KNOWLEDGES, CONTROVERSIES AND FLOODS: national-scale flood management in Bangladesh

BRIAN ROBERT COOK

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This research explores the views, beliefs and knowledges of experts responsible for flood management in Bangladesh. As one of the most disaster-prone nations on Earth, and in response to the neglect of power-holding experts within the existing literature, this project analyses the differences between academic accounts of flooding, labelled the 'prevailing understanding', and the local expertise of those responsible for management. Relative to the entrenched narrative, local experts are surveyed and an alternate interpretation is constructed using their knowledge. This combination of textual and perception-based analyses accounts for the complex interrelations between competing forms of knowing. It is on this juxtaposition that the research contributes to new knowledge.

The thesis is based on research conducted in Bangladesh between November 2007 and March 2008. To accomplish its objectives, using prominent debates as entry points, academic and government sources are used to account for the lineage of the prevailing understanding. On the basis of this narrative, qualitative interviews with 54 experts explore the construction of flood management knowledge and its relationship with decision making. The experts describe and justify understandings of flood management that are contextual, adaptive and indefinite, challenging many of the assumptions associated with the prevailing understanding. The findings inform several findings: that individuals close to the poverty line are uniquely vulnerable; that disasters merge with management to produce second-generation events; and that a hybrid socio-physical context is both a product and a producer of flood management knowledge.

Overall, despite the already complex issue of flooding, managers in Bangladesh consider increasingly issues as diverse as poverty, environmental sustainability and economic and human development. Given the scope of the controversy surrounding flood management, the findings show how analyses of competing knowledges, assumptions and framings can aid the interrogation of prevailing knowledge to generate original findings.

Knowledges, Controversies and Floods:

national-scale flood management in Bangladesh

Brian Robert Cook

This thesis is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in the Department of Geography, Institute of Hazard, Risk and Resilience, Durham University.

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LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS AND BANGLADESHI TERMS

ADB	Asian Development Bank
ANT	Actor Network Theory
BRAC	Bangladesh Rural Advancement Committee
BWDB	Bangladesh Water Development Board
CIA	Central Intelligence Agency
DND	The Dhaka-Narayanganj-Demra agricultural development project.
EPWAPDA	East Pakistan Water and Power Development Authority/Board
FAP	Flood Action Plan
FCDI	Flood Control, Drainage and Irrigation
GoB	Government of Bangladesh
HYV	High-Yielding Variety of Rice
IECO	International Engineering Company Inc.
IMF	International Monetary Fund
LGED	Local Government Engineering Department
LwF	Living with Floods/Flooding
NGO	Non-governmental Organisation
TI	Transparency International
UN	United Nations
UNDP	United Nations Development Program
WAPDA	Water and Power Development Authority
WB	World Bank

LIST OF BANGLADESHI TERMS

Aman	Traditional rice variety. Planted in early/late monsoon period. Certain varieties are flood-tolerant.
Aus	Traditional rice variety. Is planted pre-monsoon and is harvested t the beginning of the flood season.
Barsha	Normal flooding that is viewed as primarily beneficial, particularly for water resources and agriculture.
Bonna	Abnormal flooding that is viewed as detrimental, causing substantial damages to agriculture, infrastructure and individual possessions.
Boro	Dry season rice harvest mostly composed of high-yielding varieties.
Char(lands)	Deposition-created lands that emerge within river streams. These lands are often temporary and are subject to high levels of flooding. (See Figure 6). High land pressure in Bangladesh forces many landless individuals to claim these lands as they emerge.
Crore	A measure used with reference to currency. Denotes tens of millions. For example, 9 Crore = 90,000,000.
Hartals	Strikes organised for political purposes. Often scheduled by political parties to display their power to stop economic activity. A dangerous time to travel because people travelling or working during this time imply that the party is weak or lacks the power to enforce its strike.
Jotodarns	Henchmen who operate in the interest of local individuals. There is a connotation that these individuals operate outside of the common law.
Lathiyal	Literally a police baton but its usage implies power enforced through violence.
Robi	Vegetable crop.
Taka	The Bangladeshi currency.
Tulukdars	Locally powerful individuals who maintain control of regions through henchmen and violence. They often hold large amounts of land and, through these resources, control many landless Bangladeshi who depend on the Tulukdar for employment.

DECLARATION

The material contained in the thesis has not previously been submitted for a degree in this or any other institution. It is the sole work of the author, who takes full responsibility for any errors contained.

ACKNOWLEDGEMENTS

It has become cliché for me to acknowledge the importance of Erin for all that I do. This is the third degree of which she has been a part and it is the one that has been most dependant on her unwavering support and care. I would have failed without her. I am indebted to her forever and look forward to repaying my debt in the ways she sees fit.

Single authorship misrepresents the work, support and advice that produced this thesis. I am grateful to the dedication and professionalism that Cheryl McEwan and Stuart Lane have shown in equal parts. If I am able to ever match their attention to detail, constructive criticisms, patience, insightfulness and willingness to overlook foolish over-optimism, I will consider this a great accomplishment.

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I would also like to acknowledge the support I have received from my family, especially the proofreading and suggestions from my father. Jeff and Bettina have been a constant source of support. Bettina's designer eye was invaluable to the figures and graphs. Mark and Laura have also been an invaluable connection to the real world during this challenging endeavour. Finally, the graduate students and faculty of the Geography department at Durham also deserve thanks, sharing their knowledge and experience while contributing to such an energetic and challenging yet supportive atmosphere.

INTRODUCTION

1

> *The emerging risks and vulnerabilities associated with climate change are the outcomes of physical processes. But they are also a consequence of human actions and choices. This is another aspect of ecological interdependence that is sometimes forgotten. When people in an American city turn on the air-conditioning or people in Europe drive their cars, their actions have consequences. Those consequences link them to rural communities in Bangladesh, farmers in Ethiopia and slum dwellers in Haiti. With these human connections come moral responsibilities, including a responsibility to reflect upon - and change - energy policies that inflict harm on other people or future generations.*
>
> (UNDP, 2008: 3)

Bangladesh has become an actant within the developed world's consciousness and understandings of the human-environment relationship. In addition to being an entity of its own making, it is a character that is conjured to serve a purpose: to pose as a surrogate for those unfortunate nations and people in the developing world inundated by social and environmental calamity. Said (1978: 21 italics in original) provides an enlightening description of the process underlying this claim. With reference to Aeschylus's play, *The Persians*, he explains that the:

> "dramatic immediacy of representation in *The Persians* obscures the fact that the audience is watching a highly artificial enactment of what a non-Oriental has made into a symbol for the whole Orient".

The dramatic immediacy of disasters, whether as part of an fundraising campaign for Oxfam (Oxfam, 2008b; a), as a high-school textbook case study (Bowen and Pallister, 1999; Widdowson et al., 2001), within media reports of distant suffering (Wooldridge, 1998; Abdullah, 2010; Oxfam, 2010), as an example to enliven academic publications[1]

[1] I include this thesis as a similar example of 'using' Bangladesh.

(Smith and Ward, 1998; Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009) or, as the epigraph illustrates, to personalise the climate change debate, shows how Bangladesh has been made synonymous with catastrophe and suffering. In this context, my thesis is very straightforward. Quite simply, I ask those responsible for flood and disaster management in Bangladesh to consider their own knowledge and opinions in relation to the knowledges and understandings that inform this caricature, with particular reference to the prevailing understanding within the academic hazard, risk and vulnerability literatures. This type of analysis is important because the power embedded within present flood management rests in the perceived veracity of its historical basis. In this light, by exploring the origins and entrenchment of the prevailing understanding relative to the perspectives of those responsible for present management, we might better understand the issues, knowledges and controversies that shape increasingly how disasters, development and sustainability are understood in Bangladesh.

In addition to describing the research questions that shaped this project, in this introductory chapter, I describe how my analysis of flood management in Bangladesh was formulated, exposing the context and rationale of my topic and methodology. I aim to communicate its relevance to not only flood management in Bangladesh but also as a way of exploring its connections to hazard and risk research more widely. Given the complexity and controversy that shapes research of the human-environment interface (Stengers, 1997; Nowotny et al., 2001; Nowotny, 2005; Whatmore, 2009), there is need for such reflexive explorations of knowledge and the assumptions that enable its entrenchment. In addition, it is important to admit that knowledge contestation has become endemic. In cases such as the acid rain controversy, the bovine spongiform encephalopathy scare, the resistance to genetically modified foods and the climate change debate, controversy is a precondition, becoming the backdrop of the science-society interface. This situation requires further consideration in relation to hazard and risk. With this context in mind, I acknowledge that this research and the research

problem did not simply appear and, so, my aim in this chapter is to problematise[2] the presumptions that shaped the formulation of my thesis. I begin with a discussion of the structure, providing an outline and description of the context in which this project began. I follow this discussion with a brief summary of the topics, backgrounds, findings and arguments from each of the chapters, including an account of my ontological and epistemological positions. I then explain my over-arching and formative research questions, outlining the relationship between the historical narrative and the expert understandings. Finally, given the critical importance of space and place, I conclude with a description of the physical and social geography of Bangladesh.

THESIS STRUCTURE

This research focuses on the multi-dimensional issues of flooding, flood management and vulnerability in Bangladesh, drawing on disparate groupings of scholarship to follow several interwoven issues (Latour, 1993; 1999) within the wider context of disaster management, the social sciences, development studies, engineering, the natural sciences and flood management (Figure 1). The overlap between different fields enables the research to draw upon multiple interpretations, some of which hold opposing assumptions or seek competing objectives. This tension complicates the research but also enables innovation, recognising that research of environmental management cuts across traditional academic divides (see Figure 2 for a rough example of how the chapters draw upon multiple fields).

[2] I seek to emulate the concept of a *problématique*. By this, I mean to attach the context and the methodology to a discussion of the questions, and sub-questions, that shape the research, admitting and emphasising the implicit embedded elements that underpin the research questions.

