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Published in:
Systemist

2010

[Link to publication](#)

Citation for published version (APA):

Wamsler, C. (2010). An Innovative Systems Approach for Research on Urban Risk Reduction and Climate Change Adaptation. *Systemist*, 23(3), 188-215.

Total number of authors:

1

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VOLUME 32 No. 3 WINTER EDITION

SYSTEMIST

An Innovative Systems Approach for Research on Urban Risk Reduction and Climate Change Adaptation

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ABSTRACT

This paper presents an innovative research on urban risk reduction and climate change adaptation that combines case studies, grounded theory and systems analysis, which could be used as a template for similar urban and interdisciplinary investigations. This new approach allows theory to be built not only on any specific situation/system, but also on how this situation/system could be improved. Moreover, it allows investigations that cross the traditional boundaries between disciplines and sectors as regards: (a) the methods applied; (b) the research focus; (c) the heterogeneous set of practitioners and experts involved; and (d) the outcomes that are relevant to more than one discipline or sector.

KEY WORDS

Adaptation; Case Study; Climate Change; Cultural Theory; Disaster; Grounded Theory; Risk Reduction; Systems Analysis; Systems Research; Urban Research.

1. INTRODUCTION

Climate change and disasters are among today's most pressing issues. The damage caused by the worldwide increase in disasters is staggering, with the urban poor being most at risk. Disasters make their already precarious living conditions worse, creating a vicious circle of poverty. More and more attention has thus been given to the need to address changing climatic conditions and disaster risk through development work. Despite related efforts, urban development actors still struggle to effectively reduce risk in their daily work. This is, not least, due to a lack of adequate research approaches allowing to analyse (a) the complex effects that disasters and other climate change impacts have on the poor, and (b) how these effects could be addressed to sustainably reduce climate and disaster risk.

Against this background, the paper's objective is to present an innovative research study on risk reduction and climate change adaptation that was undertaken from 2003 to 2008. In line with systems thinking and theory, and in comparison with traditional and commonly used analyses, the research looks at how the matter under study interacts with other parts of the system, and analyses complex matters that involve a great variety of actors and their interactions. It combines case studies, grounded theory and systems analysis, a new approach which could be used as a template for similar intersectoral and interdisciplinary investigations.

The research study presented here was driven by the need to provide a better understanding of the challenges of increasing disaster and climate risk and its impact on the living conditions of the urban poor, as well as to provide new conceptual and strategic approaches to face those challenges. Such approaches are especially required within the pre-disaster context. Technically speaking, they come under the heading of 'adaptation' or 'ex ante disaster risk reduction'. With this in mind, the overall research objective was to enhance and develop new knowledge and innovative ways in which urban development actors can contribute more effectively to reducing risk and adapting to climatic extremes and variability, thus

demonstrating their role and potential within this field. The overall research question was thus framed as: how can disaster risk reduction and adaptation be properly integrated into urban development planning? To answer this question, the following three areas were investigated at the global level, as well as the national, municipal, and local household level in El Salvador: (a) the existing interlinkages between disasters, climate change, and urban development; (b) the current relationship between the working fields of disaster risk reduction, adaptation, and urban development planning; and (c) the possibilities for overcoming existing challenges and gaps in order to increase the potential of urban development to reduce climate and disaster risk.

In the following, the paper describes, first, the theoretical positioning of the research study (*section 2*) and, second, presents in detail its research design (*section 3*), including methods of data collection (*section 4*) and methods for data analysis (*section 5*). Finally, *section 6* summarises related conclusions on the potential of systems research for sustainable risk reduction and adaptation.

2. THEORETICAL POSITIONING OF RESEARCH

The theoretical positioning of the research study undertaken from 2003 to 2008 is described in this section. It was determined to be in accord with its purpose and objectives, the questions it raises, as well as its intersectoral and interdisciplinary field of enquiry (*cf. section 1*).

2.1 Research paradigm

The underlying philosophy (i.e. the philosophical positioning) of the research was post-positivist critical realism. This is the belief that there is an external reality (independent of an individual's own view of reality), that every observation is fallible, and that all theory is thus revisable. In line with this, the research was further predicated on constructivist thinking, according to which everybody constructs his/her own view of the world based on personal

perceptions. Hence, objectivity is not a characteristic of the individual, but rather an inherently social phenomenon that is achieved through discussions among multiple individuals (Trochim and Donnelly, 2006). In other words, the research was based on the belief that there is no single shared reality, thus emphasising: (a) the social construction of theory and concepts; and (b) the importance of qualitative approaches and triangulation to achieve knowledge through appropriate approximation (Guba, 1990).

Apart from the philosophical positioning described, the research was further positioned within the spheres of academic science and actual practice. In fact, as far as permitted by the research setting, the selected research paradigm lies within the tradition of so-called ‘Mode 2’ knowledge production. This entirely new mode of knowledge production, which began to emerge during the last decade, is slowly gaining prominence over an older mode of knowledge production, ‘Mode 1’ (Gibbons et al., 1994; Nowotny et al., 2001). (Note that ‘Mode 1’ is also known as basic research, where problems are set, examined, and solved in a context governed by the academic interests and codes of practice of a single disciplinary community. In the words of Patton (1990:12), ‘the purpose of basic academic research is to generate theory and discover truth, that is, knowledge for the sake of knowledge. The purpose of applied research and evaluation is to inform action, enhance decision making, and apply knowledge to solve human and societal problems.’)

