

The Study and Example of application for the Establishment of Cadastral Methodology in Morocco

Hyunjin KIM, The Republic of Korea

Key words: Cadastral, Methodology, Morocco, KCSC

SUMMARY

The registration rate of land in Morocco is not very high for now and it hinders Moroccan economic and social development. Therefore, the research which finds the most accurate and economical way to solve the problem faced by Morocco and the analysis of field application are highly needed. So, Korea Cadastral Survey Corporation(KCSC) which is the biggest survey company in South Korea implemented of the program to establish the methodology of land registration in Morocco. Within the context of this implementation, Korean human resources, technology, and advanced system can take an effect on land administrative environment to be more improved in Morocco.

The objectives of the program are to

- A. Enhance the cadastral surveying and management technology by sharing Korean know-how and technology.
- B. Develop and implement cadastral methodology as part of the program.
- C. Contribute to the modernization and improvement of the cadastral surveying system and service.
- D. Strengthen the relationship and cooperation between both countries through the successful implementation of the Program.

The program site is located in Tangier, Morocco. The size which will be covered by the program is around 1,000ha, and the period of the program shall be implemented for two years. (2007-2008)

For more detailed analysis, those three things which are the statement and issues of land registration, the process of the establishment of land registration and the process of field surveying would be mainly dealt with in this paper. And the economic and social effect anticipated after finishing land registration would be presented at the end of the paper.

The Study and Example of application for the Establishment of Cadastral Methodology in Morocco

Hyunjin KIM, The Republic of Korea

1. INTRODUCTION

The objective of the paper is to improve the situation regarding a low land registration rate which hinders economic and social development in Morocco. Through developing a cadastral methodology and implementing a pilot project, the project is intended to contribute to economic development, stabilized land market and land tenure security.

To meet the objective of the project it has been implemented through keeping pace with the whole process of land registration and providing of surveying equipment and invitation of Moroccan officials for education as well.

Firstly, the effective and scientific methodology for improving land registration rate has been suggested by using the cadastral technology and system know-how of South Korea.

Secondly, all technical processes for land registration such as prior investigation, field survey, making plans and registration have been demonstrated to see if the technical feasibility could be applied to Moroccan context.

Thirdly, the integrated land management system combined with attribute and graphical data has been developed to contribute to the modernised cadastral system and its service.

Lastly, the invitation of National Agency of Land Registration, Cadastre and Cartography(ANCFCC) officials has been made to share information of the mutual system regarding cadastral technology and land management system and also to promote economic development through a variety of technical visits.

Within the context of this implementation, Korean human resources, technology and advanced system can take an effect on land administrative environment to be more improved in Morocco. These efforts would not only contribute to enhancing Moroccan land management system but also to be a good opportunity to have strong relationship between two countries by leading a successful implementation of the project.

2. IMPLEMENTATION OF THE PROJECT USING ODA FUNDS

KCSC has focused on overseas projects using ODA funds of Korea International Cooperation Agency(KOICA) which is a government agency to maximize the effectiveness of Korea's grant aid programs because it could help KCSC to be able to not only manage initial risks on overseas projects but also secure liquidity of raising funds.

Country	Period	Type	Scale	Remark
Morocco	2007~2008	Land registration	\$ 1 million	Pilot project
Azerbaijan	2007~2010	Land registration	\$ 1.5 million	Pilot project
China	2007	Feasibility Study	-	Expert dispatch
Cambodia	2007	Education and Training	-	

<Table 1> The status of overseas projects using ODA funds conducted by KCSC

As Korea became a member of DAC(Development Assistance Committee) in 2010, the government has increased the percentage of ODA funds with much responsibility on grant aids. Therefore KCSC has given more weight to overseas businesses using ODA funds.

