Stakeholder-specific assessment of environmental, economic and social effects of resource-efficiency measures in urban districts - first results

IOP Conf. Series: Earth and Environmental Science **588** (2020) 052036 doi:10.1088/1755-1315/588/5/052036

Stakeholder-specific assessment of environmental, economic and social effects of resource-efficiency measures in urban districts - first results

Rebekka Volk*, Thomas Lützkendorf, Sophia Schambelon, Elias Naber, Kai Mörmann, Denise Böhnke, Stefan Norra, Rainer Schuhmann, Anke Ehbrecht, Maria Balouktsi, Frank Schultmann

Karlsruhe Institute of Technology (KIT)
Kaiserstr. 12, 76131 Karlsruhe, Germany

*rebekka.volk@kit.edu

Abstract. There is a great interest in society in making urban districts more sustainable. Sustainable and resource-efficient urban development (SDG 11) is a process that, based on the analysis of the initial situation, leads to the formulation of specific goals and must be planned, accompanied, assessed and managed. Thus, this contribution presents a fundamental, multi-perspective concept to assess and manage the use of (natural) resources (stocks and flows), in particular (1) water (rain, potable and waste water), (2) land use (settlements, traffic area, open/green areas, ecosystems), (3) raw materials (material in- and outputs, recycling and disposal, C&D waste, and fossil fuels) in a defined urban district.

1. Introduction

Cities and communities are increasingly important in sustainable transition and development of societies (SDG11 *Sustainable Cities and Communities*). They are centralized spaces of societal coexistence in living, working, consumption and production, systems of energy and material flows, and governance units due to the wide range of involved stakeholders. Urban areas have a strong influence on environmental impacts. However, they are also increasingly affected by climate change and consequences of the use of natural resources and environmental pollution. But, they are not only subject matter, as their administrations can also take active measures to reduce environmental impact. City administrations can directly or indirectly influence for example buildings, infrastructures, mobility, industry and trade, e.g. for GHG reduction (SDG13 *Climate Action*) or resource protection (SDG12 *Responsible production and consumption*). The city administrations have already recognized the need for actions and have been working intensively on energy and climate protection plans, climate neutrality (defossilization/decarbonisation) and strategies for climate adaption. However, for a sustainable urban development these efforts have to be extended by other protection goals, e.g. SDG6 *clean water*, SDG15 *life on land* (biodiversity), SDG3 *good health and well-being* and natural resources (SDG12, especially circular economy). In city governance and urban transition, a trend to district management is visible, because the identification, engagement and motivation of both active and affected stakeholders is typically easier.

This contribution combines sustainable district transition with assessment and targeted management of land, water and materials use complementing traditional energy and climate topics. It is the goal to develop tools which enable city administrations and other stakeholders to monitor the use of natural

resources (here: water, land, materials) on district level and establish an active resource management. The tools shall recognize, model and analyse subsequent effects (e.g. land sealing effects or the heat island effect). All these functions help to identify goal conflicts between sustainability dimensions or stakeholder interests and to moderate a fair balancing of burden shifting, as well as to show measures' and decisions' impacts of resource use. Envisioned are assessment and visualization tools to support city administrations, urban planners and decision makers in a sustainable urban transition process.

2. Research approach

To manage (natural) resources efficiently, their use has to be measured and assessed. On this basis, requirements for action can be identified, measures can be designed and targeted goals can be monitored. Thus, the proposed four-step approach includes (A) the definition of requirements, (B) the development and agreement on an assessment scheme with relevant aspects in each field, (C) the modelling of interrelations, effects, side effects and consequences as well as (D) the implementation and testing (see **Figure 1**). The approach aims at supporting multi-criteria decision making and urban/district resource management and is described in more detail in the following.

