Assessment of Sustainable Land Use within the Town Planning Process

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Key words: Land consumption, sustainable land use, multi-criteria indicator matrix

SUMMARY

Land is one of the natural resources, which is irreplaceable for all demands of life, urban and rural development as well as agricultural production. But the efficiency of land use is already very low and furthermore decreasing and so the deficit concerning sustainable land use will be also declining. During the last years urban expansion and the development of settlement areas have been the driving forces of an enormous land consumption, the usage of natural resources and the loss of ecosystem services. Facing a land consumption of 114 ha/d between 2002 and 2005 the German government has implemented a qualitative development goal for a reduced use of 30 ha/d. To realise this urban planners have to focus on an inbounded and concentrated settlement development characterised by additional densification of built-up areas and land recycling of brownfields. The current trends of outbounded settlement development and an increasing urban sprawl have to be stopped for the sake of a sustainable settlement development. Against this background the paper presents a multicriteria indicator matrix covering the three dimensions of sustainability supporting a zoning-plan-based analysis and assessment of current and prospective spatial developments. After a short introduction focussing on the German policy strategies for reduced land consumption the second part of the paper discusses the concrete contribution of the project FIN.30 towards sustainable urban development discussing an approach of “intelligent land use”. The third part is divided into a discussion and presentation of the needs and requirements of sustainability indicators in general as well as a presentation of the main points of the three dimensions of sustainability being operationalised by categories and criteria in within the project FIN.30. The expert- and planning- oriented development of an indicator matrix covering the three dimensions of sustainability is part of the research project FIN.30 of the University of Bonn, Chair of Town Planning and Real Estate Management in cooperation with the cities Essen, Erftstadt and Euskirchen in Northrhine- Westfalia. BIOGRAPHICAL NOTES Theo Kötter studied Geodetic Sciences and Spatial Planning at the University of Bonn. He was assistant at the Institute of Urban Planning and afterwards he was chair of the town planning departments of town development companies in Munich and Bonn. Since 2003 he is Chair of the Department for Urban Planning and Real Estate Management at the University of Bonn. His professional and research interests comprise all aspects of sustainable town and country development, land management, land valuation and CAD/GIS applications in spatial planning. He is co-editor of the magazine “Land management and Land policy”. Since 2003 he is chair of the FIG working group „Disaster Risk Management“.

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1 METHODICAL BACKGROUND

The elaboration of a multicriteria assessment scheme (MCA) for suitable housing land potentials under the premise of sustainability shows are many technical and structural requirements on indicators and criteria. These requirements significant determine the applicability, transparency and communicability of such a MCA-approach. Technical influences such as the availability of data essentially determine the choice and applicability of the indicators. The more, to ensure an integration of the MCA into current planning processes addressing issues of sustainability it is of great importance to keep the demands and decision processes of future users (municipalities and local decision-makers) in mind.

Based on this the focus has lie on local models to reduce an often fairly high level of abstraction and to achieve a direct and comprehensible reference to land. A comprehensible MCA-scheme is an important step towards a transfer and communication of scientific knowledge into local assessment and land management approaches ("learn from others"). In addition, such an approach requires a scientifically consistent design but has to bridge the gap towards municipal planning practice and subsequent user-friendliness. The synthesis of a consistent and scientifically representative MCA-scheme towards an applicable, decision- and policy relevant assessment framework for municipal planning is a crucial task of the presented approach.

As mentioned above, beside structural determinants we have to face concrete practical technical requirements influencing the MCA-design and selection of indicators. These requirements related to available data-sets especially determine the characteristics of indicators (qualitative/quantitative) and their spatial application. As a consequence these aspects such as quality and availability of data have crucial influence on the main focus of the MCA-scheme. These constraints limit a scientifically consistent operationalisation of sustainable settlement development but are limiting factors scientists have to be aware of.

Finally, these requirements are resulting in three priority tasks which the presented MCA-scheme has to fulfil:

- Deduction and thus operationalisation of complex system- interrelationships to provide a broad understanding of practitioners and to allow its communicability (analysis function).
- Reduction of complexity and information to depict reality (communication and information function).
- Control, warning and decision-making function: Within the planning process a sustainable regional development can be partially controlled using appropriate indicators. Planning alternatives can be evaluated based on an assessment framework using MCA.

