explained that while much information could be identified from the image including the location of farms, certain valuable information was not immediately visible, for example clan boundaries.

Second Stage – Integration of Community Knowledge into Geo-referenced Map

Now that all participants had viewed the satellite image map, it was time to ensure they could navigate within this map. To achieve this, a small exercise was conducted.

The meeting attendees were divided into two groups. Each group was given the same task and materials. Their task was to identify the settlements in a particular area of the map. An outline of the visible road network was traced onto the two flip chart sheets by the mapping specialist and then given to each group.

They were then specifically asked to place, in order, the settlements along these roads (Figure 5). The groups were given 15 minutes to complete this task.

Figure 5 – Meeting attendees identifying the order of villages along a known geographic feature

Once completed, the results from both groups were posted on the wall at the front of the meeting, side by side. A facilitator from each group was then asked to present the work of their group. The facilitators took turns reading out two or three settlement names before the alternate took over. This way, the results of both could be quickly combined to assure a common correct listing. The other meeting attendees were asked to raise their hands if they believed that a settlement had been listed out of turn.

Upon completion, a finalized list of settlements with their local spellings had been obtained and key villages labeled using a permanent marker on the laminated map.

Third Stage – The identification of the Clan Boundary

By this stage, all participants were looking closely at the satellite image map and navigating themselves using physically identifiable features. It was time to collect the non-visible boundaries. Before the exercise began, certain points were made clear. Firstly, the mapping specialist requested that participants provide the best and most accurate work possible. Secondly, the handheld GPS unit was introduced. A brief description of how the GPS worked, an analogy was made to the cell phone, and exactly what it could do was provided. This was done as a precursor to comments made that the boundaries identified today were preliminary and they would all need verification using the GPS device in due course. Once this was understood, the exercise continued.

At this stage, the group(s) was given 15 minutes to discuss amongst themselves their understanding of the clan boundary. This time allowed for consensus building and all participants to contribute their views.

After the discussion phase, depending upon the group, two different approaches were used. If the group contained members of two adjacent clans, then they were separated by clan. If they were from the same clan, then they were kept together. While there was excitement about drawing on the large paper maps, the groups had to first provide a written description or narrative of the boundary. In the cases where two clans were present, one group started at one end of the boundary and the other group the opposite end. Once again an individual was identified and held responsible for writing down the descriptions provided by the rest of the group.

The groups then began to provide a list of features that when combined fully described the boundary in question. This process took up to 30 minutes and resulted in animated discussions between group members. Once finished, the resultant lists were posted on the wall in front of all participants and read out in order (Figure 6). When participants felt there was an error, they were encouraged to speak up in an orderly fashion. It was important to maintain order during this reading phase. After a further few minutes, a general consensus was reached that the boundary had been correctly described and it was time to put an estimated boundary on the map.

Figure 6 – Reading out the written descriptions of Clan Boundaries

As the entire gathering had been involved in the written description of boundary markers and it had been made clear that the maps to be drawn next were only preliminary, only one or two individuals were required to annotate the large paper map that was now hanging in front of the meeting room. The process of annotating the map (Figure 7) with the preliminary boundary took no more than five minutes and the results were then reviewed by all attendees. Little to no discussion as to the positioning of the boundary lines was evident as agreement had been reached beforehand.

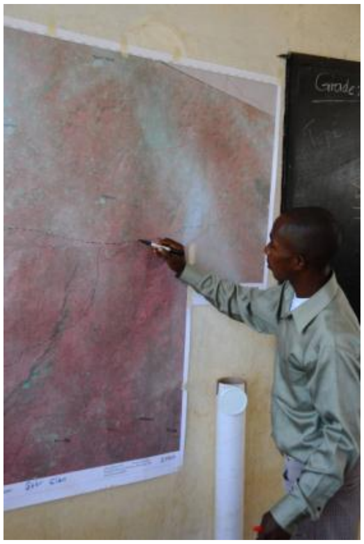


Figure 7 – Annotating the map with a preliminary clan or community boundary

Fourth Stage – Conclusion of the Meeting

The attendees were congratulated on their work, a brief description of how this information would now be incorporated into the next phase of the project was given by the mapping specialist and any final words and questions were answered by the project team.

Mapping the Outputs of the Community Meetings

The data created as part of these meetings was then digitized by the GIS consultant and the following maps were created. Additional data, collected while travelling to the meetings using a handheld GPS was added to the map as were the locations and names of villages in each surrounding area.

Figure 8 – Preliminary Community Boundaries in the Big Gio Forest, Nimba County

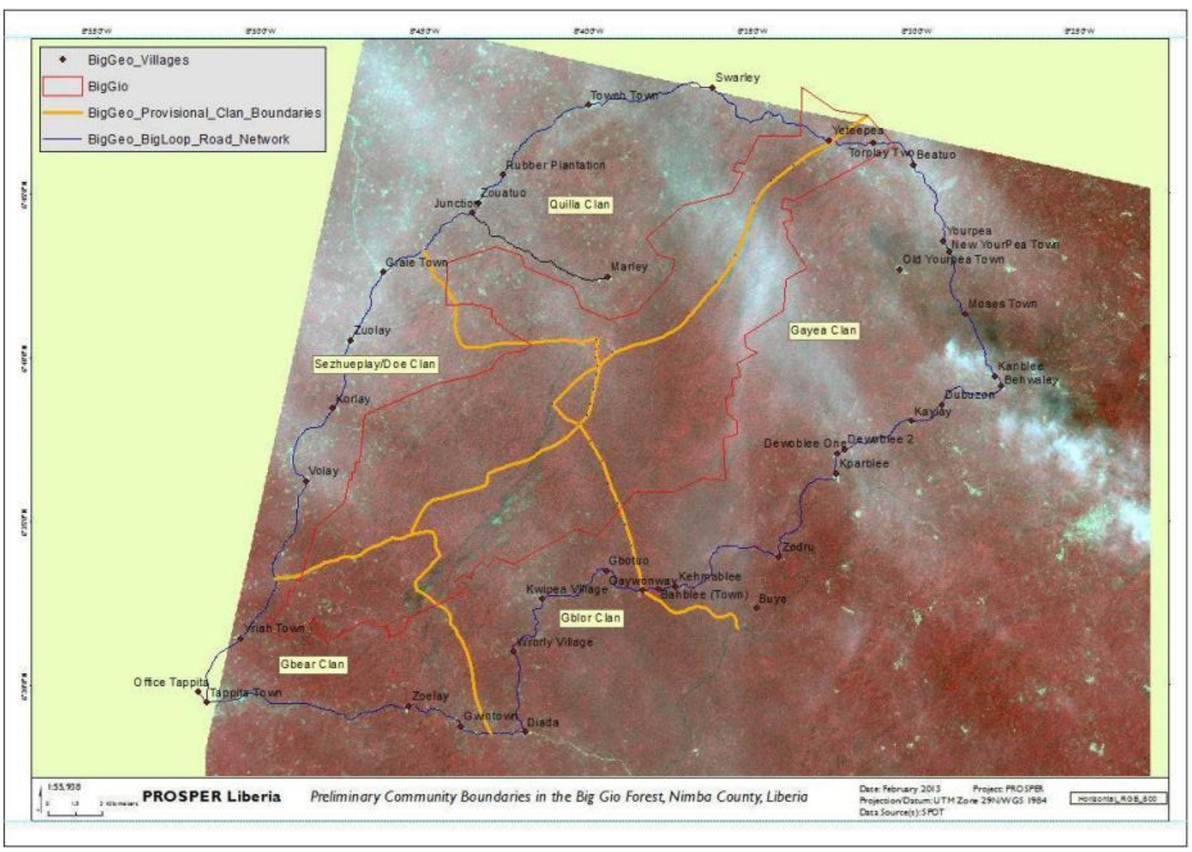
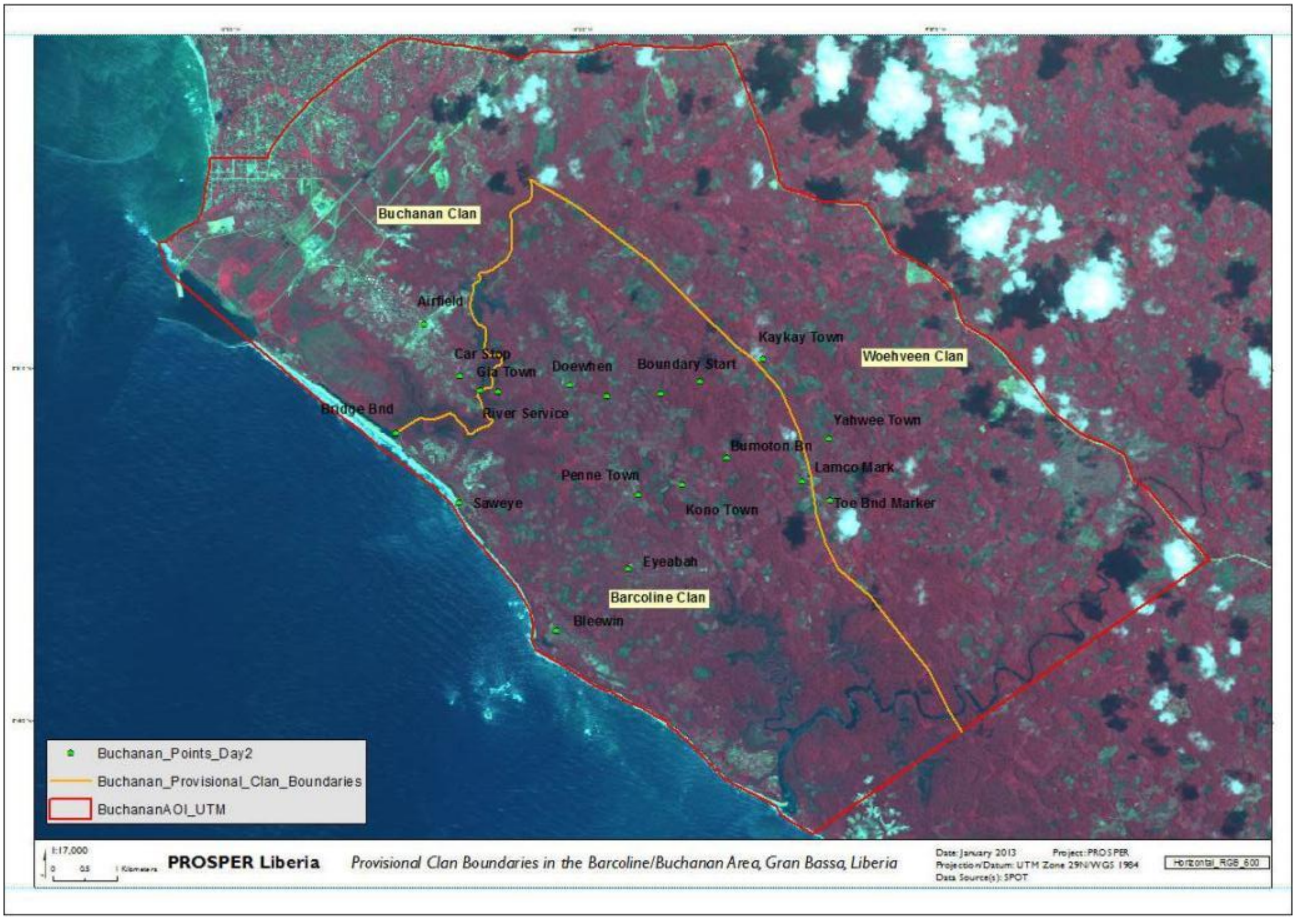


