FINAL REPORT

Evaluation of Cadastral Surveying Component:

Moldova Land Titling and Registration Project

Grenville Barnes
Cadastral Consultant

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1. Introduction

This report summarizes the work, findings and recommendations related to the rapid evaluation I carried out in a visit to Moldova from May 7-12, 2002. This evaluation was done in collaboration with a USAID team composed of Bohdan Chomiak (agricultural policy specialist), Val Chodsky (land reform adviser) and Greg Myers (land tenure specialist).

The specific terms of reference for my contribution to this evaluation were:

- Review survey methodology implemented by USAID contractor
- Determine what, if any, errors may have been made
- Propose appropriate technical solutions, if necessary
- Suggest costs for these remedial actions

I should preface this report by emphasizing that the USAID-supported land titling project achieved remarkable results given the number of parcels to be titled and the extremely tight time frame under which it was operating.[1] It managed to successfully implement a massive privatization and property formalization using a decentralized approach that employed local human resources. This was done in the face of significant political, institutional and technical challenges. In the context of cadastral surveying it also developed a private sector surveying capability that did not exist prior to the project.

This evaluation was limited to the surveying related aspects of the project and did not, for example, include an evaluation of the registration system. The evaluation was based on information gleaned from project reports, personal communication with World Bank personnel and consultants, and meetings with: private surveyors, a representative of the national cadastral agency, lawyers and cadastral engineers working in the NGO sector, an ex-Minister of Agriculture, the leader of a legal advocacy unit (PFAP), members of the Center for Strategic Studies, the mayor of Ungheni, employees of the Territorial Cadastral Office for Ungheni, representatives of the National Federation of Moldovan Farmers, local leaders and individual farmers (including "early leavers"[2]).

In this report I first deal with methodological issues and then with errors that have arisen in the application or misapplication of the methodology. In each subsection I briefly summarize my recommendation to address the problem or error and then in the following section I give a more detailed description of these recommendations.

[1] 2.8 million titles were issued between 1997 and 2001

[2] those members of the farm that chose to take land prior to the project.

2. Evaluation of Cadastral Surveying Methodology

In this section of the report I examine methodological issues and address questions concerned with whether or not the basic surveying methodology used in the project was flawed. Many, possibly even 90%, of the problems described to us in interviews and asserted in reports seem to relate to the allocation process that took place prior to surveying. While these problems are beyond the scope of my work, the nature of the problems must necessarily be considered for designing appropriate technical solutions. For example, the apparent corruption of local leaders can be counteracted by implementing solutions that are explicitly designed to be transparent and which involve the broad participation of land holders.

Briefly, the cadastral surveying methodology employed in the land titling project consisted of the following steps.[3]

(a) Compile existing land use maps that depict the location of forests, pastures,[4] and orchards, as well as land features such as roads, rivers
(b) Carry out field reconnaissance of survey area to determine location of traverse points and methods to be used for surveying field[5] boundaries
(c) Set reference monuments (at least three per field or group of adjacent fields) and survey these in as part of the initial control traverse[6]
(d) Survey the perimeter of each field by means of tape/theodolite traverse, tacheometry or total station measurement
(e) Compute all control and field traverses and check that angular and linear closures meet specifications[7]
(f) In the office delineate individual parcel boundaries by protraction based on arrangements decided by the Land Commission and *primeria*[8]
(g) Assist the *primeria* with the preparation of individual titles
(h) Prepare final cadastral plan and submit plan together with technical report, field books and sketches and a list of all geodetic control points

The methodology and products resulting from it are shown in Figure 1 on the next page.

This methodology does not follow a classic cadastral surveying model, but is an attempt to streamline the process as much as possible in order to maximize efficiency. For some years cadastral specialists, including myself, have argued for a more business-oriented approach to cadastral surveying and less attention to maximizing spatial accuracy in those

[3] The specifications and procedures are laid out in a document entitled Provisional Instructions on Preparing Land Arrangement Projects (MD RM-36-02-03-97)
[4] Forest and pasture land is explicitly excluded from privatization.
[5] An arable field generally contains a number of individual parcels.
[6] In a few instances this traverse was connected to the national geodetic control network, but in general this was not done as apparently this network only covered less than 20% of the country.
[7] Angular misclosure should not exceed +_ 1 √no of traverse angles, and linear misclosures cannot exceed 1/2000
[8] local mayor's office.

