Responsible Land Governance:
Towards an Evidence Based Approach
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MASS REGISTRATION OF LAND PARCELS USING FIT-FOR-PURPOSE LAND ADMINISTRATION: PROCEDURES AND METHODS

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Abstract

In many countries land parcels have not yet been demarcated and registered. With no complete and accurate land register a country cannot effectively manage its land and resources. It will need to carry out mass registration and establish the land administration system necessary to ensure secure land tenure, which in turn can attract national and international investors. The fit-for-purpose land administration approach has been applied in many countries in Asia, Eastern Europe and Africa. When mass registration is necessary there are two main procedures / methods which may be followed. For the purposes of this paper the two procedures will be labelled respectively the Carta and Terra procedures: (1) the Carta procedure because community participation commences with marking up boundaries on an orthophoto map and (2) the Terra procedure because community participation commences with marking up boundaries on the ground before producing the orthophoto maps. Both these procedures adhere to the fit-for-purpose land administration approach principle, in that they are flexible, inclusive, participatory, affordable, reliable, attainable, and upgradable. Countries which plan to implement mass land registration can choose which of the two procedures fits them best or choose the procedure that combines the advantages of both methods.

Key Words:

Adjudication, fit-for-purpose land administration, mass land registration, orthophoto, tenure rights

Introduction

In many countries land parcels have not yet been demarcated and registered. Without a complete and accurate land register a country cannot effectively manage its land and resources. It will need to carry out mass registration and establish the land administration system necessary to ensure secure land tenure, which in turn can attract national and international investors. National investors are in the main small land holders who are often ready to contribute as a community to the process of land registration. International investors are usually agro-economic corporations. Mass registration and systematic adjudication can best be undertaken on the basis of the Fit-for-purpose Land Administration approach.

The fit-for-purpose land administration approach has been applied in many countries in Asia, Eastern Europe and Africa. For example, in Rwanda more than 10 million land parcels were mapped and registered over a period of 4 years (2009 – 2013) using the fit-for-purpose land administration approach. This approach is also currently being used by the Land Investment for Transformation (LIFT) project in Ethiopia. The project, funded by the Department of Foreign International Development of the United Kingdom, plans to mass register and issue second level land certificates for fourteen million parcels in less than six years, from 2014 to 2020. This paper will describe two current mass land registration procedures based on sample projects / countries which have applied such procedures and will suggest a method which combines the advantages of both current procedures.

Mass Registration Procedures

When mass registration is necessary there are two main procedures / methods which may be followed. For the purposes of this paper the two procedures will be labelled respectively the Carta and Terra procedures: (1) the Carta procedure because large scale community participation commences with marking up boundaries on an orthophoto map and (2) the Terra procedure because large scale community participation commences with marking up boundaries on the ground before producing the orthophoto maps. Both these procedures adhere to the fit-for-purpose land administration approach principle, in that they are flexible, inclusive, participatory, affordable, reliable, attainable, and upgradable. They can be applied within a short time frame and allow mass land registration as well as scaling up from a pilot project to a nationwide land registration project. The involvement of the local communities in these procedures can help guarantee the acceptance of the results at local level.

The Carta Procedure

The Carta procedure is currently the most frequently applied method in mass land registration. It involves using orthophoto maps derived from aerial or satellite imagery. These orthophoto maps are plotted according to defined cadastral blocks / cadastral cells and then taken to the field to demarcate the land parcels for the

registration process. The local land holders' contribution during the demarcation process is of crucial importance since they help land surveyors, or land registration experts, to define the boundaries of their land on the plotted orthophoto maps. After the surveyors have manually drawn the parcel boundaries on the orthophoto maps, on site, the orthophoto maps are scanned, geo-referenced, and then digitized. While the parcels are being digitized, the legal tenure rights of the land holders / claimants, which have been collected during the field work, are registered as attributes in the land administration system. The final step is the issuance of the certificates / the title deeds once the registration information and the parcel boundaries have been verified by the concerned land holders / claimants during public displays of the data.

An example of the Carta procedure is the systematic land tenure regularisation (LTR) program / project in Rwanda. During this mass land registration project more than 10 million land parcels were mapped and registered over a period of 4 years (2009 – 2013). At the conclusion of the project the Rwanda Land Registry was established.