Figure 9 – Preliminary Community Boundaries in the Barcoline Forest, Grand Bassa County



Boundary Verification Field Visits

Throughout the initial boundary identification meeting, it was reiterated that any results were preliminary and that all boundaries would eventually be verified by physically walking them with a GPS unit (Figure 10). After completing the community meetings in both the Buchanan and Big Gio areas, two separate field visits were conducted. Community members accompanied PROSPER staff and were asked to specifically identify boundary markers. Once located, these were geo-referenced and subsequently incorporated into the GIS database. On average, 14km were walked through the forest each day.

The results of the field visits verified the written and visual boundaries created the previous day and indicated that the provisional boundaries were, in fact, fairly close to reality.

Figure 10 – Field Verification of Preliminary Community/Clan Boundaries

3.2 EXAMPLES OF OTHER LAND RIGHTS INVENTORY PROJECTS FROM OUTSIDE LIBERIA

3.2.1 Benin – MCA Access to Land

Project Context – Enabling environment

Land disputes comprise 70% of the cases appealed to tribunals in Benin. One major contributing factor to this statistic is the estimation that 80% of rural landholders use oral records to justify their access to land. This environment complicates land tenure for women and other vulnerable populations even though women are guaranteed equal access to land under current legislation. Passed in February 2007, Benin's land legislation established Rural Land Rights Mapping (PFR) as the official government approach to land tenure management in rural areas.

Project Description

The Millennium Challenge Account – Access-to-Land Project was designed to improve tenure security and land administration in both rural and urban areas of Benin. The project's urban focus worked to upgrade land occupancy certificates to full civil law titles, modernize Benin's geodetic network, establish new technical systems and administrative structures for management of land documents in land rights registration offices, train agency officials and assist the government in the development of a new comprehensive national land policy and code. The second component of the project focused on rural land tenure security using PFR to recognize and certify land held under customary rights. The project mapped agricultural fields and defining rights under custom in 300 villages (10% of Benin's villages). Over five years, the project mapped 72,413 individual parcels and created village land holding plans for the project's 300 villages.

Mapping Process (Elbow et al., 2012)

Stage 1: Establishment of technological requirements

The project worked across multiple stakeholders of land management and administration roles to form an implementing partnership to define the degree of rigor to be applied to technical quality control of the PFRs and to define the precision standards for parcel surveys. The partnership determined a technical requirement of 0.5 meter precision for PFR parcel boundaries.

Stage 2: "Topo-tenure" surveys

Surveys were conducted to collect property rights information including topographic/geodetic and land tenure information in the same exercise. Secondary, access-to-land, rights as well as proprietary and management land rights were recorded in the PFR.

Stage 3: Data processing and administration

Survey data was entered into a GIS database containing detailed land tenure and GPS surveys. Databases were packaged into a commune-level land information system. These commune-level systems comprised an average of 6 to 8 village-level PFRs. After commune officials received training in use and management of the information system they were given responsibility for the GIS database administration and management.

Lessons Learned (Elbow et al., 2012)

- PFR requires significant quantities of human, logistical and financial resources to be mobilized so that mapping 300 villages over five years was ambitious. A contributing factor to the delay in mobilization was the fact that the complete methodology had not been settled upon at the outset of the project, leaving portions of the methodology yet to be developed.
- Legislation did not address all project level issues, leaving them open to interpretation. One issue concerned the definition of land uses beyond private individual parcels relating to consensus around public and common property land and resources.
- Addressing secondary, non-proprietary, land use and access rights was a challenge. Back-up systems were built into PFR methodology to mitigate the risk of disenfranchisement of vulnerable populations. Contracts were used to formalize secondary rights based on contracts as well as the development of local government capacity to manage and enforce contracts. Vulnerable groups in 16 of the 40 communes were also identified and analyzed with awareness-raising activities included in outreach to these groups.
- Data transfer of the GIS database to commune officials occurred relatively late in the project, raising questions of whether or not communes were sufficiently prepared to manage the new databases, especially regarding further tracking and updating of the new rural land titling instrument for issuing land certificates as mandated by the 2007 legislation.
- A variety of agencies had various administration roles and responsibilities for land management in Benin. The complexity of technical standards and precision levels for boundary delimitation should be fully debated and validated by all interested parties before project implementation begins.

3.2.2 Botswana – Tribal Land Integrated Management System

Project Context

Customary tenure is the dominant land tenure regime in Botswana. In Botswana, 47% of the population lives in rural areas though urban dwellers often have land rights in tribal areas. 71% of the land area is tribal land, 25% state land, and 4% freehold land; a system inherited from Great Britain in 1966. Customary tenure entitles every citizen age 18 and older to be allocated land for residential, cultivation and grazing purposes. Individuals have security of tenure as long as the land is used and their rights are inheritable, but cannot be sold or mortgaged.