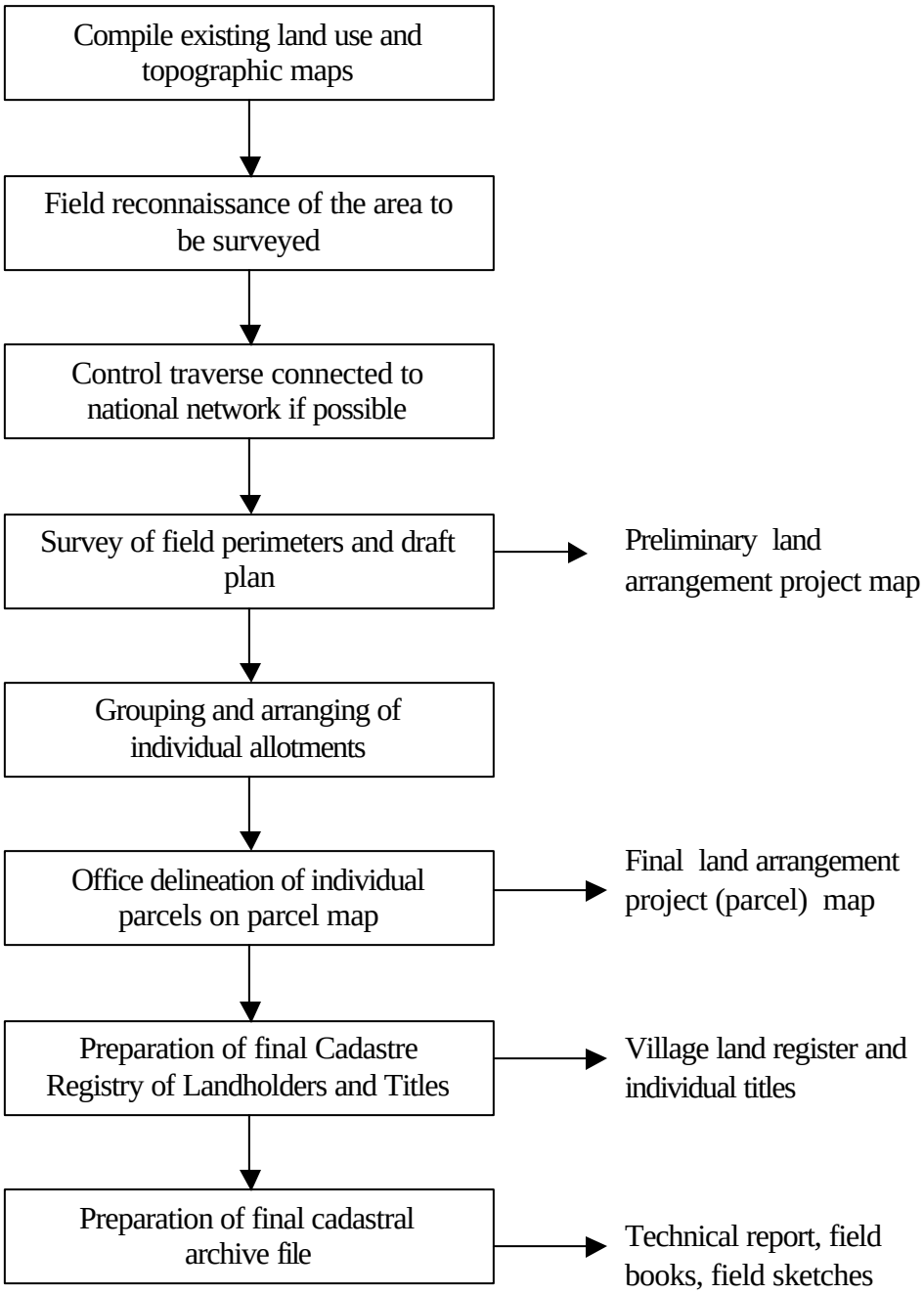

Figure 1. Cadastral Surveying Methodology and Products

areas in the world where the cost of a traditional approach exceeds the market value of the land. The question in this evaluation is did the methodology described above push the business approach to the limit and in the process ignore certain fundamental requirements of land registration and a land market? I will respond to this question by dealing in turn with each of the major issues that have arisen with respect to the cadastral aspects of the project.