In accordance with Walther-Jacobsen (2004) and Dunin-Woyseth and Nielsen (2004), the ‘Mode 2’ approach starts the research initiative from the identification and experience of local problems. These problems take the centre stage of the research, as the aim is to produce knowledge that is directly useful or applicable at the local level. The context of the application thus drives the form and content of the knowledge sought, while at the same time the research is ‘predicated on the synergies between science and social mission’ (Nowotny et al., 2001, p. 91). ‘Mode 2’ generally stems from the experience that problems have surfaced that are too complex for specialised academic-based science to solve. Their solution requires

transdisciplinarity in the sense that the traditional boundaries between disciplines must be crossed, and a heterogeneous set of practitioners and experts must be involved if relevant new knowledge in more than one discipline is to result (Dunin-Woyseth and Nielsen, 2004; Gibbons et al., 1994; Walther-Jacobsen, 2004). Hence, 'Mode 2' provided an effective approach to the challenges of the presented intersectoral and interdisciplinary study.

Furthermore, a qualitative research paradigm was selected for the research. The choice of a qualitative research approach is directly related to the philosophical positioning of this research (see above). As such an approach does not assume that there is a universal and shared view of a single unitary reality, it acknowledges the perceptions of individuals. Consequently, it (a) accepts and deals with potential research bias through the researcher's own perceptions; and (b) puts the researcher's own interpretation and analysis of the information at the centre (as opposed to a numerical focus). This orientation was also crucial in terms of finding satisfactory answers to the research questions. These required not statistical conclusions, but mainly the analysis of qualitative data related to the studied multi-level system and the various related sources and stakeholders. This search for a contextual and systemic understanding is in line with the underlying idea of qualitative research, namely, that the best way to understand a phenomenon is to view it in its context. In other words, one small part of 'reality' cannot be viewed separately without the importance of the whole being lost (Trochim and Donnelly, 2006). Given the mainly explanatory and exploratory nature of the presented study, the qualitative research approach was also essential in that it allowed flexibility and questions to emerge (which would not have been the case with a constructed and predetermined measurement instrument). The qualitative research approach was further seen as appropriate, as its aim is both to broaden the perspective from subject-object orientation, and to include the dimensions of social relations and organisational structures that this study required (Holme and Solvang, 1996; Maxwell, 2005). Moreover, this approach was identified as being the most appropriate way of assessing complexity, while at the same time being flexible and also capable of spanning different disciplines (Capjon and Kvarv, 2002).

During the course of the research, the qualitative research paradigm (i.e. the search for a contextual/systemic understanding based mainly on qualitative methods, data and salient theory) led to the development and use of the innovative combination of: (a) grounded theory (Glaser and Strauss, 1967); (b) systems theory (von Bertalanffy, 1950), in particular systems analysis (Hördur, 2004; Sterman, 2000); and (c) a form of evaluation theory (Patton 1990, 2002), more specifically, case studies (Yin, 2003; Stake, 1995). The latter are a valuable and recognised evaluation tool and one possible design of qualitative inquiry (Yin, 2003; Patton, 1990, 2002). The emphasis of this combined ‘case studies–grounded theory–systems analysis approach’ was on developing a grounded theory on the situation/system encountered and on how this situation/system could be improved (i.e. positively influenced). Further details are presented in section 3.

2.2 Research in the ‘Making Disciplines’ – in developing countries

The theoretical positioning of the research study on urban risk reduction and adaptation was further influenced by the fact that it was carried out – and provides knowledge – within the so-called ‘making professions’ of architecture and urban planning (cf. Dunin-Woyseth, 2003; Dunin-Woyseth and Michl, 2001). Hence, it had to comply with demands of two worlds: its own professions and the academic field. ‘While the main criterion of viability in the former world is its relevance to the practice of the profession[s], in the latter it is the ability to fulfil the criteria of science (...)’ (Dunin-Woyseth and Michl, 2001, p. 2). However, this did not cause any conflict, as the study was based on the belief that there is a research-to-praxis continuum; that is, a continuum from scientific research to creative application that can link knowledge gained from academic investigation and practical experience. This is in line with ‘Mode 2’ knowledge production described above.

Because of the focus of the presented research study and the methodology needed for its development, the research was further embedded in the interface between different disciplines, as will now be described. First, architecture and urban planning, being part of the

‘making disciplines’, have only recently started to establish their academic and disciplinary identity and thus lack proper scientific research strategies. In fact, although architecture and urban planning are developing and advancing towards an academic and disciplinary positioning, their methodologies and methods are generally ‘borrowed’ from the social sciences. Second, the focus of the research lied between the disciplinary borders of architecture, urban planning, disaster studies, environmental studies, and (international) development studies. As there is no common understanding of theories, concepts and methods across these disciplinary borders that would allow communication among them, a rigorous and transparent research logic/approach was imperative for this study in order to facilitate cross-disciplinary cooperation and communication. Cross-disciplinary cooperation and communication here relates both to the implementation of the research and the distribution and realisation of its findings.