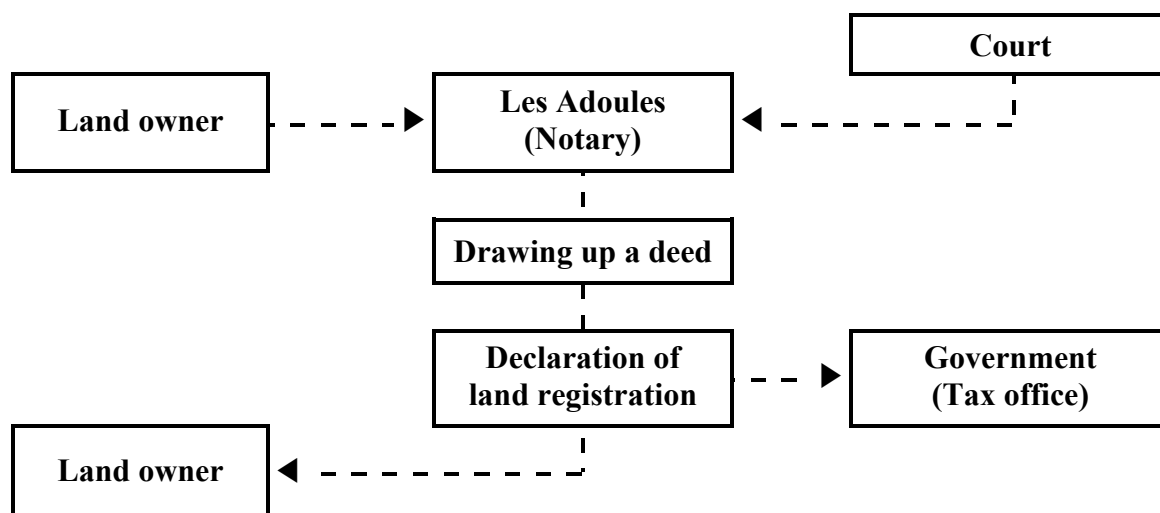
3. THE STATE OF LAND REGISTRATION IN MOROCCO AND ANALYSIS OF PROBLEMS

3.1 Land registration system in Morocco

Land registration system in Morocco is largely divided into two parts. One of them is called Mulkia which is governed by Islamic law and another is optional registration under the control of Dahir which means “Order of the king of Morocco”.

3.1.1 Customary land registration system

Under the Mulkia system, land transaction between individuals in land market should be approved by Les Adoules for coming into effects as a public trust. Les Adoules is appointed by Ministry of Justice and his/her mandates or work process is similar to Notary's.

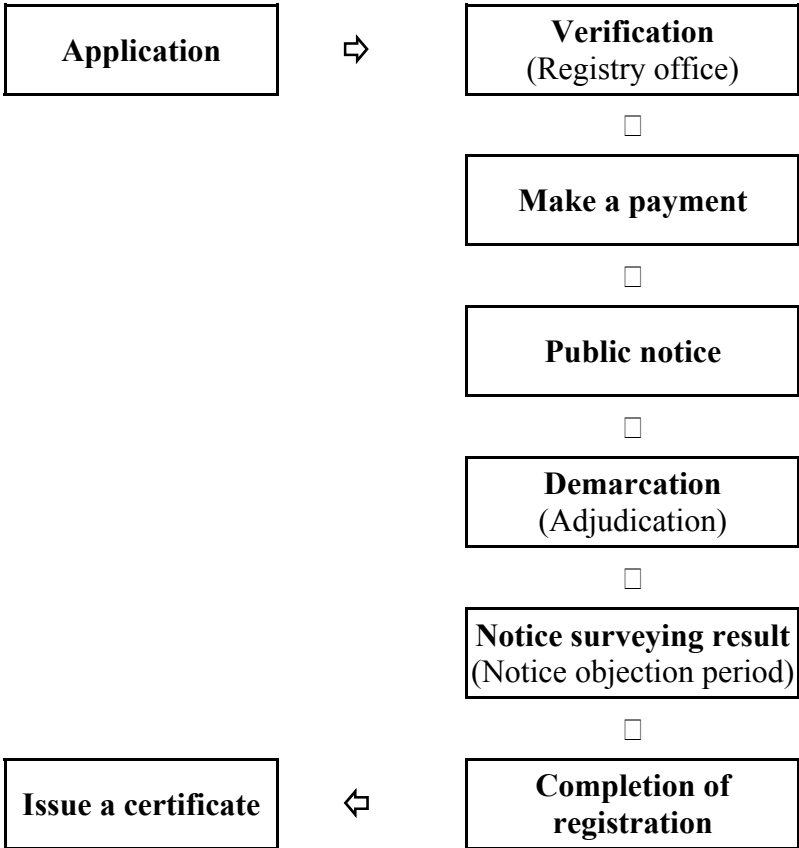


<Figure 1> Process of customary land registration

The land information registered at Land transaction office is transmitted to La Direction Générale des Impôts(Tax office) under the Ministry of Finance for making a possible to impose taxes on them.

3.1.2 Present land registration system under Dahir

Dahir enacted in 1913 is a fundamental law in Morocco for land registration. The Torrens system has been a basic principle to apply the present land registration system and the way of registration is optional except for some cases such as conveyance of national property, urban development project, special registry order from the court, etc.



<Figure 2> Land registration process

3.2 The issues of land registration in Morocco

Field surveying for land registration by the private company is performed based on the defined regulations and procedures. The surveyor's technical capacity is also generally good to be practiced.

