Local Spatial Data Infrastructure, a Solid Base for Sustainable Land Management in Germany

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SUMMARY

Following the spatial dimension of land, a working spatial data infrastructure has the potential to support land management substantially by providing very valuable spatial information. In Europe, SDI implementation currently takes place at all different levels of public administration. Due to an enormous amount of heterogeneous widespread spatial information distributed among many involved parties local SDI's face a number of specific challenges. In this article a case study from Germany is presented to illustrate the various tasks of local SDI implementation for the purpose of sustainable land management. Organizational, legal, functional and technical aspects are addressed; solutions developed within the federal political system of Germany are described and evaluated.

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1. INTRODUCTION

By nature, land is a limited resource and, therefore, may be subject to many conflicts and competitions. That is why land use has to be planned, managed and controlled with care. Major current challenges like climate change, rapid urbanization, ongoing population growth, to name a few, require inter- and transdisciplinary cooperation. Spatial information in an appropriate form, accurate, reliable, up to date and ready to use is urgently needed to meet the requirements of sector-based planning and spatial integration, of monitoring changes over time and so on.

A well-defined and implemented Spatial Data Infrastructure provides all tools needed for appropriate spatial information processing. Many ongoing initiatives and projects both at the supranational and the national level pursue the objective of implementing such Spatial Data Infrastructures. Decisions concerning land use often have to address small pieces of land. That is why spatial information has to be available at a very high spatial resolution level. Many high resolution spatial data typically are available at the lowest levels of public administration. Public administration structures, therefore, widely interfere with SDI implementation issues.

In the following sections a case study of Germany will be presented to show ways of implementation of an appropriate spatial information base for sustainable land management in a federal political system. Organisational, legislative, functional and technical aspects will be discussed particularly at the local SDI level to be in line with land management related requirements.

2. SUSTAINABLE LAND MANAGEMENT AND SPATIAL DATA INFRASTRUCTURES

2.1 Sustainable Land Management

Man interacts with nature by different forms of land use. Humans are transforming their environment continuously by changing the functionality of land, typically by modifying the natural environment into built environment such as settlements, agriculture or pasture. The land structure resulting from such processes reflects society and culture. In the capitalist system of land use, land property and its use is highly significant. The process of land parcellation yields marked land parcels or plots, pieces of land, which can be legally operated, sold or developed (Vancutsem, 2008).

Interfering demands on land generate complex conflicts and synergy options (see Figure 1). A wide variety of actors is involved, mutual interactions and interconnections exist, governance is organised at multiple levels, institutional frameworks are heterogeneous and diverse, territorial challenges are different. In this context complex problems have to be solved to maintain or to regain sustainability of land use. A good understanding of underlying structures and ongoing procedures is needed to improve the capabilities for development and implementation of new strategic approaches to handle land and soil in a sustainable way.

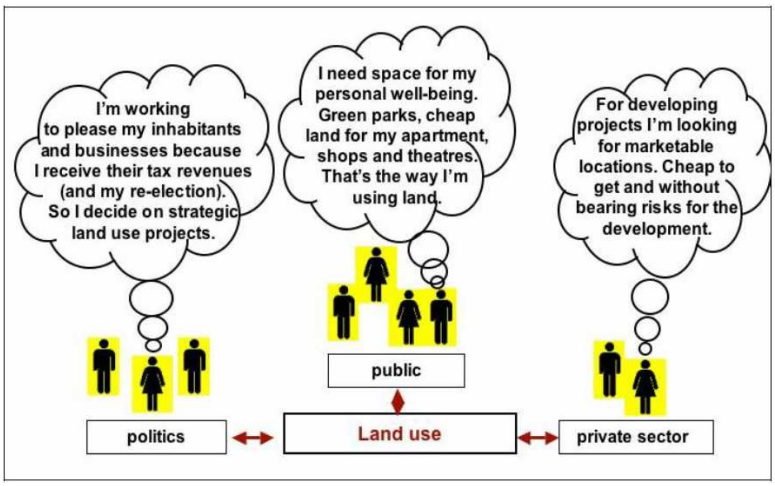

Figure 1: Demands on land (Source: Rubitzki and Vancutsem, 2009, p20)

Therefore, a proper land use management system is indispensable for coordinating spatial, sector-oriented and temporary aspects of rural and urban policy. The system has to support the debate of policy-making, strategic and operational sector-based planning, spatial integration of sectoral issues, decision making, budgeting, implementation of plans and decisions and the monitoring of results and evaluation of impacts. To be able to meet this challenge in a sustainable way land management decisions rely on basic knowledge, on relevant strategies for action as well as on suitable technologies and system solutions (BMBF, 2008).

In 2008, the German Federal Ministry of Education and Research, BMBF started a research programme for fostering innovative theoretical, methodological and conceptual approaches of spatial governance towards sustainability concentrating on the main themes (Weith et al., 2010)

- *targets of / in land use*
- *drivers of land use change (actors, interests, resources)*
- *complex regional interactions between current land use as well as land use options*
- *synergies and conflicts in land use*
- *sustainable solutions in land use (including models)*
- *land management / governance and technologies / land use policy.*

Land use planning is one of the most important instruments of land use management. At the basic level, land use planning organises the zoning areas, the transport infrastructure, and can be used for economical, demographical, social and environmental and other purposes. By nature, spatially related decisions have to be taken at a solid base of reliable spatial information. In the following section it will be discussed in which way a well-established Spatial Data Infrastructure can provide the needed base of information.

