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Research Report

Towards a climate-resilient Jakarta: An analysis of the resilience thinking behind Jakarta's current public policy approach to climate-related hazards

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Towards a Climate-Resilient Jakarta: An Analysis of the Resilience Thinking Behind Jakarta's Current Public Policy Approach to Climate-Related Hazards

Jakob Haushofer

Master Thesis

65 FORUM



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Preface

Climate change presents undoubtedly one of the greatest contemporary threats both for the planet and for humankind. Climate change adaptation is therefore a challenge that with good reason was included in the Agenda 2030 of the United Nations. SDG 13 stipulates to take urgent action to combat climate change and its impacts, in particular by strengthening resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. SDG 11 calls for governments and public authorities to make cities and human settlements inclusive, safe, resilient and sustainable, and in particular “by 2030, to significantly reduce the number of deaths and the number of people affected [...] by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations”.

Against this background, research which aims at enhancing our understanding of how to improve the climate resilience of megacities and coastal urban agglomerations is highly topical and of particular relevance to both climate action and development cooperation. The master thesis by Mr. Jakob Haushofer provides a thorough and empirically grounded analysis of climate resilience policies in Jakarta. As such, it does not only enhance our understanding of a specific conception of resilience policies in a megacity of South-East Asia, but provides important general lessons on the challenges for climate resilience policies in large urban agglomerations both in the Global South and North.

Werner Raza
ÖFSE Director



Master of Science Thesis
Socio-Ecological Economics and Policy

**Towards a Climate-Resilient Jakarta: An
Analysis of the Resilience Thinking Behind
Jakarta's Current Public Policy Approach to
Climate-Related Hazards**

by:

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Content

List of tables.....	III
List of figures.....	III
List of acronyms.....	IV
Acknowledgements	V
1 Introduction.....	1
2 Research methodology and design: exploratory case study.....	5
2.1 Policy document analysis	6
2.2 Theme-structured expert interviews and thematic interview data analysis	7
3 Two prominent approaches to urban resilience.....	11
3.1 Resilience as a flexible metaphor and concept – steady versus complex systems.....	11
3.2 Distinct approaches to urban resilience by different research traditions.....	13
3.3 Urban social-ecological systems approach and complex adaptive systems thinking ...	15
3.3.1 Social-ecological systems	15
3.3.2 Complex adaptive systems thinking	16
3.3.3 Social-ecological resilience.....	18
3.3.4 Urban social-ecological systems resilience.....	21
3.3.5 Shortcoming of social-ecological systems theory.....	29
3.4 Urban disaster resilience approach and disaster risk management.....	30
3.4.1 Disaster risk management	31
3.4.2 Urban disaster resilience	32
3.4.3 Shortcomings of disaster resilience theory	38
3.5 Going beyond distinct approaches: a great deal of complementary insights	40
4 Urban climate resilience.....	42
4.1 Resilience of urban systems to climate-related hazards in times of climate change	42
4.2 Urban disaster risk management as climate change adaptation	44
4.3 An interdisciplinary complex adaptive systems approach to urban climate resilience	45
5 Policy implications of different understandings of resilience	47
5.1 What is public policy?	47
5.2 Policy implications of different resilience perspectives and conceptualisations.....	48
6 The system under concern: Jakarta megacity.....	52
6.1 Climate related hazards in Jakarta	53
6.2 Multilevel policy addressing climate-related hazards in Jakarta	57
7 Resilience thinking behind Jakarta’s current policy approach to climate-related hazards	63
7.1 The current policy approach to climate-related hazards – an overview	63
7.1.1 Structural policies	63
7.1.2 Non-structural policies	65
7.2 Resilience thinking in policy documents analysed.....	67
7.3 Understanding of resilience by public policy actors interviewed.....	68
7.3.1 Directorate General for Climate Change (DGCC) of the Ministry of Environment and Forestry (KLHK).....	68
7.3.2 National Agency for Disaster Risk Management (BNPB)	70
7.3.3 Provincial Planning and Development Agency (BAPPEDA)	71
7.3.4 Commission for Environment and Development (CED) of the Regional Research Council of Jakarta (DRD)	73
7.3.5 Overview of resilience definitions by public actors interviewed.....	75

8	Analysis of Jakarta’s resilience thinking from a complex adaptive systems perspective	77
8.1	Varying resilience perspectives – all leaning towards engineering resilience.....	77
8.1.1	Case-by-case analysis of the policy actors’ resilience perspectives	77
8.1.2	Overall analysis of the city’s resilience perspective – engineering resilience	79
8.2	Concern for a wide range of factors for climate resilience with infrastructure in focus	80
8.3	Reflection about theoretical implications of the empirical findings for urban resilience theory	82
9	Limitations.....	84
10	Conclusions.....	85
11	References.....	88
12	Annex I.....	101
13	Annex II	102
14	Annex III.....	104

List of tables

Table 2.1 Overview of policy actors interviewed.....	10
Table 3.1 Four approaches to urban resilience	14
Table 3.2 Two complimentary definitions of resilient urban social-ecological systems.....	21
Table 3.3 Overview of key elements of an urban social-ecological resilience approach and urban disaster resilience approach.....	41
Table 5.1 Three dimensions of political systems.....	48
Table 5.2 Differences in the policy focus between an engineering and ecological resilience perspective.....	50
Table 6.1 Key public policy actors concerned with climate-related hazards in Jakarta	58
Table 7.1 Overview of main structural policies addressing climate-related hazards.....	65
Table 7.2 Overview of main non-structural policies addressing climate-related hazards.....	66
Table 7.3 Overview of resilience definitions by public actors interviewed.....	76

List of figures

Figure 2.1: Research design.....	6
Figure 3.1 Two opposing paradigms underlying different resilience perspectives	13
Figure 3.2 Two dimensions of urban resilience	23
Figure 3.3 Drivers of disaster risk	32
Figure 6.1 Geographic location of the lowland coastal area of Jakarta	54
Figure 6.2 Overview of key public actors concerned with climate-related hazards in Jakarta within the three-tier government system	59

List of acronyms

BAPPEDA	Provincial Planning and Development Agency
BAPPENAS	National Development Planning Agency
BNPB	National Agency for Disaster Risk Management
BPBD	Provincial Disaster Management Agency
BPLHD	Provincial Agency for Environment Management
CED	Commission on Environment and Development
DGCC	Directorate General for Climate Change
DKI Jakarta	Special Capital Region of Jakarta
DRD	Regional Research Council of Jakarta
IPCC	Intergovernmental Panel on Climate Change
JEDI	Jakarta Emergency Dredging Initiative
JUFMP	Jakarta Urgent Flood Mitigation Project
KHLK	Indonesian Ministry of Environment and Forestry
KPUPR	Indonesian Ministry of Public Works
NCICD	National Capital Integrated Coastal Development Master Plan
RPJMN	Medium-Term National Development Plan 2015-2019
RPJPD	Jakarta's Long-Term Development Plan 2005-2025
RTRW	Spatial Plan 2030 DKI Jakarta
UNISDR	United Nations Office for Disaster Risk Reduction

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The present thesis was written in the course of an exchange semester at Universitas Gadjah Mada (UGM) in Yogyakarta, Indonesia, as partial fulfilment of a Master of Science in Socio-Ecological Economics and Policy of the Vienna University of Business and Economics, Austria. I am grateful for this opportunity and for the interesting discussions with my fellow students at UGM. Although I have strongly aimed to take the Indonesian perspective into account, it seems important to explicitly note that this thesis is written from a European perspective.

1 Introduction

More than half of the world's population currently lives in cities and urbanisation is expected to continue. Especially developing countries have seen rapid rates of urbanisation in recent decades. (World Health Organization 2015) An overwhelming body of evidence provided by the Intergovernmental Panel on Climate Change (IPCC) suggests that our climate is changing and that this will have wide-ranging adverse impacts on both human and natural systems. Most notably, climate change does not only lead to rising sea levels, but will also increase weather extremes in terms of frequency and magnitude, including heavy rainfall and heatwaves. (IPCC 2012: 25ff) As cities concentrate people, economic activities and important infrastructure, they also concentrate risks to climate-related hazards. Indeed, cities are expected to be affected by climate change to a particular high degree. (Otto-Zimmermann 2011a: 3f) Coastal megacities are particularly vulnerable to climate change impacts because of their dense populations in areas that are greatly affected by rising sea levels and storm surges (World Bank 2010: 8f). Awareness that past greenhouse gas emissions lead to inevitable changes in climate conditions has gone hand in hand with the recognition of the importance to adapt to climate change impacts (UNDP 2007: 74ff). In this sense, urban planners and policy actors have taken up the challenge to prepare cities for climate-related hazards, including flooding, heatwaves and storms.

In doing so, urban resilience to climate change has become an increasingly popular approach to guide efforts in dealing with climate change at the city-level. As Leichenko (2011) explains, in recent years the concept of resilience is gaining more and more prominence in literature on climate change and cities. Thereby, several related but distinct research approaches have emerged within the context of different research traditions. (Leichenko 2011: 164ff) The largest and most prominent approaches are certainly urban social-ecological resilience literature, which originates from ecology, on the one hand; and urban disaster resilience literature, which stems from social sciences, on the other hand. Both approaches are discussed in chapter four and provide the theoretical foundation of the present thesis. It is important to note that resilience is not at all a new scientific concept. Originating from physical science, it has been highly influential in ecology and later in social sciences (Davoudi 2012: 299ff; Folke 2006: 253ff). So, while it has entered the field of urban studies only since the early 2000s (Yuzva & Zimmermann 2012: 101); it has been applied in other fields for quite some time. Related to this is the fact that different people understand resilience

differently. In other words, resilience is not a universal concept but different understandings exist about what it actually means to be resilient. In fact, resilience proves to be a very flexible concept that can serve different purposes (Brown 2014: 114). What all the resilience definitions have in common, however, is that resilience is concerned with the capacity to deal with disturbances, such as climate-related hazards. Beyond that, a huge variety in resilience definitions and conceptualisations exists. Firstly, one is able to identify that resilience perspectives differ with regards to their fundamental underlying assumptions about the systems under concern. More technically said, two opposing resilience paradigms can be distinguished, namely engineering resilience and ecological resilience, which underlie different definitions of resilience and in turn have huge implications on the focus of policies that aim to build and improve resilience (Holling 1996: 33ff). Secondly, understandings of resilience also differ with regards to which characteristics of cities are regarded to determine the level of urban resilience, i.e. the conceptualisation of resilience. For instance, even though researchers emphasise the central importance of social and economic aspects, these are often not featured in urban resilience thinking (Yuzva & Zimmermann 2012: 102). As a result, it is clear that the way in which urban resilience is understood has vital implications with regards to the focus of policies that aim to promote urban resilience. Given the exceptional challenges climate change poses for coastal megacities in particular, the climate resilience thinking behind their public policies is of great significance.

The delta city Jakarta constitutes a particularly interesting case of a coastal megacity since the Indonesian capital struggles to deal with climate-related hazards, in particular floods, heatwaves and storms, already today. Most importantly, as Texier (2008) explains, Jakarta is highly prone to flooding, which occurs frequently during the rainy season and has resulted in disastrous impacts in the recent past (Texier 2008: 358f). During the period from 1960 to 2010 the population of Indonesia's capital city has more than tripled from 2.7 to almost 10 million, making it one of the largest megacities in Southeast Asia (Marfai et al. 2015: 1128ff). Related uncontrolled urban development and rapid rates of human-caused land subsidence have contributed to the current problematic situation (Sagala et al. 2013: 9f; Marfai et al. 2015: 1128ff). Further important factors determining Jakarta's high risk of flooding are its coastal lowlands in the North, the city's overall low topography and land use change upstream its 13 rivers (Marfai et al. 2015: 1127ff). Overall, studies indicate that Jakarta is the most vulnerable city to climate change in Southeast Asia (Yusuf & Francisco 2009: 13ff). Given the high proneness of the city to flooding and vulnerability to climate change, it comes as no surprise that this is a high priority for the current provincial government (Government DKI

Jakarta & BAPPEDA 2012a: III 2ff). In its efforts to deal with these pressing issues Jakarta's Government uses the concept of resilience. That is greatly illustrated by the fact that the city participates in the United Nations Office for Disaster Risk Reduction (UNISDR) "Making Cities Resilient Campaign" (UNISDR 2015: 12). Bearing in mind that resilience can be understood quite differently, then the interesting question arises which ways of resilience thinking guide the city's public policy approach to climate-related hazards. Existing research indicates that the city's earlier policy approach to climate-related hazards, in particular with regards to flooding, is dominated by technical infrastructural measures and falls short on socio-economic aspects (Marfai et al. 2015: 1127ff; Texier 2008: 358ff; Sagala et al. 2013: 4ff). However, the policy mix may have changed recently due to a change in political leadership and the underlying understanding of policy actors have not yet been analysed with regards to urban resilience thinking. Yet, such an analysis of the city's policy-level through the lens of resilience is of great relevance since the way in which the concept resilience is taken up influences the policy focus and the corresponding perspective about the adequacy of the current policy approach seeking to promote Jakarta's climate resilience. In light of the significant differences in resilience perspectives, it is valuable not only for scientific purposes but also for policy actors and other stakeholders to reveal which resilience paradigm(s) and conceptualisation(s) prevail at the city level. A corresponding analysis may discover aspects in which the current understanding of resilience falls short in accounting for the complex dynamics of urban systems and the multiple dimensions of their resilience.

Therefore, the present thesis is guided by the following research question: In what ways has the concept of resilience been taken up the Government of Jakarta in its public policy approach to climate-related hazards? The corresponding investigation is done through means of an exploratory case-study strategy, which combines an analysis of current policy documents and expert interviews with high-level public officials from relevant policy actors. In its analysis, this thesis follows complex adaptive systems thinking. This is a particular perspective that considers the world to comprise of complex systems, whose central characteristics include non-linear dynamics of change, limited predictability and regime shifts (see Berkes et al. 2003: 5ff; Robinson 2009: 442). As such, it opposes perspectives that assume linear behaviour and the existence of a single natural equilibrium (Holling 1996: 33f). Another important aspect is that this goes hand in hand with seeing systems as integrated systems; which means that ecosystems and social systems cannot be separated but are truly interconnected the form of social-ecological systems (Berkes et al. 2003: 3; Folke et al. 2011:

720f). So, the analytical perspective of the present thesis is based on the understanding of resilience as a feature of cities who are a special type of social-ecological systems.

The overall structure of the present thesis takes the form of ten chapters. Following a chapter on the study's methodology and research design, chapter three discusses the two most prominent approaches to urban resilience, namely urban social-ecological resilience literature and urban disaster resilience literature. Complex adaptive systems thinking is also explained in more detail in the course of this chapter. Chapter four then elaborates on the specific concept of urban climate resilience based on preceding theoretical insights. The fifth chapter completes the theoretical dimension by elaborating on policy implications of different resilience perspectives. Central terms and concepts are defined in the course of the theoretical discussion in chapter three, four and five. Chapter seven then elaborates on the context of Jakarta with regards to climate-related hazards and central policy actors. The eighth chapter presents the empirical findings beginning with the current policy approach based on policy documents, followed by summaries of the resilience thinking of policy actors interviewed. Based on this, chapter nine analyses the empirical findings in terms of three themes: First, the underlying resilience perspective or paradigm. Second, which aspects are considered relevant for promoting Jakarta's resilience. Third, a reflection on potential theoretical implications of the present study's empirical findings on urban resilience theory. Following, chapter ten discusses the limitations of the present study. Overall conclusions are then laid out in chapter ten.

2 Research methodology and design: exploratory case study

This thesis has the objective to investigate what way(s) of urban resilience thinking lie(s) behind Jakarta's current policy approach to climate-related hazards.

Thereby this paper is guided by the following **research question: In what ways has the concept of urban resilience been taken up by the government of Jakarta in its current public policy approach to climate-related hazards?**

Based on preliminary research, the following **hypothesis** was established: **The city's approach to climate-related hazards is based on engineering resilience thinking. Moreover, there is a strong policy focus on infrastructural technological aspects.**

More precisely, the research question guides the investigation of the city's resilience thinking with regards to two aspects: First, in what ways urban resilience is actually defined at the city level. Thereby, the aim is to reveal which paradigm(s) underlie the current resilience perspective(s) behind the policy approach. Second, which factors are regarded to be relevant determinants for Jakarta's resilience to climate-related hazards, i.e. the conceptualisation of resilience. As mentioned before, existing studies indicate a strong focus on technological infrastructural policy measures and negligence of socio-economic factors (Marfai et al. 2015: 1127ff; Texier 2008: 358ff; Sagala et al. 2013: 4ff). In my view, these studies also convey the impression that a command and control mentality lies behind the policy approach, seeking to return to the pre-disturbance situation after climate-related disturbances, such as floods. Based on this, the above-stated hypothesis was established.

In order to answer this research question, this thesis follows a qualitative exploratory case study strategy. As explained by Yin (2003), case studies are comprehensive research strategies that consider the context of the contemporary phenomenon under concern as highly relevant, hence real-life contextual aspects are explicitly taken into account. The key strength of case studies is that thereby all kinds of evidences or data sources can be used. A case study may for example combine data from observations, interviews and documents. (Yin 2003: 5ff) As such, case studies have distinct advantages when "[...] a 'how' or 'why' question is being asked about a contemporary set of events, over which the investigator has little or no control." (Yin 2003: 9)

This case study follows an exploratory purpose. Existing research, such as by Texier (2008) or Sagala et.al. (2013), indicate that earlier policies focus on infrastructural technological

measures and neglect socio-economic aspects (Texier 2008: 358ff; Sagala et al. 2013: 4ff). However, the city's public policy approach and underlying perspectives of policy actors have not yet been investigated with regards to urban resilience thinking. Furthermore, the policy focus may have shifted recently due a change in political leadership. That is why, it remains to be explored in what ways urban resilience to climate-related hazards is defined and conceptualised.

The research design of this thesis, as illustrated in Figure 3.1, incorporates two methods of qualitative investigation within a case study research strategy: First, relevant policy documents are analysed through means of qualitative content analysis. Second, theme-structured expert interviews are conducted with relevant policy actors. These two methods inform each other dynamically in the research process. For example, both the identification of potential interviewees and the development of the interview guideline were informed by a parallel analysis of policy documents. Similar, policy documents that were implicitly or explicitly mentioned in the responses of the interviewees were included in the analysis.

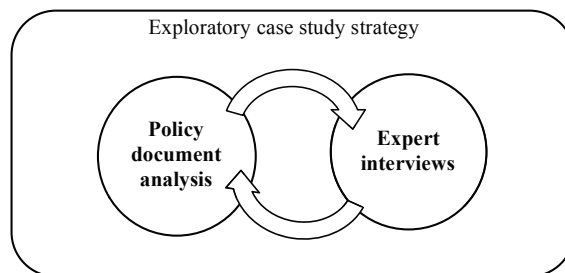


Figure 2.1: Research design

In accordance with the case study strategy, the data gained through the two qualitative methods were enhanced with information on the context of the city. For example, insights from previous studies on community hazard responses in Jakarta or reports from international organisations, such as the World Bank, were drawn upon. For the purpose of clarity and avoidance of mixing the responses from different policy actors, the findings of the document analysis and the respective interviews are laid out separately at first in chapter seven and then converged in the course of the analysis in chapter eight.

2.1 Policy document analysis

As explained by Bowen (2009), document analysis is a qualitative research method for the systematic review or evaluation of documents that is regarded to be particularly useful in qualitative case studies. Document analysis is a systematic evaluation process where

empirical data is produced and organised, such as excerpts or text passages. (Bowen 2009: 27ff) “The analytical process entails finding, selecting, appraising (making sense of), and synthesising data contained in documents.” (Bowen 2009: 28) With the research question in mind, one has to determine the relevance of documents and treat them critically with regards to credibility, authenticity and accuracy. (Bowen 2009: 27ff)

For the present study, relevant policy and policy-related documents, including development plans or strategies were analysed. Since it turned out that only a limited number of relevant policy documents are available, policy-related documents, in particular visualisations (slides) of presentations by public officials, were also analysed. In order to identify relevant text passages, keywords related to climate-resilience were used, including adaptation, adaptive capacity, climate change, disaster risk, ecology, environment, flooding, flood control, mitigation, sea-level rise, risk reduction, resilience, among others. Only recent documents, from 2012 onwards, were looked at. A list of the analysed documents is provided in Annex I. The policy documents were selected due to their central role in laying out how the city aims to address pressing development issues, particularly with regards to climate-related hazards. In doing so, these policy documents include an analysis of strategic issues, state corresponding visions and lay out policy directions. The case-study strategy proved particularly useful, as it allowed to develop an overview of the current policy approach by using secondary sources, such as research papers, multilateral reports and newspaper articles, in a supplementary manner to the limited number of relevant policy and policy-related documents available.

2.2 Theme-structured expert interviews and thematic interview data analysis

The second research method employed in the exploratory case study strategy is the expert interview. As explained by Meuser and Nagel (2009), an expert is a person that has an “exclusive realm of knowledge” that is of great relevance to the research objective. So, whether a person is an expert depends on the judgement of the researcher. In other words, the researcher recognizes a person as an expert within the field of investigation based on the research objective and the form of knowledge the person possesses. (Meuser & Nagel 2009: 18f) In doing so, expert knowledge is differentiated from other types of knowledge in the sense that it is seen to have a relevant influence on the actions of other actors within a field of practice (Borgner and Menz 2002 as cited in Meuser & Nagel 2009: 19).

The expert interviews correspond in design and structure to theme-structured interviews. As Legard and colleagues (2003) explain, this type of interviews aims to combine structure with flexibility. The structure of the interview is based on a topic guide that the researcher has prepared in advance, setting out key themes and issues that are to be covered in the course of the interview. The topic guideline allows enough flexibility so that the interviewee can set the order in which he or she would prefer to cover the themes. The great level of flexibility further allows covering themes that emerge in the course of the interview. In general, researchers commence in-depth interviews with a broad opening question, followed by the main body of the interview, where the interviewer guides through the themes. To achieve a greater level of understanding and depth the researcher ask a series of follow up-questions to broader topical questions and uses different probing techniques. (Legard et al. 2003: 141ff)

The interview data analysis followed a thematic analytical approach. Thematic analytical methods are a broad group of qualitative analysis methods that aim to produce explanations and or descriptions clustered around themes in a highly systematic manner (Gale et al. 2013: 2). This was done through means of the framework data analysis method provided by Gale and colleagues (2013). This framework method consists of a systematic stage-by-stage procedure of categorising and organising the interview data. More precisely, audio transcription and familiarisation with the interview is followed by five synthesising analytical stages, which involve coding, summarization, comparison, categorisation and charting of data in a framework matrix. The latter constitutes the output of the method, structuring, summarising and reducing the data by case, i.e. most of the time an interview, and by codes. Accordingly, the framework method enables the researcher to compare and contrast data across and within cases. (Gale et al. 2013: 2ff)

For the present study, five high-level public officials from four relevant public bodies were interviewed. For this purpose, public policy actors whose field of work is concerned with addressing climate-related hazards were first identified based on existing studies about climate-related hazards in Jakarta and a preliminary look at policy documents. A corresponding overview of the relevant public policy actors is presented in section two of chapter six. Among those relevant actors, interviews were conducted with two representatives from the Indonesian Ministry of Environment and Forestry (KHLK), and one representative from the National Agency for Disaster Risk Management (BNPB), the Provincial Planning and Development Agency (BAPPEDA) DKI Jakarta, and the Regional Research Council of Jakarta (DRD). A corresponding overview is provided in table 2.1 below. These organisations

were selected for the sample based on two aspects: First, these actors were identified to be of particular relevance to the present investigation because existing studies suggest that they have a key role in addressing climate-related hazards in Jakarta. Second, the sample includes two provincial and two national policy actors as the literature indicates that the latter also play an important role for city-level policies, for instance in terms of funding, technical expertise and programmes. Section two of chapter six elaborates on this multi-level government context and provides descriptions of the public bodies with which the respondents are affiliated. Each public body was approached at a relevant unit and then chose themselves who of the executive staff is suited best to talk about urban resilience in Jakarta. Besides, it was also important that the respondent is confident in talking in English, as interpretation was not available due to resource constraints. Since all experts interviewed were high-level officials of the respective public actors, they were identified to be in a position to represent the standpoint of their organisation. Accordingly, all respondents indicated that their resilience thinking confirms to the official point of view of their organisation, or at least unit, in the course of the interviews (Annex III). All interviews were conducted based on the same guideline within a relatively short period of time, thus insights provided by one respondent had little to no influence on how the following interviews were conducted.

The interview guideline employed in the expert interviews is stated in Annex II. This guideline consists of four sets of questions or sections: The first set of questions follows a broad opening question and relates to the definition of resilience and the perception of a resilient city. The corresponding questions were informed by key themes mentioned in the literature, such as the relation between resilience and disaster risk management and a concern for maintaining stability as indication of a steady systems perspective. Likewise, the second set of questions was based on resilience theory literature and includes questions about the conceptual level of resilience with regards to three central realms of urban resilience factors, namely ecological, social and infrastructural. Sub-questions to these three realms directly link to related policy issues in Jakarta, which was based on insights from existing studies about climate-related hazards in the city, including for instance the issue of informal settlements in vulnerable areas. The third section comprises questions about the use of the concept of resilience on a practical level. Overall, the questions are first framed around weather-related hazards in order to avoid confusion with the term climate. That is why, the fourth and final section of the interview guideline covers questions about the influence of climate change on Jakarta's resilience.

Table 2.1 Overview of policy actors interviewed

Public policy actor interviewed	Unit of representative(s) interviewed	Time of interview
Ministry of Environment and Forestry (KHLK)	Directorate General for Climate Change (DGCC)	8 July 2015
National Agency for Disaster Risk Management (BNPB)	Data and Information Centre	7 July 2015
Provincial Planning and Development Agency (BAPPEDA) DKI Jakarta	Executive Office	8 July 2015
Regional Research Council of Jakarta (DRD)	Commission on Development and Environment (CDE)	7 July 2015

3 Two prominent approaches to urban resilience

As mentioned before, urban resilience is no universal concept but it does not have the same meaning for everyone, thus it is approached differently. In fact, numerous interpretations about the characteristics that define urban resilience and differentiating standpoints about the appropriate analytical approach exist (Leichenko 2011: 164). The most prominent research approaches to urban resilience distinguish themselves mainly in two aspects: First, with regards to the dominant paradigm underlying the understanding of the concept of resilience in terms of its definition. Second, approaches to urban resilience differ significantly with regards to the key factors that are seen to determine a city's resilience. I refer to the latter as conceptualisation of resilience. For example, some conceptualisations may focus on urban infrastructure while others stress the importance of social processes. In the course of this chapter, I discuss the two most prominent approaches to urban resilience, social-ecological resilience and disaster resilience, and their corresponding main theoretical concepts. First, however, it is important to elaborate on the two opposing paradigms reflected in the different understandings of resilience.

3.1 Resilience as a flexible metaphor and concept – steady versus complex systems

The concept of resilience is featured nowadays in a wide range of scientific fields, including physics, biology as well as social sciences disciplines such as psychology or disaster studies. Resilience is by no means a new concept. Originally, it has been employed by physical scientists to describe the stability of a material with regards to external shocks. (Davoudi 2012: 300f) For example, a resilient material may not break if stressed but bend and bounce back (Norris et al. 2008: 127 with reference to Gordon 1978). Hence, the term resilience was used closely in line with the meaning of its Latin root *resi-lire*, which means to spring back. Throughout the 1960s the concept then entered the field of ecology, where different meanings of resilience emerged. This transfer of the concept to ecology was initiated by the work of Holling (2010 [1973]) and took place at the same time complex adaptive thinking gained prominence. (Davoudi 2012: 300f) From the 1970s onwards the concept of resilience then began to increasingly influence the social sciences (Folke 2006: 255). Needless to say, while resilience is widely used in research today, it does not have the same meaning for everyone. Actually, each of these scientific fields presents its own set of definitions (Brown 2014: 108). Indeed, in one of its publications the Community and Regional Resilience Institute (CARRI

2013) states over forty different definitions for resilience. Hence, as Brown (2014) points out, the concept of resilience is relatively flexible. Yet, this flexibility also means that it can be used to serve different interests (Brown 2014: 114), which is discussed further below in the context of policy.

What all the definitions featured in the different scientific fields have in common is that resilience is concerned with the ability to deal with disturbances. As the wide range of interdisciplinary research shows, one is able to apply the concept of resilience to any type of disturbance and different subjects of concern (Abbas et al. 2013: 10). For example, in psychology, resilience is frequently used to describe the ability of individuals to deal with major disturbances to their lives, i.e. hardships (Berkes & Ross 2013: 10f). In ecology, resilience is usually concerned with the ability of an ecosystem, such as a forest, to deal with disturbances, such as forest fires (e.g. Johnstone et al. 2010). Correspondingly, resilience may be perceived as a characteristic of an individual, community, or in other words systems, such as ecosystems, public transport systems or the immune system of the human body. I discuss the systems perspective in further detail below.

Based on the work of Holling (1996), one is able to discern that there are basically two opposing paradigms underlying the various definitions of resilience: ecological resilience and engineering resilience (Holling 1996).

On the one hand, engineering resilience constitutes the more traditional view on resilience. Here, resilience is defined as the ability to bounce back or return to equilibrium after a disturbance (e.g. Pimm 1991: 18ff). As Holling (1996) points out, this understanding of resilience reflects the paradigm that a system has a single equilibrium to which it returns after perturbations (1996: 33). It is assumed that there is a single point of “natural” balance for every system. Accordingly, resilience is simply measured in terms of how long it takes to return to this steady state after a disturbance occurred (Pimm 1991: 18ff). The faster, the more resilient the system (Keating et al. 2014: 25) and vice versa. Although the speed of recovery may vary, systems eventually reach their former equilibrium (Gunderson & Allen 2010: 15). In other words, to be resilient means to bounce back fast. Correspondingly, the focus is on maintaining efficiency of function near this single stable equilibrium (Holling 1996: 33). “It is about resisting disturbance and change, to conserve what you have.” (Folke 2006: 256) In light of its emphasis on “efficiency, constancy and predictability” Holling (1996) termed this resilience perspective engineering resilience (1996: 33).

On the other hand, ecological resilience rejects the idea of a single stable equilibrium (Davoudi 2012: 300f). Ecological resilience implies the understanding that multiple states are possible and nonlinear dynamics of change prevail (Holling 2010 [1973]: 42ff). Consequently, resilience cannot mean bouncing back to equilibrium. In contrast, resilience is defined as “[...] the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks.” (Walker et al. 2004: 2) In other words, resilience is concerned with the magnitude of disturbance the system can undergo before shifting to a different state (Folke 2006: 259). It is about the risk of shifting to a fundamentally different state due to disturbances. Hence, this understanding of resilience clearly reflects the notion of multiple equilibria, in the sense that it acknowledges the existence of more than one stable state, also known as domains of attraction (Holling 2010 [1973]: 41ff).

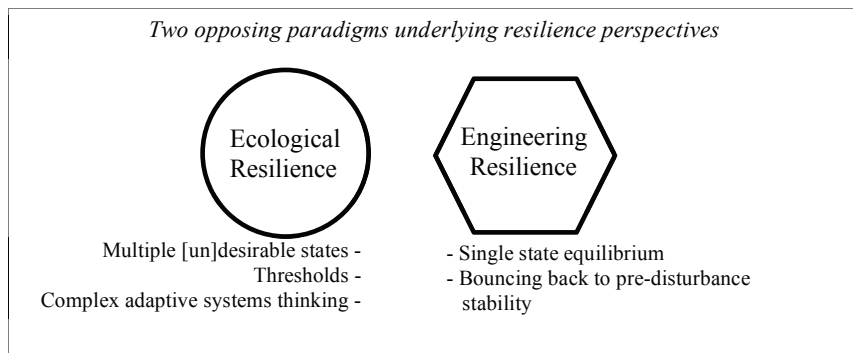


Figure 3.1 Two opposing paradigms underlying different resilience perspectives. Based on Holling (1996)

As mentioned above, these two paradigms are greatly reflected in the various approaches to urban resilience. While ecological resilience has emerged out of the field of ecology (Holling 2010 [1973]: 42ff); engineering resilience has been highly influential in the realm of social sciences (Davoudi 2012: 299ff). I elaborate on the two most prominent approaches to urban resilience following an overview of the four distinct approaches to urban resilience within different research traditions as identified by Leichenko (2011: 164ff).