In terms of the surveying method and technical issue, a specific problem is not found to implement land registration with a large area if input of manpower and budget are guaranteed. In terms of administrative support, the commune proves a series of surveying process as a basic administrative unit instead of being under supervision of other administrative organisations.

As a weak point, there is no an automated way of storing field surveying data which needs many post processing in the office. Each local office has its own land management system but there is no network tools to share information between local offices and local registry offices which makes inefficient work process.

In the perspective of administrative aspect Morocco has not been taking any measures to promote land registration and sticking to the optional and sporadic registration system causing a low land registration rate.

In the technical perspective, geodetic control network is not managed and used efficiently. Detailed surveying in field takes much time to explore installed or used control points making the work process delay or accumulating backlogs.

ANCFCC has a regulation on the period of completing the each step of registry process. However, the period is liable to exceed a certain amount of time since control management of backlog is not taken effectively. Moreover, an applicant for the land registration is not able to claim against delaying process with which surveyor or regarding agency is taking inactive measures

ANCFCC has been trying to promote a collective registration in an attempt to contribute to the popularization and generalization of the land registration since 2000. However, the average area per project is estimated 2,000ha and the project is implemented 20 projects a year.

Compared to the individual registration, the collective registration covers only 12%. Since about 500 surveying teams at private surveying companies are available, an estimation over how many project area could be completed within a year can be possible.

About 10 large size of private surveying companies own their aircraft used for aerial photogrammetry and produce a variety of topographic maps and perform field surveying as well. When it comes to apply aerial photogrammetry to land registration Morocco has good condition to implement the technical process.

Most of collective registrations were, however, conducted in small area basis to have slight chance of performing aerial photogrammetry. The demand of large scale of topographical map also has not requested by users to hard estimate the capacity of those companies.

4. PILOT PROJECT IN MOROCCO

4.1 Outline

The project which finds the most accurate and economical way to solve the problem faced by Morocco and the analysis of field application were conducted. As a result of research and analysis, pilot project was done from Jul. 5 2007 to Jul. 4 2008.

The pilot project area, Jouamaa, is located in Tetouan province which has 30km's distance from Tangier. Jouamaa is a rural commune which adjacent to the Mediterranean sea and the Atlantic ocean and the total area of the site is about 1,000ha.

Country	Region	Province	Commune	Area	Period
Morocco	Tangier-Tetouan	Tetouan	Jouamaa	1,000ha	Jul 2007~ Jul 2008

<Table 2> Location of the pilot project site

A cadastral surveying for land registration can be defined as the processes of determination of parcel boundary for security of land ownership and also plays a role in recording and disseminating information about the tenure, value and use of land when implementing land management policies. It is considered to include area calculation and mapping.

To implement a series of land registration, a method which can be suitable and effective to Moroccan environment was adopted. The aerial photogrammetry was introduced to register a number of boundaries in a fast way.

4.2 Plan of control points

Control network surveying was performed with RTK-GPS or Total Station based on considering distribution of control points. Two surveying teams carried out this work in accordance with the number of air targets to be installed and day of aerial photography.

Installation of ground control points aimed at defining perpendicular and horizontal coordinates and to restore boundary points in order to improve accuracy of aerial photogrammetry.

The control networks were used with existed points which were installed during the collective registration project in 2003 and the output of control points was provided by ANCFCC.

