Assessing the worldwide comparison of cadastral systems

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Abstract:

There is growing interest internationally in land administration and cadastral systems and especially in their role as part of a national Spatial Data Infrastructure (SDI). The important role the cadastre plays in supporting sustainable development is also well recognised. Both developed and developing countries accept the need to evaluate cadastral systems to help identify areas of improvement and whether their systems are capable of addressing future needs. Countries are continually re-engineering and implementing various aspects of the cadastre, comparing systems and trying to identify best practice within nations of the same socio-economic standing.

In order to address this need, members of a team from the Centre for Spatial Data Infrastructures and Land Administration at the Department of Geomatics, the University of Melbourne, with the support of the United Nations Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the International Federation of Surveyors (FIG), have developed a cadastral template. The template aims to assist the evaluation and benchmarking of cadastral systems and the role they play in spatial data infrastructures.

This paper aims to outline the concept and theory behind the cadastral template as well as analysing the results from 34 completed country templates. Several indicators have been used to analyse and benchmark countries cadastral systems, results of which will contribute to an improved understanding of the complex relationship between cadastral, land administration system and National SDI initiatives. This will also enable a worldwide comparison of cadastral systems, forming the basis for best practice and a tool to improve national cadastral systems.

Keywords: *cadastral systems, land administration, benchmarking*

Introduction

The use of spatial information systems as key tools in national land management and meeting sustainable development objectives is growing, but every nation uses them in

different ways. The tools are expensive in terms of financial and human resources. Sharing experiences and information is impossible unless we develop a “language of comparison”. The cadastral template project bridges this gap and provides the comparative tool, building on the work of Steudler and Williamson (2002).

The Bathurst Declaration has confirmed the powerful link between appropriate land administration and sustainable development. In doing so, it has further confirmed the gradual evolution of land administration from its cadastral, market focus to an additional facilitative role for multi-purpose spatial information infrastructures that better address the complex demands for sustainable decision-making over development of land and related resources (Williamson *et al.* 1999).

With this increased interest in land administration and cadastral systems as part of national infrastructures, there have been a number of other activities in the past to collect data and information. Many of these initiatives have previously been carried out by the International Federation of Surveyors (FIG) and the UN Economic Commission for Europe (UN-ECE) (Steudler *et al.* 2003). These studies cover a large range of different land administration issues, even though they all have their own specific objectives. As demonstrated by Lavadenz *et al.* (2002) however,

‘...despite the significant resources being invested by donor communities for modernising land administration infrastructure, there is little systematic discussion of the key elements of such a system and of what constitutes effectiveness within particular socio-economic, cultural and temporal contexts’.

The objective of the cadastral template project is to discover the basic social, conceptual and institutional context of a country's cadastral system as a whole. The project aims to identify the key cultural contexts hindering effective administration of land, as defined by Lavadenz *et al.* (2002) and researchers within the Centre for SDI and Land Administration.

Research Coordination and Collaboration

The cadastral template project is built on a collection of descriptions of national cadastral systems on a cultural as well as technical basis and makes the data publicly accessible on the internet. For this to occur, the project has relied on collaboration between the project teams at the Centre for SDIs and Land Administration at the University of Melbourne, Working Group 3 (Cadastre) of the PCGIAP and FIG Commission 7 (Cadastre and Land Management). This cooperation enabled the creation of a cadastral template that was broad enough to encapsulate the wide-ranging level of cadastral systems throughout the world, as well as being able to collect information capable of being compared and analysed.

The PCGIAP was established in 1994 with objectives pursued by four Working Groups, including WG3 – Cadastre. A major aim of WG3 of PCGIAP was to facilitate and develop discussion on a country template describing the status of cadastre and land administration. In pursuit of this aim a workshop was held in Okinawa, Japan as part of the 16th UN Regional Cartographic Conference for Asia and the Pacific in which the template was formally established under a UN mandate.

Financial support for the development of the cadastral template was gained by the Centre for SDIs and Land Administration through a competitive peer reviewed process for

funding from the Australian Government. The Centre also provides the overall coordination and facilitation of research and associated activities.