Customary tenure in tribal lands is managed by the Land Boards, which are autonomous bodies that administer land in Botswana and are responsible for all matters related to the allocation of land in all tribal areas. In 1968 the law was changed to remove authority for land administration from tribal chiefs and given to the Land Boards. These Land Boards have been criticized for not being sufficiently democratic or locally accountable. Administrative challenges in managing land records have meant that almost all land inventory projects failed to achieve their intended results.

Project Description

To address the need for improved land administration, the Ministry of Local Government developed the Tribal Land Integrated Management System (TLIMS). TLIMS was designed to provide all Land Boards with a tool to capture, convert, process, analyze, evaluate, verify, validate, update and provide easy access to spatial data regarding land tenure in tribal areas. The project was intended to enable the Land Boards to make more equitable distributions of land, manage the land more efficiently, generate reports to aid with decision making and to interface with other government databases. In addition, TLIMS was envisioned to assist Land Boards in curbing illegal land transactions, addressing land speculation, enforcing compliance, resolving and preventing land disputes and identifying undeveloped residential land and idle or vacant land.

Mapping Process (Sietchiping, 2010)

Stage 1: Task force formed

- The task force includes representatives from Department of Lands, Land Board and members of the consultant team.
- The task force works with village chief and leader of the Village Development Committee to raise awareness that the government is collecting data in the respective areas. Community is asked for its cooperation in collecting plot information.

Step 2: Data collector training

- Village residents are trained in how to capture information from Land Board files and on how to collect information from plot owners. Proper sensitization and preparation is included in training.

Step 3: Field Data Collection

- Each data collector is given a subdivision of the area to be surveyed.
- Data collectors are given clipboards, surveys, and a GPS unit.
- Data collector captures all plot and ownership details using a survey questionnaire.

Step 4: Data Quality Assurance

- Projection, datum and spheroid checked to match standard.
- Polygon boundaries checked for slivers so all lines are connected together correctly.
- Check that each plot has a unique identifier and entered into GIS database.

Lessons Learned

- One issue in improving security revolves around land certificates issued by the Land Boards. As the only legal protection in case of disputes over title, certificates are essential. However, many cultivators were offered the certificate of title only if they paid a subsidized survey fee, which many declined and thus did not receive the certificate. Many citizens felt land tenure was granted when their land boundaries were demarcated. It would be difficult to prove whether the implementation of the TLIMS contributed to tenure security due to the fact that security of tenure depends on people's perception.
- In one research location, since implementation of the TLIMS, land disputes have decreased from over 10 a month to an average of one per month.
- TLIMS is mainly concerned with the contiguity of land parcels and uses that information to support land use planning and administration. Disagreements over the level of accuracy (sub-meter as opposed to centimeter) required for planning versus cadastral purposes have not been clarified.

3.2.3 Burkina Faso – Rural Land Governance

Project Context

After all land in Burkina Faso was nationalized in 1983, the government has been engaging in a process of land tenure and property rights reform to secure rural land tenure, to decentralize responsibility for land management and administration to local levels of government and to create investment incentives to improve and protect rural land. The process has seen a trend toward local management of land and the promotion of formalized rights based on customary claims.

In 2009, the Rural land law was adopted, which provides two scales of formalized customary land rights. Under the 2009 law both rural land certificates and rural land charters may be issued. A rural land certificate (Attestation de Possession Foncière Rurale, or APFR) is similar to a local-government-issued land title granted to individuals and associations while a rural land charter (Charte Foncière Rurale) regulates the use of and access to natural resources and spaces used in common by local community members. These agreements are based on local customs, uses and tenure practices and are developed locally to take into account the full range of the local landscape including ecological, economic, social and cultural considerations (Elbow et al., 2012).

Conflict over land rights in Burkina Faso is also an issue. The 2009 law requires that conflict resolution efforts be made at the local level before the conflict can be appealed to the formal tribunal system. Higher levels of government are required by law to take all "appropriate measures" to prevent conflict. Though concern over land rights conflicts is pervasive, the practical and legal implications of this portion of the law have yet to be fully implemented.

Project Description

The Millennium Challenge Account - Burkina Faso (MCA-BF) Rural Land Governance Project worked to reduce poverty in Burkina Faso by improving land tenure security and promoting greater investment incentives in land.

Mapping Process (Elbow et al., 2012)

- Both individual and property land and resources were included.
- Common property, including village woodlots, sacred site, pastures and cattle trails, bodies of water, and sand and gravel quarries, was mapped.
- These land use types were then formalized with a rural land charter.
- Rural populations actively participated in the development of the land charter and could be developed at multiple levels – village, inter-village, commune and inter-commune.
- Each of the 17 land charters in which the project was involved focused on a specific use resource zone and defined rules for access and use of the resource. Many of the charters established a management system and body for the enforcement of these stated rules.
- Some of the charters include formalized compromises struck with individual land occupants. As this is a new mechanism it is too early to claim that these agreements will hold up long-term
- Formalized common property resources provide abundant and varied opportunities to achieve improved and sustainable natural resource management, as well as revenue generation and preservation of local customs.

Lessons Learned (Elbow et al., 2012)

- A major challenge is to go beyond theoretical training in conflict management to support development of a local institutional structure at the first level of land conflict management.

3.2.4 Guatemala - Municipal Property Mapping through Real Rural Development

Project Context

The end of the 36-year Guatemalan Civil War in 1996 left Guatemala with highly unequal land distribution, insecure tenure for indigenous groups and other vulnerable peoples, unresolved land disputes and no basic land law. Large farms owned by those with wealth and access to credit occupy two-thirds of the country's agricultural land, while 90% of farms are found on one-sixth of Guatemala's agricultural land (USAID, 2010). Indigenous Guatemalans, who comprise 43% of the population, face very insecure land tenure. Numerous unresolved land disputes and ineffective conflict resolution mechanisms discourage investment. No basic land law and limited political will for reform has challenged land tenure security.

Project Description

International donors, including USAID and the World Bank, have made substantial investments in land administration. USAID programs have resulted in 25,000 land titles issued to farmers in former conflict areas (USAID, 2010). The World Bank has an ongoing land administration project that has a goal of updating cadastral services for 50% of the country by the end of the project in 2013 (USAID, 2010).

Mapping Outcomes (World Bank, 2012)

- Cadastral surveying underway in 26 municipalities. Of the population participating in the cadastral survey, at least 40% must be of indigenous descent.
- 427 kilometers of protected areas' boundaries and 35 kilometers of national reserve areas' boundaries demarcated.
- 157 sacred site and 249 archaeological sites have been identified, geo-referenced and incorporated into the database of the Department of Cultural Resources' Registry.
- 740 kilometers of municipal boundaries have been identified and agreed among relevant parties.
- Out of 450 conflicts identified thus far, 314 are in a resolution process with 43 conflicts resolved.
- Communal lands have been identified and are in the process of being certified.
- 60% of a passive geodesic network has been established in the project areas.

3.2.5 Kenya - Securing Rights to Land and Natural Resources for Biodiversity and Livelihood in the Kiunga, Boni, and Dodori Reserves and Surrounding Areas in North Coastal Kenya (SECURE)

Project Context

The Northeast coast of Kenya, the Lamu district, is home to three National Reserves—the Kiunga Marine, and the Boni and Dodori Forest Reserves. The region supports internationally recognized mangroves, estuarine and marine ecosystems, coastal forests, water catchments, endangered species of fauna and is also the ancestral home of marginalized indigenous communities. Both the people and the natural ecosystems are facing serious threats due to weak tenure security of the communities to their ancestral lands, irregular and extralegal land allocations by the government to private investors, unsustainable exploitation of natural resources, and impending development activities such as the establishment of a new port and associated infrastructure.

The constitution of Kenya guarantees land tenure rights for communities and the Ministry of Lands approved the Community Lands Rights Recognition Model in September 2011, which provides a process for securing the recognition of communal land rights. Despite this legislative framework, claims of local communities to customary land and resource-use rights have yet to be formally recognized by the Kenyan government.

Project Description

Working with the Ministry of Lands (MoL) and the Kenya Wildlife Service (KWS), the Securing Rights to Land and Natural Resources for Biodiversity and Livelihood in the Northeast Coast (SECURE) Project is aimed at bringing transparency in land administration, securing land rights of indigenous communities, resolving land conflicts, and promoting sustainable management of the forest and marine resources. "Lessons Learned" will inform the draft National Land Policy and the draft Wildlife Policy and Bill.

