The visible boundary: more than just a line between coordinates

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Abstract—Within land administration, boundaries of people’s land plots (or parcels) are a key component. From a legal-societal perspective, a boundary is where one person’s interests in land end and the next person’s interests begin. In most conventional contexts, this ‘surface’ is depicted by the infinitesimally thin line where this surface intersects the earth’s surface. This line is often manifested physically by visible artefacts like hedges, stone walls, ditches, or land use changes.

In 19th and early 20th centuries, during cadastral and land granting activities, simple surveying technologies were used (e.g. plane tables) and associated precisions available were accepted. Later, equipment became more advanced, and so did the accuracy with which the line could be determined. The question is whether the neighbours, and society, can – and should – bother indicating this line with an ever increasing precision. Whereas ground survey methods (incl. GNSS) have continued to be more and more precise, aerial and space based approaches also emerged: these cover large areas faster, but have not (yet) caught up in precision. In any case, visible boundary features are by default not infinitesimally thin.

The above issue manifests itself in the ‘coverage over accuracy’ debate. In several (first) land registration projects, like Thailand, St. Lucia and Rwanda, aerial images were successfully used. The approaches are said to support recording the ‘70% of the word’s land parcels that are not yet mapped’ and meet FIG and WB’s “fit-for-purpose land administration” ideals (FIG/WB, 2014).

We argue that ‘visible’ boundaries actually fit the greater majority of land management and land information system purposes, perhaps with the exception of reconstructing boundaries between conflicting parties, and natural phenomena that we wish to apportion property rights (or protections) to, but are beyond human scales (e.g. migratory routes). An analysis of the societal and land right holder benefits is presented as a contribution to support ‘fit-for-purpose land administration’.

Keywords—cadastral boundaries, land administration, fit-for-purpose, visible boundaries.

I. INTRODUCTION

When we want to fully understand (cadastral) boundary issues, the first question that comes up is ‘why do we need boundaries?’. Land by itself forms a continuum; especially when we see land in the broad sense of including (the land below) water and all ‘immovables’ attached to land like buildings, other constructions and (perennial) plants. Nevertheless people’s relations with land limit themselves to certain ‘pieces of the land’. We use a certain field, we rent a house with garden, or we own a property or parcel. Especially when the interest in the piece of land is well defined, e.g. a right of freehold or ownership, the piece of land has to be separated from pieces of land to which others have interests. The separation between two land interests is the boundary.

“Newton Country, Georgia, Wyatt’s District, containing Sixty Five acres, more or less Beginning at an iron bar running Northwest to a black gum tree - Thence NorthWest to a stake; thence North west to a bunch of black gum trees. Thence West to a stake; thence North to a marked pine near the line of T. L. Ray’s land. Then with his line to an Iron bar about half way up the Mountain. Thence with Mrs. Doresy’s line to Clarence Woods line; thence with Clarence Woods land to beginning corner. Same being part of the J.J. Harris place, of Walton County. Same being part of the land deeded to me by Georgia Security Company, Athens, Ga.”

Example of a verbal property description (Hammarstrom, 1989, p 197).

As land administrators we want to document the relations people have with land, including the piece of land this relation relates to. To do so, we also need to document the boundaries. Many ways to document boundaries have been tried over the years, ranging from a verbal description in words, a ‘metes and bounds’ approach, depiction on an index map, capturing of corners in coordinates etcetera (see e.g. Zevenbergen, 2002, section 2.2.5 and 3.2.4). For at least the last century we can say that we would document them by ‘surveying and mapping’. But before we move to the (geospatial) possibilities of doing that, we need to better understand what ‘boundary’ really means, and how it is determined.

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II. BOUNDARY DEFINED

The question of what a boundary stands for is on the one hand easy to give in ‘natural language’, but quite hard in more formal terms. Different disciplines even have their
own take on this (Bennett et al, 2010). From the perspective of cadastral surveying a boundary is “either the limit at law of any estate or a physical feature such as a fence erected to mark the limit at law” (Dale 1976).