Figure 1: The disciplines that inform this research

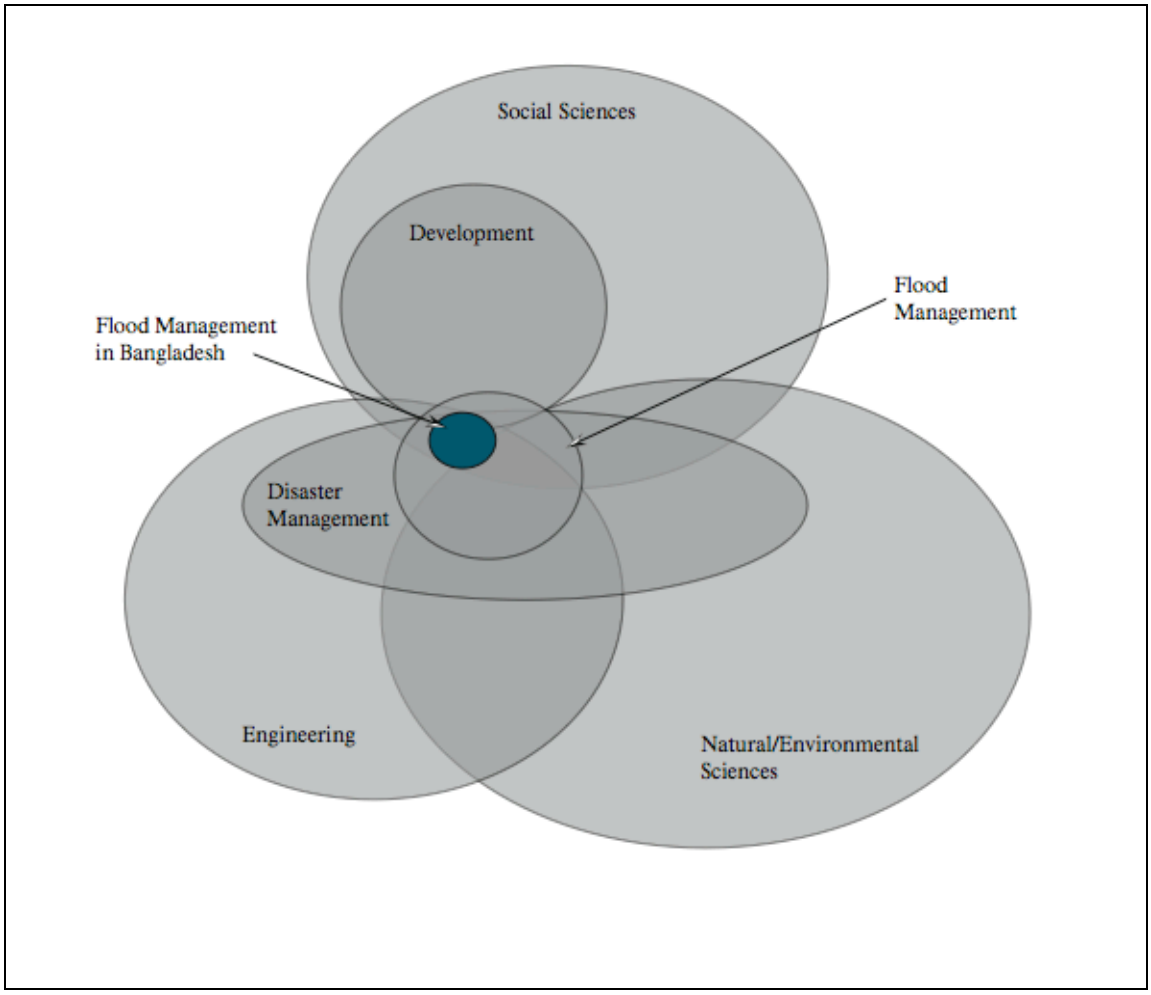

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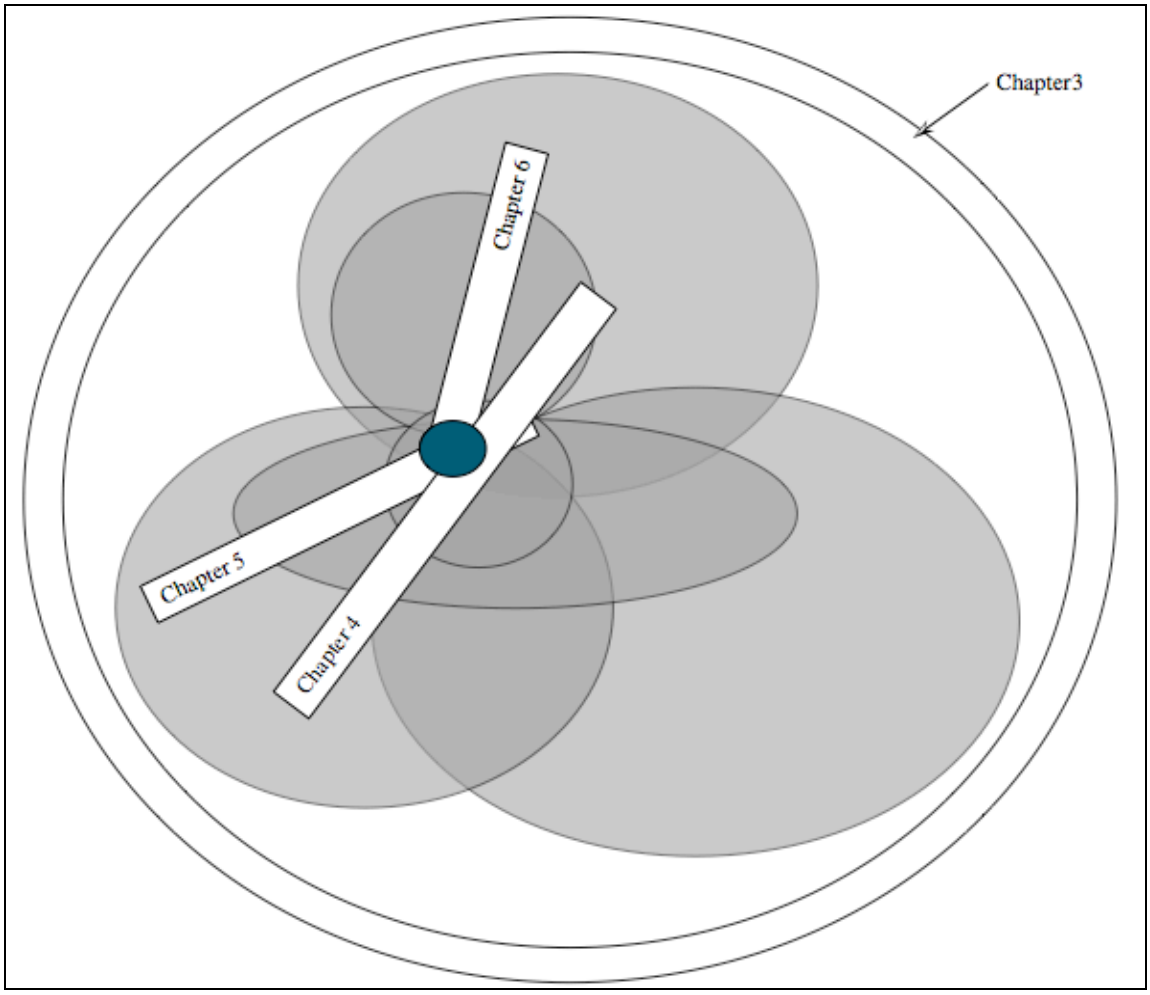
Figure 2: Chapters in relation to the disciplines



Source: author

his exploration and analysis is divided into seven chapters organised into two sections. The first chapter explains the context in which the research began. I suggest that Bangladesh acts as a proxy for the developing world within knowledge of environmental management, contributing to and in some ways vindicating the construction of this caricature. This foundation is indebted to Said's (1978) account of Orientalism. While the scope of my research is more directed, I suggest that, generally, it enables an exploration of the prevailing understanding by drawing upon the voices of experts actively shaping flood management. The second chapter explains the methodology implemented to approach the research questions. The chapter serves two purposes: first, to explain my interpretation and use of complexity theory as the basis of my theoretical framework and second, to describe the methods. I argue that complexity theory provides

an innovative epistemology and accommodating ontology that, together, facilitate research of knowledge controversies, which is the concept I adopt to conceptualise the core debates and overall conflict surrounding flood management in Bangladesh. The third chapter provides the counterbalance for the entire thesis. In it, I draw upon the academic and government flood management literatures to describe a history of what I have labelled the 'prevailing understanding' of flood management in Bangladesh, summarising the periods or paradigms of management as presented within the academic flood management literature, most recently by Smith and Petley (2009). Challenging the traditional separation of government publications, context and academic communities of knowledge (Cook and Lane, 2010), the narrative exposes three debates that punctuate the wider flood management controversy. The historical account provides the basis for the ensuing analyses, drawing upon the expert understandings to shape the three chapters that compose the second section of the thesis.

The three issues exposed by the history are prominent within the controversy over flood management in Bangladesh. They structure the thesis by providing the entry points and the themes that informed the interviews with flood management experts. The fourth chapter explores the competing understandings of flooding, flood management and vulnerability among the experts. The discussion exposes the multiple nuanced interpretations of vulnerability, each supported by numerous implicit and explicit assumptions concerning the objective of flood management. The experts describe and substantiate understandings of vulnerability that contradict several assumptions embedded within the prevailing academic understanding. They also suggest a broader interpretation, much like risk, in which disasters mutate or co-evolve with management, challenging the classifications of disasters within most of the academic hazard and risk literature. The fifth chapter explores a long-standing debate between technical and social methods of flood management. It challenges the progression of this debate toward a compromise, suggesting that such conciliation is founded more on ideal than on the implementation of flood management. Alternatively, building upon the unsettled, partial, temporary and adaptive understandings expressed by the experts, I suggest that the debate over the 'living with floods' concept provides insight into the fundamental

differences between flood management in Bangladesh and the prevailing understanding within the academic flood management literature. The sixth chapter explores the emergence, and possible establishment, of a human development understanding of flood and hazards management (Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009). This chapter focuses on the power relations, biased toward the developed world, that not only fund development initiatives in Bangladesh but also establish and entrench particular understandings, objectives and characterisations. The experts identify non-governmental organisations and the wide adoption of micro-credit to explain how development knowledge-power exerts influence over flood and disaster management. In this context, the experts warn that neglecting Bangladesh's disaster-prone nature results in an entrenchment of personal debt that increases vulnerability, particularly for those near the poverty line. Finally, the seventh chapter summarises the thesis and explores some of the resulting questions and areas for further study.

A concurrent research process

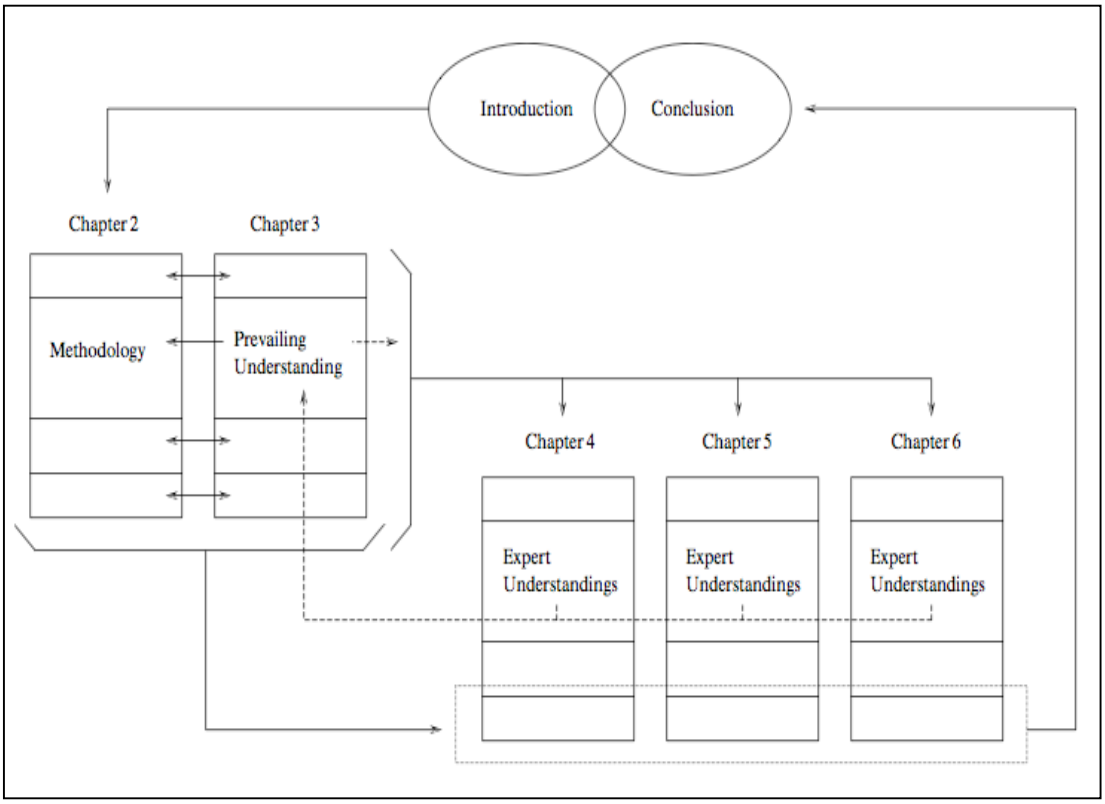
A strictly linear research process, or insistence that the research be presented in such a manner, is a poor means of recognising or communicating the complexity of the Bangladeshi socio-physical context. Rather than a sequential methodology, analyses of flood management require concurrent co-evolutionary consideration of the issues, contexts, theoretical framework(s), methods and analytical framework(s) (Figure 3). There are two issues that complicate the presentation of this research: the first is the complex relationship between the factors involved in flooding and research of flood management in Bangladesh; the second involves the communication of this complexity. Figure 3 visualises how the organisation and structure of the thesis challenge any suggestion that the research was conceived, theorised, implemented, analysed and communicated in independent sequential stages.[3] Instead, I have constructed an adaptive and relational approach to facilitate the exploration of a complex system of relations

[3] While I appreciate that few researchers would claim this is an accurate reflection of the research process, I do maintain that we allow this vision to persist because we do not acknowledge the messy realities of the research process or the distortions that accompany the communication of research findings using a thesis.

while continually assimilating knowledge and findings into the process. For example, this approach allowed early findings to challenge the assumptions used to develop the research questions, leading to re-articulation of those questions while in the field (Chapter 2). In addition, in response to the field research, I reconceptualised my use of networks and assemblages after recognising assumptions concerning the applicability of aggregated knowledges. While this adaptiveness facilitated innovative research of the interrelations between knowledge, power and environmental management, it raises the issue of consistency. I argue that it is better to have adapted the methodology while retaining the research themes than to remain inflexible to the realities of the field. As opposed to veiling the uncertainties, problems, evolution and learning that shaped this research, I have sought to capitalise on these issues to expose and explore the diverse collection of knowledges that contest, support and ultimately shape flood and disaster management, including my own. Figure 3 illustrates the connectivity of the thesis chapters, showing how the methodology (Chapter 2) and history of the prevailing understanding (Chapter 3) situate, produce and refract the subsequent chapters. The flow chart shows how the research continuously re-engages the historical narrative with the expert perspectives, encouraging reflexive findings and conclusions. Each of the chapters are organised following the same format, with an introduction followed by a discussion of the context or assumptions, findings, arguments or themes and conclusion. This symmetry feeds into the co-evolution of the thesis as a whole, confronting the reductionist-aggregate assumption (see Chapter 2) common to environmental hazard research. Briefly, figure 3 demonstrates how I maintain an appreciation of the whole, while also recognising the need to explore themes and issues at a more manageable scale. By continuously reflecting the expert perspectives and the prevailing understanding, I hope to have avoided the pitfalls of subdividing the research into interesting but incomparable components or assuming that those elements can be reconstructed in an intelligible manner (Anderson, 1972; Byrne, 1998). I recognise that my knowledge is also constantly evolving and that, much like the accumulation of disparate understandings that inform flood management (Chapter 3), my views have been fragmented by the diversity of the opinions and interpretations. A critical aspect of this research is recognition that the research process and communication are, themselves,

heuristic devices (Richardson, 2000; 2002). Following from this assumption, the methodology has continually revised, revisited and reconfigured its assumptions, knowledges and practices. This approach challenges the implication of sequence, though, at some point, the research must be 'laid down' to be communicated and assessed. This thesis, then, is more accurately a moment during the research process rather than its culmination.