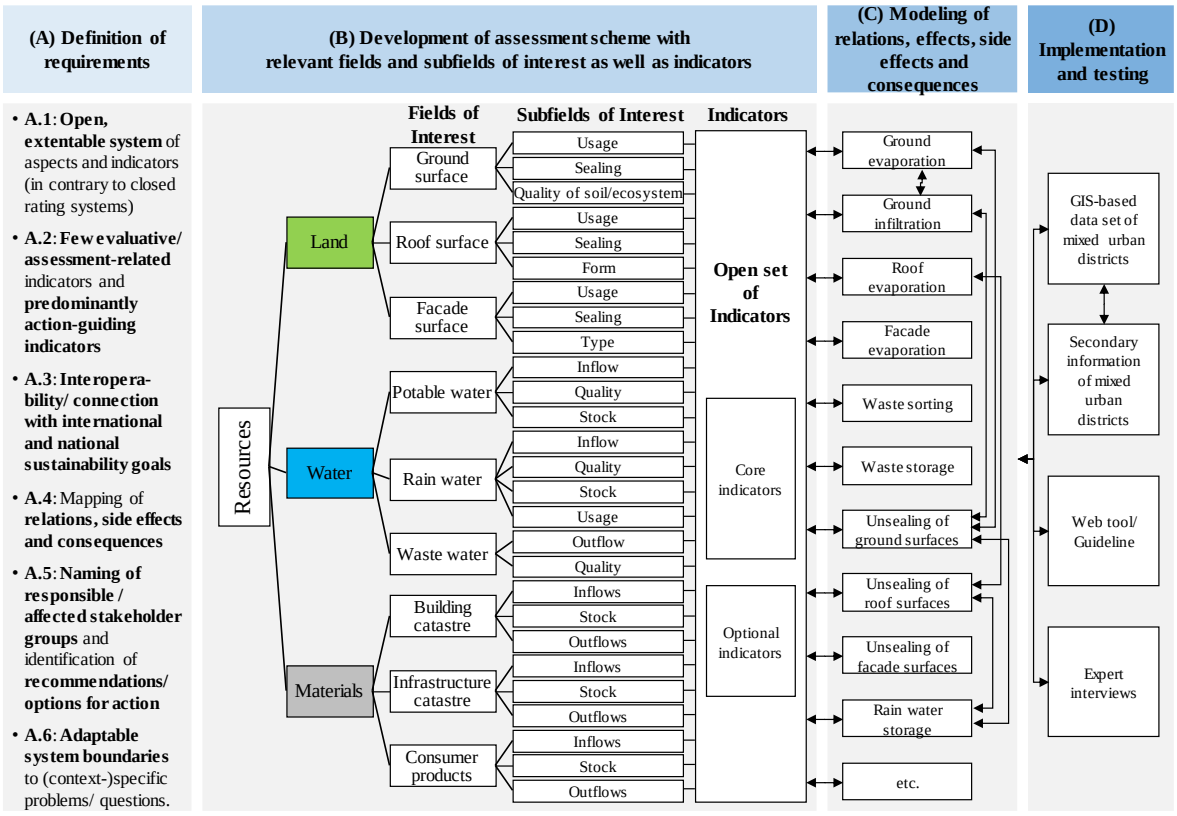

Figure 1: Research and development concept with exemplary "Fields of interest" and "Subfields of interest"

3. Urban resource management concept

3.1. Definition of requirements (A)

To develop a management tool for resource use in urban districts, an open set of indicators is required where users and decision makers can take information as needed on a case-by-case basis (A.1). This is opposed to the currently extended lifecycle assessment (LCA) approaches or the closed sustainability assessment systems for cities and small urban units such as the DGNB system [1]. Predominantly, action-guiding indicators are needed (A.2) to support the resource management and the indicator set has to be connectable/interoperable with international and national sustainability goals and strategies (A.3). The system should connect interrelated indicators and map related side effects and consequences (A.4).

Furthermore, both the responsible/affected stakeholder groups have to be identified and the recommendations/options for action be named/derived by the tool (A.5). Regarding to the interconnectedness of the urban district with the surrounding city, system boundaries of indicators should be adaptable to the respective problems/questions that are observed and measured (A.6).

3.2. Development of assessment scheme with relevant fields of interest and set of indicators (B)

For the development of a base set of indicators for an urban resource management on district level, a literature review of existing strategic and operational indicator sets and assessment frameworks was done and evaluated concerning their applicability on the neighbourhood and operational level. Furthermore, international standards were considered [ISO 37120:2018; ISO 37122:2019; ISO 37123:2019] and existing international and national sustainability assessment systems [1,2,3,4,5] as well as working documents of cities and municipalities in the context of the SDG discussion [6] were analysed.

Moreover, local stakeholders (city administration, representatives of local stakeholder groups such as energy provider, energy and climate protection agency, private owner association, urban planners, citizens) were integrated in a participative process. Additionally, focus group workshops with stakeholders and experts are performed to identify useful indicators for decision making on operational level, to prioritize most relevant indicators and to evaluate data availability. This lead to top-down, bottom-up and side-wise integration of the indicators: top-down derivation from international and national indicators, bottom-up collection of specific problems and side-wise connection to energy and climate issues. Finally, suitable and new indicators and their interrelations are compiled per aspect and stakeholder group for the assessment scheme. For the support of planning decisions on the level of small urban units the following approach was developed: (a) **Fields of interests (and subfields) are developed with subordinate indicators** for the resources land, water and materials. (b) **Fields and indicators are transferable and connectable** to international and national target and indicator systems as well as environmental impact assessment scheme standards. (c) The **indicators** are separated in **core and optional indicators** that allow for "accounting" of the resources' usage on district level. Optional indicators can be selected and integrated case-wise. (d) The indicators are able to depict **effects, side effects and consequences** of resource usage resulting from decision making (e.g. investments, change measures, retrofits, etc.). (e) The indicators are accompanied by **background information** that is relevant for the characterization of the district and base for the determination of a (non-) comparability. (f) The scheme can be extended easily by **additional fields of interest and indicators** by local stakeholders due to new problems and/or locally differing development goals.