2.2 Spatial Data Infrastructures

The aim of spatial data infrastructures (SDI) is to provide standardised data and services to a network of spatial-data-users from science, companies, government and general public to solve the problems regarding availability, quality, organization, access and sharing of spatial information. SDIs are developed all over the world, in Europe (INSPIRE), in several countries (for example Germany: GDI-DE), and in local government.

Global, national and local SDIs have to comply with different guidelines. The most important guideline in Europe is the INSPIRE directive (Directive 2007/2/EC of the European Parliament and of the council of 14 march 2007 establishing an Infrastructure for Spatial Information in the European Community). Spatial information, which is necessary for protecting and monitoring the environment, has to be collected.

INSPIRE is based on some principles: data should be collected only once and be kept where it can be maintained most effectively; spatial information should be combined seamlessly within all scales from different sources across Europe; geographic information should be easy to find, use and share with other users (European Union, 2007).

A set of formalities is required to ensure that spatial data infrastructures are compatible and usable in a transboundary community. Stakeholders are all public authorities, even at a communal level, that are responsible for a part of these datasets. To organize the implementation of INSPIRE in Europe there are guidelines available for metadata, data content and monitoring as well as technical standards for services.

The following list contains the thirty-four themes INSPIRE is organized in, sorted in three appendices (“Annex”). Data sets from communal administration are printed in bold (Klein 2010).

Annex I:
Coordinate reference systems, Geographical grid systems, **Geographical names**, **Administrative units**, **Addresses**, Cadastral parcels, **Transport networks**, **Hydrography**, **Protected sites**

Annex II:
Elevation, **Land cover**, Orthoimagery, Geology

Annex III:
Statistical units, **Buildings**, Soil, **Land use**, **Human health and safety**, **Utility and governmental services**, **Environmental monitoring Facilities**, **Production and industrial facilities**, **Agricultural and aquaculture facilities**, **Population distribution and demography**, **Area management/restriction/regulation zones & reporting units**, **Natural risk zones**, Atmospheric conditions, Meteorological geographical features, Oceanographic geographical features, Sea regions, Bio-geographical regions, **Habitats and biotopes**, **Species distribution**, Energy Resources, Mineral Resources.

Public authorities that hold data sets regarding to one of these themes have the following duties and responsibilities:

- identify relevant data sets,
- describing them with metadata to make them findable,
- transform them to the INSPIRE data model to make them interoperable,
- publish the transformed data sets in discovery, view and download services to make them usable for others,
- monitor the implementation and use.

The national SDIs are part of the European SDI. They have to ensure the implementation of the INSPIRE directive. Besides, each European Country has its own legislation and its own SDI with technical components for publishing and searching Spatial Information in a defined organisational structure (European Union, 2007).

Because of the federal organisation of Germany each of the sixteen federal states has its own laws. Local governances also have own SDIs, each of them part of the next level SDI.
As a result the German SDI is a nested SDI containing 12.320 communes, 301 local governances, sixteen states and is in their entirety part of the European SDI.

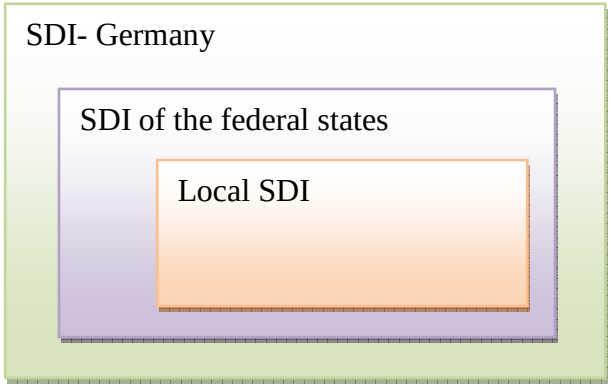

Figure 2: SDI Hierarchy in Germany, (Source: GDI-DE 2010, p9)

2.3 Local Spatial Data and Spatial Planning

Planning always means interaction and land use concurrences between nature and mankind. For a sustainable planning the view on the planning area therefore has to be holistically. Spatial data infrastructures are delivering information for sustainable spatial planning. Geographical information systems, using data from SDI, can help answering questions, identifying problems or simulating different scenarios (Burrough, 1993).

Two examples are given below:

One of the first things to know in a spatial planning process is about the current land use in the planning area. Spatial information about boundaries, ownership structures and land use are necessary. This data is produced by the official real estate cadastre and is provided in the SDI. Data for nearly 150 different forms of land use is available. By merging the land use classes into categories, for example Living, Industry, Traffic and Recreation, it is possible to see which kind of land use category exists at which part of the communal area (see figure 3). This allows identifying possible land use concurrences before start planning.