The systematic LTR in Rwanda was designed on the basis of simple procedures with the following guiding principles:

- Public and open process involving the government and the public
- Establishment of the right to land acquired by custom or by law
- Just administration with no discrimination to persons holding land
- Transparent mechanism for resolving disputes to provide fairness and satisfaction to all sides
- Replicable program characterized by a simple set of administrative and legal stages only to be modified when strictly necessary
- Legal basis with all property rights related laws incorporated thus giving rights to previously excluded people
- Speed and accuracy for achieving an effective systematic LTR
- Low cost to land claimants and maximizing value for money for the government and supporting development agencies
- Completeness with regard to establishing a complete land register of the entire country.

The stages of the systematic LTR in Rwanda are shown in the flowchart of Figure 1.

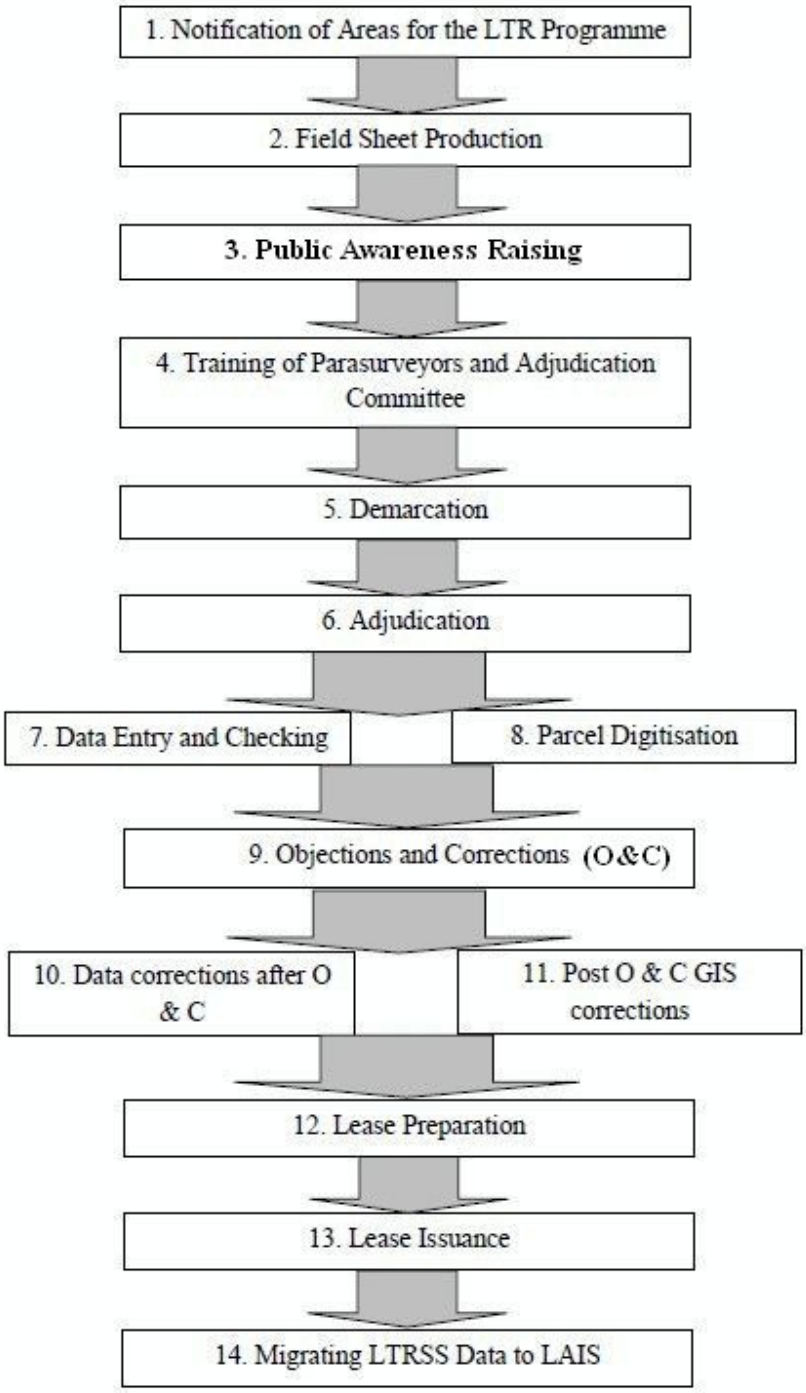

Figure 1: LTR process flowchart applied in Rwanda (source: Rwanda Natural Resources Authority, 2012)

The following paragraphs briefly describe the stages in accordance with their sequence in the flowchart.