DIVISION DU CADASTRE S. T. 2943 Propriété dite : <u>Ribat Sourak</u> Réquisition N° <u>15204/1s</u> Titre : _____ Nature du Travail : <u>I. F. E.</u>		DIRECTION DU CADASTRE SERVICE DU CADASTRE DE TETOUAN <u>Liste des coordonnées des points de triangulation du Secteur d'immatriculation d'ensemble " JOUAMAA "</u>																																																																					
CROQUIS DE LEVÉ N° <u>1</u> / <u>31</u> Les stations ont été faites : _____ Chaîne N° _____ E) (au départ _____ (au retour _____ A <u>Basablanca</u> le <u>Mars</u> <u>2003</u> GELKANT - MAROC Bureau Topographique 54, Boulevard Hassan II - Casablanca Tél : 022 90 48 07 Fax : 022 90 48 05		<table border="1"> <thead> <tr> <th>N° de point</th> <th>X</th> <th>Y</th> <th>Observation</th> </tr> </thead> <tbody> <tr><td>1</td><td>479750,91</td><td>551083,29</td><td></td></tr> <tr><td>2</td><td>480286,01</td><td>551900,29</td><td></td></tr> <tr><td>3</td><td>478936,26</td><td>552892,43</td><td></td></tr> <tr><td>4</td><td>478527,66</td><td>553269,77</td><td></td></tr> <tr><td>5</td><td>478165,66</td><td>553649,60</td><td></td></tr> <tr><td>6</td><td>479149,06</td><td>554136,09</td><td></td></tr> <tr><td>7</td><td>476822,31</td><td>553394,93</td><td></td></tr> <tr><td>8</td><td>477315,83</td><td>554070,10</td><td></td></tr> <tr><td>9</td><td>477379,62</td><td>554857,79</td><td></td></tr> <tr><td>10</td><td>477027,58</td><td>555429,39</td><td></td></tr> <tr><td>11</td><td>476597,35</td><td>555918,77</td><td></td></tr> <tr><td>12</td><td>476045,90</td><td>556357,53</td><td></td></tr> <tr><td>13</td><td>476122,40</td><td>554576,91</td><td></td></tr> <tr><td>GPS 3</td><td>475328,14</td><td>558048,54</td><td>Piquet fer</td></tr> <tr><td>GPS 4</td><td>475875,92</td><td>556709,60</td><td>borne sur terrasse</td></tr> <tr><td>GPS 5</td><td>479587,87</td><td>552172,64</td><td>Corrière rasée sur une pylone électrique</td></tr> </tbody> </table>		N° de point	X	Y	Observation	1	479750,91	551083,29		2	480286,01	551900,29		3	478936,26	552892,43		4	478527,66	553269,77		5	478165,66	553649,60		6	479149,06	554136,09		7	476822,31	553394,93		8	477315,83	554070,10		9	477379,62	554857,79		10	477027,58	555429,39		11	476597,35	555918,77		12	476045,90	556357,53		13	476122,40	554576,91		GPS 3	475328,14	558048,54	Piquet fer	GPS 4	475875,92	556709,60	borne sur terrasse	GPS 5	479587,87	552172,64	Corrière rasée sur une pylone électrique
N° de point	X	Y	Observation																																																																				
1	479750,91	551083,29																																																																					
2	480286,01	551900,29																																																																					
3	478936,26	552892,43																																																																					
4	478527,66	553269,77																																																																					
5	478165,66	553649,60																																																																					
6	479149,06	554136,09																																																																					
7	476822,31	553394,93																																																																					
8	477315,83	554070,10																																																																					
9	477379,62	554857,79																																																																					
10	477027,58	555429,39																																																																					
11	476597,35	555918,77																																																																					
12	476045,90	556357,53																																																																					
13	476122,40	554576,91																																																																					
GPS 3	475328,14	558048,54	Piquet fer																																																																				
GPS 4	475875,92	556709,60	borne sur terrasse																																																																				
GPS 5	479587,87	552172,64	Corrière rasée sur une pylone électrique																																																																				
Vu { sur le terrain le _____ ou bureau le _____ Le Chef de _____																																																																							
NOTA 1° Ne pas aller le terrain 2° Inscrire au crayon de couleur dans les angles ou dans les marges les N° des croquis adjacents. N° de _____ (1) _____ / Total des _____																																																																							

<Figure 3> Output of control point in the pilot project area

Reference points were measured to verify the output and points covering the project area equally were selected. Coordinate adjustment for making the output better accuracy was performed with graphical traversing for traverse network which a sense of error in a traverse can be obtained by calculating coordinates for each point following the path of the traverse.

4.3 Aerial photogrammetry

Flight schedule had to be arranged first with the authorities since all photographic equipments including aircraft are possessed by ANCFCC. The agreement was made tentatively for taking photos in Jan.15.2008. The schedule, however, was likely to changed due to the weather condition.

The project team prepared base map with a scale of 1/25,000 to prepare flight line course while considering scale of photography, overlapping, height and the least interval of contour, weather condition and date, and so on.



<Figure 4> Flight map

4.4 Output of control point surveying

The control points which were installed during the collective registration project in 2003 were used as a reference network. 70 newly installing points were distributed evenly based on 7 stations as the reference line. Observation values were calculated by the graphical traversing for traverse network.

Standard deviation of all new points was $\pm 0.029\text{m}$ which was considered as a good tolerance in the geodetic network regulation of Morocco. This output was proven that a good result could be acquired for any purpose in spite of measuring at any point or direction.

4.5 Comparison with preregistered output

Accuracy analysis of recognizable 3,412 points on aerial photos done based on preexisted parcel's coordinates of the project area. The analysis step was to compare between the output of aerial photogrammetry and preregistered points as well. The objects of comparison were the parcel location and parcel area.

