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Sustainability Indicators and Urban Development

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1. The Need for Sustainability Indicators

Rapid economic growth, social polarization, and the worsening of environmental and health conditions characterize the ongoing development processes especially in Asian mega cities. The economic growth is connected with enormous urban growth, as well as the increase of industrial and commercial zones and traffic. Industrial production with low environmental standards, individual cars and insufficient housing conditions produce health-endangering environmental loads. Human settlements are material and energy consuming and throughput systems: high amounts of resources (e.g. water, oil, food, building materials and energy) are imported into cities and urbanized regions, partly transformed (energy production), used – and in the end exported as solid waste, wastewater, waste heat, etc. These processes occur not only on a local level, but are also internationally linked, and thus influence environment and health on a global level; they raise global environmental and health risks. These global environmental and health risks demand for a sustainable urban development.

The recent Asian urbanization processes differ from the American and European experiences and make Asian urban development unique, thus requiring new and adequate approaches to urban management. Asian urban development is taking place much faster than the American and European processes. “In Asia challenges overlap so that within most cities, particularly those increasingly articulated to the global economic system, we find a variety of problems and unfinished agendas”¹, requiring to solve all issues simultaneously.

According to Agenda 21², sustainable development shall meet the needs of the present without compromising the ability of future generations to meet their own needs. The general public shall be involved in decision-making and especially urban development processes. Many cities try to implement sustainable *urban* development on the local level. Sustainable *urban* development is an integrative dealing with ecological, economic, social, and cultural aspects of urban development in a long-term perspective, including also good human health conditions. It takes place on the local level while considering regional, national and global interrelationships. Sustainable urban development requires the co-operation of a variety of authorities, stakeholders and social groups on different political levels. Considering the global variety of urban social, economic, cultural, and environmental conditions, it becomes obvious that the above general meaning of sustainable development has to be transferred to the prevailing local conditions. In order to discuss sustainability with various groups, and in order to find out to what extent the real urban development processes comply with the envisaged sustainability, adequate assessment procedures and accordant instruments are required.

The rapidity of Asian urban development as well as the coincidence of urban development processes and phases requires adequate approaches to urban management. Improving the steering potentials of local and metropolitan decision makers by introducing indicator-based urban management systems can be one solution for urgent environmental and health problems.

¹ Marcotullio 2004, p. 48

² UN Department of Economic and Social Affairs, Division for Sustainable Development 1992

In order to unfold a reliable basis for political and planning decisions on all levels, Agenda 21 demands for developing indicators for sustainable development. Common indicators like GDP (Gross Domestic Product) and the information about single resource and material fluxes meet the information needs of sustainable development insufficiently. The use of sustainability indicators shall support the development of self-regulating environmental, social, and economic systems, including urban systems up to mega cities.

2. Sustainability Indicators – Approaches, Purposes, Types

A broad variety of indicators and indicator sets exist, including those in the field of (sustainable) urban development, but to date no methodical standard has been derived on how to develop indicators. Commonly, indicators are parameters that describe situations or circumstances not directly able to be ascertained. An indicator also can be characterized as “a summary and synthesized measure that indicates how well a system might be performing.”³ They can measure quantitative or estimate qualitative data, answer different purposes, and be used in different contexts; hence, various indicator types can be differentiated.

Since 1992, many sustainability indicator approaches have been developed on international, national, regional, and local levels, both in industrialized and in developing countries⁴. Highly aggregated indices exist beside indicator sets with many single indicators; partly, a few complex key indicators are combined with a large number of simple indicators. The indicator sets of the World Bank⁵ and the United Nations⁶ aim at a comprehensive, integrative implementation of Agenda 21. The Urban Indicators Programme (UIP) of the UNCHS (United Nations Centre for Human Settlements) shall support both the implementation of Agenda 21 and Habitat-Agenda. The UN-indicator set and methodological descriptions are expected to be released in 2006. Most of these indicator sets also comprise human health indicators.

The indicator set of the WHO (World Health Organization) aims at supporting explicitly health and environment analyses for decision making.⁷

Also many cities and towns, mainly in the Western world, but also in China⁸ have elaborated sustainability indicators.⁹ The North American city of Seattle, for example, emphasizes the long-term cultural, economic, and environmental health and vitality as fundamental elements of sustainable urban development. The indicator set of Seattle is at present being revised; the new indicator set will be drawn up this year.¹⁰ The emergence of a European-wide urban policy has given an impulse to define comparable quality of life indicators for European cities in order to monitor urban development and policy implementation.¹¹

The ecological footprint¹² is an example of a sustainability index with an environmental focus; it estimates the amount of space that an individual or a city uses in order to survive on a global level respectively worldwide. The ecological footprint includes productive land and water that produces the resources consumed (food, water, energy, clothing, building materials, waste, etc.). As a consequence, the ecological footprint reflects one person's or the urban lifestyle. The ecological footprint is – as every index – restricted in its informative capability and preciseness, but it is useful for awareness-raising, communication and environmental education.

