

A Guideline for Establishing Digital Cadastral Information of National Land

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Key words: National land, Numerical cadaster, Land merger, Cadaster

SUMMARY

Even though, national land is the most important resource of the country, it has been short of managing cadastral records and cadastral research. It makes problem such as land occupation without permission or using ground illegally. Therefore, disagreement between present using condition of land and land category of cadastral record reduces confidence for statistics. The reason is that changing the land category to right thing is not requirement as establishing social overhead capital (SOC), so most of cadastral arrangements are applied not by numerical method but graphical method.

The purpose of this study is managing parcels effectively and makes cadastral statistics objective analysis. Because the last goal The Cadastral Resurvey Project is to construct all of the land to register numerical cadaster, this study will be based of the cadastral resurvey. Finally, established digital information can be element to develop spatial data industry even low cost.

In this paper, after suggestion for way of arranging cadastral categories and merging to reduce small parcels, establishing the system of researching digital information of national land will be discussed. In the last, when the method is combined with The Cadastral Resurvey Project, how to create range of national land zoning and solve the problems of adjacent land parcels as technical method are analyzed.

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1. INTRODUCTION

National land is essential resources, however, department pay no attention to manage registering cadastral information. When developing public facilities in territorial works, private lands separate into some parcels and among the parcels belongs to public land. At this point, none of the belonged to public land, tiny parcels, are hard to be managed without register of record. In addition, national land is vulnerable to monitor land use and it produces enormous problems such as occupation without permission land abuse and illegal land category change.

Therefore, establishing digital cadastral Information of national land prevents primary property from cadastral discrepancy. Since most of land information can be managed and registered in digital, it facilitates development of spatial data industry

2. PROBLEMS OF THE CURRENT MANAGEMENT SYSTEM

2.1 Current status of national land

2.1.1 Variation of national land

This chapter presents the Current status of national land researched between 2008 and 2012 by cadastral annual report. This step includes gains and losses in parcels of streets and river. The moment of 2008-2012, the area of national territory has grown at an average amount of 57,537,006 and the parcels have been added 55,357 pieces of land in an average year.

The area of river increases by 779,934 m² from 2008 to 2009, by 10,247,643 m² from 2010 to 2011 and by 3,659,266 m² from 2011 to 2012, but only from 2009 to 2010, the area has reduced as of 125,407 m². On the other hands, the parcels of river continuously shot up from 2008 through 2012 and the amount of parcels reached a pike of 535,381 pieces in 2012.

		National Roads					
		2008	2009	2010	2011	2012	Average
Area	National land	2,472,133,171	2,537,954,398	2,587,400,245	2,643,936,864	2,702,281,197	
	Variation	-	65,821,227	49,445,847	56,536,619	58,344,333	57,537,006
	Private land	270,740,472	269,522,290	270,835,104	270,817,525	274,208,979	
	Variation	-	-12,181,823	1,312,814	-17,579	3,391,453	
Number of Parcels	National land	4,002,643	4,071,541	4,104,889	4,153,975	4,224,071	
	Variation	-	68,898	33,348	49,086	70,096	55,357
	Private land	1,760,019	1,762,153	1,763,360	1,763,049	1,775,020	
	Variation	-	2,134	1,207	-311	11,971	

		National Rivers					
		2008	2009	2010	2011	2012	Average
Area	National land	2,716,084,851	2,716,864,785	2,716,739,978	2,726,987,021	2,730,646,286	
	Variation	-	779,934	-125,407	10,247,643	3,659,266	-
	Private land	123,366,626	120,404,153	116,703,585	113,630,917	111,540,974	
	Variation	-	-2,962,473	-3,700,569	-3,072,667	-2,089,944	-2,956,413
Number of Parcels	National land	490,620	501,199	513,160	525,608	535,381	
	Variation	-	10,579	11,961	12,448	9,773	11,190
	Private land	203,619	200,733	197,291	191,515	189,243	
	Variation	-	-2,886	-3,442	-5,776	-2,272	3,594

Figure 1 Area and number of parcels variation

According to the Figure 1, these patterns shows the area of national land contains gains and losses for 5 years, while the parcels of national land gradually grows up every year. As a result, building streets and rivers have not included merging process from original parcels; despite cadastral division has made a negative contribution to large numbers of parcels.

2.1.2 Status of land category

This chapter presents status of land category in cadastral record of streets and rivers. The data show parcels of streets and rivers of 2,335,983 at all amount of South Korea. In Figure 2, it figures at 45 percent to the parcels whose land categories are neither streets nor rivers and errors are 32,052. It means that there is enormous discrepancy between exact land use and land category from the record accounting for 42 percent and it has an effect on cadastral statistics with low confidence at the final outcome.