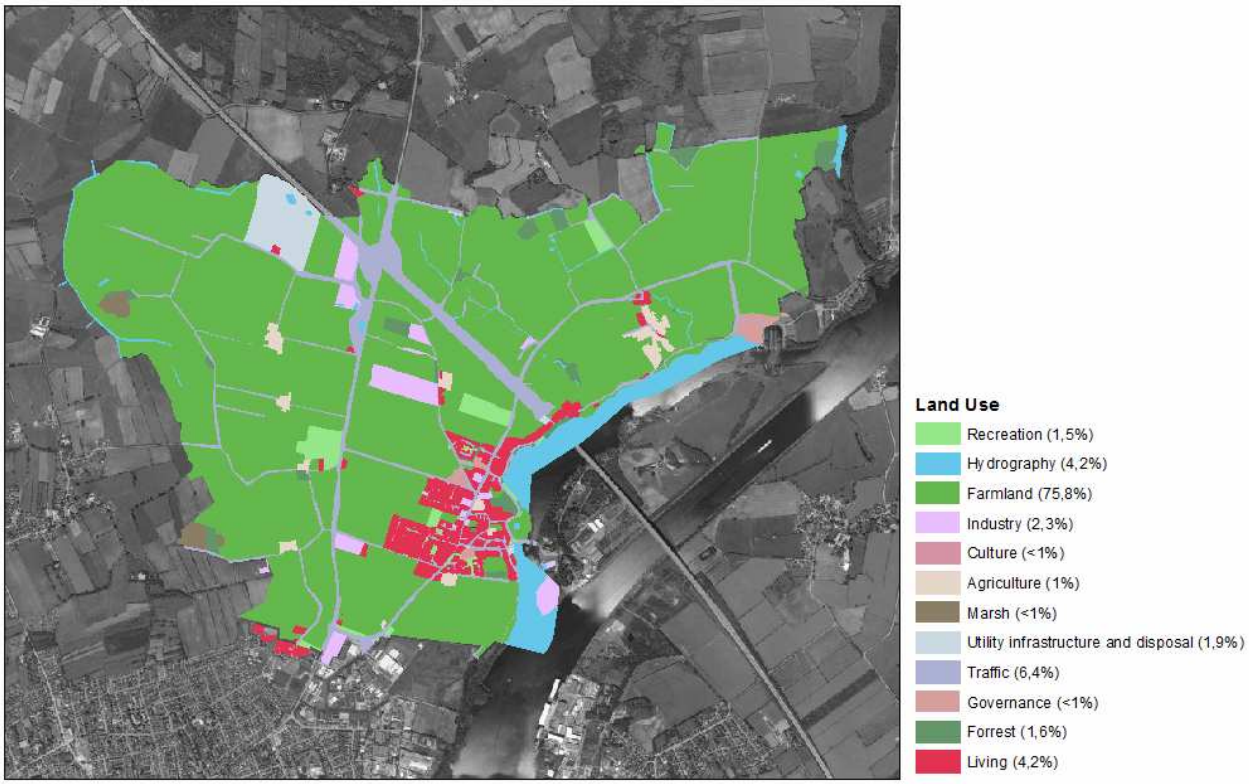

Figure 3: Land use in a prospective planning area, (Source: Own Image)

Another example is soil sealing. In Schleswig-Holstein there are many problems with flooding. The analysis in figure 4 shows a first impression of sealed and unsealed areas. It also depends on classified and merged land use data from the real estate cadastre.

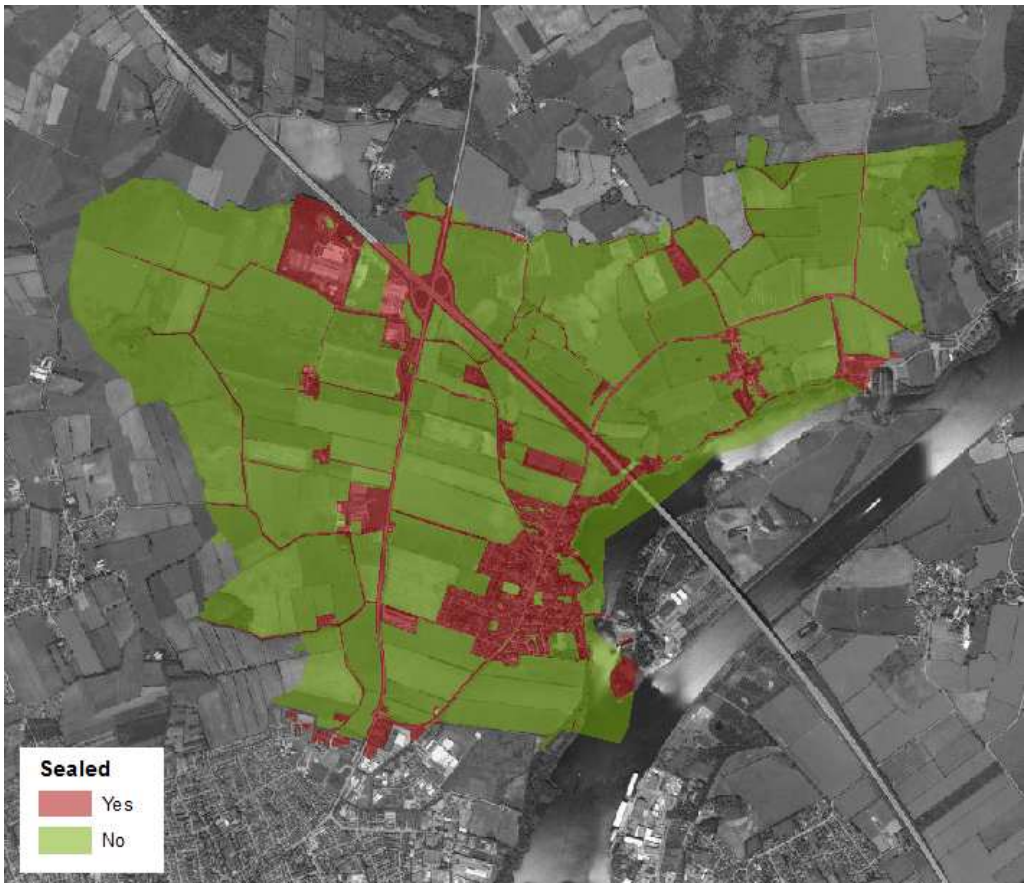

Figure 4: Soil Sealing in the planning area (Source: Own Image)

The knowledge about soil sealing is useful in combination with hydrographical data from the Department of the Environment and waste water information from the local government to identify possible flooding areas within new planning areas, even in correlation with climatic change predictions.