³ Flowers et al. 2005, p. 240

⁴ See Parris/Kates 2003 and online-compendium in IISD 2006.

⁵ World Bank 1995, World Bank 2006

⁶ UN Department of Economic and Social Affairs 2006, UN Habitat 2006

⁷ Corvalan et al. 2000, WHO 2006

⁸ Yuan et al. 2003

⁹ See IISD 2006.

¹⁰ Sustainable Seattle 2006

¹¹ Craglia et al. 2004

¹² Rees/Wackernagel 1997

Since 1992, one can ascertain a move from one-sector-approaches to comprehensive indicator sets over time. Furthermore, interest groups and the general public have increasingly participated in the elaboration of indicator sets, especially on the local level.

The main purposes of sustainability indicators are for¹³:

- Understanding sustainability: they are helpful for the identification of relevant issues, for the analysis of current states and future trends as well as for education and informing (or distributing information to) the public.
- Supporting decisions: they provide the information base necessary for the definition of objectives and goals and the identification of action requirements. Furthermore, they can be used for benchmarking processes.
- Directing: They are relevant for urban decision making and planning, especially for monitoring and evaluation, for assessing performance and for guiding and controlling.
- Involving stakeholders and empowerment: sustainability indicators play an important role in the involving of stakeholders; they can serve for communication, participation, for the initiation of discussions and awareness rising. Thus, they can play an important role in community empowerment.¹⁴
- Solving conflicts: Last but not least they can be useful in mediation processes or generally in discussions with differing values.

Different types of sustainability indicators can be distinguished. According to the DPSIR-model, driving force indicators as well as pressure, state, impact, and response indicators have been derived. Rate indicators describe a change over time; target, goal or steering indicators specify the objectives strived for; performance indicators evaluate the reaction of a political system. Some examples of different indicator types demonstrate the variety of sustainability indicators:

- Driving force indicators: population growth, prosperity level,
- State indicators: current air quality, noise level,
- Pressure indicators: CO₂ emissions,
- Impact indicators: percentage of children suffering from water-borne diseases,
- Response indicators: percentage of cars with catalytic converters,
- Rate indicators: decrease of air quality with time,
- Target / goal indicators: standard for desired air quality,
- Steering indicators: desired increase in public transport passengers.

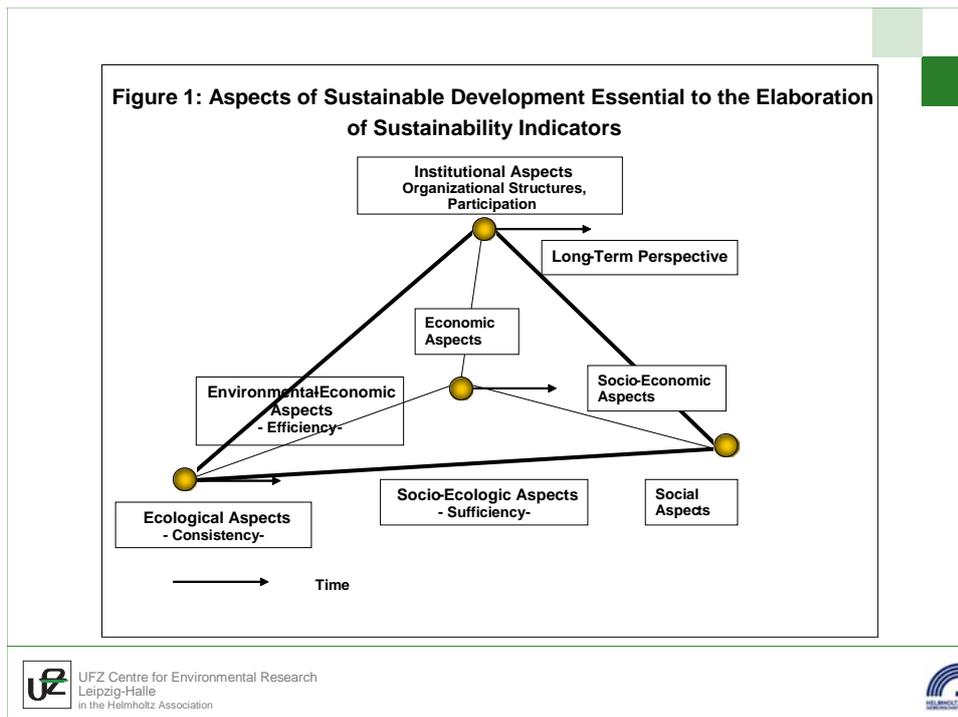
This very short depiction of state of the art of sustainability indicators makes clear that indicator sets differ more than would be justified by differing purposes and political levels. All groups, while developing a sustainability indicator set, are confronted with appreciable methodical problems. This is to ascribe to the fact that an approved and comprehensive indicator theory does not exist to date. The following section will give some methodical hints on how to establish sustainability indicators and implement them in urban decision making.