1. The first stage covered informing the local authorities and the public of when and where land regularisation activities would commence for each cadastral block / cadastral cell.

2. Stage 1 was followed by printing the field sheet index maps and the respective field sheets for each cadastral cell and delivering these to the appointed field manager in preparation for demarcation and adjudication. The basis of the field sheets were digital orthophotos produced at a ground resolution of 25cm using aerial photography.
3. Public awareness was raised in the area in which the demarcation and adjudication would take place in order to prepare local authorities and the public to give their input and to participate in the registration process. Thus the general public was appropriately informed and made aware of LTR, their rights, and their involvement in the process. Public awareness through local meetings was conducted at the smallest cadastral cell level since local participation was paramount for the accurate land demarcation and assignment of accurate tenure rights.
4. The para-surveyors, who were recruited from the local communities, were trained in map reading and tracing of physical boundaries on the field sheets (ortho-maps). Adjudication committee members, who were drawn from the cadastral cell land committee supported by employed staff, were trained in recording claims, disputes and corrections of information relevant to an identified parcel. After training all involved people were able to carry out their duties in adjudication and demarcation.
5. Stage 5 involved the identification of the land boundaries of all parcels in a cadastral cell to the satisfaction of all claimants and village leaders. The outcome of the demarcation was annotated field sheets showing all boundaries and parcel numbers in the cadastral cell. During the demarcation process land claimants and their immediate neighbours were present on their land and walked around the entire plot indicating the boundaries to the para-surveyor(s) who marked these onto the field sheet in the presence of the land holders / land claimants. Neighbours also had to verify the claimants right to the relevant land. At the village level the respective village leader also verified the claim. Each demarcated land parcel was assigned two identification numbers, one a unique nationwide number, and the other a unique cadastral cell number. When imagery was obscured by clouds or vegetation then the parcel boundaries were fixed through field surveying or by tape measurement. After demarcation the land holders / land claimants received a demarcation receipt which they took to the adjudication committee to register their claim. Disputed land was also demarcated however the claimants had to request the adjudication committee to resolve the issue.
6. During adjudication the personal details of the claimant to a parcel were recorded, a claims receipt was issued, and registration fees were levied. In addition, disputed claims, which occurred during demarcation, were registered and resolved whenever possible, otherwise dispute resolution was referred to traditional local mediators (Abunzi) or courts of law, depending on the value of the disputed land.

7. The records of all parcels, including disputed claims, and the claimant data produced during the adjudication process were checked and digitally stored with their respective unique identification numbers in the mass register (the LTR support system) during this registration process. Quality control of records was carried out prior to printing the list of the claims, which were used during the public displays.
8. In parallel to digitally inputting the data of the claimants, the demarcated parcels were digitized in the geographic information system (GIS) with their respective unique identification numbers. The digitization followed the following procedure:
    - Scanning of field sheets
    - Geo-referencing of scanned field sheets
    - On-screen digitizing of the hand drawn parcels visible in the scanned and geo-referenced field sheets
    - Quality control of digitized parcels and plotting the cadastral cell map ready for public display, if quality control checks passed the quality criteria
9. Public displays took place in order to allow the land claimants to check the correctness of the boundaries of their parcel and the correctness of their personal details, ie the correctness of spatial or textual data related to their claim. This allowed the members of the public to raise any objections to existing claims, which they had.
10. The results of the public displays, ie the objections, were incorporated in the database, which was created for the mass recording of the LTR claims. Thus, new or corrected data, which arose from the objections, was input to the database.
11. In parallel to carrying out the corrections to the database (see stage 10) the boundaries of the parcels, which were objected to, were also corrected in the GIS system, if required. All corrected parcel boundaries were digitized, thus parcel areas and cadastral extracts became available ready for finalization of lease titles.
12. The lease documents consisting of contract, certificate, and parcel cadastral extract (see Figure 2) were generated and printed for each approved parcel.
13. Lease documents for the approved parcels were issued to the land claimant or the district office, with the contract duplicates being scanned.
14. Once the lease documents were issued, all data, which was held in the mass register, ie the LTR support system database, was transferred to the land administration information system (LAIS).