Another (legal) way of describing a boundary is as follows. ‘A boundary is a surface that divides one property from another, which in the case of land parcels theoretically extends form the centre of the earth vertically upwards to the infinite in the sky. In more practical terms, however, it may be defined as: “An imaginary line which marks the confines or line of division of two contiguous estates. The term is also used to denote the physical objects by reference to which the line of division is described as well as the line of division itself. In this sense boundaries have been divided into natural and artificial, according as such physical objects have or have not been created by the agency of man.’ (Halsbury’s Laws of England, 3rd Ed. Vol 3, p. 354).

We already see the difference between natural and artificial boundaries mentioned here. Such a natural boundary is usually formed by (linear) features in the terrain -like hedges- and of course determines the land use in day-to-day practice. An artificial boundary in its most strict sense would not be visible in the field, unless specific point features have been placed to mark its corner points, as is especially done in cases of subdivision, e.g. of the parents’ land among the children, to give them all a (equal) share in the land tenure rights. Here we can already see the root of the debate within land administration, since land tenure and land use form two of the three corners of the land administration triangle (Dale and McLaughlin, 1988), land value being the third one.

This also comes close to the two types of boundaries as distinguished within the English literature on cadastral surveying, being:
- General: boundary for which the precise line on the ground has not been determined;
- Fixed: legal boundary of a property where the precise line has been agreed and recorded.

However, even these descriptions are not universally agreed upon, and Dale and McLaughlin (1988) distinguish at least three types of definitions for these concepts. For many surveyors the definitions relate to the accuracy with which the corner points have been determined (with coordinates in the national geodetic reference system). The description used here, however, firstly highlights the precision of the determination (and whether both neighbours have agreed and signed off on the determined line or not) of the place of the boundary; and thus not primarily of the accuracy of documenting the outcome of that determination. Unfortunately, a not uncommon practice throughout parts of the world is that the (technological) documentation of the boundary (corner points) is done with more rigour than the determination of its actual place with the relevant interest holders. And in many cases the actual place of (physical) boundaries cannot be determined very accurately, they have a low ‘idealization precision’ (c.f. Baarda, see Bennett et al, 2012). To determine what constitutes the middle or the edge of ditch, the middle of a hedge or what ‘at the tree’ means can be done at best in the order of 0.5 – 1 meter accuracy; even the corner of house in case of most building methods gets to 5-15 cm at best. Nevertheless such boundaries are “visible”, esp. from aerial images in most cases (unless under foliage, overhang or semi-permanent cloud cover).

Some of the above explains the rather antagonistic first reaction of many with a technological surveying background to the suggestion in FIG/World Bank’s ‘Fit-for-purpose Land Administration’ publication (FIG/WB, 2014), which urges the use of ‘general’ boundaries to quickly reach full coverage.

III. UNDERSTANDING THE DIFFERENT PURPOSES OF BOUNDARIES

In our opinion we need to properly frame the above debate by taking one step back, and thinking about the question what the boundary’s purpose is, and then what approach to documentation of ‘pieces of land’ we need for that, and how types of boundaries support that. Of course many purposes can profit from clarity on people to land relations, especially within what we can broadly determine the land management domain. In the 2005 report on Land Administration in the UNECE region - Development trends and main principles (UNECE, 2005) the following list is given:
1. Guarantee of ownership and security of tenure
2. Support for land and property taxation
3. Provide security for credit
4. Develop and monitor land markets
5. Protect land resources and support environmental monitoring
6. Facilitate the management of State-owned land
7. Reduce land disputes
8. Facilitate rural land reform
9. Improve urban planning and infrastructure development
10. Produce statistical data.

For most of these purposes the most important need is an overview of all the different people to land (use) relations, primarily given by an index map. The interest is in the plot, parcel or field as it is used (and can be seen in the field, and usually also from above). Or, as a natural resource manager recently phrased it, “you need to identify the fields”. How this is best done and with which technologies of course depends on circumstances, like topography, density of use and weather condition. For many of the land management functions, index maps based on visible boundaries go a long way in significantly improving the preparation of policies and/or decisions and their implementation. The most obvious exception is formed by the issue of boundary disputes. To be able to solve those based on geospatial information, the specific boundary information would need to have been collected with more rigour, both in regard to the process of determining where the actual place of the boundary is, as well as the survey to document it. Also of
course boundaries that by their nature are not visible, like migration corridors or a land use field to which actually two different land holders have rights to two defined pieces, might not all be visible to the human eye or aerial sensors. Nevertheless a large percentage of ‘normal’ land tenure arrangements is.