Usage of land	Highway	common state road	local road	national river	state of first class river	state of second class river	
SUM	2,335,983	322,066	821,873	851,980	127,263	16,833	196,188
Except for roads and rivers	973,396	129,553	304,686	299,157	93,466	10,295	136,239
farm	194,363	25,844	62,454	62,435	27,412	1,030	15,188
rice paddy	285,312	43,070	100,531	87,893	11,387	1,955	40,476
orchard	6,307	860	1,923	2,007	393	4	1,120
ranch	1,933	423	465	749	70	9	217
forest	139,918	25,435	45,945	49,223	6,958	718	11,639
well	3	1	2				
salt pond	292	37	186	69			
lot	44,982	3,840	18,035	17,386	3,013	165	2,743
plants	2,686	374	751	1,152	76	9	324
schools	981	48	321	517	25	2	68
parking lot	202	32	68	57	14	1	30
gas station	564	52	316	157	11	2	26
warehouse	1,045	113	297	430	45	5	155
street	1,303,145	192,513	517,187	552,823	12,991	1,527	26,104
railways	5,840	569	2,727	1,352	479	30	483
river bank	52,188	1,662	4,269	5,067	17,385	3,894	19,911
river	137,292	5,868	14,532	16,828	33,797	6,338	59,929
ditch	121,233	18,109	41,440	42,208	4,903	808	13,767
fish farm	78	7	23	15	15	2	16
canal	4,648	664	2,062	1,312	357	4	249
park	426	86	129	146	13	6	46
gym	237	12	71	110	3	2	39
amusement park	124	3	27	44	1	1	48
church area	225	13	71	87	17	4	33
Historic site	37		21	10	3	1	2
cemetery	4,290	592	1,624	1,485	436	4	147
etc	11,295	1,244	3,866	3,594	934	95	1,562
error parcels	32,052	2,553	11,091	14,823	1,420	99	2,066

Figure 2 Current status of national lands

2.2 Problems of National Land

2.2.1 Surveying on graphical cadastral

Technical advancement continues to make surveying devices and computing tasks achieve a breakthrough, but the law of cadaster regulates all personal ownerships in connection with role of cadastral survey and cadastral arrangement. Therefore, cadastral survey has maintained the old fashioned way of surveying, so problems of graphical cadastral surveying have not been solved. In this situation, numerical surveying is not essential for territorial project so that project manager doesn't have to spend money for cadastral confirmation surveying before constructing road or street.

2.2.2 Discordance between land use and category

When developing public facilities in territorial works, private lands separate into some parcels and the parcels belongs to public land. At this point, none of the belonged to public land, very tiny parcels, are hard to be managed and become worthless. After all, divided parcels consist of street without changing the land category from farm, orchard, park and forest to street which is the exact category.

2.2.3 Inaccuracy of status survey for National land

The land included project area building street or river is difficult to grasp whether it is compensated or not for the land cost. These uncompensated lots are assumed over 1billion Korean won without precise statistics and it may cause enormous litigation expenses. Moreover, national lands have been occupied without permission of government and status survey for occupied national land should be made a thorough investigation.

2.2.4 Spatial data sharing infrastructure insufficiency

National property should be shared management departments, but there are lacks of infrastructure for national land linked to comprehensive management. As a result, data sharing for details of national territories, urban planning information and cadastral information is not implemented well in effect on delay of duty.

2.3 The Test Area

In order to figure out current status of cadastral arrangement, the test area is selected as River zone called Ara-Baet-Guil.



Figure 3 Ara-Baet-Guil of river zone

Despite Ara-Baet-Guil is being used for canal between Seoul and Incheon, it just divided into river zone and other zone without changing the cadastral category. The test area is composed of 5,756 parcels and only 168 parcels are named river category. The rest parcels have paddy, fields, salt pond, lots, plant lots, storage, streets, railways, embankments, a ditch, park, religious sites and cemetery. The area of parcels accounts for 5,863,007 m² and category of river' s area is only 351,066 m².