Goal of Community Mapping

In late 2011 and early 2012 participatory community mapping exercises were undertaken with five villages along Kenya's north coast in the mostly forested area adjacent to the Boni and Dodori national reserves. The goal of the exercises was to identify, document and map the natural resources, mobility patterns and resource use patterns of the communities while also mapping the current extent of the forest by documenting the health and state of biodiversity, cultural heritage sites and social mapping. The goal of the mapping activities was not the map community boundaries. Mapping activities were an initial step toward helping communities secure their land and resource rights, protect forest and forest resources and advocate for more effective management regimes for conservation. This serves an overall goal of promoting sustainable natural resource management.

Rather than mapping boundaries, the project's participatory mapping activities were aimed at documenting resource use. Which natural resources are communities using? How do communities use these resources? To what extend are these resources used? Documenting boundaries was not a priority for this project, which instead recorded the locations of sacred sites, salt lakes, areas used for honey harvesting and places for gathering fruit and firewood.

The map produced from these exercises provides a cartographic record of the dependent relationship and coexistence between the communities and their environment and gives the commu nities a tool for an effective territorial defense strategy. Communities are able to use the map produced by these mapping activities at local and national levels to assert more secure land and resource rights over their traditional territories. In addition, maps produced from these activities support communities in dialog and negotiation processes.

Mapping Process

Stage 1: Planning, Preparation and Training

- Meeting with national stakeholders in Nairobi discussed participatory mapping and agreed to open sharing of information as other stakeholders were also creating resource maps of the area
- Local planning meeting with stakeholders in Lamu county helped define the study area
- Engaged Community Scouts from KiBoDo Trust along with rangers from Kenya Wildlife Service
- 18 Community members were trained on using a GPS unit to mark points, tracks. They were also trained in hands on mapping and familiarized with a coding system for data entry
- Due to the fact that free satellite imagery was largely obscured by cloud cover, SPOT imagery was acquired (2.5 meter pixes) and hard copy maps were produced from this imagery. These basemaps included features such as roads, rivers and villages. A basemap was prepared for each community.

Stage 2: Community Meetings

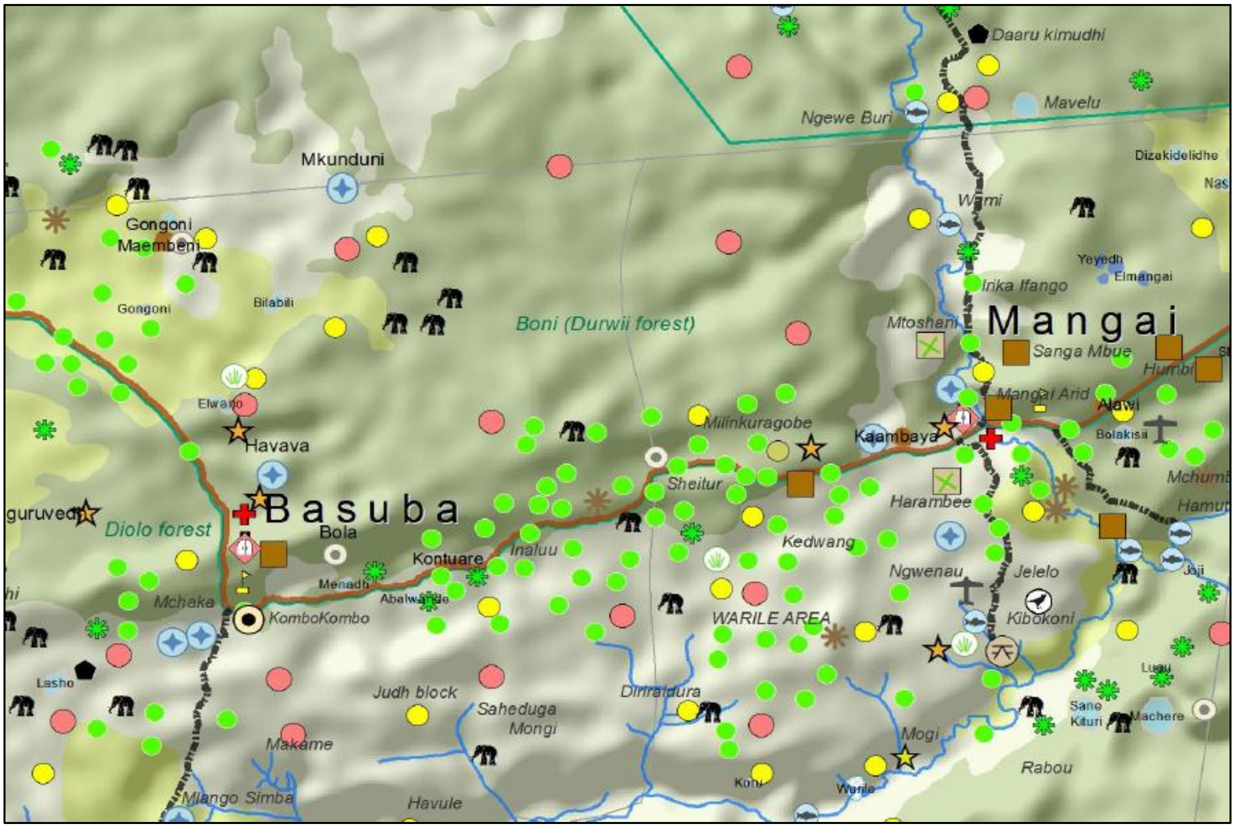
- In each community participants were divided by gender so males worked separately from females. Groups first drew maps on the ground, then transferred their map to paper sketches
- Facilitators helped participants orient themselves to the basemaps
- Community members, using the predefined list of resource uses, drew approximate resource locations on maps. Facilitators also captured local place names, which often differ from official gazetteered names, giving the local communities emphasis if names are adopted for official use.
- Resources identified on photomaps were documented using GPS. GPS teams collected resource data

Stage 3: Data Processing and Analysis

- Data were checked for quality (removed duplicates, null values, cross-referenced with manual entries from GPS logs)
- Maps were created for the communities that included a basemap of generic land cover identifying vegetation classes (forest, woodland, shrub, sand) overlaid on an elevation layer emphasizing topography
- Spatial analysis was conducted to identify spatial clusters in close proximity to villages, roads and rivers and to measure how far various groups travel to access their resources

Stage 4: Maps presented to the communities for validation

- Community meetings ratified resource uses and place names
- Participants signed their names to confirm approval of the map
- Participants were also given the opportunity to provide additional information left out of the initial mapping process



Lessons Learned

- Boundaries between villages are difficult to define because some resource uses extended well beyond the communities which raises questions about possible conflict that could arise when defining boundaries between communities
- Male and female participants highlighted different resource uses. Women tended to identify resources within the village while men focused on resources outside of the village
- Co-management of forests and other natural resources can only work when there is robust cooperation and coordination between the community and state agencies

3.2.6 Madagascar – Citizen's Cadastre

Project Context

Article 11 of Malagasy Law No. 60-004 stipulates that the State is the owner of all land that has not been publicly registered or assigned to an individual by virtue of legal land title. Only 10% of agricultural land in Madagasgar has been registered. In comparison, customary law states that continuous cultivation of land legitimizes its appropriation and also places a strong emphasis on the recognition of ancestral domains. Customary claims are largely based on oral tradition and are threatened by the modern law. The country also has a history of conflicts over the absence of a clearly identified land title and insecure tenure reduces the incentives for farmers to invest in their land. Administrative issues result in a central government that is largely incapable of responding to the demand for recognition of land rights due to a lack of financial and human resources. The process for individual registration involves 24 administrative steps with and average waiting time of 20 years (Di Gessa, 2009).

Project Description

An NGO in Madagascar called HARDI uses participatory mapping techniques to tackle land tenure insecurity. Their work helps farmers manage relations with land administrators in a more efficient way and facilitates the process for communities to obtain land titles with the shortest delays possible.