2.1 Cadastral surveys were not connected to a national geodetic network

The advantage of connecting all cadastral surveys to a national reference network is that the resulting parcels will be located within an absolute coordinate framework that covers the whole country. All parcels or parcel maps can be simply integrated because they will be on the same mathematical coordinate system. In the absence of a national grid of points, or the broad availability of GPS technology to surveyors in Moldova, the project resorted to using local, free-standing coordinate systems for each farm (ex-kholhoz). This local approach makes it a little more difficult to integrate different farms together into one coordinate or map system. However, having all parcels defined in a national coordinate system is not a prerequisite for land registration.[9]

When opting for a local coordinate system[10] it is important to provide a means to incorporate this system into the national system at a later time. In the project this was done through setting permanent physical reference monuments or markers in each farm. If desired, these points can subsequently be re-surveyed to connect them, and all the parcels on that map or local system, to the national reference system. The project methodology stipulates that three monuments should be set for every field or group of contiguous fields in a farm, thus facilitating (provided the reference monuments can be found) the future transformation of the local farm coordinates into the national system.

In some areas of the project surveying companies used a local coordinate system for one group of fields and another local system for another group of fields within the same farm. As a result it is difficult to graphically integrate these groups of fields into the same map or coordinate space, particularly if they do not share any common map objects (like roads). This integration is near impossible mathematically as the relationship between the different local coordinate systems is unknown. While this approach does not appear in the methodology described in any of the documentation reviewed, it was used by some private surveyors in the project, particularly during the first roll-out to 72 farms. It is also possible that this approach was followed by only a few surveying companies who generally produced sub-standard work.

Recommendation 1: On those farms (54) which which have been identified by the cadastre agency as problematic and which, in addition, have multiple local coordinate

[9] For example, probably less than 5% of rural parcels in the US are tied to the various state plane coordinate systems, but this does not negatively impact either tenure security or the land market.
[10] According to a Swede Survey consultant about 20% of the localities were connected to the national network.

systems on a single farm, I recommend re-surveying (using GPS) sufficient points to allow the integration of these local systems into the national coordinate system.

Recommendation 2: On farms where a single local coordinate system was used for the entire farm, I do NOT recommend any re-survey work to connect these farms to the national coordinate system.[11]

2.2 **Field and parcel Boundaries were not monumented**

Monuments[12] typically play a critical role in defining parcels, primarily because they constitute a tangible, understandable (to landowners and others) means of marking boundaries. In many cadastral systems measurements, coordinates and cadastral plans are merely regarded as evidence supporting the location of a corner monument. In the so-called 'general boundaries' system physical features such as walls, hedges and ditches can be used instead of set monuments. The important point here is that most cadastral systems use a physical means of marking boundaries that is relatively permanent and which unambiguously indicates where the boundary is located.

Our field visits and other information gathered in this evaluation indicate that in most cases field boundaries are demarcated by 'general boundaries' such as roads, etc. In addition, all field boundaries were surveyed on the ground and further demarcated through setting physical monuments in a few places along these boundaries. However, the same approach was not followed for the parcels inside the fields. They were not physically monumented or demarcated, nor were they surveyed. Instead they were computer-generated in an office, a process known as protraction. This means there is no physical or measurement evidence to perpetuate the locations of these parcels. More importantly, the farmers have no tangible means of identifying where their titled parcels are actually located in the field. The plan incorporated in their titles indicates who their neighbors are and the distances along the boundaries, but to physically locate parcel boundaries, particularly in the middle of a field, is no simple matter.

My impression is that land owners know exactly where their parcels are and have little conflict over parcel boundaries, but that these *de facto* boundaries do not coincide with the *de jure* boundaries shown on the titles. If market-driven consolidation takes place, these boundaries will eventually disappear. For this reason, as well as the dislocation between *de jure* and *de facto* boundaries, I do NOT recommend surveying and monumenting these individual parcels.

Recommendation 3. The boundaries of individual parcels as delineated on cadastral maps and individual titles should be recognized as approximate and treated as such for subsequent transactions.

