The Danish Digital Cadastral Map – A Tool for Land Management

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Key words: Digital cadastre, restrictions pertaining to public law, land management.

ABSTRACT

The establishments of the digital cadastral register and cadastral map are completed. The importance of the use of the cadastre to support land management has steadily increased over the last 20 years. Today the cadastral identification has become an important component for managing a number of environmental and financial acts. Furthermore, it is accepted that when cadastral information is part of integrated information systems, it can improve the efficiency of the land transfer process as well the overall land management process.

To support the overall land management process, the cadastre is extended with a number of restrictions pertaining to public law. The advantages of having restrictions pertaining to public law in the cadastre have been recognized as the most safe and simple way to register when many properties are involved.

Three new restrictions pertaining to public law are in the process being included in the cadastre, namely coastal zoning, windfall and soil contamination. These restrictions are described with regard to conditions and objectives for registration in the cadastre. The advantages of having the restrictions in the cadastre as well as the procedures for data capturing are addressed in this paper.

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1. THE DANISH CADASTRAL SYSTEM

1.1 The establishment of the cadastral system

The Danish cadastre, which derived from the results and the enclosure movement, was established in the year 1844. From the beginning the cadastre consisted of two parts: the cadastral register and the cadastral maps. Both of these components have been updated since (Enemark, p. 2, 1999).

As a result of the enclosure movement, the former feudalistic society was changed into a society based on private ownership to land. The primary purpose of the cadastre was to levy land taxes. Therefore, the parcels were numbered and recorded in the cadastral register showing parcel areas, parcel numbers, and the valuation of each property with the cadastral maps showing the location of the cadastral parcels (Enemark, p. 3, 1999).

The parcel identification was also used to support the land ownership and land transfer system. In 1845 the Land Registry System was established at the local district courts for recording and protecting legal rights of ownership, mortgages, easements and leases for land.

1.2 The process of the cadastral work

Over time the Danish cadastre has changed from being primarily a basis for land valuation to a legal cadastre supporting a land market. The National Survey and Cadastre (KMS) maintains the cadastre while private licensed surveyors carry out cadastral surveys.

When land is to be subdivided or property boundaries changed, both private and public landowner must apply by law to a private licensed surveyor for the necessary legal surveys and for the preparation of documents needed for submission of an application to KMS for updating the cadastre (Enemark, p. 4, 1999).

The application contains a copy of the cadastral map showing the alteration of the boundaries, measurement sheets showing the new boundaries, documents for legal rights, as well as necessary documentation showing the approval of the future land use according to planning regulations and land use laws. Part of the application procedure is in the process of being computerized, for details see, Gøtø, Arne; Interactive Graphic Software for Creating Cadastral Alterations (paper to be presented at FIG XXII International Congress).

Upon approval, KMS updates the cadastral register and map, and compile a notice of changes to the licensed surveyor. Simultaneously the notice of change is forwarded to the municipality for updating the property tax register, and to the local land registry office for

updating the Land Book. Deeds or mortgage may then be entered into the Land Book based on the updated cadastral identification (Enemark, p. 4, 1999).

1.3 The computerized cadastre

The cadastral register was computerized during the period 1984-86. The register includes 2.5 million parcels representing about 1.5 million properties. By the end of 1997 KMS completed the computerization of the cadastral maps. The digital cadastral register and the digital map are two different databases built on different technologies.

The basic function of the cadastre is still the same although the register and maps are computerized. However, the benefits is the multipurpose use of the digital cadastre, which increases tremendously when it is used in combination with other land data registers and maps, leading towards cadastral based GIS-systems. The concept of a modern digital cadastre therefore has to face the challenge of being an effective tool for the cadastral process of subdivisions and land transfer, as well as being an efficient tool for land management and administration (Enemark, p. 5, 1999).

The Land Book was computerized by 2000 and interaction between the cadastre and the Land Book operates very efficiently although the system is maintained and operated by different organizations. However, there is no direct link between the systems and information cannot be interchanged digitally. Furthermore, it is presently not possible to display easements, public rights and restrictions recorded in the Land Book on the digital cadastral map.

Five years after the cadastre was digitised, the users have realised the excellent possibilities of combining cadastral information with land management data. The following will focus on new initiatives in Denmark where three restrictions pertaining to public law are included in the cadastre.

2. REGISTRATION OF RESTRICTIONS PERTAINING TO PUBLIC LAW IN THE CADASTRE

The importance of the use of the cadastre to support land management has steadily increased. During the first half of 20th century the cadastral system served as a basis for managing the regulations of the Agricultural Holdings Act. During the last half to 20th century the cadastral identification has become an important component for managing a number of environmental and financial acts. In addition the cadastre provides the basic information to support many activities including the operation of the town and county planning processes, and utility administration.