Figure 3: Thesis structure showing chapter relations



Source: author

My theoretical basis

I approach the issue of flood management in Bangladesh with an interest in the privileged or universalist presumptions and knowledges that inform authority. As Richardson (2002: 415) explains, "[w]herever truth is claimed, so is power; the claim to truth is also a claim to power". I am concerned with how such knowledge claims shape and are shaped by the implementation of flood management, bridging the relativist-realist divide. For me, research that explores the role of socially-constructed knowledge

does not entail a denial of the importance of engaging such analyses with the material context in which they exist (Demeritt, 2002; McEwan, 2003). Given this assumption, this research is about better understanding the relationship between power, knowledge and practice with reference to flood management in Bangladesh. Parker (1998: 2) supports this interpretation with reference to psychology, explaining that realism:

> "grounds discursive accounts of mentation in social practices whose underlying logic and structure can, in principle, be discovered… Realism and critical realism run alongside the social constructionist attacks on the discipline while preventing the wholesale collapse into discourse idealism".

Building upon this argument, relativism and realism are not mutually exclusive; they can be unified as a means of emphasising the role of knowledge and power alongside efforts to explore the impacts of knowledge-power in the world. Incorporating this premise into my complexity-based methodology, I support Manson and O'Sullivan's (2006: 681) argument that:

> "[c]omplexity does not posit an all encompassing ontology in that it focuses on entities and the relations among them, a premise that directs attention to the kinds and strengths of relationships in a system… This breadth of perspective in complexity allows the application of ideas from complexity science across the continuum of realist to constructivist approaches to science".

While Manson and O'Sullivan are not endorsing a simultaneous realist-constructivist approach, there is no reason that research cannot unite the two. Such theoretical collaboration, what Reed (2008: 102) describes as 'reflexive realism', is attuned to historical change and able to consider how materially-reflexive knowledge contributes to social constructions. My theoretical basis, then, is indebted to Sayer's (1989) analysis of historical narratives, exploring the dangers and insights afforded by accounts that recognise the situatedness of historical accounts. As Gregory (1994b: 502) explains:

> "the linear narratives which are typically used to encase and carry causal chains need to be interrupted and illuminated by irony, paradox and coincidence as a way of sparking off further critical reflection. In this sense, although not in most others, the philosophy of realism intersects with the interest in representation to be found in postmodernism".

In other words, it is with the aim of sparking off such critical reflections that I relate flood management over time with the grounded knowledges of present day experts in Bangladesh.

Constructing and employing a historical narrative

Broadly, the approach I have adopted is founded on exploring the relationship between what I have labelled the prevailing understanding of flood management in Bangladesh with the understandings of the experts responsible for, and actively engaged with, flood management. In addition to comparisons amongst the expert perspectives, this situation begs the question: on what basis, or to what standard, can competing knowledges be assessed? This question raises the issue of comparing multiple relative understandings, each a product of countless material, historical, experiential, cultural and personal factors. In response, I have collected and combined numerous histories of flood management in Bangladesh, replicating the prevailing interpretation of the prevailing understanding, grounding one element of this research in the Bangladeshi caricature within developed world accounts. Rather than construct an oppositional binary (Bingham, 1996; Murdoch, 1997a; b), this juxtaposition of knowledges is predicated on recognising the integrated, mutually-dependent, interacting and overlapping relationship between different assemblages of knowledge (DeLanda, 2006; Li, 2007). By this, I mean that while the expert perspectives and knowledges are considered in relation to the prevailing understanding within the academic hazard and risk literature, they are simultaneously a part of that understanding. This use of expertise (defined in more detail in Chapter 2) enables a more reflexive examination of the power underlying the knowledge claims that inform flood management.

The prevailing understanding is a generalisation and simplification that is disassociated from its basis. The construction and entrenchment of prevailing knowledge hide the uncertainty and contentiousness of the knowledges on which dominant forms of understanding are founded (Foucault, 1977; Said, 1978; Rabinow, 1984). Given this context, I argue that the competing histories, each an actant within the assemblage, obscure the contested nature of flood management knowledge and contribute to a powerful account that influences decision making. Recalling Said's reference to Aeschylus's play, the prevailing understanding shapes the characterisation of

Bangladesh in the developed world, with all of the ramifications born out of that power relationship (see Chapters 5 and 6). Relative to the prevailing understanding within the academic literature, the experts facilitate a different perspective, one that is 'closer' to the issues, having not been generalised, categorised, simplified or extrapolated to the same degree: in essence, having not been made to conform to a developed world framing. Just as Latour and his colleagues (1999: 2 italics in original) wish to '*extend* the scientific outlook to science itself', I aim to expose a generalised understanding of flood management to the detailed knowledge claims on which it is founded. There are multiple histories of flood management in Bangladesh (see Chapter 3), each a particular framing shaped by interests, positions, histories, experiences and relations. In addition, there are multiple scales of understanding. By this, I mean that to expect a generalised account of hazard and risk to match the detailed opinions and perspectives of flood management experts over-simplifies the relationship; alternatively, the juxtaposition of such related-yet-separated understandings facilitates innovative analyses, particularly in instances where they differ. This comparison of understandings, then, is much more a negotiation of related and overlapping knowledges than a straightforward comparison of competing versions. While I do compare and contrast the prevailing and expert understandings, it is always with an appreciation for the multiple, dependent and complex interrelationship between these related means of knowing flood management in Bangladesh.

The prevailing understanding is a codified and regimented construct that fulfils the needs of the academic world and those dependent on its reproducibility (Latour and Woolgar, 1979; Latour, 1987). I suggest that it represents how science and the developed world expect societies to be understood and managed, involving a transformation of knowledge to comply with those expectations. The prevailing understanding is a sanitised product relative to the specificity of the expert perspectives on which this thesis draws. Again, drawing upon Latour (1999: 53), once a pattern or narrative is imposed upon the world, it would be astounding if it did not shape knowledge production. While there is value in multiple understandings, the simplification, generalisation and decontextualisation of the prevailing understanding severs it from the knowledges from which it originates. This research, then, is about

returning a homogenised form of understanding to its origins. I rely on Foucault (1984 [1971]: 77) to inform this objective (see Chapter 3) and his argument that such an approach:

> "does not oppose itself to history as the lofty and profound gaze of the philosopher might compare to molelike perspectives of the scholar; on the contrary, it rejects the metahistorical deployment of ideal significations and indefinite teleologies".

To answer the research questions, an account and analysis of the prevailing understanding was required. My historical narrative gathers multiple academic and government accounts of flood and disaster management as well as more specific accounts of flood management in Bangladesh to describe the prevailing understanding over time (see Chapter 3). This historical construction treads a delicate line between replicating the grand narrative motif and my aim of providing a broad basis for understanding the expert knowledges and understandings (Foucault, 1984 [1971]).

The research questions

There is growing recognition that conflict is no longer simply an outcome caused by management of the human-environment interface (Stengers, 2000; Nowotny et al., 2001; Wynne, 2006; Whatmore, 2009; Lane et al., in review). Instead, controversy is the new space in which environmental management operates, producing modern and complex assemblages, begging the question as to whether established forms of knowing can address emerging problems (Giddens, 1991; Beck, 1992 [1986]; Gibbons, 1999). The knowledges that inform competing understandings – and the resulting management strategies – offer an opening for an innovative exploration of long-standing and protracted debates such as those surrounding flood management in Bangladesh. Given this context, I develop this thesis around the central question of *how an analysis focused on competing knowledges, assumptions and framings of flood management experts differs from the prevailing or entrenched understanding within the academic literature?* This focus on the knowledges of power-holding experts, I argue, enables an analysis able to overcome the decontextualisation of the prevailing understanding: to 'see past' the shutters that normally hide the basis of expertise. This over-arching objective runs

throughout this project, shaping the ensuing questions, methods, analyses and findings. Given the controversy, this approach aims to facilitate an alternate interpretation and, ultimately, contribute to better flood and disaster management.

The historical review (Chapter 3) provides the backbone for this thesis, though it was also a product of and an influence on the methodology (Chapter 2). In this sense, despite their presentation, Chapters 1-3 were developed concurrently rather than successively. In effect, just as the methodology argues for a complexity based analysis of flood management, it is itself such an assemblage.[4] The methodology and narrative provide the basis for Chapters 4-6 by exposing the issues that punctuate the flood management controversy, according to developed world sources. In this context, building upon the initial research question, the thesis is divided into pre- and post-narrative stages in order to emphasise that the post-narrative research questions are the product of an earlier stage of the project.

Pre-narrative

The first-stage research questions asked: 'what is the prevailing understanding of flood management? in Bangladesh?', 'what is its basis or origin?' and 'how has this understanding changed over time?'[5] In addition, a secondary question asked: 'what are the key issues (debates or controversies) that have and continue to shape flood management in Bangladesh?'

Post-narrative

Following from the construction and analysis of the prevailing understanding over time, three prominent issues were identified within the flood management debate, prompting

[4] By this, I mean that changes to one argument or aspect of the thesis have ramifications for the thesis as a whole.

[5] The periodisation is inconsistent due to the availability of sources and differing perspectives. I did not want to predetermine the time span that I would include, though I accepted that the last 100 years was the approximate period for which data and commentary would be available.

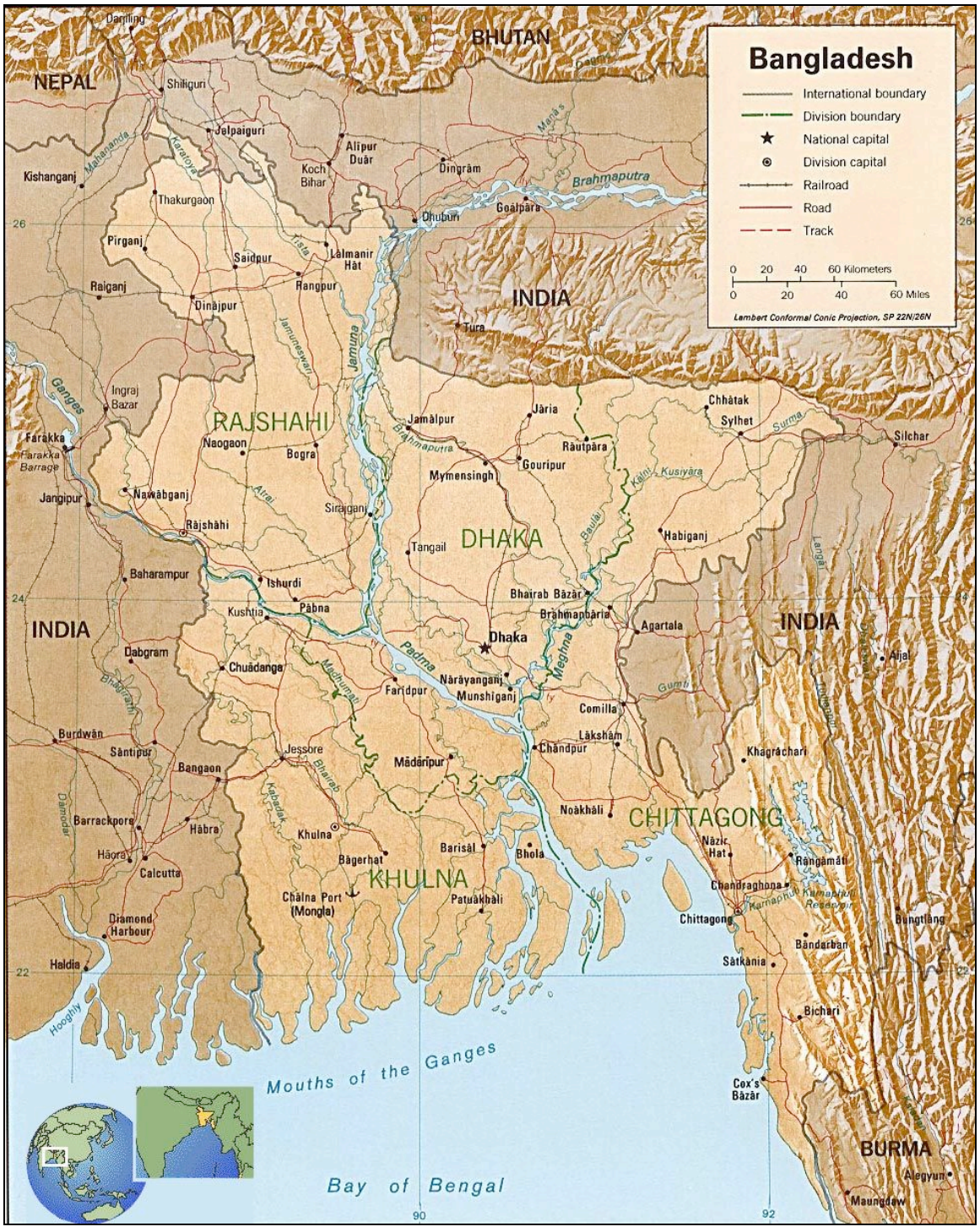
three further research questions predicated on relating and comparing the prevailing understanding with the opinions, perceptions, knowledges and beliefs of flood experts in Bangladesh. They asked: 'how do experts interpret/understand flooding, flood management and vulnerability?', 'how do experts interpret/understand the debate between technical and social forms of flood management?' and 'how do experts interpret/understand development and the development paradigm of flood management?'