Same way with the other aspects: getting an overview, analysing characteristics, patterns and land use concurrences and deciding which area should be used for what is necessary for sustainable land management and planning can be significantly supported by spatial information from different sources, available through SDI.

The required information for Spatial Planning is generated in daily administrative actions. Most of the data will be INSPIRE-relevant, which means, that it has to be available in the European SDI. For this purpose it is required that all administrative units know about spatial data infrastructure directives and laws, use spatial information in daily work, observe rules for generating and processing spatial information and work together to build functional local and national SDIs.

Two examples for local SDI in Germany and their integration in the national SDI will be given in the next chapter

3. A GERMAN STATES' CASE STUDY

3.1 Study area

In the previous sections it was explained in which way the German SDI GDI-DE is part of the European SDI. The following sections will present two local SDIs, namely the SDI's of two German Federal States, Schleswig-Holstein (GDI-SH) located in the North and Rheinland-Pfalz located in the South-West (GDI-RP) of Germany in more detail (Figure 5).

In the context of Germany one of Schleswig-Holsteins specifics is its relatively long coastline shared with the North Sea in the west and the Baltic Sea in the east. Rheinland-Pfalz particularly is involved in cross-boundary cooperation projects by taking part in a recognized European Border Region in the centre of Europe.

Figure 5: The study area in Germany (Source: http://geoportal.bkg.bund.de)

3.2 GDI-RP, Rheinland-Pfalz Local SDI

Rheinland-Pfalz, located in the South-Western part of Germany, is one of the 16 federal states of Germany, with some industry but also with a relatively high economy share of agriculture

and viticulture. The Rhine river valley, bounded by mountain chains, forms the main axis of the state.

The state takes part in the SaarLorLux Larger Region, a recognized European Border Region that consists of five different regional authorities located in four different states of the European Union. Member regions represent a variety of political structures: the state of Luxembourg; Belgium's Walloon region, the Lorraine region of France; and the German federal states of Saarland and Rheinland-Pfalz.

Derived from a long tradition of cooperation the political plans for the SaarLorLux Larger Region emerged into Vision 2020, stating that

'The Large Region should become a region:
• with a European identity and a European way of life;
• with European competence;
• which is a model for European regions.' (European Commission, 2004).

SaarLorLux in fact consists of a large amount of governmental, non-governmental and mixed cooperation. Being a part of the SaarLorLux Large Region, Rheinland-Pfalz's SDI GDI-RP, has the potential to impact the development of cross-border SDI development. In that way GDI-RP is capable to deliver a worthwhile contribution not only to the vertical integration of member states into the European SDI as defined by INSPIRE, but also to the horizontal integration of SDI's at the national level being based upon different political and governmental systems.

The following paragraphs describe the strategy of SDI implementation as given in Rheinland-Pfalz.

3.2.1 Organizational model of GDI-RP SDI implementation

Following preceding activities as from 2004 the new Federal State Act LGDIG (LGDIG 2010) which regulates implementation and management of the states SDI was put into force on 31th December 2010.

The Act constituted a Standing Committee LA GDI-RP consisting of delegates of the prime ministers office, of all state ministries and of the umbrella organizations of communes. These delegates are entitled to vote, delegates from other public institutions have the status of being consulting members.

The private sector is not yet involved in the states official steering committee nor is SDI implementation at the autonomous communal level formally defined. However, it should be noted that at the communal level a number of Permanent Working Groups exist, like the GIS plenum of the Districts Umbrella Organization (see Müller and Siebold, 2008).

The LA GDI-RP Standing Committee's mission is

- to develop the functional and technical principles of the States' SDI and geoportal implementation and management,
- to arrange the functional and technical principles with the federation, with all other Federated States, with the communes and their umbrella organisations,
- to support the establishment of INSPIRE in the State territory,
- to consult and support all public and private bodies involved in geospatial data management.

The committee's office, located at the central surveying authority of the state, performs the daily work, like managing the Geoportal geoportal.rlp etc.

3.2.2 Legal model of GDI-RP SDI implementation

Seen from the German viewpoint, the legal SDI framework in Europe has three levels, at least. At the first level it is the INSPIRE directive, which sets a base for the Member States to pass their own national legislation. SDI implementation has to take into account institutional characteristics and history of development. Considering its federal constitution Germany establishes a coordinated framework consisting of SDIs, one for each of its 16 states and one for the federation. As a consequence 17 different legal acts had to be passed to implement INSPIRE and to achieve national objectives beyond INSPIRE. The complete legal SDI framework in Germany entered into force by end of the year 2010.

3.2.3 Functional model of GDI-RP SDI implementation

The legal framework sets the legal base of SDI implementation. The functional model has to consider all involved public and private spatial data managers. Due to the very complex organisation of public administration comprising a huge number of bodies which all are responsible for defined subsets of geospatial data, moreover a political autonomy at several levels in different areas of government, this part of SDI implementation is a very challenging task.

In the case of Rheinland-Pfalz the Ministry of the Interior took the lead for Rheinland-Pfalz local SDI implementation within the federal GDI-DE framework (Müller and Siebold, 2008).

Large and small communities regularly are members of several umbrella organisations covering a more or less large number of municipalities and taking care of common needs of their members.