3.2 Distinct approaches to urban resilience by different research traditions

The concept of resilience has received wide attention in recent years in the literature about cities. According to Leichenko (2011), several sets of literature on urban resilience have emerged in the context of different research traditions, which can broadly be categorised into

four distinct approaches to urban resilience (Leichenko 2011: 164ff). An overview of these four approaches is provided in table 3.1

Table 3.1 Four approaches to urban resilience

Approach to urban resilience	Research tradition
Urban ecological resilience literature [Urban social-ecological resilience approach]	Stems from ecology and incorporates understandings of ecosystems resilience accordingly. Predominantly based on ecological resilience. Cities are studied as complex adaptive systems. Ecological factors are emphasized.
Urban hazards and disaster risk reduction literature [Urban disaster resilience approach]	Rooted in social sciences and emerged from research in psychology about the resilience of individuals to hardships. Tends to be dominated by engineering resilience. Emphasizes social determinants of urban resilience and builds on disaster risk theories.
Urban and regional economics literature	Stems from economic geography and regional planning. Focuses on the relationship between resilience and economic development in a regional context.
Urban governance and institutions literature	Focuses on the linkages between institutional arrangements and resilience. Investigates features of urban governance that promote resilience.

Table 3.1: Based on Leichenko (2011). Additional information on the respective research traditions drawn from Berkes and Ross (2013), Berkes et.al. (2003), Godschalk (2003) and Keating et.al. (2014).

The largest and most prominent approaches to urban resilience are certainly urban ecological resilience literature, on the one hand; and urban hazards and disaster risk reduction literature, on the other hand. From now on I also refer to the former as “urban social-ecological resilience approach” and the latter as “urban disaster resilience approach”. According to Leichenko (2011), the latter approach constitutes the largest strand of literature about urban resilience (Leichenko 2011: 165). As such, it also tends to be most known and most influential. Although both approaches are related and provide rich complementary insights; one has to bear in mind that each approach tends to focus on different components of cities (Leichenko 2011: 164ff). Most importantly, the two approaches distinguish themselves in the sense that each strand of literature tends to be dominated by a different resilience paradigm. Urban social-ecological resilience emerged out of ecology as a distinct approach to urban resilience (e.g. Sellberg et.al. 2015: 1ff); and is based on an ecological resilience perspective accordingly. Urban disaster resilience is rooted within social sciences and is, on the contrary, predominantly based on engineering resilience thinking. Even though some researchers in the field of disaster resilience go somewhat beyond engineering resilience; Keating and colleagues (2014) state that bouncing back is still emphasised by the great majority of

resilience definitions (Keating et al. 2014: 26). Following, both approaches are discussed in detail, which provides the theoretical foundation of the present thesis. Thereby, differences in the conceptualisation of urban resilience become apparent. Indeed, there are differing emphasis about which characteristics of urban systems are seen to determine urban resilience (Jabareen 2013: 164). It is important to point out that even though the underlying paradigms may for the most part differ between the two approaches, the conceptualisations of urban resilience greatly complement each other. More precisely, the following sections reveal that social-ecological resilience has a well-developed focus on the ecological dimension of resilience. Likewise, disaster resilience literature greatly complements the picture with regards to the social dimension. Hence, aspects introduced in one strand of literature may be equally relevant in the other. The following theoretical discussion of urban social-ecological resilience and urban disaster resilience links and builds upon the status quo of research about urban resilience in the two respective strands of literature.

3.3 Urban social-ecological systems approach and complex adaptive systems thinking

Before I elaborate on how the social-ecological systems approach has been applied to urban living spaces, it is essential to explain underlying assumptions and perspectives. In particular, one needs to point out key aspects of complex adaptive systems thinking and the corresponding social-ecological systems perspective underlying this approach because this also constitutes the analytical perspective of the present study.

3.3.1 Social-ecological systems

Underlying the concept of social-ecological systems are two insights: On the one hand, the understanding that all people depend on the functioning of ecosystems (Folke et al. 2011: 719f). The earth's ecosystems provide the biophysical foundation and critical ecosystem services for development, such as clean water or hospitable climate conditions (Steffen et al. 2005: 1ff). On the other hand, virtually all ecosystems are influenced by people (Folke et al. 2011: 719f). Indeed, human activities change ecosystems not only at the local level, but also shape the earth's ecosystem globally (Steffen et al. 2005: 1ff). That is why, one cannot exclude the human dimension when looking at ecosystems. Likewise, one cannot treat the environment as an externality of social systems. Such simplifications would miss crucial human-environment interrelations. (Folke et al. 2011: 720ff; Berkes et al. 2003: 9ff) In fact, "[...] economics and societies are fundamentally integrated into the planet and the life-

supporting ecosystems [...]” (Moberg et al. 2014: 4). Therefore, social and ecological systems are not just linked, but regarded as truly interconnected and co-evolving (Berkes et al. 2003: 3ff). Together they form integrated systems, so-called social-ecological systems (Berkes et al. 2003: 3; Folke et al. 2011: 720f). Hence, this perspective implies that any distinction “[...] between social and natural systems is artificial and arbitrary”. (Berkes et al. 2003: 3) While it is clear that speaking of two dimensions is useful for analytical purposes, the term social-ecological systems stands for linked social and ecological systems, any investigation of which requires integrated research approaches, transcending disciplinary boundaries.

3.3.2 Complex adaptive systems thinking

In order to understand the concept of social-ecological systems, one has to bear in mind that it reflects complex systems thinking. Complex systems thinking is a way of looking at and understanding the world. As explained by Robinson (2009), this perspective assumes that the world comprises of complex systems (2009: 442). Examples of such systems include weather systems, the immune system of the human body or ecosystems. Berkes et.al. identify (2003) five defining attributes of complex systems: emergence, non-linearity, self-organisation, hierarchy and openness. These attributes also distinguish them from simple systems, which can be analysed adequately by the use of single perspective. (Berkes et al. 2003: 5ff)

First, systems are complex because they have emergent properties. That means that their parts behave together as a system, which makes the system more than its parts. (Robinson 2009: 442f) Accordingly, meaningful knowledge comes only from building bigger pictures, not through the decomposition of the system (Flood 2010: 270). In other words, understanding about complex systems is gained through the examination of the relations of the parts of the system, their interconnections, how they operate together and not from looking at parts in isolation. This attribute of complex systems is generally referred to as emergence. (Berkes et al. 2003: 5)

Second, systems are complex since they are characterised by non-linear dynamics (Berkes et al. 2003: 5). In simple terms, systems are changing in the sense that there are multiple possible stable systems states and the possibility to shift from one state to another. More precisely, as explained by Berkes and colleagues (2003), complex systems organize around one of many possible stable states. If some conditions change, feedback mechanisms help to maintain the current stable state. (2003: 5f, 14) Yet, if a certain threshold of change in conditions is reached, the system may shift rapidly to another state. It is not easy to predict

such a point of change, as there are threshold effects. That is why changes tend to be relatively sudden rather than gradual. (Berkes et.al. 2003: 5f, 14) An example for such a shift to an alternative states is the case when a freshwater lake becomes polluted through an extensive growth of algae (Resilience Alliance 2015). Most importantly, “[r]estoring a system to its previous state can be complex, expensive, and sometimes even impossible.” (Resilience Alliance 2015) The fact that complex adaptive systems do not change in a predictable, linear fashion implies that there is uncertainty about future conditions.

Third, systems are held to be complex because they are characterised by self-organisation. In simple terms, self-organisation means that the systems commence processes of reorganisation by themselves in order to stabilize, i.e. to retain essential functions (Berkes et al. 2003: 6). A great illustration for a self-organising system is the human body, which self-regulates the body temperature. On the one hand, if the body temperature gets too high, the body emits warmth through sweating. On the other hand, in case the body temperature gets too low, the body increases its temperature through shivering and avoids loss of warmth through a lower perfusion. (Guyton & Hall 2006: 3ff) More technically said, self-organisation means that the system’s relationships and structures are reorganized so that those relationships and structures that are not helpful for the system as a whole are replaced by useful reproducible ones through feedback mechanisms (Robinson 2009: 442). As Berkes and colleagues (2003) point out, feedback mechanisms are a key aspect of complex systems and their ability to self-regulate. Feedback mechanisms mean that behaviour may be reinforced (positive feedback) or modified (negative feedback) by the result of preceding behaviour. Self-organisation in the light of non-linearity also implies that complex systems exhibit adaptive behaviour. It is important to point out that this is to be contrasted from adaptation to a separate environment, which is a frequent misperception. In contrast, adaptation of complex adaptive systems means that systems change with changing conditions in a co-evolving manner. Co-evolution simply refers to the process where parts of systems may change based on the interaction with one another or with parts of other systems related to them. (Berkes et al. 2003: 5ff) Given the central feature of adaptation, one usually uses the term complex adaptive systems.

Fourth, a complex system has many subsystems (Berkes et al. 2003). They are hierarchical, meaning that each system is made up of smaller systems and is itself nested in a larger system (Robinson 2009: 442). Hence, we can speak of nested systems. Each level has its own emergent properties and different levels may be linked through complex feedback loops. That

is why, an adequate analysis of complex systems requires multiplicity of scales. (Berkes et al. 2003: 6ff)

Fifth, complex systems are open in the sense that energy, information and feedback processes enter and exit the systems (Robinson 2009: 442).

Social-ecological systems constitute such complex adaptive systems (Berkes et al. 2003: 2ff). In light of these five defining attributes, it is clear that they are constantly changing through a complex web of relations and feedbacks at multiple scales between humans and biophysical elements (Berkes et al. 2003: 3ff). It is also clear that social-ecological systems may shift to a radically different stability domain when thresholds are crossed, and that this could mean irreversible changes (Folke et al. 2011: 723f). Thus, the critical question is what characterises systems that are able to adapt to and shape change in order to stay within a desirable state? This issue brings us to the key concept of social-ecological systems research, namely resilience.

3.3.3 Social-ecological resilience

Based on the understanding of fundamentally integrated social-ecological systems, Moberg et.al. (2014) describe resilience the following way:

Resilience is the capacity of a system, be it an individual, a forest, a city or an economy, to deal with change and continue to develop. It is about the capacity to use shocks and disturbances like a financial crisis or climate change to spur renewal and innovative thinking. Resilience thinking embraces learning, diversity and above all the belief that humans and nature are strongly coupled to the point that they should be conceived as one social-ecological system. (Moberg et al. 2014: 3)

As shown above, the fact that things change constantly lies at the heart of resilience thinking. Change may be fast, for example in the sense of a rapidly spreading virus disease, or slow, such as population growth or mountains rising. Change itself is never good or bad; from a human point of view, however, it can have desirable or undesirable outcomes. Most importantly, change frequently produces surprises. (Walker & Salt 2006: 6ff) Hence, social-ecological resilience is concerned with how much change a system can undergo without changing its fundamental characteristics, in other words, without becoming a fundamentally different system. In this regard, being flexible in order to deal with surprises is an important aspect. In this context, the term surprise describes the discrepancy between what is expected and what is actually experienced, thus surprises are by definition nearly impossible to predict (Norris et al. 2008: 131f with reference to Longstaff 2005).

Change may be seen as disturbance to a system. Disturbances can be man-made, such as pollution, or natural, such as forest fires (Berkes et al. 2003: 14); or a combination of the two, such as climate change (IPCC 2012: 25ff). Given the flexibility of the concept of resilience, disturbances may also refer to social turbulences, such as wars or revolutions; or natural hazards, such as floods or earthquakes (Davoudi 2012: 300). Most importantly, the more resilient, the higher the magnitude of disturbance a system can undergo without shifting to fundamentally different alternative state (Walker et al. 2006: 2). On the contrary, a system losing its resilience becomes more and more prone to flip to another stability domain when it experiences even small perturbations (Levin et al. 1998: 225ff).

Folke (2006) points out that while a lot of resilience research has focused on a system's capacity to absorb shocks so that the system can maintain its function, the concept of resilience has become broader to also incorporate capacities for adaptation, learning and self-organisation. These aspects beyond shock absorbance derive from the understanding that disturbances open up opportunities for renewal, restructuring and the emergence of new development pathways. (2006: 259) Indeed, resilient social-ecological systems react to disturbances in a way that opportunities for development, innovation and restructuring are created and adaptive behaviour is exhibited (Folke 2006: 254f), as it is greatly reflected in the definition by Moberg et.al. (2014) stated above. Accordingly, one is able to identify three defining characteristics of a resilient social-ecological system:

1. [...] [T]he amount of change the system can undergo [...] and still remain within the same domain of attraction [...] that is, retain the same controls on structure and function [...];
2. the degree to which the system is capable of self-organization (versus lack of organization, or organization forced by external factors); and
3. the degree to which the system can build the capacity to learn and adapt. (Carpenter et al. 2001: 766)

In light of the above, resilience encompasses attributes of persistence, resistance and adaptability (Folke et al. 2010: 1ff; Carpenter et al. 2001: 766); which are of course interrelated. Self-organization, as described above, implies that resilient systems start processes of reorganization at critical points of low stability in order to retain essential functions (Berkes et al. 2003: 6). Adaptive capacity refers to the characteristics of a system that determine the systems ability to adapt (Nelson et al. 2007: 400). In other words, it “[...] is a way to describe the preconditions necessary for a system to be able to adapt to disturbances.” (Nelson et al. 2007: 400) Furthermore, to be able to adapt entails the capacity to learn in light of changes. This learning is often based on experience. (Folke et al. 2010:2ff)

Since learning and adaptive capacity are primarily assigned to the social dimension of resilience, I describe them in greater detail in the respective section further below.

It is important to point out that the possibility of multiple stable states implies the existence of desirable and less desirable states in respect to human wellbeing and development, as indicated above. Broadly speaking, less desirable means that the systems have a lower capacity to provide and sustain ecosystem services and resources for development. (Folke 2006: 257f with reference to Daily 1997) In the same way, resilience can be desirable or undesirable, i.e. when undesirable system states are highly resilient (Carpenter et al. 2001: 766). So, “[r]egime shifts imply shifts in ecosystem services and consequent impacts on human societies.” (Folke et al. 2004: 558f) Most importantly, there is no universal point of view on the desirability of states. One part of society may consider one state desirable while others consider the same state undesirable. (Walker et al. 2006: 3) Therefore, humanity faces the challenge to manage resilience in order to deal with continuous change in a way that desirable development pathways around desirable stable states are sustained (Folke 2006: 254f).

For practical purposes, it is often useful to specify resilience. As explained by Folke and colleagues (2010), to specify resilience means that it refers to a particular part of a system, “resilience of what”, and to a specific set of sources of disturbances, “resilience to what” (Folke et al. 2010: 3f). For example, one could be concerned with the resilience of a certain agricultural region to drought. However, according to Folke and colleagues (2010), specifying resilience always goes hand in hand with the danger of becoming too focused in the sense that increasing resilience of system parts to a certain disturbances may result in loosing resilience in other respects. They illustrate this threat with the example of the European international travel system, where a strong focus on improving aviation has led to the negligence of sea and land travel, leading to a low resilience of the travel system to disturbances. This was revealed when cloud of airborne volcano ash from the 2010 Icelandic volcano eruption grounded large parts of European aviation. (Folke et al. 2010: 3f) Yet, bearing the risk of a too narrow focus in mind, it is of great practical use to specify resilience. In the present thesis, resilience is specified in the sense that it focuses on disturbances in the form of climate-related hazards and on human-dominated living spaces, better known as urban systems.

3.3.4 Urban social-ecological systems resilience

As pointed out before, the concept of resilience is gaining more and more prominence in the field of urban studies recently. Also within ecological resilience literature an explicit focus on cities has emerged. Within this research tradition looking at cities through the lens of resilience stems from the understanding that urban systems constitute human dominated ecosystems. More precisely, as Grove (2009) explains, the analysis of urban living spaces in ecology derives from the insight that humans are an inherent part of ecosystems and not just external influences. Therefore, cities are approached in this strand of ecology as a particular type of ecosystems. This perspective is concerned with both, ecological structure and functioning, as well as the social structure and functioning of cities. Not just green areas are of concern. (Grove 2009: 285ff) While this approach draws upon traditional understandings of ecosystem resilience, the concept has been expanded over time so as to cities are approached as integrated complex adaptive systems (Leichenko 2011: 164). Indeed, cities are regarded as human dominated social-ecological systems, also known as urban social-ecological systems, the research of which has emerged as a specialised interdisciplinary strand of social-ecological systems literature recently (e.g. Sellberg et al. 2015: 1ff). As usual, no single agreed-upon definition of a resilient urban social-ecological system exists. The following two complementary definitions, however, provide a good insight into the understanding of urban resilience within this stream of thought.

Table 3.2 Two complimentary definitions of resilient urban social-ecological systems

Definitions of resilient urban social-ecological systems	Source
“Resilience in cities – the degree to which cities tolerate alteration before reorganizing around a new set of structures and processes [...] – depends on the cities’ ability to simultaneously maintain ecosystem and human functions.”	Alberti et al. (2003: 1170)
“A (mega-) city can be regarded resilient if its inhabitants and institutions function effectively. That means that they are able to deal with unexpected disturbances and adapt to change. Furthermore, ecosystem services and their social and economic use by humans must be balanced.”	Butsch et al. (2009: 3)

3.3.4.1 Perception of cities as a special type of social-ecological systems: two dimensions of urban resilience

For analytical purposes, urban social-ecological systems are frequently perceived to consist of four components within the urban social-ecological systems approach: First, a biological

component, which is a complex set of species and their products. Second, a physical component, comprising of soils, waters, the city's topography and air. Third, a built component, which refers to man-made infrastructure and buildings. Fourth, a social component, including social institutions and norms. (Pickett & Grove 2009: 5ff) Cities are characterised by a domination of the built environment (Grove 2009: 283); or built component. Built environment refers to man-made structures or built fabric and is to be differentiated from the natural environment (Macmillan Dictionary n.d.). The latter may also be referred to as ecological side, and is a combination of the biological and physical component. Wamsler et.al. (2013) explain that cities have distinctive physical features, amongst other things, in terms of land coverage or vegetation due to the domination of the built environment. This can be seen for instance by generally less vegetation cover and a reduced biodiversity. The sealing of green areas and physical construction are among the main causes of the distinct characteristics of the urban environment, for example with regards to higher temperatures due to heat storage. (Wamsler et al. 2013: 71f) In general, components of urban social-ecological systems are spatially and temporally heterogeneous: As Grove (2009) explains, cities are seen as composites of different ecosystem types, such as urban gardens, forests, freshwaters or coastal areas. As such, they are biophysically heterogeneous in a spatial sense. For example, vegetation differs throughout the city. Similar, cities are spatially heterogeneous in a social sense, because urban areas may have clear patterns with regards to social aspects such as economic activity, level of income or family size. It is important to note that these social patterns are not fixed in time. Indeed, also the built environment should not be regarded as a constant given. The urban system is fundamentally elastic in the sense that built, social and biophysical components are constantly changing. (Grove 2009: 283f)

This dynamic nature of the city's components and interactions also implies that it is not possible to know the future state of the city, which means that precise predictions are impossible (Desouza & Flanery 2013: 90f). Like all social-ecological systems, cities are complex adaptive systems. That means that cities face constant dynamic change and organise around one of many stable states (Grove 2009: 286). Complex feedback processes resulting in emergent properties occur between all components, whereas humans play a particular important role as their actions greatly impact on the structure and functioning of all other components (Desouza & Flanery 2013: 90f). Based on the description of cities as a special type of social-ecological systems above, it should be clear that urban resilience is determined by the characteristics of all components and their complex interrelations.

For analytical purposes it is not only useful to speak of these four components of urban social-ecological systems outlined above, but it may further provide useful to speak of two broad dimensions of urban resilience: First, a biophysical dimension, which comprises the characteristics of the ecological infrastructure and supporting ecosystems as well as the built environment. Second, a social dimension that is concerned with all social institutions and processes.



Figure 3.2 Two dimensions of urban resilience

Yet, it has to be pointed out that a differentiation of these two dimensions of resilience is purely artificial in order to ease an analysis of the different realms that are relevant for urban resilience. Both are fully interconnected and interdependent. For example, social processes determine how land is used through means of spatial planning. Thereby, social processes for instance regulate to what extent natural buffers against climate-related hazards are maintained, enhanced or built on (Satterthwaite et al. 2007: 1ff). Based on these two dimensions, I discuss key factors that are seen to determine urban resilience within this line of thought.

3.3.4.2 Conceptualisation of urban resilience in the social-ecological systems approach

3.3.4.2.1 Biophysical dimension of urban resilience: ecosystem services and biodiversity

The most featured aspect of urban social-ecological systems resilience in this strand of literature is most certainly the ecological side, more precisely, the role of ecosystem services and the urban ecological infrastructure for urban resilience. Yet, the importance of the ecological side is sometimes overlooked or underappreciated in other strands of urban resilience research (Grove 2009: 283). Hence, it is central to elaborate on the role of the ecological side, i.e. the combination of the biological and physical component, for urban

resilience before taking a closer look at those ecological factors that determine urban resilience.

As pointed out by Gómez-Baggethun and colleagues (2013), an analysis of urban ecosystem services has to look far beyond administrative boundaries, since most of the ecosystem services that cities consume are generated by ecosystems located outside the urban and suburban areas. Therefore, the scope of analysis of urban social-ecological systems has to include the hinterlands that directly interact with the city through material and energy flows. Still, one has to acknowledge that hinterlands are sometimes not enough since ecosystems even on the other side of the world may be relevant to a city. (Gómez-Baggethun et al. 2013: 176ff) In this regard, Pickett and colleagues (2013) stress that urban resilience requires a perspective that does not stop at administrative or perceived boundaries of cities (Pickett et al. 2013). While cities obviously greatly depend upon the provision of services by ecosystems outside their official boundaries, in particular in the hinterlands with which they are directly related, the relevance of ecosystem services produced in urban areas has become more and more acknowledged and investigated recently. This research also shows that ecosystem services generated in cities can also serve as a key source for urban resilience. (Gómez-Baggethun et al. 2013: 176ff)

Based on the Millennium Ecosystem Assessment (2005), ecosystem services are frequently classified into four categories. Following, I provide an overview of some of the central urban ecosystem services of each category. This overview is based on a detailed analysis of urban ecosystem services by Gómez-Baggethun and colleagues (2013). (1) The first category is known as provisioning services and refers to services in terms of material products, such as food or fresh water. Clearly cities mainly depend on other areas to meet their food demands, while key products such as water supply are greatly influenced by forests and vegetation cover in their catchment area. (2) The second group of services is called regulation services. Several of these services are important for urban areas. Ecological infrastructure can first of all regulate the temperature in cities and moderate climate extremes, for example through water areas and vegetation, as plants produce shade and absorb heat from the air. The possibility of reducing noise through vegetation is also central, since urban noise pollution can negatively affect human health. Vegetation also purifies the air, and air pollution is not only a problem for human health but also for the ecosystem as a whole. Last but not least, urban vegetation and the underlying soil can reduce the adverse effects of flooding, since it significantly reduces the surface rainfall runoff by storing and intercepting water. (3)

Supporting and habitat services constitute the third category of ecosystem services. In this regard, one has to bear in mind that cities may serve as a vital habitat for many species, such as birds or butterflies. (4) The fourth type of ecosystem services is known as cultural services. In an urban context, this refers to outdoor recreation in parks, along rivers etc., which is highly valued by most people since this may lead to a reduction in stress. (Gómez-Baggethun et al. 2013: 178ff) Therefore, cultural services are most certainly the widest appreciated link between green areas in cities and health of urban dwellers (Andersson et al. 2014: 447). The exposure to green spaces may further function as a source of opportunities for cognitive development and social cohesion (Gómez-Baggethun et al. 2013: 184f) Therefore, it is clear that the availability of valuable ecosystem services in terms of quality and quantity are important determinants of a city's resilience.

In light of the above, it is clear that ecological factors that determine resilience are related to the ecological qualities that allow a particular ecosystem type, for example a forest, to continue as the same functioning ecosystem in times of change, such as a drought. Thereby, ensuring the continued generation of valuable ecosystem services. In line with the understanding of social-ecological resilience outlined above, those ecological characteristics that enable and support renewal and reorganisation are of particular importance. Yet, those ecological determinants of ecosystem resilience, urban and non-urban, are complex and related to the specific characteristics of a particular ecosystem. In general, ecosystem resilience is regarded to be positively related to the level of biodiversity of an ecosystem (W Neil Adger et al. 2005: 1037). Biodiversity commonly refers to the "[...] variability among living organisms [...] and the ecological complexes of which they are part. Biodiversity includes diversity within species, between species, and between ecosystems." (Elmqvist et al. 2013: 749) Biodiversity plays a crucial role since it can serve as a source for renewal or reorganisation. Indeed, a loss in biodiversity decreases a system's ability to keep functioning in the face of external shocks. That derives from the fact that different species frequently respond differently to change, thus the greater the number of species, the more likely it becomes that other species may take over the role of those species that cannot cope well with the changing conditions. (W Neil Adger et al. 2005: 1037; Carpenter et al. 2001: 776) For example, several different species usually perform the so-called process of nitrogen fixation in a grassland ecosystem. If somehow a species may get lost due to changing conditions, the continuation of nitrogen fixation in the grassland ecosystem is ensured through the greater number of species with similar functions. (Resilience Alliance 2015) As a result, the level

biodiversity of the respective ecosystems on which the city depends are a key determining factor for urban resilience.

Regarding the built environment or built component, resilience is linked to the characteristics of the urban infrastructure, buildings and land-use that influence a city's ability to deal with disturbances. Yet, the discussion of the built environment in the urban social-ecological systems literature is limited to the relation between the built environment and ecosystems services. For example, it is discussed how architecture can improve a city's resilience, such as through green rooftops (e.g. Andersson et al. 2014); or land use, for instance in the form of an increase in green areas (e.g. Gómez-Baggethun et al. 2013). But, the built environment is also a central key concern for the more technical side of resilience, in particular with regards to urban infrastructure. For instance, how the urban water management system is designed is of concern for the city's resilience. One could think of whether the system is able to deal with heavy rainfall or if its waterways, such as canals etc., tend to overflow in times of disturbances. Such aspects of the built environment, however, are not really featured in the urban social-ecological systems literature. Since these issues are discussed to a much greater extent in the disaster resilience and disaster risk management literature, I elaborate on these resilience factors in more detail below.

Finally, it has to be stressed that ecosystem services are not generated by ecosystems alone but in the course of complex interactions between humans and ecological processes in social-ecological systems. Indeed, humans may promote or weaken the generation of ecosystem services. (Andersson et al. 2014: 447) It is reasonable to say that virtually all parts of planet earth are one way or another managed by humans nowadays (Steffen et al. 2005: V). Thus, human activities, such as resource extraction, pollution or land-use, heavily impact the ability of ecosystems to deal with change. In the same sense, features of the built environment that influence the city's resilience are directly linked to human actions and corresponding planning practices. That is why, aspects of social processes that determine how and where humans live and how they interact with their environment are equally defining whether urban social-ecological systems are resilient. In other words, the social dimension of urban social-ecological systems is central.

3.3.4.2.2 Social dimension of urban resilience: institutional structure and adaptive capacity

While the ecological dimension of resilience has been discussed widely in this strand of literature (e.g. Holling & Gunderson 2002: 25ff), the social dimension is relatively less

developed (Davidson 2010: 1141ff). Yet, Walker and colleagues (2006) argue that one can address both domains in the common framework of social-ecological resilience outlined above. That derives from the fact that one is able to apply fundamental concepts, such as thresholds, also to societies. (Walker et al. 2006: 6) For example, abrupt changes in public policies may be explained analytically that a threshold of public pressure was crossed (e.g. Brock 2006: 47ff). However, it is clear that social dynamics and structures are different from ecological dynamics (Adger 2000: 350f). Therefore, analysing social aspects through the lens of resilience requires ideas and concepts from social sciences (Cote & Nightingale 2012: 475ff; Berkes & Ross 2013: 1ff). A one to one transfer of concepts originating from ecology to society is not possible (Adger 2000: 350f). Otherwise, essential aspects such as agency or political aspects are left out (Cote & Nightingale 2012: 475ff; Davidson 2010: 1135ff), as I explain further below.

Discussions about the social dimension of resilience in the social-ecological resilience literature focuses on institutions and the functionality of institutional structures (Cote & Nightingale 2012: 478ff). In this context, institutions are defined as socially constructed “[...] clusters of rights, rules and decision-making procedures [...]” (Young 2008: 7) that enable and constrain human behaviour (Young 2008: 7ff). “They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behaviour, conventions and self-imposed codes of conduct), and their enforcement characteristics.” (North 1994: 360) Informal institutions constitute the unwritten rules of social interactions, for example customs or widely held taboos (Kofinas 2009: 80). Accordingly, formal and informal institutions structure or guide social interactions and assign the roles individuals and organisations adapt in society. In other words, institutions are the “rules of the game”. (Young 2008: 7ff) As such, they influence “the play of the game”, which refers to all kinds of human behaviour, including how humans interact with their environment (Kofinas 2009: 80). For clarity purposes it is important to stress that institutions are to be contrasted from social organisations, which usually have some kind of legal status, membership and resources to work with. One could think of companies or government bodies. Organisations are seen as players in an institutional framework. (Young 2008: 13f)

Of primary concern to the social-ecological systems literature in the social dimension are governance systems regarding property rights and access to resources; how social systems manage knowledge in the face of dynamics; as well as morals and worldviews about the human-nature relationship (e.g. Berkes et al. 2003: 1ff). Together these institutions form

resource management systems that regulate people's interactions with their environment. Accordingly, this line of thought revolves around the question how those resource management systems should be designed in order to enhance the resilience of social-ecological systems. The essence is that aspects such as complexity, multilevel feedback mechanisms, unpredictability and non-equilibrium as well as the possibility of irreversible change, have great implications on the adequacy of these resource management systems. (Berkes et al. 2003: 1ff)

3.3.4.2.2.1 Adaptive capacity and learning

Further related social determinants of urban resilience are the concepts of adaptive capacity and learning. Indeed, these aspects are considered to central for urban resilience within both approaches, urban social-ecological systems resilience and urban disaster resilience. The term adaptability is used here interchangeably with the term adaptive capacity (Folke et al. 2010: 3). As described by Nelson and colleagues (2007), adaptive capacity refers to the ability of a system to adjust to change. The degree of this ability is fundamentally linked to the characteristics of the system. On the one hand, the system's adaptive capacity depends on the resources available. (Nelson et al. 2007: 400) Based on the work of Nelson and colleagues (2007) Keating et.al. (2014) categorise these resources in five capital classes: human capital, social capital, natural capital, physical capital, financial capital. Together, these capitals provide the foundation for the system to manage risks and provide wellbeing. (Keating et al. 2014: 29f) On the other hand, the system has to be able to make use of these resources in the course of adapting to change, which is referred to as the system's ability to respond. The latter includes for example to what extent the systems can implement adaptation measures. (Nelson et al. 2007: 400) Since social-ecological systems are dominated by human behaviour, it is reasoned that the adaptability of integrated systems is primarily determined by human actions. (Walker et.al. 2006: 3ff) Hence, Berkes and Ross (2013) argue that "[a]daptive capacity is a property of the social part of the social-ecological system." (Berkes & Ross 2013: 15) While it is clear that natural capital also plays a central role, adaptive capacity mainly depends on human behaviour, including resource and risk management measures. Indeed, as pointed out by Walker and colleagues (2006), adequate management actions may deliberately lead to the avoidance or engineering of crossing thresholds. Similar, human actions may trigger shifts to undesirable states. Accordingly, in the social-ecological systems literature adaptability describes the capacity of the systems' actors, i.e. humans, to influence resilience. (Walker et

al. 2006: 3ff) That is why, “[a]daptability is [regarded as] a part of resilience.” (Folke et al. 2010: 6)

Furthermore, it should be clear that adaptability also entails the capacity to learn in light of changes, which may be based on experience. (Folke et al. 2010: 2ff) Learning is a very important part of adaptation as it describes processes of experimentation and innovation that are necessary not only to develop but also to test knowledge and understanding about how to cope with dynamics of change and uncertainty (Walker et al. 2006: 8). That is why, institutions should also be designed in a way that fosters learning in order to enhance the system’s adaptability (Gunderson 2003: 44f). In fact, from this perspective even institutions and organisations themselves are regarded as being able to learn, similar to individuals (Berkes et al. 2003: 9).