THE DISASTER CONTEXT AND GEOGRAPHY OF BANGLADESH

More than most places on Earth, Bangladesh is a complicated mixture of wealth and poverty, cleanliness and filth, generosity and selfishness and subjugation and opportunity. In no way is it the simple, passive, incapable or homogenous generalisation common within developed world 'imaginings' (Wooldridge, 1998; Bowen and Pallister, 1999; Oxfam, 2008a; Abdullah, 2010; Oxfam, 2010). In terms of disasters, Bangladesh awaits its next water-related catastrophe, be it flood, drought, famine, storm surge, large-scale river avulsion or some combination thereof. When this occurs, a familiar controversy will emerge in which the potential benefits and negative consequences of competing management strategies will again be debated. Proponents of large-scale approaches will capitalise on the death and hardship caused by the event(s) while critics of technological adventurism will warn of uncertainty and the disproportionate distribution of negative impacts. The end result, according to precedent, will be further conflict between irreconcilable positions, producing what Stengers (1997; 2000) and Whatmore (2009) have labelled a 'knowledge controversy'. If the death toll from the disaster generates sufficient publicity, the international community will once again become involved more formally. Despite the desire to help, the fear of appearing imperialistic and criticisms from all corners will temper involvement, resulting in the dissection of the problem and an endorsement of further analyses to better understand the complex social and physical factors. At that point, the interest, enthusiasm and funding will prompt researchers to deliver timely and policy oriented findings. Of critical importance, the irreconcilable positions in this debate are rarely grounded in

Bangladesh; rather, like Said's Orientalists, they are at arm's length, relying on the prevailing understanding to inform their positions and guide their intentions (UN, 1956; IECO, 1964; World Bank, 1989-1995; Asian Development Bank, 2003; UN, 2003; IMF, 2005; UNDP, 2006; World Bank, 2006; IPCC, 2007). While the need for dependable and intelligible knowledge following the disaster is imperative, it is this *reapplication* of methodology with the aim of generating *innovative* knowledge that explains the rationale for a conceptual framework that challenges the entrenchment of the prevailing understanding.

Figure 4: Map of Bangladesh



Source: CIA (2009) World Factbook

Geography is a key aspect of the socio-physical interface that shapes flood, disaster and environmental management in Bangladesh. In this sense, the physical geography

represents an actant within the assemblage of people, things and ideas that contest, constrain and inform flood management. Bangladesh is a small nation (Table 1) with few natural resources (Brammer, 2004; Höfer and Messerli, 2006; Hossain, 2006; Central Intelligence Agency, 2009). Virtually all of its landmass is deltaic. As a result, nearly 80% of the nation is labelled as floodplain with more than 50% of that land within 5 metres of mean sea level (Hossain, 2006). Located between 20°34″ and 26°38″ north and 88°01″ and 92°41″ east, it has a tropical and humid climate (average annual temperatures range between 25° and 35°C) dominated by the Indian Ocean and the annual monsoon (July – October). In addition to extremely high levels of annual precipitation (between 2200 and 2500 mm), it is also spatially discontinuous, with occurrences between 1200 and 6500 mm (Hossain, 2006). Approximately 80% of the annual precipitation occurs during the monsoon (Höfer and Messerli, 2006), leading to a relatively ephemeral hydrological regime despite the amount of water and scale of the rivers. Bangladesh's hydrology is dominated by three river systems, two of which change name once crossing the border with India (Figure 4): the Ganges (Padma), the Brahmaputra (Jamuna) and the Meghna. The rivers have a combined catchment of approximately 1.7 million km^2 shared between Bangladesh, Bhutan, China, India and Nepal (Brammer, 2004). The massive basin relative to Bangladesh's area produces a situation in which, despite providing the outlet for roughly 1200 billion m^3 of water and 2 billion tons of sediment annually, Bangladesh controls only 7% of the combined catchments. Further complicating matters, in accordance with the seasonal precipitation, approximately 80% of the annual volume flows through Bangladesh between June and September (Hossain, 2006). Bangladesh is described as the bottleneck of South Asia, one that is clogged increasingly with sediment, infrastructure and people. Its physical geography causes damages and exacerbates disastrous flooding, though it is its social geography that is used to explain the impacts of such events (Brammer, 2004; Höfer and Messerli, 2006; Hossain, 2006). For example, figure 5 shows an informal housing area in Dhaka; rather than emphasise water levels or drainage, flood management is concerned increasingly with the socio-economic factors that produce such residences (see chapters 3 and 6 for further discussion).

Figure 5: Informal housing in Dhaka

Source: author (15/02/08)

Bangladesh's social geography is characterised as a struggle between people and their environment, often with reference to limited agricultural production (Islam, 1990; Ali et al., 1998; Ahmed, 1999a). Bangladesh is presented regularly as a developing nation beset with tragedy, including natural, socially-constructed and hybrid disasters (Smith and Ward, 1998; Collins, 2009; Smith and Petley, 2009). In addition to its physical traits, the nation has a massive population, extreme poverty (see Table 1) and governance accused of being corrupt (Brammer, 2004; Höfer and Messerli, 2006; TI, 2008; Central Intelligence Agency, 2009). Alternatively, its dense population, despite the poverty and vulnerability, is identified as a valuable resource, a claim supported by the economic influence of the garment sector and of foreign remittances from labourers working in the Middle East (Central Intelligence Agency, 2009). Bangladesh is an impoverished nation. In the most recent United Nations human development index, it is

ranked 146th between Madagascar and Kenya, though its GDP per capita ranked 155th between Benin and The Gambia (UNDP, 2009a). Its massive population and small area with limited resources are most often used to explain the development and entrenchment of poverty, particularly the 35-45% of the population who live below the national poverty line or the 81% of the population who subsist on less than two dollars per day (Central Intelligence Agency, 2009). The population has undergone significant growth and is projected to surpass 220 million by 2050 (UNDESA, 2008; Central Intelligence Agency, 2009). This growth places incomparable pressure on space. The most telling outcome of this circumstance is the quick appropriation and cultivation of *charlands* (Figure 6). Despite improvements in life expectancy, the average Bangladeshi is expected to live to approximately 60 years of age, three years shorter than in India and twenty-two years below the Japanese (Central Intelligence Agency, 2009; UNDP, 2009a). A majority of the population derives its income from agriculture, though in terms of the economy, agriculture contributes relatively little (Table 1). This situation disguises the complex relationship between agriculture, particularly rice production, and the stability of both the Bangladeshi economy and the political system.

Figure 6: Char formed in the Southern Ganges (Padma)

Source: author (06/01/08)

Perhaps the key social issue situating research of flood management is the relationship between population, rice production and poverty. Briefly, agricultural development has had to accommodate a fast growing population dependent on rice for both subsistence and livelihood. This situation is outlined by the Food and Agricultural Organisation of the United Nations (2010) and Brammer (2004: 42), who explains that:

> "crop production in Bangladesh has virtually kept pace with population growth in recent decades. Rice production grew from 10.03 million tons of clean rice in 1972-73 to 19.90 million tons in 1998-99, during which period the country's population grew from about 75 million to almost 130 million".[6]

[6] According to the FAO (2010) the figure for 2008 was just under 47 million tons, though this data set differs from the figures cited by Brammer for 1972-73 (15 million tons) and 1998-99 (30 million tons) due to differences between 'clean' and unhusked rice.

Explanations for the ability of agriculture to keep pace with population are contested, though the introduction of high-yielding varieties of rice, the expansion of small-scale irrigation to support a summer crop, the control of damaging floods and the provision of fertilisers are often cited (Brammer, 1981; Haque, 1997; Brammer, 2004; Höfer and Messerli, 2006; Paul and Routray, 2009). Flooding has a complicated relationship with rice cultivation. It provides moisture and enables the nitrogen generation required for crop maturation (Brammer, 2004); simultaneously, unusual water levels are capable of destroying crops at every stage, from seedling to transport to market. This relationship has led to the development of numerous social and physical mitigation strategies in which flooding within a particular, though subjective, range is interpreted as beneficial while levels above or below are viewed as detrimental (discussed further in Chapter 4). In addition, Sen (1981) argues that the link between flooding and famine is intuitive and that, rather than decreased production, social processes such as alarm, hoarding and economic disempowerment explain more accurately the occurrence of famine. Regardless of the exact mechanisms, agriculture is pertinent to an analysis of flood management in Bangladesh. More importantly, the beliefs, biases, traditions and cultural influences that shape understanding, in this case concerning agriculture and poverty, are crucial to an analysis of flood management. Nationally, the primacy of agricultural development (see Chapter 3) contrasts with the overwhelming emphasis on poverty alleviation externally (UNDP, 2006; 2008; United Nations, 2008; UNDP, 2009b). While the two are linked, they are indicative of the competing understandings with which flood management in Bangladesh is situated, emerging in within debates over technical management (see Chapter 5) and human development (see Chapter 6).

Table 1: Figures at a glance

Area	147, 570 km^2
Population (July 2009)	156, 050, 000 (2050: 222,495,000)
Population density	1057 people/km^2
Annual population growth rate	1.292-1.424%
Birth rate	24.68 births/1,000 population
Life expectancy (2009)	60.25 years (ranked 184th globally)
Literacy rate (7 years and above, 2002)	51%

Seasons	Winter (November – February) Summer (March – June) Monsoon (July – October)
Principal seasonal crops	Rice, wheat, jute, tea, tobacco, sugarcane, pulses, oilseeds, spices, potato, vegetables, banana, mango, coconut and jackfruit
Area of rice cultivation	89% of total agricultural land
Employment in agricultural sector (agriculture, forestry and fisheries)	63%
GDP per sector	Agriculture (19%), Industry (29%) and Services (52%)
Labour force by occupation	Agriculture (45%), Industry (30%) and Services (25%)
Per capita GDP (2009)	US[7] $1600 (ranked 192nd globally)
Population below poverty line [8]	35-45%
Human Development Index (2009)	146th (classified as medium human development)
Population living below $1.25/day, $2/day	50%, 81%

Sources: Brammer (2004); Hossain (2006); Höfer and Messerli (2006); Population Prospects UN (2008); UNDP (2009a, b); CIA (2010)

The research implications

Despite beginning with the relatively simple objective of exploring the competing understandings of flood management among experts relative to the prevailing understanding of flood management, this research has encountered significant, but not unanticipated, problems and obstacles. The issue of flood management in what is now Bangladesh has challenged researchers, politicians, civil servants and, most importantly, floodplain inhabitants for unknown generations. There is a wealth of knowledge born out of that experience, in both scientific and lay contexts, which has become the focus of academic study, sometimes labelled a collaboration between certified and non-certified experts to better understand the socio-physical and society-science interfaces (Wynne,

[7] All dollars are 2008 US dollars.
[8] The exact calculation of this figure is unknown.

1993; Wynne, 1996; Jasanoff, 2003b; Wynne, 2006; Whatmore, 2009). Simultaneously, the applicability of such knowledges and understandings is challenged by the claim that (post)modern problems may be different. The challenge of modern disaster management may rest in the inapplicability of experience and may require a reorientation of knowledge production towards an uncertain future. With reference to those traditionally involved in risk management, Beck (1992 [1986]: 71 italics in original) warns that they:

> "face *a historic turning point*: they can continue to think and work in the worn-out ways of the nineteenth century. Then they will confuse the problems of the risk society with those of early industrial society. Or they can face the challenges of a genuine, preventative management of risks. Then they must rethink and change their own conceptions of rationality, knowledge and practice, as well as the institutional structures in which these are put to work".

In the case of flood management in Bangladesh, then, the emergence and convergence of issues such as population and climate change, urbanisation, pollution, poverty, sedimentation and resource use are creating new and more complex challenges that will challenge either traditional, certified or non-certified assumptions. This situation is at best disconcerting. There is a distinct possibility that future disasters, while a product of past and present action and knowledge, may represent different or more complex issues than ever before. These assemblages of interdependent and evolving issues may not submit to knowledge stubbornly attached to past forms of understanding. In essence, the reason to question the prevailing understanding is the probable need for alternate and hybrid means of interpreting the human-environment relationship. The comparison of prevailing and experienced expert understandings offers an opportunity to juxtapose competing forms of knowledge and knowledge production. This format is not without risk. It is prone to lapses into binary comparisons between extreme or over generalised examples, which shade the more nuanced and meaningful relationships between what is known, what is experienced and what is done. In addition to the immediate issue of flood management in Bangladesh, the methodology facilitates a wider consideration of risk, expertise and environmental change within the context of complex socio-physical issues. Hazard and risk research, particularly that common within geography, is well positioned to push the methodological boundaries and challenge the prevailing assumptions and knowledges that shape management.