At the communal level three communal umbrella organisations were established long time ago, firstly the Rheinland-Pfalz Association of Cities and Towns acting for 32 small to medium size cities and towns ranging from 7.000 to 180.000 inhabitants, secondly the District

Association acting for all 24 districts of the state and, thirdly, the Association of Communes and Towns acting for over 2000 mostly small rural communes.

Larger cities regularly are capable to provide sufficient resources to operate a working city SDI on their own. For the vast majority of all small communes this is rarely the case. That is why the District Association decided to take the lead in order to build the capacity needed to operate the local SDI at the district level and, at the same time, to provide the needed services for small communes. The district administration offices roughly spoken consisting of 300 to 500 employees are intended to act as the central service points for the communal SDI components of the local SDI. SDI service centres allocated to the district administration offices in future shall provide all SDI related services by running all processes needed to connect the communal level in itself and with the state level.

3.2.4 Technical model of GDI-RP SDI implementation

In the SDI legal framework of Rheinland-Pfalz a geoportal is defined to act as the central part of the technical model of GDI-RP. A geoportal in an SDI framework is a gateway to spatial data, metadata, users and tools which are interactively connected in order to use spatial data in an efficient and flexible way. Map based websites describe and grant access to spatial information available for a specified administration territory.

Figure 6 shows the role of a geoportal within an SDI with user and software interaction. The content and interaction of the components are subject to restriction by the geo-community and the data owner's granted access rights. The portal provides the information about geospatial data and the data owners, not the data itself. The data and metadata services of different authorities and organizations are a part of the spatial data infrastructure being realized as a public data network.

Within SDI Rheinland-Pfalz (GDI-RP), it is up to GeoPortal.rlp to take the role of the service-oriented agent brokering geo data between geo users and geo service providers. The portal (http://www.geoportal.rlp.de/, see Figure 7) was launched on 8th January 2007. All data to be accessed via GeoPortal.rlp as well as related metadata information remains with the data providers thus leaving full control on all provided information to the information provider. In June 2008, GeoPortal.rlp was elected Website of the Month of the Open Geospatial Consortium OGC (OGC, 2008).

GeoPortal.rlp offers the opportunity for federal state agencies, municipal authorities and private companies to present their data and services. Online-access to the distributed data sources of each geospatial service- and product-provider ensures that information made available by these institutions on a joint platform is as up-to-date as possible. Instead of users having to copy the data, links to the original data sources enable them to have direct access. Metadata is managed by the providers themselves using the multi-client-capable administrative framework implemented by Mapbender.

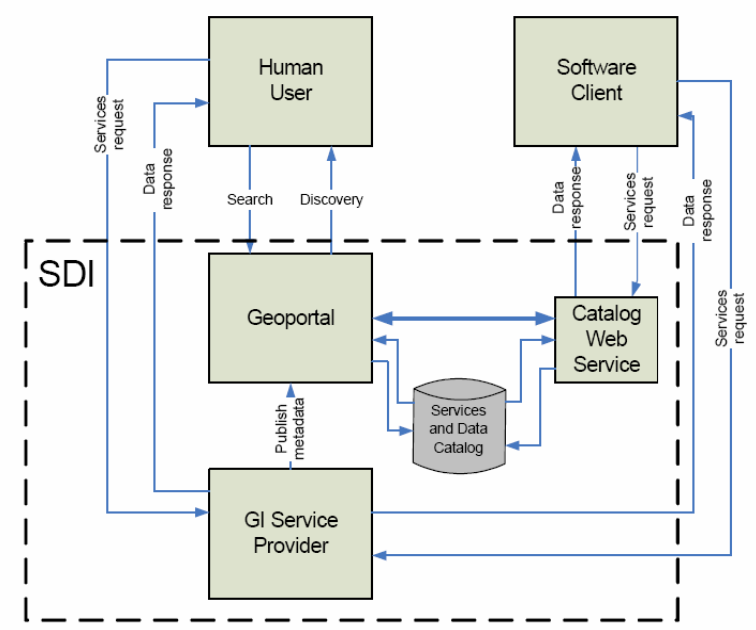

Figure 6: Geoportals and SDI (Source: Geoinfo, 2005)

GeoPortal.rlp provides information about geospatial data and the data owners, as well as offering integrated functionality for use in standard GIS viewers and in specific applications.