Mapping Process (Di Gessa, 2009)

Step 1: Spreading the Word

- Planning meeting with local stakeholders (land committee, local community president, community members, facilitator)

- Radio announcements inform land owners and inhabitants to participate in the process. Announcements ask participants to bring documentation that could prove legitimacy of their land occupancy.
- A small initiation ceremony is held where the objectives and next steps of the process are explained.
- Participants gather with an agent of the land office and a facilitator to guide discussions.

Step 2: Demarcation

- One plot is chosen and the owner asked to come forward. Stakes are placed in each corner of the plot by the owner. Neighboring rights holders validate the marker positions.
- If multiple people claim one plot, a conflict resolution process is initiated.
- Subsequent plots are dealt with in the same process.
- Documentation is examined by the land committee and land office. If no documents have been presented, family and neighbors are consulted.
- Owners fill out questionnaires to inventory the diversity of land situations.
- A certificate of recognition is signed under the auspices of the gathered community.
- Satellite imagery of the area is printed and tracing paper stuck to the back of the image. A land office agent marks the boundary with a crayon under the supervision neighbors who validate the result.
- The information is then entered into a GIS and used to create a local land use plan.

Lessons Learned

- The process has helped improve land tenure security and helps to prevent conflict over land ownership. Participants are trained in conflict resolution, which helps to diminish economic and social costs of disputes.
- Integration into a GIS should help lead to a better management of natural resources

3.2.7 Mozambique - Community Land Delimitation

Project Context and Description

Mozambique's *Lei de Terras* (1997) formalizes customary land claims by granting *de jure* land titles to individuals and communities living on land according to customary claims and also recognizes the claims of individuals and groups living on land in good faith for ten years or more. The law stipulates that rights are secure, heritable and can be transferred to third parties. Customary claims can be mapped and entered into the national cadastre.

This project was one component of the work carried out in Liberia by the International Development Law Organization (IDLO) and the Sustainable Development Institute (SDI). In Mozambique, IDLO partnered with the Centro Terra Viva to undertake similar work of testing the best methods for supporting communities in establishing customary claims to land. It is important to note that, as of 2010, only 323 have successfully had their lands delimited.

Mapping Process (IFAD, 2009 and Knight et al., 2012)

Step 1: Community sensitization, education and election of community representatives

- Community submits a request for land delimitation to the district administration and an interdisciplinary team of external facilitators is appointed
- Community receives information on the land law, its land rights and the land delimitation process.
- Meetings culminate in the election of a community coordinating committee to liaise with external facilitators and oversee land delimitation.

Step 2: Participatory appraisal and map-making

- PRA activities are conducted by community facilitators with various community interest groups (e.g. women, men, youth, new settlers) on the history of occupation and use, social interest groups and community organizations and long-term development vision. A report is produced by the facilitators.
- Community interest groups create participatory maps with the support of a facilitator. The maps include community boundaries, land use and occupancy, common-use areas, existing and new concessions, a vision of future development, and reference points where conflicts over natural resources take place.

Step 3: Boundary definition

- Boundaries and common-use areas (e.g. forests and grazing) are confirmed with neighboring communities. Elders or external mediators are called to conduct conflict mediation if there are boundary disputes.
- Surveying of community boundaries and common use areas takes place. These are then mapped on a topographic map using a suitable scale. Where a boundary cannot be identified on a map, the boundary is surveyed using hand-held GPS.
- A memorandum describing the boundary is produced by community members supported by facilitators.

Step 4: Feedback

- Information is validated at community meetings and signed by the community, facilitation team, neighbors and district administration representatives.

Step 5: Entry into National Cadastre

- A Community Delimitation Certificate is issued by the government, and all information, including the map, is registered and filed.
- The Provincial Services of Geography and Cadastre (SPGC) confirms that a proper consultation has been done.
- A new concession is granted by the government.

Lessons Learned

See section on Liberia – Community Land Titling Initiative. Lessons learned are similar as the project worked across both Liberia and Mozambique.

3.2.8 Namibia - Private and Communal Land Through Community Structures - MCA Namibia

Project Context and Description

A component of the Millennium Challenge Account Namibia (MCA-N) Compact is the Land Access and Management Activity which aims to improve rangeland management and provide more equitable and secure access to land in the Northern Communal Areas (NCAs). The Communal Land Support activity, managed by the Ministry of Lands and Resettlement (MLR), works to strengthen the land ownership verification and registration process as laid out in the Communal Land Reform Act of 2002. The MLR works with Communal Land Boards and Traditional Authorities to improve the administration and management of communal lands. One of the objectives of the Communal Land Support activity is to increase landholders' tenure security over their individually allocated properties and communities' tenure security over the commonage in the NCAs.

As part of this activity, all land parcels along with information on their use and ownership are to be mapped and registered. Commercial, community and public service properties will be verified but not necessarily registered. Supporting seven regional Communal Land Boards and 16 recognized Traditional Authorities and village heads will improve their capacity to adjudicate, allocate and administer formal land rights, especially in areas where large areas of commonage remain, and to resolve conflicts that may arise.

Mapping Process (Elbow et al., 2012)

Stage 1: Preparation

- Recruit registration teams
- Prepare satellite imagery for relevant registration areas – 1 meter resolution acquired at the end of 2007
- Orient and train registration teams (including on-the-job training)
- Fieldwork planning and organization
- Communication and training campaigns, preparing residents and headmen for the verification campaign
- Acquisition of existing land right and parcel data (e.g. National Planning Commission Secretariat (NPCS) household data, water & electricity servitude data, proclaimed roads and local authority areas)
- Collection of all existing applications from Traditional Authorities

Stage 2: Fieldwork by verification teams

- Fieldwork by verification teams (generally per village), receiving new applications, adjudicate and verify all rights where possible, mapping of land parcels and commercial areas which cannot be registered.
    a. Any parcel that cannot be identified on satellite imagery surveyed by GPS
- Referral of disputes to Communal Land Board investigating committee

Stage 3: Data Processing and Verification

- Office work (digitizing and data capturing)

- Printing of Land Right Certificates and Village Maps
- Sending village maps and lists of land rights back to the headman or Traditional Authroity, for public display for at least 7 days, for the community to inspect, verify and/or comment on.
- Applications requiring approval by the Minister, are referred to the MLR
- Approval by Communal Land Board
- Issue of certificates by Communal Land Board, through Traditional Authority, to residents
- Record and data management by Communal Land Support-teams, MLR, Communal Land Boards, Traditional Authorities and headmen
- Quality Management
- Monitoring and Evaluation

3.2.9 Sudan – Community Land Tenure Program (SCLTP)

The Sudan Customary Land Tenure Program (SCLTP) consisted of two program components: 1) Community Demarcation of Customary Land and Capacity Building for Community Land Administration Institutions; and 2) State-Level Support for Enhancement of Land Tenure Security, both contributing to the overall program goal of building peace under the Comprehensive Peace Agreement (CPA). Each of the two components had identified priorities and activities but both were inseparable in terms of achieving lasting results pending political and social stability.

Component 1 was dependent on community involvement and support that included a) community mobilization and selection of boundary committees; b) demarcation of community land area boundaries together with boundary committees; c) community endorsement of these land area boundaries through signing forms specifically developed for this purpose; and d) establishing community land councils through intensive capacity building for communities and administrations at a county/locality level.

