



## **Collecting and Analyzing Land Use and Site Information – Summary and Conclusions on the Results and Findings of the REFINA Projects**

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### **Key results and products on land use and site information in REFINA research**

In the REFINA projects, a range of results and products were compiled, which can be used for the collection and maintenance of land use and site information as well as their evaluation. Some of the results and products could be classified as auxiliary findings within the projects, as these primarily pursue different questions and goals, and are described and documented in detail in their respective publications and reports.<sup>1</sup>

In general, the results and products can be subdivided into four types:

- Methods and procedures involved in soil and pollutant assessment,
- Methods and procedures involved in the use of remote sensing data and the three-dimensional modelling of site information,
- Indicators and applications for the analysis of land use,
- Evaluation systems for a sustainable land management.

On the level of site-specific soil and pollutant assessment, the project “Funktionsbewertung urbaner Böden” (“Functional evaluation of urban soil”) featured a collection and evaluation method for anthropogenically impacted soils (substrates), which, similar to the Federal Soil Protection and Contamination Ordinance (BBodSchV), enables the evaluation of internal development sites that have been used over long periods of time. The “BioRefine” project further developed the evaluation methodology for pollutants in various soils on the basis of bio-availability.

Based on the current level of knowledge, two projects, “Automatisierte Fernerkundung” (“Automated remote sensing”) and “Flächenbarometer” (“Land use barometer”) developed new procedures for compiling land use information from remote sensing data (satellite images, aerial photographs). The use of this data for site monitoring was also demonstrated. For its part, the project “REFINA3D” points to ways of using modern three-dimensional urban models for the integration, analysis and visualization of land use and site information.

Indicators and applications in the form of software tools or web applications for the analysis of the land use in settlement and transport areas were provided by the two projects “Panta Rhei Regio” and “Flächenbarometer” (Land use barometer”).

The majority of projects presented in this volume examined the development and testing of evaluation systems for sustainable land management. Generally speaking, the goal was to come up with the most sustainable use decision in each case within a defined land pool or portfolio. The systems differ in the degree of detail of the information collected, in the adaptation possibilities to local conditions and in the projects’ respective requirements and focal points. The evaluation systems are available either as independent software tools, as Excel tables or as described methods (“SINBRA”, “Flächenkonstanz Saar” [“Saarland consistency”], “GEMRIK”, “REGENA”, “NFM-

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<sup>1</sup>

An overview of the publications and products from all the projects of the research group REFINA can be found at [www.refina-info.de](http://www.refina-info.de)



Hannover”, “FIN.30”, “Regionales Portfoliomanagement” [“Regional portfolio management”], “komreg” and “OPTIRISK”).

## **Characteristics of the methods and instruments developed in the REFINA projects**

Land use and site information, as well as the evaluation of these factors at various levels, is the main research topic in the REFINA projects. Depending on the respective focus of the project, this ranges from developing new sources of information and working techniques for the compilation of land use information, through enhancing methods for the assessment of (urban) soils and polluted soils and summarizing information from different sources into conclusive indicators for the observation of land use and its analysis, to developing concepts for the comparative analysis of undeveloped land with the goal of determining the most sustainable form of land use. The developed and applied instruments can be roughly classified with respect to their land use, planning and application aspects.

### **Land use aspect**

A range of REFINA projects deal with various techniques and methods of evaluating individual sites. The goals include optimising the analysis of contaminated sites and decontamination measures, and improving the marketing of abandoned sites and conversion areas (“SINBRA”, “optirisk”, “BioRefine” and “komreg”). These projects help improve opportunities for internal development. The project “Funktionsbewertung urbaner Böden” assumes a special status. This project developed a classification method for anthropogenically impacted soils (“urban soils”) similar to the Federal Soil Protection and Contamination Ordinance, thereby helping to improve the Federal Soil Protection and Contamination Ordinance (BBodSchG) and the Federal Building Code (BauGB).