3. Methodical Requirements for Sustainability Indicators

Sustainability indicators shall refer to the main issues or problems of sustainable development; they shall be integrative by conquering sectoral approaches, thus covering the comprehensive definition of sustainable (urban) development given in section 1. (see figure 1)

¹³ Pastille 2002

¹⁴ Fraser et al. 2006



Sustainability indicators shall meet several methodological requirements. Indicators shall be *relevant*, i.e. they should have a clear rationale, and they should be a plausible proxy for the issue in question, i.e. they should represent an adequate image of complex systems. Indicators should have *face validity*¹⁵ and with respect to composite indicators, *construct validity*. They shall be *specified clearly*, i.e. exclusive without overlaps and doublings, their use shall be *repeatable*, i.e. they shall contrive descriptions of time rows and trends. The elaboration of indicators as well as their application in political decision making shall happen in a *clear and transparent way*; the indicators themselves as well as their standards of valuation shall be *acceptable* for actors and concerned persons or groups. They shall be *adequate to their envisaged purpose(s)*, and they shall *refer to objectives of sustainable development*. The two last aspects will be explained in the following in more detail.

Adequacy to the envisaged purpose(s)

Indicators are tools; therefore, they have to be applicable and adjusted to their envisaged purpose(s). Depending on the intended indicator purpose(s), the required numbers of indicators as well as their complexity levels differ (see fig. 2):

- Sustainability indicators as communication and awareness raising tools for politicians and the general public have to be complex, but intuitively understandable. Their number should be restricted to not more than twenty in order to be captured in political debates.
- Indicators for political steering and control by administration members and well-informed interest groups can go into more detail; their number depends on the issue in question and can go beyond twenty.
- Monitoring and research indicators shall be informative for and understandable by experts and scientists; their degree of aggregation respectively their complexity depend on the prevailing tasks, and also their number is strongly related to the issue in question and can easily exceed twenty indicators.

¹⁵ "it should likely to measure what it purports to measure", Flowers et al. 2005, p. 242

Figure 2: Purpose-adequate Sustainability Indicators

Purpose, user	Intellegibility / Complexity	Types, numbers	Examples
Communication general public, politicians	high, intuitively understandable 	Key indicators, indices (<=20)	Ecological Footprint
Political steering, control administration, interest groups	middle 	Steering indicators (>=20)	Indicators compsing indices
Analysis, monitoring, research experts, scientists	low 	Monitoring indicators (>>20)	SO ₂ -emission per sq.km
overlaps between categories!			



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Reference to objectives of sustainable development

Indicators must refer to objectives of sustainable development in order to allow for interpretation of what they indicate. Indicators and objectives must correlate because the objectives will serve as benchmarks for the assessment of to what extent the real situation (analyzed with indicators) meets the envisaged objectives. All objectives shall be represented by the same number of indicators. The objectives shall depict all issues relevant to sustainable development adequately and weigh them equally; all objectives shall have a comparable complexity level.

Two kinds of reference to objectives can be distinguished:

1. The indicator allows for making evidence about the direction of a development in the way that the real development approaches the objective or differentiates from it.
2. The indicator allows for making evidence about the degree to what extent the envisaged objective could be reached or not.

In order to ensure the compatibility of objectives, indicators and data (indicator values), the German committee of experts for the environment recommends for the elaboration of indicator sets a combination of a top-down-approach with a bottom-up-approach.¹⁶ In a top-down-approach the indicators are derived from objectives of sustainable development; models for the elaboration of indicators shall ensure that the indicator set represents the reality it indicates adequately, balanced and comprehensively.¹⁷

The top-down-approach contrives a high expressiveness of the collected data, but it is exposed to the danger of considering only problems already known. Using only a “data driven” bottom-up-approach enlarges the danger of not depicting all aspects of sustainable development comprehensively.

¹⁶ SRU 1994

¹⁷ Indicators Task Force 1991, cit. in SRU 1994, p. 87

The data¹⁸ used have to be reproducible, valid and relevant to the issues in question. Quantified assertions require quantitative data¹⁹, but not all relevant information is measurable. In order to take important qualitative information into consideration, indicator sets should provide also qualitative statements.