IV. RELATIVE IMPORTANCE OF THE DIFFERENT PURPOSES

During field work of Gebeyu Shibeshi in the Amhara region of Ethiopia, 118 respondents were asked to score 9 tenure core functions on a 5 point scale (Shibeshi, 2014). The 3 that scored the lowest were cadastral survey (1.75), boundary monuments (2.16) and parcel and index maps (2.34), whereas the top two were adjudication (3.54) and updating (3.25).

During another field work by Samuel Mabikke amongst 381 responding land holders in a survey in Central Uganda, 52% experienced conflicts (Mabikke, 2014). When asked what type of conflicts, ‘boundary’ ended in the 3rd place with about 1/5 of the cases (see table 1). The largest category often links to inheritance, and might at a first glance look like boundary issue, but again it is the disagreement how many siblings share in the land, and where each of them gets his or her specific piece that precedes any issues of a survey to document this.

In another study in the North of Ghana, based on data from Wa Central Customary Lands Secretariat, in a list of disputes resolved over 7 years, only for 2 of these years ‘boundary disputes’ were mentioned, and still combined with other issues like double sales, abuse of fiduciary role, trespassing, and farmland encroachment (Biitir and Nara 2014). In the end 90% of conflicts linked to the double sales, typically something that an updated index map would warn for.

Table 1: Incidents of land conflicts in the Study Area (in Central Uganda) - adapted from Mabikke, 2014, p. 127.

<table>
<thead>
<tr>
<th>What type of conflict is it?</th>
<th>Numbers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linked to inheritance</td>
<td>157</td>
<td>41.2</td>
</tr>
<tr>
<td>Eviction by gov. agency</td>
<td>83</td>
<td>21.8</td>
</tr>
<tr>
<td>Boundary</td>
<td>81</td>
<td>21.3</td>
</tr>
<tr>
<td>Eviction by private land lord</td>
<td>56</td>
<td>14.7</td>
</tr>
<tr>
<td>No response</td>
<td>4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Of course there are also other areas in which boundary issues are more prevalent, and people would rank those higher. During a field visit for GLTN by the first author in Mexico in September 2015, it was said both by officials and community leaders that people clearly preferred ‘direct methods’ of boundary documentation (field survey, mainly with dGPS) over ‘indirect methods’ like use of aerial imagery. Anecdotal discourse from land professionals, maintaining decades of experience in cadastral development, make the same arguments: for adjudication and mapping, land right holders like to walk their boundaries, with neighbours, and the 3rd parties involved. How this can be combined with use of aerial imagery is described in (Lemmen and Zevenbergen, 2010) based on field work in Tigray, Ethiopia in 2008. Going into the field with the aerial images and drawing the boundaries on the image in the presence of the land rights holder, its neighbours and community leaders was very participatory and well understood by those out in the field. Similar methods with orthophotos were applied during much of the Rwandan Land Tenure Regularization (LTR) as well (see e.g. Rugema, 2011; Sagashya, 2014).

V. WAY FORWARD

It should be realized at all stages of design and implementation of land administration interventions that the concept ‘boundary’ is a multifaceted term, and that it is not wise to make decisions on the approach with only one lens in mind. Also the key purpose that needs to be addressed, as well as local circumstances (which are nearly never uniform throughout a country) should be taken into account.

To identify plots/parcels/field for purposes like the prevention of double sales, the preparation of land use plans, etc. we can go with what we see – visible boundaries.

We also should realize that the idealization precision of non-buildings is half a meter a best, and that today many aerial images are already at that accuracy level.

With around 70% of the people-to-land relations not captured on any cadastral map, and not cadastral surveyed, in many areas a Fit-for-purpose approach (FIG/WB, 2014) can work, and should work. This will allow a very fast increase of coverage of minimal cadastral index maps that will really contribute to a lot of the land management purposes and help alleviate a lot of land challenges.

We need to keep in mind that it all depends on the purpose, the circumstances and the technology at hand. We should not oversell the technological possibilities, and also remember that time and costs are equal components of quality, next to completeness, timeliness and accuracy.

VI. REFERENCES


FIG/WB (International Federation of Surveyors and World Bank) (2014), Fit-for-Purpose Land Administration, FIG Publication 60, Copenhagen, Denmark, 2014.