The last two decades have seen moves to establish a complete computerized cadastral information system to support these growing users. It is accepted that when cadastral information is part of integrated information systems, it can improve the efficiency of the land transfer process as well the overall land management process (Enemark, p. 8, 1999).

To support the overall land management process the cadastre is extended with a number of restrictions pertaining to public law. The advantages of having restrictions pertaining to public law in the cadastre have been recognized as the most safe and simple way to register when many properties are involved. Few years ago the two most important restrictions registered in the cadastre were:

- forest conservation areas
- agricultural land designated for continued agriculture purposes

During the last few years three new restrictions have been added to the registrations in the cadastre. They are:

- coastal zoning – registration of seashores and dunes according to the Act of Nature Conservation
- windfall – financial aid for rebuilding forests after windfall
- soil contamination – registration of soil contaminated areas

2.1 Conditions for new registration in the cadastre

KMS has a number of prerequisites which have to be fulfilled before new restrictions pertaining to public law can be registered in the cadastre:

1. The restriction must be national
2. The restriction must have a legal consequence for individuals
3. The restriction must have a statutory provision
4. The order of the assignment must pay for the registration

2.2 Advantages of new registration in the cadastre

When many properties are involved it is simple and reliable to register restrictions pertaining to public law are in the cadastre. Moreover, it is an advantage that the registration is consistent for the whole country, and that the information is easy accessible for the public. The information of restrictions pertaining to public law will always be registered on the basis of up-to-date cadastral information and the information is kept up-to-date by established work processes. Thus it is easy to see accurately which properties are concerned for the authorities administrating the restrictions as well as for the public. Furthermore, the registration in the cadastre gives possibility of using information technology when data is transferred to the cadastre. The registration in the cadastre does also have other advantages when the cadastral information is linked with data from property and building databases, e.g. property valuation, GIS analysis of cases of illness caused by pollution, etc. (Buhl, 2001).

2.3 Why use the cadastre for registration of restrictions pertaining to public law?

It is not mere a coincidence that the cadastre is chosen for registration of restrictions to public law. The reasons are many, e.g.:

- the digital cadastral map is the only national map in large scale
- the digital cadastral map is the only map with automatic linkage between other databases containing property and building data. The linkage is achieved through the cross reference register[1]
- the digital cadastral map is the only map which continuously is kept up-to-date
- the digital cadastral map is used by all counties and 93% of municipalities in Denmark. In addition the map is used in several government offices
- other restrictions pertaining to public law are registered in the cadastre and there are benefits of having them together
- the methods and work procedures for updating the cadastral map and register are firmly established in KMS and by private licensed surveyors

2.4 Examples of registration of restrictions pertaining to public law

2.4.1 Procedure for registration of windfall areas

In December 1999 and January 2000, storms of hurricane-strength hit Denmark. Large areas, especially of even-aged spruce forest, were completely decimated, but the storms also caused considerable damage to all species, including the deciduous forests. The windfall amounted to 3.5 million cubic metres of timber, corresponding to two years of annual felling for the country as a whole but up to 10–20 years of felling in the hardest hit areas.

To aid forest owners, the Danish Parliament passed the Floods and Windfall Act, which allows financial support to be given for cleaning up after the windfall and for planting new and more robust forest.

A precondition for the support is that the forest owner insures himself against similar catastrophes in the future and that the new forest has to be planted in such a manner that it is better able to withstand high wind speeds.

The only viable approach to undertake the registration of windfall areas was through the cadastre. The Ministry of Economic and Business Affairs has the overall responsibility and the registration is performed in conjunction with of Ministry of Environment and the local forest branches. Windfall areas are registered on the property unit, and it is therefore only necessary to undertake the registration in the cadastral register. Thus windfall areas are not automatically visible on the cadastral map. The registration information is forwarded to the local district courts to be registered in the Land Book.

[1] The Danish concept for integrated land management is organized as a network of interactive subsystems containing the information that are used very often. The automatic linkage between the subsystems is achieved by establishing the cross-reference register. It contains all key identifications within each subsystem, (e.g. the parcel number, the building number, the street address, etc.) and the cross-reference between these identifications. It is possible to obtain all available information on a specific property or building by knowing only on of the keys.