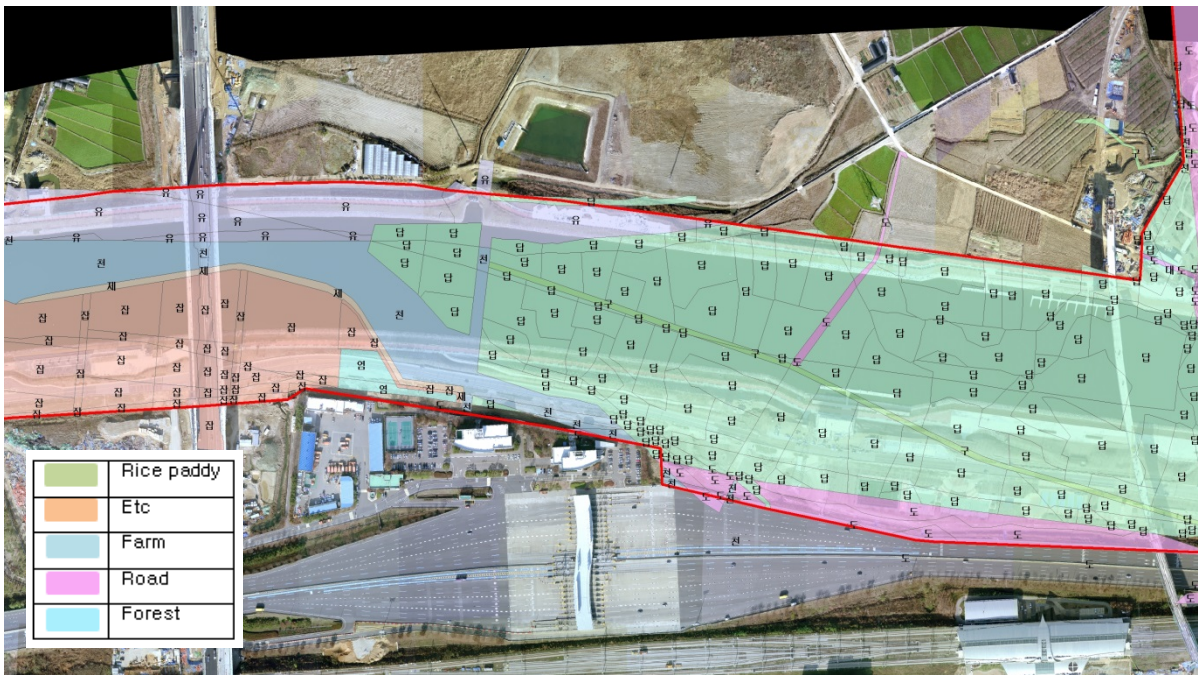


Figure 4 Status of cadastral categories in test area

The figure 4 shows categories in project area are not perfectly arranged to remain original categories after finishing the project.

3. TEST OF PARCEL ARRANGEMENT

This chapter presents simulation of parcel arrangement with the condition of merger. The test area is stream situated in Hwangnyong-myeon, Jangseong-gun, Jeollanam-do, Korea. Total amount of parcels 952 in divided region and the sort of land use is various for numerous categories without arrangement.

In cadaster system, merger means combining the different parcels each other. In order to join the lands, it is essential for the parcels to be met requirements such that soils must have equal scale, owner and land category and be adjacent to each parcel. After merging the parcels, the lands decline from 795 to 243 parcels at rate of 30 percent.

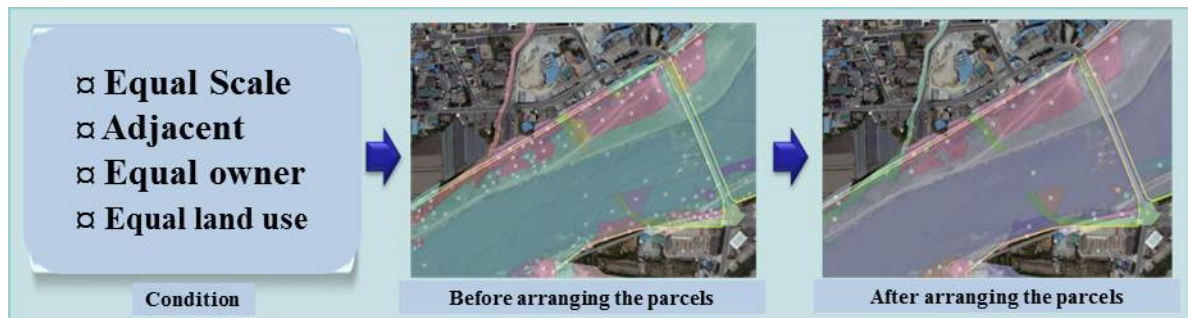


Figure 5 Experiment of annexing the river zone

Another simulation was implemented about street and the rate of reduction was 50 percent. If the rate is applied to streets and rivers over the country, 4,224,071 parcels will be reduced to 2,112,036 parcels. In the same way, the amount of parcels in rivers will be declined to 1,903,781 at the same rate.