- Monitoring function: A target-performance comparison of different planning scenarios allows a monitoring of human settlements development using sustainability indicators.

With the help of appropriate indicators sustainable settlement development can be depicted and becomes measurable (decision, controlling, monitoring). Indicator values of the status-quo and future development scenarios can be compared, measured and assessed using threshold or reference values (FLACKE 2003: 68; NIJKAMP, P. & OUWERSLOOT, H.: 4). In the presented research project FIN.30 (see chapter 2) the operationalisation of complex system interrelations and driving forces within the municipal development has been carried out aiming at the development of a tool for analysis, decision-making and monitoring to significantly contribute to reduced land consumption.

2. MCA-SCHEME OF THE PROJECT FIN.30

The MCA-scheme for assessment of additional residential land consists of an indicator-matrix covering the three dimensions of sustainability and a calculation model giving additional importance to the aspect of economical sustainable settlement development. The MCA-scheme follows a threefold hierarchy dividing the three dimensions of sustainability into categories on the top, criteria in the middle section and is resulting[1] into quantitative/ qualitative indicators and allows a systematic operationalisation of the sustainability dimensions.

The ecological dimension focuses - in terms of environmental impact- especially on environmental restrictions, which have to be taken into account against a background of new settlement development. The operationalisation of this dimension is closely oriented at the legally defined environmental protection goods of urban land use planning.

The social dimension is closely connected with a positive evaluation approach and the suitability of an area as residential land focussing on the approach of Quality of Life.

The dimension "economy" covers an integrated objective calculation of costs related to settlement development.

Final goals of the implementation of the MCA-scheme are the assessment and ranking of new residential areas implemented in municipal land use plans and to bridge the gap from science to local politician and decision-makers ("feasibility").

2.1 Dimension „Ecology“

The significance of an ecological impact caused by residential area extensions will be operationalised by five categories. The category "land use" covers aspects of urban density and settlement structure with a view to a desirable, compact urban development. The category "Green Quality / environmental land-performance" focuses on the quality of urban green characterized by Ecosystem Services (Constanza et al. 1998) or Ecosystem Functions such as natural replenishment, climate regulative functions, provision with habitats which may be significantly reduced by new residential buildings.

[1] These are not the subject of this essay. In addition, the issue of weighting indicators should lead to a later date to discuss. This situation is under the project FIN.30 not yet conclusively discussed.

Against the background of the German 30 ha/d- land saving goal including issues such as land recycling the category "resources conservation" aims critically at a negative assessment of increasing sealing rates and soil consumption. The category "urban climate" is assessing the impact of new residential building on ventilation corridors for fresh and cold air.

The category “risk” considers the vulnerability of residential areas to external environmental factors such as the risks deriving from floods or groundwater and its implementation into preliminary evaluations of new residential sites.

Beside these main aspects of the ecological dimension of the MCA-scheme, trend-setting structural priorities influencing an appropriate the operationalisation of the dimension "ecology" by relevant indicators can be named. Pragmatic and essential selection criteria for indicator-compilation are determined by the availability of communal data-sets bases, on the one hand the acceptance of local decision-makers, on the other.

In order to increase the communicability and practicability of the MCA-scheme existing and well-known planning instruments have to be considered. Therefore indicators already known from policy instruments such as environmental impact assessment (“Umweltverträglichkeitsprüfung”) have been integrated into the MCA-scheme in their original or modified set-up.

However, the presented MCA-scheme does not aim at imitating existing planning instruments but tries to highlight synergy effects between practical planning and new scientific approaches. An implementation of the scheme does not mean increasing additional workload but the fulfilment of existing planning requirements of impact analysis. Already common procedural steps such as "screening" can be adapted and extended by easily understandable and quantifiable indicators. This point we are facing the challenge to identify parallels and synergies between planning and science.

To additionally increase not only the acceptance of the MCA-scheme but, the more, to enhance its applicability our indicators are based on present communal data such as cadastral data or other GIS-based information systems (see e.g. German Land Survey Administration, Geological Service).