Mapping Process Employed

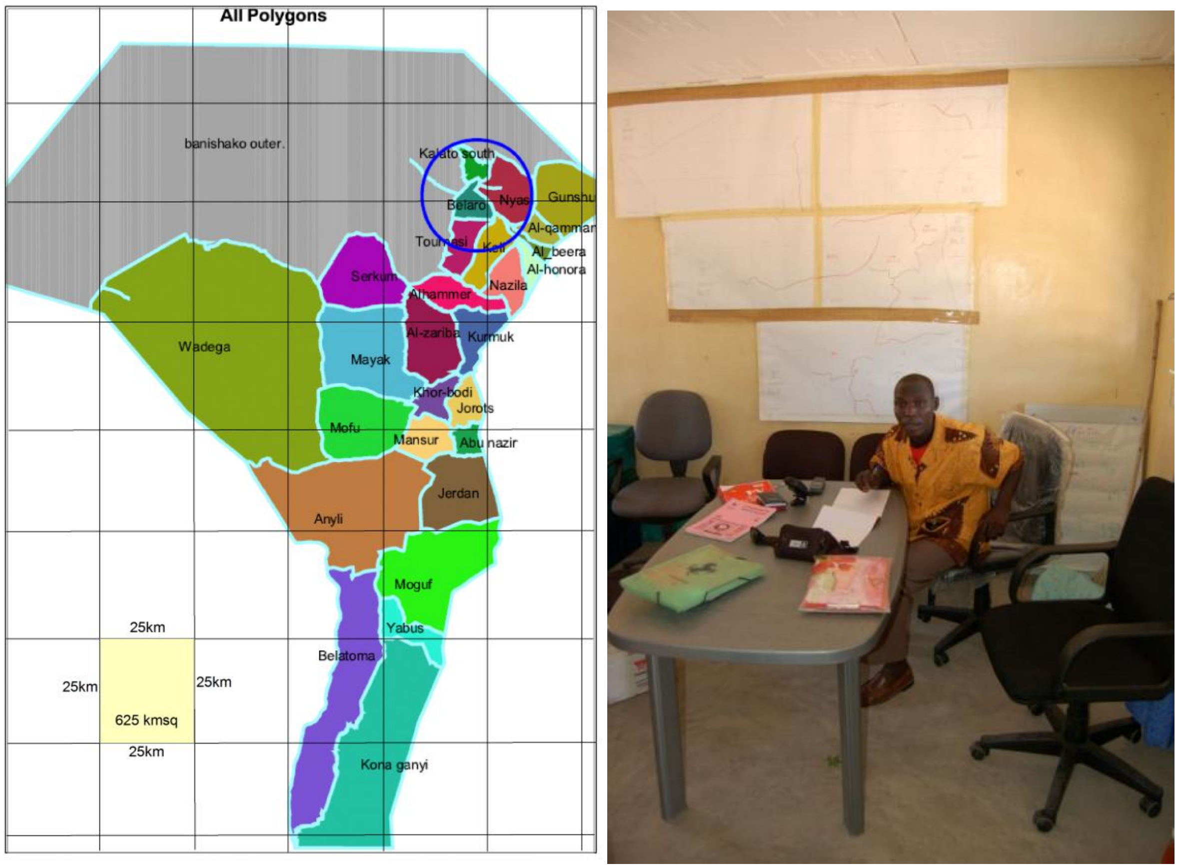
Working in two states, South Kordofan and Blue Nile, field offices and their associated teams were established. Regional staff were employed as field mapping specialists and recruited from ex-combatants as part of the reconciliation process after many years of civil war. These individuals were trained by an external GIS Specialist in how to interact with community elders and in the use of handheld GPS units to document customary community boundaries in areas that had never previously been mapped.

Due to the size of the areas being mapped, all data was collected manually via field visits. The process took a substantial investment of time and highlighted several weaknesses in previously developed operating procedures. The biggest challenge faced was transferring spatial data between the field workers and a GIS specialist located in Nairobi. GPS units were initially physically shipped to Nairobi where data was downloaded before being returned. This resulted in periods of time, up to 6 weeks, when field staff could not operate. To overcome this issue, subsequent instruction was provided to these same staff on how to download the data in their own offices. This resulted in a finalization of data. Results were overlain on imagery from Google Earth as part of the community meeting where verification of boundaries was agreed. Once this stage was completed, copies of the boundary maps were delivered to community elders.

Upon completion of the mapping phase of the project, several staff members were able to start their own mapping services company using the skills they had learned.

Results

At completion, the project had successfully demarcated twenty-five communities, settled several boundary conflicts and secured community agreements at a series of open meetings. Technically, the project staff had walked hundreds of kilometers, overcome procedural issues that were handicapping progress and exposed local communities to a low cost technical approach that could be easily replicated.



Map Outputs and Field Staff in Blue Nile State, Sudan

3.2.10 Timor Leste - Strengthening Property Rights in Timor Leste (SPRTL)

Project Context and Description

This $10.4 million project funded by USAID articulated a land policy, legal framework and administrative structure to secure the land, property and natural resource rights of all East Timorese. SPRTL worked with the Government of Timor Leste across five objectives: 1) to develop land policy laws and implementing regulations; 2) to create a land administration (cadastral, registration, and land titling) system); 3) to provide dispute resolution, mediation, and processes for competing claims to land; 4) to foster public information awareness/increased transparency; and 5) to support the national land commission (NLC).

Facilitating the legal framework under which land registration could take place was an important component of SPRTL. The project worked with the Ministry of Justice to pass key land legislation along with corresponding implementing regulations. This was the first time that land laws had been enacted and allowed the registration of private, undisputed rights resulting from the project's cadastral approach.

Passage of key land laws and associated regulations occurred while mounting a public information awareness campaign.

Across five years of implementation, SPRTL developed the technology tools, procedures, and systems for systematic claims registration leading to titling. Over 90 Timorese were employed to work in 30 teams of three people each (on average) to visit homes and properties systematically to collect claims. Land claims were initially recorded in two pilot districts, which gradually grew into five additional locations and eventually the entire country. In the first year of recording land claims, several thousand claims were recorded, growing to over 10,000 claims in the second year of collection. By the project's conclusion, a total of 51,624 parcels were entered into the cadastral database.

SPRTL included strong dispute prevention and mediation support. This support, combined with a systematic and transparent process, revealed fewer disputes than predicted. During this period only seven percent of registered claims were disputed. Most disputes were between private parties and the government and involved state institutions for which there was no legal representative. This required the subsequent passage of legislation to deal with these disputes. Most of the remaining disputes among private parties were intra-family disputes. Local community leaders were drawn upon for support in the peaceful resolution of disputes. Many resolutions included personal reconciliation between family members who had been in conflict for years. These positive results included thousands of claims being collected in the capital city of Dili. Additional teams were trained and deployed to accelerate claims collection nationwide.

Mapping Process

Stage 1 – Materials preparation

- A map book printed at 1:1,000 scale of orthopohotos collected in 2001, a parcel description collected on a survey sheet and finally a claim form spread over two A4 pages.

Stage 2 - Field data collection

- Teams of 3 people (on average) collected 4 parcels daily over four days. Fifth day used to transfer information to computers in the local office.
- Field teams collect simple line and point features to delineate boundaries and locate Unique Parcel Identifer as opposed to drawing polygons directly. The map books will be used to collect both geometric data, i.e., boundary outlines, UPI numbers and boundary markers, and annotation, e.g. status of the boundary segment, name of claimant and UPI number. Geometric data will be connected to three features classes in a standard file based Geodatabase. These are boundary lines (line features), boundary marks (points) and UPI locator (points).

Stage 3 – Field data transfer, error detection, attribute update

- The annotation will also be stored in the File Geodatabase to be used by both the local offices and the head office in Dili to correctly populate the associated tables with parcel claims.

Stage 4 – Data processing in Dili

- Transfer updates to central geodatabase where lines and points indicating parcels, boundary marks and UPI numbers will be converted into a topologically corrected polygonal database for use in the next stage of the project, map and tabular output for the Public Display Meetings

4.0 LESSONS LEARNED FROM COMMUNITY MAPPING

Introduction

The information presented so far in this report has provided a review of participatory mapping approaches and case studies that can provide a reference for making specific decisions as to which approach is best suited to need. However, it is important to realize that technical approaches alone will not answer all issues related to community land rights and the resolution of any land related conflicts at a multitude of scales. The reality is that significant frameworks, legislative, legal and social, should be present to ensure that work conducted and results achieved can be recognized, reported and acted upon in a transparent manner. The following section responds to a series of questions posed by the Land Conflict Resolution Project (LRCP) and reflect the experiences of the author in Liberia and other post-conflict countries.

1. Are legal frameworks required for effective community mapping?

In Liberia, the answer is no. This is not the same as saying that community maps might receive greater recognition if they could be clearly registered with an overarching authority. In Liberia, community maps have been created that identify and locate both physical and socio-economic data. Perhaps the most relevant data related to the question, is the documentation on the map of a community or clan boundary. This information is solicited through a transparent and inclusive process from members of a community (chiefs, elders and others) who are recognized locally as being legitimate witnesses. Initial data collected through mapping tools is subsequently verified through field visits and shared boundaries are only documented after agreement between neighboring communities. Ideally, this information would then be forwarded to a central institute for record keeping purposes however the reality in Liberia is that this does not exist.