3.3.5 Shortcoming of social-ecological systems theory

However, in light of the discussion of the social dimension of resilience above, it becomes apparent that social-ecological systems literature tends to overlook or underappreciate important insights from social sciences. As Cote and Nightingale (2012) point out, this strand of literature focuses on the design of institutions, thus it fails to account for the social process and relations that lead to the emergence and support of these institutional configurations. Indeed, power relations and the related political factor of resilience are ignored. (Cote & Nightingale 2012: 478ff) On the one hand, one cannot simply assume that there is consensus on what state is desirable (Brown 2014: 109). In contrast, one has to ask who defines for whom which states are desirable and where associated thresholds are (Cote & Nightingale 2012: 478ff). On the other hand, “[...] resilience as a process overlooks conflicts over resources and the importance of power asymmetries.” (Brown 2014: 109). For example, it may be the case that resistance against moving towards more just and fairer distributive institutions arises from those parts of society that would lose out from such a change (Cote & Nightingale 2012: 480, with reference to Berry 2009, Lund 2007, Sikor & Lund 2009). Similar, Keck and Sakdapolrak (2013) argue that resilience bears the risk to conceptualise society in an apolitical manner and emphasise the need to look at power, equity and justice (Keck & Sakdapolrak 2013: 9f). While the important work of Adger and colleagues (2005; 2009) clearly goes further by acknowledging the importance of equity and historical embeddedness (Adger et al. 2005: 77ff; Adger et al. 2009: 335ff); they continue to focus on institutional structure and functioning (Cote & Nightingale 2012: 480). As Berkes and Ross (2013) point out, key insights about what it means for a community to be resilient can be

found in the strand of disaster literature (2013: 6f). In fact, the conceptualisation of the social dimension of urban resilience in this strand of literature greatly complements the picture. When discussing the urban disaster resilience approach, it is important to remember that it tends to be dominated by an engineering resilience perspective.

3.4 Urban disaster resilience approach and disaster risk management

Given that the concept of resilience is at its heart concerned with disturbances, it seems natural that the concept of resilience has been applied in the field of disasters. As explained by Berkes and Ross (2013), resilience evolved in the disaster literature from insights in psychology, which is concerned with identifying those factors influencing why some individuals are better than others in coping with major disturbances to their lives. Examples of factors for individual resilience include personal characteristics, such as optimism, or social support. Resilience was then expanded from this clear focus on the individual to the community level and issues related to different types of disasters. (Berkes & Ross 2013: 10f) Broadly speaking, a community is a group of people within a geographic boundary that shares a fate (Norris et al. 2008: 128ff).

Disaster refers to a situation of “[...] serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.” (UNISDR 2009: 9) While such serious disruptions were seen as unavoidable “Acts of God” or “Acts of Nature” in the past (Smith & Petley 2009: 4f); it has become widely recognized that disasters are the result of complex interplays between natural hazards and social processes (Wisner et al. 2004: 4f). A natural hazard is a “[n]atural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.” (UNISDR 2009: 20) This includes rapid events such as earthquakes, tsunamis, volcanic eruptions, landslides, avalanches, floods or forest fires, as well as hazards with slow onsets such as droughts or heat waves. (Wisner et al. 2004: 95)

Most importantly, disasters happen only when vulnerable people or vulnerable assets are exposed to a hazard (Smith & Petley 2009: 13ff). Vulnerability refers to those “[...] characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resists and recover from the impact of a natural hazard.” (Wisner et al. 2004: 11) So, being vulnerable means to be susceptible to the adverse effects of a hazard

(UNISDR 2009: 30). Both, exposure and vulnerability are determined by human actions. As Wisner and colleagues (2004) explain, poverty may for instance drive people to inhabit unsafe areas, such as riversides or seashores. Other crucial social factors determining who is most at risk are for example the distribution of resources, such as knowledge or economic assets, and the level of equality in social protection. Therefore, it is impossible to analyse natural disasters separately from the broader social context, i.e. the social processes, including political and economic aspects, which structure critical aspects in the life of people, such as the type of buildings in which they live or the level of hazard protection. (Wisner et al. 2004: 4ff) As such, disasters are related to development processes. More precisely, poor development processes may create increased vulnerability and exposure to disasters when a greater number of people and more assets locate in unsafe areas (UNISDR & WMO 2012: 3ff).

3.4.1 Disaster risk management

Central to this approach is that promoting resilience links to managing the risk of disasters (Sharma et al. 2011: 9). Indeed, it is widely agreed that disaster risk management is central for building disaster resilience (Combaz 2014: 4). In doing so, a risk perspective is adopted, which means that interactions between nature and society are seen to bring along not only resources but also to create risks (Travis & Bates 2014: 2). Such risks are characterised by a combination of uncertainty about events and their consequences (Travis & Bates 2014: 2); that could be both, positive and negative (Jones & Preston 2011: 296f). Accordingly, the term disaster risk describes the potential harm a hazard could bring to a society or community, in terms of lives, assets or health, over a certain future time period (UNISDR 2009: 9f). In light of the ample human-driven factors that determine the vulnerability and exposure of people or assets, it is clear that humans have the ability to manage risks. As pointed out by Smith and Petley (2009), while it is impossible to totally eliminate risk, they can be managed on a practical level in order to reduce adverse impacts (Smith & Petley 2009: 50f). According to Preventionweb (2015), disaster risk management is a

[...] systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster; aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness. (PreventionWeb 2015)

These management processes and the involved decision-making is assisted and guided through means of established theories and practices of risk analysis (Travis & Bates 2014: 2).

Thus, an important part of risk management is risk assessment, which aims to evaluate risks. For that, probabilities play an important role in determining the level of risk as they intend to quantify the likelihood of certain impacts (Dessai & Hulme 2004: 114). In the assessment, disaster risk is commonly regarded as driven by three underlying factors: hazard, exposure and vulnerability (Smith & Petley 2009: 50f). These driving factors are illustrated in Figure 4.1.



Figure 3.3 Drivers of disaster risk. Based on IPCC (2012)

However, one has to admit that there is no such thing as objective risk estimation. That derives from the fact that it is difficult to estimate risks because of inevitable uncertainty about future conditions. Therefore, both the assessment itself and risk management are by nature linked to personal beliefs and the wider social context. (Smith & Petley 2009: 50f; Barrie Pittock et al. 2001: 249) Such unavoidable judgements are particularly striking when it comes to the decision what an acceptable level of risk for a society is. Traditionally the disaster community used terms like mitigation, response or prevention with regards to efforts to reduce risks, while resilience is more and more applied nowadays (Surjan et al. 2011: 18).

3.4.2 Urban disaster resilience

Even though the concept of resilient cities is widely used in the field of disasters nowadays, its theoretical foundation is still developing (Valdés et al. 2013: 5). In fact, Stumpp (2013) suggests that the practical application of urban resilience even outpaced science (Stumpp 2013: 165). Basically, it is widely held in this line of thought that the concept of urban resilience is “[...] based on the inherent capacity of cities to bounce back, or recover, after disasters.” (Sharma et al. 2011: 9) Most prominently, the United Nations Office for Disaster Risk Reduction (UNISDR) considers a resilient city to be characterised by “[...] its capacity to

withstand or absorb the impact of a hazard through resistance or adaptation, which enable it to maintain certain basic functions and structures during a crisis, and bounce back or recover from an event.” (UNISDR 2012: 11) In other words, (urban) disaster resilience is “[...] the ability to ‘resile from’ or ‘spring back from’ a shock [...] in a timely and efficient manner [...].” (UNISDR 2009: 24)

Cities face different types of hazards, which are commonly classified into shocks and stresses. According to Sharma and colleagues (2011), in an urban context, shocks are unusual events to which the urban community cannot withstand, thus they have a high impact in the form of abrupt damage to lives, assets and the environment. Examples include earthquakes or tsunamis and climate-related events, such as floods or cyclones. Shocks, however, do not only include natural hazards but can also be man-made, such as fires or terrorist attacks. Broadly speaking, from a risk perspective, the occurrence of shocks has a relatively low probability, but they strike suddenly. Stresses, in contrast, have a slow onset, low impact and a high probability. Stresses often remain unnoticed by urban communities because their impacts in the form of erosion of assets and increased vulnerability occur slowly. (Sharma et al. 2011: 8f)

In order to improve a city’s disaster resilience, it is central to integrate disaster risk management into all city development processes (UNISDR 2012: 11). More precisely, disaster risk management lowers the chance of adverse consequences from hazards, i.e. lower the level of risk from shocks and stresses, through means of various activities including mitigation and preparedness. For instance, as explained by Prasad and colleagues (2009), mitigation of potential disaster impacts on cities may include measures, such as risk-based spatial planning, while preparedness may include plans for hospitals readiness or community trainings (Prasad et al. 2009: 20ff). Disaster risk management frameworks, however, do not stop at the mitigation and preparation phase, but also include disaster response, recovery and reconstruction. That is linked to the fact that disaster risk can never be fully eliminated. (Abbas et al. 2013: 12ff) Therefore, a quick urban disaster response system, including well-equipped emergency units, disaster recovery and reconstruction are further critical elements of disaster risk management. (Prasad et al. 2009: 20ff) Taken together, these different phases of activities form the so-called disaster management cycle (Abbas et al. 2013: 12ff). Ideally, such disaster risk management activities are integrated into the work of all actors in a city in order to improve its resilience (Prasad et al. 2009: 20f, 34).

3.4.2.1 Promoting urban resilience is more than reducing disaster risk

Most importantly, however, promoting disaster resilience goes beyond reducing the city's risk to hazards. Indeed, as Abhas and colleagues (2013) explain, the concept of disaster resilience embraces the fact that uncertainty is always part of any disaster. Therefore, resilience implies that uncertainty and residual risks have to be approached in a way that the urban system is able to adapt flexibly to unknown disturbances and surprises. Accordingly, urban planning has to ensure that the city's systems are designed in a way that they have enough redundancy and flexibility. (Abhas et al. 2013: 12ff) Redundancy describes the extent to which elements of the system can be substituted in the light of disturbances (Norris et al. 2008: 131). In the context of urban systems, redundancy may refer to alternative energy sources, leadership or transport systems (Baud & Hordijk 2009: 131). For a city, redundancy "[...] always implies that alternative systems can take over in case the main system fails." (Baud & Hordijk 2009: 131) That is why, building urban disaster resilience means not to focus on optimal urban design solutions, but to take the possibility of system failures, potential weaknesses and diverse future conditions into account in design, planning and maintenance of urban systems (Abhas et al. 2013: 12f). Nevertheless, traditional disaster risk management approaches often fail to acknowledge unpredictability and the fact that surprises are likely.

Put differently, building resilience goes hand in hand with enhancing the city's adaptive capacity, i.e. the city's ability to adapt to disturbances or to adjust to change; which is a function of the city's characteristics (see Nelson et al. 2007: 400). As explained in the context of social-ecological systems, adaptive capacity is a central part of resilience. This is also reflected in the definition of urban resilience by UNISDR (2012) stated above, stating that resilience also includes adaptation to disturbances (UNISDR 2012: 10). Being flexible in order to cope with and adapt to changing conditions is central for building resilience, in particular because future developments are complex and to a large extent unknown. Accordingly, adaptive capacity is particularly emphasised in the light of uncertainty.

While disaster resilience literature may emphasise adaptation in the context of returning to pre-disaster functioning, it is important to point out that some authors in this line of thinking acknowledge that post-event functioning may not be equivalent to pre-event functioning (Norris et al. 2008: 127ff; Mayena et al. 2011: 417ff). Indeed, as Norris and colleagues (2008) explain, adapting to a changed environment may imply that post-event functioning constitutes a "new normal" or renewed, adapted functioning (Norris et al. 2008: 132). Accordingly, Mayena and colleagues (2011) emphasise that the notion of bouncing back has limitations in capturing change and that resilience should be rather viewed as "bouncing forward" instead of

bouncing back (Mayena et al. 2011: 418ff). Pre-dominantly, however, this strand of literature adheres to the notion of bouncing back.

3.4.2.2 Conceptualisations of urban disaster resilience: four resilience components

When it comes to conceptualising urban disaster resilience, different authors emphasise different factors. As pointed out by Godschalk (2003), in general a disaster resilient city may be perceived as “[...] constructed to be strong and flexible, rather than brittle and fragile. [...] [It] is a sustainable network of physical systems and human communities.” (Godschalk 2003: 137)

When it comes to detailed conceptualisations of urban disaster resilience, features of resilient cities are frequently divided into four resilience components: Urban resilience is seen to consist of (1) social resilience, (2) infrastructural resilience, (3) economic resilience and (4) institutional resilience (Abhas et al. 2013: 11). Each of these components entails a great level of detail about the factors that determine the resilience of a city because each component is often discussed as a specific type of resilience in a specialised stream of literature. Yet, all components jointly determine the resilience of an urban system, which means that each component is of great relevance to building urban disaster resilience. It needs to be highlighted that this categorisation into distinct components constitutes a simplification for analytical purposes. As the elaboration below shows, the four urban resilient components are highly interconnected and have overlapping features.

(1) Social resilience

“Social resilience refers to the capacity of a community or society to cope with and adapt to disturbances and changes.” (Abhas et al. 2013: 22) As such, it is concerned with the socioeconomic and demographic characteristics as well as the social capital of urban communities, which jointly determine the community’s self-organisation ability and capacity to adapt and learn (Abhas et al. 2013: 11ff). In the context of community resilience, social capital refers for the most part to the level of cooperation within communities. Accordingly, more resilient communities are regarded to jointly work towards common goals, to share social resources and to address collective concerns. (Burton 2012: 18) Besides, several other social factors, such as flexibility, knowledge, communication networks, values and beliefs, health, risk understanding are important (Berkes & Ross 2013: 14f; Cutter et al. 2008: 603ff; Godschalk 2003: 137). The social resilience component further encompasses the issue of

inequality in terms of vulnerability and adaptive capacity. As Steele and Mittal (2012) point out, it is necessary to recognize that vulnerability is unevenly distributed among urban citizens, with marginalised groups, such as the urban poor, elderly and children, as the most vulnerable. Indeed, the urban poor are generally most at risk. (Steele & Mittal 2012: 188ff) Thus, “[a] more resilient city is one with less social inequalities and a fairer distribution of resilience resources.” (Jabareen 2013: 224 with reference to UNISDR 2010). Therefore, urban planning and policy processes have to take the multifarious differences in vulnerability into account, instead of wrongly addressing a city as a homogenous whole. As a consequence, equity concerns should be at the forefront of building resilience, which implies that they are to be integrated into resilience policy and planning processes. (Steele & Mittal 2012: 188ff)

(2) Man-made and natural infrastructural resilience

First of all, infrastructural resilience relates to characteristics of buildings and transportation systems that reduce their vulnerability to hazards on the one hand, and the availability of infrastructure and facilities, such as roads or hospitals, on the other hand. The latter is also critical for evacuation and supply in the disaster response and disaster recovery phase. (Abhas et al. 2013: 18) This links to the design of, for example, energy grids, water infrastructure or roads, in a way so that they are able to deal with disturbances. As Schramm and Felmeden (2012) explain, it is widely held that decentralised or semi-central partial infrastructure systems are more resilient, since a breakdown of one part would not affect the whole city but only a small area. Accordingly, they stress that having multiple water sources enhances urban resilience. (Schramm & Felmeden 2012: 178ff) The same can be argued for other infrastructural systems, such as transport or energy grids. When it comes to flood protection infrastructure, urban resilience is concerned with, among others, the flood depth or amount of flood water that critical infrastructure, such as dikes or canals, can deal with before overflowing or breaking. Yet, as Schneider et.al. (2012) describe, flood protection measures may also include non-technical measures, such as lowering the generation of run-off through enhancement of the natural storage capacity of the soil in the catchment area, for example by removing sealing, or the re-naturalization or non-sealing of flood zones (Schneider et al. 2012: 95f). As such, non-technical flood protection measures serve as a good illustration for the argument that resilient oriented urban infrastructure planning has to integrate ecosystem services (e.g. Abhas et al. 2013: 28f). In fact, infrastructural resilience can be thought to refer to both, man-made and natural infrastructure. So, the urban ecological infrastructure is part of the infrastructural urban resilience component. The examples above also link to another

central aspect to infrastructural resilience, namely risk-based land use planning. As Abhas et.al. (2013) explain, this refers to planning processes that use risk information to direct urban spatial expansion by setting out specific areas for specific uses with the aim to reduce and avoid the increase of hazards risks. Examples of how this may work are the avoidance of development on steep slopes or floodplains and the related prevention of surface sealing in catchment areas. (Abhas et al. 2013: 26f)

(3) Economic resilience

According to Adger (2000), central economic factors for community resilience are the stability of economic activity, in terms of economic growth and livelihoods (Adger 2000: 354f). As Norris and colleagues (2008) point out, it is not only the level of economic resources that matters for community resilience but also their diversity (Norris et al. 2008: 137). As such, economic resilience is concerned with the level of diversity in the economic realm of an urban society, for example, in terms of employment. It further refers to the ability of the city's companies to function in the disaster recovery phase. (Abhas et al. 2013: 18) Other important economic aspects for resilience are the distribution of income and assets (Adger 2000: 354f); which is discussed above under the social resilience component.

(4) Institutional resilience

Institutional resilience refers to the ability of urban administration systems, both governmental and non-governmental, to deal with change and disturbances (Abhas et al. 2013: 11). As Surjan and colleagues (2011) point out, it refers in particular to authorities that are concerned with urban management or planning. In order for a city to become resilient, it is necessary to have well-developed urban institutions that are able to work efficiently in the face of extreme events and take different future scenarios into account. (Surjan et al. 2011: 33f) In fact, urban resilience means that the city's governance can restore basic services promptly following a disaster and resume urban activity (Jabareen 2013: 223). In simple terms, "[...] governance is [...] the exercise of economic, political and administrative authority to manage a country's affairs at all levels." (UNDP 1997: 5) What is more, it is widely held that citizen participation and an open dialogue are fundamental for resilient governance (Jabareen 2013: 220ff; Norris et al. 2008: 127ff; UNISDR 2012: 8ff). Based on these insights, one has to bear in mind that the use of the term institutions in the context of the institutional resilience component above tends to refer to governance structures, in terms of public bodies and organisations, and not to institutions in terms of rules and norms.

3.4.3 Shortcomings of disaster resilience theory

It is important to point out the disaster-related literature does not regard resilience as an outcome, but resilience is seen to constitute a dynamic process (Berkes & Ross 2013: 10f). Still, in other respects, the most common definitions of disaster resilience in this strand of literature are not at all in line with complex adaptive systems thinking. Related limitations of disaster resilience theory are outlined below.

First, while disaster-related literature provides highly valuable insights into the social dimension of urban resilience, one is able to detect that the ecological side of resilience is neglected. In fact, from the conceptualisation of disaster resilience introduced above, it can be seen that the ecological dimension is not fully featured. Essential qualities of ecosystems, such as biodiversity, on which the sustained provision of valuable ecosystem services depends (e.g. Haines-Young & Potschin 2010: 110ff; CBD 2015: 1f), are usually not identified as explicit factors. In contrast, the ecological side is mainly reflected in a way that social-ecological resilience literature would identify as resource management aspects, as for example land use, livelihoods or access to resources. While some authors acknowledge the importance of ecosystem services for urban resilience, it is reasonable to argue that the main lens through which urban disaster resilience is viewed is the social dimension lens, hence the complex interdependencies between social and ecological systems are not accounted for. As pointed out by Folke (2006), a society may be able to deal well with change if adaptation measures are only analysed through the social dimension lens. But overall the system may lose resilience because the ecosystem may not be able to sustain this adaptation for long. (Folke 2006: 260) A great example of such a case is provided by Walker and colleagues (2009), who have conducted a study on dry-land farming in a certain region in Australia, which depends upon irrigation systems and is economically thriving, hence it is socially desirable to maintain the current irrigation strategy. However, by expanding the perspective of analysis from the social to the ecological, they have revealed that irrigation and clearance of native vegetation have led to a severe soil salinization problem. More precisely, it becomes apparent that the strategy of large-scale irrigation has gradually reduced the overall resilience of the system, threatening it to shift to an alternative state, facing severe potential irreversible changes in terms of “infertile” soil. In short, it gets clear that the system cannot sustain the socially desirable high level of farming based on groundwater irrigation. (Walker et al. 2009: 3ff) Likewise, several other studies indicate that enhancing social resilience may come at a cost of ecological resilience (Davidson 2010: 1139). In the same sense, however, an exclusive focus

on the ecological dimension leads to wrong conclusions (Folke 2006: 260). As a result, it is clear that an integrated social-ecological systems perspective is required for urban resilience in order to avoid a one-sided analysis.

Second, most of the definitions of resilience by the disaster community clearly reflect the notion of bouncing back to the pre-disaster situation (e.g. Twigg 2009: 8f; UNISDR 2009: 24). This, however, does not account for the dynamics of constant change, the existence of multiple stable states and the chance of irreversible undesirable change when crossing a critical threshold. The explicit or implicit emphasis on returning to the pre-disaster situation does further not acknowledge the opportunities that disturbances open for renewal and innovation. In fact, disasters frequently create room, within which a resilient system has the ability to reorganise or renew based on lessons learned and future scenarios (Annex IIIe). As pointed out by Keating and colleagues (2014), even when the understanding of disaster resilience goes beyond the notion of bouncing back, there is a clear tendency to regard disaster resilience simply as the ability to do “good” disaster risk management (Keating et al. 2014: 26). The latter, however, is a just tool that can help in the effort to build resilience. More precisely, resilience goes beyond a disaster risk management framework by integrating disaster risk reduction in an overarching resilient-oriented development pathway. Risks may be in part manageable, but resilience is about developing a wider set of capacities to deal with change, most prominently in the form of unexpected extreme events, or any other type of disturbance; such as food price fluctuations (e.g. ACF 2014: 4). Resilience further enhances disaster risk management in a way that identifying and managing critical thresholds becomes a central concern. In doing so, resilience building has implications on all realms of the system under concern. Additionally, resilience adds the opportunity for transformative interventions (ACF 2014: 4); meaning that the system may be intentionally transformed in a way that it shifts to a more desirable state, with different basic functions and structures. Related to this, it becomes clear that traditional disaster risk management is usually not founded on complex adaptive systems thinking, thus it fails to account for non-linearity, self-organisation, emergence and integrated social and ecological systems. It is reasonable to argue that even the notion of “bouncing forward” implies a sense of linearity, as it considers changes only within the current state. As a result of the above, urban resilience has to be seen as a broader feature of complex adaptive systems that goes hand in hand with redundancy, diversity, flexibility and learning. While important insights can be obtained from community resilience literature; it is necessary to have a systems-based understanding of the communities under concern

(Keating et al. 2014: 28). That is why, urban resilience requires an interdisciplinary complex adaptive systems perspective.

3.5 Going beyond distinct approaches: a great deal of complementary insights

In light of the above, it is clear that a building urban resilience requires the development of broader city resilience that spans across all four resilient components; or both resilient dimensions, depending on the analytical perspective. As such, the concept of urban resilience influences the policy agenda of a city in a wider sense, “[...] with implications in the fields of urban governance, infrastructure, finance, design, social and economic development, and environmental/ resource management.” (Otto-Zimmermann 2011b: 566)

Taken together, urban social-ecological systems literature and disaster-related literature greatly complement each other in developing an understanding about what urban resilience means. Social-ecological systems literature, on the one hand, brings complex adaptive systems thinking and a corresponding need for threshold identification in. It further provides valuable insights on the ecological dimension of urban resilience as well as the importance of an integrated social-ecological systems perspective. Disaster-related literature, on the other hand, greatly enhances the picture with regards to the social dimension. In particular, it emphasises equity, social-determinants of vulnerability as well as a need to assess and manage risks in order to build resilience. As a result, a comprehensive perspective on urban resilience builds on going beyond research traditions in the sense of combining elements and insights provided by both approaches in a complementary manner. For better clarity, table 3.3 provides an overview of key points mentioned in the course of the discussion in this chapter. Given the diversity and wide-ranging aspects within each urban resilience approach, table 3.3 does not seek to be exhaustive, but rather serves as a rough overview of key elements of each approach. Thereby, table 3.3. also seeks to assist the identification of complementary aspects.

Table 3.3 Overview of key elements of an urban social-ecological resilience approach and urban disaster resilience approach

	Urban social-ecological resilience approach	Urban disaster resilience approach
Predominant resilience paradigm	Ecological Resilience	Engineering Resilience
Central concepts	<ul style="list-style-type: none"> - Fundamentally integrated social and ecological systems - Critical thresholds and radical shifts to alternative stable states - Desirable and undesirable resilience 	<ul style="list-style-type: none"> - Risk perspective and disaster risk management - Socially determined vulnerability and exposure to hazards
Conceptual focus	Ecological aspects	Social aspects
Conceptualisation of urban resilience	<p>Two dimensions of urban resilience:</p> <ul style="list-style-type: none"> - Biophysical dimension <ul style="list-style-type: none"> - E.g. ecosystem services and biodiversity in and outside of city boundaries - Social dimension <ul style="list-style-type: none"> - E.g. institutional context of resource management - E.g. adaptive capacity and learning 	<p>Four urban resilience components:</p> <ul style="list-style-type: none"> - Social resilience <ul style="list-style-type: none"> - E.g. income distribution, social networks, communication, flexibility, inequality in terms of vulnerability and adaptability - Man-made and natural infrastructural resilience <ul style="list-style-type: none"> - E.g. land use, risk-based planning - Economic resilience <ul style="list-style-type: none"> - E.g. economic diversity - Institutional resilience <ul style="list-style-type: none"> - E.g. participation, urban administration

Table 3.3. Based on preceding discussion. Sources include, among others: Abhas et al. (2013), Adger (2000), Berkes et.al. (2003), Berkes & Ross (2013)

Finally, it has to be pointed out that the novelty of the concept of resilience means that there are still gaps in our understanding about what it means for a city to be resilient (Yuzva & Zimmermann 2012: 102); or on how to measure the level of urban resilience (Jabareen 2013: 221). Nevertheless, resilience is already widely applied in the urban context and new insights are developing rapidly. Since climate change is predicted to increase risks to extreme events, such as droughts, fire and floods (IPCC 2012: 29ff); resilience to climate change as a specified type of resilience has emerged as a prominent perspective in recent years. Thereby cities are frequently in focus, as they will be affected by climate change to a particular high degree (Otto-Zimmermann 2011b: 4).

4 Urban climate resilience

4.1 Resilience of urban systems to climate-related hazards in times of climate change

The concept of urban resilience to climate change has received a wide range of attention in recent years because awareness about the inevitability of climate change impacts and the particular high risk of cities has grown (Otto-Zimmermann 2011: 4ff). As such, climate change has become a topic across all approaches to urban resilience (Leichenko 2011: 164ff). At the same time, broad agreement among experts has emerged that cities have to assign importance to promoting their resilience to climate change impacts (Yuzva & Zimmermann 2012: 101f; Otto-Zimmermann 2011a: 4ff). This enormous interest in urban climate resilience is greatly illustrated by the establishment of a multidisciplinary international scientific forum on urban adaptation and the launch of a special UNISDR campaign on “Making Cities Resilient” to encourage and support corresponding policymaking (Otto-Zimmermann 2011a: 4ff). As explained above, urban resilience can be established with regards to a wide range of disturbances (Leichenko 2011: 165). For example, the concept has also been used with regards to terrorism or the recovery from economic perturbations (Coaffee & Rogers 2008; Rose 2007). That is why, climate-related hazards constitute only one of many areas of urban resilience. Furthermore, it is widely held that climate change-related shocks usually come together and interact with other disturbances of all kind, environmental, political and economic. (Leichenko 2011: 164ff) One could think of the fact that direct and indirect climate change impacts are expected to lead to an increase in food insecurity, in particular of the rural poor, and to exacerbate inequalities (IPCC 2014a: 39ff; IPCC 2014b: 793ff); which could go hand in hand with social and economic disturbances. This leads to the fact that building urban climate resilience requires the development of resilience against a broad set of overlapping and interrelated shocks and stresses (Leichenko 2011: 164ff). In simple terms, however, urban climate resilience can be regarded as the specified resilience of urban systems to weather related hazards in light of changing climate conditions. The term weather has to be differentiated from climate: Weather refers to the meteorological conditions at a place at a certain point in time, whereas the term climate describes the overall long-term weather characteristics in terms of average weather conditions and their variability, including extreme events (United Nations 2008: 2).

While climate change is expected to impact natural and human systems in many complex ways, the following direct impacts on cities have to be highlighted: According to Hunt and Watkiss (2011), cities are directly effected by sea level rise and extreme events, such as

floods, heat waves, droughts, storms and storm surges (Hunt & Watkiss 2011: 15f). It is predicted that climate change will increase these weather extremes in terms of frequency and magnitude, amplifying the related risks (IPCC 2012: 29ff; IPCC 2014a: 39ff). And it is these types of climate-related hazards that are usually in focus for climate resilience. Accordingly, urban climate resilience refers to the resilience of cities to floods from land and sea, heat waves, droughts, storms and storm surges. Still, climate-change has further related impacts on urban living spaces, which may also be of concern. As Hunt and Watkiss (2011) point out, the health of urban citizens is expected to be affected through water born diseases as well as temperature-related health impacts. What is more, climatic variability will change the availability of water and urban energy use, for example because of a higher demand for heating and cooling. (Hunt & Watkiss 2011: 15f) It is further widely agreed that climate change will become one of the greatest threats to ecosystem biodiversity, which in turn threatens to lower their ability to provide valuable ecosystem services (IPCC 2014a: 39ff).

Resilience has become a prominent concept in guiding efforts to deal with climate change-related challenges nowadays. Hence, more and more reports and guidebooks on how to build urban climate resilience are being published (e.g. ADB 2014: 1ff; Prasad et al. 2009: 1ff). The concept of urban climate resilience is regarded as particularly useful for addressing climate change, as it embraces mitigation, adaptation as well as disaster risk management activities. In doing so, it further acknowledges the great level of uncertainty and complex dynamics involved with climate change and urbanisation. (ADB 2014: 4) In a climate change context, mitigation refers to, on the one hand, actions to reduce the concentration of greenhouse gases in the atmosphere, i.e. reducing emissions. Furthermore, it may also refer to the reduction of potential adverse climate change impacts in a broader manner. More precisely, mitigation may also refer to climate risk reduction through lowering vulnerability, exposure and hazard. (IPCC 2012: 561, 291ff) Adaptation is “[...] the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities.” (IPCC 2012: 5) As Surjan and colleagues (2011) point out, in the context of climate change, adaptive capacity is particularly emphasised as central element of resilience and widely discussed. That derives from the fact that cities often have to accept and learn to live with some of the changes that result from climate change (Surjan et al. 2011: 30); details of which are largely unknown.