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[11] Having all parcels tied into the national coordinate system would facilitate planning, land management, etc., but it is not required for land registration.

[12] Monuments are defined as artificial markers (concrete or wooden posts, iron pipes or pins, etc.) that are placed at boundary corners.

2.3 Insufficient quality control in the methodology

Quality control in the context of this report means specific mechanisms for checking that the survey work of the various private surveying companies complies with the required standards. This does not only mean checking the format and completeness of the survey products, but also the quality of the work. One approach is to re-survey a percentage (e.g. 5%) of the work done, but this is costly and can create confusion in the minds of the landholders. If the work was done correctly in the first place, landholders question why it is necessary to repeat it. The better approach to quality control is to incorporate internal checks in the methodology so that the company doing the work is required to do its own quality control and to present the results of these checks[13] as part of the final documentation. In addition to this, quality control teams can conduct random field visits[14] to check visually (without re-measuring) that the cadastral map is in general conformance with the situation on the ground.

In the initial pilot project adequate quality control was apparently in place, but with the extra volume of work generated by the first roll-out of the project this critical aspect seems to have been overlooked. Poor quality work was reportedly turned in by certain survey companies and this was not picked up in any review process. This would have been particularly important in the first part of the project when surveyors were on a steep learning curve. While incentives[15] were provided for completing the survey work on schedule, this was not apparently tied to the quality of the work. In summary, I believe insufficient attention was given to quality control.

Recommendation 4. Review in detail the 56 farms identified as problematic by the cadastral agency, categorizing the different types of errors and specifically identifying the parts (e.g. fields) of these farms that need to be re-surveyed.

Recommendation 5. Acquire GPS technology and train private surveyors in the use of this equipment.

Recommendation 6. Employ the trained private surveyors to re-survey the parts of the 54 farms that require re-measurement.

2.4 Insufficient public review of the cadastral/titling information

An important step following cadastral surveying and adjudication is the public exhibition of the results. This is a critical step because it not only provides a valuable check on the results by people who have an intimate knowledge of the land, but also presents an opportunity for interested parties to buy into the whole cadastral and titling process.

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[13] Such as traverse and field perimeter misclosures.

[14] In interviews with surveyors, they asserted that one of the biggest problems was that there was no field review of the survey work.

[15] BA&H offered a 50% discount on survey equipment if contracts were completed on time.(BA&H 2000, p.17)

It is apparent from the various survey errors (see next section) that there was no proactive effort to publicly exhibit the cadastral and titling information. The project relied on mayors in the different primerias to do this, but for a variety of reasons (including corruption) this was not generally done. The final cadastral map was ostensibly made available for public viewing, but this seemed to rely more on the initiative of individual farmers than on promoting the active participation of all stakeholders. A better approach would have been to require all landholders to examine the cadastral map and list of names (with associated parcel numbers) and to sign that they agreed with the data. If they were not in agreement with the data, this should have been documented and returned to the surveyor or responsible party for rectification.

Recommendation 7. In all further surveying work (and in other titling projects in the region), survey plans and owner information should be explicitly checked and signed off on by all affected landowners.

2.5 Insufficient landholder involvement in the cadastral surveying process

In the first survey of cadastral boundaries it is essential to obtain input from local inhabitants or their representatives to ascertain what constitutes the actual boundaries and other features to be surveyed. In many cases, the field boundaries may have been obvious to the surveyors, but in other cases this was complicated by the absence of clear field boundaries (especially in winter when there is snow on the ground), the existence of early leavers in part of the field, and by the lack of up to date base maps[16] showing the location of roads, natural features, forests and pastures.

This lack of coordination with local landholders or leaders has led to a number of errors described in the next section.

Recommendation 8: In all future survey work require private surveyors to consult with local community leaders on field boundaries and on any other boundary that is unclear.

[16] Surveyors interviewed that this was the case for about 10% of the maps provided.

3. Surveying and Titling Errors

The national cadastre agency has identified a list of 54 farms in 10 judets which contain survey errors. Almost half of these problem farms were surveyed by a single company. During this rapid evaluation there was not sufficient time to reliably estimate the number of surveying errors and instead I will focus on the types of errors encountered and what can be done to rectify these errors (see recommendations section).