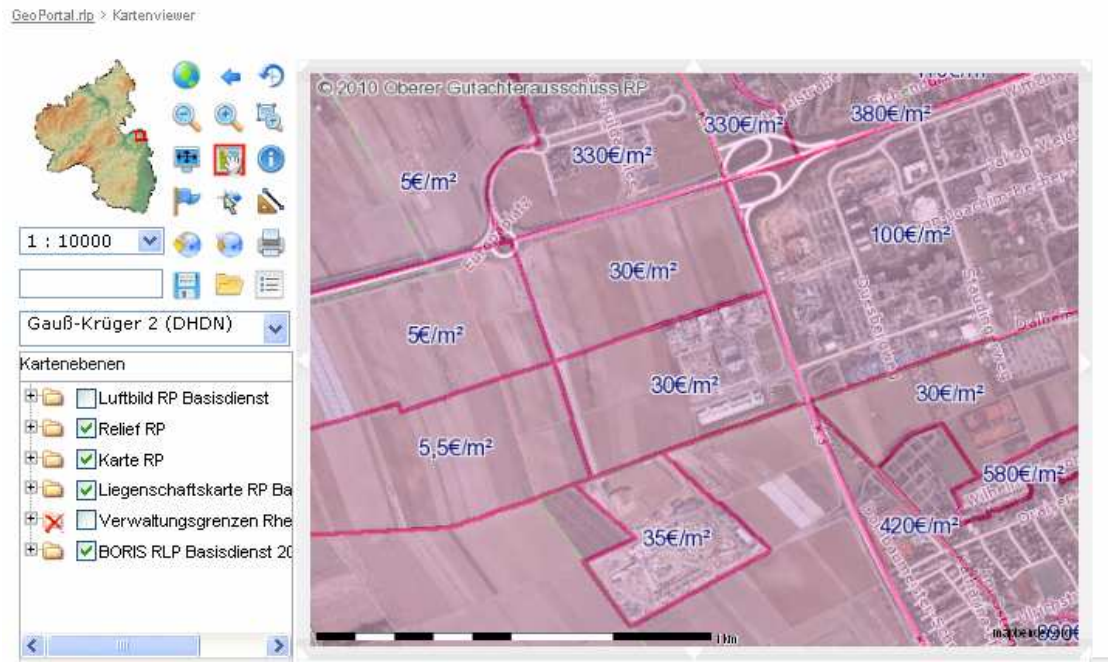

Figure 7: Public access to land values within GDI-RP federal state SDI (Source: http://www.geoportal.rlp.de/)

The States' geoportal is embedded in the Federations GDI-DE, and at the European level connects seamlessly into the emerging INSPIRE platform.

3.3 GDI-SH, Schleswig-Holstein Local SDI

The federal state Schleswig-Holstein is located in the North of Germany surrounded by the North Sea in the west, the Baltic Sea in the east, Denmark in the north and the River Elbe in the south. Schleswig-Holstein is mainly rural and rather lacking in infrastructure. The economy is focused on maritime and energy industries, tourism and food production.

Schleswig-Holstein is divided into 11 districts and, 4 independent cities, 87 administrative bodies and 1,116 communities. There are 910 communities with less than 2000 citizens. Those communities are led by honorary mayors.

Because of the position between the seas, marine data is very important for sustainable land use. On account of that the initiative "Marine SDI - DE" was founded in the year 2010. The aim is to provide spatial information for all questions concerning flooding, coast protection and civil defence.

Building a Spatial Data Infrastructure in Schleswig-Holstein (GDI-SH) started in the year 2002 based on a decision from the federal state government. The GDI-SH has to be in line with the INSPIRE- Directive and the structures of GDI-DE and implements the according guidelines for data exchange and the architecture of spatial data infrastructures.

3.3.1 Organizational model of GDI-SH SDI Implementation

Since 2004 an interagency working group for geographic data ("Arbeitskreis Geodaten") has implemented the GDI-SH. The management was taken over by the ministry for internal affairs of Schleswig-Holstein which is staffed by representatives of the federal and local administration as well as deputies of science, economy and data protection. The aim of the working group is to support the use of geographic data, the coordination of common interests, the exchange of experiences between the participants, consulting and implementation of activities of the German country as well as supporting the IT-commission. The central office of geodata ("Leitstelle Geodaten"), which comes from the department of the ordnance survey, is assisting the working group in its activities. For getting the spatial data to the users every district and department of Schleswig-Holstein has implemented a head-quarter of geodata ("Kopfstelle Geodaten") (GDI-SH, 2011). Especially in the districts, initiatives with the aim to build new SDIs have been founded.

Because of the lack of networking between the participants coming from administration, economy, science and public the Centre of Geographical Information ("Zentrum für Geoinformation" – ZfG) located at the Christian-Albrechts-University in Kiel has been founded in 2009 and is funded by expenses of the European trust for regional development (EFRE) and of Schleswig-Holstein since then. The aim of the ZfG is to build efficient

structures of organisation, management and technological structures with the result that the developing geographic information network as a part of the GDI-SH is strengthened.

3.3.2 Legal implementation

Since December 2010 the legal basis of the GDI-SH is formed by the *Geodateninfrastrukturgesetz für das Land Schleswig-Holstein (GDIG) vom 15.Dezember 2010* which matches the INSPIRE-directive and applies it into national rights (Land Schleswig-Holstein, 2010).

3.3.3 Functional Implementation

Most important aspect for the functional implementation of the GDI-SH is that spatial base data are available free of charge. In return all spatial thematic data has to refer to this geometries.

Currently there is no harmonized data processing. Because of that, data is managed in different places at the same time with different precisions and actualities. Apart from high costs for data collecting and maintenance, the greatest disadvantage is that there is no reliable base for decision-making because nobody knows which the right data set is. That is why the aim of the GDI-SH is to collect and maintain the data in only one place so that there is no unnecessary and expensive double collection. An example is given in the extract of a concept of the inter-communal, interagency data flow diagram. Green fields symbolize the need of data viewing, yellow fields the need of data processing, orange means data administration and red full access including rights-management (Figure 8).

For building a sustainable SDI it is important to develop a master plan for the data model including data privacy. This model has to include the own government as well as the surrounding governments, data providers and citizens. Modelling starts in the GDI-SH with the help of the INSPIRE directive.

It only makes sense to provide and use spatial information when users have „geomedia literacy“. Geomedia literacy is the acknowledgement of content and implementation from the different geomedia and the ability to use them target-orientated to raise awareness for local and regional phenomenon, to allocate, rate and communicate them and to integrate them in global context (Klein 2009, p37). Thus knowledge and technology transfer play a great role in the functional model of the GDI-SH.