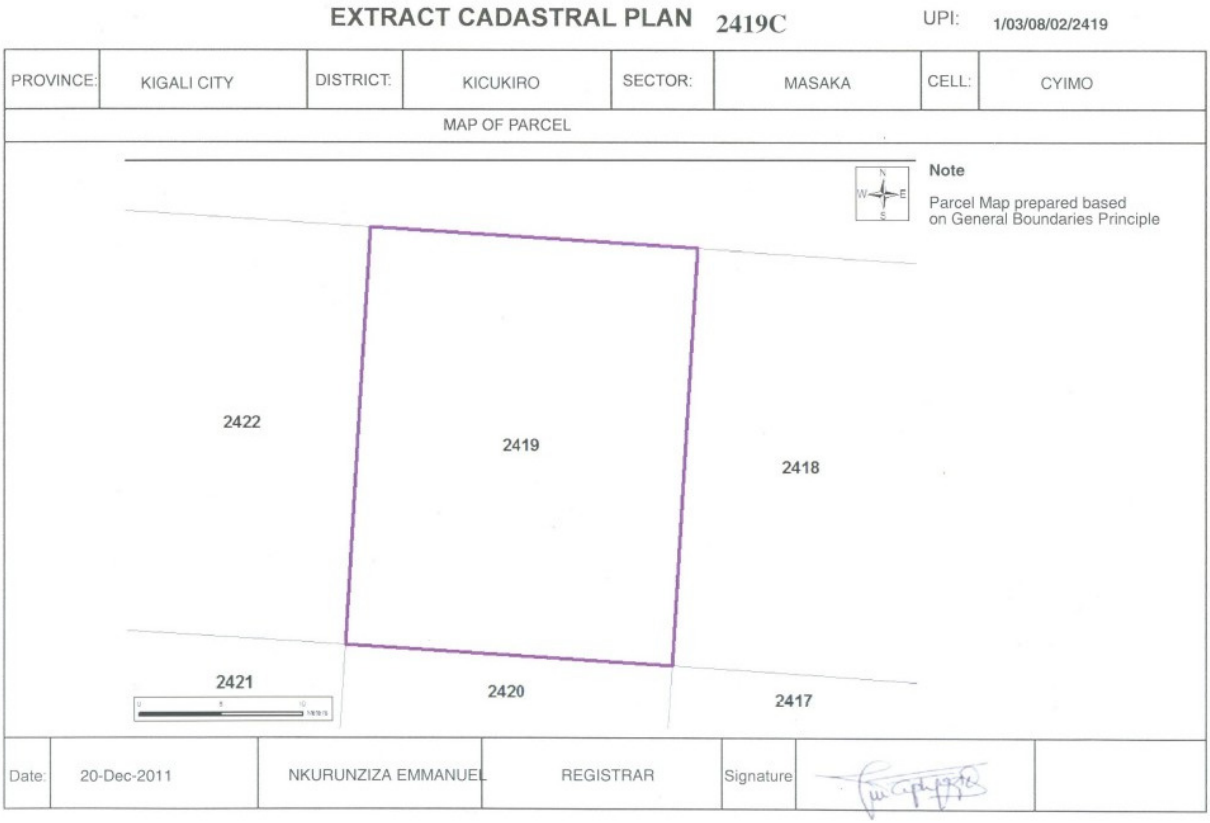

Figure 2: Sample of a cadastral plan extract for a parcel (source: Rwanda Natural Resources Authority, 2012

For each of the fourteen stages described risks were assessed and mitigation schemes were developed and applied in order to counter the risks. The LTR in Rwanda was carried out by around 100,000 people, around 500 of whom were fulltime employees. The rest were hired on temporary basis from the local communities.

A similar approach to the one in Rwanda is also currently being used by the Land Investment for Transformation (LIFT) project in Ethiopia. This project, funded by the Department of Foreign International Development of the United Kingdom, plans to mass register and issue second level land certificates (SLLC) for fourteen million parcels in less than six years, from 2014 to 2020. Figure 3 and Figure 4 show the stages and the workflow of the second level land certification in Ethiopia.

