

# **Cadastral, Land Information Systems and Planning - is decentralisation a significant key to sustainable development?**

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**Presented at the UN-FIG Conference on Land Tenure and Cadastral  
Infrastructures for Sustainable Development, Melbourne, Australia  
25-27 October 1999**

## **ABSTRACT**

The paper presents an overall framework for understanding the role of the cadastre in facilitating an efficient land market as well as an effective land-use administration. The Nordic way in this area is illustrated and some recent developments in the use of multi-purpose cadastral systems as support for land-use management are presented. Finally, the paper deals with the issue of decentralisation and the impact of central vs local government in efficient land-use planning in support of sustainable development.

*Keywords and phrases: Cadastral Systems; Land Administration; Land Use Planning; Decentralisation; Sustainability.*

## **INTRODUCTION**

The last decade has seen moves towards establishment of fully digitised cadastral systems throughout the world. It is recognised that cadastral systems are not ends in themselves. It is also recognised that digital cadastral systems must be tailored to facilitate an efficient land market as well as effective land-use administration and thereby, more generally, promote economic development, social cohesion and sustainable development. Cadastral systems must serve a multi-purpose use and thereby meet the challenge of a modern GIS and IT environment.

The paper presents a vision for the role of the cadastre in a global land management perspective. The cadastre is seen as the basic infrastructure for providing economic, social and environmental benefits. This cadastral infrastructure will permeate through the land administration and land management systems. The paper will present a number of examples to illustrate this multi-purpose use.

It is recognised that it is difficult if not impossible to conceive a multi-purpose cadastre without fully understanding the cultural and judicial system of which it is an

integral part and which it serves. The paper therefore also discusses the issue of establishing appropriate institutional and organisational infrastructures as a crucial key for achieving sustainability in any society. In this regard decentralisation is seen as a significant key to sustainable development.

## **THE ROLE OF THE CADASTRE**

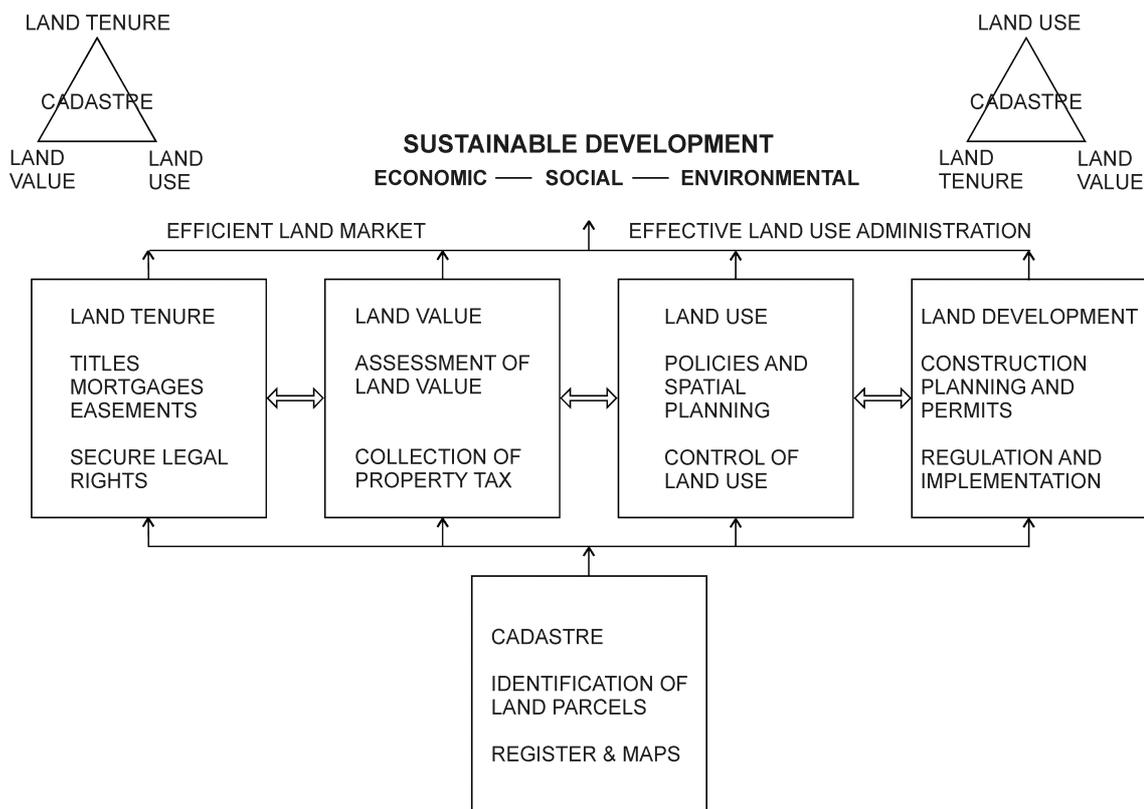
The International Federation of Surveyors (FIG, 1995) defines a cadastre as a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (valuation and taxation), legal purposes (conveyancing), to assist in the management of land and land-use planning (planning and administration), and enables sustainable development and environmental improvement.