According to McBean and Rodgers (2010), more than 75% of all disasters worldwide in the first decade of this century have been triggered by climate-related hazards (McBean &

Rodgers 2010: 871ff). Given the corresponding expertise with climate-related hazards in the disaster management field, it comes as no surprise that this body of knowledge and the corresponding urban disaster resilience approach commonly constitutes the foundation for efforts to promote urban climate resilience. Yet, urban climate resilience requires more than disaster risk management. Indeed, it is widely advocated that building urban climate resilience is greatly supported by linking disaster risk reduction and adaptation (IPCC 2012: 29ff).

4.2 Urban disaster risk management as climate change adaptation

Key to promoting urban climate resilience is the integration of climate change adaptation with disaster risk management. This argument is made because these two concepts are usually used in isolation by two distinct research communities (Thomalla et al. 2006: 39ff). Yet, integrating adaptation and disaster risk reduction seems natural, because they share a common objective in the context of climate change: broadly said, both aim for a reduction of adverse impacts from extreme events and the promotion of urban disaster resilience (Solecki et al. 2011: 135). As such, the concepts and resulting activities are highly complementary and overlapping. Linking disaster risk management and climate change adaptation may be complex in details, but the central aspects of an integration are as follows: As pointed out by Thomalla and colleagues (2006), climate change increases the level of uncertainty about disaster characteristics significantly. Whereas traditional disaster risk management works often considerably-well with knowledge based on historical experiences, climate change impacts are much more difficult to predict, as high uncertainties are inherent to climate scenarios and models. (Thomalla et al. 2006: 41f) Still, even though specifics are unknown, there is agreement that overall climate change is expected to increase existing risks or create new risks through changes in extreme events and increasing vulnerability. In other words, the challenge of climate risk management is to manage changing risks. (IPCC 2012: 439ff) Consequently, integrating disaster risk management and adaptation means that disaster risk reduction strategies have to be flexible in order to account for a changing risk profile and have to be based on a longer-term planning horizon that includes climate scenarios and models. On the one hand, measures such as infrastructure projects, may be assessed and perceived differently under climate change conditions. As a result, otherwise rejected large-scale investments may then be justified. On the other hand, climate change requires greater efforts to increase adaptive capacity of urban residents and the city's ability to respond to perturbations. (Solecki et al. 2011: 136ff) Therefore, when disaster risk management is conducted in a way that current and future climate change impacts are accounted for, disaster

risk management can greatly contribute to climate change adaptation. In fact, studies show that even when there are no explicit climate change adaptation measures, but disaster risk management aims to meet contemporary adaptation needs to current weather extremes, the related disaster risk reduction activities can serve as early adaptation to climate change (e.g. Schinko et al. 2015). As a result, disaster risk management plays an important role in promoting urban climate resilience, both in theory and in practice. In addition, measures to mitigate greenhouse gas emissions in order to reduce future potential climate change impacts are also of concern for building urban climate resilience. That derives from the fact that urban living spaces are a major contributor to global greenhouse gas emissions. For example, it is estimated that cities account for a share of 67 percent of global energy-related emissions (The World Bank 2010: 10ff).

4.3 An interdisciplinary complex adaptive systems approach to urban climate resilience

Understanding urban climate resilience greatly builds on the insights provided in the preceding chapter. In light of earlier discussions, it is clear that urban climate resilience has to go hand in hand with complex adaptive systems thinking and has to be conceptualised in a way that insights from different research traditions are combined. Therefore, while the urban disaster-resilience approach may constitute the most common foundation of urban climate resilience, insights from the urban social-ecological resilience approach and corresponding systems-based thinking are essential for understanding urban climate resilience. This implies that urban climate resilience does not mean that the city returns to a previous equilibrium after a climate-related disturbance but rather that essential functions and structures are maintained so that a desirable climate-resilient development pathway is sustained. In doing so, it requires a focus on identifying critical thresholds and recognition of the existence of alternative stable states and related non-linearity in the sense of unpredictability and surprises. Thereby, climate resilience acknowledges the opportunities for renewal and innovation that are created by climate hazards. Besides, it also adds the opportunity to deliberately shift to an alternative state that turns out to be more desirable and sustainable in light of climate change. Therefore, it certainly goes beyond traditional disaster risk management, whereas risk assessment and risk-based planning and design are vital elements. In fact, in this context, climate resilience can be interpreted as the antithesis of climate risk (Wamsler et al. 2013: 70). Taken the strengths and shortcomings of both resilience approaches together, urban climate resilience

has an ecological, economical, governance, infrastructural and social resilience component, and embraces central concepts such as flexibility, redundancy, learning and equity.

5 Policy implications of different understandings of resilience

As mentioned in chapter two, the present case study focuses on the analysis of Jakarta's public policy approach with regards to urban resilience thinking. Before looking at the system under concern, it is necessary to clarify what is actually meant by policy and to outline key policy implications of different resilience approaches.

5.1 What is public policy?

In order to understand policy, one has first of all to bear in mind that political systems can be analysed in three dimensions: polity, politics and policy (see for example Von Alemann 1995; Pennings et al. 2006):

Polity refers to the institutional dimension of political systems. It is concerned with the characteristics of formal and informal institutions that constitute the rules of political governance. As such, these institutions jointly constitute the framework within which political interaction happens. (Pennings et al. 2006: 25f) Examples include institutions and organisations such as parliaments or administrative bodies (Von Alemann 1995: 142); as well as informal societal expectations on appropriate behaviour (Pennings et al. 2006: 25). In short, polity refers to the institutional structure of political systems.

Politics is the process dimension of political systems. More precisely, it is through processes of interaction between individual and collective actors with conflicting interests that solutions to societal problems are achieved. (Pennings et al. 2006: 25) Accordingly, politics describes a constant process of interest intermediation and political decision-making. Thereby, all forms of power, formal and informal, have to be considered. (von Alemann 1995: 143)

As pointed out by Von Alemann (1995), the term policy refers to the content dimension of political systems and constitutes the results of the political processes. As such, policy refers to the objectives or intentions, subjects and tasks of political systems. (von Alemann 1995: 142f) Policy is constituted by the political decisions that were undertaken (Pennings et al. 2006). Consequently, public policy is defined as “[...] a statement of a government – at whatever level – of what it intends to do about a public problem.” (Birkland 2005: 9) As pointed out by Birkland (2005), public policy is characterised by the fact that it seeks to contribute to the solution of a problem. Ultimately policy is made by governments on behalf of the public and reflects what the government decides to do or not to do. (Birkland 2005: 8f) Figure 5.1 provides a concise overview of these three dimensions of political systems.

Table 5.1 Three dimensions of political systems

Dimension		Key aspects
Polity	Structures	<ul style="list-style-type: none"> - Organisations and institutions (parliament, ministries, parties,...) - Legislation and cultural aspects, norms and values - “Rules of the game”
Politics	Processes	<ul style="list-style-type: none"> - Political processes and dynamics - e.g. decision-making processes and processes of implementation
Policy	Results	<ul style="list-style-type: none"> - Political programmes, ideas and objectives - Government actions or inactions

Table 5.1. Based on Pennings et al. (2006); Von Alemann (1995); Birkland (2005)

As mentioned above, the present study’s research design follows a case-study strategy within which policy documents are analysed and expert interviews with officials from public policy actors are conducted. Consequently, this thesis has a clear focus on the policy dimension. Political processes, out of which the current policy approach developed, are not of concern. The polity dimension, however, is featured in terms of an outline of central public actors that were identified to have functions concerned with climate-related hazards in Jakarta. Still, these public actors and their administrative characteristics are not discussed extensively, but rather in terms of context. This is also important, as the identification of relevant public policy actors developed the basis for interviewing policy experts, which allows going beyond the resilience thinking reflected in policy documents, in order to achieve a greater depth of analysis in terms of assumptions, perceptions and conceptualisations underlying the current policy approach, and to better situate the corresponding results.

5.2 Policy implications of different resilience perspectives and conceptualisations

Scientific data, concepts and theories may inform the basis of policy decision-making and support related policy development processes. While policy makers not always regard scientific information ‘useful’ or to be available in a timely manner (McNie 2007: 17ff); resilience has been taken up widely as a concept to guide urban policies (Stumpp 2013: 165); in particular with regards to climate change. Yet, the focus of policies seeking to promote resilience is strongly influenced by how resilience is actually defined and conceptualised by public policy actors and their respective policy developers. Most importantly, the focus of public policy is greatly determined by whether an engineering or ecological resilience paradigm underlies the resilience perspective.

As explained above, the engineering resilience paradigm implies that the system has a single stable equilibrium to which it eventually returns after disturbances (Holling 1996: 32ff). Accordingly, policy focuses on controlling change in order to maintain the system's efficiency of function and to return to normal stability in light of disturbances. Engineering resilience policies aim to ensure the system's constancy or, in other words, to conserve the system in times of change. As a consequence, such policy approaches tend to focus on optimum solutions or "fail-safe designs" in an allegedly predictable world. (Folke 2006: 254ff; Holling 1996: 32ff; Eradyin & Tasan-Kok 2013: 5ff) That leads to the situation that command and control mentalities tend to direct systems management (Berkes et al. 2003: 8ff).

In contrast, the ecological resilience paradigm breaks with the perspective that systems stabilize around a single equilibrium. Thus, it also breaks with policy approaches that aim to control change in order to maintain stability. (Adger et al. 2005: 1136; Folke 2006: 254; Holling 1996: 32ff; Carpenter et al. 2001: 766) Ecological resilience goes hand in hand with complex adaptive systems thinking and the corresponding chance of shifting to an alternative state when critical systems' thresholds are crossed. (Holling 1996: 32f; Folke 2006: 256f) The policy focus consequently shifts from control towards coping with, adapting to and shaping change (Low et al. 2003: 83ff). Ecological resilience policy is about maintaining systems' existence of function or persistence in an ever-changing unpredictable world. Therefore, it aims to find "safe-fail designs", also because surprise is likely. (Holling 1996: 32f; Folke 2006: 256f) Put differently, policy seeks to intentionally induce actions or inactions at multiple scales that increase the amount of disturbance a system can deal with, thereby extending or avoiding crossing thresholds. The overall objective is to sustain desirable development pathways in a constantly changing world. Key differences between a policy focus based on an engineering and ecological resilience perspective are summarised in table 5.2 below.

Table 5.2 Differences in the policy focus between an engineering and ecological resilience perspective

	Ecological Resilience	Engineering Resilience
Perspective	<ul style="list-style-type: none"> - Multiple (un)desirable stable states (complex adaptive systems perspective) - Unpredictability, surprise is likely - Critical thresholds - Chance of collapse and irreversible change 	<ul style="list-style-type: none"> - Single stable state (steady systems perspective) - Predictability - Return to normal pre-disturbance stability
Policy focus	<ul style="list-style-type: none"> - “Safe-fail designs” - Coping with, adapting to and shaping change - Maintaining existence of function - Extending or avoiding to surpass critical thresholds - Sustaining desirable development pathways 	<ul style="list-style-type: none"> - “Fail-safe” designs / optimum solutions - Controlling change (command and control mentality) - Maintaining efficiency of function

Table 5.2. Based on Holling (1996); Folke (2006); Low et.al. (2003); Berkes et.al. (2003)

Related to this are the policy implications of different conceptualisation of resilience. In light of the preceding chapters, it is clear that policies seeking to promote resilience are greatly determined by which factors are considered to determine resilience and in what way they are accounted for. In other words, the level of concern or awareness about central resilience factors in the ecological, economical, infrastructural, institutional and social resilience component and their complex interrelations has a significant influence on the policy agenda and policy direction seeking to build resilience. One could think of the fact that policies are impacted by to what extent awareness about the central role of social processes in the creation of vulnerability and the corresponding level of risk is given. Another example is that policies may differ when ecosystem services and fundamental linkages between the social and ecological dimension are accounted for.

As a result, it becomes clear that not only the paradigms underlying the resilience perspective greatly influence the policy approach, but so does the conceptual level of resilience. Of course, resilience paradigms and conceptualisations of resilience are somewhat related because of their emergence within distinct fields of science. However, in theory this is not necessarily the case, as it is possible that resilience is defined in terms of ecological resilience, but at the same time ecological factors are greatly overlooked at the conceptual level. Furthermore, one has to bear in mind that policies are of course the result of political

decisions, meaning that factors may deliberately not be featured because of political reasons, even though they are captured in the underlying resilience thinking. In order to at least partly account for such potential discrepancies between resilience thinking and policies, it is necessary to go beyond policy and policy-related documents and to conduct interviews with policy developers from relevant public policy actors. Based on these theoretical insights and those provided in the preceding chapters, it is possible to analyse the ways of resilience thinking behind Jakarta's current policy approach to climate-related hazards.

6 The system under concern: Jakarta megacity

Jakarta is the capital of the Republic of Indonesia. Historically, the city was founded long before the Europeans arrived for the first time. Jaya Karta, as it was known during the Banten Sultanate, constituted an important port for Javanese Kingdoms and following Sultanates. During Dutch colonialism, a period of over 350 years, the city became the capital of Netherlands East Indies. At that time Jakarta was called Batavia. Colonial processes transformed the city significantly. Batavia became a trading centre of colonial exploitation and Dutch city planners and architects influenced its urban development. In the past century Jakarta has seen rapid rates of urbanisation. In particular during the period following the independence of Indonesia as a sovereign country in 1945, Jakarta grew at such a high rate, that it eventually became one of the largest cities in the world. (Silver 2008: 14ff) From 1960 to 2010 the population of Jakarta has more than tripled from 2.7 to almost 10 million (Marfai et al. 2015: 1132); making it the most populous Southeast Asian city (Silver 2008: 18). It is estimated that daily commuters even further increase Jakarta's population by an additional two million. Correspondingly, the city also constitutes the largest concentration of economic activities in Indonesia today. (Sagala et al. 2013: 4f)

As such, Jakarta is a magnet for people seeking better living conditions, especially the poor rural population. In 2011 around 400,000 people below the national poverty line and 300,000 people shortly above the poverty line lived in Jakarta (Firman et al. 2011: 172). Currently the national poverty line is set at a little bit less than three hundred thousand rupiah per month (World Bank 2015); which equals approximately twenty Euro at the time of writing (Bloomberg 2015). Most of these low-income groups reside in informal settlements, for example along railway tracks, in the riverbanks or near the seashore. That derives from the fact that fast and uncontrolled urbanisation has led to limited space and lack of housing in the city, making traditional neighbourhoods expensive, thus forcing the poor to dwell in the remaining vacant places, for example marginal areas in the river basins. (Texier 2008: 362ff) Indeed, the constant inflow of migrants to the city, which is estimated at around 250,000 people every year, in combination with an under-regulated real-estate market have led to a big lack of provision of housing, in particular for the poor (World Bank n.d.: 6). The resulting informal settlements are officially regarded as illegal settlements (Texier 2008: 362ff); but they are an integral part of Jakarta's society and economy. Given the low living costs in the

informal settlements and their proximity to the city centre, studies show that not only poor migrants but also other people with a low income from the formal sector deliberately live in these communities (Wilhelm 2011: 50). Thus, it is likely that even a higher number of people reside in these informal settlements than the numbers above suggest, since poverty alone cannot serve as the sole indicator. In fact, the actual population of informal settlements in Jakarta is unknown due to unmonitored immigration to the city and the fact that these communities have not been documented in the form of a census up to now (World Bank & Government DKI Jakarta 2011).

Administratively Jakarta constitutes a special province with the name *Daerah Khusus Ibukota* (DKI), which means Special Capital Region (Sunarharum et al. 2014: 2). The city's built environment is characterised by skyscrapers in the central business district on the one hand, and densely populated neighbourhoods in most of the rest of Jakarta, on the other hand. The latter are highly diverse in terms of household income. In general, however, the population of Jakarta is considered wealthy compared with other Indonesian provinces. (World Bank n.d.: 5f) Population figures of people officially residing in DKI do not account for the full scale of the city, though. Since the surrounding cities and hinterlands are greatly intertwined with the urban centre, one has to look beyond administrative boundaries (Silver 2008: 18ff). In fact, in order to properly understand the context of Jakarta one has to account for the fact that the city constitutes the urban centre of a greater metropolitan area that spans over more than 7,500 square kilometres, involving 10 administrative units and inhabiting more than 28 million people in 2010. (Sagala et al. 2013: 8f) Related to the high population density and high numbers of daily commuters is the major problem of traffic congestion. As pointed out in a case study by the World Bank (n.d.) this is caused, among other things, by the fact that the constantly rising numbers of vehicles outpace the infrastructural development. Jakarta's recently established public transport system is not yet developed enough to relieve daily traffic congestion. (World Bank n.d.: 6) At the time of writing the first section of the Mass Rapid Transit (MRT) inner-city, partially underground, railway system is under construction, which is expected to complement the existing TransJakarta Busway system in 2018 (Van der Schaar Investments B.V. 2015).

6.1 Climate related hazards in Jakarta

Geographically, Jakarta is located in a deltaic plain on the north coast of Java Island (World Bank n.d.: 5). The city is characterised by its flat topography and coastal lowlands in the Northern part of the city (Marfai et al. 2015: 1129). Around 40% of the city is below sea-level

(World Bank n.d.: 5); overall the city's elevation is less than 10 meters above sea-level (Marfai et al. 2015: 1129). Thirteen natural rivers and more than 1,400 kilometres of man-made waterways cross the delta area of Jakarta (World Bank n.d.: 5). South from the city, upstream the rivers, lies a mountainous area (Marfai et al. 2015: 1129f). The satellite towns and villages in this area are also tightly connected to the development of the city (Silver 2008: 23); and their development has a significant impact on the rivers going through the city (Marfai et al. 2015: 1129f), as is discussed in more detail below.

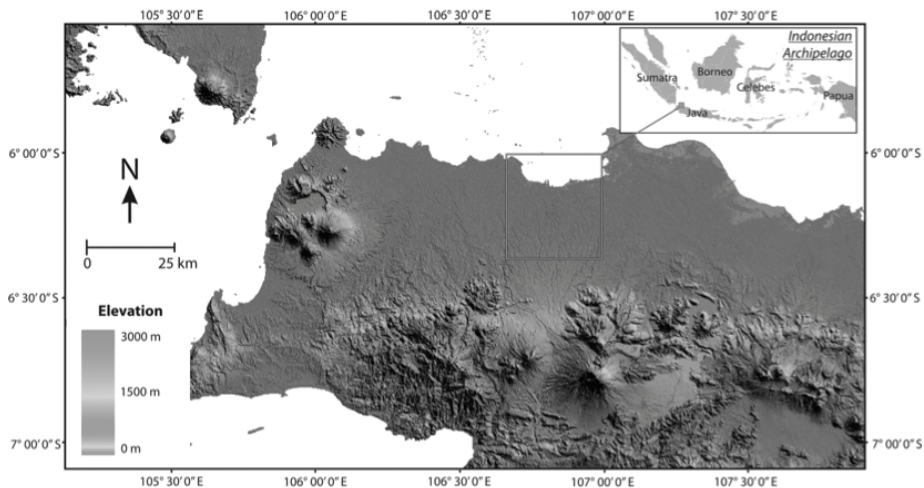


Figure 6.1 Geographic location of the lowland coastal area of Jakarta. (source: Marfai et al. 2015: 1130)

As Firman et.al. (2011) points out, most studies about climate-change related impacts in Indonesia have focused on the country-level, only a few looked at the city level (2011: 377). In the climate vulnerability assessment by Yusuf and Francisco (2009), however, Jakarta is clearly identified as one of the most vulnerable coastal cities. In fact, central Jakarta ranks first in Southeast Asia in the overall vulnerability assessment. (Yusuf & Francisco 2009: 13ff) Most strikingly, the city is vulnerable to floods, storm surge and sea level rise. The city is facing more severe climate-related hazards, in terms of more frequent and heavier rain and tidal flooding, which is expected to worsen with global warming (Firman et al. 2011: 372f; Sagala et al. 2013: 10ff). Indeed, Jakarta is highly prone to flooding, which occurs almost annually during the rainy season and experience with floods has shown that they can have a disastrous impacts. The worst flood up to date occurred during the rainy season in 2007 and affected around 60 percent of Jakarta city. Hundred houses were destroyed and dozens of people died. (Texier 2008: 358f)

Only very few studies discuss the potential impacts of climate change on Jakarta. In light of the high exposure of the city to flooding, however, a wide range of research exists on the city's risk to flooding and respective policies (e.g. Marfai et.al. 2015: 1127ff; Texier 2008: 358ff; Sagala et.al. 2013: 1ff; Wilhelm 2011: 45ff). Several of those studies focus on the community level. For example, Marfai et.al. (2015) investigated the community flood response and adaptation strategies in flood-prone areas. They conclude that communities cannot overcome the underlying causes of their high level of vulnerability themselves. Accordingly, community adaptation strategies have to be seen as a short-term emergency response and not as solutions, but government action is required. (Marfai et al. 2015: 1127ff) Texier (2008) investigated the root causes for vulnerability to flooding with a focus on informal settlements in Jakarta. She concludes that the government policy focus on structural flood control measures does not address the underlying socio-economic causes of the high level of vulnerability. (2008: 158ff) Other studies focus more on the governance side of Jakarta's flood management and reveal that technical measures dominate the corresponding political discourse (Ward et al. 2012: 518ff). Sagala et.al. (2013), for example, stress that Jakarta's flood management has to go beyond the city's administrative boundaries in order to account for the fact that the flood problem is closely related to the upstream areas (2013: 4ff). All in all, existing studies on the flooding problem in Jakarta indicate some shortcomings of earlier public policy approaches and provide sufficient insights in order to understand the underlying causes of the city's high level of vulnerability, which I summarise below.

The main reason for Jakarta's susceptibility to climate-related hazards are directly linked to its geographic characteristics. According to Wilhelm (2011), the city's strategic location as a harbour town is in fact the major reason for frequent floods. Particularly the city's low-lying coastal areas in the North are easily flooded by high tides and this is also where the water-run off from heavy rain cannot easily discharge into the sea. Given these unfavourable geographic characteristics, it comes as no surprise that flood management was already part of Jakarta's urban planning during colonial periods. However, urban planning could not cope with the extreme rate of urbanisation that the city experienced in the past decades. (Wilhelm 2011: 49f) In fact, while Jakarta is highly prone to flooding as a result of the natural features of its location, flooding has worsened nowadays because of drivers that are directly linked to urbanisation, i.e. anthropocentric causes (Texier 2008: 358ff; Wilhelm 2011: 45ff). Following, I discuss some of the main drivers that are linked to human behaviour.

Due to the nonexistence of a piped water supply system in Jakarta, urban residents and industries are directly extracting groundwater, which causes Jakarta to sink rapidly (World Bank n.d.: 6). In other words, the city faces a rapid rate of land subsidence, which results from the extraction of groundwater for drinking and industrial purposes. (Abidin et al. 2001: 383f) The rate of land subsidence in the past decade, which differs spatially throughout the city and is estimated to vary between 1-10cm per year (Abidin et al. 2008: 23ff); is actually much higher than the sea-level rise of 0.57cm per year over recent decades (Firman et al. 2011: 373 with reference to Hadi et.al. 2005). There is no citywide solid waste management, but rather private companies handle solid waste against a fee. Therefore, solid waste of the poorer residents, in particular in the informal settlements, is not handled well and significantly contributes to the pollution and clogging of waterways. (World Bank n.d.: 6) In fact, huge amounts of solid waste in Jakarta's waterways create a significant problem. Marfai and colleagues (2013) highlight that around 300 tons of solid waste end up in Jakarta's rivers every single day, which results in blocked water flows (Marfai et al. 2013: 71).

Another important driver of Jakarta's high vulnerability to climate-related hazards is land use change, which is linked to the rapid growth of the urban population as the high demand for land causes large-scale land conversion (Marfai et al. 2015: 1131f). In this context, land conversion " [...] is the process by which land is converted from agricultural use to urban uses and from one urban use to another [...]." (Firman 2009: 332) Firman (2009) found that most parts of Jakarta's open green space have been converted into built-up areas over time. Indeed, the proportion of open green areas of the total area of Jakarta has decreased from 28,8 percent in 1984 to an estimation of only 6,2 percent in 2007. (Firman 2009: 332 with reference to Tempo 2007) Thereby rapid urban development not only waterproofed the downstream area (Texier 2008: 362); but also led to the fact that more buildings and infrastructure are constructed in flood prone and low-lying areas. This clearly increases the vulnerability of Jakarta DKI as more assets and people are exposed to floods (Sagala et al. 2013: 9f). In particular the marginal areas and their dwellers described above are highly exposed to floods. Indeed, these informal poor districts constitute the most affected areas when it comes to flood related hazards. Accordingly, the people in these informal settlements are held to be extremely vulnerable. Besides, daily structural constraints, such as limited access to official drinking water or waste management systems, further increase these people's vulnerability. (Texier 2008: 362ff) On the other hand, developments upstream the rivers are of similar importance. Here, land use change has generated greater runoff into the rivers of Jakarta. That derives from the fact that tea plantations led to a massive reduction in forests on the slopes of

the mountains and that the rapid growth of residential areas, such as in Bogor, has progressively waterproofed the surface. (Texier 2008: 362) The land conversion connected to the latter often resulted from violations of land-use plans, both by local politicians and the private sector because of weak enforcement of land-use plans and the fact that hardly any sanctions for violations exist. That is also one of the main reasons why it was possible that the hilly area in Bogor, Pinjak, Cinanijur, which was initially designated by spatial planning as a natural reserve because of its functions as a water catchment and recharge zone, was progressively built up by new town projects. (Firman 2009: 332ff) Therefore, it becomes clear that the described land conversion is one of the main reasons for increased levels of flooding in Jakarta in terms of severity and frequency (Firman 2009: 334ff). Accordingly, Sagala and colleagues (2013) conclude that coordination between the regions and agencies with regards to spatial development is not sufficient, as the impacts of upstream development on downstream areas are not taken into account (Sagala et al. 2013: 10).

In light of the above, it goes beyond doubt that human actions have led to the fact that flooding is a bigger problem in Jakarta today than it was in the past. In other words, due to the results of social processes, especially those related to urban dynamics, the risk of adverse impacts of high tides, heavy rain and corresponding floods has increased significantly. Given the urgent current situation and the fact that floods are expected to increase in terms of frequency and magnitude with future changes in climatic conditions, Jakarta's public policy actors face the challenge to develop flood adaptation and mitigation strategies today. While it is clear that Jakarta will never be flood free given the natural characteristics of its site, urban planning and adequate flood management may reduce floods (Wilhelm 2011: 50).

6.2 Multilevel policy addressing climate-related hazards in Jakarta

The administrative head of the provincial government of DKI Jakarta is the Governor. The province of Jakarta comprises of five municipalities, namely Jakarta Barat (West Jakarta), Jakarta Utara (North Jakarta), Jakarta Pusat (Central Jakarta), Jakarta Timur (East Jakarta), Jakarta Selatan (South Jakarta), whereas each municipality has its own mayor. (World Bank 2011: 5) A great deal of competences and development resources have been allocated to regional governments as a result of Indonesia's decentralisation policies since late 1990s and early 2000s (Firman 2008: 281ff). In line with increasing decentralisation, the city's government system in respect to flood risk management and climate change adaptation is based on a three-tier government system (Ward et al. 2013: 521ff). According to Firman et.al. (2011), there is no specialised agency in Jakarta for managing climate-change data and

corresponding vulnerability and risk assessments (Firman et al. 2011: 377). A recent study further indicates that the city’s administration is fragmented, which results in a striking lack of clarity about responsibilities and implementation powers in addressing climate-related hazards (Ward et al. 2013: 521ff). Nevertheless, existing studies still allow to detect that the responsibilities and functions of some policy actors under the Jakarta City Government and at the national level are directly concerned with addressing climate-related hazards. The present study focuses on both, national and provincial, public policy actors within the three-level government system. Relevant national policy actors concerned with climate-related hazards are also part of the study because their understanding of resilience, corresponding programmes, plans and strategies most certainly influence related policies at the provincial level. Besides, many infrastructural projects in Jakarta are partly financed by the national government (World Bank & Government DKI Jakarta 2011: 29). Moreover, national-level actors frequently provide technical assistance to provincial actors. Hence, it goes beyond doubt that national-level public actors are also relevant to answering the research question outlined above. Based on previous studies, the following public actors involved in Jakarta’s policy approach to climate-related hazards have been identified to be of relevance.

Table 6.1 Key public policy actors concerned with climate-related hazards in Jakarta

Public Policy Actor	Acronym	Policy Level
Ministry of Environment and Forestry	KLHK	National
Ministry of Public Works	KPUPR	National
National Agency for Disaster Risk Management	BNPB	National
Provincial Disaster Risk Management Agency Jakarta	BPBD	Provincial
Provincial Planning and Development Agency	BAPPEDA	Provincial
Provincial Agency for Environment Management	BPLHD	Provincial
Regional Research Council of Jakarta	DRD	Provincial

Figure 6.2 illustrates these policy actors within the prevailing three-level government system. In light of a lack of clarity and the complexity about the governance side of addressing climate-related hazards, it is important to note that this graph does not claim exhaustiveness, but aims to provide an overview of key public policy actors relevant to the present study within the government context. Following, I describe each identified policy actor briefly. In

accordance with the focus of the present study on public policy, and due to the lack of further details about responsibilities and functions, these descriptions are limited to providing a broad overview about the role that each actor plays in addressing climate-related hazards in terms of context.

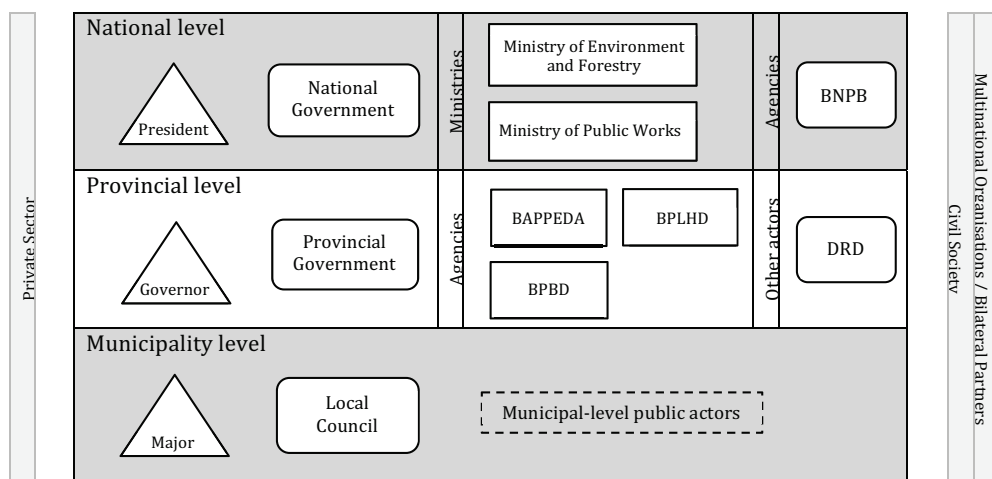


Figure 6.2 Overview of key public actors concerned with climate-related hazards in Jakarta within the three-tier government system

6.2.1 KLHK – Ministry of Environment and Forestry

Kementerian Lingkungan Hidup dan Kehutanan (KLHK), the Indonesian Ministry for Environment and Forestry, is the result of a recent merger of two separate ministries, namely the Ministry of Environment and the Ministry of Forestry (The Jakarta Post 2014). Two separate websites suggest that the merger is still in progress at the time of writing (see KLHK 2015; KLH 2015). It is important to note that the functions of the National Council on Climate Change, *Dewan Nasional Perubahan Iklim*, have also been incorporated into the newly established ministry (The Jakarta Post 2015). This is of relevance since a previous study on climate change vulnerabilities in Jakarta identified the National Council on Climate Change as an actor of central importance to the city, also in terms of climate change action programs (Firman et al. 2011: 376). The main functions of the ministry are the development, implementation and coordination of policies related to the environment and forestry (Presidential Regulation 16/2015: 2f). A programme for the protection of the coastline near the city through means of mangroves, for example, was run by the former Ministry of Forestry (Ward et al. 2013: 528). As such, KLHK constitutes an important actor in promoting Jakarta's resilience to climate-related hazards. As pointed out in the Presidential Regulation

on the establishment of KLHK (Presidential Regulation 16/2015), the ministry further provides other public bodies with technical expertise. As any other Indonesian ministry, KLHK reports directly and is a subordinate to the President. The ministry consists of several Directorates General, each specialised in a certain area, such as the Directorate General for Climate Change (DGCC) or the Directorate General for the Conservation of Ecosystems and Natural Resources. (Presidential Regulation 16/2015: 1ff) Due to its specific focus on climate change, DGCC constitutes the most relevant unit of KLHK for the present study.