The collaborative nature of the project is also important within the wider spatial information community. Barriers to effective access to data and services are no longer technical, but cultural in nature, typically with various organisations and agencies at local, state and national levels not sharing data. Language barriers, lack of trust and ineffective institutional arrangements impede cooperation. The cadastral template project builds relationships and transparency between nations, making important cadastral information available to a wide audience and creating more effective institutional relationships between nations.

Methodology

The ability to compare cadastral systems worldwide is difficult due to the cultural, language, technical and social differences between each country. In order to aid in an assessment, the cadastral template was used as part of a survey of countries national cadastral activities. The survey aims to address three research problems including:

- development of a benchmarking framework
- an evaluation process to respond to the problem, and
- a better understanding of the relationship between land administration systems and cadastral activities.

The results of the cadastral template will enable policy makers to monitor more easily how components within cadastral systems change, in response to improvements in organizational capacity, technology and availability of and access to spatial information.

Cadastral Template Design

The cadastral template is a standardised generic proforma that enables the discovery of information, including matters concerned with member countries' land policy, laws and regulations, land tenure, land administration and cadastre, institutional arrangements, spatial data infrastructures, technology as well as human resources and capacity.

The basic principles for the design of the template were:

- it had to suit and serve the purposes of the 55 member nations of the PCGIAP, as well as of the FIG-Commission 7 member nations, which are mainly European with a few African, South American and Asian representatives;
- it had to be easy to complete;
- it had to have a simple structure, while the results should still reflect the main issues of cadastral systems;
- it had to be as short as possible because it was mainly to be filled out by senior executives; and
- it had to be simple with the questions easy to understand in order to have a satisfactory response rate.

The research team also defined four key issues that the template should endeavour to cover. These key issues were:

- to get an indication of the order of magnitude of the basic tasks in a cadastral system, i.e. how many parcels there are to survey and to register;
- to get an indication of the magnitude and problems involved in the informal occupation of land;
- to understand the role of the cadastre in Land Administration and related SDI activities, and to get an appreciation of the completeness, comprehensiveness, use and usefulness of spatial cadastral data; and
- to gain an understanding of the capacity which is in place or which should be established to support the system.

The template is available in English, Spanish and Portuguese to enable a greater number of participants. There are currently 36 nations who have completed the cadastral template (as seen in Figure 1) from Africa, the America's, the Pacific, Asia, Europe and the Middle East (there were only 34 at the time the analysis for this paper was undertaken).

Figure 1: Map of cadastral template participating nations

Structure and Content of the Cadastral Template

The template was structured in two main sections with section one being a country report, while section two was a short questionnaire. Section one of the template is a descriptive report of the national cadastral system, structured into five main topics, as described in Table 1:

A. Country Context	<ul style="list-style-type: none"> • Geographical Context • Historical Context • Current Political and Administrative Structures • Historical Outline of Cadastre
B. Institutional Framework	<ul style="list-style-type: none"> • Government Organisations • Private Sector Involvement • Professional Organisations or Associations • Licensing • Education
C. Cadastral System	<ul style="list-style-type: none"> • Purpose of Cadastral System • Types of Cadastral System • Cadastral Concept • Content of Cadastral System
D. Cadastral Mapping	<ul style="list-style-type: none"> • Cadastral Map • Example of a Cadastral Map • Role of Cadastral Layer in SDI
E. Reform Issues	<ul style="list-style-type: none"> • Cadastral Issues • Current Initiatives

Table 1 - Section one of the cadastral template: topics and sub-topics

Section two of the template is split into two parts, with part one identifying the basic cadastral principles of a country and part two outlining the main statistics of the cadastre. This includes statistics identifying the degree of land title registration in urban and rural areas and the approximate number of professionals that are active within the cadastral system, giving an indication of the efficiency of the cadastral system. Table 2 below lists the parts and questions of section two of the template.