The cadastral infrastructure includes a unique identification of the land parcels deriving from the cadastral surveys. The cadastral identification is then seen as the core component of any land information system. It is argued that within the next ten years such land information systems will form an integral part of a model of our man made and natural environment. The model will build on the core cadastral and topographic data sets which will be complete on a country wide basis and kept up-to-date. The focus will be on providing land information to the mass market to support the land market, financial and business sectors, environmental management, land administration, urban systems and community information systems (Williamson, 1997).

A vision for the future role of the cadastre in a global land management perspective should reflect this scenario of IT development. This means that the cadastral systems must provide adequate information on the land parcels to be presented in a variety of interfaces. The design and maintenance of cadastral systems must reflect this multi-purpose use.

A cadastral vision of the future, as presented in the UN Bogor Declaration 1996, is to: “develop modern cadastral infrastructures that facilitate efficient land and property markets, protect the land rights of all, and support long term sustainable development and land management”.

In Figure 1, the cadastral system is seen as the basic infrastructure to support the different systems in the area of land management.



THE ROLE OF THE CADASTRE  
TO FACILITATE AN EFFICIENT LAND MARKET AND EFFECTIVE LAND USE ADMINISTRATION

*Figure 1*

The systems supported by the cadastral infrastructure are:

- Land Tenure System, to secure legal rights in land such as titles, mortgage and easements
- Land Value System, to assess the value of land and properties and to levy land taxes
- Land-Use Control System, to enable comprehensive and detailed land use planning
- Land Development System, to enable regulation and implementation in change of land use.

These systems are interrelated. The actual economic and physical use of land and properties influences the land value. The land value is also influenced by the possible future use of land as determined through zoning and land-use planning regulations. And the land-use planning and policies will, of course, determine and regulate the future land development.

The design of adequate systems in the area of Land Tenure and Land Value should lead to the establishment of an efficient land market; and the design of adequate systems in the areas of Land-Use Control and Land Development should lead to an effective land-use administration. The combination of an efficient land market and an

effective land-use administration should then form the basis for a sustainable approach to economic, social and environmental development.

The cadastral identification of land parcels permeates through the land administration and land management systems and provides the basic infrastructure for running the interrelated systems within the areas of Land Tenure, Land Value, and Land Use. As a result, the traditional surveying, mapping and land registration focus have moved away from being primarily provider-driven to now being clearly user-driven. However, each of those systems includes tasks and processes that impose quite different demands on the cadastral system. The success of a cadastral system is a function of how well it achieves these broad social and economic objectives

Even though the cadastral systems are now clearly user-driven, it must be argued that within a country/jurisdiction there can be only one cadastral system and only one cadastral map providing the basic infrastructure. This means that the design of the cadastral system can not be determined by only one of the users e.g. the Land Registry. The cadastral system should be designed for serving all users, and their requirements for cadastral products should be carefully considered. By taking this global approach to land management the cadastral system must be able to serve all kind of cadastral information ranging from a scale of 1:1 to a scale of 1:25,000.

To face this problem it must be understood that the origin and main objective of cadastral systems historically has been to identify the land parcels for the purpose of levying land taxes and/or securing legal and economic rights to land. The cadastral process thus is focused on the relative accuracy between the parcel boundaries. However, today some users such as local authorities and the utilities will see the absolute accuracy as necessary in order to combine the legal property features in the cadastral map with the spatial features in the large-scale topographic map. The tension between the relative and absolute accuracy of the boundaries may therefore be seen as the main problem of establishing multi-purpose cadastral systems. The relative accuracy must be maintained for legal reasons while an absolute accuracy should be obtained for the reasons of multi-purpose use (Enemark, 1998*a*).

This problem may be and has been dealt with in different ways depending on the origin and judicial setting of the cadastral system. However, in this paper the main argument is that the organisation of the systems should reflect the global land management approach as described in Figure 1 above. The multi-purpose use of the cadastral system will not be achieved by only improving the digital cadastral information to a very high absolute accuracy. Some issues/problems may be more adequately addressed by adjusting the legal or institutional approach e.g. in the land registration process or in the process of land-use planning.

