Towards Sustainable Urban Land Use – A Methodological Design for Implementing Socio-Ecological Targets into the Strategic Planning of Cities in Germany

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Key words: land consumption, multi criteria assessment (MCA)

SUMMARY

Sustainable land use and the reduction of land consumption have become one of the most prominent issues and tasks of spatial planning during the last decades in Germany. The use of natural resources – especially of the non-recoverable resource soil – is still on the rise. Set against this background the paper presents an approach for a socio-ecological multi criteria assessment (MCA) for a sustainable settlement-development. The approach was developed at the University of Bonn in close cooperation with urban planners. The paper will give insight into its conceptual and theoretical framework and will highlight the incorporation of the MCA within a Decision Support System (DSS).

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1. INTRODUCTION

Urban expansion and the development of settlement areas both have been the driving forces of an enormous consumption of land, the usage of natural resources and the loss of ecosystem services in Germany (SCHETKE ET AL. 2009). Facing continuous land consumption, the German government has elaborated a quantitative benchmark fostering reduced land consumption towards 30 ha/d in 2020 from 114 ha/d between 2002 and 2005. To realize this enormous step urban planners and politicians have to focus on infill and compact settlement development characterized by (re-)densification of built-up areas and recycling of brownfields (KÖTTER & WEIGT 2006; KÖTTER ET AL. 2009; SCHETKE ET AL. 2009). This paper presents an innovative approach for a multi-criteria assessment (MCA) of assessing particularly the socio-ecological potentials and limitations of future housing sites in cities in terms of their contribution towards a sustainable and resource-efficient settlement-development.

The development of the MCA-scheme and its incorporation into a Decision Support System (DSS) for urban planners was realized using a participatory approach: Regular workshops and training with stakeholders from local planning departments helped to shape the tool. The research project FIN.30 funded by the German Federal Ministry of Education and Research (BMBF) gave the framework for that. Beside the scientific coordination of the project at the Department of Urban Planning and Real Estate Management at the University of Bonn, planners form three cities of the German state North Rhine-Westphalia have been intensively involved in the project. Valuable contributions to both the conception of indicators for socio-ecological site-assessment and the design of the DSS and helped to bridge the gap between science and planning practice.

2. SUSTAINABLE LAND USE AND URBAN PLANNING

The approach of the project FIN.30 aims at the MCA of future housing sites against the notions of a sustainable and resource-preserving settlement-development. In doing so, three partner-cities in North Rhine-Westphalia as one of the biggest states of Germany were used as case studies. Subject of the assessment were future housing sites displayed in the land use plan of each case study city. The land use plan is the instrument of German preparatory land use planning.

One of the crucial tasks in operationalizing sustainability for planning processes – such as the presented MCA – is to optimize the selection of criteria and indicators following demands of practicability, usability and communicability. In doing so, the limitation of complexity and of content of the MCA is inevitable. Moreover, the compromise between scientific aspirations and practical relevance for planners needs to be made. The use of public and existing municipal digital data sets is thereby one of the crucial steps. It avoids additional data-mining for local planners and enables a selfstanding GIS-based assessment of housing sites (KÖTTER

ET AL.*). The integration of the MCA within a planning-oriented DSS using a graphical user-interface (GUI) is one of the crucial tasks of the implementation of the assessment DSS within planning processes. Last but not least, the practical and technical demands for the incorporation of each single indicator within the MCA (qualitative/ quantitative) and their translation into one aggregated result need to be considered and will be outline in the next section.

3. METHODOLOGICAL BACKGROUND

The following paragraphs highlight the conception of the MCA-scheme and the planning-oriented operationalization of the ecological and social dimension of sustainability. Afterwards, the translation into a DSS, its conceptual requirements and the technical realization will be outlined.

3.1 Design of the MCA

The MCA-scheme (fig. 1) is hierarchical in nature and divided into four levels: the two dimensions of sustainability form the first level. The second level is formed by associated categories which are subdivided into criteria (level 3). These criteria help to systematically define measurable indicators (level 4).