The mass registration procedure in the LIFT project is based on the Rwandan LTR project. The land rights and the parcels resulting from the mass registration will be maintained in the Ethiopian National Rural Land Administration Information System (NRLAIS), which is being developed by Hansa Luftbild.

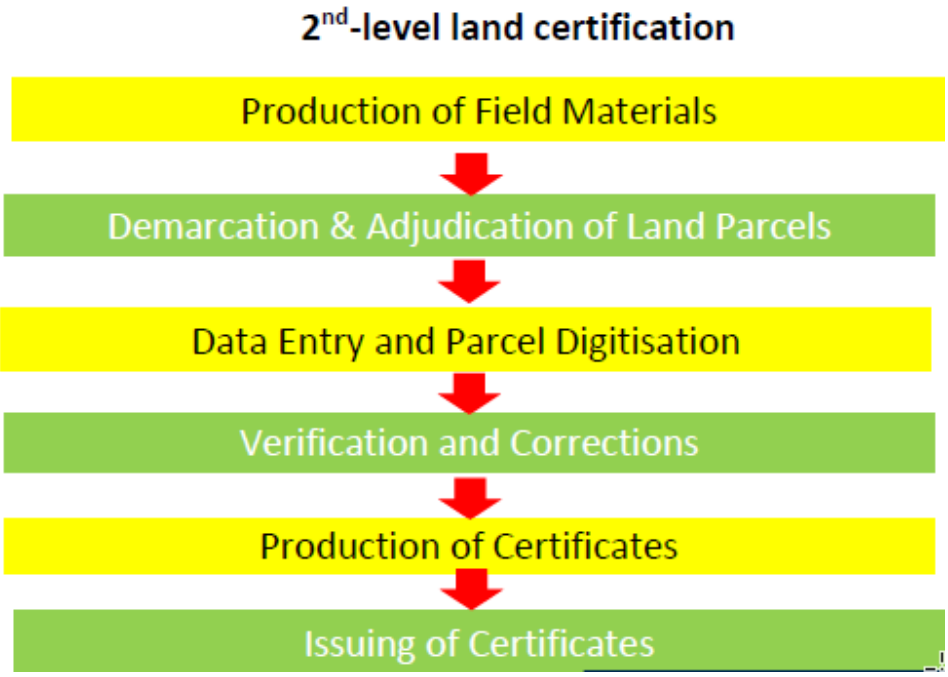

Figure 3: Second level land certification stages in the Land Investment for Transformation (LIFT) project in Ethiopia (source: LIFT Second Level Land Certification, 2016)