6.2.2 KPUPR – Indonesian Ministry of Public Works

Kementerian Pekerjaan Umum dan Perumahan Rakyat (KPUPR), the Indonesian Ministry of Public Works, has the main function to develop and implement infrastructural policies, including policies in the field of water resource management and public housing, and to provide related technical guidance to other public actors (Presidential Regulation 15 2015: 1f). KPUPR is involved in the development, funding and maintenance of major large-scale infrastructure in Jakarta, such as the East Flood Canal. The literature further suggests that the ministry will also be engaged in future major infrastructural adaptation projects. (World Bank & Government DKI Jakarta 2011: 29)

6.2.3 BNPB – National Agency for Disaster Risk Management – and BPBD – Provincial Disaster Management Agency

The Indonesian Government established the National Agency for Disaster Risk Management, *Badan Nasional Penanggulangan Bencana* (BNPB), in 2008 as a specialised agency for Indonesia's disaster management. While predecessor organisations existed, BNPB was set up as a large-scale organisation following the country's experience with the 2004 tsunami in order to provide expertise and information for Indonesia's disaster management. In this regard, BNPB develops disaster management policies. The agency further implements, coordinates and guides disaster management activities throughout Indonesia, which range from disaster prevention, emergency response to rehabilitation and reconstruction. One key aspect is to develop information about disaster risk for policy makers and communities. The National Agency for Disaster Risk Management reports to the President of Indonesia. (BNPB 2015)

Regarding the provincial level, one of the objectives of BNPB is to assist regions in establishing regional disaster management agencies (BNPB 2015). Accordingly, a citywide

BPBD, *Badan Penanggulangan Bencana Provinsi*, was established in Jakarta in 2010. At present, the formal role of BPBD and its empowerment in the policy process of DKI is not yet clearly developed (World Bank n.d.: 7).

6.2.4 BAPPEDA DKI Jakarta – Provincial Planning and Development Agency

The Provincial Planning and Development Agency, *Badan Perencana Pembangunan Daerah* (BAPPEDA), is concerned with managing, financing and monitoring the spatial development and infrastructure of the city. Thereby, it also manages large infrastructural projects that are key parts of Jakarta's flood management system, such as the construction of the giant sea wall, the East and West Flood Canals or floodgates along the risers. (World Bank n.d.: 7) In that, BAPPEDA is an important developer of public policy. One central instrument of the Provincial Planning and Development Agency is the so-called regional development plan, which is discussed in further detail below. The head of the agency is a direct subordinate of the Governor of Jakarta. (BAPPEDA 2015)

6.2.5 BPLHD – Provincial Agency for Environment Management

The Provincial Agency for Environment Management, *Badan Pengelola Lingkungan Hidup Daerah* (BPLHD), is an agency of the Government of Jakarta for the management of the environment. On the one hand, this agency monitors Jakarta's environment, such as the water levels in the rivers. On the other hand, BPLHD is concerned with the implementation of policies and enforcement of legislation in several other areas, such as urban natural resource management, environmental preservation and pollution control, including wastewater management, and the reduction of adverse environmental impacts, such as floods. (BPLHD 2015: 25ff)

6.2.6 DRD – Regional Research Council of Jakarta

The Regional Research Council of Jakarta, *Dewan Riset Daerah Provinsi* (DRD), is a non-structural research council under and directly responsible to the Governor of Jakarta. The council was established by the Governor with the objective to support regional development through the proactive provision of research inputs to the regional government with regards to the direction, priorities and policy framework for development activities as well as the identification of alternative solutions to the problems the region faces. In order to do so, the council also aims to empower related research activities. Experts from various entities, such as research institutes, non-governmental organisations, universities, communities and local

governments, constitute the members of this council, which are elected by a special committee. In its work, the research council is structured into four specialised commissions: (1) Government Commission; (2) Commission of Economy and Finance; (3) Public Welfare Commission; (4) Commission on Environment and Development (CED). On an operational level, DRD is coordinated by the head of BAPPEDA, the Provincial Planning and Development Agency. (DRD Jakarta 2015) As such, DRD is an important co-developer of Jakarta's policies.

7 Resilience thinking behind Jakarta's current policy approach to climate-related hazards

7.1 The current policy approach to climate-related hazards – an overview

As mentioned in chapter two, through a combination of primary sources, i.e. policy and policy-related documents, and secondary sources, including research papers and media articles, the following policy approach to climate-related hazards was identified. This outline of Jakarta's current policy approach does not seek to be exhaustive, but rather intends to provide an overview about the central elements of the current policy mix addressing climate-related hazards.

Jakarta's Long-Term Development Plan (RPJPD 2005-2025) states flooding as one of the major problems for the city today. The document further acknowledges that the city is highly vulnerable to climate change. In fact, climate change is identified as a strategic issue because rainfall patterns are already changing and extreme climate events, in particular flooding, will increase. (Government DKI Jakarta & BAPPEDA 2012a: III 2ff) Therefore, it is hardly surprising that the current policy approach to climate-related hazards is centred on addressing river and tidal flooding. In fact, it can be identified that no specific city-level policy or program for climate change adaptation exists (Firman et al. 2011: 373ff); but, according to the respondent from DRD, climate change issues are mostly addressed as part of water infrastructure management up to now (Annex IIIe).

For the purpose of clarity, one is able to divide policies into structural and non-structural policies. The former includes physical constructions or engineering measures to reduce possible adverse impacts from hazards on structures or systems (UNISDR 2009: 28). Non-structural policies, on the other hand, are “[a]ny measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.” (UNISDR 2009: 28)

7.1.1 Structural policies

On a structural level, Jakarta's flood management follows a two-fold principle: First, to “[...] hold as much water as possible in the upstream area in reservoirs, water retention areas, and recharge wells [...].” (Marfai et al. 2013: 70) Second, to allow the water to flow downstream

through rivers and canals, where a polder pump system supports the water flow through the low land areas of the city. In doing so, several structural measures have been initiated. (Marfai et al. 2013: 70) Most prominently, the East Flood Canal (*Banjir Kanal Timur*), which was opened recently (BAPPEDA 2013: 1ff; Marfai et al. 2013: 65ff). Other important fields of work are dredging initiatives, such as the current Jakarta Emergency Dredging Initiative (JEDI) as part of the Jakarta Urgent Flood Mitigation Project (JUFMP). The aim of dredging is to restore Jakarta's floodway, canals and water retention ponds, which suffer from a reduced water handling capacity due to sedimentation and solid waste accumulation. (Ministry of Public Works 2015: 1f; BAPPEDA 2013: 1ff; World Bank 2014) What is more, the city's polder pump system, which is needed so that the water flows out of Jakarta's low lying areas, is being expanded (Parikesit 2015; BAPPEDA 2013: 1ff). A minor flood in February 2015 allegedly resulted from the fact that power outages put the pumping system out of action (Nurbianto 2015); which illustrates that the system requires improvements. Besides, it is also recognised that ongoing land subsidence means that larger pumping capacities are required to discharge water into the sea (NCICD 2014: 25).

Another project that is frequently mentioned also in the context of climate change adaptation is the new Mass Rapid Transit (MRT) system. More precisely, it is argued that this infrastructural project is going to increase Jakarta's evacuation capacity, in particular in times of flood, as traffic congestion is one of the main problems for evacuation efforts. (Marfai et al. 2013: 70)

As mentioned above, Jakarta not only has to deal with floods resulting from excessive rainfall upstream or in the city itself, but also has to address the growing threats from tidal flooding and sea level rise. Corresponding measures include projects for the planting of mangrove trees in the bay area (World Bank & Government DKI Jakarta 2011: 28ff). But by far the largest and most ambitious structural project addressing these threats constitutes the plan to construct a giant offshore sea wall as part of the National Capital Integrated Coastal Development Master Plan (NCICD). The NCICD Master Plan (2014) states that this ambitious undertaking builds on the insight that improving existing sea dikes, river dikes and pumping systems is simply not able to protect Jakarta's coastal area from floods from the sea in the long run. Since urgent action is required, NCICD also states short-term measures, which includes strengthening the existing coastal defence system, piped water supply in order to lower the land subsidence rate, and measures to improve the water quality in Jakarta's waterways. In the long run, the plan is to protect the North of Jakarta against flooding from the sea by closing

off certain parts of the bay with a giant offshore sea wall. Thereby, huge pumping stations ensure that the created retention basin remains at a low level, allowing a natural water flow coming from the rivers even through low lying areas. These protective measures go hand in hand with integrated plans to reclaim land for seaward urban development. More precisely, the plan is to create a new city district for more than 1.5 million people in and around the retention basin, including a new central business district and residential areas, as well as major infrastructure, such as highways or a port expansion. (NCICD 2014: 11ff)

Table 7.1 Overview of main structural policies addressing climate-related hazards

Structural Policy	Climate-related hazard(s)
Dredging initiatives	Tidal and river flooding
East Flood Canal construction	River flooding
Giant sea wall construction	Tidal and river flooding, sea level rise
Mangrove planting	Tidal flooding and sea level rise
MRT and road infrastructure (evacuation)	Tidal and river flooding
Piped water supply	Tidal and river flooding, sea level rise
Polder pumping system expansion	Tidal and river flooding, sea level rise
Solid waste and waste water management	Tidal and river flooding
Strengthening existing coastal defence	Tidal flooding and sea level rise

7.1.2 Non-structural policies

The NCICD Master Plan also includes the relocation of local poor communities in informal settlements along the seashore (NCICD 2014: 99f). Such relocation measures are already undertaken in respect to informal communities along the rivers in the form of a large-scale resettlement programme. This programme combines the provision of public housing with the demolition of informal settlements along the riversides in order to be able to implement flood reduction measures and to subsequently lower the risks from flooding. (Parikesit & Rikang 2015; BAPPEDA 2013: 8; Marfai et al. 2013: 72) An equitable access to decent and affordable housing is among the city's main long-term policy targets (Government DKI Jakarta & BAPPEDA 2012a: V 1ff). Related to this is also spatial planning. Jakarta's 2030 Spatial Plan (RTRW) states that climate change adaptation and mitigation are integrated in the city's spatial planning in order to anticipate climate change impacts and the increased risk of disasters (Government DKI Jakarta & BAPPEDA 2012: V 8). In this regard, central planning aspects include the mapping of Jakarta's disaster prone areas in order to inform

disaster risk reduction efforts. Furthermore, when it comes to adaptation, a key aspect is the provision of space for water (open blue space) in order to anticipate increasing rainfall intensity. The utilisation of areas prone to climate-related hazards is to be directed towards activities with high adaptability. What is more, the city aims to increase the quality and quantity of green open space, green roofs and green walls as a means of climate change mitigation and to improve its urban ecological balance. It is worth noting that disaster risk reduction is mentioned as an explicit policy goal in the RTRW, which is to be achieved mainly through means of infrastructure, in particular for flood control. Besides, the objective to integrate water management systems with upstream areas is stated. (Government DKI Jakarta & BAPPEDA 2012: Article 5e; 6(5,6,8); 11(1,3); 12(2); 14(1,2,3)) The latter point is in fact a central part of Jakarta's most recent river management strategy, which is themed around "one river, one plan, one management" (DRD 2014: 8). Increased development coordination and integration with the neighbouring provinces is also stated as a long-term policy goal. In fact, the RPJPD states that it is important that the city and its surrounding areas are perceived as one ecosystem. (Government DKI Jakarta & BAPPEDA 2012a: V 9)

Other important non-structural measures include a flood early warning system (Dutch Water Sector 2013; World Bank & Government DKI Jakarta 2011: 33; Marfai et al. 2013: 73); and community awareness campaigns, about issues such as domestic waste and flooding, as well as community preparedness programmes (Marfai et al. 2013: 74; World Bank 2010: 14). The latter link to the city's objective to increase the capacities of communities for disaster management, climate change adaptation and early warning (Government DKI Jakarta & BAPPEDA 2012a: V 9).

Table 7.2 Overview of main non-structural policies addressing climate-related hazards

Non-Structural Policy	Climate-related Hazard(s)
Community awareness programmes	Tidal and river flooding
Community preparedness programmes	Tidal and river flooding, sea-level rise
Flood early warning system	River flooding (from upstream)
Relocation of informal settlements to public housing	Tidal and river flooding
Spatial planning – increase in open green and blue space; risk zoning;...	Tidal and river flooding, sea level rise
Water management and development coordination with surrounding provinces	River flooding

7.2 Resilience thinking in policy documents analysed

When it comes to resilience in the policy documents themselves, it is essential to point out that the term (urban) resilience is mentioned only in one instance: RPJPD states resilience to climate change impacts among several other aspects that are regarded important for achieving the vision of the city's environmental balance and carrying capacity of its natural environment (see Government DKI Jakarta & BAPPEDA 2012a: 2f). As the expert from the Jakarta Research Council explained, that derives from the fact that up to now resilience is only used as a central concept in one policy document, namely in Indonesia's most recent Medium-Term National Development Plan 2015-2019 (RPJMN) (Annex IIIe). Here, building climate and disaster resilient cities is explicitly stated as a central element of Indonesia's urban development strategy (BAPPENAS 2015: 6-43(3)). Surprisingly, however, the term (urban) resilience does not show up in policy documents at the Jakarta provincial level, apart from the minor instance mentioned above. This finding is contrary to expectations, as Jakarta participates in the UNISDR Making Cities Resilient Campaign (UNSIDR 2015: 12). Nevertheless, the expert interviews revealed that the city uses the concept of resilience already as part of visions and within planning processes (Annex III). Therefore, it is clear that resilience already guides Jakarta's approach to climate-related hazards, even though it is not yet featured explicitly in the policy documents analysed. Besides, the respondent from CED DRD also pointed out that Jakarta's public actors are commencing the process of bringing resilience down to a more practical level at the time of writing (Annex IIIe).

Since resilience to climate-related hazards is part of the vision that is to be achieved through means of policies, it is reasonable to say that the current policy mix constitutes Jakarta's approach to promote its climate-resilience. That is why, when it comes to investigating resilience thinking, the policy document analysis and resulting outline of the current policy approach make it possible to derive an impression of the factors that are regarded important for building the city's resilience to climate-related hazards. But, it does not allow deeper insights, most importantly because the RPJPD does not specify what is actually meant by resilience, while other terms like sustainability are defined in the document (Government DKI Jakarta & BAPPEDA 2012a: Iff). This illustrates that resilience does not enjoy a prominent position in the RPJPD development plan. In this regard one has to highlight that the RPJPD (2012a) explains that the city's high vulnerability to climate change is linked to its poor communities and that climate change may further increase urban poverty. Examples of aspects that aim to address poverty in the policy direction laid out in the document are

equitable access to education, food security and inclusive urban growth. (Government DKI Jakarta & BAPPEDA 2012a: V 4ff) This suggests that poverty reduction is also among the factors that are regarded important for improving Jakarta's climate resilience, which is not explicit in the policy overview above.

7.3 Understanding of resilience by public policy actors interviewed

As mentioned above, five expert interviews with high-level public officials from four public policy actors were conducted in order to gain insights about their understanding of resilience. More precisely, two executive officials from KLHK and one high-level representative from each BNPB, BAPPEDA and DRD were interviewed. Further details on the structure of the interview guideline employed and the development of the related sets of questions are provided in section two of chapter two. The interview guideline itself is listed in Annex II. Since each expert was familiar with the concept of resilience and aware about climate change impacts, the interviews provided valuable insights about the understanding of resilience of their respective organisations. Following, central insights provided in the course of each interview are presented in a summarised manner (from national to provincial level).

7.3.1 Directorate General for Climate Change (DGCC) of the Ministry of Environment and Forestry (KLHK)

Two officials from DGCC KLHK were interviewed. The second interview emerged spontaneously and was initiated by the first respondent in order to talk in more detail about climate resilience-related projects. Since it turned out that the second interview shed additional light on the understanding of resilience by DGCC KLHK, in part clarifying underlying assumptions, these aspects of the second interview are summarised below separately.

7.3.1.1 Summary of the first interview with a high-level representative of DGCC

According to the first respondent, DGCC officially defines urban resilience as the capacity of a city to “adapt and survive” in response to an “external force”. This requires the ability to “anticipate and manage the probability of future hazards”, and to adapt and cope with an “unexpected phenomenon”. It was further pointed out that resilience is about managing the “threshold capacity” of the urban environment to support the population. (Annex IIIa)

The first interviewee also stated that being resilient goes beyond maintaining stability, as the latter is based on maintaining “historical pathways”, which is regarded as the “minimum”.

Resilience, on the contrary, is “above stability” as it is about “anticipating, coping and adapting to unexpected future events”. Since disaster risk management is about understanding the risk based on historical experiences, resilience goes further than disaster risk management, as the respondent explained. Building resilience implies a “learning process” in addition to managing risks so that negative hazard impacts are minimised and at best avoided completely. The first interviewee indicated that the Indonesian language is very rich in potential terms for resilience; the term mainly used by DGCC is *ketahanan*. In addition, *apasitas untuk pertahanan*, i.e. capacity for defence, are sometimes also used. (Annex IIIa)

Regarding resilience factors, the first respondent highlighted that urban infrastructure has to be constructed in a resilient way. Furthermore, she regards a “wise management of the ecosystem” to contribute to the city’s resilience. It is important to recognize that the city depends upon ecosystem services from outside its boundaries. In accordance with a concern for ecosystem services, the interviewee indicated that biodiversity is a resilience factor and that an increased level of “biodiversity is one positive outcome of managing urban resilience”. In relation to the social side, she underlined that promoting resilience in terms of capacity building needs to take the differences among city’s inhabitants into consideration: “Everyone has a different adaptive capacity to the environment or they need to cope in a different way.” In this respect, income distribution plays a role, as “higher income groups and the poor have different manners to cope with unexpected risks”. (Annex IIIa)

When it comes to weather-related hazards in the city of Jakarta, she explained that water management infrastructure is a very important resilience factor. The flooding problem links to land use in the upstream areas and its corresponding impacts on the level of water runoff. “Flooding will be more often if the upstream land use is not managed in a proper way.” She also mentioned that the communities in Jakarta’s informal settlements along the rivers have to be trained in environmental friendly ways of living so that they can become “partners of the government in managing the river, instead of the disturbance”. It is further clear to the first respondent that climate change will impact Jakarta in many ways, particularly in terms of flooding, sea level rise, availability of drinking water, or water-born diseases. (Annex IIIa)

On a practical level, she pointed out that DGCC has developed a resilience map of all Indonesian cities and villages, which indicated their respective adaptive capacity to climate change. This helps to prioritise DGCC’s regional activities, she added. (Annex IIIa)

7.3.1.2 Summary of key additional points mentioned by the second interviewee from DGCC

The second respondent, however, acknowledged that resilience is mainly used so far in terms of a vision in the form of a national goal and that the index mentioned by the first respondent only captures vulnerability. In this regard, the second representative of DGCC mentioned that resilience could be regarded as the positive flipside of vulnerability: “Vulnerability is the negative. Resilience is the positive.” Yet, at the same time he stressed that resilience is a more complex concept, of which the measurement requires indicators in addition to those captured in the vulnerability index. “But many vulnerability indicators can be used for that.” He further mentioned that DGCC currently discusses how to translate the concept of resilience into practice and is in the drafting process of a list of resilience criteria. (Annex IIb)

7.3.2 National Agency for Disaster Risk Management (BNPB)

The expert from BNPB stated that his organisation officially considers resilience as the capacity to anticipate, protect and to “bounce back better” after a disaster. Resilience further encompasses the ability to “live in harmony with hazards”, in particular when exposure cannot be reduced. (Annex IIIc)

According to the interviewee, BNPB regards community resilience to imply five components: easy access to information, capacity in anticipation, protective measures, and the capability to bounce back. “Disaster risk management is a tool to achieve resilience”. Since “disasters are very dynamic”, being resilient is not about maintaining stability, as the latter “is something static”. He added that BNPB aims to combine disaster risk reduction with climate change adaptation, especially in respect to hydrological disasters. BNPB uses the Indonesian term *ketangguhan* for resilience. (Annex IIIc)

When it comes to resilience factors, the respondent stated that infrastructure is an important determinant of urban resilience, such as in terms of evacuation routes. Moreover, he highlighted that “it is impossible to become resilient if the ecosystem is not managed well”. Promoting resilience is further a long-term process, whereby social and cultural aspects are key components. Indeed, he explained that “structural measures are easier” compared to promoting resilience in the social realm. The latter, more difficult measures, for example, aim to enhance the capacity to live in harmony or to educate communities about ecosystems. But, “the social is more important than structural measures.” According to the respondent, resilience also links to income distribution, as resource constraints were clearly the main reason why the poor tended to live in flood-prone areas. (Annex IIIc)

He explained that Jakarta is not yet resilient to flooding because of a lack of adequate

infrastructure. Since the beginning of this decade, however, the provincial government aims to address the flooding problem with a particular emphasis on infrastructure. As a result, flooding is about to decrease. But, at the same time he stressed that Jakarta is not doing well in terms of ecosystems and biodiversity, because “the environment’s carrying capacity is already surpassed”. The share of green and blue areas in Jakarta is far too small. In this regard, he mentioned that possible solutions include bioengineering, such as rainwater infiltration wells, in order to reduce the rate of land subsidence. Besides, he noted that it is also important to conserve the green and blue space that is still there. Related to this, the interviewee explained that the flooding in Jakarta is strongly linked to ecosystem services upstream. Indeed, he stressed that the “water fluctuation level in the Ciliwung River is very extreme” because of the low water absorption capacity of the land in the upstream areas. When it comes to the informal settlements downstream, he explained that relocation measures often prove to be difficult because of a low availability of land for housing, budget constraints or simply because people do not want to be relocated, as their livelihoods are linked to the river and due to the proximity of their home to their workplace. In such cases, the respondent emphasised that establishing the capacity to live in harmony with the hazard is important for building community resilience. BNPB’s work shows that communities in these areas of Jakarta have already developed aspects of such a living in harmony strategy: houses are constructed with two levels and belongings are moved to the upper floor during the most intense months of the rainy season. Another aspect of their living in harmony strategy is a flood warning system based on the mosque crier technique. (Annex IIIc)

On a practical level, the respondent mentioned that it is important to bear in mind that strategies to promote resilience are context dependent. He added that the communities in these areas are very much aware of the risks; they are even able to anticipate when the flooding is most likely to occur. Finally, he noted that climate change impacts are already felt in Jakarta, as rainfall patterns have already changed in terms of more frequent heavier rain and a shifting rainy season. (Annex IIIc)

7.3.3 Provincial Planning and Development Agency (BAPPEDA)

According to the interviewee, BAPPEDA defines urban resilience as the capacity of a city to “overcome” hazard-related problems “through a quick and proper response”. Resilience means “to be prepared, to have early warning and readiness to overcome after the hazard”. (Annex IIId)

She mentioned that BAPPEDA approaches building resilience in two ways, which are in practice often combined: On the one hand, in the form of disaster mitigation through means of building requirements for infrastructure. On the other hand, resilience is about “adaptation in the sense of dealing with the hazard”. The latter includes for example widening canals, she explained. The respondent further pointed out that resilience is not about maintaining stability since all aspects of life are constantly changing, and resilience means “to face the changes”. BAPPEDA uses the Indonesian term *ketahanan* for resilience, and a resilient city is known as *kota perketahanan* accordingly. (Annex IIId)

While the respondent regards Jakarta’s water management infrastructure as a central factor for the city’s resilience, she highlights that resilience also encompasses ecological aspects. This links to the fact that the rivers in the area have to be managed as “one river system”, and not divided among administrative units. She added that BAPPEDA “cannot only think about the city itself, but Jakarta has interdependencies with its surrounding cities”. That is why Jakarta needs integrated planning processes with its surrounding areas, including integration in terms of land use planning. The expert further mentioned that conservation measures and biodiversity are important resilience factors. Resilience is, however, not only seen to be concerned with physical features, but BAPPEDA defines resilience also “social, cultural and economically”. Accordingly, she considers collaborative action among neighbours, which is known as *gotong royong*, as an important aspect of community’s coping capacity that needs to be maintained and improved in the city’s efforts to build resilience. What is more, the provision of social housing and the relocation of the poor in informal settlements are part of Jakarta’s resilience strategy because the income distribution and poverty are of concern for the city’s resilience, she explained. (Annex IIId)

On a practical level, she stated that BAPPEDA’s planning processes are “framed around resilience”. In doing so, the concept of a resilient city has become embedded into the organisation’s daily work. In this respect, resilience thinking has had a significant impact on BAPPEDA’s work, according to the interviewee. Finally, she highlighted that it has become apparent that climate change already impacts Jakarta in the sense of higher tides in the Northern bay area, and that corresponding adaptation requires the construction of higher dikes. Furthermore, Jakarta’s rain patterns are already changing, which means that heavy rain shifts from the Southern hill area to the city centre itself. (Annex IIId)

7.3.4 Commission for Environment and Development (CED) of the Regional Research Council of Jakarta (DRD)

The interviewee explained that DRD comprises of several commissions and the concept of resilience has not yet been integrated explicitly in its work. However, he highlighted that resilience thinking underlies many of the Council's recommendations, in particular those of the Commission for Environment and Development (CED). (Annex IIIe)

According to the expert, the recommendations from CED are based on an understanding of resilience as the capacity of a system to “rebound with better condition rapidly” without a “deformation or rupture of the system”. This means that the system has “the ability to respond quickly, recover and rebuild in a better condition”. (Annex IIIe)

He explained that resilience, however, is not about simply rebounding to the original situation of the system. The ability to do so is rather the “minimum capacity that we have to develop”. A resilient city has the additional capacity to use the “opportunities to build better” that are created by unfortunate events or disasters in the form of “freely available room” for development. He emphasised that this also requires a change in mind-set to see unfortunate events as an opportunity to build better instead of a “setback”. The respondent from CED further noted that an important aspect of building urban resilience is “to enrich the whole disaster risk management cycle with the perspective of resilience”. In this respect, disaster risk management is often practiced in a way that one returns to business as usual shortly after the disaster, leading to a situation where “disasters happen again with larger scale, with larger impacts”. Resilience, on the contrary, means that the rebuilding phase considers lessons learned and takes future scenarios into account, so that future impacts are reduced, he said. As a result, resilience goes beyond disaster risk management – “it does not stop at disaster”. Furthermore, the respondent noted that, in the context of resilience, cities can be regarded to be in three different zones, namely a “comfort zone”, “okay zone” or a “sub-okay zone”. If disasters or unfortunate events are seen as an opportunity to improve resilience, “they can jump” to a better zone. According to the interviewee, it is reasonable to think about stability only in case the city is within the so-called comfort zone, but commonly resilience is used in the context of a vulnerable state. Moreover, the expert explained that urban resilience is seen to consist of three pillars: First, risk-sensitive spatial planning and zoning. The capacity to understand and assess risks is, therefore, regarded as a prerequisite for resilience. Likewise, spare capacity, for example in terms of space, is identified as a requirement for resilience. Second, “urban ecosystem restoration”, since ecosystem services greatly contribute to

resilience. Third, the respondent mentioned that financing resilient infrastructures within the context of “urban upgrading” is important. Building resilience on a greater level further includes community participation and economic regulations, he added. In Indonesian, CED uses the term *ketahanan* for resilience. (Annex IIIe)

With regards to resilience factors, the expert from CED mentioned that resilience has four components: “economic resilience”, “social resilience”, “institutional resilience” and “infrastructural resilience”, which comprises man-made as well as natural infrastructure. He highlighted that the latter is critical because “functioning ecosystems” are an important part of being resilient. Accordingly, one needs to manage to stay within the bearing capacity of the ecosystem in order to be sustainable. Furthermore, the respondent mentioned that “infrastructure is as an enabler” of resilience. In order to do so, it has to be “risk-proof” and address risks on a long-term planning horizon. When it comes to the social component of resilience, he stated that aspects such as gender, disability or income distribution play a central role. In this regard, he added that socio-economic aspects also determine discrete social spatial patterns of cities. This aspect has to be addressed also in terms of spatial planning, so that a “smooth social landscape” is created. He underlined this by explaining that people with a lower income tend to live in vulnerable areas because of their lack of resources and “empowerment”. (Annex IIIe)

The respondent noted that Jakarta’s resilience is limited because it lacks free space. Currently the city’s share of green space is only around 6 percent, even though it should be around 30 percent according to spatial planning. He added that the situation in the upstream areas is even getting worse, which increases the problem of flooding. According to the respondent, the underlying reasons for the problematic situation in Jakarta are “market-driven urban sprawling” and “lack of clear zoning”. Yet, he noted that it is not only about zoning, but the “intensity” of built-up areas also matters. This is illustrated by Jakarta’s skyscrapers, which do not need much land but extract an immense amount of groundwater. Furthermore, the respondent mentioned that the “mind-set” towards flooding of Jakarta’s inhabitants – from the laymen up to the policy makers – is problematic: Many people consider flooding as a normal part of life. In doing so, they stress that it only occurs during two months each year. The expert emphasised that this, however, neglects the fact that “the impact of flooding in Jakarta is escalating” in the sense that less rain creates more damage. Indeed, he stated that in 2007 around 300 millimetres of heavy rain triggered a disastrous citywide flood, and in 2013, only 250 millimetres resulted in a fourfold impact in terms of economic damage. (Annex IIIe)

The interviewee from CRD further mentioned that Jakarta's current policy approach boosts infrastructural measures, but from his point of view all policies take social aspects into account. This can for instance be seen in the city's relocation and social housing programme. According to the respondent, the city's policy actors are not discussing resilience on a practical level yet. For now, the city is focusing on disaster risk reduction. He explained that this is the case because policy actors are fully occupied by addressing several pressing issues, such as flooding or traffic jams. However, at the time of writing resilience training and corresponding capacity training has commenced at the city level. When it comes to climate change, he added that rising temperatures remain largely unseen by society due to the fact that people have the means to live with it comfortably due to air-conditioning, but it is a "creeping disaster". Finally, the respondent noted that he is a key consultant of the Indonesian Ministry of Public Works (KPUPR) in respect to resilience thinking. (Annex IIIe)

7.3.5 Overview of resilience definitions by public actors interviewed

The summaries above show that the policy actors interviewed have a more or less different understanding of resilience. Table 7.3 provides an overview of the respective policy actor's resilience definitions as communicated in the course of the interviews. There are, however, important similarities between the actor's resilience thinking. Most apparently, all interviewees expressed a concern for a similar set of resilience factors in the infrastructural, social and ecological realm. As the detailed analysis in chapter eight further reveals, there are also central similarities in the resilience perspectives underlying the somewhat different definitions outlined below.