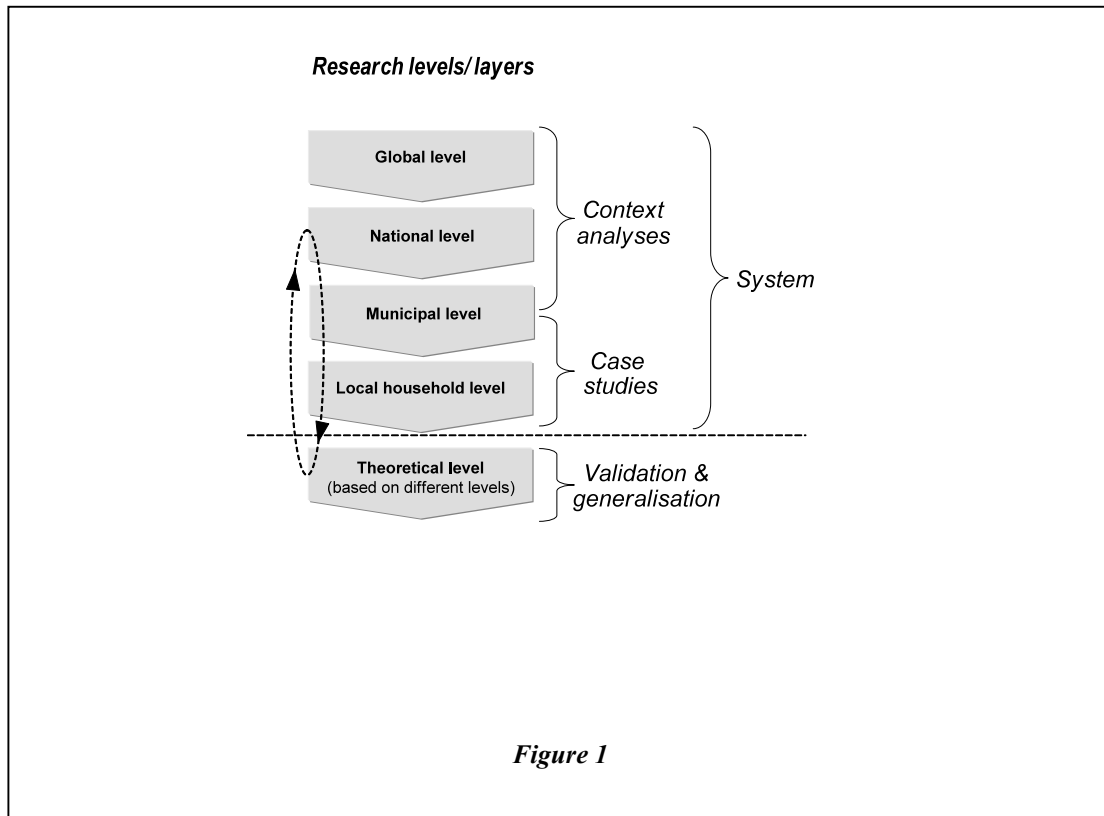
The relation of this research to development studies and its implementation in developing countries entailed additional methodological challenges. In fact, Sumner and Tribe (2004, p. 1, 22) state that ‘many generic concerns in social science concepts and methods are amplified in a developing country context (...)’ ‘For example, concerns over the validity of research, the extent to which the results are representative, the reliability of data, and the subjectivity and interpretation of results are particularly problematical in developing countries (...)’ Hence, the above-mentioned rigorous and transparent research approach required had to be based on logical processes that linked the research from start to finish with a coherent thread throughout, with each stage informing the next.

The following *sections 3–5* describe the conduct of the research, which corresponds and responds to the challenges resulting from its theoretical positioning, as presented. This conduct is described by discussing, in each section, both the conceptual basis of the different implementation strategies and/or methods and their practical realisation within the research context.

3. RESEARCH DESIGN

In general terms, the research design is a logical and strategic plan that defines how to get from ‘here’ to ‘there’, where ‘here’ may be defined as the initial set of research questions and ‘there’ as a set of conclusions concerning these questions (i.e. answers and theories) (Yin, 2003). It further links the study’s theoretical positioning, presented in section 2, to the practical conduct of the research by ‘translating’ and adjusting it to the specific research context and setting.

The overall research design of the presented research study was based on (qualitative) case studies and the analysis of their context at different levels (i.e. the global, national, municipal, and local household level) (see *Figure 1*). This multi-level system was studied using an ‘onion-peel strategy’ (which can also be described as a ‘layered case study approach’ [Patton 1990:385; Patton 2002:297, 447, 448]). This gradual analysis of the cases’ broader surrounding environment at global, national, municipal and household levels in El Salvador allowed a holistic multi-perspective analysis that included the voice and perspective of the various stakeholders, as well as the interaction between them. In fact, Feagin et al. (1991) stress that case studies provide a good tool for analysing a variety of different perspectives, including those of the ‘powerless’ and ‘voiceless’. The case studies and context analyses carried out were, however, not only subject-focused (i.e. they did not just analyse people’s perceptions), but were also object-focused. In fact, aspects such as risk-generating processes and the content and limitations of different programmes were studied in detail.



The case study approach was in full accordance with the setting and theoretical positioning of this research described in *sections 1* and *2*. Its aim is to reconstruct the world both holistically and realistically by identifying significant characteristics and regularities of a (scientific) problem in its entirety (Lamnek, 2005). It is based on the assumption that generalities can be created through the particularity of a case (Fatke, 1997). Case studies were also appropriate for this research in terms of answering questions that aim primarily to: (a) gain an understanding of the underlying reasons for an existing and contemporary phenomenon within its ‘real-life’ context, where the boundaries between that phenomenon and its context are not clearly evident; (b) provide insight into the setting of related problems; and (c) generate possible ideas for solutions and recommendations that cannot a priori be foreseen (Yin, 2003; Maxwell, 2005). To find the best possible answers to the research questions, the case studies carried out were mainly explanatory, which is appropriate for studies on causal relationships and the development of theory building (Tellis, 1997); they were also to some degree exploratory and descriptive (see research matrix included in appendix).