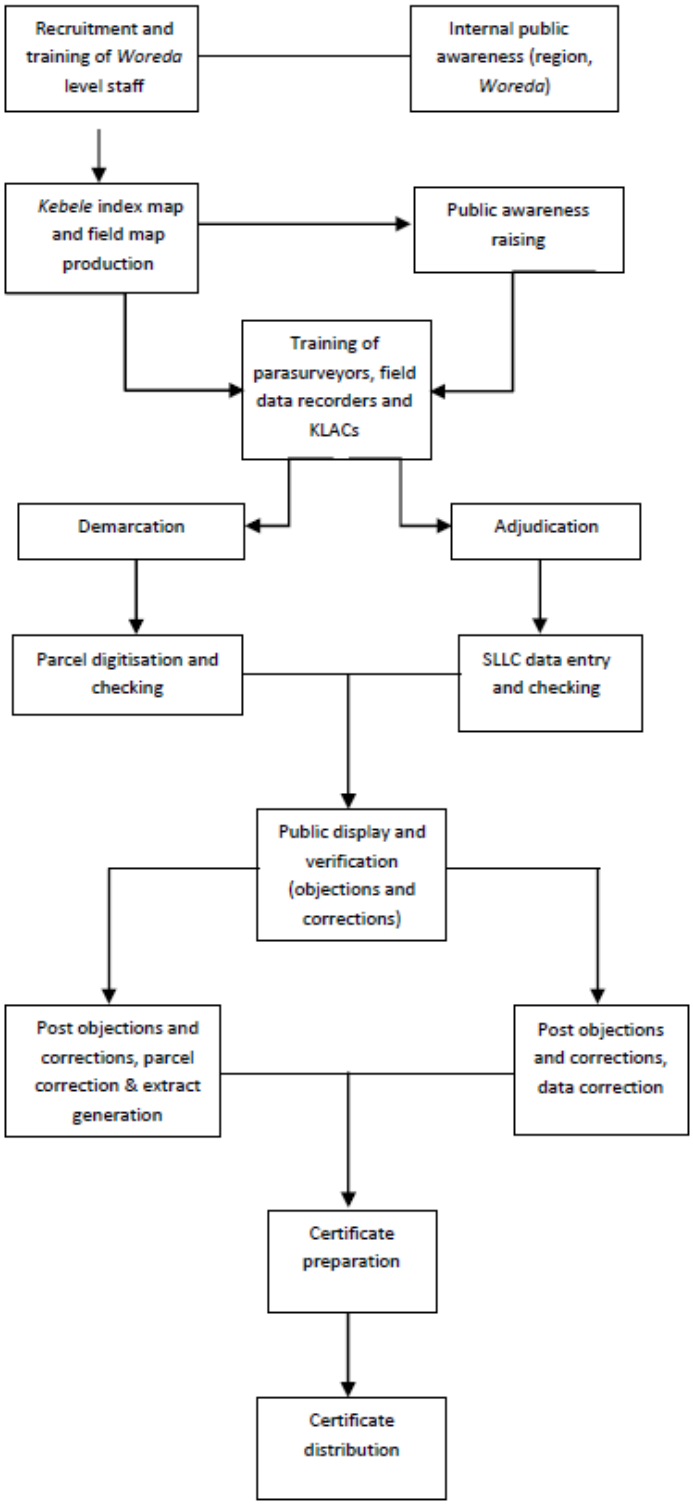

Figure 4: Workflow diagram of the SLLC activities (source: LIFT Second Level Land Certification, 2016)

The Terra Procedure

The Terra procedure, which appears to be not widely known to the land administration community, follows an approach which involves the local community / the land holders prior to production of the orthophoto maps. The community involvement commences with land holders who neighbor each other agreeing on their common boundaries and marking the corners of the boundaries on the ground. At the same time land registration experts collect all legally required information about the land holders. Once the boundary marking on the ground is complete airborne / satellite image acquisition is carried out. Following image acquisition and production of orthophotos, the boundaries are mapped on the basis of the visible marked corners of the parcels. The parcels are mapped by experienced mapping technicians, who know how to interpret remote sensing imagery objects. The parcels with the legal details of the land holders will then be registered in the land administration system. As in the Carta procedure, following registration the parcel boundaries are verified by the land holders through public displays, and the certificates / the title deeds are issued to the respective land holders.

The Terra procedure with respect to pre-marking the corners of the boundaries on the ground before aerial image acquisition and mapping the parcel boundaries using the digital orthophotos has been used in Montenegro. In Montenegro digital orthophotos with a ground resolution of 5cm were used in the urban and built-up areas while those with a resolution of 50cm were used for other areas.

Comparison of Methodologies

Both methodologies / procedures have distinct advantages and disadvantages. A primary advantage of the Carta procedure is that land holders are able to see their parcels clearly delineated on a map before the registration process takes place. Experience has shown that this ability to see and outline their landholding in concrete documented form on a map is highly favored by community participants. The Terra procedure could possibly provide a similar opportunity for community participants by taking medium resolution satellite imagery into the field.

The Terra procedure requires the presence of surveyors in the field to record geographic co-ordinates, for subsequent input / referencing during the in-office registration process. Such surveyors are not required for the Carta procedure. However, the Carta method requires the plotted orthophoto maps to be both scanned and geo-referenced. These two steps involve additional quality control measures. In addition scanning and geo-referencing reduce the overall positional accuracy. The Carta procedure can deliver a positional accuracy of around 2m for an image resolution of 40cm / 50cm while the Terra procedure can deliver a positional accuracy of better than 1 m for the same resolution for a clear and visible land surface.

The following table compare the two mass land registration methods with regard to demarcating and digitizing the parcels of land holders.