In conclusion, the role of the cadastre has changed from a purely legal and fiscal use to a more managerial and global use aiming to serve the mass market as well as political aims on sustainability within in a modern IT-based society.

## **THE NORDIC WAY**

Cadastral systems have a long history in the Nordic countries. Historically the purpose of the cadastre was to collect land taxes. Today the cadastre has a much broader objective, and it is accepted that when cadastral information is a part of

integrated information systems, it can improve the efficiency of the land transfer process as well as the overall process of land management.

The structure of the cadastral systems, however, varies between the Nordic countries according to the cultural and judicial setting of the individual country. (Enemark, 1998b). The Norwegian cadastral system is presently being revised. A new cadastral law is under preparation to come into force by the year 2001/2002. As a result of the new law the Danish and Norwegian systems are now coming closer together, just like the systems in Sweden and Finland are rooted in the same tradition. However, as a common trend in all the Nordic countries there is a development towards a multipurpose use of computerised cadastral information through interactive GIS-systems and through the Internet.

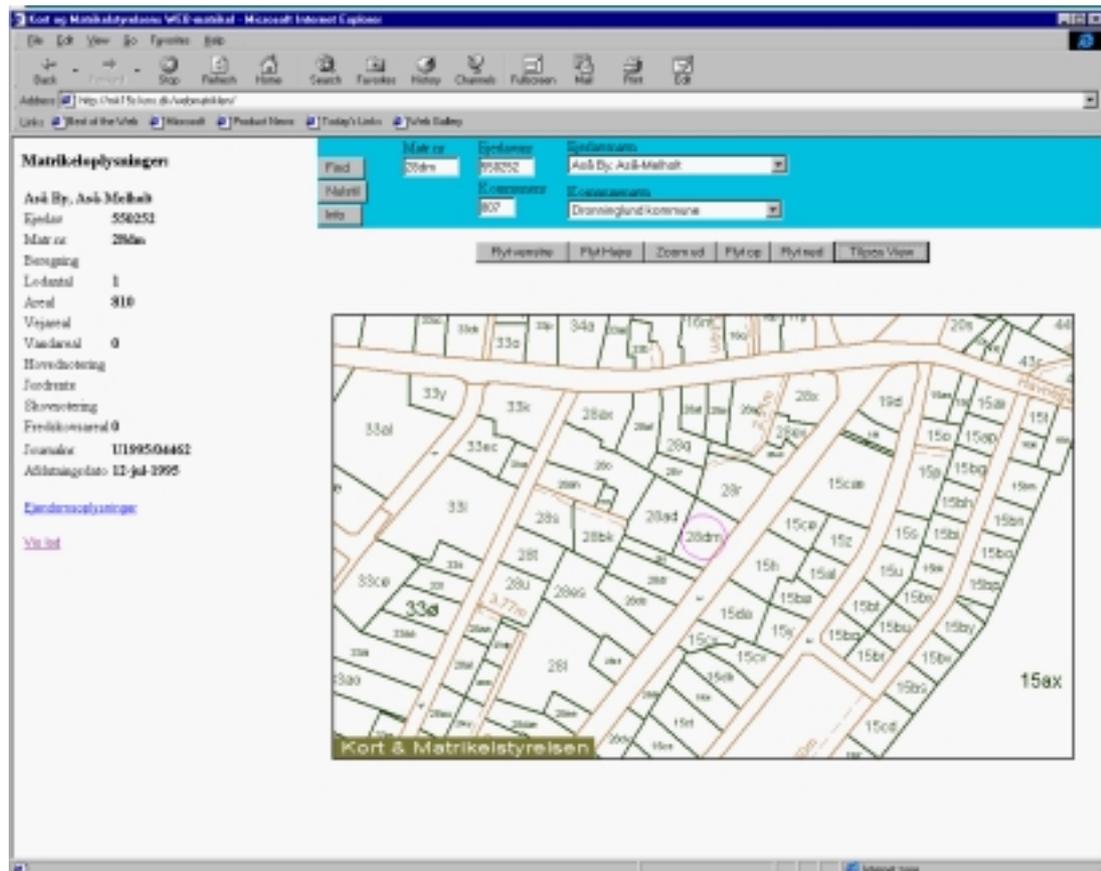


Figure 3. The Danish cadastral information system on the Internet. The textual information is presented on the left side of the screen by pointing on the relevant property (circled) in the map or by asking for this property by cadastral number or address. Zoom facilities etc. is available as well.