3.1 Inadequate information on early leavers

One of the biggest problems repeated by almost all groups interviewed was caused by confusion over the land allocated to early leavers. Not only were the perimeter boundaries of their land allocations unclear, but the boundaries of individual parcels were difficult to determine. In many cases the *primeria* did not have an accurate list of early leavers.

Recommendation 9: In all future survey work surveyors should acquire information on early leavers, or consult with their representatives, prior to any fieldwork.

3.2 Parcels depicted on titles are difficult to locate on the ground

The land commission and *primeria* were supposed to work with the surveyor on defining the parcel layout within individual fields. Once a decision was taken, the surveyor delineated individual boundaries on paper without the benefit of a survey. The exact location of these boundaries only become important when members of a group decide to split off and demand their separate parcel. In the absence of physical monuments, it is difficult to precisely locate the parcels that are depicted on the cadastral map and on individual titles.

Recommendation: See recommendation 3.

3.3 Typographic and Minor Errors on Titles

It is estimated that there are more or less 50,000 errors of this nature including: misspelled names, birth dates where month and day have been switched around,[17] duplicate parcel identifier numbers. These types of errors are apparently being fixed without any major problems.

Recommendation 10: Employ a group (3) of local consultants to (i) assist territorial cadastral offices and *primarias* with the rectification of errors in the office, and (ii) monitor the progress of this work.

[17] Reportedly about 9000 such cases.

3.4 Transitional Errors

Due to the lag in time between the allocation of land shares and the first registration of titles, these titles may be in the name of individuals who have died. Although there is a process for dealing with inheritance of land, the fact that no final title was registered has held up both this process and the registration of titles.

Recommendation 11: Employ a group of local consultants who will work with the national cadastre agency to prepare and disseminate simple guidelines for resolving the inheritance problem described in this subsection.

3.5 Title changes are being made outside the registry

We were shown a specific case where an early leaver was allocated an arable land parcel by the *primeria* in 1993 and then in 2000 was issued a formal title (see Appendix A). As evidence of the first allocation, he had a sketch plan (see Appendix A) that showed the measured sides of his parcel. The title, however, had different distances. In order to correct this he approached the *primeria* who simply changed the distances on the title to coincide with what appeared on the older sketch plan. No change was made to the area on the title and this change was apparently not made in the registry.

This issue raises important questions about the continued maintenance of the registry and the seems to indicate that there is not sufficient recognition that the legal tenure situation is described in the registry not on the title held by owners. If the legal situation (or boundaries) changes through transactions or amendments, the changes can only be formalized through the registry. If not, the *de jure* land tenure situation as described in the registry will start to differ from the *de facto* tenure situation and ultimately tenure security will be compromised.

Recommendation 12: Employ a group of consultants (same as in above subsections) to prepare and disseminate simple guidelines and promotional material on the process and importance of formalizing both changes and transactions in the registry.

4. Detailed Recommendations

4.1 Review and categorization of survey errors on problem farms

I recommend that a more complete review be carried out of the survey errors, focusing particularly on the 54 problem farms identified by the cadastre agency. The primary objective of this exercise would be to identify those errors that require revisiting the field for re-survey or other purposes (such as connecting sub-farm local coordinates systems – see previous subsection). Survey errors, such as duplicate parcel identifier numbers and minor typographical errors, will be much easier to fix and should not in most cases require re-measurement.

4.2 Review and adapt legal framework to facilitate error rectification

The objective of this review is to identify any legal obstacles that may block or impede the rectification of surveying and other errors. This is necessary in the first phase of the proposed rectification work to ensure that the resurvey data can be used to rectify the existing legal record. This should involve an examination of the laws, regulations and orders pertaining to changing unregistered or registered titles, cadastral plans and other registry records and information that is in error. A local (if possible) or international legal consultant with knowledge of legal systems in the region, and preferably in Moldova as well, should be responsible for carrying out this activity.