The picture is confused by the presence of community deeds, issued in the late 1980's that define communities using meets and bounds survey techniques. Figure X provides an example for a community in Nimba County but no documentation as how the process of survey was conducted including community engagement has been discovered and therefore their provenance cannot be proven. This situation could not have been more clearly highlighted as when during a recent conversation with the Acting Head of the FDA, it was mentioned that 99.9% of the community deeds used to secure Private Land Use Permits (PUPS) had been proven to be forgeries.

The degree to which community map outputs can be considered legally robust, depends upon the reason the map was created in the first place. Community maps generated as part of efforts to recognize and subsequently improve management of community assets including forests should be registered to ensure that future claims or concessions issued do not overlay existing rights as extended through the customary land law. If the framework does not exist or has not been communicated to community member then it must be the communities themselves that retain this information and use it to protect their resources as they see fit.

2. *What are enabling conditions for a legal framework that recognizes the outputs of community mapping?*

In the case of Liberia, political will from central government that not only recognize community rights but formalize them will be essential if the outputs of community mapping are to be accepted within a legislative framework. The will already exists at the local level. Experience has shown that communities are most willing to identify their own boundaries to mapping specialists even without fully understanding the ultimate use of the data. This lack of information is entirely reflective of the land rights situation in Liberia, but communities themselves desire more formal recognition of their customary rights from a centralized authority.

When a fully mandated and functional land administration institution exists in Liberia, it must be accessible and accountable to communities. Information should not be shielded on land possessions as it has in the past if any attempt to reduce the locally accepted perception that secretive land transactions authored in Monrovia threaten the livelihoods of many communities outside of the capital.

As suggested by DiGessa (2008), by encouraging formal partnerships between a land authority and community or civil society structures, even secondary rights on use of natural resources could be documented.

3. *Where should maps be registered and recorded?*

The current situation in Liberia as to where community maps should be stored is confusing and is divided by thematic purpose as opposed to recognizing outputs simply as community perspectives on multiple issues depending upon the purpose of the map. The proposed Ministry of Agriculture and Lands would be a good repository for this type of information, but having said that, the physical location is less important than the degree of access and official registration that community maps might receive.

4. *Does community mapping incite conflict? What are the risks of community mapping?*

The approach adopted to successfully produce community maps that identify boundaries must be adapted to the level of perceived sensitivity and subsequent risk of conflict. The degree of antagonism present between communities can be ascertained through the normal sensitization visits planned before every community mapping exercise. If a conflict between communities is identified then separate visits to the two communities should be planned as opposed to having a collective meeting when none exists. This approach was managed successfully in Nimba County between the Gbapa and Zortapa communities south of the East Nimba Nature Reserve. By separating the communities when mapping the boundaries, it was discovered that only 15% of the boundary between the two was conflicted. This resulted in community outreach officers being able to focus a discussion on these areas that resulted in a resolution being reached. The lesson learned in this case was that more information about a conflict actually precipitated a faster resolution that not addressing it at all.

A clear risk for community mapping is related to what the communities involved can expect out of the exercise. Such setting of expectations must be completed before any mapping conducted. Even after expectations are set at a lower level, as has been the case in Liberia to date, communities remain enthusiastic about the exercises as the results are often the first visual evidence of perceived ownership even if those rights are secondary such as land use. This sentiment can itself lead to the ‘risk’ that a community that has a map in hand has greater dominion over lands that are still not recognized by their central government. Avoidance of this ‘risk’ is difficult if the central structures to dispel such a sentiment are absent as is the case in Liberia.

5. Are national data standards needed?

Standards can be applied to many parts of the process of community mapping. A thorough description of these standards is needed if their use is to be considered as a viable way of soliciting and obtaining information about land holdings in the future. In their absence and without strict adherence to those standards developed, there is a significant risk that poor practices will be conducted resulting in sub-standard and questionable outputs. However, prior to standards being developed there are several clear categories of such. These include standards for community outreach and sensitization, mapping approaches and procedures, the certification of individuals or companies qualified to undertake such work and finally technical standards associated with the geospatial data including suitable geographic map projects, acceptable errors from GPS devices and symbology for features to be mapped. The ultimate steward of community maps and ancillary data collected in the communities should also be responsible for formulating these standards and ensuring compliance.

6. What is the appropriate degree of accuracy/scale of community mapping?

The answer to this question depends upon the type of information being collected and so it would be easier to explain the degrees of accuracy available according to technical approach and then select the most appropriate level of accuracy accordingly.

Hand held GPS units have without fail, even in challenging environments, yielded a locational accuracy of +/- 3metres or 10 feet. Satellite imagery can provide a spatial resolution or level of detail of less than 1 meter though other sensors used in the past produce images of +/- 5 meters. As the most commonly used methods to facilitate community mapping, experience has indicated that this degree of accuracy is sufficient for most community mapping exercises. Features that have successfully been mapped at this scale include community and clan boundaries, social fabric, infrastructure and natural resources such as forested areas and agricultural farms. Of the two technical options, satellite imagery has proven itself to be invaluable given that many community boundaries are often associated with geographic features on the ground. If the feature is visible on the imagery for community members to see, great savings in time can be made and potential confusion avoided.

A degree of accuracy higher than +/- 3 meters would not be recommended as to achieve such precision requires an exponential rise in technical investments for little to now return.

7. What is the ultimate benefit of mapping for community members?

When correctly managed, a community based mapping experience can bring a multitude of benefits to all participants including those individual citizens engaged and representatives from government agencies present. As documented previously, most effort is dedicated to explaining the purpose of the exercise and how the process will unfold to ensure community buy-in before the commencement of any mapping activity. An important outcome from these steps is a general empowerment of community members that should lead to a feeling that they themselves are directing the process with support from external parties as opposed to being led by outsiders. Once this position has been reached, all subsequent activities can be undertaken rapidly. To solidify the feeling of empowerment, it is important that the community itself be provided with hard copy prints of any final maps to be used for their own use.

On many occasions, the mapping work conducted with communities is the first such activity undertaken in living memory for the majority of participants. As such, for many it presents an opportunity to document or quantify their immediate environment for the first time in their lives. This experience can result in a newfound understanding of the value that a community places upon its sometimes limited resources that in turn can raise awareness of environmental concerns and land use planning especially associated with drinking water supply or quality.

To some degree, social conflicts will always exist specifically land conflicts between adjacent clans or communities, however experience shows that rather than exacerbating an issue, the community mapping approach can facilitate a resolution that is mutually acceptable. The results often deliver a degree of clarity not previously available and certainly offer an objective starting point for negotiations between parties.

Finally, through engagement with the process, community members themselves learn some simple yet useful mapping skills that can be applied elsewhere.

8. Training community members and field staff on Spatial Methods and Technologies

The majority of community mapping activities cannot rely upon any technical capacity in terms of spatial tools and methods. While not unexpected, the situation is resolved through capacity building of both project staff and local individuals albeit in slightly different thematic areas. Staff tend to receive training in the physical management of tools such as satellite image maps and GPS units. Community members are trained in how to explain the location of geographic features using the image maps and facilitation of the field walk that is always undertaken for verification purposes.

GPS training is led by the GIS Specialist and is undertaken in a single day. This time is divided into some limited GPS theory and then practical exercises conducted under the guidance of the specialist. By the end of the day, up to 12 field staff can be trained. Additionally, for data management purposes, at least two local staff are trained on data download and storage practices that in turn leads to basic GIS skiils building including map production. The GIS specialist remains on-site with the staff when they begin field visits to ensure that all previously documented procedures are adhered to.

9. The Role of the GIS Specialist with Field Mapping Staff and the Division of Responsibility

Experience shows that the application of participatory mapping techniques produces the best results when there is both a local mapping specialist available and a GIS Specialist who is able to provide an objective evaluation of best practices and performance in addition to strategic plans for field implementation. The absence of a local staff counterpart severely detracts from the likelihood of success as much as not having an external GIS Specialist available with a demonstrated history of participatory mapping. For project management, it is important to realize that not all GIS Specialists are created equally in terms of participatory mapping.