In contrast, a large number of projects focus on defined land portfolios, more extensive land networks or overall areas. The project targets thus pursued can be roughly subdivided into two classes:

- Some projects are concerned with new methods for generating site information and the deduction of indicators. These can then be used to support the process of monitoring and explaining land use. Furthermore, new control options can be developed, as necessary, for reducing land use and deriving a sustainable land management strategy (“Flächenbarometer”, “Panta Rhei Regio”, “Automatisierte Fernerkundung”).
- A larger number of projects treat more extensive land networks; some of these projects have been designed for compiling construction potential in the internal area (gaps between buildings); others provide a comparative analysis of land use pools (“Flächenkonstanz Saar”, “GEMRIK”, “REGENA”, “NFM-Hannover”, “FIN.30”, “Regionales Portfoliomanagement”).

Additionally, the projects also feature new approaches to visualizing land use or planning in order to deepen the understanding of processes and problems connected with land use transformation, as well as opportunities for specific projects (“optirisk”, “Flächenbarometer”, “Panta Rhei Regio”, “Automatisierte Fernerkundung”, “REFINA3D”).

### **Planning aspect**

The tasks of decreasing land use for settlement and transport purposes, and ensuring the sustainable use of land, affects spatial planning at all levels. Accordingly, the projects covered in this volume developed technologies and methodologies for information-gathering and evaluation for different land- and site-specific assessment levels. At this point, one can distinguish between three levels: land development scheme (microspatial assessment level), land use plan (citywide assessment level) and regional planning (regional assessment level). The information and



analysis tools can thus be used both in the context of mandatory legal regulations (land development scheme, land use plan) and informal planning (other urban planning, including city and village development concepts, neighbourhood planning) and also support these. Further application possibilities can be developed in the context of other legal regulations, e.g. the Federal Nature Conservation Act (BNatSchG) and the Federal Soil Protection Act (BBodSchG), as well as corresponding legal provisions in the respective Land.

In their *evaluation approaches*, three projects refer specifically to the land development scheme level (“SINBRA”, “optirisk” and “NFM-Hannover”). The projects “FIN.30” and “Regionales Portfoliomanagement” evaluate residential building land sites on the land use plan level. The projects “GEMRIK” and “REGENA” are intermunicipally oriented, thereby following a regional approach. In the project “Flächenkonstanz Saar”, a concept was developed to limit new land use across the Saarland region.

As far as the *site information* projects are concerned, the classification into assessment levels is not possible in many cases, as methods were developed for different levels and are used accordingly. The results of the projects “Automatisierte Fernerkundung” and “Flächenbarometer” can be used on all three spatial levels, as defined above. “REFINA3D” and “komreg” are both oriented on the land development scheme and land use plan. In contrast, the project “Panta Rhei Regio” targets the (small-scale) land-use and regional planning levels. The projects “Funktionsbewertung urbaner Böden” and “BioRefine” are microspatially oriented on individual sites and thus on the land development scheme.

### **User aspect**

In terms of the user aspect, the synoptic evaluation of the methods and instruments centres on those who have made the evaluations, or to which participant the methodology applies. Generally speaking, all the methods and instruments are designed for experts from the respective planning and specialist disciplines. The projects “GEMRIK”, “REGENA” and “NFM-Hannover” also meet the prerequisite of involving politicians in the process of defining indicators and assessment criteria. This requirement necessitated customized evaluation systems, both in terms of scope and the technical depth of processing.

In terms of user acceptance, it is also important to ask whether the developed evaluation methods work with technically defined evaluation rules or whether municipal findings and/or weightings can be incorporated within a developed evaluation framework. The inclusion of governments and/or the citizens they represent has been cited as a particularly important factor of success in associated projects for general awareness of the instruments and the implementation of results.

## **Requirements for using the methods and instruments**

### **Integration within the target system**

Before the information systems and evaluation processes can be used for sustainable land management, basic questions must be answered regarding the precise problem or issue and the requirements placed on the methods or instruments.

First and foremost, the following questions must be answered: which task in the municipality or region needs to be resolved and which goals/objectives are to be pursued by using a particular method or instrument.