Furthermore, the developed and allocated indicators cover – as far as possible – economic, ecological, social, technical, institutional and process-related dimensions and allow a stakeholder-wise perspective. In contrast to closed systems, the problem of double counting does not arise with an open system without a claim to an overall rating/certification. **Table 1** shows an example.

Table 1: System of indicators (selected example)

Background information: Characterization of the district (e.g. residential, commercial or mixed)				
Field of interest: „Land use/land use change"				
Type of Indicator	**Core Accounting Indicators**	**Optional Accounting Indicators**	**Additional Accounting Indicators**	**Effects, side effects, consequences**
Example	Sealed land area (status, trend)	Quality of ground cover	Area of leisure	Effects: *Ground evaporation*, *Ground infiltration*, *Rainwater collection/storage*, *Urban heat island effect* Related Aspects: *Ground surface, Ground usage, Waste water*

3.3. Modelling of relations, effects, side effects and consequences (C)

Known relations, side effects and consequences of resource use in urban districts relations will be modeled based on literature (e.g. on environmental impact assessment), knowledge and models from natural sciences about (urban) ecosystems (including soil, air, water and materials) as well as expert interviews. The model will be used to simulate and evaluate effects of resource use (e.g. for local ecosystem services) as well as options for action in a district.

3.4. Implementation of an Urban Resource Management and Decision Support Tool (D)

Overarching goal of the management support tool is to expose and visualize the use of resources in urban areas and its potential consequences for different stakeholders to fill blind spots in the planning process. To support sustainability-focused decision-making in urban resource management, municipalities need well-organized data of the local conditions and easy access to analyses regarding the district status and development. Thus, a GIS-based tool will be developed to provide a joint data platform and to compile the developed indicators of land, water and materials and their interactions. The indicators will be flexible to choose by the involved actors, so that the tool can be adapted to the local needs. The tool can be used to monitor the district status (e.g. as an alert mechanism) as well as to compare potential measures' effects. The GIS-based approach offers some crucial advantages. Using the spatial reference of the data, the tool can scale up and down the observed area and indicators can be compared in different district sections to localize hotspots/areas with high transformation potentials.

The indicators and assessment system will be tested in the application "unsealing of backyards" in a case study district. The data base includes GIS-related district data provided by the city of Karlsruhe, further primary information collected by the research team and secondary data that are adequately linked and processed.

4. Discussion and conclusion

Until now, strategic and operational indicators for sustainable city development still diverge. This paper contributes interim results from an ongoing research project to close the existing operationalization gap in sustainable urban transition and thus supports achieving SDG11 and related goals. The developed assessment scheme and its indicators allow an observation, analysis and monitoring of resource use in existing urban districts. They can also be transferred to other district types and upscaled from the urban districts to the city level. It can be used as an integrated information platform for governance processes or other forms of inter- and transdisciplinary cooperation, since shared information can lead to a mutual and more holistic understanding of the topic. In the sense of *Smart City*, it is also conceivable to show the monitoring results at an online citizen platform, so that locals can access the sustainability performance of their urban district to take bottom-up actions themselves.

However, due to the openness and flexibility of the proposed approach, this paper does not provide a comprehensive set of aspects and indicators. Another important characteristic of the developed indicator set is decision support without scoring for competitive judgement. This is why it is adaptable to local issues and probably more acceptable to users. Furthermore, the results always have to be interpreted by involved experts and decision makers with respect to the background information and local circumstances.

Acknowledgements

The authors gratefully thank the German Federal Ministry of Education and Research (BMBF) for its funding of the research project NaMaRes (#033W111A).

References

[1] DGNB (2019): DGNB System: Nachhaltige Quartiere planen und zertifizieren, https://www.dgnb-system.de/de/quartiere/index.php (last access: 20 Dec 2019).
[2] LEED (2009): LEED for Neighborhood Development, The U.S Green Building Council.
[3] BREEAM (2009/2012): BREEAM Communities. SD5065B Technical Manual. BRE Global Ltd.
[4] CASBEE (2007/2014): CASBEE for Urban Development, Technical Manual, 2007/2014 Edition, http://www.ibec.or.jp/CASBEE/english/downloadE.htm (last access: 08 Jan 2020)
[5] OROVA, M.; REITH, A. (2013): Comparison and evaluation of neighbourhood sustainability assessment systems, PLEA2013 - 29th Conference, 10-12 September 2013, Munich, Germany
[6] BERTELSMANN (2018): SDG-Indikatoren für Kommunen/SDG indicators for communities; https://www.bertelsmann-stiftung.de/fileadmin/files/Projekte/Monitor_Nachhaltige_Kommune/SDG-Indikatoren_fuer_Kommunen_final.pdf (last access: 08 Jan 2020)