One limitation of present study is that the limited data collected for the analysis contain inaccuracy to apply whole national territories. However, in spite of those limitations, we believe that our report had explained that parcels reduced at 60 percent will be managed more effectively and create additional tax profits to country.

4. INVESTIGATION FOR ESTABLISHING DIGITAL CADASTRAL INFORMATION OF NATIONAL LAND

4.1 Cadastral Confirmation Surveying

According to the law of cadaster, boundary confirmation surveying must be implemented and has numerical terriers in some projects as Urban Development Act and Rearrangement of Agricultural and Fishing Villages Act. Additionally, if Ministry of Land, Transport and Maritime Affairs admit the project by 24 of the Cadastral Law, the undertaker could imply confirmation survey with numerical terrier not in 11 types of development project.

For examples, both four-river project and Ara-Baet-Gil project didn't adopt boundary confirmation surveying but choose ordinary dividing surveying. The result clearly shows that project area filled with useless tiny parcels. It was found from the result that even if there was enormous amount for establishing the development, current nonnumerical cadastral system has legal difficulties.

Not every developing process in street and river can carry out confirmation surveying, but at least essential resources like road, street and some facilities should be managed digital. In addition, 7 types of SOC(transportation, spatial facilities, distribution center, cultural facilities, prevention facilities, sanitary facilities, environment facilities) as for National Land Use Law are necessary to mandate for registering numerical coordinates of boundaries.

4.2 Annexing by Right of Competent Agency

As the law of cadaster, land owner should apply for change of the land to competent agency. In case none of application, the lands should be annexed by right of competent agency after surveying and researching for the contents. Even though certain parcels are used different way from land category in cadastral record, competent agency can survey for oneself and decide land category with exact purpose.

It was explained in the previous chapter how to rearrange the parcels which are equal owner, scale and adjacent location. This brings us back to the effectiveness of managing the lands and reducing the number of parcels.

The area of annexed parcels should be sum of the parcels area, but if boundary or area of the lands is unclear, there should be boundary surveying or reconnaissance surveying. So as to make certain the land's details, it is necessary to promote enacting a law such as "If the precise boundary or coordinate of annexed land are required, cadastral survey should be needed."

4.3 Connection with Cadastral Resurvey Project

The Cadastral Resurvey Project as a national work can be connected and the budget can be spent with designated range. Because the Cadastral Resurvey Project is implemented on the zone of cadastral inconsistency where take possession of whole country at 15 percent, if streets and rivers of national land is arranged based on digital, there should be positive effects to parcels not conducted the Cadastral Resurvey Project.

5. TECHNICAL PROJECT

5.1 Error Checking

The cadastral maps were digitized 10 years ago without collecting errors in long time. For instances, there are some parcels having more than two neat lines, lying on border of different provinces and not connected each other. The sort of error types classifies four perspectives. Overlaying type is overlapped boundaries of parcels and gap type is that two boundaries are open and empty. Deflection type seems to drop as a group from original location and random pattern type means the boundaries are twisted irregularly.

In order to enhance establishing digital cadastral information of national land continuously, these errors should be collected first. However, there are plenty of errors on parcels and the collecting process would not come easy. Therefore, technical projects are essential pre-requisite to be considered that various kind of errors are arranged more systemically.