Secondly, the organizational environment must be considered, in which a method or an instrument is to be used:

- Will the method or instrument be used exclusively within the municipal administration, or should intermunicipal cooperation be initiated?
- Should participants from outside the administration be included in the planning and decision-making process? If so, which?

The answer to these questions indicates the target groups, i.e. the users of a method or an instrument, as well as the parties addressed by the results of land use and site evaluations. The more necessary it is to integrate non-planning experts into land use decision-making process, the stronger the method needs to accommodate the information and awareness level of these persons. This means that complexity needs to be reduced. It also requires the simplification of indicators and evaluation rules, or the simplified presentation of study results. Only in this way can non-experts grasp the entire evaluation process. This also entails designing the process transparently, so that the evaluation results are comprehensible – and ultimately gain acceptance. More detailed information on communication strategies and approaches for the site-related targets of REFINA can be found in Volume IV of the REFINA series.<sup>2</sup>

#### **Data access and data management**

Land use and site information is always compiled for a specific purpose, and normally results from official requirements, planning targets, and economic or scientific interests. The collection and use of data for official purposes is based on a legal foundation with precise stipulations regarding scope, depth and application. In contrast, data collection for economic and scientific purposes is usually more freely organized. For this reason, collected data cannot be readily used for other purposes than those specified at the point of collection. If land use and site information is to be used for other purposes or combined with supplementary data, incompatibilities, inaccuracies or uncertainties may arise – due to the level of generalization required. Moreover, spatially relevant data and information are subject to copyright protection. For this reason, the use of such data is not permitted if it goes beyond the scope of licences and/or user rights granted by the author.

Therefore, in the case of land use information and evaluations in the context of sustainable land management, a careful examination must first be completed as to whether and to what extent data which has been collected for other purposes can be used for the respective question or issue at hand. For cost reasons, this may at first appear convenient or useful. But it must always be verified first whether the type of information, frame of survey, collection timeframe and copyright are all suitable for use in the context of land management.

Experiences<sup>3</sup> regarding the integration of fragmented or heterogeneous information which is relevant for the site, as well as collecting new land use and site-specific data, have shown other problems in practice:

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<sup>2</sup> Stephanie Bock, Ajo Hinzen and Jens Libbe (ed.): Nachhaltiges Flächenmanagement – in der Praxis erfolgreich kommunizieren. Ansätze und Beispiele aus dem Förderschwerpunkt REFINA. Beiträge aus der REFINA-Forschung, REFINA Series, Volume IV, Berlin 2009.

<sup>3</sup> See also the following report in this volume: Lutz Ross, Jürgen Döllner and Birgit Kleinschmit: Flächeninformationssysteme auf Basis virtueller 3D-Stadtmodelle. Innovative Kommunikationsinfrastrukturen zur Integration und Bereitstellung von verteilten und heterogenen Flächeninformationen.



- Project participants may communicate that planning data is available in “digital” form. However, this data frequently consists of PDF files, which – if presented in the form of vector elements or perhaps only as scanned raster data – only represent a graphical interface for the underlying GIS data. This means that the GIS (geographic information system) data can only be processed with varying degrees of complexity (extraction, georeferencing, masking, topology corrections, digitization), before being suitable for re-use in combination with other data.
- The access to GIS data is frequently controlled by specialist departments, which may licence the data use. Depending upon the intended use, fees may be charged, even if the data is intended for public planning purposes, e.g. sustainable and municipal land management. In such cases, data procurement can turn out to be unexpectedly complex and expensive. This frequently involves cases in which GIS data are transferred in the form of PDF result card files, the applicability of which, however, has not been legally clarified.
- Without precise planning and organisation, the collection and processing of land use and site information can quickly lead to an unclear file structure given a file system-based data structure. Therefore, the use of GIS databases is recommended. These provide functions for the storage and administration of extensive data sets.
- Information that has been collected and processed can be utilized in the long term only if a data management workflow has been developed and implemented from the very beginning. Otherwise, information inventories that have been built up with a great deal of effort could quickly become outdated and thus only be suitable for limited use. Any allocated expenditures and personnel capacities should also be taken into account in the cost calculation.
- Research projects, such as those included in the funding priority REFINA, allow partners from the practice to receive high-quality and innovative GIS data and information, which they can then use for their own internal purposes. Following the conclusion of a project, the question of regular and permanent data management and enhancement also arises. If the project concept has not allowed for this being taken over institutionally by a project partner, e.g. by integration within existing systems, it is highly recommended that the appropriate workflow be developed. This workflow should be anchored in the organizational structure (with a view towards time, personnel and costs).
- The collection and application of land use and site information to ensure sustainable land management can also produce synergies with other (municipal) tasks, such as environmental administration, real estate management, development planning and business promotion. Due to the fact that these synergies are systematically opened up and developed, the readiness to collect and maintain data also increases, which, in turn, heightens interest in the development of sustainable data collection and management and thus interest in the development of sustainable land management.