ENGAGING WITH THE GROWING COMPLEXITY OF FLOOD HAZARD RESEARCH

2

> *In managing such a project, you have to integrate data and information that the managers can discuss with the people. You have to integrate the national flood forecasting, so that when the risks are higher, you can mobilise more people, more rivers, more money. These things will have to all be linked with forecasting. Right now, people make decisions based on their memories or past experience 'now I have to do this' but they don't actually link it with available data. It is an extremely complex river network. You cannot actually design or decide about a plan by looking at one particular river. You cannot be sure that the water isn't coming from another river. To know all of these things you must have a clear picture of the locality in terms of the national river system.*
>
> (Cons 1[9]: 26/01/08)

Water, flood and disaster management in Bangladesh is arguably the most complex human-environment relationship on Earth (Haque, 1997; IPCC, 2007; Sultana et al., 2008a). Individually, demographics, climate and resource projections present staggering challenges to the long-term stability and security of South Asia (Myers, 1993; Brammer, 2004). Together, these issues contribute to a potentially insurmountable problem that cuts across issues as diverse as health (Hawkes et al., 1999; Hawkes and Hart, 2000), poverty alleviation (Yunus, 1999; Rigg, 2006), fisheries (Halls et al., 1998; Rohde et al., 2006), environmental justice (Paul, 1999; Coles and Wallace, 2005), climate change (Mirza, 2002; Mirza et al., 2003) and geopolitics (Ahmad and Ahmed, 2003; Brichieri-Colombi and Bradnock, 2003). Within the wider environmental hazards context, the diversity of these interconnected issues, along with evolving social science methodologies (Thrift, 1999; Law and Mol, 2002; Callon and Law, 2004; Urry, 2005),

[9] I have adopted an anonymised reference system for the experts who participated in this research (discussed in detail later in this chapter). The descriptions are outlined in Appendix A but, briefly, Cons 1 denotes the first independent consultant while, for example, NGO 2 refers to the second NGO manager interviewed.

has resulted in widespread recognition for the importance of *complexity* and of the *networks of relations* that frame controversies (Anderson, 1972; Horgan, 1995; Thrift, 1999; Zimmer, 1999; Stengers, 2000; Cilliers, 2001; Clifford, 2002; Thrift, 2002; Turner, 2002; Urry, 2005; Wynne, 2005; Whatmore, 2009). In much the same way that positive and negative feedback inform analyses of physical systems, as the epigraph shows, emphasis on the interactions between connected actants is being applied to not only social but also to hybrid socio-physical contexts (Bingham, 1996; Murdoch, 1997b; Whatmore, 2002). The breadth and overlap among the related issues, particularly concerning environmental hazards, have resulted in controversy, uncertainty and widespread dissonance between the competing knowledges, interests and stakeholders.

Relative to hazard and risk, research has only recently begun to engage with complexity and networks of relations (Warner et al., 2002; Dynes, 2004; Smith and Petley, 2009), though it could be argued that these issues have long been an underlying concern of researchers and managers. A long-standing emphasis on tangible impacts and mitigative reactions has inhibited the adoption of emergent social theory, resulting in a relatively stagnant field content to replicate established frameworks (Hewitt and Burton, 1971; Hewitt, 1983; Watts, 1983; Cutter, 2003; Smith and Petley, 2009). To address this impasse, I have constructed a conceptual framework founded on confronting three underlying assumptions from environmental hazard research. First, that environmental hazard research relies on scientific reductionism and an associated faith in the aggregation of knowledge. Although reductionism is an informative means of understanding systems, there is a simultaneous need for perspectives of the whole, ideally informed by those with both expertise and experience. Second, environmental hazards research has undergone a shift from realist to constructivist world views (Chapter 3), resulting in understandings that promote perceptions whose connections to the material world are unspecified. Third, following from the de-materialised understandings, environmental hazards research has become overly reliant on perceptions drawn from victims and vulnerable segments of society, leading to what Katz (1996) has referred to as a ‘competitive victimology’. This chapter outlines how I

accommodate these issues by implementing a methodology that draws upon complexity theory and incorporates aspects of network approaches.

This chapter explains the origins, development, application and refinement of my methodology. The interwoven nature of the issues informing this thesis require the ability to follow knowledge (Latour, 1993) by shifting emphasis away from disciplinary perspectives towards relations between actants (Callon, 1986; Latour, 1996b; Murdoch, 1997b; Sayer, 1997; Law and Hassard, 1999; Barry et al., 2008; Law, 2008) and the emergent systems that result (Manson, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006; Manson, 2006; O'Sullivan et al., 2006). The chapter explains the adoption and modification of complexity theory as a means of understanding the assemblage of knowledge, people and things that sustain the debate over flood management in Bangladesh. I adopt complexity theory's limited ontology and epistemological premises to explain my realisation of the research objectives. This chapter is divided into four sections: the first provides a background discussion, explaining why a new conceptual framework is required; the second summarises the premises of complexity theory that inform the methodology; the third explains how the inclusion of network theory resolves shortcomings within complexity theory; and the fourth summarises the issues that shaped data collection and analysis. Additionally, in describing the methodology, the chapter recounts some of the challenges that sparked reconsideration of the research assumptions, objectives, processes and/or findings.

THE ASSUMPTIONS THAT SHAPE THIS RESEARCH

The expansiveness of controversies restrained by a problem

Environmental hazards research must account for controversy, particularly consideration of the science-society relationship (Beck, 1992 [1986]) and of the issues that sustain such debates. Cutter (2003: 3) highlights some of the issues that shape the context, identifying:

> "large volumes of information about the risk or an event from the media, disputes over factual information (arguments among technical or scientific

> experts challenging data, assumptions, findings), and the visual dramatization of the event all lead to the amplification of the risk (or the risk event) along with its attendant impacts and management challenges".

In terms of flood management research in Bangladesh, the degree and vitriol of the controversy surrounding competing management strategies is renowned (see Chapter 3). Within academic, government and non-government publications, the aim to reduce disaster impacts and mitigate suffering has oriented research towards ends at the expense of considering the means (Thompson and Tod, 1998; Haque and Burton, 2005; Haque and Etkin, 2007; Sultana et al., 2008b). Haque and Burton (2005: 335) exhibit this tendency, arguing that:

> "there is a need to move towards the 'mission' of the International Strategy for Disaster Reduction which aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses".

This type of framing aligns research with the aims of management instead of the theories and epistemologies required to improve understanding. This process presumes a shared understanding and universal set of aspirations, values, knowledges and abilities. As a result of this emphasis on ends, debate over hazards management centres the social construction of differing visions, prioritising the people who promote or detract from competing futures (Cutter, 2003). More simply, the tension between actants is becoming more important than the underlying knowledge claims (Latour, 2003; Callon and Law, 2004; Sarewitz, 2004). As Whatmore (2009: 591) explains, in the context of uncertainty and controversy, attention shifts:

> "away from closer interrogation of the substantive differences between knowledge claims in terms of the knowledge practices, and the demands of the phenomena and processes enmeshed with them… They focus instead on tracing the organisational affiliations and language commitments of competing contributions/contributors to ground an evaluation of different 'positions' on the 'issue'".

The solution, according to Whatmore and others (Stengers, 2000; Nowotny et al., 2001; Nowotny, 2005; Whatmore, 2009; Lane et al., in review), is through public engagement, the redistribution of expert knowledge and more egalitarian decision making, though the viability and applicability of such conclusions are debated and situated (Haraway, 1991;

Cross, 1998; Pidgeon, 1998; Collins and Evans, 2002; 2003; Jasanoff, 2003b; Wynne, 2003).

The development or conceptualisation of knowledge controversies provides an opportunity for generative research in which the controversy enables exploration of the conditions that perpetuate discord. In part, it is the unsettledness of the controversy that provides the opportunity. Framing the analysis around controversy allows the research to escape the established remit of flood management research, in this case allowing me to enlist those with experience and/or expertise (Wynne, 1996; Collins and Evans, 2002). The use of controversy is very similar to Jackson's (2000) call to 'rematerialise' research or Gieryn's (2002: 130) description of 'truth spots', in which knowledge claims are taken:

> "back to their place of provenance, at which they were born, but from which they have escaped into the universal space of transcendent truth, no longer necessarily tied to the woods, farms or labs".

The use of controversies as starting points offers this research the opportunity to engage with and understand the social, cultural and material contexts that inform competing knowledge claims (Latour and Woolgar, 1979; Latour, 1987). In relation to the science-society controversy, Whatmore (2009: 593) argues that such flash-points ought not to be just about the confrontations between opposing perceptions, but of harnessing the "uncertain and provisional nature of the production of scientific knowledge claims". It is the generative opportunity provided by controversy that initiates this analysis of flood and hazards management in Bangladesh.

The generative and expansive nature of knowledge controversies is not without problems, raising the possibility of an ever expanding set of relevant and related issues, knowledges and actants. This 'opening-up' approach requires an equivalent 'closing-down' mechanism, providing an opportunity to adopt what Brewer (1999) labels a problem designate approach. He argues that the problem, however one defines it, is one way of directing research, recognising that "problems designate theory and methods, not the reverse, in sharp contrast to discipline-based and curiosity-driven inquiry" (Brewer,

1999: 328). The benefit of this orientation is the ability to use the problem to designate theory and method while also helping to constrain the research. While Brewer's overriding concern with human understanding is debatable (Bingham, 1996; Murdoch, 1997a; Whatmore, 2002), a problem-led approach can enable an innovative analysis of knowledge controversies by disregarding traditional research boundaries. Transdisciplinarity is ascribed this ability to overstep or challenge the prevailing research order (Clark and Dickson, 2003; Lawrence and Despres, 2004; Pohl, 2005; Barry et al., 2008; Demeritt, 2009). It is the combination of willingness to challenge prevailing knowledge and to cross disciplinary boundaries that unites problem designate and transdisciplinary analyses of knowledge controversies. The approach grounds research by focusing attention on the material realities of problems experienced in the world. As Pohl (2005: 1160) explains, transdisciplinarity is an approach "to compliment the ongoing specialization of science in order to address large societal challenges" while Brewer (1999: 328) notes that problem designate is "a means to shed new light on an actual problem".

Alternatively, transdisciplinary research, which by definition seeks to increase the amount and types of knowledge, neglects the issue of reconciling the resulting disparate and potentially opposing knowledges. Surprisingly, of the countless papers that contemplate interdisciplinarity's failure to produce successful findings (Brewer, 1999; Aligica and Brewer, 2004; Pohl, 2005; Barry et al., 2008; Petts et al., 2008; Pohl, 2008; Demeritt, 2009; Tress et al., 2009), there is very little consideration for the possibility that including all, or more likely a great deal of, relevant knowledge may inhibit both process and outcome. Within hazard and risk research, additionally, the integration of knowledge is widely held as a means of overcoming uncertainty. Along with the inadequacies of current analytical frameworks, the need for more integrated understandings are labelled the 'twin issues' facing vulnerability and hazards research (Cutter, 2003). Given this context, I use the problem to constrain the controversy; it provides a loose border that limits ascribing relevance ad infinitum. In this sense, the problem helps to reign in the potentially inhibitive scope of the controversy, conflict and debate surrounding flood management in Bangladesh.

Socially-constructed knowledge grounded by material understandings

"The shift from better-understood hazards to less-understood hazards has placed an enormous burden on science to identify hazards and assess their risks". As Kates' (1985: 56) prescient citation shows, the problem of overcoming uncertainty has been a common challenge for hazard and risk researchers. More specifically, the complexity of systems, diverse interests and objectives and unforeseeable relations has required that hazard and vulnerability research rely on a relatively narrow assemblage of knowledge. In addition, to grapple with the complexity, researchers must rely on simplifications and value laden perceptions to identify, explore, inform and manage hazard and risk (Kates, 1987; Freudenburg, 1988; Cutter, 1996; 2003). This dependence on perception has led to the creation of a false dichotomy between expert and lay knowledge in which 'real' (quantifiable) and 'perceived' knowledges are distinct and opposing. In reality, the division is a dubious assumption. Closely related to this characterisation, lay knowledge is portrayed as being flighty and easily manipulated by media and emotion. In particular, Kasperson et al. (1996) describe a situation in which social, economic and cultural factors can amplify or attenuate the perception of risk, thereby raising questions about the value of such knowledge. Interestingly, despite the possible sway or detachment from traditional forms of understanding, perceptions remain important determinants of action, knowledge and mitigation strategies (Cross, 1998; Pidgeon, 1998).

Broadly, environmental hazard research in Bangladesh is in the latter stages of a transformation from predominantly realist to moderate constructivist or relativist interpretations of disasters and disaster impacts (Chapter 3). More explicitly, I suggest the occurrence of a shift from interpretations that presume a reality apart from our perceptions to those in which perceptions and understandings are paramount (Freudenburg, 1988; Gould, 2000). Emphasising context, authors have come to recognise that knowledge of the environment cannot be divorced from the culture or society in which it forms (Douglas and Wildavsky, 1982; Woodgate and Redclift, 1998; Lupton, 1999; Demeritt, 2002; Jones, 2007). Constructivist interpretations frame hazard

and risk as the product of situated cultural understandings (Douglas and Wildavsky, 1982; Douglas, 1992; Cutter and Finch, 2008; Cutter, 2009). In this sense, following Demeritt (2002: 769), constructions are being used "to refute taken-for-granted beliefs about the essential nature of things – like gender differences – by showing that these things are not natural at all, but instead are somehow socially-constructed". Following these arguments, the concept of a disaster is being challenged on the basis that the prevailing definition is a western construction imposed on foreign contexts, much like Said's (1978) thesis on the construction and impacts of 'Orientalism'. This argument has led to numerous important findings regarding the nature of disasters, most notably that similar events in different, or even the same, spaces can result in distinct outcomes. This argument taken further, shows that a disastrous event in one context may not represent a disaster in another. In terms of disaster impacts, constructivist research continues to challenge accounts in which the environment affects people, instead arguing that it is the socially-constructed, institutionalized and reproduced relations that explain the distribution of impacts (Blaikie et al., 1994; Smith and Ward, 1998; Blaikie, 2000; Wescoat and White, 2003; Smith, 2004; Wisner et al., 2004; Smith and Petley, 2009). In addition, it is important to recognise that constructivist arguments are political and imply a need for radical change, a claim that is evident within the normative findings associated with the emerging human development interpretation (see Chapter 3) of hazard and risk research (Blaikie et al., 1994; Blaikie, 2000; Wisner et al., 2004).