## A GLOBAL LAND MANAGEMENT APPROACH

Throughout the world, the cadastral concept has developed significantly over the past few decades. During this time these systems, whether developed from a land market or a land taxation perspective, have increasingly played a multi-purpose role. The most recent examples are current world concerns of environmental management, sustainable development and social justice. Due to this, multi-purpose cadastres are increasingly seen as fundamental to economic development, environmental management and social stability in both the developed and developing worlds

(Williamson and Ting 1999). The paper describes the cumulative evolution of the humankind/land relationship and the consequent developments in the evolution of cadastres and the function of cadastres towards a global land management approach. The Danish experience in this regard is presented below.

### **The Danish evolution**

The Danish cadastre, which derived from the results of the enclosure movement, was established in the year 1844. The main purpose was the collection of land taxes from the agricultural holdings based on a valuation of the yielding capacity of the soil.

From the beginning the cadastre consisted of two parts: the cadastral register and the cadastral maps. Both of these components have been updated continually ever since. As a result, the cadastre was also used to support the land ownership and land transfer system. The Land Registry System was established in 1845 at the local district courts for recording and protecting legal rights of ownership, mortgage and easements.

In the late 1800's the cadastre changed from being a fiscal cadastre primarily as a basis for land valuation and taxation to a legal cadastre supporting a growing land market. This evolution was completed in the first years of the 1900's when taxation became based on the market value. Simultaneously, in the 1920's a new Land Book System was established. The new system was based on the cadastral identification and a close interaction between the two systems was established.

During the first half of the 1900's land was increasingly seen as a commodity and the focus was on agricultural production and industrial revolution. Land-use regulations were introduced to improve agricultural productivity and at the same time sustain the social living conditions in the rural areas. These regulations were based on the cadastral information. The yielding valuation unit was used to control development in the rural areas until the late 1960's. Historically the cadastre, this way, has been very closely connected to the agricultural policies. This is underlined by the fact that the Cadastre was the responsibility of the Ministry of Agriculture until the late 1980's when it was moved to the Ministry of Housing.

The 1960's introduced a close interaction between the cadastral process (e.g. subdivision) and the relevant land-use regulations. Any property formation or change of property boundaries must include the necessary documentation showing the approval of the future land use according to relevant planning regulations and land-use laws. The cadastral process performed by the private land surveyors this way must include a pre-approval of the future land use.

An administrative reform was adopted in the early 1970's to reorganise regional and local administration. The reform reduced the number of counties from 25 to 14 and the number of local authorities from almost 1,400 to 275. The reorganisation created the basis for transferring a number of responsibilities and decision-making power to the counties and especially to the municipal councils by means of decentralisation. Each authority levies taxes (income and land taxes) and the elected councillors are responsible for utilising the revenue. Today, the local authorities administer more than 50 % of the total public expenditure.

Land was increasingly seen as a community scarce resource and zoning and planning regulations were introduced to control land development. Environmental concerns appeared in the late 1970's and have developed to be the major issue through recent years. Today, comprehensive planning and environmental protection is seen as the main tools to secure sustainable development. Cadastral information based on the modern IT-opportunities has evolved to support these processes of sustainable land management. A few examples of this multi-purpose use are given below.

### The GIS Concept

The Danish concept for integrated land management is organised as a network of interactive subsystems containing the most relevant information. The cadastral register was computerised during the period 1984-86. The Land Registry will be computerised before the end of 1999. The computerisation of the old analogue cadastral maps was ongoing for about ten years and was completed by the end of 1997. The remaining components of the system have been computerised for a number of years. The system is illustrated in Figure 4.