3.1 Unit of analysis – the case

The unit of analysis is the so-called ‘case’. Within the framework of the presented research study, the ‘cases’ to be studied were programmes that target urban slum dwellers living in disaster-prone and climate-sensitive areas and that integrate to a certain extent three fields of activity, namely, urban development planning, disaster risk reduction and climate change adaptation. The selection of programmes as the unit of analysis is in line with the case study methodology, which is a valuable and recognised tool for project/programme evaluation (Yin, 2003; Patton, 1990, 2002). The main components of the unit of analysis to be studied were: (a) the selected programmes and related programme measures; (b) their beneficiaries; (c) implementing organisations; and (d) the programmes’ geographical setting/location.

3.2 Context analysis of cases

Before making a final selection of the specific programmes/cases to be studied, the general context of the programmes was analysed. The aim of this context analysis was to: (a) gain an understanding of the particular environment of the cases (for instance, the support available to them, their development context, as well as their design and implementation process); and (b) to search for causal explanations and conditions regarding the setting of this context. In practice, after a short pre-study in the Philippines, the empirical research began at the global level. International aid organisations play an important role within the research framework in that they influence national and local agendas and policies related to urban development, risk reduction, and climate change adaptation. Thus, those international organisations that support or carry out programmes in the fields of urban development, risk reduction, and/or adaptation were the initial focus of the enquiry at the global level. Subsequently, the national and municipal context in El Salvador was studied.

The context analyses at the different levels determined the final choice of the specific cases to be studied (i.e. programmes implemented at the local household and in parts at the municipal level). The local level studies were begun in parallel with the national and municipal level

analyses. These initial studies were then followed up by gradual and in-depth research of a more limited number of at-risk slum communities (15 in total, being the implementation areas of four programmes). This procedure was followed so that the most appropriate cases could be identified at an early stage of the research and, most significantly of all, to ensure that the research was based on the problems and risk as perceived by the urban poor themselves. The initial outcomes of the context analyses and the case studies were subsequently compared, validated and further generalised to reach a higher theoretical level (cf. *Figure 1*).

3.3 Purposeful sampling of cases

The search for the most information-rich cases (as regards the research objectives and questions) guided the research process. In fact, the selection of the programmes to be analysed was not based on their statistical representativeness but on their potential to increase knowledge as regards the focus of this work. This procedure – originally developed within the framework of grounded theory (Glaser and Strauss, 1967) – is a consecutive and cumulative procedure in the course of which additional cases are selected to confirm, control, modify, relativise and expand the outcomes of the cases selected previously (Ludwig-Mayerhofer, 1999). The gradual selection of specific programmes was thus based mainly on: (a) their content (i.e. the existence of a certain level of integration of urban development and risk reduction/adaptation); (b) their context (i.e. their implementation in an urban environment); and (c) the type or character of the respective implementing organisations in terms of matching the direct target group of the research. The selection was furthermore based on the risk perception of the programme beneficiaries, that is, the identification and prioritisation of the local risk by the inhabitants of the slum communities in respective programme areas. Only areas where ‘natural’ hazards/disasters and other climate-related impacts were seen as one of the main risk to lives and livelihoods were selected. Finally, access to information was another selection criterion.

Based on the first three selection criteria described, namely, programme content, context, and implementing organisations, a total of eight programmes were initially assessed at local household and institutional levels (i.e. from the perspectives of the programme beneficiaries and the representatives of the implementing organisations). This original selection can be seen as a nearly 100 percent sample, as hardly any other programmes could be identified that fulfilled the established selection criteria, especially as programmes that integrate(d) to some degree urban development and risk reduction/adaptation in urban areas were, and are, rare. On the basis of the increased knowledge gained of the eight initially selected programmes in terms of their information richness, and of their compliance with the fourth and fifth selection criteria established (i.e. access to and risk perception of programme beneficiaries), four of the eight programmes were selected for the case studies. In-depth evaluations were then carried out of these four programmes and within the 15 slum communities where they were implemented.

3.4 Mode of enquiry

The mode of enquiry for the case studies and their context analysis was an iterative process of both induction and deduction. As Strauss and Corbin (1998, p. 22) state: ‘at the heart of theorizing lies the interplay of making inductions (...) and deductions (...).’ To focus and narrow down the research, tentative propositions or preconceptions were established. These were constructed using elements of pre-existing theoretical and conceptual models in conjunction with emerging theory from initial data collection and analysis (e.g. pre-studies and theoretical desktop work). Based on these propositions or preconceptions, deduction was applied with an emphasis on manifest facts, such as risk generation, the inter-correlation between the working fields of settlement development planning and disaster risk management, as well as their respective risk reduction potential. During the research process, and based on the emerging data/information, new preconceptions or propositions were continuously established and tested in a cyclical process, with the final objective being to create theory. In contrast to deduction, induction, which is by its very nature more open-

ended and exploratory, was an important means of looking into the meaning of the phenomena and perceptions encountered at the different research levels, of understanding them, and of finding solutions to them.

The use in this research of an adapted and advanced grounded theory approach, as described, to allow the generation and testing of theory, is supported by the ‘adaptive theory’ of Layder (2005). It supports the interchange and dialogue between pre-existing and emergent theory. In line with this, ‘prior theoretical concepts and models suggest patterns and “order” in emerging data while being continuously responsive to the “order” suggested or unearthed by the data themselves’ (Layder, 2005, p. 27). The resulting theory is not only grounded but can also be ‘general’ and thus of ‘universal’ character (Layder, 2005).

4. METHODS OF DATA COLLECTION

One of the strengths of the research study being designed around case studies is that this allows (and necessitates) the use and mix of many different techniques for collecting and analysing empirical data. The selection of the specific methods used was dictated by the research setting, the research’s theoretical positioning and design, and the resulting data requirements.

The data collection methods selected are described in the following sections. They include interviews, walk-through analyses, observations, text reviews, questionnaires as well as research workshops and ‘hands-on’ practice.

