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Perceived Contribution of Indicator Systems to Sustainable Development in Developing Countries

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ABSTRACT

The contribution of indicators and indicator systems to sustainable development is discussed controversially – from positive and limited to negative impacts. Yet, the perception of the potential and risks of sustainability indicator systems influences the success of their implementation. In view of this correlation and the existing research gaps, we investigate the perceived contribution of indicator systems to sustainable development in five Asian cities of developing countries. Thirty interviews with local key actors have been held and a Qualitative Content Analysis has been conducted, drawing on the interview material. Results include a typology of positive and negative contributions based on the type of indicator systems' use, as well as a quantitative description of the level of awareness of different actors. Perceived positive and negative contributions are discussed considering the actors' functions, experiences and cities. The research shows that developers of sustainability indicator systems and scholars have the most awareness concerning risks whereas users and potential users are lacking this, and it portrays future implementation requirements.

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Introduction

Since the launch of the Local Agenda 21 (UNCED, 1993), an impressive number of indicators, indicator systems and indices has been developed for the assessment of the sustainable development of cities. Indicators are parameters describing the state of cities 'with a significance extending beyond that directly associated with a parameter value' (OECD, 1994, p. 9). Indicator systems consist of a purposeful selection of different indicators, whereas sustainability indices are formed by weighted and aggregated indicators. Sustainability indicators, indicator systems and indices are more than pure information and 'raw' statistical data: they have a normative character and should have implications for political decision-making.

Indicators, indicator systems and indices are considered as means for the operationalization of sustainable development. Agenda 21 argues that information in the form of data, experience and knowledge is needed both

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on all levels of decision-making and on the individual level because information is a prerequisite for action. (UNCED, 1993, p. 284).

When indicators, indicator systems or indices for the monitoring of sustainable development are developed and implemented, they reflect not only the technical process by which they were generated, but also a specific cultural context. Like the concept of sustainable development, they are social constructs with meanings assigned to them against the background of the societal context in which they are employed (Astleithner *et al.*, 2004).

Sustainable Development has published a valuable series of literature on sustainability indicator, indicator system and index development (Bell and Morse, 2004; Blanc *et al.*, 2008; Hartmuth *et al.*, 2008; Mitchell, 1996; Morse *et al.*, 2009; Spangenberg, 2002; Zahm *et al.*, 2008), on implementation processes (Becker, 2004; Keirstead and Leach, 2008; McAlpine and Birnie, 2006; Velázquez *et al.*, 2008), on the effective use of indicators and indicator systems (Hildén and Rosenström, 2008; Lehtonen, 2008; Lyytimäki and Rosenström, 2008; Vascetta *et al.*, 2008), and on their degree of implementation (Garcia-Sanchez and Prado-Lorenzo, 2008). Yet, the influence of sustainability indicator systems on policies and practices is still unclear.

A number of authors describe a limited or missing influence of sustainability measurements on policies and practices (Bell and Morse, 2001, p. 293; Briassoulis, 2001, p. 423; Pinfield, 1996; Pinter *et al.*, 2005, p. 3; Stirling, 1999). This is because the contribution of sustainability indicator systems cannot be measured by their analytical soundness, but only by the way they are successfully implemented to monitor and change policy processes and impacts, to educate citizens and to increase objectivity and accountability on the institutional level (Lehtonen, 2008, p. 242).

In general, sustainability indicators, indicator systems and indices have potentials and risks. Most authors assign a positive contribution (Bell and Morse, 1999; Bossel, 1999; Cuthill, 2009; Hoornweg *et al.*, 2006; Pinter *et al.*, 2005; Zieschank, 2006). Negative contributions have rarely been reported (Astleithner *et al.*, 2004; Owens and Cowell, 2001; Pfister, 2006, p. 10). Literature on this topic, even if it is scarce (see also Cornelissen *et al.*, 2001, p. 174), shows that the value of indicators, indicator systems and indices can be perceived in different ways. However, the perception influences implementation success.

In view of these correlations and the research gaps, it is necessary to further investigate the perceived potentials and risks of indicator systems. Are local actors aware of positive and negative contributions? How do they judge the contribution of indicator systems in their environment? Which are their detailed arguments?

