Boundary dispute settlement using Mobile GIS

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Abstract

Boundary disputes in Tanzania are occurring because of land tenure insecurities. Settling disputes is necessary to enable land use planning at village level as required by the national planning authorities.
Visualisation of boundaries aids villagers in understanding the extent and importance of various boundary disputes concerning their lands and resources. Including these visualisations in participatory group discussions between conflicting parties in Kisanga, Tanzania has illustrated this.
Villagers indicated that through these tools they are able to focus better on pressing issues and that this enabled them to solve disputes more easily.

Introduction

Land Use Planning (LUP) in Tanzania is for a large part the responsibility of local government. District and village authorities together develop plans for the management of their natural resources and economic development. Spatial information about land ownership (deeds and records) or the extent of the natural resources on these lands is only scarcely available at district level (Tembo, 2003) and even less at village level. Village authorities therefore lack the necessary information to monitor local developments and cannot effectively manage their lands and resources. One of the limiting factors for LUP at village level is the absence of clearly demarcated boundaries, which prevents them from defining the administrative boundaries that serve as a basis for planning (maps).
Students and staff of ITC and the University College of Lands and Architectural Studies (UCLAS) conducted a small semi-participatory research project in Kisanga, a small village in the Kisarawe district, some 40 km inland from the capital Dar es Salaam. The aim of the project was to derive the necessary information for the village government to develop their land use plans. Main activities of the project were to work with village community members to map the boundaries of the village and the natural forest reserves in and around the village and to make an inventory of potential developments for the village with respect to agriculture, forestry, conservation and the marketing of their produce.

Land tenure insecurity

It was observed that most of the villagers in Kisanga follow a customary land tenure system. The colonial Land Regulation of 1923 governs this. In this land tenure, landowners in the village posses what is called “deemed right of occupancy”, which is not a title deed. This “right” to the land is transferred from one generation to another by inheritance.
The land tenure was useful at the time when there was not much immigration and interaction with people from different areas.
The weaknesses of the customary land tenure began to manifest when people started migrating in their search for land in the aftermath of the socialist period (1967

– 1990). This is especially problematic in places like Kisanga because of their proximity to the capital city, Dar es Salaam, with its hyper-growth, a factor of 10 or so over the past 30 years. Immigrants could acquire land either directly from the villagers or from the village government. There were no guidelines, rules and procedures for land transfer. Neither was there any administration of ownership or transfer. This gave way to land speculation. As a result, village governments could allocate more and more land to buyers as a serious source of income. This system thus allows people to utilize that weakness of the system for illegal business purposes and speculation. As soon as one received the right of occupancy the land could be developed and sold for profit because the land tenure regards whoever buys the land as the legitimate owner and can transfer this to any one the land afterwards if he wishes.
In 1991 the Tanzania government formed a directorate to study land issues and in 1993 the study report was developed (URT/ Shivji, 1994). The report indicated weaknesses with the customary land tenure system, which caused a lot of land disputes. One of the problems was that there was no clear land policy. In 1999, Land Act no. 4 and Village Land Act No. 5 were issued to solve many of these issues.

The village Land Act of 1999 states that; among other guidelines;

- The Village council will manage the land
- Individuals will acquire land through the village government.

“The Village government will grant land to individuals, which does not exceed 20 acres and it will offer to the individual certificate of customary right of occupancy. The power of allocation of village land by the village council is, however, subject to the approval of the village assembly, which is the supreme authority on all matters of general policy making in relation to the affairs of the village.”