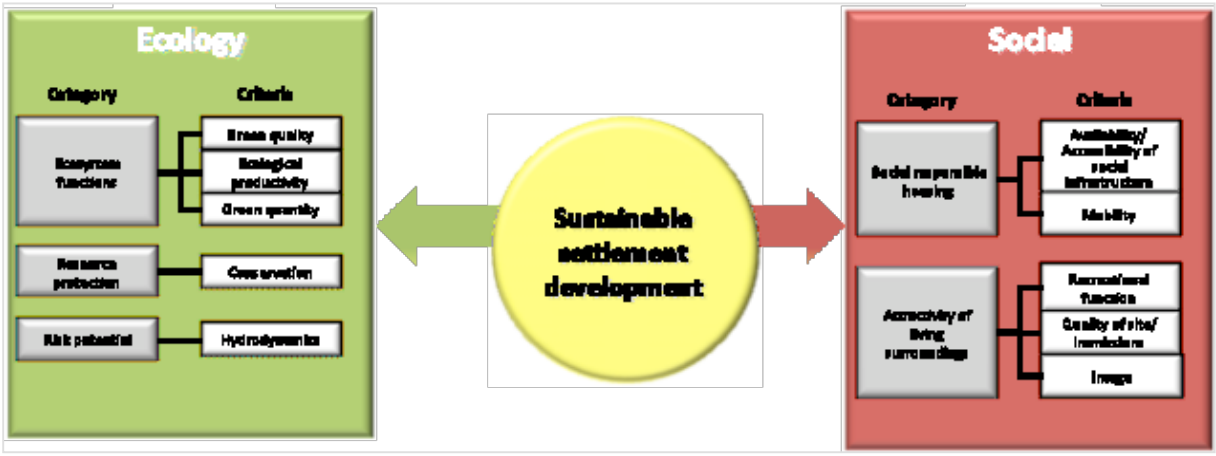

Figure 1 MCA-scheme (modified according to SCHETKE ET AL. 2009)

The indicator-selection and the definition of focal points of the MCA were integrated into a regular consultancy with planners from the partner cities Essen, Erftstadt, Euskirchen and external experts. In doing so, quarterly workshops with planners form the three partner-cities and additional workshops with external experts from science and planning practice (1-2 times a year) helped to shape the tool. Valuable insights into the importance and scientific approval of each indicator could be derived. This formed an essential step in bridging the gap between science and practical planning (fig. 2).

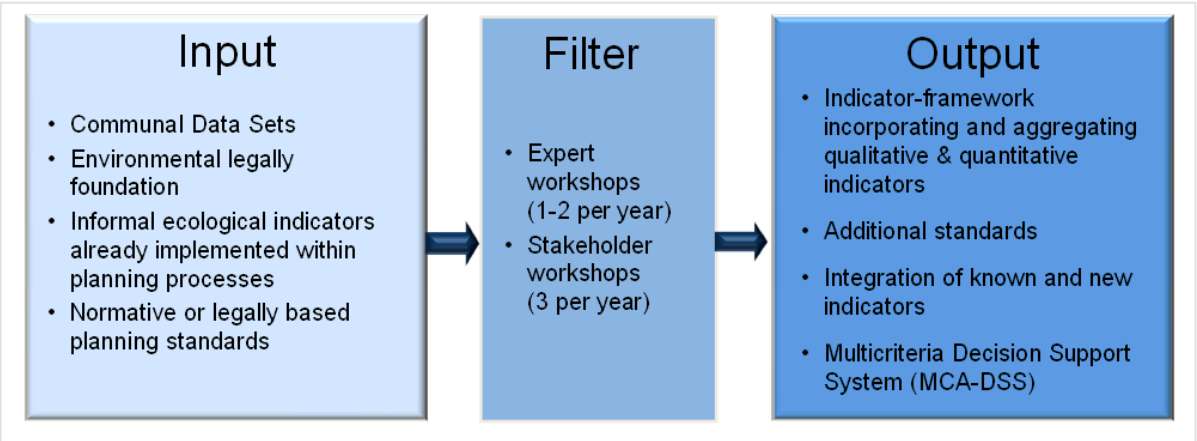

Figure 2 Structure of the process of indicator-selection (source: SCHETKE ET AL.*)

Next to new indicators also established indicators used by the planners of the partner cities were used. Existing data sets helped to formalize the selected indicators:

Ecological Dimension: The assessment of future housing sites according to the ecological dimension of sustainability and the formulation of indicators followed the three categories as presented in figure 1. Driving forces of suitable and planning-oriented indicators were – amongst others – the "assessment of ecosystem functions being affected by additional settlement areas, the use of natural resources […] and that natural risk potentials affecting the suitability of a site for settlement-purposes" (SCHETKE ET AL. 2009, p. 105).
Social Dimension: The assessment of future housing sites concerning the social dimension „focuses on the technical and nature-oriented quality of life and human well-being." (SCHETKE ET AL. 2009, p. 105, 117). Regarding scientific literature, the concept of quality of life was frequently used and interpreted in many ways over the last years (see e.g. studies of SANTOS & MARTINS 2007, JIRÓN & FADDA 2000). The two major categories for this dimension assess *i)* the accessibility of social and technical infrastructure (SCHETKE & HAASE 2008) and *ii)* the quality of living surroundings and the neighborhood due to e.g. noise exposure. In doing so, planning standards enabled a comprehensive assessment.

3.1.1. Theoretical requirements

In general, a MCA integrates different aspects and takes also conflicts between interest groups and stakeholder within planning processes into account (NIJKAMP ET AL 2002). It claims to fulfill conceptual and technical requirements and has to be applicable to different tasks. To facilitate the use and applicability of a MCA within planning processes the following demands need to be taken into account besides the above mentioned content-related issues (SCHETKE ET AL.*): technical, software and usability-related requirements, which determine the use and function of each MCA. A wide discussion on planner-oriented indicator-systems to promote sustainable settlement growth and municipal development uses can also be stated for many countries across Europe, so eg in Germany (o.a. HEILAND ET AL 2003; DÖRING ET AL. 2004; COENEN 1999; GEHRLEIN 2003; WRBKA 2003; KORCZAK 2002; FLACKE 2003).