Constructivist interpretations have refined and deepened understanding of environmental hazards, challenging the assumptions underlying many knowledge claims. For example, assumptions have been contested concerning how people respond to disasters (Burton and Kates, 1960) or the universal application of disaster-reduction strategies (White, 1945; 1974; Cuny and Abrams, 1983). Unfortunately, this circumstance has also resulted in a disconnection from the physical environment (Demeritt, 1996; Proctor, 1998; Demeritt, 2001; 2002; Jones, 2002) and from the materiality of disaster impacts. By presupposing a socially-constructed nature, and by then adopting perception- and opinion-based methods as the means of better understanding that construction, environmental hazard research is engaged in a self-fulfilling logic. This situation

undervalues the physicality of disasters, resulting in a problematic assemblage of numerous relativist understandings with little means of judging their applicability (Bonnett, 2003). This criticism is not a call for a return to positivist interpretations (that a description of the world is an accurate reflection); instead, it supports increased attention to the socio-material context of knowledge production and entrenchment. The prominence of constructivist analyses of environmental hazards, along with the undeniable importance of the material world, support the development of a conceptualisation able to accommodate both socially-constructed and material understandings (Latour, 1987; Woodgate and Redclift, 1998; Latour, 1999; Jones, 2002) of the disasters that arise via socio-physical relations. I argue that this context requires a conceptualisation able to accommodate both realist and constructivist approaches to hazard and vulnerability research.

The need for knowledge following disasters and the need for reflexive research

Environmental hazard research is recognised as being empirically or findings driven (Hewitt, 1983; Watts, 1983; Woodgate and Redclift, 1998; Jones, 2002; Adger, 2006; Smith and Petley, 2009). The immediacy of disaster impacts explains this privileging of established knowledge, as does the need to inform management and policy in the immediate term. Empiricism fulfils the need for grounded knowledge concerning specific locations under specific conditions, as opposed to more abstract ontological or epistemological explorations. Empirically-led research that aims to address societal issues, or what Barry et al. (2008: 24) label 'the logic of accountability', recognises "the range of ways in which scientific research is increasingly expected to be accountable to society", supplanting innovation and reflexivity with predetermined objectives (Nowotny et al., 2001). According to Whatmore (2009: 591), situations such as these produce findings that are "less attuned to the ontological demands of the complex phenomena they study" because they are overly concerned with their applicability and reception. This perspective orients environmental hazard research towards planning, mitigation and recovery. As Cutter (2003: 6) explains, "current trends in hazard vulnerability, however, are too focused on local social dynamics or identification of

physical exposure". These emphases help explain why hazards research has not engaged effectively with recent ontological and epistemological themes emerging from social and geographical research (Hewitt and Burton, 1971; Hewitt, 1983; Watts, 1983; Smith and Petley, 2009). Simultaneously, it is not that research must be either theoretical or empirical, but that dominance by one runs counter to innovation.

Environmental hazard research in Bangladesh continues to fixate on disaster impacts, reapplying descriptive empirical methodologies. Given the array and recurrence of disasters and the density of the population, the tendency is understandable. For example, the 'risk society' theory, which suggests that the modern context has changed to such a fundamental extent that the production of wealth has been replaced with reflexive concern for the production of risk (Giddens, 1991; Beck, 1992 [1986]; Blowers, 1993; 1997), is largely absent from discussion of disasters in Bangladesh. Whilst this theory has been criticised for being situated in the developed world (Harrison and Burgess, 1994), environmental hazards research in Bangladesh continues to endorse arguments that recommend a return to traditional coping strategies, such as raising plinths, planting tall trees to escape to and living with disasters (Haque and Zaman, 1989; Islam, 1990; Paul, 1998; Sillitoe, 1998b; Rashid, 2000). This advocacy for traditional coping mechanisms may be the most advantageous strategy available, but such conclusions would still benefit from consideration of their applicability in a (post)modern Bangladesh. Despite re-conceptualisations of the socio-physical environment, flood and hazards research in Bangladesh continues to focus on the prevention, distribution, recovery and coping of particular regions, households or individuals to disasters. Furthermore, the demands placed on research following a disaster reinforce established knowledges, methods and findings. More specifically, the immediate needs privilege the prevailing ways of understanding disasters. This is problematic in two senses. First, disaster research is cyclical and connected to the most recent disaster, creating high demand for knowledge that conforms to specific expectations and immediate usage. Second, the ends-orientation appears to encourage a context that lacks reflexive consideration for 'how' disasters are understood.

Environmental hazard research relies on several assumptions that are debated amongst geographers, including reductionism, universalism, social constructivism, normativity and activism. It is not surprising that reductionism shapes hazard and flood research. It is an intuitive and practical assumption that disasters can be broken down in order to facilitate analyses of such complex socio-physical phenomena. For example, cyclone impacts are dissected and allotted to disciplinary experts such as oceanographers, climatologists, sociologists and anthropologists. Conversely, small-scale processes are extrapolated to larger scales in order to grasp macro-scale phenomena. For example, river behaviour informs knowledge of the basin while individual behaviour is applied across regions and nations. Similarly, environmental hazard research assumes that relations between individuals are additive and projectable to other scales or contexts. In addition, environmental research assumes 'stationarity', or what Milly et al. (2008) define as the assumption that there is sufficiently little variation within environmental systems to assume that the future will 'behave' like the present. This assumption is closely related to the belief that the environment tends to return to a state of equilibrium following disruption (Schwartz and Thompson, 1990). Despite recognition that disasters are a normal and relatively constant aspect of society, hazards management, public expectation and hazards research remain fixated on lasting solutions, neglecting theories in which the environment is conceived as evolving constantly (Schwartz and Thompson, 1990; Bankoff, 2003; Smith and Petley, 2009).

There is wide recognition that the persistence of environmental 'problems' is at least partially a result of the entrenchment of the methods and theoretical frameworks used to construct the 'solutions' (Brewer, 1999; Aligica and Brewer, 2004; Pohl, 2005; Barry et al., 2008; Pohl, 2008). There is a need for an innovative conceptual framework able to account for the complexity of water, flood and disaster management in Bangladesh. I do not claim that this methodology should replace existing practices, which are predominantly reductionist, constructivist, atemporal or normative. Rather, I suggest that the prevailing conceptual framework requires a complementary perspective that is able

to challenge entrenched assumptions, understandings, methodologies and findings. In relation to flood and hazards research in Bangladesh, reaction to positivist and realist research founded on falsification has been replaced with normative 'minor theories' (Katz, 1995; 1996) seeking to affect equality, environmental justice and more egalitarian wealth and power distribution (Blaikie et al., 1994; Blaikie, 2000; Wisner et al., 2004; Collins, 2009). Most associated with the human vulnerability model of hazards (Blaikie et al., 1994; Wisner et al., 2004), the emerging understanding (Chapter 3) assumes a world dominated by inequality, injustice, impoverishment and oppression with the aim of intervention. I question whether, in this case, the normative assumptions of minor theory do not result in a major straw person? I have witnessed the negative forces that shape the context of water, flood and disaster management in Bangladesh. That said, I challenge the value of research that uses this presumption as a starting point. This is the rationale for a material and problem-led analysis of the competing knowledges that sustain the controversy: one that engages with the power holders whose job it is to manage a complex socio-physical environment.

COMPLEXITY THEORY AS A METHODOLOGICAL BASIS

In every sense, disasters are complex phenomena. Complexity theory offers a valuable collection of theoretical premises with which to inform an analysis of environmental hazards. In addition, the empirically focused nature and neglect of recent theoretical developments within hazard research suggests that the field might benefit from the application of a different conceptual approach. The nonlinear and integrated nature of environmental hazards requires a methodology sufficiently flexible to accommodate a diverse and often tense assemblage of actants, including competing knowledges, things and people. Social science and geographical research frames environmental issues as complex networks of relations between an increasing number of diverse actants (Mol and Law, 1994; Thrift, 1999; Sayer, 2000; Law and Mol, 2001; Urry, 2005). Relative to the prevailing methodologies (for example empirical, descriptive or ends oriented), emerging research themes emphasise the importance of agency, unstable contexts and nonlinear relations that reverberate through whole systems. In each case, the world is

characterised as increasingly complex, with unknown positive and negative feedback between different actants, and increasingly diffuse, with connections spreading across numerous scales over time. As applied to this research, complexity theory provides the basis for an innovative theoretical framework able to engage with the complex realities of environmental hazards (Thrift, 1999; Cilliers, 2001; O'Sullivan, 2004; Urry, 2005; Wynne, 2005; Manson and O'Sullivan, 2006).

The accommodating ontology of complexity theory: systems of relating actants

Despite recognition for three types of complexity science (see Manson, 2001), social and environmental research is concerned with what Manson (2001) and O'Sullivan (2004) label 'aggregate complexity', which they define as "the study of phenomena characterised by interactions among many distinct components" (O'Sullivan, 2004: 284). This form of complexity theory is described as having an accommodating ontology (Manson, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006; O'Sullivan et al., 2006; Doak and Karadimitriou, 2007; Bennett and McGinnis, 2008; Brown et al., 2008). This trait is summarised by Manson and O'Sullivan (2006: 681), who declare that complexity theory:

> "makes few restrictive assumptions about how the world is (in simple terms, its ontology), at the same time as it assumes a great deal about how we can learn about the world (in simple terms, its epistemology)".

They provide a brief summary of this argument, explaining that the limited ontology "directs attention to the kinds and strengths of relationships in a system" (2006: 681), a view adopted by most of the recent examples of complexity research. In one of the few examples of complexity research not predicated on modelling, Brown et al. (2008: 2 italics added) justify their application of complexity theory to the social sciences in relation to prevailing approaches. They argue that:

> "rather than proposing a set of hypotheses to be tested (e.g. as a theory) or making specific ontological claims, *the array of complexity science themes* offer a flexible ontology based on things (or actors) and their relationships and makes epistemological claims about how we can learn about systems".

It is this epistemology, as outlined through the themes of complexity theory (discussed in the following section), that informs this conceptual framework and the resulting analysis of flooding and environmental hazards in the context of Bangladesh.

I interpret complexity theory as an epistemology rather than as a theory in the traditional sense. While I accept that researchers applying complexity theory admit its ontological mutedness in order to facilitate a robust epistemology (Byrne, 1998; Manson, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006; Doak and Karadimitriou, 2007; Brown et al., 2008), I am concerned with the presumption and nature of 'systems'. Within complexity theory, system is used to describe the assemblage of relating constituent elements. As Manson and O'Sullivan (2006: 683) explain:

> "guided by an underlying ontology of entities and their relationships, complexity research turns us away, for example, from reductionist aggregation and simplification of the characteristics or behaviour of entities within a system and towards representation of individual entities and their relationships with few a priori assumptions of how these should be represented".

Following this example, systems are the product of relations between actants but, importantly, are not reducible to those entities or concepts. This definition builds upon Kauffman and Johnsen (1991) and Kauffman's (1993) 'fitness of landscapes' hypothesis. Using an ecosystem analogy, they argue that a system cannot be understood through analysis of individual actants in absolute terms. Instead, the fitness of the landscape/system is determined through relative understanding of the relations between the actants present. As O'Sullivan et al. (2006: 613) explain, "a given mix of species creates an environment that collectively determines the fitness of each". This relative understanding of actants producing systems informs my methodology and analysis. For example, in the historical narrative (Chapter 3), I employ this hypothesis to challenge paradigmatic (Kuhn, 1996) interpretations of the prevailing understanding of flood management to argue that management periods are not marked by an evolution from one dominant theory to another, rather, they are assemblages of numerous competing views constantly vying for control. As Byrne (1998: 32) explains:

> "[l]andscapes represent available options but can themselves be changed because evolution is not just a matter of change in a single organism but also reflects the impacts of change in one organism on others – coevolution".

Complexity theory's interpretation of systems overlaps with the use of networks within actor network theory, which emphasises "the *heterogeneity* of networks; that is ANT seeks to analyse how social *and* material processes (subjects, objects and relations) become seamlessly entwined within complex sets of association" (Murdoch, 1998: 359 italics in original). The assemblage literature provides a similar interpretation, though with the added emphasis on agency and power. As Li (2007: 264) explains:

> "assemblage flags agency, the hard work required to draw heterogeneous agents together, forge connections between them and sustain these connections in the face of tension. It invites analysis of how the elements of an assemblage might – or might not – be made to cohere".

Following from these definitions, systems/networks/assemblages are understood to be synonymous, though for practical purposes they are used intermittently when drawing from different bodies of literature.