While the external GIS Specialist is responsible for the technical approach to be undertaken, training and initial field data collection, the local mapping staff are expected to continue the work as required. To do this a work plan of deliverables is crafted and the work is undertaken much the same as a sub-contractor would in another context. If technical issues arise, the local staff member either resolves it directly or refers to the GIS Specialist for advice.

APPENDICES

TECHNICAL APPROACH FACTSHEETS

Hands-on Mapping

Participants draw a bird's eye map of their surrounding environment from memory using the ground or large pieces of paper to record local community knowledge. For mapping on the ground raw materials such as soil, stones, sticks and leaves are used to represent surrounding cultural and physical landscape. On paper, markers and pens are used to depict the local landscape. Measurements and scale are not exact, but show the relational size and position of features.

Resources	• For ground mapping ○ Raw materials such as stones, soil, sticks, leaves ○ Open space ○ Camera to photograph final map or paper to draw final map • For sketch mapping ○ Large sheets of paper ○ Pencils, colored pens, markers
Practicality	• Useful for framing principal decision making issues and for acquainting participants with maps to stimulate community discussions • Participants can relate to product • Highly tactile • Requires little training • No GIS specialist required
Potential Pitfalls	• Weather dependent, not produced to scale or precise • Product can't be replicated • Not accurate or produced to scale • Lack of geo-referenced outputs make integration with formal maps difficult • Not useful when location accuracy is important • Outside facilitator largely benefits from learning local community knowledge rather than direct benefit to community itself
Data management burden	None
Cost	Low

ARD project experience: Liberia LRCFP, Mozambique LGP, Kenya PROMARA

Transect Mapping

Participants walk a cross-section of their landscape to document the location and distribution of geographic features and land use types.

Resources	• Paper and colored pencils • More effective with GPS units • Depending on scale of transect, conducting transect on foot, animal, cart or motor vehicle is helpful
Practicality	• Most effective when combined with 2D maps and GPS • Relates well to participants' daily movements and activities because it replicates their travels • Helps analyze linkages, transitions, patterns and interrelationships of land use and ecological zones along the transect
Potential Pitfalls	• Provides a limited perspective of the landscape
Data management burden	Medium – management of GPS waypoints
Cost	Medium for acquisition of GPS units

ARD project experience: Sierra Leone PAGE

Scale Mapping – Drawing information on existing scale maps

Using existing maps of a region or area, participants add relevant geographic features to transparency, which can then be scanned, geo-referenced and digitized.

Resources	• Up-to-date scale maps • Acetate/mylar transparencies
Practicality	• Most commonly used in areas where accurate, up-to-date scale maps are available. • A good format to communicate community information to decision-makers because it employs formal cartographic protocols. • Can be used for quantitative measurements.
Potential Pitfalls	• In many developing countries, access to accurate, up-to-date scale maps is limited • Training is required for participants to understand formal cartographic standards (e.g. scale, orientation, coordinate systems)
Data management burden	Community knowledge collected on transparencies must be scanned, digitized and geo-referenced.
Cost	Low cost if accurate, up-to-date scale maps are available.

ARD project experience: Sierra Leone PAGE, South Sudan CLTP

Participatory 3-D modeling (P3DM)

Using a three-dimensional stand-alone, scaled and geo-referenced relief model, participants add geographic features relating to land use and land cover. Features are depicted on the model using pushpins (points), yarn (lines) and paint (polygons). A grid is then overlaid on the model to facilitate data extraction.

Resources	• Topographic map • Pushpins, colored yarn, paint, plaster, chicken wire
Practicality	• The finished model can serve as a resource for community members and serves as a reusable resource • Creating the model is a community-building activity • Can depict overlapping layers of information • Participants can easily related to the 3-D aspect of the model
Potential Pitfalls	• In many developing countries, obtaining access to accurate topographic maps is difficult • Time consuming to create the model • Storage and transport can be difficult
Data management burden	Relatively intensive to digitize data
Cost	Low

GPS Mapping

Participants record geographic features using a handheld GPS unit, which records the exact location on the earth's surface using latitude and longitude.

Resources	• GPS unit(s) • Logbook is helpful to for waypoint back-up • Waterproof box for storing GPS units and spare batteries
Practicality	• Adds accurate location information. • Data are stored in a digital format, facilitating easy data transfer and sharing. • Increasingly affordable
Potential Pitfalls	• Training is required to correctly gather waypoints • Equipment requires batteries • GPS accuracy (connection to satellites) is sometimes difficult in heavily forested areas
Data management burden	• Initial training on usage of GPS units
Cost	Varies with sophistication of GPS unit and desired accuracy of collected data

ARD project experience: Liberia LRCFP, South Sudan CLTP, Kenya SECURE

Photomaps

Aerial photos or satellite images serve as the basemap for geographic reference. Participants draw geographic features of interest on transparencies overlaid on the image. Information from the transparencies can then be scanned, digitized and geo-referenced.

Resources	• Aerial photos or remotely sensed images • Transparencies • Pencils, colored pens and tape
Practicality	• Imagery is increasingly more accessible and cheaper • Can provide broad overview of community land use • Can give participants a perspective of their area that they have never seen before.
Potential Pitfalls	• Imagery for equatorial zones can be difficult to obtain cloud-free • Imagery can be expensive and images may not be readily available • Community members may have difficulty relating to images
Data management burden	Images must be procured, processed and printed to create basemaps. Then information must be digitized.
Cost	Relatively high

ARD project experience: Nicaragua/Guatemala LGP, Sierra Leone PAGE, East Timor SPRTL, Liberia LRCFP, Liberia LCRP, Liberia PROSPER,

Mobile Device Enabled Mapping

Using a satellite image or an alternative as a basemap, geographic features can be directly recorded into a GIS using a mobile device (smartphone/tablet) and associated software.

Resources	• Smartphone/tablet
Practicality	• Highly efficient, reduces processing time by creating digital geographic features while present with the community. • Reporting loop between technology intermediary and community is closed.
Potential Pitfalls	• Expensive relative to other low cost options • Training time is required to accurately collect spatial data • Questions over whether and how the community can best utilize the data Need to produce tangible maps for community benefit
Data management burden	Basemaps and collected data are already digital, so easily transferred. Users must be familiar with mobile applications to correctly manage data.
Cost	High – procurement of mobile devices

ARD project experience: Kenya SECURE, Malawi ARCC, Armenia Water Assessment

Crowdsourced Mapping

Interactive, online maps allow users to click on map features to access information. Community knowledge, documented using digital video, photos and text, are loaded through an Internet mapping site.

Resources	• Computers • Internet access • Digital cameras/videos
Practicality	• Efficiently provides rich, geo-referenced community knowledge to a large audience • In comparison to a GIS, relatively simple and easy to understand • Provides multiple perspectives of a landscape
Potential Pitfalls	• Requires high speed internet access • Turns local knowledge into public knowledge, which raises questions of control • Training is required to master webmapping applications • Access to electricity is required
Data management burden	Variable
Cost	Variable

ARD project experience: None

GLOSSARY

Aerial photography – Photographs taken from an airplane that are corrected for measuring distance and area.

Basemap – A map that contains geographic reference information to which community mapping participants can add local knowledge.

GIS – Geographic Information Systems. A computer-based system used for spatial data capture, storage, management, analysis, and reporting.

GPS – Global Positioning System. A system of satellites and ground units that enable the user of a GPS unit to determine absolute location on the earth using latitude, longitude and elevation.

Paper – large-scale paper is often used in community mapping for drawing communities and relevant geographic features.

Remote sensing – Process of gathering information about the earth's surface from a distance. Both aerial photography and satellite imagery are examples of remote sensing products.

Satellite imagery – For the purposes of community mapping, photographs collected from sensors on satellites orbiting the earth.

Scale Map – A map where a distance measured anywhere on the map always represents the equivalent distance on the ground (1cm on the map equals 1km on the ground).

Smartphone – A mobile telephone with advanced computing capability. Many smartphones include camera and GPS functionality. Smartphones can be used to capture geographic feature data in community mapping.

Tablet – A mobile version of a computer, usually operated with a touchscreen. Many tablets include GPS and camera functionality.

Transparency – A clear plastic sheet, often made from mylar or acetate, which can be overlaid over a basemap so that the underlying basemap can be viewed. Geographic features can be drawn on the transparency using markers.

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