Carta Method	Terra Method
1. Aerial / satellite image acquisition	1. Pre-marking of corners of parcels on the ground with local community input
2. Production of orthophotos	2. Aerial / high resolution satellite image acquisition
3. Plotting of ortho-maps as field sheets	3. Production of orthophotos
4. Demarcation of land parcels in the field with local community input	4. On-screen digitization of parcel boundaries using pre-marked border points
5. Scanning of ortho-maps with hand drawn boundaries	
6. Geo-referencing of scanned ortho-maps	
7. On-screen digitization of parcel boundaries of geo-referenced ortho-maps	

Table 1: Comparing demarcation and digitization of parcel boundaries in Carta and Terra methods (source: Hansa Luftbild AG, 2017).

As can be seen in Table 1 the Carta method consists of 7 steps for the demarcation and digitization processes while the Terra method needs 5 steps to complete these processes.

In combining the advantages of both methods and eliminating their disadvantages a method could be established which has a workflow as shown in Figure 5.

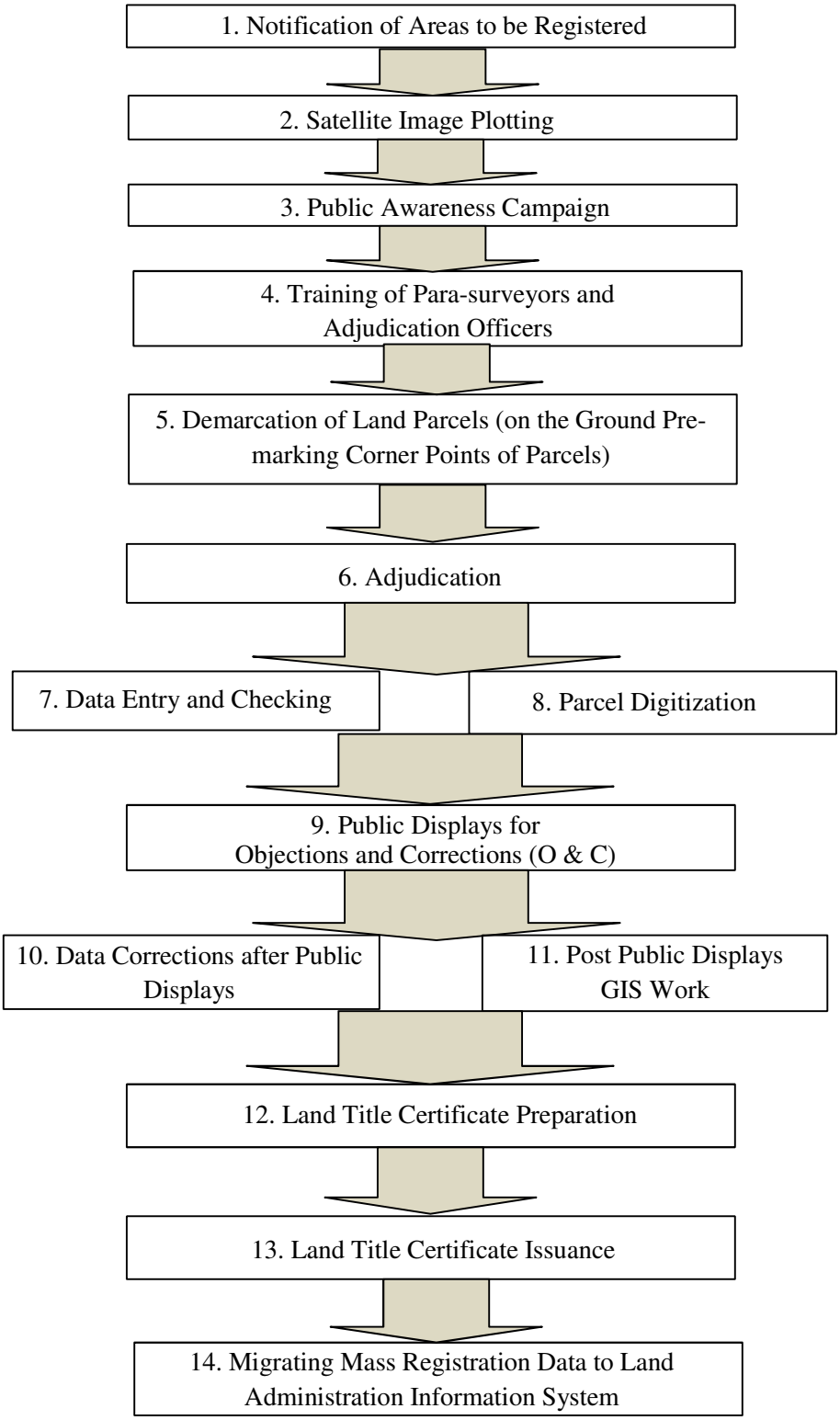

Figure 5: Workflow showing combined advantages of Carta and Terra methods (source: Hansa Luftbild AG, 2017)