The registration ensures that:

- a complete registration of areas where The Ministry of Economic and Business Affairs contributed financially to the windfall
- the windfall areas are registered as forest conservation areas
- the information is accessible both in the cadastre and the Land Book

2.4.2 Procedure for registration of coastal zoning areas

The coastal area has for many years been protected by a 100-meter zone. Within this area it is not allowed to construct buildings without special permission. The zone was in 1994 extended to a 300-meter zone and it was decided to determine and map the zone line. The task would have been manageable if the line had to be determined 300-meter parallel to the seashore but existing towns, cities, dwellings, agricultural buildings had to be excluded from being zoned. Furthermore, the cadastral map does not include the "correct" shoreline, because the line constantly changes as a result of the influence from current and wind. Obviously it is not possible to keep the shoreline updated. Therefore it was an enormous task to determine approximately 7000 km costal zone line.

The Danish Parliament passed changes to the Nature and Conservation Act making provision for registration of the costal zoning in the cadastre. The Ministry of Environment in cooperation with KMS prepared a proposal for a combination of utilising orthophoto and the digital cadastral map.

The procedure for determination and mapping of the costal zone line:

- the Costal Zone Commission proposes the costal zone line based on the orthophotos
- the proposal is sent for public hearings and individuals are informed by mail
- the Minister of Environmental Affairs determines the costal zone line based on recommendations from the Costal Zone Commission
- KMS updates the cadastre and the Minister promulgates the line
- the local land registries, municipalities and local forest branches are informed by KMS

The coastal zoning areas are visualised on the cadastral map as well as the information can be shown on the WEB version of the cadastral map.

2.4.3 Procedure for registration of soil contaminated areas

Factories, farmers, fruit growers and petrol stations have over decades contaminated the ground with chemicals and pesticides from cleaning spray machinery, bury of barrels containing toxicated left over from production, etc. The environmental authorities have in many cases not been aware of the magnitude of the contamination as well as being unaware of the exact location of the contaminated areas.

The environmental authorities have to assist in the prevention, elimination, or reduction of soil contamination and to hinder the detrimental impact of soil contamination on

groundwater, human health, and the environment. Consequently, it was decided in January 2000 to register and map all soil contaminated areas.

Counties in cooperation with municipalities were tasked to identify contaminated areas and forward the information to KMS for registration. It is often difficult to define accurately where the soil is contaminated and in some cases the authorities can only presume a site to be contaminated. Therefore, two types of registration are performed depending on the knowledge of the extent of the contamination on the parcel.

1. In cases where soil contamination cannot be defined precise, it is registered as a "V1-registration". The V1-registration is made on the full parcel both in the cadastral register and on the cadastral map.
2. In cases where soil contamination can be defined precise, it is registered as a "V2-registration". The V2-registration is made on the area contaminated, which can be the full or a part of the parcel. The registration is made both in the cadastral register and on the cadastral map.

KMS uses two different signatures for V1 and V2 on the cadastral map and the information can be visualised on the WEB version of the cadastral map. KMS informs the local land registries and municipalities of the registrations and the Land Book and the property tax register are updated respectively.

3. RESTRICTIONS PERTAINING TO PUBLIC LAW REQUIRED FOR LAND MANAGEMENT PURPOSES

The system of planning control is based on the principle of framework control, in which any plan must not contradict the planning decisions at higher levels. The counties are responsible for regional planning with emphasis on the regional infrastructure and the sectoral interests of the countryside. The municipalities are responsible for municipal planning with emphasis on the local issues and the function and development of urban areas (Enemark, p. 9, 1999).

The planning control is supported by sectoral land use acts, which the counties and municipalities administrate. Moreover, the planning control system is supported by updated information from the cadastral register and map, the property tax register, building and dwelling register, etc. (Enemark, p. 10, 1999).

The total concept of land management is illustrated below:

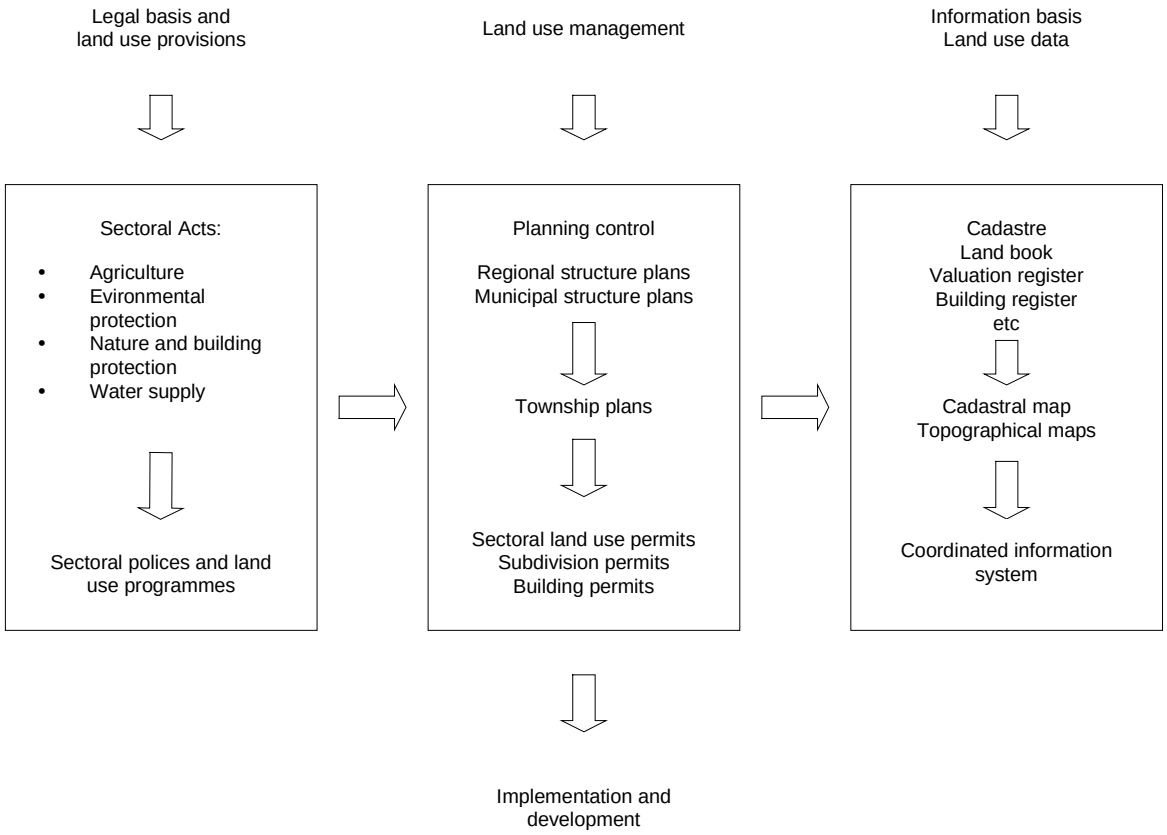

Fig. 1. The concept of land management (based on Enemark, 1999).

It is obvious that having restrictions pertaining to public law as an integrated part of the cadastral register and map has many advantages for land management and land administration, e.g. it:

- supports general land administration by providing land-related information in an integrated form
- supports land taxation by having easy access to land use information
- supports land transfer
- shows the legal situation of land including public rights and restrictions
- offers easy access for the public and private sector and not at least to the private citizen, who can get the information through the Internet

The development in Denmark integrating restrictions to public law in the cadastre is a firm step in the direction of creation a multipurpose cadastre. However, there is still much information needed to produce information that satisfies the users' needs. Most of this information is available in an analogue format, and it not accessible digitally. This includes:

- spatial registration of public rights and restrictions in land, e.g. servitudes, building limitation zones, etc.
- regional and municipal structure plans

- town planning schemes
- unambiguous geo-coding of buildings in order to create a link between the building register and the cadastral map

Whether such information should become integrated in the cadastre will depend on the pros and cons, needs and expense. If a decision is made to continue creation of a multipurpose cadastre, it will however take considerable time to make the information digitally available.

4. CONCLUSION

To integrate the new restrictions pertaining to public law in the cadastre has been a major challenge to the Ministry of Environment, counties, municipalities and KMS. However, the real challenge will be to make the advanced information accessible to a wide range of users. Obviously KMS sees the Internet as the main vehicle for distributing such information. It requires that the Internet services are accessible in an open standardised way allowing utilisation by Internet providers. Based on the Open GIS Consortium standards, KMS offers access to cadastral and topographical products through "KMS Map Supply".

Another major challenge for KMS is to abolish the separation between the cadastral map and register. Specifications for the integration are considered by KMS and can be implemented in near future. Logically the next step would be to abolish the separation between the cadastre and the Land Book. However, for the time being this is wishful thinking.

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BIOGRAPHICAL NOTES

Søren Christensen

Background:

- M. Sc. in geodesy, cadastral science and planning, University of Aalborg, Denmark
- Licensed to conduct cadastral surveys in Denmark
- Licensed to conduct cadastral surveys in Namibia
- Member of the Danish Association of Chartered Surveyors and newly appointed member of FIG Commission 7

Brief career history:

1998 -	Principal, National Survey and Cadastre, Denmark Responsibilities: Project manager on different national and international projects
1992 – 1998	Adviser to the Ministry of Lands, Resettlement and Rehabilitation – Department of Surveying and Mapping – Namibia Responsibilities: Design of a land registration system for urban informal settlements and development of the national survey organisation
1990 – 1992	Surveyor European Storebælt Group Responsibilities: Hydrographical survey and processing, land survey and setting out
1986 – 1990	Charted land surveyor in two different private survey companies Responsibilities: Cadastral survey, land survey and survey of gas pipes.