To date, explicit assessments of the contribution of sustainability indicators, indicator systems and indices are typically conducted through individual experts' opinions (Brugmann, 1997; Pfister, 2006; Pinfield, 1997; Zieschank, 2006), through criteria-based theoretical analyses (Briassoulis, 2001) or through case studies analyzing existing indicator programs (Astleithner *et al.*, 2004; Besleme *et al.*, 1999; Gahin *et al.*, 2003; Hart, 1999). Further, publications on the new development of indicator systems and indices partially include (mainly positive) aspects of contribution (e.g. Bell and Morse, 2001).

Our study investigates the perceived contribution of indicator systems to sustainable development in four developing countries on the basis of five case study cities and the statements of numerous experts. First, we identify indicator systems and indices developed within the case study cities, and give an overview of the extent to which these indicator systems have been implemented. A categorization of the perceived contributions of indicator systems is developed on the basis of Hezri's taxonomy of indicator use (Hezri, 2004, p. 366). The perceptions are assessed considering the functions and indicator system experiences of the experts. The empirical approach allows for conclusions to be drawn on indicator system implementation needs in the case study cities. Finally, the implications of the study's findings for the implementation of sustainability indicator systems are discussed.

Sustainability Indicator Systems and their Types of Use

Indicator research and literature, especially in its early stages, focused mainly on the instrumental use of sustainability indicators and indicator systems. From this perspective, indicators and indicator systems are seen as properly functioning tools addressing a variety of challenges arising from the need to develop towards a sustainable environment. Key roles traditionally assigned to indicators include technical support, e.g. in structuring complex

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issues, results-based management assistance, political objective-setting, communication to the public and scientific exploration (Failing and Gregory, 2003; Hezri and Dovers, 2006; Pinfield, 1997).

However, indicators and indicator systems are in practice not only used for technical reasons. Their use is embedded in differing cultural, institutional and legal contexts, which may boost or hinder the indicator/indicator system use. They are further dependent on personal perceptions and aims of persons in charge. Hezri (2004, p. 366) formulates five types of indicator uses based on publications in public policy, knowledge utilization and social indicators, which also apply for indicator systems:

(1) *Instrumental use* describes the direct, rational application of indicators for action in the form of new policies or other measures taken to respond to indicator values.
(2) *Conceptual use* results if indicators influence decisions indirectly by enlightening or sensitizing users so that their actions are infiltrated by the indicators.
(3) If used in a *symbolic* way, indicators can transport the image of rational users and decision-making processes and so form ritualistic assurances for outsiders.
(4) Indicators are used *politically* if they are employed as an instrument to support a decision taken beforehand or to legitimize actions.
(5) A *tactical use* of indicators is established if the process of indicator development or assessment allows for postponing, substituting or distracting from other actions.

Other authors working with similar typologies have only suggested a single category for *tactical* and *political uses* of indicators (e.g. Lehtonen, 2008; Weiss, 1999) arguing that political use can be tactical as well. However, in the framework of this paper we keep the differentiation, as *political use* has the positive component of legitimization. In democracies, meaningful long-term decision-making depends on, among other things, the legitimacy of the decision-makers and the decision-making processes (Feinstein, 2002, p. 477; Lehtonen, 2008, p. 243).

In general, the function in which sustainability indicators and indicator systems are used can be perceived positively or negatively – depending on the underlying motives. The specific types of use therefore restrict the perceived impacts that indicator systems can have. If indicator systems are, for example, used tactically for delaying or pushing a certain program, they will not have the impact of an objective overall measure at the same time. Indicator systems are typically designed to increase rationality in decision-making. Some types of uses, however, undermine this goal.

Methodology

Qualitative research approaches allow a focus on the analysis of interpretation, perceptions and complex interpretation systems (Mayring, 2003, p. 30). We conducted 30 qualitative expert interviews in Jakarta (Indonesia), Bangkok (Thailand), Shanghai (China), Hyderabad and Ahmedabad (both India) from March to May 2008 and analyzed them using a Qualitative Content Analysis (QCA). The intention of the interviews was to record the knowledge of the interviewees in a descriptive way and to obtain their perception of the contribution of indicator systems to sustainable development.

Given our interest in broadly applicable information, our selection of case study areas should ensure a maximal variation. The choice was based on a set of criteria, namely: (1) multiple countries to ensure results independent of national policies, (2) different city scales from upcoming (5–8 million) to large (>10 million inhabitants) megacities, (3) data availability concerning indicator programs, (4) both national and provincial capital cities, and (5) special emphasis on Indian cities where few indicator programs have been implemented to date. Concerning the last aspect, we found it essential to densify the results with regard to places with marginal indicator experience.