As a result of the analysis, a difference within 15cm had the biggest portion with 61.1%. In case of extending a error within 30cm, the accuracy was with 89.3%. Generally, it could be acquiring more accurate values since boundaries demarcated in building or fence are registered without aerial target. When taken into consideration that a demarcated boundary width in a rural area is normally ranged from 50cm ~ 1m, the output of aerial photogrammetry had a accuracy of 99%.

4.6 Development of cadastral management system

This project is the construction of land registration system for Morocco ANCFCC. The main purpose of this system is the establishment of the land administration & management system. The Morocco ANCFCC asked Korean government to transfer the technique and training of the land registering process. Starting with this pilot project, the Morocco ANCFCC plans to expand this land registration system to the whole country.

The purposes of this project include :

- The development of the land administration & management system for the model area (Tanger-Tetouan, Jouamaa)
- The improvement of Moroccan cadastral survey and management skill.
- Build the tie-up relationship between two counties through the successful project.

5. INVITATION OF MOROCCAN OFFICIALS FOR TRAINING

The invitation of Moroccan officials for training in Korea was conducted as a part of the project components. The invitation aimed at identifying and comparing the cadastral and registry system of two countries in that the effective or ineffective aspects of each system can be analysed. Through this training course, the officials of ANCFCC can be motivated of their system to be improved. More specifically, training of the advanced surveying technologies and visiting related organisations contribute not only to promote economic development but also to strengthen cooperative relations.

Course Title	The Program for the Establishment of Cadastral Methodology and Pilot Project in Morocco
Duration	November 27 (Tue.) ~ December 11 (Tue.), 2007
Venue	Seoul, Korea
Number of Participants	13 persons from Morocco
Training Institute	Cadastral Technology Training Institute(CTTI)
Accomodations	KOICA Training Center

<Table 3> Outline of the invitation

The planning of the program was made according to the following approach:

- The program course shall be arranged for the recipient country to promote and improve the surveying technologies required by priority.
- The course and its duration shall be arranged considering the capacity of the training institute and trainees.
- Trained staff may have an opportunity to contribute to the project.
- Monitoring for the evaluation of the program shall be strengthened.

6. CONCLUSION

In recent years, technological advances have changed the way geographic analyses are done. Increasingly, computers are used to automate aspects of cartography and remote sensing, producing data that are easily integrated into a GIS.

In terms of productivity, aerial photogrammetry can not only extract individual parcel coordinates but also to generate DEM, digital orthophoto, and topographic map considered more cost effective than ground surveying method.

The accuracy of location by image stripping and simultaneous bundle adjustment was 0.124m by means of RMSE and comparison of parcel area showed that an over 99% parcels were within a tolerance regulated in Morocco. Based on the output of the pilot project, a methodology appropriate to Moroccan context could be applied. With closing description of this section some problems and solutions have been suggested.

In the perspective of reducing time and cost, as a modern technologies, introduction of digital camera for aerial photography and direct georeferencing method using GPS/INS can reduce the working process enabling suggest an improved land registration methodology and also a digital-oriented environment can be realized.

A key concept of the pilot project is to establish an effective methodology for Moroccan land registration. Spatial information acquired by a variety of surveying methods should be guaranteed a reliability and be upgraded periodically. Aerial photogrammetry is able to meet those requirements in terms of land security and establishment of National Spatial Data Infrastructure(NSDI) as a basic geographical information. In addition, the spatial data can be used as a dissemination purpose among land related agencies and for those who need a 3-dimensional spatial analysis as well.

REFERENCES

Kim, Tae-Hoon, 2009, *A Methodology for the Improvement of ODA to Help Public Sector's Access to Overseas Market*, Korea Cadastral Surveying Corporation.

KOICA and KCSC, 2008, *Final Report of the Program for the Establishment of Cadastral Methodology and Pilot Project in Morocco*, Korea Cadastral Surveying Corporation.

Nabil BOUNAJMA, 2004, *Moroccan Cadastre: Unique Experience*, FIG Working Week 2004

BIOGRAPHICAL NOTES

Hyunjin, Kim is an assistant manager at the cadastral information business department, Korea Cadastral Survey Corporation. He graduated at Chung-Nam National University.

CONTACTS

Hyunjin, Kim
Korea Cadastral Survey Corporation
45 Yeoido-dong Yeoundungpo-gu
Seoul
The Republic of Korea
Tel. +82 2 3774 1092
Fax +82 2 3774 1229
Email: hjkim09@kcsc.co.kr
Web site: www.kcsc.co.kr