According to these studies three priority tasks/functions (KÖTTER ET AL. 2009) of the MCA can be defined:

- Analysis functions: Deduction and operationalization of complex system-interrelationships to provide a broad understanding of practitioners and to allow its communicability,
- Communication and information function: reduction of complexity and information to depict reality,
- Control, warning and decision-making function: within planning-processes a sustainable settlement-development can be partially controlled using appropriate indicators. Planning alternative can be evaluated and strategies adjusted.

3.2 Development of the DSS

The elaboration of a DSS is an essential step for the incorporation of the theoretical conception of the MCA and the derived indicator-set to issues of practical planning. The DSS fulfills the central task of the integration of the results of the MCA. It translates them into comprehensive aggregated statements. An aggregation into comprehensive statements and a degree of abstraction of scientific results is very important as decision-making processes on future land use of a city are bound to the political arena. In order to launch issues of sustainable settlement-development those statements have to be concise in order to convince.
Major requirements for the DSS were the integration of heterogeneous indicators from the *i)* ecological and social dimension of sustainability and *ii)* showing different characteristics, namely qualitative and quantitative. Additionally, the integration of individual indicator-weights into the final statement of the MCA forms a mandatory requirement of the DSS. These weights were derived from stakeholder workshops with local planners (see figure 2) representing the partner cities. The weights indicate the decision-relevance of each indicator. Therefore, the DSS meets the needs and demands of different stakeholders and enables a site-specific assessment (KÖTTER ET AL.*).
In doing so, the project staff of the research-project FIN.30 elaborated a user-interface as a DSS. It enables an integrated land use assessment based on communal data sets and provides an individual and planner-oriented assessment of current strategies of land use planning. In order to test and optimize the DSS several workshops were conducted. Central aspects were not only the usability of the DSS but also issues such as decision-relevance, communicability and user-friendliness. Central demands of local planners were the clear arrangement of the interface, a summarizing display of the results of the MCA within dossiers and a ranking of all future housing sites according to their assessment. The DSS was realized using *Visual Basic*, which was widely accepted by local planners. Reservations could be reduced by an implementation of the DSS into MS EXCEL and leads to a quick application. The test- runs showed that the extent of data-input and the number of indicators were assessed positively by the planners (KÖTTER ET AL.*).

3.3 Integration into urban planning

The central task of the DSS is the assessment of future housing estates in terms of sustainability. In order provide with a strategically valuable integration within the planning process, the assessment refers to future housing sites displayed in current land use plans

("Flächennutzungsplan") or land use plans under elaboration ("Planaufstellungsverfahren"). As the DSS aims at the analysis decision-making and monitoring of land use in under the headline of sustainable settlement development it needs to be applied at the scale of strategic, preparatory land use planning ("Vorbereitende Bauleitplanung") (SCHETKE ET AL. 2009). Within the dual framework of German land use planning, a land use plan is an instrument of preparatory land use planning and generally displays the different land uses within a municipality such as areas such as housing areas, commercial zones or areas of mixed use, areas for social and technical infrastructure, regional and local highways/streets; green and open spaces and areas for agriculture and forestry (§5 German Federal Building Code, BauGB). The land use plan therefore provides the major development paths of a municipality for the coming 10-15 years. It also includes aspired municipal development trends. An embedding of the DSS into this strategic level of land use planning and assessment of political strategies gives planners the opportunity to adjust planning targets according to the goals of sustainability (KÖTTER ET AL. 2009a).

4. DISCUSSION AND CONCLUSION

The presented MCA-scheme and the associated DSS of the research-project FIN.30 provides with valuable contributions to a user- and planning-oriented assessment of settlement development. It focuses on a sustainable development and was exemplified at the application at the strategic level of German preparatory land use planning. A practicable MCA providing a comprehensive set of ecological and social indicators and its integration into a DSS facilitate a proper implementation within planning- and decision making processes (KÖTTER ET AL.*).

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BIOGRAPHICAL NOTES

Sophie Schetke studied Geography, Meteorology and Geology at the University of Leipzig (Germany) and Amsterdam (Netherlands), since 2006 she is scientific associate at the University of Bonn, Department of Urban Planning and Real Estate Management of the Institute of Geodesy and Geoinformation. Her professional and research interests comprise all issues of sustainable settlement development, Multi criteria assessment (MCA) and Decision Support Systems (DSS), and issues of Ecosystem Services and Quality of Life in urban areas.

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Dagmar Haase studied Geography, Biology and Geology at the Halle-Wittenberg University and Sociology at the Leipzig University in Germany. Since 2000 Dagmar Haase has been a member of the scientific staff of the Helmholtz Centre for Environmental Research - UFZ, Department of Applied Landscape Ecology. She co-ordinates the research work on urban modelling and monitoring at the Department. Another subject of her current research refers to environmental effects of urban land use change such as flood impact and risk assessment, recreational and habitat functions of urban greenery. Since 2009, Dagmar is Professor for Landscape Ecology at the Humboldt-University of Berlin.

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