1. Cadastral Principles	<p>1.1 Is the cadastral system based on deeds registration or title registration?</p> <p>1.2 By law, is registration of land ownership compulsory or optional?</p> <p>1.3 Comments on the actual practice and the legal consequences of the above indicated type of registration.</p> <p>1.4 Approach for the establishment of the cadastral records: systematic registration during initial establishment of the cadastre or sporadic registration?</p>
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2. Cadastral Statistics	2.1	Population of the country.
	2.2	Population distribution between urban and rural areas.
	2.3	Number of land parcels.
	2.4	Number of registered strata titles or condominium units.
	2.5	Degree of registration of land parcels in URBAN areas.
	2.6	Degree of registration of land parcels in RURAL areas.
	2.7	Number of professional land surveyors.
	2.8	Proportion of the time that these land surveyors commit for cadastral matters.
	2.9	Number of lawyers/solicitors.
	2.10	Proportion of time that these lawyers/solicitors commit for cadastral matters.

Table 2 - List of the topics and questions of section two of the template

The results from each of the cadastral templates completed on a national basis are published on a dedicated website accessible through www.cadastraltemplate.org. The website is maintained and updated on a continuous basis as country templates are returned. All of the country data is integrated into the website, on both a country by country basis, as well as in a data field format, to enable multiple comparisons of the data. Statistical data are also presented in graphical charts.

Cadastral Template Data Analysis

Analysis of the cadastral template was undertaken through the use of both statistical and descriptive results. The first section of analysis focuses on the statistical data collected (indicators 1-6) and the second part on the descriptive details of the template (indicators 7-8). The approach taken to analyse the vast and varied data was to develop a list of performance indicators that would help assess how well the cadastral systems of each country were operating in key areas. There are a wide range of options that can address the various land administration responses to the management and relationship of humans to land, and the indicators have been developed so that they can take into account the different needs of various countries at different stages of development. The indicators were also developed with the available data in mind, so they did not require additional data that was not obtained from the cadastral template. A list of the principles and associated indicators is shown in Table 3.

STATISTICAL ANALYSIS		
Principles	Indicators	
Cadastral Principles	Indicator 1: Registration Systems	Indicator 1 contains data relating to the basic principles of the cadastral system, including whether the system of registration is deeds or title based, whether registration is compulsory, optional or a mixture of the two, and what the approach for the establishment of the cadastral records is.

Cadastral Statistics: Population and Parcels	Indicator 2: Parcels vs Population Indicator 3: Strata Units Indicator 4: Percentage of Parcels Registered	Indicators 2, 3 and 4 of the analysis utilize parts of the statistical section of the country template including data relating to individual countries’ population; population distribution (% urban/rural); number of parcels; number of strata titles; and the level of registration, legal occupation and informal settlement.
Cadastral Statistics: Professionals	Indicator 5: Surveyors and Lawyers Indicator 6: Surveyors vs Lawyers	Indicators 5 and 6 relate to data on the number of professional land surveyors and lawyers or solicitors active within cadastral procedures in each country. The data obtained from the cadastral template questionnaire is the total number of professionals and the percentage of their time spent on cadastral matters or the upkeep of the land market for both surveyors and lawyers/solicitors.
DESCRIPTIVE ANALYSIS		
Educational and Professional Bodies	Indicator 7: Education and Professional Bodies	Indicator 7 relates to the level of educational activities and professional bodies within countries.
Cadastral Reform Issues and Current SDI Initiatives	Indicator 8: Cadastral Reform Issues and Current Initiatives	Indicator 8 relates to current cadastral reform issues which countries are facing. This feeds in to initiatives which are being undertaken by countries.

Table 3 – Principles and associated indicators

Results and Discussion

The presentation of the results is grouped using the indicators for the statistical and descriptive sections of the template as described above. The statistical analysis is presented first, followed by the descriptive analysis. Figures and Tables were developed to demonstrate the statistical analysis, with weighted averages used to more effectively compare countries and eliminate gross misrepresentation of data by taking into account the size of each sample. The weighted averages were generally weighted by either population or total number of parcels, depending upon the data. In some instances, country data was excluded from the weighted averages due to either extremely small or large values influencing the average significantly.