4.3 Acquire GPS technology and train private and government surveyors

The objective of this activity is to develop local capacity to carry out the resurvey work using a GPS-based methodology that is faster and more effective than the approach followed in the project. The national cadastre agency has recently acquired GPS technology, but beyond that there is little experience with this technology. In spite of this fact, I recommend the use of GPS technology (sub-meter code receivers)[18] for the following reasons:

- The World Bank project has completed a re-measurement of the geodetic reference framework and the re-definition of the geodetic system that brings it onto the datum used by the GPS system.
- The use of sub-meter GPS will not require any densification of the existing control network, since a single base station[19] can cover an area with a radius of 200 to 300 kilometers (4 – 8 base stations would cover the entire country)

[18] These are receivers (e.g. Trimble ProXR) which use code signals and carrier wave smoothing for processing as opposed to the more precise receivers which use phase processing.

[19] This is comprised of a GPS receiver with antenna set up over a known control point which collects GPS data at the same time as a rover receiver and is subsequently used to differentially correct the rover measurements to produce coordinates of sub-meter accuracy.

- Field measurement is much quicker than conventional surveying technologies as rover receivers need only one minute at each point to be surveyed (e.g. field corner, reference monument)
- Surveys on local coordinate systems can be simply transformed into the national coordinate system using the GPS points measured

Surveyors from the national or territorial cadastre offices should also be included in this training so that they become familiar with and support this GPS-based cadastral surveying methodology.[20] To use this approach will involve acquiring at least 6 rover receivers and a minimum of 2 base station receivers,[21] setting up base station sites and training surveyors in the operation of GPS receivers and processing of these measurements. Training should be provided not just by equipment vendors but also by someone who understands the requirements of cadastral surveying and has experience with sub-meter type receivers. My recommendation here is specifically for the sub-meter category of GPS technology and I do NOT support the acquisition and deployment of the more precise category of GPS[22] that is not as efficient nor as robust. This activity can occur concurrently with the review of errors.

4.4 Resurvey problem farms with multiple local coordinate systems and connect to national reference system

The objective of this activity is to obtain a consistent cadastral map for each farm that can be used to support land registration. The only solution to the multiple local coordinate system problem is to revisit these farms and to re-survey a number (not all) of field boundary points of the fields. Ideally, this could be done by surveying and computing the coordinates of the physically monumented reference points that were set in each field. Practically, this may be difficult due to the fact that the monuments may not have been set in the original survey, or, if they were set, have subsequently been destroyed.[23] If the database of the original survey data is still available, the integration may be done mathematically. However, it is more probable that this will have to be done graphically using whatever map points can be re-identified on the ground and resurveyed.

4.5 Re-survey problem areas on farms (54) with major survey errors

The comprehensive review of survey errors will identify those farms where re-surveys are required. I recommend that several qualified survey firms be contracted to revisit these farms and re-measure only those areas (such as specific fields) that have problems.

[20] The University of Florida, in collaboration with a private surveying engineering company in the US, has developed a full methodology (including quality control steps) for GPS-based cadastral surveying. This work was funded by USAID and tested in land titling projects in Albania and Belize.
[21] A basic pc should also be procured to manage the data at each base station.
[22] This includes single and dual frequency receivers.
[23] Better collaboration with local inhabitants in the project would also have minimized the destruction of these points through conveying the importance of these points to farmers and the necessity to protect them.

If these farms were surveyed on a local system, sufficient additional points should be re-surveyed to transform the local into the national coordinate system.[24]

4.6 Recognize approximate nature of parcel boundaries

Given the fact that parcel boundaries were not monumented nor surveyed in the field, I recommend treating these as approximate boundaries. In other words, if a survey is done subsequent to titling and first registration and this results in boundaries and dimensions that differ from those shown on the title, the later survey should be given priority, both in terms of dimensions (distances) and area. This may be the only way to accommodate the transaction of parcels where actual boundaries on the ground differ from the formal record.

4.7 Collect baseline and monitoring data on formal and informal land market

The land titling project was not ultimately about creating legal documents, but about facilitating a land market and providing tenure security within a private rights system. Even with perfect documents there is no guarantee that these goals will be achieved. Farmers interviewed in our rapid evaluation made it clear that the cost of formalizing transactions (including leases) is a major obstacle. Although land is increasingly being leased out, these leases are predominantly leases of less than 3 years. Even though both parties want to lease for longer periods, the notarial costs of formalizing these leases is blocking this option. It appears that farmers are resorting to the informal market to conduct lease and possibly other transactions. If this option becomes more popular it could completely undermine the investment in the formal system (as happens in other countries around the world). It is therefore critical that the land market, particularly the informal market, be monitored and investigated to identify why formal mechanisms are not being used.