Developing an epistemology based on the premises of complexity theory

My conceptual framework draws from complexity theory to enable analysis of complex systems of relations between diverse actants. To date, despite the recognition that it may suit the social sciences (O'Sullivan, 2004; Manson and O'Sullivan, 2006), complexity theory is rarely applied outside of a modelling context (for an example see Doak, 2007). Instead, complexity theory research, owing to its origins in chaos theory and modelling, is applied in order to inform and refine computational simulations (O'Sullivan, 2004; Pahl-Wostl, 2004; Manson and O'Sullivan, 2006; O'Sullivan et al., 2006; Doak and Karadimitriou, 2007; Martin and Sunley, 2007; Bennett and McGinnis, 2008; Brown et al., 2008; Manson, 2008). Building on O'Sullivan's (2004) discussion of human geography, I argue that complexity theory offers a useful set of premises that support the analysis of the prevailing understanding of environmental hazards. The following discussion explains my adoption of what Brown et al. (2008) call the array of

complexity science themes. The discussion is divided into two sections: first, those that explain systems and, second, those that address relations between constituent elements.[10]

Systems:

(A) are not explained by their constituent elements

There is agreement that the axiom that unites complexity research is the claim that systems are more than the sum of their constituent parts, a trait sometimes labelled non-additive or non-aggregate (Anderson, 1972; Goodchild and Mark, 1987; Horgan, 1995; Manson, 2003; Reitsma, 2003; Doak and Karadimitriou, 2007; MacKay, 2008). Cilliers (1998: viii) presents this premise, explaining that:

> "the interaction among the constituents of the system, and the interactions between the system and the environment, are of such a nature that the system cannot be fully understood simply by analysing its components".

This premise represents a fundamental critique of scientific method and, more specifically, of environmental hazards research (Anderson, 1972; Smith and Petley, 2009). It challenges the assumption that reductionism is the ideal approach for understanding the diverse collection of actants that contribute to complex phenomena. Referring to scientists studying 'fundamental laws', Anderson (1972: 393) explains that "the ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe", as his title aptly declares: 'more is different'. In terms of environmental hazard research, this premise challenges the aggregation of local knowledges to inform national-scale understanding. In this context, the assumed applicability of knowledge gained at the local level, at which scale all relations take place (Manson, 2001), is questioned on the basis that its nature may change when extrapolated to other scales. The premise also challenges the assumption that national level understandings can be broken down to be better understood or applied to local contexts. Complexity theory recognises the tension between appreciation for a system and the problems presented by reductionism (Anderson, 1972; Cilliers, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006; MacKay, 2008). In response, it argues

[10] It is critical that this division be recognised as a tool for communicating my ideas. The premises are, in reality, interwoven and are applied as a group rather than individually.

that reductionism is needed in order to identify and understand the constituent elements, but that such knowledge, while required, is insufficient. Instead, it maintains that some system characteristics are only present at the system scale and that an understanding of the whole is not only an aggregate of the parts. Similarly, it argues that knowledge of the national-scale cannot be assumed to be applicable at the local level.

(B) evolution is path dependent

A second premise of complexity theory incorporated into this conceptual framework is the view that systems evolve following path-dependent trajectories (Manson, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006). This premise complements arguments within the social sciences that recognise the role of historical context in directing present and future states (Massey, 1999). As O'Sullivan (2004: 285) explains, "path dependence holds that a system's trajectory is a function of past states, not just the current state". This premise emphasises appreciation for the historical context, and along with inclusivity towards actants, recognises how past ideas, people and things may reverberate into the present. For example, it recognises how past conceptualisations, priorities or physical structures influence current decision making. This premise is also important with regard to the presumption that environmental systems 'seek out' equilibrium (Schwartz and Thompson, 1990), which is defined as a "static and a-historical state, towards which a system evolves, and to which feedback effects inexorably return the system should it stray" (O'Sullivan, 2004: 285). The premise also challenges the implicit assumption within environmental management that correct solutions are timeless. For example, mitigation strategies and national policies often presume that current problems are endemic and envision future problems apart from past, present and future mitigation strategies. This premise recognises that entrenched knowledge undermines consideration of alternatives; in effect, traditional knowledge and practice are privileged due to their history and 'lock-in' (O'Sullivan, 2004; Manson and O'Sullivan, 2006; O'Sullivan et al., 2006). When stated, it is easy to find fault in such practices, while in reality, traditional wisdom is a common fallacy. The premise directs attention to the entrenchment of knowledge-practice. This is particularly relevant

when considering the evolution of environmental policy and practice. Specifically, it is wary of assessments that label past efforts as failures, promoting a more situated space-time understanding.

(C) emerge via relations between constituent elements

Perhaps the most important complexity theory premise incorporated into this conceptual framework is recognition for emergent properties. This concept blurs the distinction between system and constituent elements by arguing that system characteristics are produced through constituent element relations. Linking this concept to criticisms of reductionism, Manson and O'Sullivan (2006: 682) argue that "emergence results from synergism, whereby system-wide characteristics are not a simple superposition of the additive effects of system components". The premise promotes a reflexive appreciation for system-wide reconfigurations that emerge following changed relations. For example, new national policy or the construction of flood defence structures reconfigure the system and result in new emergent properties, challenging interpretations in which system disruptions are followed by a return to equilibrium (Schwartz and Thompson, 1990). With reference to socio-physical systems, emergent properties are thought to be largely unpredictable "beyond the short term because other components of the system adjust to this intervention" (Manson, 2001: 410). An important aspect of emergence, in combination with the path dependence premise, is acknowledgement that systems change. The premise helps focus attention on the tension between evolution and stability. For example, changes to actant relations are thought to result in changes to the emergent system properties, contributing to constant evolution and periodic permutations in which the form and function of the system are challenged and potentially disbanded (Shackley et al., 1996; O'Sullivan, 2004; Ratter, 2005; O'Sullivan et al., 2006; Uprichard and Byrne, 2006).

The premise that systems result from relations between constituent elements raises important issues regarding how such relations are incorporated into a conceptual framework. Of particular importance is the emphasis on relations rather than on the

individual characteristics of constituent elements (O'Sullivan, 2004; Manson and O'Sullivan, 2006). As Manson (2001: 409) explains, "a complex system is defined more by relationships than by its constituent parts".

Relations:

(A) operate on multiple scales

Closely connected to the notion of emergence, complexity theory presumes that all relations occur between actants at the local scale and that these interactions can reverberate to the system scale. O'Sullivan (2004: 284) explains that this premise assumes "that the local spatial configuration of interactions affects outcomes at the whole system level". Much like Latour's (1993) railway analogy – in which train tracks are simultaneously local and global – this premise addresses the long-standing research problem of scale and extrapolation, or what Swyngedouw (1995) terms 'glocal'. Essentially, research involving relations takes place at the local scale which, in each case, reverberate to the larger scale. It is the degree, intent and appreciation for this extension that becomes important. This premise is particularly applicable to national-scale environmental hazard research, which is shaped by local analyses of vulnerable groups (Cuny and Abrams, 1983; Blaikie et al., 1994; Wisner et al., 2004; Blaikie, 2006). Following this premise, actants are able to occupy multiple spaces simultaneously (O'Sullivan, 2004; O'Sullivan et al., 2006). For example, government managers are members of a household, an extended family, a ministry and a nation while a flood is a resource, a hazard, a toilet and a source of friction between geopolitical entities; in each instance, the actant can perform a different function or engage in any number of relations. In tandem with emergence, this premise recognises the direct impact local-scale relations have on national-scale systems. Taylor (2001: 142) expands on this argument, recognising that emergent properties, despite being generated through local interactions, 'tend to cover the whole system', raising important issues concerning the identification and emphasis on particular actants within the system.

(B) are unequal

Taylor's (2001) recognition that constituent relations can 'cover the whole system' feeds into another premise shaping this conceptual framework: the unequal nature of relations. Citing Gibson-Graham (1993), Manson (2001: 411) situates this premise with reference to the emphasis on relations over attributes. He argues that appreciation for unequal relations "supports [the] reconceptualisation of identity and representation, whereby a person is not limited to a singular identity but instead is situated in a web of relative power relations". In addition, complexity theory deepens this premise by recognising that constituent elements need not be human (Manson, 2001; O'Sullivan, 2004). In terms of environmental hazard research, this premise appreciates the potential role of non-human actants (Bingham, 1996; Murdoch, 1997a; Whatmore, 2002). For example, Sultana et al. (2008a) describe how significant flood events have spurred paradigmatic reconfigurations of governance regimes while Paul (1984; 1995) explains that the presence of physical flood management structures (for example embankments and dams) affects people's opinions concerning their viability. Manson (2001: 409) argues that unequal actant relations shape emergent system properties, explaining that the "components of a system and their relationships are not an undifferentiated mass. Relationships of differing strengths between component parts define the internal structure of a system". An important aspect of the unequal nature of relations is the assertion that they are nonlinear. Brown et al. (2008: 6) explain that an "analysis of a complex system often begins with patterns in space and/or time that are difficult to explain with simple linear relationships", arguing that it is the assumption of linearity that distinguishes complex from simple or complicated systems. This aspect of the inequality premise is particularly relevant to arguments surrounding chaos theory, in which seemingly small actions or actants can have disproportionate impacts on the entire system (Zimmer, 1999; Manson and O'Sullivan, 2006; Doak and Karadimitriou, 2007; Manson, 2008).

In addition to the theoretical premises, an important reason for the adoption of a complexity-based methodology is its aim to problematise established forms of understanding. Manson and O'Sullivan (2006: 689) describe the potential benefit of linking complexity with geographical research, arguing that:

> "the robustness of complexity [in conjunction with] place-and-space-based research gives both the latitude to risk pushing methodological, theoretical, and disciplinary boundaries, so that novel, relevant, and intellectually exciting approaches can be developed and new knowledges uncovered".

In addition, while complexity theory is often applied to computational modelling, there is a sense that its premises should be of value, and are amenable to, human geography and environmental research (Byrne, 1998; Clifford, 2002; Gatrell, 2003; O'Sullivan, 2004; Bennett and McGinnis, 2008; Brown et al., 2008). The adoption of this collection of complexity theory premises, then, offers a framing with which to conduct environmental hazard research while providing a means of challenging the prevailing understanding. However, the origin of complexity theory and its predominant use among modellers has resulted in some weaknesses that require consideration, particularly its disregard for individual characteristics and hushed consideration of space and scale.

BORROWING FROM ACTOR NETWORK THEORY AND ASSEMBLAGES

While the strengths of complexity theory justify its adoption, it retains two weaknesses that demand more explicit consideration: first, appreciation for the spatial context and second, the messiness of relations. Fortunately, the inclusive ontology of complexity theory allows for the incorporation of additional premises able to augment and make more explicit the premises informing this research. As discussed, current environmental hazards research privileges attributes over relations and predetermined ends over means. So far, my methodology privileges emergent system properties, material contexts and problem-led approaches that emphasise the relations that sustain controversies (O'Sullivan, 2004; Manson and O'Sullivan, 2006; O'Sullivan et al., 2006). The weakness of this conceptual framework rests in complexity theory's vague consideration of the spaces in which relations take place. To remedy this omission of space, place and cultural contexts, I incorporate premises from network approaches, primarily actor network theory (hereafter ANT) and the assemblages literature into my conceptual framework.

Relations do not occur in a vacuum

In addition to complexity theory's emphasis on relations, network approaches also emphasise the material context (Latour and Woolgar, 1979; Callon, 1986; Law, 1987a; 1991; Law, 1992). More specifically, network research is concerned with the role of context, whether space, time, place or culture, in privileging certain relations over others, which in turn shape the network. Furthermore, they are explicitly concerned with how space and relations feed back into each another, evolving and mutually influencing subsequent relations and the spaces in which those relations take place (Mol and Law, 1994; Law and Hassard, 1999; Law and Singleton, 2000; Law and Mol, 2001; Law and Mol, 2002). Again, the modelling origin of complexity theory undermines the incorporation of space and scale by requiring quantifiable simplifications. As O'Sullivan (2004: 288) explains, the formalisation of space required for modelling complex systems does:

> "not reflect the untidy real-world geographies… These are troublesome issues for many engaged in complexity science, because they disrupt attempts to develop formal schemes for representing and exploring complex systems".

Furthermore, networks augment complexity theory's recognition of space (that relations take place in space, that systems and relations are context-dependent and that relations operate on multiple scales) by recognising the privileging that space affords some actants, some identities, some strategies, some spatial and temporal horizons and some actions over others (Jessop, 2005). In this way, network research is concerned with the analytical assumptions that shape understanding of space and place (Law and Hassard, 1999; Law and Mol, 2001; Bennett, 2005; Latour, 2005b; Li, 2007). Of importance, network theorists challenge the binary concepts that influence understanding and research (for example, subject vs. object; human vs. non-human or social vs. physical) and encourage critical analysis of the knowledges that promote binary perspectives (for example, urban vs. rural or technical vs. social). Along with complexity theory, networks enable analyses to recognise the relational and complex contexts that shape knowledge production and practice (Murdoch, 1997a; 1998; Law and Hassard, 1999; Law and Singleton, 2000; Bennett, 2005; Latour, 2005b; Li, 2007; McFarlane, 2009).

The appreciation for the context of relations within network analyses represents an important contribution to this conceptual framework.