Table 7.3 Overview of resilience definitions by public actors interviewed

Public policy actor	Resilience definition according to interviewee(s)	Indonesian term(s) for resilience
DGCC KHLK	Urban resilience is the capacity of a city to “adapt and survive under an external force”. It encompasses the ability “to anticipate and manage future probability of future hazards”, to adapt and cope with an “unexpected phenomenon” as well as learning processes, so that future impacts are minimized. Resilience may also be seen as a (rough) counterpart of vulnerability.	<i>Ketahanan / apaistas untuk pertahanan</i>
BNPB	Resilience is the capacity to anticipate, protect and to “bounce back better” after a disaster. It also includes the ability to “live in harmony with hazards”.	<i>Ketangguhan</i>
BAPPEDA	Urban resilience is the capacity of a city to “overcome” hazard-related problems “through a quick and proper response”. Resilience includes “preparedness, early warning and readiness to overcome after the hazard”.	<i>Ketahanan</i>
CED DRD	Resilience is the capacity of a system “to rebound better” in a rapid manner “without a deformation or rupture of the system”. This means that the system has “the ability to respond quickly, recover and rebuild in a better condition”.	<i>Ketahanan</i>

8 Analysis of Jakarta's resilience thinking from a complex adaptive systems perspective

This chapter consists of three sections. The first section analyses the resilience perspectives underlying the respective definitions of resilience by the public actors interviewed. Each definition is first discussed separately, followed by an analysis across interviews. The second section of this chapter discusses the conceptualisation of resilience in terms of the key factors that are considered important for promoting Jakarta's resilience to climate-related hazards, based on the current related policy approach, corresponding policy documents and insights provided in the course of the interviews. Finally, I reflect upon theoretical implications of the empirical findings of the present study for urban resilience theory in section three.

8.1 Varying resilience perspectives – all leaning towards engineering resilience

8.1.1 Case-by-case analysis of the policy actors' resilience perspectives

8.1.1.1 Directorate General for Climate Change (DGCC) of the Ministry of Environment and Forestry (KLHK)

One is able to infer that both respondents from DGCC regard resilience as the antonym of vulnerability. That derives from the fact that there is a close resemblance of the conveyed understanding of resilience with the definition of vulnerability by Wisner and colleagues (2004) stated above. Actually, the relationship between the two concepts is lively debated. It is widely held that vulnerability and resilience are related properties of a system, have a common concern about dealing with change and offer potential synergies as research concepts (Brown & Adger 2011: 109ff; Adger 2006: 268ff; Miller et al. 2010: 1ff). In fact, adaptive capacity is usually seen as a part of both, resilience (Folke et al. 2010: 6); and vulnerability (Brown & Adger 2011: 110). However, resilience is not simply the positive counterpart of vulnerability for two main reasons. First, resilience is concerned with the chance of shifting to alternative stability domains, whereas vulnerability usually refers to changes within the current state. Furthermore, resilience is an internal feature of a system, but vulnerability usually also includes an external aspect, namely exposure to disturbances. (Gallopín 2006: 301) Second, vulnerability is always portrayed as a negative feature of a system, whereas resilience, on the contrary, may be either desirable or undesirable. More precisely, as Walker et.al. explain (2006), it is possible that an undesirable state may be highly resilient, which means that it is difficult to transform to a desirable alternative state. Examples of such highly

resilient undesirable states may include desert ecosystems or oppressive authoritarian regimes. (Walker et al. 2006: 3) In other words, the definition of resilience as a counterpart of vulnerability by DGCC fails to reflect complex adaptive systems thinking and the corresponding existence of multiple stable states and critical thresholds. Furthermore, associating resilience with external forces neglects the fact that disturbances can also emerge within a system. Still, it is worth noting that the DGCC's focus on adaptive capacity implies dealing with change through adaption and self-organisation instead of controlling change. It is further important to point out that dealing with unexpected events was emphasised, which conveys an understanding of unpredictability. The first respondent also emphasised learning processes, in particular in the period following disasters, and the future-oriented nature of the concept, which implies dynamics of change in the form of reorganisation and renewal.

As a result, it is not possible to clearly assign the resilience perspective of DGCC to either ecological resilience or engineering resilience in a narrower sense. Thus, it is more adequate to regard the two opposing paradigms more as ends on a spectrum of resilience perspectives, with complex adaptive systems thinking at one end and steady systems thinking at the other end. In that case, the understanding of resilience of DGCC could be seen somewhere central but certainly still on the engineering resilience side, as it fails to reflect complex adaptive systems thinking and a corresponding concern for critical thresholds.

8.1.1.2 National Agency for Disaster Risk Management (BNPB)

The definition of resilience by BNPB clearly adheres to the notion of bouncing back better. Still, the respondent also made it clear that disasters are highly dynamic, thus resilience is not concerned with maintaining stability. Besides, the elaboration on the concept of living in harmony with hazards certainly links to adaptive capacity. However, even though the notion of 'bouncing back better' captures dynamics of change, especially in the form of reorganisation, it still cuts short on the possibility of irreversible changes due to shifts to alternative stable states. Put differently, the resilience perspective of BNPB does not reflect complex adaptive systems thinking, but rather implies a return to a new normal. Therefore, it clearly leans towards engineering resilience on the resilience paradigm spectrum.

8.1.1.3 Provincial Disaster Risk Management Agency Jakarta (BAPPEDA)

Even though the representative of BAPPEDA emphasised dynamics of constant change in all realms of urban systems, the demonstrated understanding of resilience does not explicitly

recognise the opportunities of renewal and reorganisation that are created by disturbances. That is also reflected in the terminology of ‘overcoming’ disasters, which conveys the image that disturbances are seen in the sense of setbacks. Thereby, it is rather the speed of recovery that is of concern instead of the amount of change the system can deal with. Hence, I would argue that resilience is seen as the capacity to return to business as usual or normality in a time efficient manner. Yet, it is important to point out that the responses indicate that this point of return is not a state of stability in a narrow sense, but constantly changing. BAPPEDA’s resilience perspective further builds on the insight that surprises or unexpected events are always possible, which conveys some sense of unpredictability. As a result, even though a clear notion of returning to pre-disturbance normality can be detected, BAPPEDA’s resilience thinking does not reflect engineering resilience in a narrow sense. However, it still leans towards engineering resilience to the relatively largest extent of all actors interviewed.

8.1.1.4 Commission for Environment and Development (CED) of the Regional Research Council of Jakarta (DRD)

Obviously, CED’s understanding of resilience adheres to the notion of bouncing back better and emphasises the key significance of the time factor. However, at the same time the interviewee highlighted the possibility of system collapse and deformation. What is more, the explanation that cities may be in different zones could be interpreted to refer to different stable states. However, the related statements conveyed the image that cities move from one zone to the other in the course of promoting resilience. Therefore, I would argue that these zones do not refer to alternative stable states but rather constitute something like resilience stages within the current state of the system. Accordingly, resilience is still understood in terms of returning to a better normal as fast as possible. Although one has to acknowledge that DRD’s resilience thinking features some elements of ecological resilience, such as dynamics of change in the form of reorganisation, it is therefore reasonable to state that it does not reflect complex adaptive systems thinking. As a result, on the resilience paradigm spectrum DRD’s resilience perspective is somewhere central but certainly still leans towards engineering resilience.

8.1.2 Overall analysis of the city’s resilience perspective – engineering resilience

Taken together, the resilience perspectives of all public actors interviewed do not reflect complex adaptive systems thinking. On a spectrum between ecological and engineering resilience thinking, it is clear that some responses are closer to the engineering resilience end

than others. In other words, one has to highlight that some elements go beyond a narrow engineering resilience perspective. Some experts, for instance, argued that dealing with surprises, learning and reorganisation are central aspects of being resilient, and others also stress constant change of all components of cities or the chance of system collapse. As such, with BAPPEDA being the only exception, basically all resilience perspectives more or less reflect that resilience is about the capacity to adapt to change rather than a narrow focus on controlling change. However, none of the responses acknowledges the possibility of radical shifts to fundamentally different stable states when crossing critical thresholds and the corresponding risk of irreversible undesirable impacts. As a result, all resilience perspectives lean towards engineering resilience thinking to a varying but significant degree.

Finally, it is important to mention that a common view amongst interviewees was that being resilient is not the same as ‘doing disaster risk management well’, and that some regard risk management as a central tool to promote resilience. Hence, the often-featured misperception that resilience equals “disaster risk management done well” does not prevail at the city level, at least not in a narrow sense. The expert from DRD further explicitly mentioned that humans are regarded as part of ecosystems, while several others expressed a concern for the carrying capacity of the environment. This indicates that there is some level of awareness about the fundamental linkages between social and ecological systems at the city level. I discuss this aspect in the next section on the conceptualisation of climate resilience further.

8.2 Concern for a wide range of factors for climate resilience with infrastructure in focus

As indicated above, there is wide agreement among all respondents in respect to the factors that are regarded to determine Jakarta’s climate resilience. That is why, it is possible to analyse the conceptualisation of climate resilience by the public actors interviewed across interviews and to combine this with the insights provided by the overview of the current policy approach and the corresponding policy document analysis.

As shown in chapter seven, Jakarta’s current policy approach focuses on infrastructural measures, especially water management infrastructure for flood control. Yet, all interviewees stressed that while infrastructural measures are at the moment at the forefront of the policy agenda, other factors, including ecological and social aspects, are also of concern and taken into account. When it comes to ecological factors, one is able to detect that the central role of human influences on the underlying ecological processes are at least partly reflected by

recognizing the importance to stall ground water extraction and the need for more open blue and green space. Indeed, several experts expressed their concerns that the carrying capacity of Jakarta has already been crossed. Furthermore, ecosystem services and the related role of biodiversity are regarded as important factors for Jakarta's resilience. In this regard, both, policy documents as well as the respondents, highlight the importance of services from ecosystems outside of the city, in particular with regards to water regulating services in the upland areas. However, despite the awareness about ecological factors, Jakarta's policy approach is not really about restoring or enhancing the sustained provision of ecosystem services, but tends to be about dealing with the consequences of lacking services. In contrast, such policies seeking to promote critical ecosystem services would for instance include the re-naturalisation (reforestation) and removing of sealing in the upstream areas in order to increase their natural water absorption and storage capacity. This indicates that the city's measures to promote its climate resilience are mainly viewed through the social lens, neglecting the fact that the ecological foundation of the city may not be able to sustain the current path of urban development any longer. As a result, even though some level of concern is there, it remains highly questionable that an integrated systems perspective underlies the city's resilience perspectives. Turning to social resilience factors, inequality in terms of vulnerability and the related issue of poverty are of concern to the policy approach and regarded as critical determinants of resilience by all respondents. In doing so, strengthening community responses and increasing their adaptive capacities is of concern. The most prominent policy in this regard is certainly the resettlement and social housing programme. However, it is worth mentioning that the current programme cuts short on addressing the underlying causes of vulnerability of the urban poor. For instance, Texier (2008) argues that this programme fails to meet the needs of the people because the costs for social housing are still beyond affordability for many. She further argues that awareness campaigns about flood risks are inadequate as her research indicates that the risk perception, especially in informal settlements, is already very high. (Texier 2008: 368f) Indeed, it is reasonable to say that the underlying issues of extreme rates of urbanisation (see Sagala et al. 2013: 15); and income inequality are not fully addressed in the contemporary policy approach. A greater recognition of social determinants of resilience could for example include policies to reduce the prevailing inequality through means of taxes and subsidies for the poor. Additionally, it could include measures to damper inner-city migration so that pressure on the city centre is reduced subsequently.

An analysis of the adequacy of the policy approach certainly goes far beyond the scope of the present thesis. The brief discussion above, however, reveals that even though a wide range of factors within the infrastructural, social and ecological realm are captured in the city's resilience thinking, the latter two are only reflected to a limited extent in the current policy approach to climate-related hazards. Indeed, the lack of policy initiatives or at least intentions to restore and improve critical ecosystem services in the surrounding region is striking. In the same sense, Sagala et.al. (2013) conclude that the city's policy approach with regards to flooding is too structural, neglecting the social causes of its high vulnerability (Sagala et al. 2013: 12ff). As a result, it is reasonable to assume that even though awareness about these factors is there, there is a lack of understanding about their significant influence on the climate resilience of the city.

8.3 Reflection about theoretical implications of the empirical findings for urban resilience theory

The findings of this study have also theoretical implications. Most prominently, the findings reveal that elements of an ecological resilience perspective can be featured in resilience thinking even though resilience is not understood as a feature of complex adaptive systems and leans towards engineering resilience. This greatly illustrates the flexibility of the concept. An implication of this may be to develop an interdisciplinary resilience theory framework that adheres to complex adaptive systems thinking, while allowing at the same time a significant degree of flexibility in order to serve as a bridging concept between different fields of science and corresponding distinct approaches to urban resilience. Otherwise, implications of central resilience aspects, such as non-equilibrium, critical thresholds and the possibility of irreversible change, on policies as well as the wider institutional context get lost. Put differently, resilience runs the risk of being reduced to a concept that fits within a worldview that neglects the fundamental linkages between ecological and social systems and their complex nature to a great extent. Related to this, one needs to highlight that a central aspect of resilience as a feature of complex adaptive systems is that it reveals the opportunity and or need to shift to an alternative development pathway in case the current trajectory proves to be undesirable, for example in terms of sustainability. I would argue that this is of particularly relevance to the policy level of megacities, as enormous urban living spaces constitute an immense challenge for sustainability. In short, the findings of the present study suggest that it would be useful to develop an overarching resilience theory framework that is based on an

ecological resilience paradigm and encourages the combination of theoretical insights from different resilience approaches, in particular between social sciences and ecology.

Furthermore, the study reveals a discrepancy between the resilience conceptualisation of policy developers and the actual policy approach. This calls for further theories to better understand the science-policy interface between urban resilience frameworks and urban policies. In other words, further knowledge about the actual guidance and implications of the concept of urban resilience on policies is needed. Linked to this is the investigation of institutional challenges for complex adaptive systems thinking within the context of multilevel urban governance.

9 Limitations

Before drawing final conclusions, one needs to acknowledge two areas of limitations of the present study.

First, it is important to mention that language barriers led to limitations in the depth of the investigation. On the one hand, in almost every interview language was an issue. At some points I had the impression that the interviewees found it difficult to find the right words in English. In return, this discouraged me in probing. On the other hand, some respondents felt more comfortable to communicate in English when having a copy of the interview guideline and following the questions in the order suggested. In my opinion, this led to some loss in flexibility in the conversations. Therefore, I would suggest that further research and a deeper analysis requires either proficiency in Indonesian or professional interpretation.

Second, one has to note that the generalizability of the results is limited. That derives from the fact that not all of Jakarta's policy actors were interviewed, hence it is possible that other policy actors understand resilience differently. Not included in the sample among the actors identified to be concerned with climate-related hazards in Jakarta are KPUPR, BPBD and BPLHD. Even though all respondents indicated that their definition of resilience confirms to the official point of view of their organisation or at least unit, it is important to bear in mind that it is not necessarily the case that the resilience understanding of all public officials within the respective public body actually adheres to this official way of resilience thinking. Moreover, it must be born in mind that the findings present only a snapshot of resilience thinking at the city level, which may change in the course of upcoming trainings. Accordingly, the results of the present study are limited in respect to their generalizability.

10 Conclusions

The aim of the present thesis was to investigate and analyse the urban climate resilience thinking at Jakarta's policy level with respect to climate-related hazards. Surprisingly, the concept of resilience does not really show up in the city's policy documents. However, the findings of the study show that urban resilience is already used in terms of a vision for planning processes. Correspondingly, all interviewees from key public policy actors were familiar with the concept of resilience and provided important insights about the ways in which urban resilience has been taken up to guide Jakarta's public policy approach to climate-related hazards. The analysis of policy documents and the corresponding current policy approach further enabled insights about the conceptualisation of resilience at the city level. The study confirmed that resilience is a flexible concept, as elements of different schools of thought are combined in the resilience thinking at Jakarta's policy level. While all policy actors interviewed define resilience somewhat differently, a detailed analysis clearly revealed that all perspectives lean towards engineering resilience thinking to a varying but significant degree. Thus, it becomes apparent that the exposed paradigm underlying the resilience thinking fails to account for the existence of fundamentally different stable states, critical thresholds and the chance of irreversibility. In other words, the findings suggest that the resilience thinking behind the efforts to promote Jakarta's climate resilience of the policy actors interviewed is based on an inadequate perspective on urban resilience. Even though adaptation and learning are regarded as important aspects for Jakarta's climate resilience, there is a distinct emphasis on bouncing back better, either explicitly or implicitly. Despite the fact that dynamics of change and unpredictability are acknowledged, it seems that resilience is still concerned with the ability to return to a "new normal" state following a disturbance. Indeed, it is reasonable to conclude that the identified resilience thinking implies a focus on maintaining the city's current development trajectories, mainly through means of structural policies, irrespective of the striking evidence about the escalating human-driven degradation of its ecological foundation in terms of a loss in critical ecosystem services. According to the public policy actors interviewed, social processes are central factors for Jakarta's climate resilience, in particular urban poverty and inequality. Taking a look at the current policy approach, however, suggests that the policy mix falls somewhat short in addressing the underlying social processes that exacerbate the vulnerability of the city to climate-related hazards. Another important finding is that climate change impacts tend to be associated solely

with increased level of flooding, which is problematic as it neglects threats from other climate-related hazards, in particular heatwaves.

In light of the above, the results confirm, in essence, the hypothesis that Jakarta's resilience thinking is based on engineering resilience. Yet, one has to acknowledge that important aspects of the resilience thinking of key policy actors certainly go beyond a narrow engineering resilience perspective, as there is no narrow focus on controlling change. On the contrary, some level of unpredictability, dynamics of change and the importance of adaptability are acknowledged. But, the investigation indicates that there is no concern for identifying critical thresholds and no awareness about the chance of irreversible radical shifts to undesirable alternative states. Especially when considering the striking human-driven loss in critical ecosystem services and Jakarta's high level of vulnerability to climate change, such a perspective would, however, provide fruitful in guiding public policy seeking to promote Jakarta's climate resilience. What is more, the present study finds that structural policies, especially in terms of technological measures for flood control, still dominate the policy agenda.

It goes beyond doubt that the insights provided by the present study contribute significantly to research on climate-related hazards in Jakarta. Additionally, it may also inform policy development processes at the city level, as the findings suggest that some level of rethinking by the public policy actors interviewed towards resilience as a feature of complex adaptive systems is required, so that important aspects such as critical thresholds become of concern. Since all four public policy actors interviewed base their work on somewhat varying definitions of resilience, I would further suggest to introduce some level of coordination with regards to resilience thinking in the form of developing a common resilience perspective to increase the level of consistency in guiding policy efforts to promote Jakarta's climate resilience. Since not all relevant public policy actors were included in the sample, further studies on the resilience thinking behind Jakarta's policy approach are encouraged.

Moreover, the theoretical discussion in the present thesis provides a valuable overview about central aspects of the most prominent urban resilience approaches and emphasises the need to develop an overarching interdisciplinary resilience framework based on complex adaptive systems thinking. Besides, this is the first study to analyse climate resilience thinking at an urban policy level. As such, it may also serve as a foundation for future research with a similar focus.

Finally, it is important to highlight that some level of discrepancy between the conceptualisation of resilience by policy actors and the actual policy approach illustrates the importance of the politics dimension for urban policy development. That derives from the fact that ultimately governments decide about policies, while scientific concepts, such as resilience, may provide guidance in doing so. Therefore, political interests may account for some of the exposed differences between resilience thinking and the current policy approach. Politics, however, may also have influenced in what ways public actors have taken up resilience in the first place. Consequently, it is essential to bear in mind that in the context of policy, resilience is not an apolitical concept. Being limited to policy, this study leaves these political aspects open for further research. Indeed, it would be interesting to explore and theorize in what ways the concept of resilience meets the demands of urban policy makers in times of climate change.

11 References

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12 Annex I

Overview of policy documents analysed

Policy document		Abbreviation	Year
DKI Jakarta Long Term Development Plan 2005-2025	Provincial Regulation 6/2012 [in Indonesian]	RPJPD	2012
National Capital Integrated Coastal Development Master Plan		NCICD	2014
DKI Jakarta Spatial Plan 2030	Provincial Regulation 1/2012 [in Indonesian]	RTRW	2012
Urban Water Management in Jakarta	Presentation by BAPPEDA Infrastructure Division		2013
National Medium-Term Development Plan 2015-2019	<i>Analysis limited to Book I and paragraphs on resilience</i> [in Indonesian]	RPJMN	2015
Towards Sustainable Green Growth Jakarta	Presentation by DRD Commission on Environment and Development (includes integrated water management)		2014

13 Annex II

Interview guideline for theme-structured expert interviews with high-level public policy officials

1. *Opening question:* Can you tell me about the weather-related hazards that Jakarta faces today?

Perception of a resilient city

2. How do you define resilience?
 - 2.1. What term(s) are you using for resilience in Bahasa Indonesia?
 - 2.2. Does your organisation see resilience the same way you do?
3. What do you think does it mean for a city to be resilient?
 - 3.1. What do you relate to a resilient city?
4. Do you think there is a difference between maintaining stability and being resilient?
5. What differs between disaster risk management done well and being resilient?

Conceptualisation of urban resilience

6. How do you think resilience relates to urban infrastructure?
 - 6.1. What role does the construction of water management infrastructure for the resilience of Jakarta play?
7. How do you think resilience relates to the ecosystem in and around a city?
 - 7.1. How do you think does Jakarta's resilience relate to ecosystem services and biodiversity?
 - 7.2. How do think Jakarta's resilience to flooding is connected to the land-use upstream the rivers?
8. How do you think resilience relates to social processes?
 - 8.1. What role does the income distribution play?
 - 8.2. What role do informal settlements along the riversides and seashore play for Jakarta's resilience to weather-related hazards?

On a policy/practical level

9. Can you tell me about how you decided to work with resilience?
 - 9.1. How do you think resilience thinking has changed your work?
 - 9.2. What do you think does it add to your work?
10. What are concrete steps that your organisation is taking in order to increase Jakarta's resilience to weather-related hazards?

Climate Change

11. Climate change is an important issue. How do you think climate change will affect the issues we just talked about?

14 Annex III

Interview transcripts of theme-structured expert interviews with high-level public officials from relevant public policy actors concerned with Jakarta's climate resilience

(a): Directorate General for Climate Change (DGCC) of the Indonesian Ministry of Environment and Forestry (KHLK) [I]

1 A: What are the weather-related hazards that Jakarta faces today?

2 B: Jakarta faces several weather-related hazards because of population-related activities, such as transportation
3 but also river environmental-related challenges and from the ocean. These are the factors that have to be
4 tackled in the future. That is basically population-based and the environmental condition connected to the other
5 cities surrounding Jakarta, as well as upland area, Bogor, Puncak, Cianjur, which come down to the ocean.
6 There are so many weather and environment related challenges that we need to take that affect health and also
7 the livelihood of the people in Jakarta.

8 A: How do you define resilience?

9 B: Resilience is the adaptive capacity of a city to an external force. That is how I understand what resilience is.
10 How the city can adapt, survive under external force as well as internal capacity to survive to the problem.

11 A: What terms are you using for resilience in Bahasa Indonesia?

12 B: Ketahanan. Sometimes we also use the term kapasitas untuk pertahanan (i.e. Capacity for defence). Or also
13 Klenting. Bahasa Indonesia is very rich in words and meaning. It depends on what context are we using.

14 A: But the main word is Ketahanan?

15 B: Yes, Ketahanan. But Ketahanan sometimes also means secure / security. Resilience is ketahanan or kapasitas
16 untuk bertahan.

17 A: Okay, that is very good. Because there are so many words, that is why I am asking. And you define resilience
18 as the capacity to adapt - is this your personal understanding of resilience or is it the same with the Ministry of
19 Environment and Forestry?

20 B: I think this is my personal understanding.

21 A: And is it the same definition that is used in the climate change division.

22 B: Yes, I think so.

23 A: What do you think does it mean for a city to be resilient?

24 B: The city needs to be able to understand the threshold capacity. The threshold capacity to support the
25 population, to support the activities. Not only support but also to manage the carrying capacity of the city to
26 make everybody live in harmony, beyond the per capita income.

27 A: What do you relate to a city that is resilient?

28 B: What do you mean?

29 A: How is the city characterised - what are the features of the city?

30 B: A city is resilient when it's inhabitants are happy. There is no flood there are affecting very bad. There is no
31 hazard-related pollution that can effect now or in the future the health problem. We can anticipate all the hazard-
32 related based on current condition. So, this kind of anticipation and also managing the probability of future
33 hazards or future risks. How to anticipate the risk.

34 A: Do you think there is a difference between maintaining stability and being resilient?

35 B: Yes, I think there is a big difference. Maintaining stability is based on the historical conditions, historical
36 pathways. We need to maintain that, at least at the minimum. Stability is the minimum. But being resilient is
37 above the stability. Being resilient requires anticipation and the ability to cope and be warning as an early
38 capacity to adopt when there is a sudden unexpected risk and unexpected phenomenon.

39 A: So, unexpected events are very important?

40 B: Yes. That is the difference between maintaining stability, is the standard. While being resilient is above the
41 standard. That is what the city is supposed to be.

42 A: What differs between disaster risk management done well and being resilient?

43 B: Disaster risk management is that we understand the risk based on the history will happen like periodically.
44 That is disaster risk management. We have to understand what like flood in Jakarta happens every 5 years. That
45 needs to be anticipated and coped in a very well manner to minimise the impact. And being resilient is that we
46 have to be more than that. In addition to be able to manage the risk we also need to be able to have no impact at

all. So the impact is very minimal. And maybe we have to make sure that it does not happen again. No cost in terms of life - there is no tangible or intangible negative impact.

A: So it is also about learning - trying to avoid that the same things happen again?

B: Yes, it is a learning process.

A: How do you think does resilience relate to the infrastructure in a city?

B: It is very related. Urban infrastructure needs to be constructed in a way it will be resilient to the weather-related hazards. So one needs to invest - maybe need a lot of investment - in the infrastructure of resilient-related - Like how to do the building architecture, and also the surrounding river, river bay - which is very fragile or vulnerable to the weather-related hazards. So that is kind of which can accommodate a lot of people but also very friendly to the environment - that is the kind of the infrastructure that we need to think about to build. And also the road, transportation - how to design sewerages under the road. That is kind of the infrastructure that needs to be resilient. Maybe it is also about what kind of mass rapid transportation that is very friendly and also very convenient for people to use.

A: So, when you look at Jakarta. What role does the construction of water management infrastructure play for the resilience of the city?

B: This is very important. Because Jakarta is surrounded by ocean and there are also so many rivers going through the city. Jakarta is maybe like in some areas maybe like Netherland. So we have to build so many canalisation and maybe deepening the water. Managing the water is very important - it can be a source of future income if we use that water management for tourism or for other activity. I believe that there will be a lot benefits derived from these constructions.

A: How do you think resilience relates to the ecosystem in and around a city?

B: What do you mean?

A: The ecosystem in Jakarta - the ecosystem services - and in the surrounding area. How does this relate to resilience?

B: I think the ecosystem in Jakarta can be seen from the positive and negative side. The positive refers to for example if we use it in a very wise manner, the ecosystem can become a benefit for us. Like I said, water management, and the people - if we educate the people not to throw the rubbish, education of the people. Managing this is challenging - it is not an easy task. But it can be an investment that is good for the future so that we can manage ecosystem-based resilience programme in Jakarta. Because Jakarta has potential to manage the ecosystem-based very friendly.

A: And how does resilience relate to biodiversity?

B: In Jakarta?

A: Yes, in and around the city.

B: Maybe ecosystem services between Jakarta and upland area of Jakarta, like Bogor, Cianju, and also biodiversity. We can develop many mechanism: ecosystem service payment through fiscal policy for example or through other mechanism that can directly affect the ecosystem service and also biodiversity in the upper area of Jakarta as well as it can affect the low-land area of Jakarta. The upland and lowland ecosystem management is a must. It is already done - there are so many MOUs undertaken between the provinces and districts in Jakarta and the surrounding areas. How to monitor the progress and the scheme mechanism, and also how to enforce the system is a task that needs to be done to maintain the resilience.

A: Have I understood you correctly that biodiversity plays a role for resilience?

B: Yeah, biodiversity is one of the positive factors that will come if we manage the resilience of the city. For example, we will be able to understand which species or vegetation can adapt very well in conditions. And what kind of vegetation and also animal that can survive in Jakarta ecosystem or in the upland area. So, biodiversity is one of the factor that need to be considered if we are talking about resilience of the city.

A: So, you already mentioned Bogor. The land use in Bogor is connected to Jakarta?

B: Yes, not only Bogor. Bogor is 200 meter above sea level, Jakarta is below sea level. Cianjur is another high are, and over there is also Punja and Bandung. If the landscape in Bogor or Cianjur is not managed in a proper way, so land use, Jakarta will be affected problematically: flooding will be more often. Also especially during the high season, and due to other phenomena like climate change or other phenomena like the sea level rise - it will come in the same time - that will be disaster.

A: How does resilience relate to social processes?

B: Yes, social processes is one important thing, especially for cities like Jakarta with a very large population. Social processes need to be segregated based on level of education, livelihood activities and also stuff, from the house and also stuff from the neighbours. That is kind of the understanding that resilience needs to be undertaken from that fact. I think it is very related. Everyone has a different adaptive capacity to the environment or they need to cope in a different way. That is why we have to be able to manage what is the best way in their own uniqueness and in their own capacity to be resilient.

A: What role does the income distribution play?

106 B: Yes. Maybe a higher income group will have a different manner to cope with the disaster, to cope with the
 107 unexpected risk. But the poor will also have a different manner. So we have to be able to understand these
 108 differences. We have to differentiate. The general target is that the people within their own circumstances will
 109 be able to cope with this disasters or with this risks.

110 A: When we think about Jakarta - what role do the informal settlements along the riversides and seashore play
 111 for Jakarta's resilience?

112 B: I think to some extent the informal settlements. What do you mean by informal settlements?

113 A: The Kampung in the river basins and along the seashore.

114 B: I think the government of Jakarta has been dealing with this challenge. I think one of the challenges is how
 115 the settlements along the rivers need to be managed in a more environmental friendly way. Education and also
 116 through proper training. Proper knowledge needs to be given in periodical time so that they become partner of
 117 the government in managing the river. Instead of the disturbance.

118 A: Can you tell me how you decided to work with the concept of resilience?

119 B: Yes, we in here have what we call a resilience map. We map the resilience in all the regions in Indonesia.
 120 Based on this map of resilient cities. Adaptive capacity, resilience. We also have a pilot what we call is
 121 programme for climate village - Proklim, And these climate villages are kind of green villages. How to enhance
 122 adaptive capacity of the people so that they are not disturbing the environment. So we provide capacity of
 123 rescue and resource to utilise as much resource that very abundant in their area and how to process this resource
 124 to make it a source of income. Like processing jackfruit. With a lot of jackfruit we can drive through. And how
 125 to make herb medicine to become commercialised. Kind of this. So it will distract the attention to destroy the
 126 environment. Kind of that. Green village - Proklim - that kind of programme, which is based on the index of
 127 resilience. Next to Proklim we also have a programme called SIDIKS - system inventari index ketanahan - for
 128 all cities in Indonesia.

129 A: And before resilience was there - has your work changed since you used the concept of resilience in your
 130 work?

131 B: Yes, to some extent. We are now able to understand to prioritise where and what activities. That kind of
 132 prioritising of programme and activities in a particular area. And of course the impact is measurable. We have to
 133 be able to measure the impact. Therefore we use the index.

134 A: What are concrete steps - you mentioned already quite a few - like capacity building - you are undertaking to
 135 build the resilience of Jakarta?

136 B: Yes, for example we have already "Pinpoint" Jakarta as one of our study case for transportation hazard. And
 137 they claim that there is no moving from to allow emission transportation. And we have developed MRV system
 138 for them. Monitoring for low emission transportation - we check for verification of the low emission
 139 transportation. And we have also given them feedback that there is some emission factor that need to be
 140 corrected because of the different use of the factor emission. That is kind of the programme that we have
 141 undertaken in relation to weather emission related transportation.

142 A: So you are talking about mitigation. What about adaptation?

143 B: Yes, Jakarta is one of our priorities so far.

144 A: Now, you already mentioned climate change a few times. How do you think climate change will affect the
 145 weather-related hazards in Jakarta?