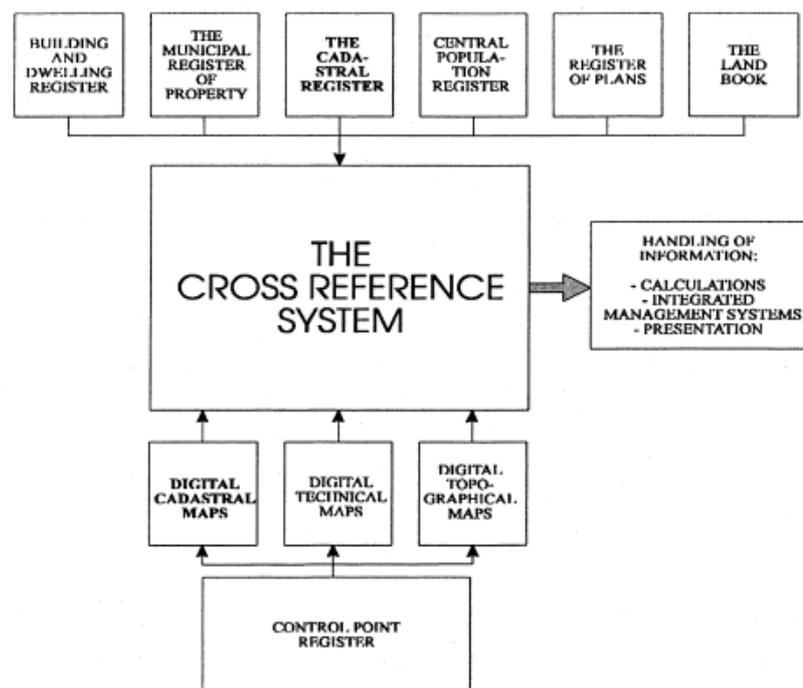


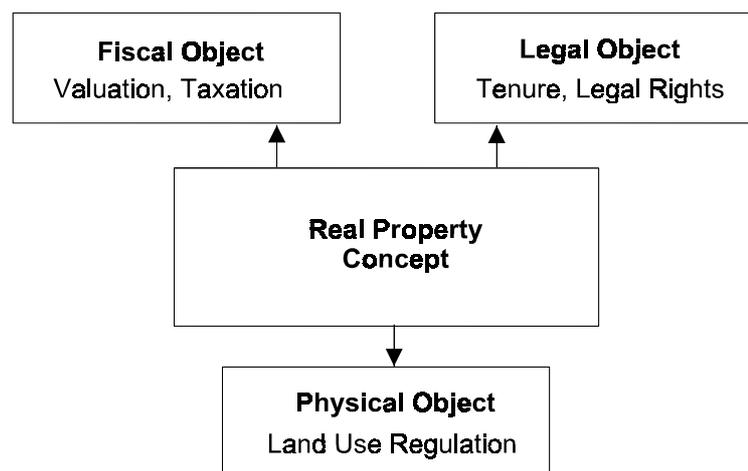
Figure 4. The Danish GIS concept for land and property data. The system includes a number of interactive subsystems linked together through the Cross Reference Register

The automatic linkage between the subsystems is achieved by establishing the ACross Reference Register, which contains all key identifications within each of the subsystems (e.g. the parcel number, the building number, the address, etc.) and the cross-reference between these identifications. This means that it is possible to obtain all available information on a specific property or building by knowing only one of the keys. Furthermore, the identification-keys are linked into the relevant physical element represented in the digital maps, e.g. the parcel, the building, etc.

The main feature of this concept is that the daily running of the individual subsystems should, whenever possible, be decentralised and the maintenance should rely on an integration of the data-collection within the administrative routines. The responsibility for the vitalisation of the systems should rest with those (custodians) who need the data and therefore care for the updating procedures and the applications as a part of their daily administrative routines. The digital cadastral system is designed for application into this GIS-concept, and the benefits for improving the process of land management should be obvious. (Enemark, 1994)

### **The Real Property Concept**

The Danish Cadastre is not only a registration of the land parcels. The cadastre also identifies the individual real properties. A real property may consist of just one land parcel/ cadastral number or it may consist of several land parcels. The real property concept is a legal definition in the Cadastral Law saying that a real property must be owned and mortgaged as one legal unit. The real property unit is an asset that includes the land as identified in the cadastre as well as the buildings on the land. The real property concept, this way, enables control of land as both a legal, fiscal and physical object. This is illustrated in Figure 5.



*Figure 5. The real property concept enables control of land as both a legal, fiscal and physical object*

Land as a fiscal object is addressed through public valuation as a basis for levying land tax at regional and local level. Public valuation is based on statistics of the actual sales prices in combination with information about the actual land use (from the Building and Dwelling Register) and information about the land-use opportunities and restrictions (from the Register of Plans). A countrywide valuation is carried out every four years. In between the valuation is updated yearly.

Land as a legal object is addressed through the Land Book system based on the cadastral identification. The Land Registry Law provides security of legal rights to land such as ownership, mortgage, easements, leases etc., when these rights are entered in the Land Book. The real property is the legal entity of the Land Book. Consequently, the legal rights will encompass the total property (except for easements) and the rights appear in the order of priority deriving from the day of entry. This order of priority is also the basis for fulfilment of mortgages through e.g.

a forced sale. The Land Book is open to public inspection and the information is now available in an on-line digital format. The real property concept this way provides security and order regarding the legal rights to land.

Land as a physical object is addressed through the land-use provisions provided in the planning regulations and sectoral land-use laws. In this regard, the land parcels may be seen as physical entities and the properties as legal entities consisting of one or more land parcels. The real property concept enables that land-use and planning regulations can be imposed on the land parcels as a legal means to be respected by owners and users of the properties. For example, the Agricultural Holdings Act requires that all farmland be operated in accordance with agricultural and environmental considerations. This duty applies to two thirds of Denmark's land. The duty appears through the registration of farmland as agricultural properties in the cadastral register. The duty then simply applies to all properties registered as agricultural holdings. Other examples could be zoning, building density or environmental regulations applying to the use of land and properties in certain areas.