Pivotal actors interviewed included scholars of local universities ($n = 16$), a representative of an urban planning association ($n = 1$), government officials on national, provincial, regional and municipal levels ($n = 7$), as well as representatives of international organizations and social/environmental organizations ($n = 6$). Experts' experiences with indicators encompassed a broad range as well: indicator system development, indicator system use, observation of development and monitoring processes, and potential future use of indicator systems. The manifold functions and experiences of experts shed light on indicator systems from diverse perspectives

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(maximum variation sampling strategy) and should also ensure that potentially critical voices would be considered.

We conducted the interviews as investigative, semi-structured interviews. Our research questions, especially an introductory question on the names and types of existing sustainability indicators, clearly required investigative interviews mainly working with open questions. The interviews were semi-structured allowing for elaboration on certain subject areas, but at the same time remained systematic and broad. The face-to-face interviews were individual to respond to the partly precarious nature of the topics. Only in one case, where an expert brought a colleague along to comment on the subject, did we hold a group interview.

Besides the general information on the background of the project, we did not provide the experts with a standardized definition of sustainable development. Generally, the understanding of sustainability is linked to the specific cultural setting in which it is referred to. We therefore geared the perspective of the experts on sustainable development to their own experiences with the concept. In the course of the interview, the specific understanding of the experts came to the forefront through the topics they mentioned in the context of sustainability.

Indicator systems are in use at different levels representing administrative entities (Morse *et al.*, 2009). We asked the experts, which sustainability indicator systems have been developed and which are or have been in use on municipal, regional and national levels. In large-scale cities, especially in megacities, where the built-up area often spreads beyond municipal boundaries, provincial and regional programs are also of great interest for the urban area. They allow for mapping urban areas comprehensively, including their environmental interlinkages. In capitals, national indicator programs are most appropriate to describe sustainability.

Additionally, we requested that they elaborate on the state of implementation of the identified systems and two indices. Figure 1 shows the correlation between indicators, indicator systems and indices on the exemplary basis of a four-dimensional sustainability model. Models for sustainable development are typically based on the three dimensions environment, economy and socio-cultural aspects, partly with an extension to institutional issues (Spangenberg, 2002). Our results concern the two indicator products 'systems' and 'indices'. When we use the term 'indicator systems' in the following, this includes the two indices identified.

Further questions queried experts' perception of the contribution of indicator systems to sustainable development in general and in their city. Raising the latter questions for the generic case, the experts were provided with some examples of standard indicators for pollution (CO_2 emissions, river pollution) and for socio-economic aspects (literacy rate, income per capita).

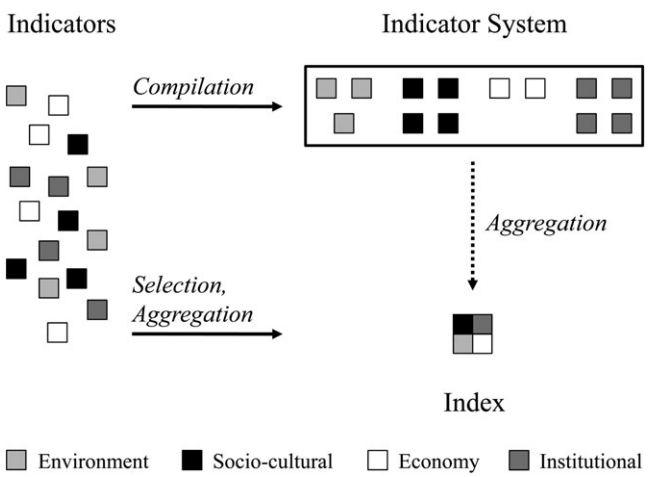

Figure 1. Correlation between indicators, indicator systems and indices on the exemplary basis of a four-dimensional sustainability model

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In the framework of the interviews, we also collected written materials (user guidelines, reports, scientific texts, regulations and data entry forms) on the systems mentioned. During the subsequent analysis, the written materials provided additional information and served as references to cross-check the information on facts obtained in the interviews.

Given the government-related context, the majority of interviews were recorded in written form to maintain a relaxed atmosphere. Four interviews were recorded on tape and in the form of notes.