146 B: Yes, for example Seribu islands North of Jakarta will sink. We won't be able to call it Seribu anymore. That
 147 kind of influence. Flooding as well. And drought in the dry season - lack of drinking water, sanitation problems.
 148 Maybe even many viruses spreading, like flu buru. Many virus that are not very often found.

149 A: Okay. Thank you so much.

(b): Directorate General for Climate Change (DGCC) of the Indonesian Ministry of Environment and Forestry (KHLK) [II]

A: I am sorry but I have to improvise because I did not expect to have two interviews within the Ministry of Environment and Forestry.

B: That's okay.

A: So, you are also working with the concept of resilience.

B: Yes. Especially in the context of vulnerability. Because resilience is a national goal. The indicator, so far, we are still using vulnerability. Resilience is more complex.

A: How do you define resilience?

B: There are many factors. But as I mentioned before we still use vulnerability. Resilience is too complex. The concept, the definition you know that but how to get it into practice is another issue. We are working more than a year now with the practical issue we can achieve with our vulnerability data of course. Because so far we can "what we can risk now". But in the national action plan we use resilience. There are targets related to resilience, like ecosystem, economics and livelihood and special area. That's the focus of this national action plan. In practice we are now providing a vulnerability index now. We are developing now. We call it SIDIK, which stands for sistem informasi data indexical kerentanan.

A: In your opinion, what is the main difference between vulnerability and resilience?

B: It is just the way around - how you look at it. Vulnerability is the negative. Resilience is the positive. That's how I understand. But the indicators of course are very different. Some indicators is very difficult for us to get the information, the data. But in the future I think we already think about to develop this. Our regulation now also talking about vulnerability - Act No. 32/2009 - we use vulnerability as part of the climate change indicators. There are many articles - 10, 15 - you can check there.

A: You said resilience has more indicators than vulnerability. So it is more complex?

B: More complex, development. Governance - how can we measure governance? And then. But many vulnerability indicators can be used for that. But we need more, you know.

A: Do you think resilience requires a systems perspective. So looking at systems?

B: Yes, we are developing a system now. SIDIK is a system of roots. So I think we would develop the same system. This country is very big, so we need that system. If not, and then when we can finish with the indicator. Our basic issue is system - how can we develop a national system for adaptation measures. We started with vulnerability,

A: And, when we talk about resilience - what role do surprise or unexpected events play when we think about resilience?

B: What?

A: Unexpected - we do not know what is going to happen and suddenly there is an unexpected disaster.

B: You mean hazards?

A: Yes, unexpected hazards.

B: Hazards the part of this indicators - hazards will be part of this indicators. So, we talk about risk, ya. If you can suggest - I don't know - how can we link the risk and the resilience. We need that input. So far we have not talked about that yet. But we use risk by combining vulnerability and hazards. That system we are now ready already started. We still need to improve the system. You know that we have an online system now.

A: I did not know, no. What is it?

B: We call it ABANON - adaptasi.menlh.go.id. And that is when you can find on the right corner SIDIK online. That is the vulnerability index of all villages in Indonesia, accessible to everybody. With a still limited number of indicators. Because there are thousands of set of measurements not yet available in every single village. That is the problem. We need to expand this indicators in the future. Now only nine basic information related to the village like education, energy, access to the water, health facility, infrastructure and so and so on. You can that on our website.

A: And if I click on Jakarta. It will be...

B: You can see Jakarta.

A: The different Kampung.

B: Different colours and then different. In each village you can click and you will get the spider graph. That is what we hope can be used as a starting point for development intervention. Let's say you work for an Austrian funded agency and you have money to develop a special project in Indonesia, for example in Jogja. What kind of issue would you like to look at - agriculture, tourism?

A: At the moment I am interested in issues related to mega-urbanization - Jakarta.

B: What kind of indicator would you like to improve? What kind of sector would you like to improve.

A: Weather-related issues. Flooding.

B: Flooding. Flooding is the risk, hazards. What is the main issue related to flood that you would like to stress?

57 A: Human impacts on the increased level of flooding in terms of frequency and magnitude. So land use change
58 upstream and also the informal settlements along the riversides.

59 B: Okay. So you will evaluate the households. Individual or household? You will survey this?

60 A: I would love to but at the moment I am more on the policy side.

61 B: You need information. At least one or two villages you have to find as your pilot. So you can add to the
62 indicator we are developing now, related to your concepts. I think this very interesting now, maybe you have
63 drafted your thesis. Maybe we can adopt this methodology, this structure and we can put it in our system. As
64 you mention, the impact of humans on the level of risk.

65 A: That would be interesting and good to do. But my thesis has a policy focus for now. I am exploring how the
66 concept of resilience is used in public actors concerned with Jakarta. I have conducted interviews with
67 BAPPEDA, BNPB and the Jakarta Research Council. It is more about finding out how the concept of resilience
68 is used in and behind the policy approach. But I can link you to a flood resilience project between the IRC and
69 IIASA

70 B: IIASA - what is that?

71 A: International Institute for Applied Systems Analysis. They have collected data on resilience in for example
72 Bogor.

73 B: Yes please.

74 A: And in the climate change division - is someone already working with the concept of resilience or is it still
75 developing?

76 B: It is not yet discussed in detail. We know that resilience is our national goal - there are many you know in the
77 national action plan already there. Targets and so on. Sectoral related. How to translate this into practice is not
78 yet. We are still in the drafting process regarding the criteria for resilience. Once this is finished we can integrate
79 it into our SEDIK system. That is why if you have some input, let us know. Based on your findings - this is the
80 realistic and this the ideal condition that you propose. Why not. Before you go home. Homework.

81 B: Yes. I am happy to share whatever I find.

82 A: I am not your professor but I give you homework.

83 B: At the moment there is not talking about resilience here. But it in our draft we put resilience. Ministerial
84 Degree for mainstreaming adaptation into development. But how do we transfer it into real. How do we link
85 resilience and vulnerability. Theoretically this is okay but how can we put it into the system so everybody can
86 see their level of resilience. This is a resilient city - but what are the indicators for a resilient city? The threshold,
87 you know. We we talk about disaster - related to DRR. Now we are also with BNPB trying to develop a
88 convergence adaptation and DRR. How we translate into the system. The commitment is there, the indicators
89 related to DRR is vulnerability. Which is covering risk also. And the threshold we do not know. We need to
90 have a kind of threshold.

91 A: Threshold identification.

92 B: When we talk about disaster.

93 A: What word are you using in Bahasa Indonesia for resilience?

94 B: Could be Ketahanan. Could be Ketangohan. Tangu. Ketahanan. Resilienci - I think we use resilienci because
95 there is an Indonesian word resilienci but definition we adopt the internationals. What means resilienci.

96 A: So resilienci.

97 B: There is an Indonesian word resilienci but sometimes BNPB using Ketahanan or Ketangohan. Because more
98 on disaster they are using Ketangohan. In the national action plan Ketahanan.

99 A: So what is the difference between Ketangohan or Ketahanan?

100 B: That is strong in a. Strong. But similar. That is why we use resilienci. Tangu could be you know strong
101 endurance, could be power. In the vulnerability we have adaptive capacity. More specific indicator now. We
102 have vulnerability is related to exposure, sensitivity and then adaptive capacity. But what is resilience? There is
103 no standard yet. If you can show us, please.

104 A: Yes, there is no agreed standard yet.

105 B: Now I heard that the Rockefeller Foundation started to identify six items. We just discussed a few weeks ago
106 about this indicators, related to ecosystems. There are six indicators there. But we are still discussing about that,
107 that is why I cannot state that.

108 A: I know, it is specifically about urban areas. So, regarding the flooding problem in Jakarta. Maybe, what is
109 your opinion about the current policy approach? From the literature I had the impression that it is mainly about
110 infrastructure, for example construction the giant sea wall, dams, dikes. And I am missing a bit other aspects.

111 B: Maybe they talk about short-term. You know, making infrastructure is short-term. But when we change the
112 land-use it is long-term to mid-term. But it is a very critical point, how can we translate long-term indicator into
113 short-term indicator. To let them understand that what we should do is upstream land use, space management
114 and then. Related to development of course. Spatial planning, settlements, agriculture, water management,
115 hydrology issues. But again, what you read in the news is mostly short-term. But actually attitude building,

116 capacity building and knowledge of the people is there but maybe not published. It is difficult to translate the
 117 long-term into easiest way that can communicated, easy to understand.
 118 A: So, the social aspect is there?
 119 B: I think the programme is integrated, but again, publication is something else, news is something else.
 120 Because they only take some hot news.
 121 A: And you always see the informal settlements along the riverside.
 122 B: Yeah, they just take the picture only the victims. But why they are living there? Why? How long? What is the
 123 policy behind this? But now we need to cut this. But they already stay there a long long time.
 124 A: The rapid urbanization pushes them to the rivers.
 125 B: Yeah. And the enforcement is the basic issue. When the government cannot enforce strongly, there is social
 126 end you know. Very complex. But again that should be understood the issue and how to approach this step by
 127 step with not crossing the issue of human rights. You know.
 128 A: It is mainly the poverty why the people live there, right?
 129 B: Yeah, there is but again, not easy. Now Governor developed building. It is a good start, a good commitment.
 130 But again, they need more land. And relocation issues. How can we develop a consistent way to policy. Maybe
 131 this Governor very strong, but what about the next Governor? If the regulation is not put in place, and then it
 132 can be changed. Even now, the regulation is there but they cannot enforce fully. Because the situation is already
 133 complex. He worked so strong and then many protests, related to human rights. It is political also, part of the
 134 scheme. But I think we need that kind of strong system, not strong person, strong person is behind. But how can
 135 we develop a strong system so everybody. Attitudes, behavior - throwing litter everywhere. Because of
 136 education as well as awareness. People may be high educated, but awareness very low. They need kind of a
 137 figure, how can he reflect.
 138 A: You mentioned integrated systems. What do you mean by that?
 139 B: Yes, informations. If the Governor does not know exactly what is the main problem, and what is the problem
 140 behind this. By using the vulnerability index, we can see, and then we can put information and analyze in the
 141 vulnerability or resilience index in this area, for example. And then we know the right approach or the right
 142 programme, the right projects, for example. Whether moving to other places or just changing the way of
 143 thinking. I think that system as a tool for decision-making.
 144 A: Okay thank you. I will let you know in case I come back to Indonesia for research and I will share this
 145 findings.
 146 B: Thank you. I hope you have success for this.
 147 [off-record comment: In Indonesia the concern for climate change adaptation is less than for mitigation.]

(c): National Disaster Management Agency (BNPB)

A: So, can you tell me about the weather-related hazards that Jakarta faces today?

B: Yeah, I think weather-related disaster trend in Jakarta now increased. And the natural in Jakarta, this is more vulnerability. Because high population, many problem, like social, economic and other. So, vulnerability especially in the floodplain area. And so, every year many community or many village near the river occur flood. Last, I think 2014 flood in Jakarta this is total loss about five trillion rupiah. So we have the impact, economic losses, from since 2007 this is about five point eight until eight trillion rupiah. And then occur again in 2013 this is flooding, more bigger and then 2014 bigger again. And this year, 2015, this is flooding but more little than

A: 2014

B: Yeah, I think this is related about the rainfall. There is more little in 2015 than 2014. I think this is a complex problem. Especially in the North area, in the coastal, the land in Jakarta already subsidence. I think this is influenced by water exploitation and then the condition is more heavy, population and building, and then sea level is rising. Land use change, to become to influence - runoff more increasing. I think the carrying capacity in Jakarta environment is already passed. Yeah, I have many presentations about Jakarta. I will give. And powerpoint about how Jakarta, how about the problem in Jakarta flooding. And what is the policy and how to involve Government to tackling the flooding. So I think since Jokowi has Government in Jakarta they have in direction, especially dominant to infrastructure. So, I think this is a flooding in Jakarta is about to decrease. Because the river already more wide and many infrastructure, mitigation, dominant to in the river. So, weather-related hazard is in Jakarta more, more, vulnerability. Vulnerability in the flooding.

A: And, how do you define resilience?

B: Yeah, define resilience? Resilience is how do local community, they have to anticipate. They have to protecting them. Themselves protecting. And I think how they come to bounce back better. After the disaster they can go to bounce back better. And I think finally it is the living in harmony. Yeah, I think this is difficult - but all community in the floodplain, in the river in Jakarta, they all must be relocated. This is difficult because we local Government must be spend many apartment housing. But yeah, I think, available land for housing is limited. So, I think how to live in harmony with the floodplain. How to live in harmony with the river. I think many village and community in the floodplain already have living in harmony. Because they build the house with two floors. While December they know that the rainy season will increase. So they move all their peralatan rumah tangga [household appliances] to the higher floor. Yeah, so empty in the first floor. And is there flooding, they are in the second floor. The motor bicycle is moved to the street on the higher level. The have the system in traditional, like use the sound of mesjid [mosque] - this is the warning. And they have traditional early warning system like bamboo - the colour green, yellow and red. So, while the flooding in the yellow level, so what will they do they know then. So this is in many area - especially in the Chilliung river area - they have live in harmony.

A: Yeah, that sounds interesting. And you said to bounce back after the disaster?

B: Yeah, as you know, exactly while the flooding occurs the community they not want to give support from government. But the media provoke that this is disaster. Because this is every year and they know house is in the floodplain and they know when the flooding will occur. But from media Indonesia and local, this is a flooding this is oh my goodness.

A: And what word are you using in Bahasa Indonesia for resilience?

B: Ketangguhan [thoughtness]. Not Ketahanan. Yeah, ketangguhan.

A: Ketangguhan. And does your organisation see resilience the same way you do?

B: Yes. Because the BNPB mission is to build the community and national resilience to disaster.

A: Because sometimes the organisational and personal opinion is different - that is why I am asking.

B: Yes. yes.

A: So, what do you think does it mean for a city to be resilient?

B: Yeah, I think, we have five indicator of resilience. We can to define that the community has resilience if the have five factor. We have five factor to define the national and community resilience. [brings laptop] This is the vision of Indonesia to how to become community resilient. To become resilient a community have: The first, easy access to information. Easy to access information. The second, they have the anticipation. The third, they have to protection. The fourth, they have to adaptation. And the fifth is to bounce back.

A: Bounce back, okay.

B: Yes, so, our strategy how to achieve community resilience. Strategy BNPB: The first, we move community from the hazard. Then the second, the hazard must be far from community. The third, live in harmony with risk. Fourth is we must be to develop local wisdom. This is our strategy to become community resilient.

A: Thanks for showing me this. That sounds really great. I would love to speak more Bahasa Indonesia but it is only sedikit sedikit

B: Yeah, no problem.

A: So, do you think there is a difference between maintaining stability and being resilient.

B: Yes, I think this different. Maintaining stability - this is static. And disasters are very dynamic. In the location they they have difference. As you know, we may be successful to handle volcano eruption in Yogyakarta, in Central Java. We have the same method, same strategy in Merapi and then we move, or we adapt, to Sinabung eruption. Not successful - because there is different. Community different, social different, character different, characteristic of the hazard is different, weather is different. So this is our strategy to become a resilient community, we must adapt suitable to the local characteristics. So, I think this is different. I think this is more strategy - resilience - than stability.

A: And what is the difference between disaster risk management and resilience?

B: I think disaster risk management is a tool to achieve resilience. The end of our goal in disaster risk management is to become community, national, community resilience. So this is our strategy how to manage the risk.

A: So, if you talk about disaster risk management done well and being resilient - do you think this is the same?

B: This is different.

A: Okay. So how do you think does resilience relate to infrastructure? What is the relationship between infrastructure and resilience?

B: Yes, I think infrastructure influence the resilience. As you know, like the evacuation route, yeah, this infrastructure is not good. And soon this is easy, the community will evacuate. And early warning system, if we have the early warning system is good. So the access to information for the community is good. So I think, the five resilience components are related to infrastructure.

A: Yeah. And when you think of Jakarta, we have the water management infrastructure, so like dikes and dams.

B: Yes.

A: And what role does this play for the resilience of Jakarta?

B: Yes, I think this is. Yeah, why Indonesia and Jakarta not yet resilient to the flooding - because the infrastructure is not good. So, I think this is very related.

A: Very related, okay. And, so the next question is: How do you think resilience relates to the ecosystem in and around a city?

B: Yes, I think they have related. It is like if there is a good ecosystem, so the local community resilience or city resilience is more easy to achieve. As you know, hydrological disasters like floods, landslides. This depends on the ecosystem. So, it is impossible we become resilient, community resilient, if the ecosystem is not good managed.

A: Okay, yeah. And when it comes to Jakarta - how is Jakarta resilience related to ecosystem services and biodiversity?

B: Yes. But Jakarta is not yet to good about the ecosystem and biodiversity. As you know, the total area in Jakarta at present, I think, about only 11% green area.

A: Yes, that is very little.

B: So, this is too little. Because the ideal to ecosystem, 30% of the total area must be green. So, how about Jakarta, we - this is impossible to remove all the housing and then change the planting. So, I think, we must do bioengineering. And soil, water and conservation must be in Jakarta. Must be informed to Jakarta. Which is too many. I think like us the sumur resapan [infiltration wells]. Sumur resapan - this is like rainfall harvesting in the house and the water must be injected into the ground. If Jakarta had more - I think five million - sumur resapan, I think this would have big influence on the flooding.

A: Yes, maybe the land subsidence would also become less.

B: Yes, exactly.

A: And how is Jakarta's resilience connected to the land use upstream the rivers?

B: Yeah, because this is - we have many data about flooding in Jakarta. Two types of flooding: The first flooding is caused by local rainfall only in Jakarta. Like flooding in January 2015 and flooding 2014. These were dominantly caused by local rainfall in Jakarta. And the second flooding is depend on flooding from Bogor, from upstream. Yeah, in 2007, the big flooding in Jakarta had multiple cause: the first cause is the flooding from upstream. And the second, and the more bigger, rainfall in Jakarta. So, the flooding became much bigger. So, this is the upstream. If you analyse in detail how to do warning level in Jakarta, especially from early warning system. Especially in the Katulampa [dikes in Bogor], it is very easy to move from normal to the red alert level, the fist. Because this is influenced by the land, water sink is not good - so this fluctuation is very extreme.

A: Okay. So, how do you think resilience relates to social processes?

B: Yes, I think this is related. Because if to become community resilience this is not only talk about the infrastructure. This is a process how about the social, how the culture - this is a long-term to become resilient. Yeah, and in Indonesia it is easy to form the mitigation structure, like a dike, like naturalisation and then river normalisation. This is more easy. But how to ensure that the community, they know about the ecosystem, they know how to live in harmony, they know about the waste management. This is related to the social. This is more important than infrastructure, than structural measures.

119 A: And what role does the income distribution play?

120 B: Yeah, community vulnerability is related to income per capita, income per household. In Indonesia, this is

121 really getting too dominant, like us in Jakarta too. Community - they live in the prone area because their income

122 is small. They want to stay, they want to build house in Menteng, for example. But they lost the competition.

123 So, the cheap land is only in the prone area. So, why in the prone area become the development and then more

124 increase.

125 A: And you already mentioned the informal settlements in the prone area on the riverside and the seashore in

126 Jakarta. So, what do these communities play for Jakarta's resilience?

127 B: Yeah, if the ideal, rumah liar [wild house], illegal - must be relocated.

128 A: Okay.

129 B: But that is not easy. We must pay the budget, we must be to community relocated. In many area, like us in

130 Jakarta, the community does not agree to be relocated. Because they have many reason: near to work, they have

131 cultural with their neighbours, and their livelihoods are related to the river. So, this is not easy, to relocate them.

132 And then they long time, many years, they stay there - everyday activities are related to the water. And then they

133 move to the apartment, so this is, I think, a cultural shock. So, I think if we are about resilient city and the

134 informal settlements, the ideal is to relocate them. And then to manage how to ecosystem, or how to household,

135 how to infrastructure. But for this the budget is very little. Budgetary conflict. So, I think we must live in

136 harmony. But must be managed, good managed.

137 A: Okay. So, on a practical level, can you tell me how you decided to work with the concept of resilience at

138 BNPB?

139 B: Yes, yes, we have the strategy about how to combine disaster risk reduction and climate change adaptation.

140 Yeah, this is, especially to the hydrological disaster. So, how to concrete this, because there are many literatures.

141 This is only about the theory, how do you integrate it, CCA and DRR. And we have experience in Yogyakarta

142 and in Bandung. In Imogiri environmental. Why we come before to the village, this is area, in rainy season is

143 flooding and in drought season this is drought. The water well is empty. And then the farmer can only two

144 activity: in the rainy season and the transition. So, we introduce how to integrate the CCA and the DDR. The

145 priority need by community is the water. So, we built a small dam in the small river. We construct with our

146 engineering dinas [service] and we talked together with community in [?] and finally we built the small dam.

147 Participatory. By participation. Only need eighty million rupiah. And this is provided by the government. But all

148 activities were processed by the community. So, budget from community in Kahen seventeen million. And three

149 years after finishing this work, we came back to that location: the ecosystem was green, already like a forest.

150 This is different because all we interview in the community. We ask the questions before and after the project.

151 So, the community explained to us that after the small dam was constructed, all is greening. Temperature is not

152 hot. Water in the deep available all year long. Flooding in the downstream stopped. Water is no problem

153 anymore, all year long. And the farmer can activate three times [work the land]. So, how to Jakarta, if from

154 upstream many river, small small river, we build small small dam or small canal. I think this could have a very

155 amazing influence on the flooding problem. From upstream until the middle, many area we can to improve

156 through small dam. Because if the water long time, so the waste water began to reduce, about the greening,

157 about the ecosystem. I think.

158 A: How do you think the concept of resilience has changed your work?

159 B: Yes.

160 A: How has it changed?

161 B: Resilience is our vision. So all our activities are about how to improve resilience.

162 A: And has it changed when you started using resilience, your strategy? Or is it the same strategy, just a new

163 vision?

164 B: Because since BNPB was established, in 2008, the national vision is to build resilience.. So, all our activity is

165 to become resilient.

166 A: So, the concrete steps you are taking, you already mentioned them. How about Jakarta?

167 B: Yeah, we have the division in BNPB in DRR. We have preparedness deputy, under chief BNPB. They have

168 the main function to do DRR, to empower community and to preparedness. So this is to weather-related

169 hazards, we cooperate with the Ministry of Environment and Forestry, DNPI [National Council on Climate

170 Change], BMKG [Indonesian Agency for Meteorology, Climatology, and Geophysics], Ministry of Agriculture,

171 Public Works Ministry, and other, including universities in how to develop the strategy to become resilient to

172 weather-related hazard..

173 A: And you mentioned that climate change adaptation is also integrated into the DRM/

174 B: Yes, yes.

175 A: So, how do you think climate change will affect the weather-related hazards in Jakarta in the future?

176 B: Yeah, I think this is. We cannot move to climate change. So, our strategy is to live in harmony. As you know,

177 this is the BNPB strategy. Related to Jakarta, we must live in harmony. First, this is relocated the final strategy

178 is to relocate. But if the community does not agree to our policy, so live in harmony. To become live in
 179 harmony, we must improve our early warning system, socialisation, spatial planning and other.
 180 A: That's interesting. And when you think of the whole city, not just the informal communities, do you think
 181 climate change will be a big problem for Jakarta?
 182 B: Yes, because we have the long-term data on rainfall characteristic - this is already different. More intensity
 183 and frequency occurs. And sometimes in the higher location but not in the other location, lower. So this is
 184 different. Intensity is already influenced, is already changed. And rainfall duration already changed too. So our
 185 strategy to disaster risk management, yeah, we depend on the natural phenomena.
 186 A: Thank you. Very much. Ah, by the way, do the recommendations of BNPB to also look at the ecosystem and
 187 social side taken up the other government bodies, such as the Governor of Jakarta?
 188 B: Yes, we have in the local government we have BPBD [Provincial Agency for Disaster Management], has the
 189 function to coordinate with the SKPD [Leaders of Working Units], many sectoral. And as a national [BNPB],
 190 we have coordination with many ministerial agencies on how to implement that on how to do strategic policy to
 191 achieve climate change resilience.
 192 A: Great, yeah, because from the literature I had the impression that in Jakarta the focus is more on
 193 infrastructure. And that is why I was wondering whether they are taking up the social and ecosystem start. So, it
 194 is just about to change.
 195 B: Ya, ya, we talk about to flood mitigation just not only infrastructure - this is related to how the ecosystem and
 196 but population, economic, like income, social, cultural and leadership of government. This is very complex. But
 197 this must be processed. We must be passing, we must get through to the resilient community. And when
 198 community resilient or city resilient will happen, we do not know. This is a process. A long time process. And
 199 we must be sustainable programme.
 200 A: Okay, thank you very much - this was really interesting and helpful. This was my last question.

(d): Provincial Planning and Development Agency DKI Jakarta (BAPPEDA)

1 A: Can you tell me about the weather-related hazards that Jakarta faces today?

2 B: Yes. You mean the weather? The weather-related hazards?

3 A: Yes.

4 B: Normally, and most of all, the weather-related hazard is raining. Rainy season. During the rainy season will
5 be facing a very very prone to hazards, especially flood. Flood hazard is during rainy season normally. But
6 nowadays due to climate change we also have another hazard. High level sea rise, sea level rise I mean. And
7 another hazard normally during what we call rainy and dry season we have fire. Fire is normally very prone
8 during the dry season. Those two hazards are predominantly happening.

9 A: And when you think of resilience - how do you define resilience?

10 B: Yeah, we define resilience as a quick and prompt response to hazard. Quick and prompt, I mean, perfect, I
11 mean, can overcome in a very quick and very proper manner and proper solution to the problem.

12 A: And what word are you using in Bahasa Indonesia for resilience?

13 B: For resilience, ketahanan. Resilience is ketahanan. Resilient city is kota perketahanan. Resilient people,
14 manusia perketahanan.

15 A: Good. Because there are often different words used. That is why I am asking.

16 B: Okay, no problem. Many many terminologies were translated from resilience into Bahasa. Right, you are
17 right.

18 A: And resilience as a quick and proper response - is this definition of yourself or BAPPEDA in general?

19 B: Yeah, of my institution. And it was driven by a result of a workshop among various stakeholders and also
20 various experts. An we define by our team. Resilience as a quick and proper response to hazards.

21 A: I also spoke to Prof. XYZ.

22 B: Yes. Pa Jan. I know him.

23 A: That is why I am asking - maybe he was also involved or something. Because he is also a Kota .

24 B: Perketahanan experts. I know him.

25 A: Do you think there is a difference between maintaining stability and being resilient?

26 B: Maintaining ability?

27 A: Stability.

28 B: Yes, because I think it is a different concept. Because our future is changing. We face the changing. And we
29 have to face the changes. So, I mean maintaining stability means maintaining something that will not be happen
30 in the future. Because future means changing. Changing in everything. Changing in ecologically, economically.
31 Changing in people, mind and perception. We are changing so we cannot maintain something stable. But we
32 have to work with our strategic environment that keeps changing all the way.

33 A: And if everything changes all the time, does this also mean that there are surprises or unexpected things
34 happening?

35 B: Yes, in some extent this is already estimated and also projected by us. But something force major I think
36 everywhere is. Force major means unexpected. But we can estimate it and also we can project it. Something that
37 has been already - has a certain, what we call - cycle and also a certain shape. Yeah, something like that. We can
38 project that. But things happen when it combine with climate change, like before we have a five year cycle of
39 very big scale of flood. But now it could be shorter, could be 4 or 3 years. It's changed. It again changes.

40 A: Yeah. And is there a difference between disaster risk management done well and being resilient?

41 B: Okay. Yeah, yeah. Being resilient means we are ready, we are ready for preparedness. We have an early
42 warning system, we have, yeah, we have preparedness rather than only something done well after the disaster.
43 But before disaster, we already kept prepared, we already have preparedness. I think being resilient we have all:
44 preparedness, early warning and ready to overcome after the hazard comes.

45 A: So, response, yes?

46 B: Yes, response.

47 A: When we come to urban resilience, how do you think does it related to infrastructure?

48 B: Urban resilience related to infrastructure?

49 A: Mhm.

50 B: We have two approaches what is mitigation to the our resiliency. Mitigation and also adaptation. Mitigation
51 meaning that all infrastructure should fulfil all the requirements in terms of our disaster mitigation. For example,
52 when we build buildings or develop our transportation, it should be environmental friendly. And how the
53 adaptation approach is, how to deal with the hazard. For example, if we want to build building so please. For
54 example, if we want to overcome the flood, please extent for example the canal and also deepen the canal etc.
55 That's adaptation approach. But mitigation approach, please along seashore plan another, what we call, plant on
56 seashore. What we call in English? mangroves?

57 A: Yes, mangrove.

58 B: Ah, okay. Plant more mangroves for mitigation of our infrastructure there. If it does not, if no mangroves our
59 sea dike will be hit by corrosion and also hit rapid by the sea rise. I mean also by the wave etc. As, we mix
60 mitigation and adaptation approaches.

61 A: So, for Jakarta the water management infrastructure is very important for resilience?

62 B: Yes, yes, sure. That is one of the most important for us. Water management infrastructure: sea dike, and also
63 our water retention and also our lake. Yeah. Lake to be built dike along the lake and also deepen the lake and
64 also broaden the lake to extent the capacity for water from upstream to downstream.

65 A: And, how do you think is urban resilience related to the ecosystem in a city and around a city?

66 B: Yeah, normally, we have to think about integrated planning processes among cities surround Jakarta. We
67 cannot only think about Jakarta itself but we also interdependency with other cities surround Jakarta since they,
68 the river system is cross-border as well. So we have to think about how to manage our, what you call, our...
69 A: ... the land use?

70 B: Yes, the land use along the river. The river has to be managed as one system, one river system. We cannot
71 divide it into oh this is your responsibility and this is mine etc. It should be, it has to be managed as one system
72 along the river.

73 A: Mhm. And how do you think is Jakarta's resilience related to ecosystem services and biodiversity?

74 B: Mhm. Yeah, our biodiversity is now still managed I think, is still managed well. We have some preservation
75 area on biodiversity. We still provide and we still preserve and we still manage our biodiversity. For example,
76 we have our genuine plants, animals and also we have genuine things like biological form Jakarta and we still
77 preserve and also still maintain it in certain area.

78 A: And do you think it plays a role for resilience?

79 B: Yes, it is important. Resilience is for us not only in terms of infrastructure, not only in terms of people but we
80 mean also for our genuine heritage in terms of plants and animals etc.

81 A: And, you mentioned people. How do you think resilience relates to social processes?

82 B: We have something good to preserve as our resiliency strategy. We have, in Bahasa Indonesia we have
83 gotong royong, means collaboration action, collaborative action. This is something that has to be preserved and
84 also to grow up in a better manner. I mean, in a win-win solution manner. But the gotong royong or the
85 collaborative action is a kind of very big local, what we call, local capital. Very big local capital that should be
86 preserved. For example, if there is a flood, so among neighbourhood will be work together. Gotong royong to do
87 things first. First aid to our neighbourhood. Gotong royong is I think a good example for our social processes.

88 A: So, coping capacity of the locals.

89 B: Yeah, yeah, coping capacity of the locals. And also improve how we work with our gotong royong
90 approaches

91 A: Sounds really good. Do you think the income distribution also plays a role for resilience?

92 B: Yes, sure. Yes, it is, sure. That is why we define our resilience not only physically but also social, cultural,
93 economically. So, Mr. Governor intends to improve the quality of living of Jakarta people, for all, not only the
94 official but also also for all Jakarta people. That we want, we like to improve. What Governor said, we like to fill
95 their mind, their head and also. Full head, full stomach and full wallet, he said. That mean with resilient for
96 people. Head, stomach and wallet. Full with knowledge, full with food and full with money. That is to simplify
97 what we like for our people.

98 A: So the poor people are also of concern for being resilient?

99 B: Yes, sure.

100 A: And when you google flooding in Jakarta, you always see the informal settlements along the river and the
101 seashore. I heard that the Governor is constructing apartments for the people.