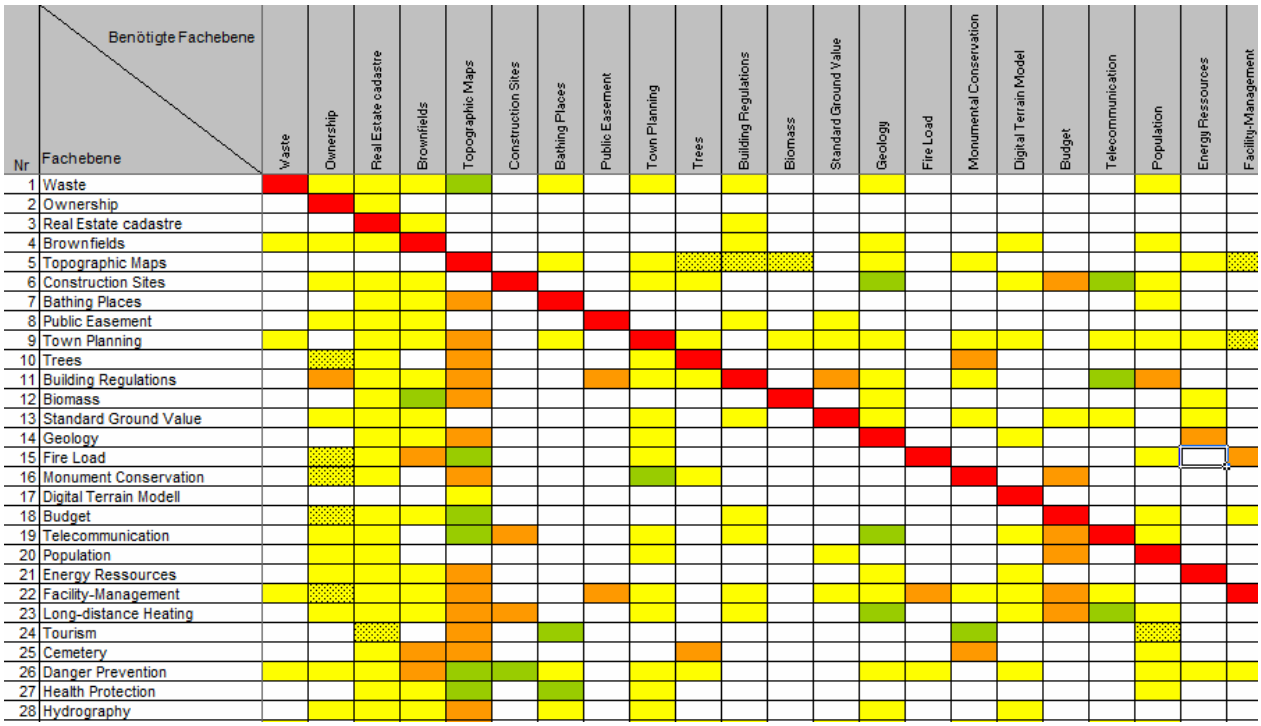

Figure 8: Extract from an interagency data flow chart example. (Source: Own Image)

3.3.4 Technical Model of the GDI-SH implementation

The technical Model of the GDI-SH is based on three central components: An information system for Metadata, a Geoportal and a Geoserver. All components are free to use.

- The Metadata information system ”SH-MIS” (www.sh-mis.schleswig-holstein.de) is used for creating and querying metadata. It is free for all data providers and users. It allows an interactive enquiry in a web based frontend. Exchange with other Metadata information systems is possible with the OGC conform CSW-interface (Figure 9).

- The data is available in the spatial information portal ”Digital Atlas Nord” (http://digitaleratlasnord.de). It is used for visualizing and access of primary and secondary spatial information. The data services are provided by local and regional governance and are presented homogenously in the Digital Atlas North (Figure 10).

- The ”Geoserver” is used for presenting and providing analogous and digital data. It is the main distribution agency for governance, companies, science and the general public.

Figure 9: Metadata information System SH-MIS (Source: www.sh-mis.schleswig-holstein.de)