We summarized the information in protocols following the generalization guidelines according to Mayring (2002, pp. 94–97). Mayring's approach aims to reduce the material, which rendered the 30 expert interviews more manageable. The interviewees were given the opportunity to comment and add to the protocols. The reviewed and anonymized protocols formed the basis for the analyses: an analysis of the extent of indicator system use, an analysis of the sustainability dimensions covered, as well as a QCA and a quantification of the perceived contribution of indicator systems to sustainable development. In the QCA, we developed codes from the interview material through paraphrasing, generalization to higher levels of abstraction, bundling and reductions based on pre-defined rules. This inductive process of category development was combined with a deductive application of dimensions which is typical for QCAs. To improve the quality of the analysis, the entire interview material was coded twice and the results were merged to the final category system.

The dimensions of Hezri's (2004, p. 366) taxonomy of indicator use was especially suitable for the application to the interview material because indicator systems' use can be perceived positively or negatively depending on the underlying motives. Figure 2 gives an overview of the taxonomy of indicator use. The placement of uses in the coordinate system is based on general characteristics. Yet, all types of use can have secondary effects not corresponding to the initial intention of use (Rich, 1979, p. 22).

Additionally, we split the *instrumental use* into content-related, institutional and socio-cultural dimensions. The arrangement is based on elements of theoretical models for sustainable development[1]. Instrumental use is often seen as the ideal type of use of indicator systems and most of the arguments of our experts focused on this area. It was therefore helpful to cluster this area, especially when analyzing risks and the perceived negative contributions of sustainability indicator systems.

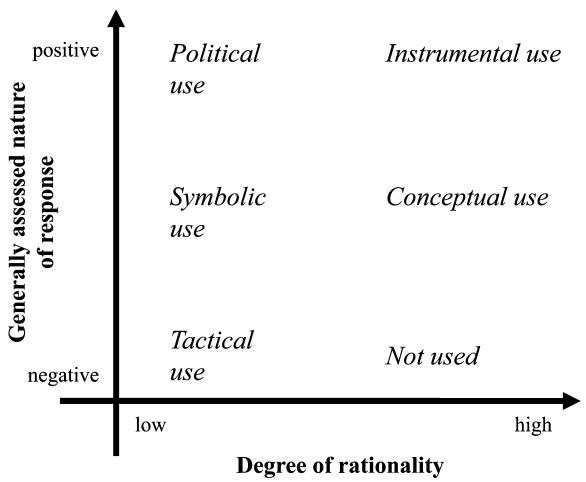

Figure 2. Overview of the taxonomy of indicator use[2]

[1]The dimensions covered in sustainable development models form the *contents* of sustainability. Social and cultural sustainability are dimensions that also have strong influences on the other 'contents' of sustainability, which means that the *socio-cultural* dimension consists of a supplementary second layer that lies crosswise on the 'content pillars'. Another significant role in the process of sustainable development is commonly attributed to *institutions* in the form of an overarching dimension.

[2]Adapted from Journal of Environmental Management, 73(4), Hezri A.A., Sustainability indicator system and policy processes in Malaysia: a framework for utilisation and learning, 366, Copyright (2004), with permission from Elsevier.

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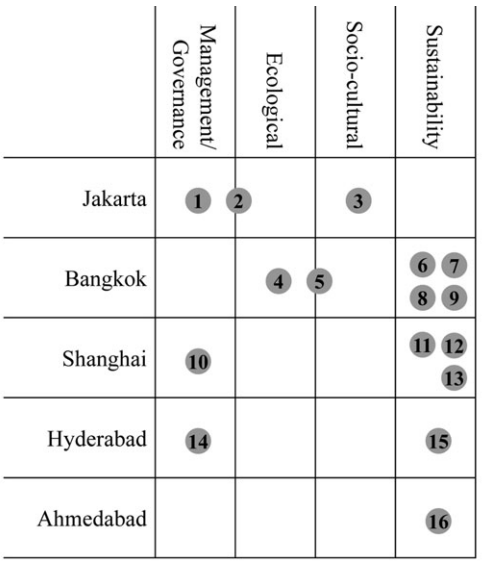
Results

Indicator Systems' Use in the Case Study Cities

The experts provided details on 16 indicator systems and indices. All of them measure sustainability on municipal, regional or national levels. Each indicator system or index surveyed in the megacities covered one or more of the four sustainability dimensions. An overview on the systems identified in this project and their linkages to the dimensions of sustainability is given in Figure 3. As none of the systems covered solely economic issues, we omitted this dimension in the figure.