In 1999, the legislature adopted the Village Land Act (VLA), however, in many Tanzanian villages it has not yet come into operation. Since most of the natural resources in Tanzania are under lands earmarked as village land, it is therefore logical to conclude that management of such resources are directly linked to how village lands are being managed and owned. Lack of a proper system of land administration and tenure in the village areas where most of the resources are, would, undoubtedly, lead to serious natural resources degradation. The “villagisation program” seriously affected the ecological balance of several places and hence led into severe food crisis in 1970s in Tanzania. (McCall 1985; Kikula 1997)
Before the enactment of the VLA, people who owned land under customary tenure had an inferior "title" compared to the granted right of occupancy. The title owned under customary tenure was a "deemed right of occupancy". The new Land Acts 1999 allow for the traditional ways of holding land to be recognized and supported fully in the national law. Further they allow for the fundamental operational base of customary land law and tenure to continue, for community assent and direction through embedding local level authority and management of village land in the hands of villagers (the elected village council). Therefore customary right of occupancy under the new Land Acts is, in every respect, of equal status and effect to a granted right of occupancy. Furthermore under this customary tenure the certificates of ownership are inheritable and transmissible by will. Such a system guarantees an absolute ownership of land as well as security of tenure. One problem from this is however the loss of what was the traditional and customary ‘common property

regime' for land & resources which also means a loss of cultural heritage to villages as only the elderly still have this traditional knowledge.
However a sound system of land administration needs records of ownership and (spatial) information about the owned lands. Between villages and between individuals within villages, boundary disputes exist. More significantly, disputes commonly exist between village lands and state owned forest or nature reserves. Most villages lack boundary maps that clearly demarcate where their jurisdiction ends. These disputes therefore leave many unsustainable uses of natural resources unattended.

Boundary disputes in Kisanga

There are several sources of boundary conflicts in Kisanga. The poor demarcation of boundaries is one of them. Although the land ownership boundaries are not clearly demarcated, most of the people know their ownership boundaries very well based on landmarks. Especially older people in the village (men and women) have the specific knowledge on the location of the boundaries. In our study, community leaders (village committee members) were a main source for this information but also the women that do much of the water and firewood collection were very knowledgeable on ownership and boundary issues. A mix of marked trees, historical markers and landmarks demarcate the boundaries between Kisanga, neighbouring villages and the National Forest Reserves (NFR). Marked trees are recognised and avoided by resource users in the forest. Although this does not prevent them from entering restricted areas, these trees seem to be spared from charcoal and pole collection activities. Another reason for this is that most of these individual (old) trees are "owned" by villagers and are technically not in the forest reserves. These tree resources mainly consist of large mango and cashew nut trees. Most of these trees are cut for firewood when they stop giving fruits. Only secondary uses like being a "marker" or providing much needed shelter and shade protects these trees. Historical markers are less abundant and less visible. They mainly consist of damaged boundary markers from the German colonial era (1891-1918). Only a few of these are left to demarcate the extent of the NFRs (fig. 1).

Figure 1: old forest boundary marker

As a consequence of poor demarcation there is confusion and dispute between villages and it becomes unclear for farmers where the Village Forests stop or the NFR begins.

Without clear demarcation of the boundaries it is not possible for the village government and district authorities to enforce the many laws that exist to protect the natural resources.
A mix of tenure insecurity, unclear boundaries and insufficient NRM policy has caused land allocation conflicts within the village. In Kisanga a Village Forest Reserve (VFR) was established in 1998. A VFR is a community project to conserve the village forest resources. VFRs usually have the support of the district authorities and NGOs. Over the years however several pieces of VFR land appear to have been allocated by the village government to farmers who have used their customary rights to cut a large part of the forest to plant their crops. The student research team in Kisanga set out to clarify and analyse this dispute because it was considered to be a boundary dispute "within the village" thus limiting the number of stakeholders involved. After marking the VFR area by GPS with the help of the farmers in the VFR and representatives of the village government an interesting conclusion came to light. Following this simple investigation by the research group to indicate where the original boundary used to be, it became apparent to all parties that the current boundary was by no means correct. Moreover crossing the coordinates of the original VFR boundary with the village boundary showed that the original VFR was partly located on land of the neighbouring village of Sungwi (fig. 2.)