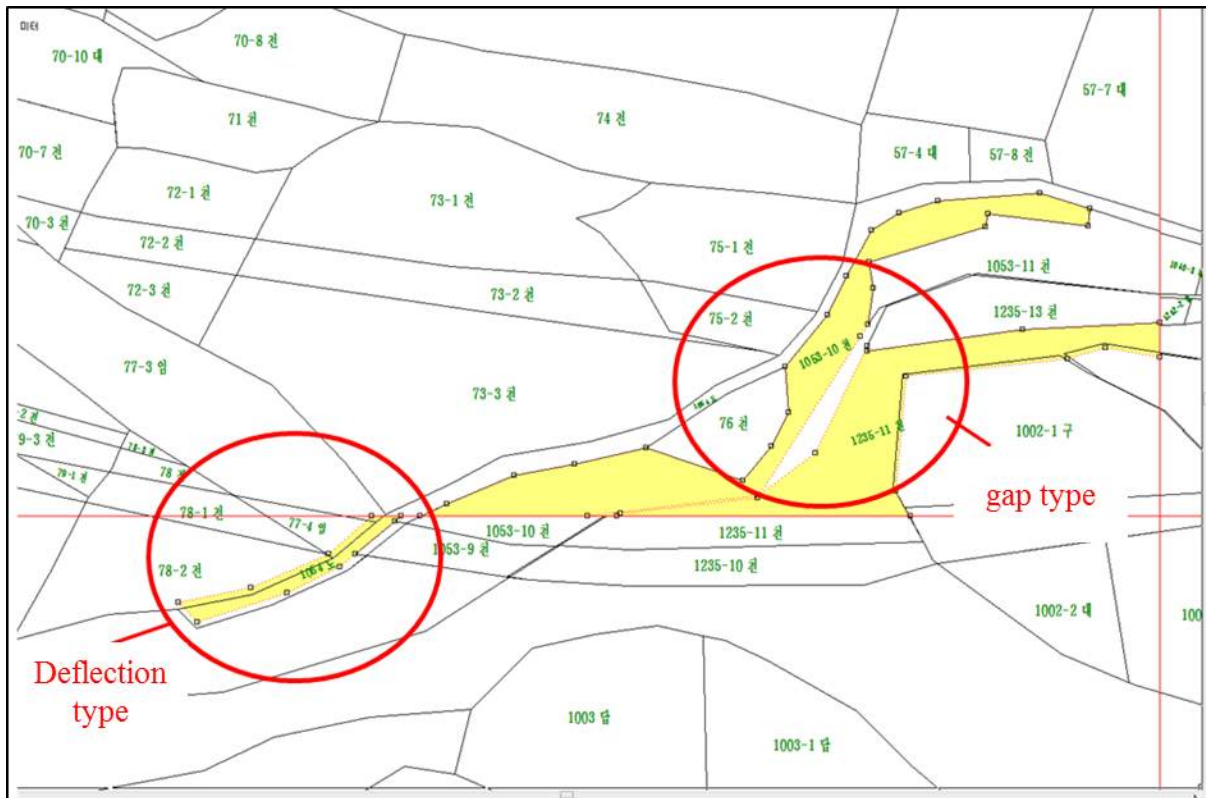


Figure 6 The type of errors

5.2 The way of Deciding Surveying Results

In graphical cadastral, the way of deciding surveying results are in two ways. One is result decided by control point and another is decided by fixed objects based on graphical map. Decision making method by control point has one result not depend on who survey the land, but decision by fixed objects depends on surveyor's opinions and experiences. For this reason, the second way have problems of distinction between surveyors and it causes conflicts of boundaries. Figure 7 shows different surveying decision between zone A and B. There are numerous occasion of decision making matters across the streets and rivers in Korea.