Statistical Analysis

Cadastral Principles:

Indicator 1 – Registration Systems

Table 4a shows the mixture of registration systems and registration methods for 34 countries. The same data is presented as a percentage in Table 4b. The data shows that the most common combination of registration system is where registration is compulsory

within a titles registration system, which accounts for half of the participating countries. The matrix data also shows that no matter which type of registration system (deeds or title), the most common option is for compulsory registration. There are not enough countries utilizing a mixed system of deeds and title registration for any correlations to be drawn, however the small number does suggest that this type of system is not used very widely throughout the world. The difference between the deeds and title registration systems is not as significant in modern cadastral systems as it used to be, however it is still important to recognise the difference, especially in more developing cadastral systems. The major difference between a deeds registration and title registration system is that the former involves registration of instruments (chain of deeds), while the latter involves registration of title which is guaranteed by the government. The perceived advantages of the title registration system is that it creates certainty of title, helping to encourage investment and sustainable use of land, although the deeds registration system has evolved to include aspects such as insurance, which helps to guarantee certainty. The percentage of countries utilizing a title, deeds or mixed registration system is also shown in Figure 2.

	Registration Method			
Number of countries	Compulsory	Optional	Both	Total
Deeds	5	2	1	8
Title	17	5	1	23
Mixed	1	2	0	3
Total	23	9	2	34

Table 4a - Matrix of Registration System vs. Registration Method

	Registration Method (%)			
%	Compulsory	Optional	Both	Total
Deeds	14.7	5.9	2.9	23.5
Title	50.0	14.7	2.9	67.6
Mixed	2.9	5.9	0.0	8.8
Total	67.6	26.5	5.9	100

Table 4b – Matrix of Registration System vs. Registration Method (%)

Figure 2 - Cadastral Registration Systems

Table 5a shows the mixture of registration systems and the establishment approach of each of the systems. The same data is presented as a percentage in table 5b. The tables show that the title registration system has a higher percentage of countries with all their properties already being recorded at 35% than the deeds system at 13%. This could show the effectiveness of a titles system of registration over a deeds system in the ability of a

country to record properties. The figures however do not take into account outside influences such as the prevalence of other mechanisms which support land administration and hence further investigation would be needed in this regard to clarify the data. The matrix also shows that it is very common for a deeds registration system to use a systematic approach to registration, with 71% of deeds systems that do not already have all properties recorded utilizing this approach. For a mixed registration system (using both deeds and titles registration) it is most common to use both a systematic and sporadic approach for the establishment of cadastral records. The percentages of countries utilizing each cadastral system establishment approach are shown in Figure 3.

	Systematic	Sporadic	Both	All properties recorded	Other	Total
Number of countries						
Deeds	5	1	1	1	0	8
Title	8	2	5	8	0	23
Mixed	0	0	3	0	0	3
Total	13	3	9	9	0	34

Table 5a – Matrix of Registration System vs. Establishment Approach

	Systematic	Sporadic	Both	All properties recorded	Other	Total
%						
Deeds	14.7	2.9	2.9	2.9	0	23.5
Title	23.5	5.9	14.7	23.5	0	67.6
Mixed	0.0	0.0	8.8	0.0	0	8.8
Total	38.2	8.8	26.5	26.5	0	100

Table 5a – Matrix of Registration System vs. Establishment Approach (%)

Figure 3 - Cadastral System Establishment Approach

Cadastral Statistics - Population and Parcels

Indicator 2 - Parcels vs Population

The populations of the 35 countries in the study are shown graphically in Figure 4. They range from 80,000 in Kiribati to 1.2 billion in the Peoples Republic of China (China). The average population is 97.8 million, however when the two highest (China & India) and two lowest values (Kiribati & Brunei) are excluded the average lowers to 36.6 million.

Figure 4 - Population of the countries in millions

The distribution of the population between urban and rural areas is shown graphically in Figure 5.

Figure 5 - Urban/Rural Population Distribution in the countries

As the data for the Czech Republic was not supplied, only 33 jurisdictions information is included in Figure 5. The urbanisation of the jurisdictions range from under 20% in Cambodia, a nation with high agricultural activity, to 100% in the Macao Special Administrative Region (in China), a small metropolitan area of less than 30 km². The urbanisation average value is 63.0%, however when weighted according to population this value is lowered to 55.2%.