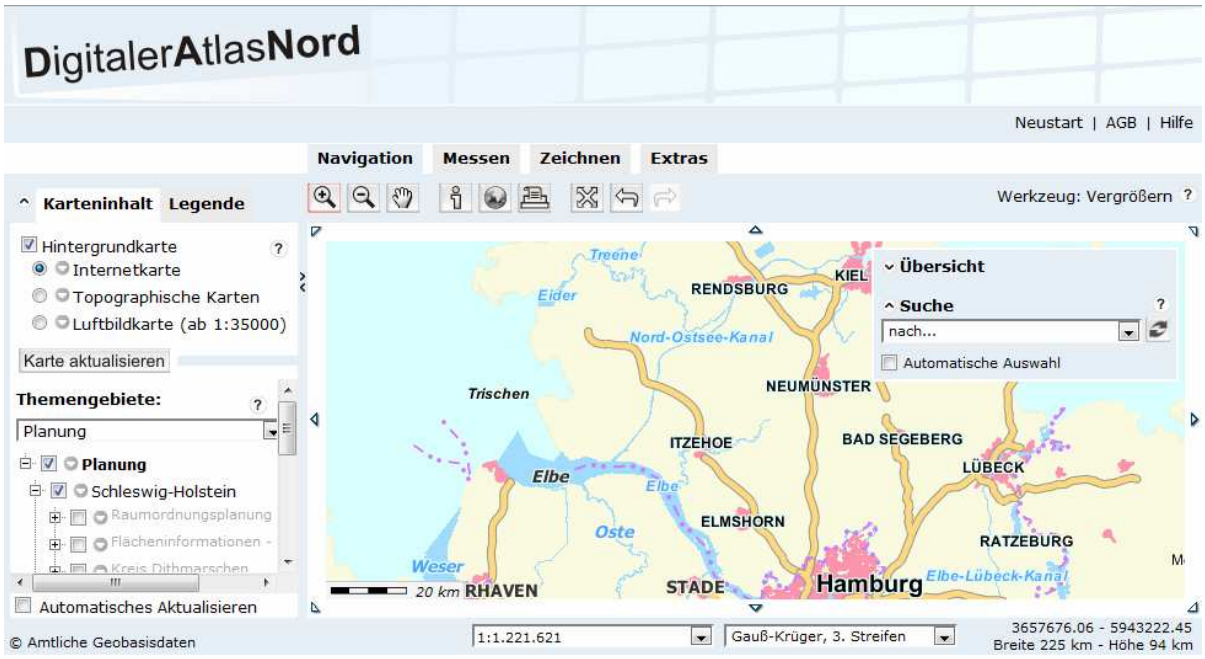

Figure 10: Digital Atlas North (Source: www.digitaleratlasnord.de)

Besides this there exist many different GI-Software and databases, mostly uncoordinated and unknown from the other users. For implementing the INSPIRE-directive, GDI-SH has the aim to build a central information architecture allowing a spatial information logistic.

4. STUDY POST EVALUATION

In the previous section the organizational, legal, functional and technical challenges of an SDI implementation at the local level were addressed. For two Federal States of Germany it was shown in which way action is taken to meet the requirements in all four fields of activity. The discussion shows that in all fields an ongoing process takes place. Still, the SDI development in both states faces a number of obstacles.

- Fundamental SDI directives, laws and concepts (INSPIRE, GDI-DE, GDI-SH, GDI-RP) are not yet known sufficiently in local government, economy and science.
- In many cases, collection and processing of local spatial information is organised inadequate.
- Benefit, potential and added value of spatial data infrastructures is not communicated well enough.
- Collection of functional data is done without considering all relevant standards. Therefore seamless transboundary data processing is limited and, regularly, requires extensive efforts of data harmonization.
- Widespread knowledge of data collection, management, presentation and quality control is not available in many public authorities. Lack of knowledge may result in insufficient quality of spatial information.
- Until now not much analysis of spatial governmental processes took place, which results in a negative impact on data quality and availability.
- There is not enough communication between the SDI stakeholders. Areas of responsibility are unknown and, in many cases, activities are not coordinated. In some cases parallel development of new functionalities, data models and applications takes place.

(See for example: GIW-Kommission 2005, KGSt 2007, Klein 2010)

To overcome the listed obstacles, the following activities are needed for the future development of sustainable feasible Spatial Data Infrastructures:

- Consequent further education of staff working with spatial information in government, science, economy.
- Clear communication structures that ensure information dissemination to all SDI partners; communication of benefits, potential and added value to motivate engagement.
- Clarification of stakeholders and their areas of responsibility, financing the availability of data and services.

- Functional standardisation of data models and regulations to enable the transboundary use of spatial information.
- Availability of technical interfaces between GI-Software, governmental applications and communication services.
- Involvement of affected parties, experts and management in the development of SDIs.
- Consequent use of spatial information in government processes referring to a place on earth (e.g. buildings, parcels, addresses).
- Supplying the technical infrastructure including telecommunication.
- Control of observing rules and standards.

5. CONCLUSIONS

Very obviously, many tasks of land management face the spatial dimension of land. To manage land in a sustainable way, ready to use spatial information is urgently needed in many processes related to spatial planning, for instance. A well-defined and implemented Spatial Data Infrastructure has the capability to form the base for appropriate spatial information provision. In Europe, SDI implementation currently takes places at all different governmental levels. Due to a huge number of involved institutions and individuals the challenges of SDI implementation are particularly high at the local SDI level. Organizational, legal, functional and technical solutions have to be developed in agreement with the public administration system. In a federal political system, co-operation and co-ordination are particularly crucial success factors. In Germany many efforts are made to implement SDI both at the national and at the local SDI levels. Progress has been achieved in creating feasible networks of stakeholders and in establishing a feasible legislation framework. Technical solutions are developed on the basis of widely accepted international standards both in the field of information and communication technology in general and of spatial information technology in particular. Enormous challenges will remain present in the coming years to raise and to increase awareness of a huge number of involved institutions and individuals for SDI related issues, to convert and to maintain large amounts of available spatial information in SDI compatible formats, to establish related process chains in all spatially related sectors of society.

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BIOGRAPHICAL NOTES

Ulrike Klein got her diploma in geomatics at the university of applied sciences in Hamburg, Germany. After two years in a spatial consulting company she turned 2003 to Kiel University where she got her doctoral degree in Geography. Since 2009 she is on one hand director of the Centre for Geoinformation at the Kiel University and on the other hand director of an engineering company. She is part of the DVW - German Association of Geodesy, Geoinformation and Land Management working group 2 – Spatial Information and Spatial Data Management.

Hartmut Müller got his diploma and doctoral degree at Karlsruhe University, Germany. After 8 years of research he turned into the marketing and software development departments of international enterprises for 6 years. Since 1991 he is a professor at Mainz University of Applied sciences. Since 1998 he is a member of the board of i3mainz, Institute for Spatial Information and Surveying Technology. In the DVW – German Association of Geodesy, Geoinformation and Land Management he was the chair of working group 2 –Spatial

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