### **The Planning Concept**

The system of Planning Control is based on the principle of framework control, in which plans must not contradict the planning decisions at higher levels. The county councils carry out regional planning with emphasis on the regional infrastructure and the sectoral interests of the countryside. The municipal councils are responsible for municipal planning with emphasis on the local issues and the function and development of the urban areas. The municipal councils are also responsible for the legally binding detailed planning of specific neighbourhood areas, and for the granting of building permits that serve as a final control-point in the system. The Minister for the Environment can influence the planning at regional and local levels through, national planning directives and public information (Enemark, 1999).

The system of planning control is supported by a number of the sectoral land-use acts such as the Agricultural Holdings Act, the Environmental Protection Act, and the Nature Protection Act. The sectoral land-use provisions are managed by the county and municipal authorities on the basis of sectoral land-use programmes that also form the basis for comprehensive planning at regional and local level.

Furthermore, the system of planning control is supported by appropriate and updated Land-Use Data Systems, such as the Cadastral Register, the Land Book, and the Building and Dwelling Register. These registers are organised to form a network of integrated subsystems and are connected to the cadastral and topographic maps. The total land-use management concept is presented in Figure 6.

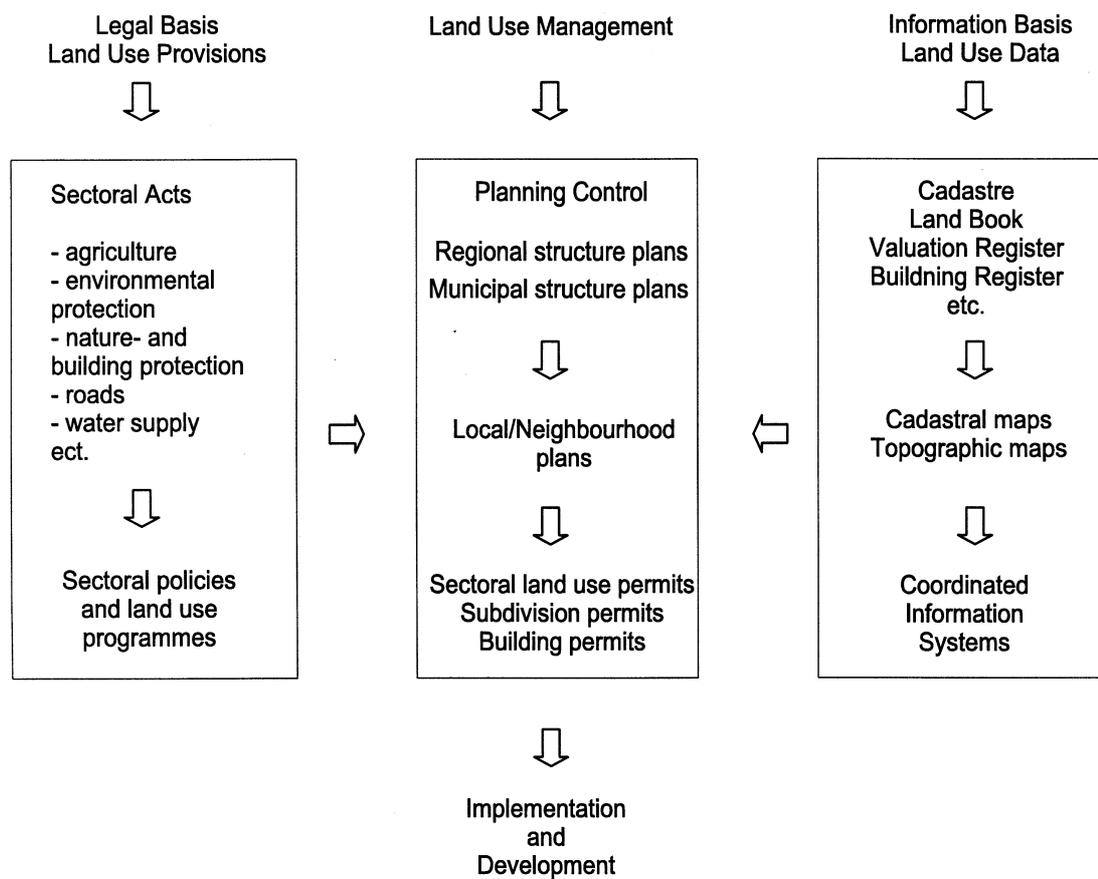


Figure 6. The Danish Concept for Land Use Management

The cadastre is increasingly used as a basic instrument in the planning process. Some local authorities use the cadastre map as the basic layer in the municipal structure planning. This digital process provides a number of opportunities. The land-use regulations are easily identified on the relevant properties with links to the addresses and name of the owners. The detailed regulations such as zoning and building restrictions can be identified on the relevant properties and located according to the property boundaries. This facility is also used when presenting the planning regulations on the Internet. The citizens can then achieve any relevant planning information just by asking for the specific property.