The number of parcels in each jurisdiction varies dramatically. As would be expected the larger countries, such as China and India, have the most parcels, while the smaller jurisdictions have the least. The average number of parcels in the dataset is 34.3 million. The number of parcels per million people in each jurisdiction is shown graphically in Figure 6. The average number of parcels per million people is just under 630,000; however when this is weighted by the population of the countries, the weighted mean is just over 350,000 parcels per million, or one parcel per 2-3 persons.

Figure 6 - Number of parcels per million population

The graph shows that the range is quite evenly spread between 22,000 and 1,030,000; with three outliers (Japan, Czech Republic and Kiribati) between 1.57 and 3.75 million. Only four of the 35 countries have more parcels than people, most likely due to historical factors and the evolution of society within the country and its cadastral system.

The country with the highest ratio of parcels to people, Kiribati (3.75 parcels per person), has issues dating back to the establishment of its cadastral system that are still causing problems today. The main problem is their unique approach to dividing the land between the inhabitants. As shown in the example of their cadastral map (Figure 7) the land was

simply divided into strips, with buildings, roads and sports fields running through many parcels. The Czech Republic also has a high level of parcels per population (2.1 parcels per person); this is due to their approach of registering buildings and gardens as two separate parcels, and then combining these as a “property”. This creates the need to clearly define the terms “parcel” and “property”, explained further in Steudler *et al.* (2004). These issues are specific to Kiribati and the Czech Republic

The extremely low ratio of parcels per population in jurisdictions such as Macao and Hong Kong is predominantly due to their high population densities. The high densities indicate the existence of condominiums and apartments in these jurisdictions, and as the parcel dataset does not include strata or condominium titles the results of this ratio are misleading. In Hong Kong there are only 300,000 land parcels, but about 2 million strata or condominium units. If these strata units were included in this ratio the number of parcels per million people in Hong Kong would be just over 340,000; which is extremely close to the weighted mean of this ratio. The number of strata and condominium units for Macao was not supplied.

Figure 7: Kiribati approach to land parcelisation - Source: Kiribati Country Report (Ereata 2003)

Namibia’s ratio is also quite low; however this is not due to a high level of strata units, as Namibia has only 7000 strata units. This statistic is most likely due to their high level of informal (illegal) occupation of land, 38% in urban areas and 70% in rural areas (see indicator 4 below). As stated in the country report (Owalabi 2003), all land which is not ‘otherwise lawfully owned’ shall belong to the state. The poor economic state of the country and the culture of its people (eg. extended families living together) would also have quite a significant impact on this figure.

Fiji also has quite a low ratio value (112,500 parcels per million) which can be largely attributed to native lands being administered by the Native Land Trust Board (NLTB). As many people are residents of these vast native lands the number of parcels per person is greatly diminished. An example of the Native Land Commission

Figure 8: Native Title Parcels within Fiji - Source: Fiji Country Report (Masikerei 2003)

the register also includes assets (such as buildings, etc.) on the property. The weighted average of strata parcels per million people excluding Lithuania is 86,733.

The number of regular parcels per registered strata unit in each jurisdiction is shown graphically in Figure 10. Hong Kong and Lithuania are the two countries with the lowest ratio of regular parcels to registered strata units due to high urbanization and issuing strata titles to buildings, engineering utilities and premises respectively. Similarly, Indonesia and Nepal have the highest parcel per strata values. The weighted average of this ratio was four regular parcels per one registered strata unit. Most of the countries with strata parcel data have a ratio of between 2.5 and 20 regular parcels per registered strata unit.

Figure 10 - Regular parcels per one registered strata unit

The ratio of regular parcels to strata titles versus the level of urbanisation (%) is shown graphically in Figure 11. In this scatterplot values of less than 2.5 in the ratio were excluded for aesthetic purposes; this included Hong Kong (0.15), Lithuania (0.5), and China (1.3). An expected trend can be found from this plot, with jurisdictions having high strata to regular title ratios also having a high level of urbanisation (the percentage of persons living in urban areas). It is evident from this fact that an effective strata titling system is much more important for areas of high urbanisation, although some highly urbanised countries (such as Indonesia) are yet to fully implement strata initiatives.