When combining the advantages of both methods the workflow stages stay the same as for the Carta method, ie the one applied in Rwanda or currently being used in the LIFT project in Ethiopia. However, stages 2, 5 and 8 will have different processes. The following briefly describes the differences in these processes:

2. Acquisition of medium resolution archived satellite imagery with 5m resolution or better. Using the satellite imagery index maps, the respective field sheets for each cadastral cell are created, printed and delivered to the appointed field manager in preparation for demarcation and adjudication.
5. This stage involves the identification of the corners of land boundaries of all parcels in a cadastral block / cadastral cell for all land claimants. The para-surveyors should show the land claimants how to use locally available material, such as twigs, stones, pebbles or similar, in order to pre-mark the corners of their land on the ground. The size of the ground mark should be around 1 m² if the aerial image resolution chosen for mass registration is 30cm. As a rule of thumb the ground mark should be 3 times the image resolution. Figure 6 and Figure 7 show a ground mark with 1m diameter photographed on the ground and which is visible in the aerial image.

Figure 6: Ground mark with 1m diameter painted in white to be visible in an aerial image (source: Hansa Luftbild AG, 2016)

Figure 7: Ground mark shown in Figure 6 visible in an aerial image with 30cm ground resolution (source Hansa Luftbild AG, 2016)

During the demarcation process claimants should be present on their land and walk around the entire plot indicating the boundaries of the land plot with its corners to the para-surveyor(s). The para-surveyors would mark these onto the field sheet in the presence of the land claimants. At the same time, the land claimants and their neighbours should mark on the ground the corners of the land plot, thus verifying the claimants' right to the relevant land. At the village level the respective village leader can also verify the claim. Each demarcated land parcel is then assigned a parcel identification number, ie a unique nationwide number. In addition, the para-surveyor should record the coordinates of the centre of the land plot using a hand held GPS receiver. The unique parcel identification number chosen for the land plot should also be assigned to these coordinates in order to match the parcel with its the land claimant(s) during the digitization stage. If satellite imagery is obscured by vegetation then the parcel corners can be fixed through clearing the vegetation at the location where the corners fall in order to mark these on the ground. Another option would be using a handheld GPS receiver to record the coordinates of the obscured corners and to assign these to the respective parcel identification number. After demarcation the land holders will receive a

demarcation receipt which they can take to the adjudication committee to register their claim. Disputed land should also be demarcated; however, the claimants will have to request the adjudication committee to resolve the issue. The outcome of the demarcation will then be annotated field sheets showing the approximately delineated boundaries and their relevant corner points and parcel identification numbers in the cadastral cell.

8. Aerial / high resolution satellite image acquisition is to take place after the corners of land parcels has been marked on the ground. The land holders should maintain the ground marks until the image acquisition is completed. This will require coordination between field managers and land claimants so that claimants can be informed when the imagery acquisition is completed. Orthophotos can then be produced and used to digitize the corners of the land parcels in a GIS and each parcel can be assigned its relevant unique identification number. As a reference the recorded coordinates of the center of the land plot should be input in the GIS to check and confirm that the digitized plot is assigned the correct identification number. Then it will subsequently be assigned to the legal land holder(s) / land claimant(s).

The combined procedure can benefit the mass land registration process in that it provides higher accuracy while maintaining local community participation during the demarcation and adjudication process.

Conclusion

The fit-for-purpose land administration approach is being used for mass registration and systematic adjudication in many countries. Two main procedures are applied for mass land registration. Both fully adhere to the fit-for-purpose principles, each has its advantages and disadvantages and both yield fully satisfactory and acceptable results. Countries which plan to implement mass land registration can choose which of the two procedures fits them best or choose the procedure that combines the advantages of both methods.

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