It is recognised that the cadastre can support the process of land-use management in many ways, and a number of uses have developed through recent years. Examples include areas such as identification of forest declarations, identification of the coastal zone protection line (in principle 300 metres from the coastline) and administration of development proposals within this protection zone. Other examples are the identification of all land-use restrictions imposed by the public such as development restrictions connected to the protection of specific natural features, identification of urban and rural zoning areas, and of local planning areas (Hvidegaard, 1998). The digital cadastral map is fulfilling a multi-purpose use.

To repeat, the cadastral system is serving not only the process of cadastral management and security of land rights. It is also providing a multi-purpose use and facilitates a global approach to land management through an efficient interaction between the areas of land tenure, land value, and land use. The information in these areas is increasingly available for the mass market through Web-based information systems.

## **DECENTRALISATION AND SUSTAINABILITY**

A global approach to land management, as presented above, depends on appropriate structures of governance. In this regard, the issue of decentralisation may be seen as a significant key to achieving the general aim of sustainable development.

Decentralisation of land-use planning and decision-making immediately raise the question of suitable local institutions and organisations for managing these tasks. Such local institutions and organisations must be able to handle conflicts in a very concrete and direct sense. In the context of sustainability, the conflict between immediate gains and needs on one hand, and the concern of future generations on the other, is of course crucial. This relates to the core content of the term “sustainable development” defined as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission, 1987).

In the Nordic setting, and many other places around the world, the obvious local arena for land-use planning and decision-making has been the commune - the municipality. The concept of decentralisation has developed through the 1900's. A breakthrough, as described above in the case of Denmark, was achieved in the early 1970's by implementing the reform of local governance. The objective of this reform was to establish local authorities being sustainable in a political and economical sense and being able to manage an increasing number of tasks transferred from the national to the local level.

This movement of decentralisation was based on democratic ideals or conceptions such as to establish a local representative democracy comprising a decentralised comprehensive approach to local self-government and a local modernised unitary administration. These ideals developed in society through the second half of the 1900's and they are still developing. Today, the conceptions regarding local self-government are directed more towards expectations of prosperity and performance of balanced control towards sustainable development in a local as well as global sense. For example, it is politically understood that environmental problems can only be solved by involving/mobilising the local people.

### **Subsidiarity**

The principle of subsidiarity is useful in considering the role of central and local government in land-use management for sustainability. Subsidiarity governs the distribution of competencies between jurisdictional levels in federal countries and is also used in the allocation of competencies between the national, regional and local level. The general principle is that competencies should rest with the lowest possible level of jurisdiction.

This principle is well known in the economic literature and has recently been formally adopted by the European Commission. Such decentralised provision, it is argued, will produce not only more efficient service through making better use of local knowledge, but it will also lead to greater participation and democracy, increased popular consent to government, and hence improved political stability. It should also produce increased resource mobilisation and reduced strain on central finances, greater accountability, and more responsive and responsible government in general. Therefore, it is not surprising that many countries have seen decentralisation in and of itself to be intrinsically valuable (Bird, 1994).

Another argument is, that whatever outcome may emerge from a decentralised system of decision-making it must be assumed to be the right decisions in relation to local needs. Decentralisation thus institutionalise the participation of those affected by the local decisions. This argument is particularly valid in the area of land-use decision-making and administration. Land-use planning this way becomes an integrated part of local politics within the framework of plans and policies provided at regional and national level.

In the Nordic setting, the decentralised model is based on a cultural tradition which strives for a broad political and social consensus. The concept of decentralisation comprises a precise and finely tuned relationship between a strong national authority and autonomous county and municipal councils, based on a series of laws that establish which decisions are to be delegated. The purpose is to solve the tasks at the lowest possible level so as to combine responsibility for decision making with accountability for financial and environmental consequences (Enemark, 1999).

However, the distribution of competencies between national, regional and local level will vary depending on governmental structures and the capacity and maturity of institutions at different levels. This is particularly important in the case of countries in transition. Strict adherence to the ideal of local decision making may be counter-productive as important competencies were decentralised to regional and local government institutions before they were operating effectively (Nadin, 1999).