102 B: Yes, social housing.

103 A: So, this is also part of his resilience...

104 B: Resiliency

105 A: ... resilience programme?

106 B: Resiliency - yes, yes, it is. And before, it is very very difficult to remove people from seashore and also from
107 river bank. But when Governor provides social housing with fully furnished, they are not comment. And easily
108 removed. Yeah, can you imagine, with fully furnished: with refrigerator is provided by us, and also furniture
109 and also cooking devices etc. Everything is fully furnished. Social housing with very very low...
110 A: ... rent?

111 B: Rent, only, per day it is only five thousand rups, which means only fifty cent.

112 A: fifty US Dollar cent, yeah.

113 B: Yeah, five thousand rupiah per day. So per month, onehundredandfiftythousand. Very very cheap. Very very.
114 Can you compare to your rent in Jogja.

115 A: Yeah, mhm.

116 B: Very very cheap.

117 A: In order to make it affordable for them.

118 B: Mhm. Very affordable.

119 A: And it is a very new programme?

120 B: Very new. And this is something like a breakthrough from the Governor.
121 A: So, on a practical level. Can you tell me how you decided to work with the concept of resilience in your
122 work?
123 B: We have approaches in our planning process. So, one is we have document on resilience. The document can
124 be used for various and intersectoral - this is about action plan to reduce greenhouse gas emission. And we have
125 targeted 30% of our greenhouse gas emissions will be reduced in 2030. And then the roadmap is using resilient
126 city approaches, to get there.
127 A: Because it is a very new concept in the urban context. It is not a very long time used for urban planning.
128 B: Mhm. Yes

(e): Jakarta Research Council (DRD)

A: When you are looking at Jakarta, can you tell me about the weather-related hazards that Jakarta faces today?

B: You mean in general or today or whatever?

A: The weather-related hazards Jakarta faces in general, such as flooding.

B: Yes, in general, we get the impression that the government knows this very well of course. And it has done quite something at least to reduce the flooded areas much better. Especially since the flooding of 2007. That was really the turning around, you know, of that the about the emergency state of this city in Jakarta the flooding. And by having the big, it was very big flooding in 2007, because of the severe, say, rainfall, there are especially. So, that was about the end of February 2007, ah, the end of January 2007 until the 4 February, something like that. It was quite big. More than three hundred millimetres. It started in South Jakarta, in West and East. And that gives a flooding simultaneously in Eastern and Western part of Northern plain. Very big. And then the rain moves to Puncak area. And that gives the final blow of Jakarta so the whole Jakarta was flooded. So since then the planning of the East Banjir Canal, East Flooding Canal, was accelerated. And it was built since then after 2007 and I think around by 2010 it was ready. The East Banjir Canal. And that reduced at least the vulnerability of Eastern Jakarta and the intensity of that. So although they are still there, that, in flooded area in East Jakarta in there because the area was formerly an area of wetland, of rice fields and so on. But now especially in Krokoladin area, Suntra and so on, and then because of heavy property development there, maybe combined also with land subsidence and so on, and maybe also groundwater extraction - so the flooding cannot be avoided. But in terms of the intensity it was reduced after the development of the East Canal. Now the construction is now for Western Jakarta. So, and then, in 2013 there was again another bigger-scale flooding, because of the river and it was breached, you know, the river, bendu[ngan (dam)], I mean, the near Koto nesia, that gives central Jakarta business district was flooded. That also has to do with the pumping system and also the lessening of the capacity of the Pluit [seashore area in the North], what we call reservoir, because of the shallowing, also of that occupation by the slum squatters. So, since then the government, the governor and so, they clean up the Pluit areas. Now, as long as the West Banjir canal, they can handle it. But Western Jakarta still the problem of this borders [?]. Because of, so there are several borders [?] that still have to be managed. And the amasiris [?] provisional or temporary solution is by having some pumping networks. And in the future, the climate-related hazard is still there. That has to do, you will have to check also of course with the people from the Metrology and Climatology Agency, about what will be the future trend of this flash rain. But I have seen very low resolution model or scenarios that in the future the probability of having flash rain with short-term but with intensity of higher than sixty millimetres is getting higher. So that means we still have to watch especially in Western and Eastern Jakarta. Because the central part, which is drain by the Chiliwung River from Puncak area - I think that they can handle it. I mean they know it already what behaviour and so on, it is the question now of relocation the people from the flooding areas into another location or making or this can be combined with kampung [village] improvement on that flood plain. For the central part of Jakarta because of this Ciliwung. So the future challenge will be on this smaller river in the Eastern and in the Western part. Combined with the possibility of having shorter, shorter time rain but with higher intensity. So that will be the future challenge as far climate is concerned especially rainfall.

A: You mentioned already quite a lot of important points. Before move back to Jakarta, how do you yourself define resilience?

B: Resilience is very simple. Resilience has to do with a system - how a system can rebound itself with better condition rapidly without having a situation or the system break out, the system deform or rupture. So this is what I and what we follow as resilience. So, if you make it shorter - rebound with better condition. So the system has the ability to respond quickly and recover and rebuild a better condition. So then of course there are quite a number characteristics and prerequisites that have to be provided if we have to follow this. So it just like bamboo, you can swing him back and forth without breaking without deformation. So that is what we use as practically for resilience.

A: Mhm. And what term are you using in Bahasa Indonesia for resilience?

B: Ketahanan. So, ketahanan is resilience. But then the verb resilient is kepertahanan. The noun, ya. Like you have Lembaga Ketahanan Nasional - National Resilience Institute.

A: Alright.

B: Because BNPB they use Tangu. They have for example Desa Tangu Programme. Desa Tangu Programme, Kota Tangu. But to our opinion is just that you can resist against any shock, internal shock. So in resilience you will have relate it external shock. Something unfortunate from external system. So another use lamting is something like that we get, or lentur. But finally the Ministry of Public Work which I consult them, they use this resilient city is Kota Perketahanan.

A: And the definition you are using is the definition of the Institute of the Urban Resilience and Infrastructure?

B: Yes.

A: Is it also the one this Research Council is using or is this different?

B: This council has not really adapted that. Because we have several programmes and I am chairing the Commission for Spatial Planning, Infrastructures, Transportation, City Economics and Environment. So we have so many sectoral issues, which are, it means, on my Commission which I am chairing is responsible to or having some activities.

A: And when you think of human dominated systems, so cities - what does it mean from your perspective for a city to be resilient?

B: Human-what?

A: Cities. A urban system. What does it in your opinion mean for a city to be resilient?

B: Of course when you talk about resilience it depends on what level you are dealing with. You have national resilience, you have city resilience, regional resilience until the human scale. But what we would like to start with is just to think just city-wide resilience. And we have gone down until to for example to settlement resilience or district resilience. Or even up to human. But eventually we have to really break it down until that level. So it depends on which level you are dealing with.

A: So what do you relate to a resilient city?

B: Yeah, so we take this city-wide in terms of spatial planning, in terms of spatial planning have to risk-sensitive. So we have, what we call, three major pillars when we talk about resilient cities: One is risk-sensitive spatial planning and zoning. And second is the urban ecosystem restoration. And the third is financing for infrastructures within the context of urban upgrading. So urban upgrading, ah sorry, risk-financing for urban upgrading. Including the resilient infrastructures. So in terms of planning you will have to take into account and incorporate the risk factors. Especially the spatial planning and zoning. Second, we consider we take ecosystem as really important not only on its roles but also it gives a great contributions to be resilient. So we talk about ecosystem services and so on. And the third the financing aspect for urban upgrading, something like that.

A: So you mentioned the risk management aspect. What differs from your perspective between disaster risk management done well and being resilient?

B: Yeah, so this is very crucial because resilience, we do not stop at disaster. We go beyond disaster. Because when you talk about, of course the whole cycle of the disaster management, we follow that, so we enrich the whole disaster management cycles within the perspective of resilience. So when you talk about disaster management then you are dealing with the pre-disaster preparedness and then when disaster happen, then emergency response and then recovery and then redevelopment and mitigations and then go back again to the preparedness. So that is the whole disaster management cycle. But in practice, in many cases, not only in Indonesia, even in the US, maybe Europe also, I don't know, the focus is mostly on the disaster happened and then shortly afterwards and afterward people start forgetting it. And then they go back to business as usual and disaster happens again with larger scale, with larger impact and so on. So that was happening in Jakarta, for example. I have media little survey, not really scientific, but I am collecting some information from the internet on how actually and this proof what I call as the creeping disaster or slow-onset disaster. That is more dangerous I must say than the so-called rapid onset or instantaneous disaster. Because when you have instantaneous disaster like earthquakes or volcanic eruptions or landslides, people will move very quickly and there will be a rapid response and so on and so on. And then they building, relocation and so on and so on. And finish. But with this creeping disasters you do not realize that the disaster is escalating because you live with that and you feel comfortable and you feel that disaster is part of your life. And incorporate that disaster into your lifestyle and way of thinking. Especially when you talk about flooding. That happens, you know, because they say ah okay flooding only maybe one or two months in a year, after that we can just, life must go on. So, okay, in this one or two months we can just evacuate to another safe place. And then they go back to that hazard prone areas. But then, you know, so this kind of mentality and mind-set, not only in the laymen but also up to the decision maker. When disaster happen, okay, they are quite busy, giving some assistance, logistics and so on, hospitals and some sick people, some died or some malfunction system, whatever. But soon they forget and next year when flooding happen again, okay they do same thing, but they do not realize that the impact is higher. So by comparing the flooding in 2002, 2007 and 2013, especially the last one: You can see for example that in 2007 the rainfall was above 300 millimetres. And the rainfall from flooding of 2013 it was only 250 or something like that. But the impact was four times as large, you know. And 2013, the governor, which is now president, Jokowi, he declared state of emergency in Jakarta. So you see this kind of escalating impact of what I call creeping disaster or slow going disaster, that happens. So with this resilience concept, okay we don't want to destroy or make another cycle, but within that disaster management cycle, when you rebuild it, you will have to take into consideration the past lessons learned, you know, from what there is, what the impacts and so and the future scenarios are. And you incorporate that into the investment planning to have a better condition and so on. So by having that then we will come to what I call disaster-based economy. Disaster-based business. With this new perspective, there will be new economy, new economic cycle within the context preparedness and building resilient infrastructures. I think the people, educating people, to get more prepared, providing more and better logistics. All kinds of activities are all business, economy - new lifestyles. But then when disaster comes, okay. You see that the impact is lesser while at the same you are building your economy. So this is the core message

that I always shout here and there. Okay, disaster is there but don't cry to that because disaster also provides new opportunities. So resilience is now becoming a new opportunity. So that is the core message that I am delivering always here and there, everywhere. And I also I am writing a book on that particular issues. So with that mind-set, I think we will have to, you know, develop finally it is the society, which is resilient, not the building not whatever, the whole society with the government they are getting better. Something like that.

A: So I became to hear that there is also difference between maintaining stability and being resilient?

B: Stability of what?

A: Stability of the city, of the urban system.

B: Yeah, not only stability. I think the core, the key word is improvement and resilience. Not stability.

A: Yes, I just wanted to ask because I had the feeling that what you said about resilience is not about stability. Because for some resilience means being stable.

B: Yeah, this has sometimes also to do with sustainability. Sustainability of what? Sustainability of supply, of your market share or what. I mean, so this is because we know of course, we will have to agree first that we are now dealing with the unfortunate or some risky situation. That is where the resilience concept is introduced. That means improvement and getting more resilience. So, if you are already entering the so-called comfort zone or no problem zone or whatever, then we maybe talk about stability or sustainability and so on. But now we are dealing with the vulnerable state or condition of the system that we are talking about. Because you might have, okay, for example, this is more or less the okay-zone, you have the sub-okay condition and above that. You know. So we are talking about because the one which is not okay, they can take this disaster or unfortunate event to becoming resilience, they can jump if they see it as an opportunity. At the same time, for example, if they are already entering within this zone, they may collapse. It depends on how you see this as an opportunity or some unfortunate situation if it gives them some kind of setback or whatever. So the perfect is always when it happens we have to rebound with better condition. Wherever you are, whether you are in the okay-zone or above the okay-zone or below the okay-zone.

A: So, you already mentioned the ecosystem services as a source for resilience. And how do you think Jakarta's resilience to flooding is connecting to the land-use upstream the rivers?

B: Terrible. Ya, of course, first, of course Jakarta itself, we don't have anymore, how to say. One of the prerequisite of having resilience is you have spare capacity. In this case, spare room or spare space. So in the spatial planning, it is mandated that Jakarta, or mostly, or most of the city have what they call green open space areas. 30 percent. But in Jakarta, I don't remember what the statistic says, but 65 percent is occupied by settlement and housing and so on and so on. So then the green open space is I think 6 percent or something like that. So meaning that you do not have room anymore to make whatever, you know, as what you call spatial strategic stock. That in Jakarta itself. And then when you go hinterland, upstream there, now situation is even worse. That is I think the very basic value or, we must say, what we call, wrong in mindset, or in the development practice and paradigm, is that one the urban sprawling goes without any control. That does not mean, you know, that we don't like sprawling. Melbourne is also sprawling city but there are minutes you know, there are control sprawling. So, you don't have this. So in Jakarta is because of the market-driven sprawling. It is not by government driven. That is one thing. Second, is what we got is urban development is primarily by the private car oriented. And so that is you know question mark. And that indication coupled with of course the development of you know road network and so on, which is not wrong. But you know they always say about the road ratio and so on, you will never be able to fulfil the demand and the explosive growth of this. One million car per year coming in Jakarta and three million of this motor bike, Jakarta only. So would you provide road network for such an aggressive of this private cars. So makes this situation even worse. So, the only way to that of course if you transform into public transportation. Which is now starting with MRT RIT, whatever. But of course the situation may be late but better late than never. It takes time. And can we see, the thing about what we need is really visionary, consistent and coherent long-term planning, which is from one government to the next government continues that. This is the challenge, because, you know, the development goes by five cycle, depending on who the governor and the president is. And this applies for almost all the city because of this regional [?]. So we are democratic but in practice, we are even more liberal than Europe, more liberal than the US. So that is the challenge to solve system and the underlying regulatory and so on so on. So physically you see, you know, the landscape images or how practically Jakarta is already occupied by all this built-up areas. And no clear zoning. The key is not only zoning but intensity that is important. Okay, that is all accredited for office but they build office towers, with very much, maybe the land space you occupy is not so big but they might use very intensive groundwater, ecosystems and so. That is why ecosystem restoration is quite important. Not only the green but the total ecosystem services, from provision, regulating, support and cultural aspect and so on and so on.

A: That is one important part of being resilient - functioning ecosystems.

B: Yeah, because the ecosystem provides with all your basic needs for free. That because of that free that people abuse it. They think the nature will provide that for eternity. But that is not the case. Especially for water also.

So I also always say that water is not a renewable resource. It is renewable within a hundred years or maybe two hundred years. It is not free, you know. And you mentioned already the importance of infrastructure.

A: So, you mentioned already the importance of infrastructure. So, from your perspective, what role does infrastructure play for the resilience of a city?

B: Of course infrastructure is an enabler. One, what infrastructures you are dealing with, you are building with for what purpose. Second, is of course, infrastructure has their own specification, for this we need that and for this that and so on. But also nowadays people are talking about green infrastructures. What is meant by green is for example they use materials which has nothing to do or fairly little in terms of the greenhouse gas emissions and so on. They have this kind of what we call ecological footprint and so on. Second, of course, when we talk about infrastructure, at least you will have to expect that this infrastructure will have a lifetime or service time is one hundred years, something like that. That means when you are talking about investment in infrastructure, you will have to have a long-term perspective. You cannot talk about only within in the terms of governor or president, 5 years or maximum 10 years. It goes intergenerational investment. So that is why it should be risk-free or risk-proof and second it goes beyond generation, it has to have, their service time, you know, is 50 years or 75 years, you know. Otherwise the infrastructure is useless. Then, third of course, risk has to be incorporated when you build infrastructure. This infrastructure you invest to address what risk.

A: Flooding for instance.

B: Flooding, or traffic jams or city health or sanitation or whatever or to reduce the population density, whatever. So the key point with Jakarta is managing the densities in spatial terms. Managing density and mobility, so that is.

A: And how does resilience related to social processes?

B: Of course very big. One, when you talk about the resilience at least you are dealing with four components: One is of course economic resilience. Second is the social resilience. The third is infrastructural resilience. And the fourth is institutional resilience. So, social resilience is just one component of the four resilience components. So ecosystem, and I put it under, or can we group into this infrastructure, as being a green infrastructure, or natural infrastructures. So you are dealing with man-made infrastructures and natural infrastructures. Mangroves, forests, groundwater, whatever. That is the natural.

A: And in the social resilience - what role does, for example, the income distribution play?

B: Very high. Income, gender perspective and the disabled people. And of course in relation with the social resilience is you also have to have good spatial planning perspective. Because some of the social and resilience or social unrest or social conflict can be driven by the wrong spatial planning or by the negligence of spatial planning. For example, you have here, I can show you for example in the case Kamiorang and Antscho area, suburb in the Mijoran and Sutra area you have very densely area with a population and so on. And then you get this toll road and the railroad. To the North of that you have this luxury areas of this wealthy people in Anjol areas, you know. And to the East you have this poor and so on and so on. So we get this kind of discrete landscape instead of having a smooth social landscape, socio-economic. So that of course, you can normally, you don't have to be genius of what that you can expect that kind of fractions because of spatially induced social conflict.

A: This is also one explanation for the informal settlements along the riverside.

B: Yeah. Of course, in that sense, then you have this kind of structural segregations because of that income, because that. And mostly, the people who have for this lower income people, mostly they live in the vulnerable areas. Not because they like it, because they do not have the capacity, you know, to alleviate that, to. And that happens also for example in the case of the Katrina hurricane. Mostly of these black people they are suffering because of that they live in the vulnerable areas, they cannot, they are not able to evacuate and so on and so on. That is why income, empowerment and put that within the spatial context is quite important.

A: Okay. Thank you very much. So, coming from the concept and how resilience relates to the different dimensions. On a practical level, you are obviously using it in your research and in your recommendation. So, how, from your perspective, has the city of Jakarta and the public actors, how have they taken up the concept of resilience?

B: I think when you talk about Jakarta, they haven't talked about resilience. But they are talking and quite serious in addressing the disaster. I think that is their priority. To reduce the impact of flooding, to reduce the loss because this traffic jam and also to improve the provision of this public housing. Because they are now trying to accelerate the development of this public housing - apartments - for the people who are relocated from the disaster areas or for the lower income peoples and so on and so on. So these are the three major issues of Jakarta. And they have not thought about - to my opinion - about resilience. First of course is to address and to lower the risk of this disaster. That's it, you know. If they can do that, then that is great. The next step will be about resilience.

B: So, for now it is about disaster risk management?

A: Ya, I think there they are quite good. It's quite okay. Because we have the BNPB [National Disaster Management Agency] and usually we have BPBD [Provincial Disaster Management Agency]. If you ever visit

238 BPBD, they have also, what we call, a command control room for flooding especially. But that is not enough,
 239 you know. I think we will have to build also an early warning systems for flooding. The concept is already
 240 there, the knowledge is already. Especially not for the Chiliwung but for the thirteen river areas, maybe that is.
 241 And that is quiet an opportunity for the business. So, I mean I know that Austria is quite good in water
 242 management.

243 A: Yeah, from the literature I had the impression that the current policy approach is more about infrastructure,
 244 neglecting a little bit the ecosystem side and the social side. Do you think that is an accurate impression or is it
 245 changing at the moment?

246 B: It is not fully wrong. Physical structures is quite important and they boost the development of this. All the
 247 policies and exams what the city Government is taking is that, you know, to reduce the flooding areas and of
 248 course the social aspect is taken into consideration. In for example, they are willing and doing to relocate this
 249 population who live in this flooded areas along the riverbank and also around the what we call the reservoirs,
 250 retention ponds and son on. To move to another public housing, public apartment for example.

251 A: And do you think the concept of resilience has the chance to balance this focus which is now on
 252 infrastructure towards more ecosystem and more social aspects, or do you think it will just be a new term for
 253 practically the same?

254 B: At least for now they have not talked about that. But we from the council we advocate that continuously. But
 255 not by saying it, but we implant this concept, you know, into their programmes. So, we advise, for example, the
 256 city water management office, for example. When they are talking about this flooded border areas in west
 257 Jakarta, for example, we advise for example to better transform that flooded areas with quite dense housing into
 258 open blue space, for example. Then housing can be put upward, that means that we will have to give more open
 259 water, space for water, especially in the Northern part. So that is our strategy, because from this area to the
 260 North, basically you should have more blue spaces. And to the South, green spaces. So that is our side. So
 261 whenever we have this flooded areas, maybe then that is the opportunity to have, what we call, subsidy
 262 improvement and regeneration or retrofitting or upgrading by giving more space for the water. So we do not talk
 263 about the concept. The concept is just underlying our input. Because they say: tell us what we have to do. That's
 264 it. Don't let us think or whatever. It is your job to think and give us some advice to do that.

265 A: So, they are increasing resilience by not talking about resilience.

266 B: Something like that. This is what we are doing. Give them quite a simple recipe and they will do that, for
 267 example.

268 A: So, my last question is - because now I am talking to a resilience expert - in the literature I found that there
 269 are different paradigms underlying resilience. Holling said that there are two paradigms: Ecological resilience
 270 and engineering resilience. Engineering resilience is more about that there is an equilibrium of the system. And
 271 resilience then means to get back to equilibrium, or maybe we could call it business as usual, after a disturbance.
 272 And ecological resilience assumes that there are many different states a system can be in and resilience is the
 273 ability to deal with constant, to adapt and shape the change in order to maintain in a desirable state. I am trying
 274 to find out which of the two paradigms is underlying the current understanding of resilience behind the city's
 275 policy approach. What do you think from your perspective about that when it comes to resilience thinking in
 276 Jakarta's public actors?

277 B: Yeah, I think maybe it is more towards this social-ecological resilience. I mean, but, I mean we are
 278 underlying how the system works in which that human being is part of the ecosystem. Human being is part of
 279 the ecological system. Because if I understood you well, from the engineering resilience we just rebound and go
 280 back to the original situation. To our school of thought this is not resilience. Because, that is of course the
 281 minimum, kind of requirement, and the minimum capacity that we have to develop. But by having that we don't
 282 put resilience as an opportunity. For us, resilience is opportunity to build better and to attain better condition.
 283 Because why this so, because when disaster happens, you create some rooms, more rooms and you are free to do
 284 whatever with new state of condition because of that unfortunate event or disaster. You take for example the
 285 case of Kobe, you take for example now the example of Fukushima. Kobe is developed now by using the
 286 concept of disaster resilience city. Of course you see now Kobe is much better than before. Also Panda Aceh.
 287 But Fukushima they are already implementing the resilience concept. So it goes beyond disaster, right. So of
 288 course when you go beyond disaster it means that when you rebound with better condition that would imply that
 289 the original situation before that happens is being recovered but you add more, you know. Certain aspects that
 290 are much better than previous one. By having this paradigm or mindset, people will see this as an opportunity
 291 and there is some kind of incentive for them, you know, to build better. If it is just to recover to the previous
 292 condition, I mean, you are not only neglecting but you don't use the opportunity of the rooms which are created
 293 by having the disaster. Because by having disaster you demolish certain parts. Say for example 30 percent or 40
 294 percent of the existing system. Now you are free to do whatever. That is why, in our campaign, whenever we
 295 start, or we would like to talk the resilience, we start with this unfortunate stories. Lessons learned from other
 296 areas or region and so on. This can happen with you, because the condition is the same, for example. With some
 297 comparison but then we see in the case of Aceh or Yogyakarta after the earthquake or Bandung, I do not know

about the Merapi situation, I mean there should be some kind of inner drive to build better. So, but we will have to do that in such a way that this grows organically, some like the social and ecological relation, because these two, you do not overpass the capacity of the ecosystem or natural system. This system is to rebuild themselves, so that means if you force, you know, something that is over the bearing capacity then you know it will work but that will not be sustainable. So of course that is why, in practice we have so-called full scale or full-fledged resilience intervention or we have minimum intervention. But both of them, which start with the capacity of the system, the capacity of city and so on, to understand the risk and to assess the risk. That is prerequisite - you have to do intensify the hazard, you have to do vulnerability, exposure and risk analysis and so on. That is minimum. From there, you can jump directly into the, what we call, the resilience measures. Consisting of urban upgrading, ecosystem restorations, and spatial zoning. So, that is the minimum. Just to do this, technocratically with clear and visible physical impact. But that is the minimum package. But with full-fledged package you have to incorporate the community participation, you have to develop your GIS capacity - geospatial - you will have to develop the resilient economy, you have to align all these things, you have to have these regulations and so on. All these soft and hard measures all together. So, we give all this, this year we are going to give this sort of prescriptions, so to say, to these 23 cities. In four cities we are now experimenting, we are incubating we call it. That is Banda Aceh, Yogyakarta, Samarinda and maybe Manado or Mantaram, we do not know yet. So this is our experimental cities. With this all tools, complete tools or shortcuts, something like that. So this is, with all that kind of mind-set, then we adjust the investment planning for example, they would like to build dam or drainage system here or whatever in addressing disaster. So we add the values of that by giving or understanding and guiding them, you know, in giving some more long term resilience. For example what is important is also, the city must have a vision. A city is not just a flock of buildings a flock of people, aggregation but what is the vision. This is not easy because it has to be implanted and infused into the city population itself. Not only in the government but also all the population, they should share this vision. So that is our vision. What are going to be in the year of that and that and so on. Not only the vision of the Governor but this vision of the whole city. So this is not easy because of

A: lots of different perspectives. Wow, that is really interesting. Thank you so much. So up to now the only aspect that you may be able to help me with is trying to find out what are the actors involved in the climate-related hazard policies, and how are they related. So, I am going to talk to BAPPEDA and to the Climate Change Division in the Ministry of Environment and Forestry and I also spoke to BNPB today. So what do you think, who are further main actors when it comes to climate-related hazards in Jakarta?

B: Ya, to me, and many of people at my institute, climate-hazard is something clear after you point them. Because the knowledge in the society, the knowledge in decision-makers is not complete. I must say, when I am talking about not complete is that maybe it is concentrated only within a certain circles and not so well understood by the common people. That because of course the data, scientific background, of course it is there, theoretically or normatively you can talk a lot about that. Second, I mean, for Indonesia in general, climate change because of we are many time contended, Mostly when you talk about climate change is the change in temperature or atmospheric temperature. But you won't feel it. Of course you feel that now the city is getting warmer and warmer but that as I said, this you are dealing with the creeping disaster. You feel and you live with that disaster. You are still comfortable with that because you still have the means to avoid that by having an air-condition, whatever whatever. What people are talking about for example, okay now we have, what we call, heat island effect because of traffic and so and so on. Or you have emerging diseases, the incidence of dengue fever or whatever. But that people will always say that we have already before we talk about climate change. So who cares. To me, or to many of the laymen, climate is scientifically exciting but practically still you know.

A: Yes, that is why I tend to speak about weather-related hazards because then they know it is hazards like flooding or heatwaves. Because in the interviews I realized when you talk about climate change it is more about temperature rise.

B: Because the term itself is also under debate in science. I know because my son is a climate scientist. He works in the BMKG. What I am trying to say is, okay, we have this national concept for climate change, but again that is a kind of game, it is elitic [elit-level] you know, rather elitic thing you know. Especially when you talk about resilience and climate change, we are immediately related with the peat land, in which they are blame to be the largest contributor of this greenhouse gases. And the Indonesian Government is going to reduce it, by 26% or 41% if another country helps us something like that, Norwegian, REDD+ project or package and so on. What I am trying to say, we have not really realized that the urban sector actually contribute larger than the forestry. That is the thing we have not realized, you know, from this air-condition from the greenhouse gas emissions and so on. But that maybe will apply mostly on Jakarta maybe or other big cities like Surabaya or Bandung or Medan. Something like that. But the rest, who cares. But for the forestry, yes we can see clearly, changing into the palm oil plantation, of course they make this kind of greenhouse gas balance or related to green but it is not green. But this is kind of a game between banking, business, large-scale corporations and ministers and director generals and so on. They are busy collecting this and go to IPCC conference in New York

358 or whatever, you know, but the laymen, who cares. Of course Singapore or Malaysia is quite concerned because
359 of the smoke. But that is has nothing to do actually with climate change but has to do with the forest fire. Of
360 course the forest fire can be ignited by the negligence in managing this wetlands, peatlands. I could talk a lot
361 more about that.

362 A: Thank you so much. That is already very helpful. So I think for now, having this three institutes BNPB,
363 BAPPEDA and the Ministry of Environment and Forestry is good. Is there anyone else when you think about
364 urban resilience in Jakarta, this is someone you should go to?

365 B: You are already dealing with the best person. Resilience is abstract sometimes. You will have to translate it
366 clearly, because we just started, you know. Even with BAPPENAS. I am not advising BAPPENAS but the
367 World Bank, they have a urban resilience programme, and the Ministry of Public Works. I am now in the
368 middle of that. But of course unfortunately I have not really written down all of my thinking. Of course I wrote
369 some reports but thinking to publish also kind of a book or publications about the resilience cities within the
370 Indonesian perspective. So, hopefully maybe soon with the World Bank and some of my colleagues of my
371 institute, we are planning also to write a book because this quite important. Because the incidence of disaster
372 increases. So, resilience is a must, is no longer a luxury or remaining abstract. It is our challenge to make this
373 simple and communicable.

374 A: I started my research because I realized that Jakarta is part of the Making Cities Resilient Campaign.

375 B: Jakarta, Semarang and Bandung.

376 A: That is why I assumed that resilience is already used by the actors, it is already part of the work of
377 BAPPEDA and so on.

378 B: They have too many problems, you know, challenges, issues to be addressed. They do not talk about
379 resilience but they do talk about flooding, about slums, traffic jams, and so on. And I don't think they have
380 anything special for climate in DKI [Jakarta Governorate]. I think climate is incorporated or embedded in this
381 water services. But they are not addressing the climate itself but they are addressing the infrastructure for water.
382 And when you talk about hazard. Jakarta, that is under the industrial and energy services. They are dealing with
383 the earthquakes, land subsidence, flooding of course. But from the disaster point of view this is in the industrial
384 and energy, formerly it was mining services but they changed to industrial. But then recently the new President
385 all this hazard issues, especially flooding, we leave them to the water management division and services.

386 A: Okay. Thank you so much. I think even if my research says the concept of resilience has not yet really
387 applied or not yet really arrived, it is also an interesting finding.

388 B: Resilience is mentioned in the most recent Medium Term Development Plan 2015-2019 BAPPENAS. So it is
389 already in the policy. So, of course for you the challenge is to get really this thing. We just started. Even just
390 started now. Okay we have already the kick-off of this programme already July last year, but that is just mostly
391 talking or brainstorming and so on. BAPPENAS have what we call the sustainable city programme. In this you
392 have green city, you have resilient city, you have smart city. So this three thematic programme are under the
393 BAPPENAS sustainable city programme. So that is how far the policy is concerned. It is mentioned in the
394 policy directive for the mid-term policy directive. But for the city itself we just started training and capacity
395 building last week.

396 A: And your institute and this council is the main?

397 B: We are now regarded as the resilience institution by the World Bank or BAPPENAS or also by the Ministry
398 of Public Works because no one else this kind of. So we are also because we are the first, the challenge is of
399 course we have to educate. And luckily of course this three.

400 A: Okay, wow, that is really interesting. Thank you for your time.

401 B: There is one more thing before we stop, when you talk about resilience, it is resilience of what and then
402 against what. you have to be clear.

403 A: Yes, I am going to say clearly that it is about the resilience of Jakarta to climate-related hazards.

404 B: And what should be resilient, the government, the people, the business, infrastructure. You have to clearly
405 define what should be resilient.

406 A: Yeah, thank you for your kind advice.