Figure 11 - Scatter plot of regular parcels per strata unit: vs. urbanisation (%)

Indicator 4: Percentage of Parcels Registered

Figures 12 and 13 show a graphical representation of the percentage of parcels that are legally registered and surveyed; legally occupied, but not registered or surveyed; and informally occupied without legal title in urban (Figure 12) and rural (Figure 13) areas.

The weighted averages of these (with respect to total parcel numbers) are shown below in Table 6:

	<i>Legally registered and surveyed (%)</i>	<i>Legally occupied, but not registered or surveyed (%)</i>	<i>Informally occupied without legal title (%)</i>
<i>Urban</i>	70.3	26.6	3.1
<i>Rural</i>	70.6	22.7	6.7

Table 6 - Weighted averages of parcel registration data with respect to total parcel numbers

Table 6 shows that informal occupation of land is twice as common in rural areas as it is in urban areas. The level of legally registered and surveyed parcels is a standard 70% in both urban and rural areas. As shown in Figures 12 and 13, although the weighted average of informal occupied land is only 3-7% it is as high as 38% for urban and 70% for rural regions in Namibia. Other countries with exceptionally high levels of illegal settlement are Indonesia (60% in rural areas, 10% in urban areas), Philippines (25% urban, 5% rural), and South Africa (20% urban, 5% rural). The percentage of land legally occupied but not registered or surveyed is also quite high across both urban and rural areas at an average of 24.7%.

Figure 12 - Percentage of parcels legally registered and surveyed, legally occupied but not registered or surveyed or informally occupied without legal title in urban areas

Figure 13 - Percentage of parcels legally registered and surveyed, legally occupied but not registered or surveyed or informally occupied without legal title in rural areas

In terms of the registration and surveying of land, the nations faring the worst are Cambodia, Indonesia, Japan and Namibia. Only 10% of rural and 18% of urban parcels are legally registered and surveyed in Cambodia, which is largely due to a rebuilding phase (post Khmer Rouge) that the country is currently undertaking. Japan is another country with low levels of registration (18% urban, 46% rural) and the reason for this is unclear. Japan has the highest total number of land surveyors out of all the nations in the study (200,000+ see indicators 5 & 6); however data pertaining to the percentage of time they spend on cadastral matters was not given. The large number of surveyors may indicate an attempt to rectify the lack of legally registered and surveyed parcels; this theory is supported by the systematic approach they are taking to the establishment of cadastral records. Indonesia has a total of 20% of rural and 40% of urban parcels registered and surveyed. The reason for the low percentage of rural parcels surveyed and registered is predominantly due to the occupation of land by illegal settlers.

The nations with total coverage of their cadastral records (100% legally registered and surveyed) include Belgium, Brunei, Czech Republic, Denmark, Germany, Hungary, South Korea, the Netherlands, Sweden, and Switzerland.

Cadastral Statistics – Professionals

Indicator 5: Professionals – Surveyors and Lawyers

Indicator 5 relies on knowledge of the number of professional surveyors operating within each country. Some anomalies in the data are apparent from the extremely high value for Japan. The country report (Fukuzaki 2003) suggests that there are 201,351 professional surveyors in Japan, but does not state the percentage of time they commit to cadastral matters and there is no reason given for this large number of surveyors.

Figure 14 - Number of full-time equivalent professional land surveyors per million population

The total number of professional full time equivalent surveyors per million persons is shown in Figure 14. It would be expected that if a country has a low number of professional surveyors, it would also have a low figure per million people (Figure 14). However, although Kiribati has only five professional surveyors, they commit 100% of their time towards cadastral matters and with a population of only 80,000 have a very healthy 62.5 full time-equivalent surveyors per million. The average value from the 30 countries with sufficient data was 58, but when the average was weighted by population this value dropped to 25.5 surveyors per million.

Germany has 223 professional full time equivalent surveyors per million people, the highest of the thirty jurisdictions. A high professional surveyor ratio may be an indication that the country currently has a very strong land market. This is due to the fact that the number of surveyors needed within a cadastral system is highly dependent on the level of land transfer occurring within the system (although this should be qualified however with the fact that not all countries use re-survey on land transfer). The high ratio of surveyors could also be an indication of the set-up of the system or also a difference in how the data provider for Germany counted the number of surveyors.