2.2 Social dimension

The operationalisation of the social dimension of sustainability focuses on the suitability of new residential sites according to the concept of Quality of Life (QoL). It analyses the availability and accessibility of adequate recreational facilities as well as social and technical infrastructure (SCHETKE & HAASE 2008, in press). These factors are integrated into two categories named "justice of supply" and "attractiveness of the living environment". While the first solely deals with standards of accessibility of different types of social infrastructure being important determinants for QoL the latter integrates static prerequisites of urban green infrastructure and the impacts of emission loads and noise.

The accessibility of facilities of social infrastructure contributes not only to an increasing QoL but has significant impact on the marketability of potential housing sites as a deficit of facilities not seldomly results into prime costs for new facilities. Coming from a pure analysis of supply and accessibility of social infrastructure the category "attractiveness of the living environment" analyses not only the accessibility of recreational spaces in the closer residential area (SCHÖNING & BORCHARD 1992: 85) but is also dependent on adequate land use type and size of the green space.

The use of normative threshold values deriving from scientific literature related to a GIS-based accessibility analysis provides the possibility to identify pros and cons related to both categories of any individual site. The more, the use of threshold values used for accessibility analysis can be undermined by analysis capacity utilization of existing facilities. Facing a decline of the population and decreasing numbers of children in the wake of the second demographic transition smart representation of residential sites can reduce follow-up cost and has consolidating effects on the persistence of social infrastructure.

2.3 Dimension „economy“

Beside environmental acceptability and social suitability of new residential areas economic viability and feasibility play are crucial decisive factors in times of reduced municipal budgets. The economic dimension does not focus on a monitoring of the economic performance of a municipality but tries to highlight cost and revenue- effects of certain land use alternatives. As the MCA-scheme shall act as a decision support system (DSS) on the scale of land use plans economic calculations in the MCA are executed dynamically covering a period of 15 years (planning horizon of a German land use plans). It integrates both project-related as well as communal economic effects which demand a dynamic approach. The calculation model presupposes plausible assumptions and scenarios e.g. in terms of building structure and temporal cycle taking resulting quantitative uncertainties into account. Nevertheless, local costs and revenues as well as associated pros and cons of certain residential areas become consistently illustratable.

Economic consequences of new residential areas are reduced to decision-relevant costs and revenue regardless to cost-bearers. That means a reduction to all economic effects related to the respective locations. External effects are not integrated into MCA as they cannot be related to a certain single site. The same counts for opportunity costs or so-called “shadow-prices”.

The result of the economic dimension is a monetary ranking of potential housing sites differentiated by target groups and structures within a municipality.

Here, a complete compilation of development and long-term maintenance costs for new infrastructure associated to new residential area and its potential funding is of particular importance.

A low performance level of ecological and social indicators suggests deficiencies in the provision of social and technical infrastructure and green spaces. An assessment of these deficits is given within the evaluation criteria “preparation and implementation costs”, “interim financing costs”, “technical and social infrastructure” and “compensatory measures”. In addition to that cost-relevant characteristics of a potential residential area have to be identified.

Several examples can be named: e.g. soil type and slope can have significant effects on prime costs of internal and external development. The geographic location of sites of white land areas has particular influence on the existing network of technical infrastructure. A necessary extension of the existing network would lead to significant additional costs for new construction and maintenance.

The cost of long-term maintenance and operation of these facilities usually has to be paid by the municipality. As the amount of these costs highly depends on settlement and the building structure the municipality is able to reduce these long-terms costs by smart representation of additional residential areas. In that context we reduce the analysis of the "refinancing potential" being mainly related to manufacturing costs. As it is not possible to integrate a large number of manifold and different approaches of refinancing potentials on city-level the identification of potential refinancing is related to single building sites.

3 SUMMARY

In this paper a MCA-scheme for sustainable resource and human settlement development has been presented and discussed. The discussion of requirements of sustainability indicators schemes shows that in most cases great effort has to be put into bridging the gap between scientific consistency and practical applicability of such a assessment-scheme.
It is not the main task of the MCA-scheme to solely promote modest and adequate density related to consumption of natural resources - especially the resource soil – but shall increase transparency and rationality of local decision-making process of settlement development. The more, especially this qualitative, resource-oriented approach is supposed to bridge that gap between scientifically oriented sustainability research and planning-oriented reduction of land consumption.

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