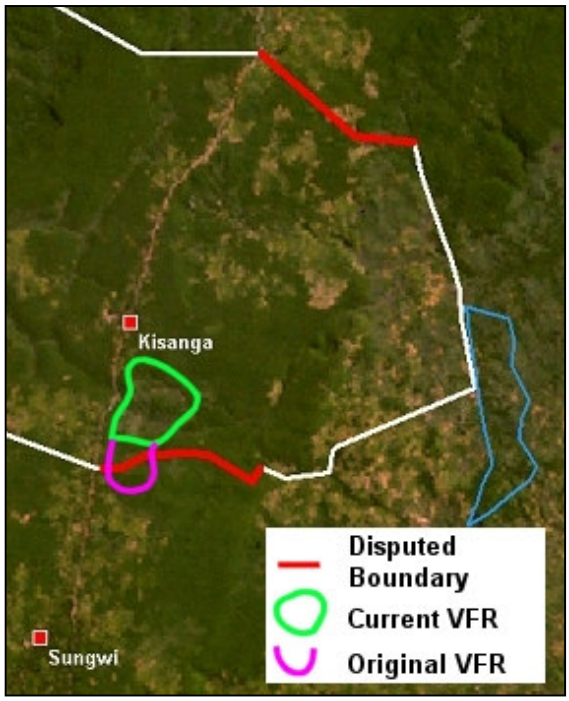

Figure 2: detail of map with disputes boundaries

During discussions between landowners and representatives of the village government it was agreed that the new boundary with the corresponding changes in land use inside (from protected forest to agricultural use) should be changed to better match the original boundary and to avoid conflicts with the neighbouring village. The need to accurately map the village boundaries persuaded the village government to seek a settlement in this dispute that they had postponed many times before.

Using GPS and PDA in practice

Local communities are very much aware of the extent and location of their resources (source). Especially the elderly are an important source of information. During one of the first meetings with the Kisanga villagers they were asked to draw a map of the village area indicating the most important features, landmarks and land uses. The sketch map proved to be a good representation of the actual situation taking into account the personal perceptions of the villagers. Trails that were travelled very often appeared shorter on the map, whereas trails that were used to transport (heavy) goods by head loading and push bicycles appeared to be longer. The villagers were

quite content with their map when it was finished after a few hours of deliberations. The research team however had a hard time finding their bearings on it, as their only comparison was an outdated topographic map. To assist them in using the sketch map they had to locate several landmarks by GPS to get a better understanding of the layout of the village. The sketch map also showed the village boundary. Part of the study was to demarcate this boundary (digitally) to provide district authorities with the actual coordinates of boundary corner points.
The team was equipped with a PDA running ArcPad™ 6.0. This GIS software provides the user with the ability to bring geometrically correct maps and images into the field with the possibility to add and change the attributes attached to the maps and images during the actual observations. As there were only few maps and information available to the research team the PDA proved a welcome reference aid. Connected to a Global Positioning System (GPS) the position of the team was shown in real time on the map on the PDA screen. A practical difficulty with the PDA is the very small screen size, which makes it difficult to use 'participatorily', i.e. for more than 2 or 3 people to view it at the same time. This is compounded when trying to use it in bright tropical sunlight, even with its backlighting facility.

ArcPad™ 6.0 offers users through Windows CE the ability to connect different GPS systems to the PDA. ArcPad™ 6.0 can communicate through standard protocols with a range of GPS from most manufacturers. The configuration for this project consisted of a Compaq Ipaq 3850 and a Garmin Etrex GPS. Recently similar exercises have been conducted with the Ipaq 3950 and two GPSes, the Garmin 12 XL and the Navman 3000. Although the communication between the devices can be sensitive to errors it is quite reliable. The most cumbersome part of the interface between PDA and GPS are the physical cable connections. The interface is not a pre-engineered product. To connect both devices two non-dedicated cables have to be joined by a home made connector. The schematics and materials however are easy and inexpensive to obtain. The final result nevertheless is an awkward contraption of two small devices connected with 10 feet of cable.