From a quantitative perspective, Bangkok is the city where most indicator systems have been identified, reflecting the experience of experts with these tools. Fewest systems are available in the Indian case study cities. Whereas indicator systems aiming at addressing sustainability comprehensively are available in the Indian, the Chinese and the Thai cities, the Indonesian capital is lacking such a system.

The extent of implementation varies from instrument to instrument. Jakarta has at its disposal well-established tools in the ecological and the governance dimensions (Krank *et al.*, 2009), as well as a socio-cultural system that has never been approved by the government. According to the experts, discussions on sustainability challenges and the development of the city are often tactical and dependent on specific persons. The Thai experts consider that if too many systems are being used, priority setting in decision-making becomes complicated, even though we noticed that a considerable number of programs were not fully implemented or remained short-term projects (e.g. the Indicators for Liveable and Sustainable Municipalities and Districts in Bangkok). In Shanghai, local experts consider indicator systems as important instruments, as government officials are evaluated on the basis of their work with indicator systems. Other local actors, however, doubt the seriousness of indicator system use by local governments. Hyderabad has experienced some initiatives of sustainability indicator system development, but long-term implementations are lacking. According to the experts, indicators and benchmarks are used in an informal way or not at all. In Ahmedabad, the local government supports work on indicators; however, indicator systems have only been developed in single initiatives and have not been implemented for long-term monitoring.



1 Performance Evaluation of Local Governments in Public Works
2 Adipura Program
3 Frame Indicators for Socio-cultural Development DKI Jakarta
4 Air Quality Index
5 Gross Domestic Happiness Index
6 Thailand Sustainable Development Indicators
7 Thailand Sustainable City Indicators
8 Indicators for Liveable and Sustainable Municipalities and Districts in Bangkok
9 Healthy Cities Indicators
10 Urban Management Indicators
11 Urban Sustainability Indicators on National Level
12 China's Best Resident Environment Indicators
13 Model City in Environmental Protection
14 Assessment of the State of Governance
15 Performance Evaluation of Municipalities
16 Urban Indicators and Performance Measurement Program

Figure 3. Overview of the systems and their linkages to the dimensions of sustainability identified in this project

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Perceived Contribution of Indicator Systems to Sustainable Development

The actors interviewed in Jakarta, Bangkok, Shanghai, Hyderabad and Ahmedabad perceived the contribution of indicator systems to sustainable development as rather positive. Overall, 57% of respondents saw positive aspects of contribution, 39% mentioned both positive and negative arguments and 4% focused solely on negative effects and risks.

The individual perceptions of the 30 actors towards the concrete contribution of sustainability indicator systems varied. They had a number of diverse expectations of the contributions of these instruments. Most of them focused on aspects of instrumental use, some adding contributing factors for conceptual, symbolic, political or tactical use. Contributing aspects arising from conceptual use were only named by scholars. None of the government officials, of the users or the potential users of systems and indices referred to symbolic, political or tactical use.

The positive aspects of the perceived contribution have arisen from instrumental and, marginally, from conceptual use (Table 1). The positive contributions mentioned in the field of *instrumental use* include, among others, priority and target setting, evaluation/control and planning as conventional application fields of indicators. The experts referred to these three repeatedly. In the numerous other contributions, the local actors included their personal experiences: indicator systems were 'useful to do one's job better' (Expert PA1 A). For the experts interviewed, the *conceptual use* of indicator systems did not seem to play a significant role for development towards sustainability. The small number of perceived contributions in the conceptual area shows that indicator systems are primarily considered to be effective if directly used for action.

Perceived negative contributions were recorded in four of the five types of use. A summary of arguments is given in Table 2. Even though *instrumental use* commonly has a positive connotation, experts describe a number of dangers for sustainable development arising from the technical use of indicator systems. If results are, for example, misinterpreted, there is a risk that the wrong measures are derived. The *symbolic use*, as well, has a negative connotation for the actors in their description of contributing factors. One expert stated for example: 'developing and applying indicators is a fashion' (Expert IO2 B) and does not entail any further impact.