Hong Kong has the lowest value once again but most likely due to the high level of strata units in the city. South Africa, the Netherlands and China also have very low surveyor ratios, which could be caused by a number of things. The cultures of the country or region must be taken into account when analysing this data. In many cultures around the world land transfer is not as common as in other cultures, and this is a strong influence in the number of land transactions being carried out. Other influential factors in land transfers and transactions are economic and political factors such as land transfer taxes. The number of surveyors needed within a cadastral system is highly dependent on the level of land transfer, as the bulk of surveyors' duties traditionally come about from transactions in some form (e.g. subdivision, etc.).

Indicator 6: Professionals – Surveyors vs. Lawyers

The number of full-time equivalent lawyers or solicitors per professional surveyor, and vice versa, is shown in Figure 15. Nine countries had insufficient data, therefore only 25 countries were included in the analysis. As can be seen below, most of the ratios are of the 1:4 to 4:1 magnitude. There are five substantial outliers in this dataset; Sweden has 20 surveyors to every lawyer, while four countries (Hong Kong, Netherlands, Malaysia, South Africa) have over 15 lawyers to every surveyor. This could be brought about through the different functions and roles that surveyors can play. In some cases, surveyors are also legally qualified and can act as lawyers, lessening the need for lawyers to undertake work within the land administration field.

Figure 15 - Ratios between professional surveyors and lawyers/solicitors

Descriptive Analysis

Educational and Professional Bodies

Indicator 7: Education and Professional Bodies

There is a lack of education for prospective cadastral surveyors in many Asian and Pacific Island jurisdictions, due to the small nature of island nations and subsequent cadastral systems. Many countries (such as Kiribati) have no formal training and must send any perspective surveyors to educational facilities in neighbouring countries. There is also no guarantee that individuals who undertake training overseas will return to work in their home country. Greater emphasis on educational capacity building is needed in the Asia and Pacific region. Universities which cater for regions rather than simply countries such as The University of the South Pacific based in Fiji could be encouraged to offer cadastral educational courses. This could be done through combined funding from the various island nations who benefit directly from the University as well as perhaps some initial funding from more powerful regional countries such as Australia and New Zealand.

Cadastral Reform Issues and Current Initiatives

Indicator 8: Cadastral Reform Issues and Current Initiatives

Cadastral systems throughout the world need to continuously change and adapt in order to meet the needs of an information society and the evolving relationship of people to

land. Indicator 8 highlights some of the cadastral reform issues that countries are facing. There are a variety of issues as would be expected amongst 35 countries, however analysis of the results shows that these issues can be grouped in line with a countries level of development.

Issues concerned with digital cadastral mapping are seen across countries with either a low development level such as Namibia or Eastern European countries which have been under some form of communist rule such as Czech Republic and Hungary. Similar countries such as Uzbekistan also face a lack of coordination in cadastral issues with different coordinating agencies for land registration and cadastral surveying causing conflict and anomalies in the countries land information systems. The major issue for such countries however is a need for capacity building, including a need for greater educational facilities, access to funding and financial support, training and re-qualification of surveyors and other staff, and better coordination of cadastral projects and initiatives.

At the next level of development, newly industrialized countries such as Indonesia and India suffer from a lack of cadastral infrastructure. This needs to be continuously built up by each country and the development of educational facilities and professional bodies will aid in this.

Well developed countries such as Australia, Japan, Switzerland and Sweden are looking at the need to create maintenance systems for their cadastral infrastructure, the importance of a comprehensive system in order to support a transparent and fair land market, and the need for international compatibility within European nations.

It is interesting to note that the cadastral issues facing poorly developed countries are the same issues which have been resolved by those more developed countries. The ability to learn from and gain an understanding of expertise and capacity building experiences from these more developed countries is one of the major outcomes of the cadastral template project.