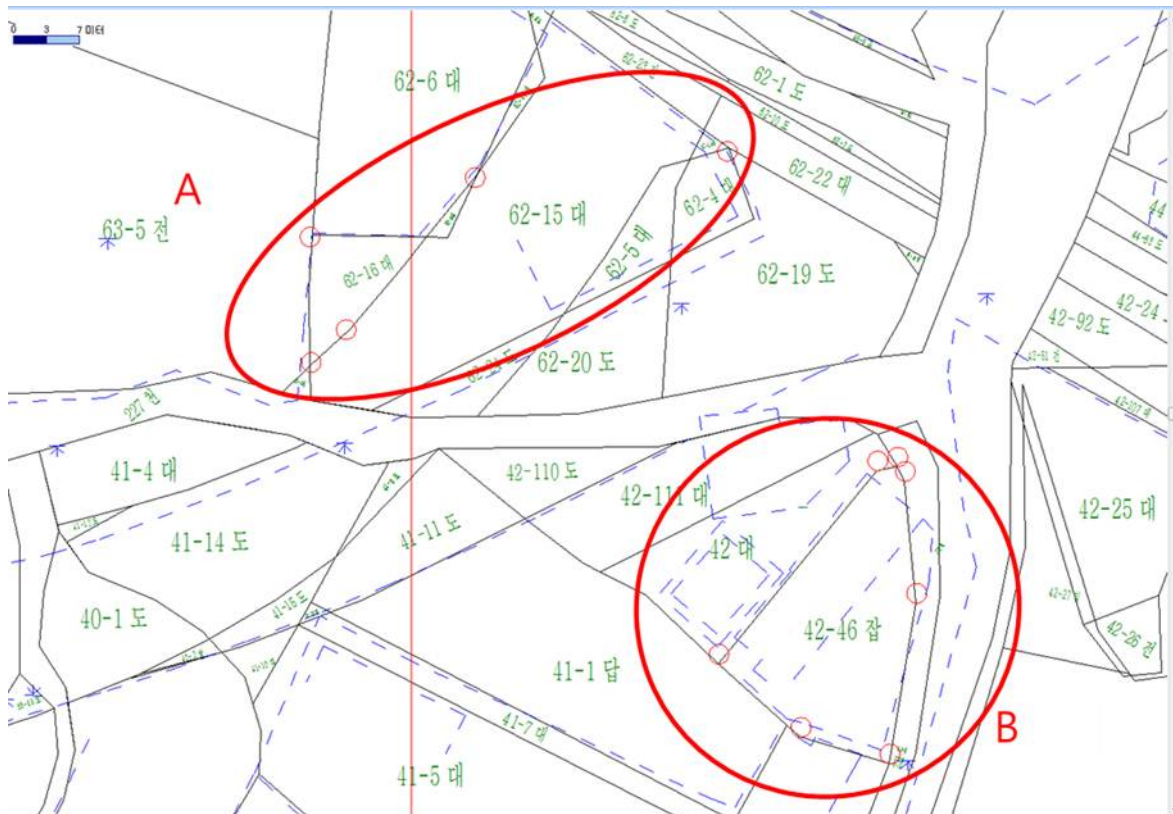


Figure 7 Decision by fixed objects

To digitalize national land of street or river, cadastral surveying decision making process should be pre-requisite around the areas. However, the areas are too long and broad to have one decision of surveying, so there are chances to exist decisions by fixed objects. After all, what is important to keep up establishing digital cadastral Information of national land project is that the way of accurate decision making matter will be needed to solve this issue.

5.3 The Amount of Achievable Project

Roads are various from narrow streets to broad highway and rivers are also various from small stream to national river. Because of limited budget and labors, it is difficult for person in charge to arrange every national property registering digital form. As a result, it is concluded that there has to be analysis process considering condition of location and arrangement and categorize the streets and rivers through the size.

5.4 Definition of Information Possible for Investigation

People use national properties illegally and these problems cause continuous issues, but none of accurate investigation is implemented now. So to speak, annual status research provides information around national facilities to manage numerical cadastral information. It will minimize the management expenses and simplify complicate administrative procedures. In order to establish the information system, it is necessary to define possible investigation for

land information and both investigation method and alternative for data construction.

6. CONCLUSION

A Guideline for Establishing Digital Cadastral Information of National Land clearly shows following effectiveness:

First, accurate cadastral information could be established by changing the management system through arranging small parcels, digitalizing and annexing the affordable streets and rivers. Second, latest land use information is provided to prepare policy of public sector and promotes effective policy making for land. Third, it is possible for competent agency to grasp lands occupied without permission of government easily and set up an action plan to compensate the lots. Finally, with managing usage of national land and facilities in digital, the departments can reduce the cost of survey the area and affect operating manpower more effectively.

In this paper, an effective method is suggested to establish national information for national facilities by collecting management system of cadastral terrier. This is because changing over from graphical map to numerical cadaster means managing every parcel more effectively. In conclusion, the managing cost can be reduced and precise national statistics can be acquired in convenience. Besides, as managing national lands and surroundings, national spatial data infrastructure (NSDI) will form the basis for vitalization and the facilities also will be managed by the system without setting up additional system.

REFERENCES

Spatial Information Research Institute, 2013, Research on the Numerical Basis for National Infrastructure

BIOGRAPHICAL NOTES

Young-Jin JUNG holds a Master degree of University of Seoul and he is in the doctoral course in Cadastral and GIS at University of Seoul also working at Spatial Information Research & Institute of LX as a researcher.

Hyun-jung HA graduated from University of Seoul studying GIS, Remote Sensing, Surveying and Photogrammetry. She is an assistant manager in Korean Cadastral Survey Corporation and also had a presentation in FIG2012 Working Week as representative of South Korea. She is an engineer both cadastral survey and information processing.

Prof. June-Hwan Koh is professor at the Department of Geoinformatics, University of Seoul, South Korea since 1996. He graduated with a Post-graduate diploma in GIS for Urban Application from ITC, The Netherlands, in 1991. He holds a PhD from University of Seoul. He is director of the Korean Society of Cadastre since 2008. He was the dean of the graduate school of Urban Sciences at University of Seoul (2011-2013) and also president of the Korea

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