4.1 Interviews

Interviews are usually one of the most important sources of case study information (Tellis, 1997), especially as they are excellent tools for understanding complex phenomena, beliefs and attitudes in less well known research domains (Hastings and Chad, 2000). Interviews were further crucial because of the limited literature available on the specific topic of this

research, as well as its multi-perspective nature. Because of their importance at all research levels, numerous and different types of interviews were conducted, including semi-structured interviews, focused interviews, and focus group discussions.

The interviews held at global level were followed by the interviews at national, municipal and local household level in El Salvador. The interviews for the context analysis at the global level were carried out with 64 key stakeholders, consisting of programme managers, operational or academic staff working at 33 multilateral and bilateral aid agencies and governmental and non-governmental organisations, including developmental or financial organisations, consultancies and research institutions working at the international level. Apart from these individual interviews at global level, focus group discussions were carried out within the framework of several research workshops in El Salvador, Costa Rica and Sweden. The workshops' 125 participants were from key stakeholders from Africa, Asia and Latin America working in urban development and some also in disaster risk management and/or adaptation. For the studies at national and municipal level, interviews were carried out with 71 programme managers and operational staff from 40 organisations. At the local household level, during the initial case studies of eight programmes, focus group discussions of around 35 beneficiaries were held. These were followed up during 2006 with in-depth studies of four cases, which included single interviews with 62 households, comprising 331 persons, living in 15 disaster-prone slum communities. In addition, within the context of a research workshop in El Salvador, focus group discussions were held with around 20 professionals from key stakeholders, both governmental and non-governmental.

The interviews held at global, national, municipal and local household level in El Salvador aimed to analyse the different-level perspectives and practices of the three aspects investigated (see *section 1*). After the first field study trip, the research-related organisations, programmes and geographical areas were screened and the most important/relevant ones identified. In addition, the integration process of urban development into disaster risk management/adaptation after Hurricane Mitch in 1998 and the 2001 earthquakes was

analysed in terms of driving forces, convergences and divergences, and results. During the second field study trip, the initial interviews were followed up and further directed at (a) the evaluation and validation of preliminary research outcomes (especially their limitations and possible ways of solving them); (b) the identification of financial means of supporting the integration of risk management and adaptation; and, most importantly; (c) the perspectives, needs, capacities and efforts of people, households and communities living at risk.

4.2 Walk-through analyses

In parallel with the national and municipal level studies, walk-through analyses were carried out in seven of the eight case study areas selected initially. Two to five local key informants participated in each case study area. Together with the implementing organisations, these informants were selected because of their information richness, that is, their knowledge of the programmes and the respective implementation area and beneficiaries. By walking through the areas and recording the inhabitants' explanations, observations and impressions along the way, initial assessments could be carried out. Aspects analysed were, for instance, the programmes' content, context and main features (both successful and unsuccessful), as well as local risk perceptions, needs and capacities. These initial 'walk throughs' provided important input for the selection of the four main case study areas, which were then followed up by more in-depth analyses to complement and validate initial research findings.

Walk-through analyses were also used during the participatory research workshop in El Salvador (cf. *section 4.6*). Here, it was possible to select the composition of the guiding groups independently, thus ensuring that important members of society were not excluded. In fact, the workshop participants were divided into five groups and then guided through the settlement in question by either a group of local women, children, men, builders, or members of the resident development committee. In this way, it was assessed if preliminary research outcomes (here, mainly the elaborated 'Operational Analysis and Integration Framework')

adequately reflect as well as match the needs of both the local dwellers and the professionals working in comparable programmes and/or programme areas.

4.3 Questionnaires

To select the focus country for the case studies of this research, a first questionnaire was developed, which addressed seven potential cooperation partners working in Bolivia, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, and Peru. On the basis of this questionnaire, and in combination with the personal experience and information obtained from key informants and the review of literature, El Salvador was selected. A second questionnaire was used for minor and basic background studies at the beginning of and throughout the research to assess the general risk reduction/adaptation knowledge of planners. The target group of this second questionnaire were around 100 professionals from Africa, Asia and Latin America, who had participated in different further educational training courses at Lund University.

Towards the end of the research, two more questionnaires were drawn up. The third questionnaire was developed to (a) help validate and refine preliminary research outcomes (presented in the 'Operational Analysis and Integration Framework'), and (b) assist in reaching a higher level of generalisation and transferability of the outcomes to other geographical, disciplinary/sectoral or institutional and programmatic settings. The fourth questionnaire was on financial mechanisms for social housing and disaster risk reduction/adaptation and was used to analyse the importance and possible inclusion of financing issues within the different research outcomes in the form of analytical, conceptual, strategic and operational frameworks. Both questionnaires were distributed to selected operational staff and programme managers of different (aid) organisations, most of whom were working in urban development planning. To reach a broader audience, the two questionnaires were further included on different Web sites. However, compared to the return rate of the first two questionnaires, which was 100 percent, the return rate of the other two

was very low. Hence, the information obtained through these questionnaires could not be analysed statistically, but was used to triangulate the information obtained from other data collection methods.

4.4 Observations

Observation was of great importance for the case studies. In fact, during the visits to the case study areas, a range of aspects crucial to the research could be observed. Examples of such aspects are the ‘real-life’ context of the cases/programmes; the way they were implemented; the quality of structural mitigation measures (quality of workmanship, technologies and techniques applied); success and/or failure factors; local relevance and acceptance of programme measures; accessibility; social relations; physical conditions and layout of settlements; local capacities, efforts and needs; as well as existing risk factors. Observation was especially important for crosschecking/triangulating information from other sources, for instance, that obtained from interviewees who overemphasised the programmes’ merits and strengths or downplayed their weaknesses.