### **Sustainability**

Environmental sustainability requires action at all jurisdictional levels. There are obvious global and transboundary environmental issues that need to be addressed at the international and national level. It is also generally agreed that the search for solutions to unsustainability should be concentrated at the regional and local level. This includes the complex task of policy integration through local decision making.

Central government is of course responsible for providing guidance and control within the various sectoral policy areas such as transport, housing, nature protection etc. This includes a number of potential conflicts since the policies may contradict in a way that can hardly be solved only at national level. However, in the case of Denmark, the strict sectoral traditions of handling their own affairs are now increasingly being influenced by a more integrated and environmentally sound approach. A number of action plans have been launched for providing sustainability for sectors such as energy, transport, tourism, and agriculture.

Using the Danish example, sectoral policies are implemented in different ways. Some areas such as pollution control, agriculture and nature and heritage protection are mainly implemented through vertical connection, by setting standards and regulations at national level to be administered at regional or local level. Other areas, such as transport and energy, provide a rather firm framework at national level to be further detailed through sectoral and comprehensive planning at regional and local level. Finally, areas such as housing, the environment, nature and resource management, tourism and economic development are organised by fulfilling the overall national policies through efforts of comprehensive planning based on regional and local considerations and needs.

The impact of central versus local government in support of sustainable development is a mix of vertical connections where each sectoral policy is implemented by a top-down approach; and horizontal connections where the different sectoral policy areas are balanced on the same level through comprehensive spatial planning. A sustainable approach to land use management is achieved through the planning system where plans must not contradict decision at higher levels. This principle of framework control ensures, in principle, that the regional and local decision making will be in conformity with overall national policies.

The means to make this system work are monitoring, dialogue and the national power of vetoing a proposal for a regional structure plan or a local/neighbourhood plan. The means of veto is replacing national adoption of the plans. To facilitate the planning process and to avoid the use of veto, a comprehensive national report is prepared prior to every four-year revision of the regional plans. The report presents the current preconditions for managing the national aims and objectives within specific and topical policy areas. Through this report, national interest are considered, discussed and dealt with prior to the process of revising the plans every four years. A national veto can also be imposed against a local/neighbourhood plan when national interests are at stake. The means of monitoring, dialogue and veto, work this way to achieve a sustainable balance between the three levels of administration.

### **The research agenda**

As stated in the introduction, the issue of establishing appropriate institutional and organisational infrastructures is seen as a crucial key for achieving sustainability in any society.

In a theoretical sense, “institutions are the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction” (North, 1990). Institutions are the formal and informal rules, norms and standards guiding human choices and behaviour. It also includes implementation aspects such as enforcement mechanisms. Agencies, organisations and persons are actors. North uses the analogy of a football match. The institutions are the rules of the game; the teams and players are the actors.

Property right is such an institution in society and the cadastre plays a most important role to make the institution of real property right work by facilitating and

reducing the costs in a variety of transactions such as land transfers, land taxation and control of land use and land development.

To understand and eventually improve "the land use game" at local level in a sustainable sense, the institution of real property right and the actors with their legal base in that institution should be included in the model. Over the last decade, there have been some huge world-wide efforts in various social sciences in this direction. The most fruitful approaches have been made across traditional disciplines, by names like "common property theory", "collective action", "development studies", etc. See (Agrawal and Yadama 1997) for an example.

The main focus in these studies is whether local communities are able to develop and maintain adequate institutions (and organisations) in response to external and internal pressure on scarce resources. This is of course neither a new nor a pioneering question. However, the point in this paper is about the extensive body of microlevel, empirical knowledge produced in this field over the last decade. Even if such empirical studies must be related to specific societies in time and space, a few more general points can be made:

- Local communities are able to make adequate responses to resource pressure. This is proved by a huge number of empirical studies. The "tragedy of the commons" is not a necessary outcome.
- The relationship between central and local levels is important; political responsibility and financial accountability must be combined at each level; local institutional development is a response to policies at central level.
- Local institutions matter; peoples' behaviour patterns are framed more by local than central institutions. Policies and actions devised at central levels are mediated through local community institutions.
- Monitoring is important. Without efficient monitoring of the conditions of the resources in question, no actions can be taken either on central or on local levels. According to context, access to information of this kind must be readily available and affordable, and the local level should be involved in the monitoring process. The emphasis on monitoring has a very direct implication for the design of adequate land information systems based on the cadastral identification.

These empirical efforts are still in the phase of assembling and massing up knowledge and insights in a rather theoretical sense. The insights somehow have to be made operational by taking the step from "know-how" to "do-how". It is a major challenge for the surveying profession to contribute in this process.

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