During the *political use* of indicator systems, experts fear the instrumentalization and data manipulation, which might lead to negative outcomes: 'as the data in municipal statistics is surveyed by city governments, the question has to be raised if it is correct' (Expert PA1 A). On the personal level, *tactical use* is perceived as a source for further

Type of use	Dimension	Positive potential
Instrumental use	Content-related	Policy formulation
		Priority and target setting
		Evaluation/control
		Early warning
		Planning
		Comparisons
		Benchmarking
		Breaking down complex issues
		Itemization of issues
	Institutional	Performance evaluation of a government
		Feedback for planners/managers
		Increase in objectivity
	Socio-cultural	Education of citizens
		Communication (internal/external)
		Increase rationality in decision-making processes
Conceptual use		Understanding existing situation
		Existence valuable (agreement process in political decision-making)

Table 1. Positive contribution of indicator systems to sustainable development as considered possible by pivotal actors in developing countries

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Type of use	Dimension	Dangers
Instrumental use	Content-related	Pointing at wrong effects
		Delivering wrong results
	Institutional	Not known if system-based reasons are responsible for results
	Socio-cultural	False interpretation
		Overstretching the range of applications
Symbolic use		Ritualistic application
		Effectless application
		Fashionable usage
Political use		Political instrumentalization
		Data manipulation
Tactical use		Selectivity based on personal interest

Table 2. Perceived negative contribution of indicator systems to sustainable development as named by pivotal actors in developing countries

dangers of indicator system/index application. Selectivity in the use of results can lead to a biased picture of the actual situation.

Even though we asked the actors to differentiate their statement between their general perception and the situation in their city, we were not able to find city-specific results. Only a few city-specific factors of contribution were mentioned and the QCA revealed that actors of other cities also referred to the same factors.

Perceived Contribution versus Personal Function, Experience and Megacity

The perceived contribution of sustainability indicator systems varies significantly according to the particular function of the various pivotal actors interviewed (Table 3).

	Positive		Mixed		Negative		No response		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Function										
Scholars*	6	35	7	41	1	6	3	18	17	100
Government officials	4	57	–	–	–	–	3	43	7	100
Representatives of organizations	3	50	2	33	–	–	1	17	6	100
Experience										
Users/potential users	4	50	1	12.5	–	–	3	37.5	8	100
Developers	3	33	4	45	–	–	2	22	9	100
Observers	6	46	4	31	1	8	2	15	13	100
City†										
Jakarta	3	50	3	50	–	–	–	–	6	100
Bangkok	2	33	2	33	1	17	1	17	6	100
Shanghai	2	33	2	33	–	–	2	33	6	100
Hyderabad	6	55	1	9	–	–	4	36	11	100

Table 3. Nature of response based on function, experience and location of the experts
*Including the representative of a planning organization.
†Ahmedabad has not been analyzed separately because the sample was too small.

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Perceived Contribution of Sustainability Indicator Systems

Among the government officials ($n = 7$), composed of both users and potential users, none expressed a critical or a mixed attitude towards the contribution of sustainability indicator systems. However, more than 40% of this group did not answer the respective question, but switched the topic. It is believed that the role has an impact insofar as (potential) users are prone to criticism concerning their 'correct' or desired use of the instruments. The scholars ($n = 17$) offered a much more diversified picture of effects of sustainability indicator systems: 41% considered both positive and negative contributions possible, one expert named only potentially negative effects and 35% argued for exclusively positive effects. The awareness for risks and conceivable misuses seems to be much higher among researchers. However, only one researcher had experience in indicator application; the majority was familiar with sustainability indicator system/index development or observation of development and assessment processes. The group of representatives from social, environmental and international organizations ($n = 6$) who were expected to fill the most critical position in their observing role argued rather positively.

Besides their different functions, the experts have, as discussed above, different experiences within system/index development and assessment processes. The group of sustainability indicator systems and index users and potential users ($n = 8$) is almost congruent with the group of government representatives and shares their view on positive indicator effects. In contrast, program developers ($n = 9$) are sensible to potential negative contributions: 45% consider negative connotations of implemented indicator systems. Among observers ($n = 13$) the contribution is evaluated as relatively positive (46% mentioning only positive effects).