Compared to the case studies, observation was a method of lower importance for the context analyses at global, national and municipal level and was limited to ‘participant observation’ during interviews, research workshops, and specialised conferences on disaster risk management.

4.5 Text reviews

The review of ‘grey’ and ‘white’ literature was conducted constantly during the research process with the aim of identifying relevant past and present studies, research-related theories, appropriate research methods, and experts in the field. It was further crucial for determining preconceptions or propositions, the elaboration of interview protocols, and the triangulation of information obtained through other research methods. Once the first research outcomes

were obtained, literature review was again crucial for their theoretical validation and systematisation.

4.6 Research workshops and ‘hands-on’ practice

In line with ‘Mode 2’ knowledge production, which aims to produce research outcomes that are directly useful or applicable at the local level, research workshops and ‘hands-on’ practice were essential for this work, for both data gathering and analysis. Research workshops and ‘hands-on’ practice assisted in: (a) testing the outcomes against ‘reality’ (i.e. the perceptions and needs of the direct and indirect research target groups); (b) refining and adapting them where needed; and (c) assessing their potential generalisation and transferability to other disciplines/sectors, as well as to other geographical, institutional and programmatic settings.

Research workshops are part of participatory research methods, also known as ‘knowledge workshops’, ‘field action workshops’ or ‘participatory research workshops’. The participants of four workshops, totalling 125 professionals, were drawn from key urban development actors, both governmental and non-governmental, working in Africa, Asia and/or Latin America. The workshops combined practical exercises to apply research outcomes at local household level (e.g. the ‘Operational Analysis and Integration Framework’) with horizontal exchange between the participants, other potential beneficiaries of the outcomes (e.g. people living at risk), and the author.

During the workshops, the participants assessed, amongst other things, if the research outcomes, in particular, the ‘Operational Analysis and Integration Framework’, were comprehensible, comprehensive/complete, relevant and applicable/useful. They also analysed if there were any financial, political or institutional threats that could hamper the use and implementation of the framework (i.e. the ‘risks’ to the framework itself), and how these could be overcome (cf. section 3.4.2).

Apart from the practical exercises during the workshops, some of the research outcomes have been tested in a 'real-life' situation in programme implementation. This 'hands-on' practice was carried out in Central America, as well as in El Salvador and the Philippines. Moreover, the strategic concepts developed for integrating risk reduction and adaptation are also being used by other international organisations within their ongoing mainstreaming processes. This re-introduction of academic analyses into the 'real-life' context (together with new data obtained through questionnaires, etc.) did provide feedback and thus input for the improvement of the research outcomes.

4. Methods of data analysis

On the basis of the data collected through the case studies and their context analysis, the emphasis of this research was on developing a grounded theory on the situation/system studied and on how this situation/system could be improved (i.e. positively influenced). For this purpose, and in line with the research's setting and theoretical positioning, for the data analysis and interpretation a combination of literal reading, grounded theory (Glaser and Strauss, 1967; Strauss and Corbin, 1990) and systems analysis (Sterman, 2000; Hördur, 2004) was applied. Cultural theory was also partly used (Thompson et al., 1990). These methods are described in the following.

4.1 Literal reading

The analysis of 'white' literature throughout the research was mainly done through literal reading, which is the assessment of the information provided in relation to the research focus. This is an iterative analysis process, using constant comparison of information from different literature (Booth, 2001)

4.2 Grounded theory

As stated in the previous sections, the overall research design was influenced by grounded theory. Written down and systematised in the 1960s by Glaser and Strauss, this theory helps researchers to look systematically at data that have been gathered. Kraimer (2003) mentions grounded theory as a suitable data analysis strategy for case study research. Through a permanent comparison, coding and categorisation process, the data gathered are conceptualised and thus a theory is generated that has a higher level of abstraction than the initial data description.

Within the framework of this study, the different texts to be analysed were first read and, where needed, interview recordings were played to cross-check transcripts and reorganise and rewrite interview notes. A combination of open coding, axial coding, and selective coding was then applied, which is described below. Compared to quantitative research, the goal of this coding process is not to count things, but to ‘fracture’ the data, and rearrange them into categories (Strauss, 1987). This facilitates comparison among items in the same category and helps to develop theoretical concepts (Maxwell, 2005).

The focus of the categorising strategy called ‘open coding’ is on similarities that could be used to sort data into categories (Maxwell, 2005). Data are compared, and similar incidents are grouped together and given the same conceptual label. This process of grouping concepts at a higher, more abstract, level is termed categorising. Based on the research setting and related preconceptions or propositions, organisational categories were often established prior to the interviews, observations or review of documents. These functioned as primary ‘bins’ for sorting the written/transcribed data for further analysis. Parts of the data were then copied and pasted within the respective categories. During this process of matching empirical evidence and predictions/propositions, categories sometimes needed to be changed or complemented.

Whereas open coding fractures the data into concepts or categories, the process of ‘axial coding’ or ‘pattern matching’ puts those data back together in new ways by making connections between a category and its subcategories. Thus, within the established organisational categories, patterns were identified through a comparison of the different empirical data. The patterns were established during, and not before, the analysis process, based on their occurrence throughout the different texts. To avoid the accumulation of unanalysed field notes and transcripts, the analysis began often immediately after the interviews. Thus, during the initial listening to interviews and the reading of the different texts, notes were already being written to develop tentative ideas about patterns and their relationships. During the process of axial coding, both substantive and theoretical patterns were identified. The substantive patterns are mainly descriptive, stay close to the data analysed, and can in a further step be used to develop theory. The theoretical patterns place the data into a more abstract framework, which is derived (a) from an inductive developed theory (i.e. the concurrent development of concepts and theories from emerging data) (Maxwell, 2005); or (b) from deductive theory (i.e. based on the research propositions made). Theoretical patterns were, for instance, based on the theoretical classification of interviewees’ perceptions, in contrast with the denoting of interviewees’ own concepts (i.e. concepts being understood and expressed in the interviewees’ own words).