The Ipaq com-port was not designed to hold such a weight of cables. To make this set field operational therefore a roll of gaffer tape is necessary to hold it all together. Another drawback to the Ipaq was its limited battery life and RAM memory. A full day of fieldwork could not be sustained with this version that could only operate for 2 to 3 hours straight. On emptying the battery all data would be lost.
Newer versions of the Ipaq (i.e. 3950) have solved these problems however to a large extent. They are equipped with a much more sturdy connector (making old cables unfortunately useless) that can better hold the cables, they have a greatly improved battery life (up to 8 hours) and can hold optional flash memory cards (SD) for data storage).

There are of course ways around the "cable contraption". Several manufacturers offer a "jacket" GPS for many types of PDA (i.e. Navman for HP/Compaq). This combination makes a very portable tool but has several drawbacks. These GPS draw on the PDA battery power, reducing the operating time considerably. The jacket GPS offer fewer features and communicate less data (with limited protocols) to the PDA. These GPS can only operate in combination with the PDA thus limiting their functionality. Accuracy of the different GPS is comparable under good conditions. The jacket GPS tested by this team (Navman 3000) displayed somewhat

weaker reception of satellite signals under less favourable conditions, especially under canopy cover but position errors remained acceptable within 10 metres. Acquisition times of the GPS signals were more or less the same and reacquiring positions after shutting down the PDA was limited to 30 seconds or less. The Navman GPS appears to have more difficulties with initial acquisition of signal when the sky is obstructed than the Garmin GPS to the point of not being able to acquire at all. However when signal has been acquired the Navman can still track weakened signals under canopy cover, which is specially useful in mapping forest boundaries. Experiences with the newer Ipaqs and Jacket GPS are much better considering the much longer battery life and the capacity to store data permanently on SD cards (capacity 128Mb or more).

Location accuracy is normally well within 5 to 10 metres even with cheap commercial GPS under optimal conditions. For recording village boundaries this can be quite sufficient. In this project the main data to serve as a mapping background were Landsat TM satellite images with 30 metres resolution which leave some margin of error for the positional data. In many cases, the positional accuracy will be between 30 and 50 metres (or worse) under forest canopy cover. Recording “tracks” to follow the boundary exactly will in that case only be sensible when ArcPad™ is configured to discard positional data with low accuracy. This however runs the risk of missing crucial corner points. ArcPad™ can also give warnings when accuracy is below the users setting and can be configured to average out the records to present a smooth track.
In Kisanga the recording of the boundary could be done quite easily as the villagers indicated that the boundary was considered a straight line between several marker points. This enabled the team to concentrate on recording data under favourable conditions at a limited number of points.

Conflict settlement efforts

The tool itself is of course not the solution to boundary disputes. But in this study it has definitely shown its additional value on the margin. Particularly the immediate visual output that can be provided and assist in discussions is of value. The Kisanga villagers were well aware of each boundary dispute. But there were some discrepancies as to exactly which parts of the boundary were disputed. In the VFR example the visual output immediately confronted the villagers with the problems at hand and made them aware of the extent of the issue. Their relationships with two neighbouring villages were quite tense because of the boundary disputes. Showing exactly the conflicting boundaries on a map made the problem areas spatially explicit and could focus the efforts of the involved villages to mitigate the problems. One of these problems dealt with (illegal) settlers from other parts of the country encroaching in the boundary areas. The main source of income for these settlers is charcoal burning and small-scale agriculture for which they need to clear (protected) forest areas. Around the disputed boundaries some areas were more or less no-mans land. Because of the conflicts over jurisdiction between the neighbouring villages the settlers were left alone and their resource destruction could continue.