4. Steering towards Sustainable Urban Development

Striving for sustainable development, which encompasses good health conditions, requires modifications of present decision making procedures and instruments²⁰. Sustainable urban development requires strategic long-term goals and objectives acceptable for the majority of the urban population. The development goals and objectives should be comprehensive and balanced; they should cover all aspects of sustainable urban development.

In order to allow for assessing and controlling to what extent the envisaged goals could be realized, the urban situation, including health conditions, have to be monitored by sustainability indicators. The former linear model of (urban) development and decision making thus turns into a management cycle, similar to the management cycles of firms and businesses²¹ (see fig. 3). Based upon information on local economic, social, environmental and health conditions, the local community shall elaborate guidelines, objectives and strategies for a sustainable urban development. Development strategies, action plans and the formal planning instruments shall help to implement the objectives and prepare the realization of concrete measures and projects. The analysis and regular monitoring of the real urban development with the help of sustainability indicators is a necessary precondition for the evaluation to what extent the real urban development processes equals a sustainable urban development. This evaluation is called "sustainability assessment". The sustainability assessment can help to derive new guidelines and objectives, to redefine strategies and planning instruments, to modify urban development projects as well as the sustainability indicators themselves.

Sustainability indicators have crucial roles in several phases of this decision making model. They deliver information on the economic, social, environmental, and health situation. This information allow for deriving adequate and sound urban development objectives. The indicators are, together with the objectives, decisive elements for the assessment of the real urban development processes.

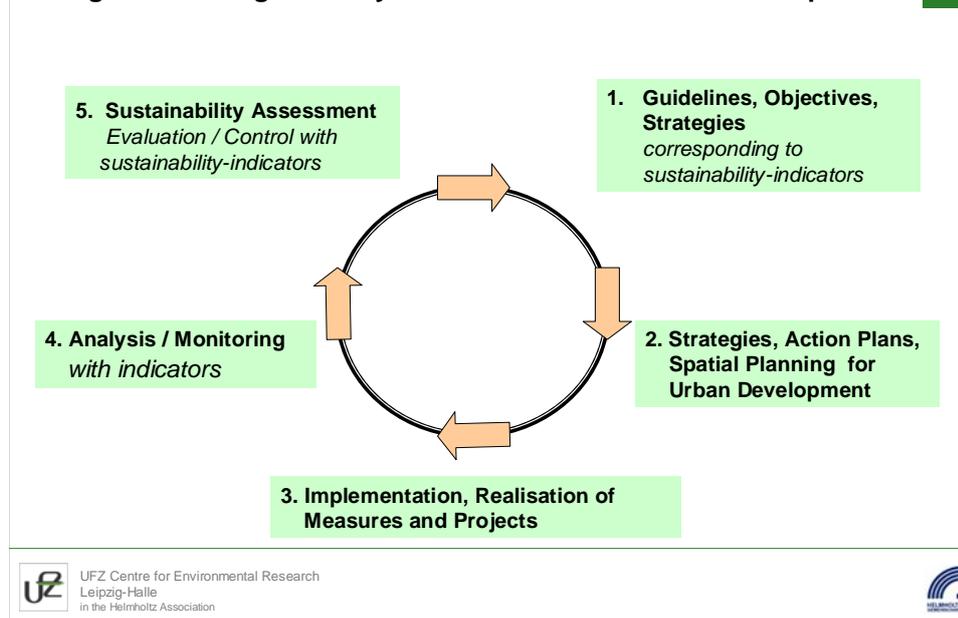
¹⁸ The availability of data is crucial for the elaboration and use of an indicator set. Realizing a management system for a sustainable development can require the modification or amendment of existing data sets and information systems.

¹⁹ OECD 1994, OECD 1997

²⁰ With respect to urban health: see Lorenz/Garner 1995, pp. 60 f.

²¹ Weiland 2001

Figure 3: Management Cycle for Sustainable Urban Development



5. Conclusions

The current urbanization processes combined with the worsening of environmental and health conditions especially in the fast growing Asian agglomerations require new steering approaches towards sustainable urban development.

A large variety of sustainability indicator sets exist worldwide with a wide spectrum of purposes on different levels. They often include human health and occasionally quality of life aspects. Despite the lack of a comprehensive theory on sustainability indicators, one can extract several methodical requirements for sustainability indicators and their elaboration process.

Sustainability indicators can be mighty instruments for understanding and communicating urban development; they are helpful for stakeholder participation and empowerment as well as for solving conflicts. But they can only then serve as steering instruments towards sustainable urban development – and only then are they powerful decision support instruments – if the indicators are incorporated into a management cycle, and if their application impinges steering measures and projects towards sustainable urban development. To date, the steering efficacy of sustainability indicators has not yet been analyzed, and a management cycle including a sustainability assessment has not been elaborated. The fast development of Asian agglomerations provides the opportunity and implies the necessity of elaborating effective urban management instruments.

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