Concerning the different case study cities, the potential of sustainability indicator systems is perceived the highest in Hyderabad ($n = 11$). At the same time, about one-third of the experts did not respond to the specific research question. Hyderabad is the case study where long-term implementation of sustainability indicator systems has not yet taken place. It might be argued that the sparse experience of local actors in terms of practical application led to the focus of reporting on best-practice experiences and assumptions. We assume that the missing responses are either due to the limited experience of actors or the fact that experts did not want to reveal their negative perception of sustainability indicator systems. In Bangkok, Jakarta and Shanghai (each with $n = 6$), the distribution of experts naming positive and negative aspects of contribution was almost identical with half of the actors listing both positive and negative arguments for contribution and the other half focusing on positive effects. Yet, in Bangkok, where the most experience with diverse systems and indices exists, an expert perceived their contribution as purely negative. We assume that the actors' lacking responses in Shanghai (33%) are related to the specific Chinese culture, which avoids being critical of the system and cautions against losing face. The expert sample in Ahmedabad is too small to draw valid conclusions regarding the perception of sustainability indicator system contributions.

Discussion and Concluding Remarks

The perception of indicator systems' potentials and risks by pivotal actors influences the implementation success of sustainability indicator systems. Our study investigates the perceived contribution of indicator systems in five megacities of developing countries. Rather than attempting to create an integrally closed list of contributing factors or a comprehensive survey of all sustainability indicator systems and indices available in these megacities, the aim is to identify a general trend of perceptions.

We found that pivotal local actors in the field of indicator system/index development and application are aware not only of the potentials, but also of the risks of their application. Compared with previous international literature, we find a number of similarities. The perceived positive contributions mentioned in the instrumental field are similar to the functions of indicators and indicator systems conventionally described in literature such as the structuring of complex issues, political objective-setting or communication to the public (Hezri and Dovers, 2006; Pinfield, 1997).Two arguments, also given in literature, have been referenced for conceptual use: first, the general value of the existence of indicators as a decisive point in political decision-making (see also Zieschank, 2006) and, second, the application of indicators and indicator systems to gain knowledge about sustainability in a specific system (Bell and Morse, 1999; Zieschank, 2006). Instrumentalization (political use) in the form of staged sustainability politics is also referred to in literature (Pfister, 2006). The argument given for tactical use finds similarities in Astleithner *et al.* (2004), who describe indicators as a means to individually exercise power and to retain status.

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However, the actors of developing countries focus more on effectless application and on the dangers of the application process. It is also found that a highly rational application of indicator systems (instrumental use) can have dangers. Socio-cultural dangers in the instrumental use (such as false interpretation, overstretching the range of applications) and political instrumentalization (including data manipulation) are especially highlighted by the experts. The individual expectations of the contribution of sustainability indicator systems vary. Even though most experts refer to opportunities and/or risks in instrumental use, government officials avoid mentioning symbolic, political and tactical use and only scholars are aware of a conceptual contribution.

The effects resulting from indicator system application, positive or negative, are not attached to a specific city, but can be found in similar forms in all the cities surveyed. However, the research shows that the consciousness of risks in indicator application is higher in cities with an excessive implementation of indicator programs (Bangkok) than in cities without implemented indicator systems (Hyderabad). Concerning the actors' functions, scholars are more conscious than government officials. Another influence can be mapped based on the experts' experiences with indicator systems: developers of sustainability indicator systems and indices are in principle the most critical group whereas users and potential users give the most positive assessments.

Our study shows that it is essential not to focus solely on indicator system development, but also on the inclusion and education of pivotal local actors. On the one hand, they need to know the dangers to avoid possible pitfalls. On the other hand, the more critical local key actors are towards sustainability indicator systems, the more difficult it is to implement future indicator programs.

Another implementation need that can be derived from this study is the necessity to increase awareness of infiltrating effects that indicators can have towards sustainability. Gahin *et al.* (2003) concluded in their study on five community indicator programs in the USA that the contribution of indicators is vague in most cases, rather with an infiltrating effect on community development. They explain the slow development of change with 'the nature of the problems that indicators are aimed at addressing,' (Gahin *et al.*, 2003, p. 665). Comparing these findings with our results, the potential of conceptual use might have more weight than the statements of our experts suggest.

Finally, the study highlights that it is further necessary to shed light on reasons for pitfalls and on the specific contexts in which such pitfalls occur. This expansion of knowledge allows indicator system owners to avoid failures and to increase the trust of actors.

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