Conclusion

Much of the quality and usefulness of the data recorded with this combination of PDA and GPS depends on the skills and knowledge of the operator. Although the tools are pretty straightforward to use, even for inexperienced users, it requires specific knowledge to prepare the right configuration in order for it to become straightforward. GPS and ArcPad™ settings will be different for each country or region and therefore need to be carefully observed and should correspond to the geo-reference and projection settings of the background data (maps and satellite images).
With the survey results quickly available from the use of Mobile GIS the actual boundary dispute locations became available to the village government. The visual representation on the PDA display and later on a map offered insight into the extent of the real problems. Representatives of the village council expressed their view that the problem became much more tangible.

The results from this short field research are much in line with more generalised statements about the proper use of participatory geo-information approaches and tools in spatial planning. (e.g. McCall 2003)
In applying 'good governance' in geo-information systems, certain criteria and conditions are paramount. For the GI approaches and tools to strengthen good government, they should:

- support 'accountability' expressed in terms of 'transparency' and 'visibility' of decisions – mobile P-GIS does this, so long as there is a representative group involved in the transect and boundary walks.
- promote 'participation' of the disadvantaged and less articulate, and usually, of women as a particular group – as above, mobile GIS will support this, if some training is given and the mapping activities are scheduled for the right time.
- support 'respect for local knowledge' and indigenous spatial knowledge – mobile GIS makes explicit use of local people's knowledge of spatial boundaries, resource conditions, indigenous zoning principles, etc.
- provide for 'equity' in terms of local manageability of the tools – mobile GIS has not yet achieved this, but the technology is becoming increasingly user-friendly.
- competence, i.e. the capacity to acquire and understand and use the actual information that has real meaning for the local people – as in the villagers' statement above that 'the problem is now more tangible'.

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References

Abdi H, Kaale B.K, Kimaryo B.T., Maro R.S, and Ramadhani H.K., Participatory Forest resource Assessment: CARE Tanzania Misitu Yetu project. Tanzania, 2002.

CARE- Tanzania, Misitu Yetu Project, A Study on Income Generating Activities. Tanzania, 2001a.
CARE- Tanzania, Misitu Yetu Project, Baseline Survey Pre-field Study Report (Draft report). Tanzania, 2001.
CARE- Tanzania, Misitu Yetu Project Proposal Supporting Communities to Manage and Benefit from the Biodiversity Forests of Eastern Tanzania. Tanzania, 1999.
CARE- Tanzania, Project Monitoring and Evaluation Plan: Supporting Communities to Manage and Benefit from the Biodiversity Forests of Eastern Tanzania. Tanzania, 2000.
Ellis, F., 1997. Household Strategies and Rural Livelihood Diversification. Paper submitted to the Journal of Development Studies. University of East Anglia, Norwich.
Kikula, I.S., Policy Implications on Environment: the case of Villagisation in Tanzania. Dar es Salaam: DUP, 1997.
McCall, M.K., Environmental and Agricultural Impacts of Tanzania's Villagization Programme, In: J.I. Clarke, M. Khogali and L.A. Kosinski (eds.), Population and Development Projects in Africa, pp.123-140. Cambridge University Press, 1985.
McCall, M.K., Seeking good governance in participatory GIS: a review of processes and governance dimensions in applying GIS to participatory spatial planning, Habitat International, 2003.
MNRT (Ministry of Natural Resources and Tourism), Forestry and Beekeeping Division, Community – Based Forest Management Guidelines. Tanzania, 2001.
MNRT (Ministry of Natural Resources and Tourism), National Forest Policy. Tanzania, 1998.
Tembo, M.D., Assessing Spatial Information Gaps: a decentralisation perspective on district natural resources management planning in Tanzania. ITC, 2003.
United Republic of Tanzania, The Village Land Act. Tanzania, 1999.
United Republic of Tanzania, The Village land regulations: subsidiary legislation, (supp. No. 16 of 4th May 2001), Tanzania, 2001.
United Republic of Tanzania, Chair: Shivji, I.G., Report of the Presidential Committee of Inquiry into Land Matters: Vol. 1, Land Policy and Land Tenure Structure. Dar es Salaam: Ministry of Lands, Housing & Urban Development and Uppsala: Scandinavian Institute of African Studies, 1994.

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