[24] This refers to the system known as Moldref 99, which uses the GPS datum and a Gauss Kruger projection.

5. Proposed Activities and Estimated Costs

A rough estimation of costs by activity is given below in Table I.

Activity	**Responsibility of:**	**Approx. Cost[25]**	**Duration**
1. Review and categorization of survey errors on 54 farms	Cadastre agency	$2000	1 month
2. Review of legal framework	Legal Consultant (local or international)	$8000	2 weeks
3. Acquire 6 GPS receivers and 2 base stations[26]	USAID	$85,000[27]	4 months
4. Train Surveyors on GPS and GPS Methodology	• Consultant (international)) • Equipment Vendor	$13,000[28]	2 weeks
5. Resurvey problem farms with multiple local coordinate systems and problem areas within targeted farms	Contracted private surveyors (4)	$70,000	15 months[29]
6. Rectification of survey errors in office	3 local consultants[30]	$54,000	9 months
7. Prepare and disseminate simple guidelines for resolving inheritance and title rectification problems	Local consultants (2)	$10,000	4 months
8. Monitor and investigate land market dynamics	Consultant (international and local)	$75,000	3 years
9. Overall management and coordination	USAID		2 years

[25] Local consultants and private surveyors are estimated at $50/day
[26] This includes two pc's for the base stations as well as the software to process GPS measurements.
[27] Private surveyors should be given the opportunity to purchase this equipment through the project in the same way as was done in the land titling project.
[28] Includes per diem
[29] Booz Allen report an average production rate of 4.5 months per farm in the project. I have assumed that 40 out of the 54 farms will have to be re-visited with half of the work repeated, but with greater efficiency using GPS. Estimating 1.5 months per farm for survey work and processing of titles, etc. this will require 60 months. With 4 surveyors (or firms) it would require 15 months to complete the task.
[30] These consultants can do the quality control for the resurvey work.

6. Concluding Remarks

Land transactions are apparently occurring, with a reported 100,000 sales in the past three years. It is difficult to judge whether or not survey errors and problems are creating an obstacle to a more active land market. The farmers we interviewed tended to point more towards the high transaction costs of registering sales and leases, and the general lack of financial resources, as the main factors slowing the land market.

While this report has focused to a large extent on a fairly narrow technical aspect of the project, it is important to view this against the broader objectives and goals of the project. Cadastral surveys, plans and titles are only the means for promoting tenure security and facilitating an organized land market. The success of this project will ultimately be judged on its contribution to these larger policy goals.

APPENDIX A. Illustration of Title Rectification outside Registry

Figure A1. Sketch map of arable land parcel issued by primeria

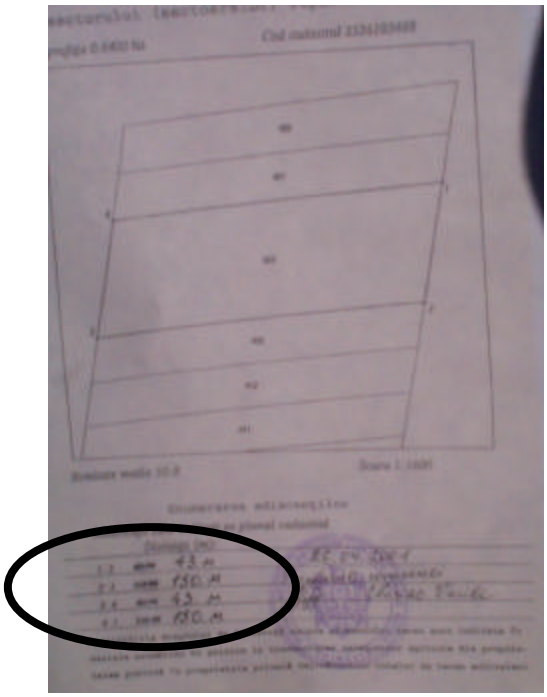

Figure A2. Title showing rectified parcel dimensions