### **Data protection**

Data protection regulations set limits on the collection and processing of land use and site information. These regulations ensure that an individual’s basic right to privacy is not infringed upon with regard to the treatment of his or her personal data.

The example of the REFINA project “komreg”, in which personal data and property-related data were used, shows that allowances must also be made for data protection aspects. Though it would be desirable from the municipal viewpoint to receive early information about possible vacancy levels caused by old age or death, the data protection regulations must be strictly adhered to. Art. 200, Paragraph 3 Federal Building Code BauGB allows for the creation of building land registries. However, the information included in these registries is limited to land parcel



designations, street names and details regarding the property size. This information can only be published if the respective property owners do not object (Art. 200, Paragraph 3 Federal Building Code BauGB).

### **Processing effort and costs**

Collection, use and administration of GIS data frequently involve a good deal of time and effort, which is pitted against the municipal administrations' increasingly limited personnel, time, technical and financial resources. In view of these municipal constraints, municipal users should have a major interest in keeping the time and effort expended as low as possible. Feedback from municipalities participating in REFINA shows that the acceptance of new land use and site information methods and instruments is crucially dependent upon what types of financial and human resources are required. If possible, additional data collection should be avoided, or reduced to the absolute minimum; data collection expenses and the costs of procuring software tools and training should also be strictly limited. From the municipal viewpoint, the expected benefit must justify the human, technical and financial expenditure. The economic benefit of long-term sustainable land management can frequently only be defined with difficulty, as it is shown less in direct short-term profits and more in the prevention of medium- and long-term costs for settlement development.<sup>4</sup> It has also been observed that while the technical equipment is available for data collection and management, the personnel charged with the respective tasks do not always receive the necessary training. Automated data collection processes can reduce the burden in this area so that employees can focus on their actual conceptual, planning and management tasks.

### **Outlook**

The funding measure REFINA involves over 100 projects in 45 research groups nationwide, as well as single projects. In addition to project partners from universities, scientific institutions, development companies and private offices, over 70 municipalities are actively involved in the joint research project. Additionally, some 15 further regional authorities (administrative districts, regional associations, etc.) have also collaborated in the project. Most of the projects have been completed. Final reports and products, such as guidelines and software tools for implementation, are available for use in both municipal and regional practice.<sup>5</sup>

In order to move away from the documented pilot applications and toward a wider distribution of the methods and instruments of sustainable land management with an eye toward achieving the 30-hectare goal, municipalities, regions, planning offices and the real estate industry are invited to replicate this methodology. This objective will be supported by further phases of knowledge transfer and experience exchange.

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<sup>4</sup> Thomas Preuß and Holger Floeting (ed.): Folgekosten der Siedlungsentwicklung. Bewertungsansätze, Modelle und Werkzeuge der Kosten-Nutzen-Betrachtung. Beiträge aus der REFINA-Forschung, REFINA Series, Volume III, Berlin 2009.

<sup>5</sup> The products from the REFINA projects are available at [www.refina-info.de](http://www.refina-info.de)