The so-called ‘linear paradigm model’ is commonly used for axial coding. Its basic purpose is to enable the researcher to systematically analyse data and relate them in complex ways by dividing data into ‘causal conditions’, ‘phenomenon’, ‘context’, ‘intervening conditions’, ‘action/interaction strategies’, and ‘consequences’. In the context of this research, the linear paradigm model was expanded by the broader systems analysis approach described in *section 4.3*, to allow the analysis of more complex (i.e. non-linear) interrelations, including feedbacks.

The final step, called ‘selective coding’ (or ‘theory building’), was the identification of connections and relationships through a comparison of different categories and patterns. This

last step was crucial for identifying the underlying reasons for the situation/system identified and, finally, for theory building.

Certainly, during the analysis of categories and patterns to develop theory, attention was always given to the context of the texts to be analysed, as they were ‘produced’ under certain conditions. Hodder (1994) states that there is always a tension between the text and context. Within the framework of this research, such contexts were, for instance, false expectations of the interviewees at household level from the interviewer (i.e. the author of this study), and at institutional levels, the need of organisations to protect their reputation by overemphasising the programmes’ merits and strengths or by downplaying their weaknesses.

Glaser (1998) suggests two main criteria for judging how well the emerging theory performs, namely (a) that it must fit the place studied and, thus, be suitable; and (b) that it works (i.e. it helps people in a particular situation not only to make sense of their experiences, but at the same time to help better manage their situation). Thus, with the aim of extending and/or sharpening the emerging theory by filling in categories that might need further refinement and/or development, workshops were held with the research’s target group to present and evaluate the outcomes that were developed initially (cf. *section 4.6*). In addition, the outcomes were again compared and complemented with existing literature to examine what was similar, what was different, and why. Eisenhardt (1989, p. 545) states: ‘overall, tying the emergent theory to existing literature enhances the internal validity, generalisability, and theoretical level of the theory building from case study research (...).’

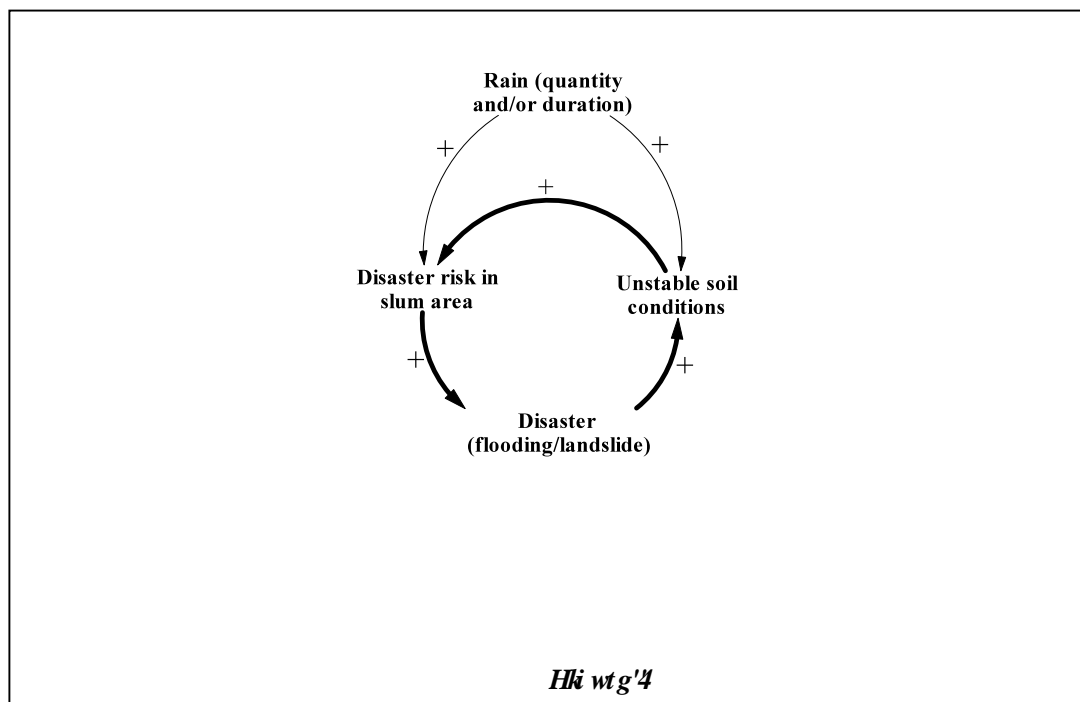
4.3 Systems thinking and analysis

The overall research design of this study, composed of case studies and their context analysis, implies systems thinking. In fact, in line with systems thinking and theory, and in comparison with traditional and commonly used analyses, this study looks at how the matter under study interacts with other parts of the system, and analyses complex matters that involve a great variety of actors and their interactions. In the words of von Bertalanffy (1950:134), ‘in the past centuries, science tried to explain phenomena by reducing them to an interplay of elementary units which could be investigated independently of each other. In contemporary modern science, we find in all fields conceptions of what is rather vaguely termed “wholeness”.’ This kind of systems thinking is thus certainly in line with case study research (cf. section 3).