The need to constantly re-engineer cadastral systems can be seen through the wide-ranging list of current initiatives being undertaken by various countries at all development levels. As with reform issues, the major initiatives within countries were capacity building. This includes both capacity building of Land Information Systems through the use of technology (creating online registration information and making cadastral data and maps available over the internet) and also through institutional initiatives such as increasing coordination, cooperation and communication among cadastral organisations. Many countries are also reforming land law and cadastral legislation with Namibia concentrating its reforms on low income communities in an attempt to deal with the large percentage of illegally occupied land.

Developed countries are also engaging in the re-engineering process but are broadening the role of the cadastre into a spatial environment such as a Spatial Data Infrastructure to tackle issues within the “triple bottom line” objectives (economic, environmental, social) of sustainable development.

Conclusions & Recommendations

The main objective of this paper is to analyse and present worldwide developments within cadastral systems through four key issues identified at the beginning of the paper. These key issues have been covered through the development of various indicators with the conclusions drawn from these indicators discussed above.

An indication of the order of magnitude of the basic tasks in a cadastral system was analysed, with a title registration system with compulsory registration being the most common, accounting for half the participating countries. The title registration system was also found to have the highest percentage of countries with all properties recorded (at 35%) as compared to the deeds system (13%), demonstrating the possible effectiveness of a titles system of registration over a deeds system of registration (although outside influences are not taken into account in making this assumption).

An indication of the scale of problems countries are facing in terms of informal occupation of land was also seen within the data analysed. It was found that informal occupation of land was twice as common in rural areas as it was in urban areas. Although the weighted averages of informal occupation were 3% (urban) and 7% (rural) it was found that some countries such as Namibia, Indonesia, the Phillipines and South Africa had percentages of informal occupation as high as 70% (Namibia – rural) and 25% (Phillipines – urban).

In terms of the completeness and usefulness of spatial cadastral data within countries, only 10 countries (Belgium, Brunei, Czech Republic, Denmark, Germany, Hungary, South Korea, the Netherlands, Sweden and Switzerland) had total coverage of their cadastral records. Data also showed that countries with a low level of completeness of registration had a high level of illegal occupation of land (with the exception of Japan).

Data from the cadastral template also revealed a lack of educational capacity within some nations, particularly within the Asia-Pacific region, highlighting a need for greater emphasis on educational capacity building.

The cadastral template has been created to enable policy makers to monitor more easily how cadastral developments and components change, in response to improvements in organisational capacity, technology, and availability of and access to spatial information. It will also help countries to determine which questions they should be asking in regards to reforming their systems.

Continued support of the cadastral template by the PCGIAP and FIG will extend coverage, providing a broad basis for comparing systems and for identifying best practice among the participating countries. There are however several issues which could be taken into account for future work. Additional data would have added to the ability to draw more effective conclusions from the template. This could include:

- Annual growth rates for population, parcels and professionals in order to gauge the expanding/subsiding nature of a countries land market.
- Annual number of boundary disputes, subdivisions, newly created parcels etc.
- GDP of each country to indicate the economic situation of a country.

The development of the cadastral template project has also improved the ability of nations to administer their land through an increased knowledge of best practice techniques in the development of their cadastral systems. This process extends the ability of not only those countries that are only just beginning to grapple with the huge task of effectively administering their land, but also well developed countries such as Australia, who are provided with a platform of ideas for re-engineering their cadastral systems.

The project also enables smaller, underdeveloped nations, particularly within the complex Asia and Pacific region, to share ideas and experiences in how to go about developing complex cadastral systems which meet their similar needs. Under-developed nations are also able to see the methods and processes that more developed countries have gone through in attempting to create and implement a cadastre, aiding in the formation of effective 'road-maps' for cadastral creation and reform. The research also aids in understanding the capacity building ability of a country which needs to be established to support a cadastre within the context of a wider Land Administration System and SDI.

Caveat

The data used in this paper has been collected with reasonable care and is presented in good faith. However since it was sourced from contributions from individual jurisdictions, the authors of the paper, the International Federation of Surveyors and PCGIAP take no responsibility for any errors or omissions in the data, for misinterpretations by individual jurisdictions in filling out the cadastral template or the conclusions which are drawn from the data. As a result, care must be taken in its use.

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