According to Laws and McLeod (2004), the combined ‘case study–grounded theory approach’ breaks new ground in systems research, providing valid and reliable research outcomes based on rich and detailed data. Within the framework of this research, the use of systems analysis tools for data analysis can be further seen as an extension of the linear paradigm model of grounded theory used during axial coding (cf. *section 4.2*). In fact, in contrast to the linear paradigm model, systems analysis offers better tools for conceptualising and constructing circular connections, which is especially useful for research related to sustainable development (Haraldsson, 2004). Systems analysis was thus crucial throughout the whole research.

Systems thinking has been evolving and developing over the last 60 years and is having increasingly more influence on scientific research. It is a field of science that deals with the organisation of logic and integration of disciplines for understanding patterns and relations of complex problems (i.e. complex systems in nature, society, and science). It embeds ‘system dynamics’, a term coined in the 1960s by Jay Forrester at Massachusetts Institute of Technology (MIT) (Forrester, 1961). System dynamics refers to the re-creation of the

understanding of a system including its causal factors and feedbacks. Causal loop diagrams are used to map out the structure and the feedbacks of a system so that its mechanisms can be understood (see *Figure 2*). This can, importantly, further help in developing strategies to counteract the mechanisms that have been identified (e.g. undesired behaviour) (Hörður, 2004).



Causal loop diagrams were explicitly used at the local household level in this research. They were used to develop illustrative models of the key variables and their causal relations that underlie the complex system of climate and disaster risk in slums. A causal relation between two variables is portrayed by an arrow with a plus sign (+) or a minus sign (-) (see *Figure 2*). A plus (+) or a minus (-) sign indicates the type of change that occurs if variable A, at the beginning of the arrow, increases. A positive symbol (+) shows that the increase in variable A affects the increase in B. However, a negative symbol (-) means that the increase in A results in a decrease in B. The inclusion of non-linear relationships is one of the most important advantages of causal loop diagrams compared to conventional models, such as the above-mentioned linear paradigm model or flow charts. They are also valuable in that they can identify reinforcing loops that can represent vicious circles – and thus the search for ways of

interrupting and/or balancing them. Reinforcing loops consist of two or more variables, all of which are connected by arrows of the same polarity (i.e. plus or minus signs) going in the same direction, and are generally highlighted through bold arrows (see *Figure 2*).

Although causal loop diagrams were explicitly only used at the local household level, systems thinking was crucial throughout this work. It is also reflected in the final outcome of the research study, the 'Analysis and Adaptation Model' (Wamsler, 2009a,b), which (a) brings together the different key stakeholders that 'run' the system, and (b) indicates ways of 'breaking' negative reinforcing loops that were identified in the current system.

4.4 Cultural theory

Cultural theory was originally developed in anthropology and political science to explain risk perception. Cultural theory aims to understand why different people and social groups view, and hence react, differently to risk. Four basic social patterns were established by Thompson et al. (1990) to explain the key differences in perception and behaviour: individualistic, communitarian/egalitarian, hierarchical and fatalist. These can also be applied to other, non-risk-related fields. For the research study on urban risk reduction and adaptation, these patterns were explicitly used to analyse the data gathered on: (a) institutional approaches to (and related measures of) risk reduction, adaptation and urban development; and (b) slum dwellers' behaviour to cope with climate and disaster risk. As regards the local coping strategies, individualistic behaviour can be characterised by the use of self-help to fix things without assistance from people outside one's own household; communitarian behaviour is based on the belief that everybody sinks or swims together and is hence characterised by community efforts; hierarchical behaviour relates to the belief in authority structures for assistance, control and organisation, including strong prescriptions; and fatalist behaviour is a non-strategy for survival based on the idea that taking action or not taking action has the same (negative) result. As identified by cultural theory, under certain conditions the different patterns can move from the underlying social pattern of one strategy to another pattern

(Thompson and Wildavsky, 1986). Hence, cultural theory was further crucial to analysing if the programme measures studied helped or hindered such transitions, and if they were in line with the ways in which people actually cope with risk and disasters.

5. CONCLUSIONS: SYSTEMS RESEARCH FOR SUSTAINABLE RISK REDUCTION AND ADAPTATION

From the presented research study on risk reduction and climate change adaptation conclusions could be drawn that contribute to knowledge development at the level of research methodology. The research paradigm selected lies within the tradition of so-called ‘Mode 2’ knowledge production (Gibbons et al., 1994; Dunin-Woyseth and Nielsen, 2004), which takes as its starting point the identification and experience of local problems and aims to produce knowledge that is intended to be directly useful or applicable. On this basis, an innovative research methodology was developed and used that combines case studies, grounded theory, and systems analysis, which could be used as a template for similar intersectoral and interdisciplinary investigations. Such a ‘case studies–grounded theory–systems analysis approach’ permits a grounded theory to be built from case study data, which is viewed and analysed as part of a system that includes causal factors and feedbacks. This is an important advancement of the linear paradigm model commonly used for axial coding, which is one of the data analysis tools of grounded theory. Moreover, this approach allows theory to be built not only on any specific situation/system, but also on how this situation/system could be improved (i.e. be positively influenced).

The approach used allows investigations that cross the traditional boundaries between disciplines and sectors as regards: (a) the methods applied; (b) the research focus; (c) the heterogeneous set of practitioners and experts involved; and (d) the outcomes that are relevant to more than one discipline and/or sector. In this context, the combined use of interviews, group discussions, walk-through analyses, observations, text reviews, questionnaires, and,

importantly, research workshops and ‘hands-on’ practice proved to be an effective means of attaining this.

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