The incorporation of ANT and assemblages into the conceptual framework encourages an appreciation for evolution and volatility. While complexity theory maintains that systems evolve relative to their past and present, networks are said to persist (Mol and Law, 1994; de Laet, 2000; de Laet and Mol, 2000). This argument is important because it recognises that networks are inscribed and solidified via actants and their performances within the context of space. For example, embankments perpetuate a specific form of water management, they entrench particular gender relations and customs and, ultimately, they influence who is able to work or hold power (Sultana, 2010). From a knowledge perspective, policies require specific structures and understandings that in turn shape which issues can be questioned and which are beyond reproach. Overall, it is not only the relations that contribute to the emergent properties of the system/network but also their spatial context (Callon, 1986; Latour, 1987; Law, 1987b; Law, 1987a; Callon and Law, 1997; Murdoch, 1997b; a; 1998; Law and Singleton, 2000; Law and Singleton, 2004). The issue of context is expanded with the addition of a temporal, or space-time, conceptualisation. As Massey (1999: 271) explains, past conceptualisations and arguments "implicitly drew upon, and thereby established as unthought assumptions, a highly particular conceptualisation of time, of space, and of the relationship between them". Arguing this position, Manson and O'Sullivan (2006: 684) recognise that, compared to complexity theory,

> "place and space research presents ample opportunity to fold space and time into substantive areas in a manner that frees research from being trapped at a given level of analysis".

The network understanding of space-time is an important addition to a conceptual framework founded on complexity theory because of its explicit consideration of space. Informing this understanding, network approaches interpret space as relational rather than absolute (Murdoch, 1997b; a; 1998). This is an important difference because, while complexity theory presumes nonlinear relations, its consideration for space is predominantly linear. In comparison, network approaches challenge any assumption of

linearity, arguing that actants can relate across distant space-times (Law, 1987a; Law and Singleton, 2000; Law and Mol, 2001; Law and Mol, 2002). O'Sullivan (2004: 284 italics in the original) recognises the importance of space in complexity-based research while admitting that it is more an implicit consideration than an explicit one, declaring:

> "implicit is the idea that each entity has different relations to others and, therefore, that *where* an entity is in the system has significance for the unfolding behaviour of entities individually, and of the system collectively".

This understanding lends further support for the inclusion of network premises into my methodology.

While complexity theory recognises that actants can be anything (Byrne, 1998; Gatrell, 2003; Ratter, 2005; Portugali, 2006; Doak and Karadimitriou, 2007), networks explicitly challenge any predetermination of the relevant actants (Murdoch, 1998; Law and Hassard, 1999). In particular, network research emphasises the role of material objects (actants) that transfer and sometimes translate knowledge. For example, computer software developed in one region applied elsewhere. Perhaps the most enlightening example of these 'immutable mobiles' (Latour, 1987) is de Laet and Mol's (de Laet, 2000; de Laet and Mol, 2000) exploration of the Zimbabwean bush pump. This idea/object is mobile, in the sense that the pump is transferred throughout Zimbabwe; it changes, in the sense that it breaks and is mended; and it retains its 'immutability' despite evolving because it continues to function as a pump. In addition, by function, the pump is recognised for its multiple performances: as an irrigation and sanitation device, as a device to lighten the burden on women, as a means of advertising government involvement and as a tool to challenge/entrench power relations (de Laet and Mol, 2000). It is the material context that supplements this type of analysis and understanding of relations; while complexity theory might argue that such understanding is embedded within relations, networks operationalise the important role that space plays in shaping actants and knowledge. Closely related, mobility within a system is neglected within complexity theory. Again, it is implicitly embedded within relations, but this is inattentive to how knowledge and actants move in space-time and the impacts that such movement has on networks and relations (consider again the bush pump).

The messiness of human relations

The open ontology of complexity theory enables broad and inclusive analyses of systems of relations. Unfortunately, recognition for relations does not help explain those relations, particularly the messy realities active in the real world. This weakness can be traced to the modelling origins of complexity theory, in which relations must be quantified to be included in simulations. While valuable in the sense that models offer a lens with which theory and reality can be viewed (Manson and O'Sullivan, 2006), they are simplified versions that lack the depth of real world relations. The emphasis on 'relations over attributes' is an important strength of complexity theory, but it raises the issue of whether attributes are not needed to understand relations, for example race, nationality, gender or wealth. A more forgiving reading of complexity theory might accept that attributes are important, but would argue that they are embedded or implicit within the relations. More likely, they are among the unquantifiable aspects of social relations that computational models cannot accommodate. Network approaches problematise relations, arguing that heterogeneous actant interactions are more fragile, capricious and hybrid than complexity theory implies and models require (Mol and Law, 1994; Law and Hassard, 1999; Law and Mol, 2001; Law, 2002; Whatmore, 2002). As Doak and Karadimitriou (2007: 226) argue:

> "insights from ANT provide an analytical perspective and methodological device to examine network building through processes of problematisation, interressement, enrolment and mobilisation… more recent transmutations of ANT emphasise contingency, fragility and hybridity instead of linearity in network building".

In addition, relations change over time, particularly with reflexive actants that "are routinely capable of detecting, reasoning about and acting on the macro-level properties (the emergent features) of the societies of which they form part" (Gilbert, 1995: 151). Complexity cannot accommodate the fleeting, perhaps unique, nature of individual relations, needing to instead simplify in order to fulfil formulas. Network approaches appreciate that relations are unstable and that some may evolve within the context of study or may never be repeated (Murdoch, 1997b; de Laet and Mol, 2000; Law, 2002; Law and Mol, 2002).

The resolute emphasis on relations within complexity theory is also neglectful of the role of controversy and conflict. As previously argued, Whatmore (2009) argues that the focus on relations shifts the emphasis to the controversy at the expense of the knowledge claims that support differing perspectives. Key elements of controversy, such as power and the labour required to enact and maintain networks, is an important emerging theme within network analyses (Bennett, 2005; Li, 2007; McFarlane, 2009) that is neglected within the complexity literature. This perspective is a valuable addition to a complexity based conceptual framework because it refines the notion of relations by recognising the energy required to construct and maintain a system. In this sense, systems are performed by actants whose decisions are shaped by power relations and who are engaged continuously and reflexively with the assemblage of actants shaping the system/network.

Once combined, premises from complexity theory and network approaches contribute to a conceptual framework able to engage with the complex assemblages of relations that frame knowledge controversies. Most importantly, complexity challenges the reductionism and aggregation that dominate the prevailing understanding of environmental hazard management and research in Bangladesh. In addition, the inclusion of network approaches refines and deepens appreciation for the context in which relations occur. Complexity theory is an adept analytical tool within the social sciences, but it requires the addition of network theory to strengthen its incorporation of the hybrid, folding and inconsistent relations that produce complex networks, which in turn result in emergent knowledge and produce debate and controversy.

METHODOLOGICAL CONSIDERATIONS

The conceptual basis of this research is intentionally unsettled. It aims to confront what Massey (2001) describes as the closures that limit the opening of differing perspectives. The methods enable this objective. As mentioned in Chapter 1, throughout the process, the concepts (theoretical premises), methods (data collection) and analytical framework

(data analysis) were juxtaposed. The objective to explore the prevailing understanding through knowledge controversies demanded a methodology able to accommodate diverse framings. The process evolved continuously in response to challenges, unforeseen events, findings and suggestions from those involved, resulting in an iterative and heuristic methodology. For example, the conceptual basis of the research changed from a human ecology approach to a postmodern emphasis on knowledge. This change was prompted by archival analyses, recognition for the role of entrenched knowledge, an over emphasis on individual behaviour and the neglect of the agency of non-human actants. The behavioural approach emphasised how people reacted to hazard and risk with little reflexive consideration of why, leaving key elements of flood management implicit or dependent on analysis of individual perception. Most importantly, the existing literature situated controversy and conflict as a product of the debate without appreciation for its generative and active involvement in shaping what is known or done. More pragmatically, the research adapted when envisioned group discussions became unfeasible in Dhaka due to difficulties arranging times and locations. The remainder of this chapter explains the methodological issues that informed the research. It describes how the conceptual premises, literature, discussions with experts and practical realities contributed to my analysis of the controversy surrounding flood and disaster management in Bangladesh.

Experience, expertise and experienced experts

Emerging from research within the sociology of science,[11] the role, nature and status of expertise has been challenged. At heart, the debate over expertise can be generalised as a disagreement over 'whose knowledge counts?' or perhaps less confrontationally 'whose knowledge counts more?' (Collins and Evans, 2002; Jasanoff, 2003a; Rip, 2003; Wynne, 2003). With reference to a shift towards socially-constructed understanding, Jones (2002: 249) explains that:

> "[h]aving established the applicability of the (moderate) social constructivist perspective to environmental problems, it remains to be established how to

[11] This is sometimes labeled social studies of science (SSS) or science and technology studies (STS).

> choose between alternative views. Whose reality counts? Whose views are to be heard and acted upon?".

Wynne (1996) challenges the dominance and hierarchy embedded within the science-society relationship by exploring how the scientific method, and the less acknowledged human dimension of scientific knowledge production (Latour and Woolgar, 1979; Latour, 1987; 1999; 2005a), exclude non-traditional or non-certified knowledge producers. Using Cumbrian sheep farmers whose knowledge contradicts the prevailing scientific consensus, Wynne (1996) describes how science is prone to meet its own expectations, thereby discounting knowledges and means of knowing that do not conform. Taken to an extreme, the criticisms of scientific knowledge production and knowledge maintenance inform a rationale that explores how science can inhibit progress, limit options and perpetuate specific framings (Sarewitz and Pielke, 2001; Sarewitz, 2004; 2007; 2008; 2009). Rather than weakening science, criticisms of expertise challenge the binary construction that separates public knowledge and formal science. Summarising this argument, Wynne and others challenge the objectivity of scientific practice and knowledge, leading them to argue for further recognition of the cultural construction of science and of meaningful collaborations with the public (Wynne, 1996; Jasanoff, 2000; Oreskes, 2002; Jasanoff, 2003b; Sarewitz et al., 2004; Jasanoff, 2006; Sarewitz, 2009).

By challenging the distinction between certified and non-certified expertise, different types of knowledge are reconciled. In this context, the differences between lay and expert knowledge are recognised without attributing rank; rather, the knowledges provide alternate perspectives with which to explore issues. Methodologically, the inclusion of stakeholder knowledge is more broad than typical expert opinion. Rather than a proclamation or explanation, stakeholder research directs attention towards experiences, senses, feelings, interests and cultural and historical contexts, extending value to knowledge that, within the traditional model of science, is excluded from the process. Countering this perspective, Collins and others have argued that, rather than expanding the definition of expertise and redistributing authority, expertise and management are best served by clear distinctions between technical or certified expertise

and experiential or non-certified expertise (Collins and Evans, 2002; 2003; 2008). As Collins and Evans (2002: 249) explain:

> "rights based on expertise must be understood one way, while rights accruing to other 'stakeholders', who do not have any special technical expertise, must be understood another way. Stakeholder rights are not denied, but they play a different role to the rights emerging from expertise".

While critical of equality between stakeholders and experts, Collins and Evans (2002) are equally critical of certified experts who overstep their field, choosing to value pertinent experience and core expertise over wider stakeholders or tangential expert knowledge.

In terms of the methods adopted for this research, 'whose knowledge counts?' is a crucial issue. The democratisation of expertise and power is justified using the perceived need to affect change and improve management. This presumption is grounded in the developed world. The premise assumes the existence and operation of democracy, government institutions, accountability and the ability to engage with members of a public. This expert-lay dichotomy, while having exposed assumptions embedded within environmental research, is of particular relevance to vulnerability science (Freudenburg, 1988; Cutter and Finch, 2008; Cutter, 2009). However, at present, the dominant response to this hierarchy of knowledge is to make lay knowledge equal to expertise (Wynne, 1993; Nowotny et al., 2001; Collins and Evans, 2002; Jasanoff, 2003a; Sarewitz, 2004; Wynne, 2006; Whatmore, 2009; Lane et al., in review), elevating excluded knowledge to make the decision-making process more egalitarian. Again, this process makes several assumptions that are grounded in the developed world. Specifically, it assumes a population with sufficient resources to set aside subsistence efforts, knowledge of the system beyond the immediate locale, a cultural setting where each opinion is judged on its merit, a tradition of voicing concern and, among many others, a governance structure willing and/or able to respond. For each of these assumptions, the aim of reconciling lay and expert knowledge in Bangladesh is questionable, though not prohibitive. More fundamentally, this form of collaborative research presumes that power can and should be distributed. While appreciative of the value that collaborative explorations of lay and expert knowledge enable, I have chosen a different approach in response to the

concentration of power in Bangladesh. My use of experts and their perceptions challenges the methodological division that accompanies the assumed divergences between lay and expert knowledges. In effect, in this thesis, recognising the socially-constructed nature of scientific knowledge and expertise, I treat experts as lay participants, asking them for their beliefs, intuitions, values, norms, practices, perceptions, rules and routines as would occur in research of lay stakeholders. While also interested in their expert opinion, I suggest that the inclusion of such supporting or background knowledge, which is disregarded in traditional explorations of expertise, provides an avenue to explore the processes that shape expert knowledge. This social nature of expert knowledge is summarised by Latour and Woolgar (1979: 17 italics added), who explain:

> "[r]ather than making scientific activity more understandable, social scientists have tended through their use of highly specialised concepts to portray science as a world apart. A plethora of different specialised approaches have variously been brought to bear on science, such that the resulting overall picture is largely incoherent. Analyses of citations in scientific papers tend to tell us little about the substance of the papers; macroanalyses of science funding remain virtually silent on the nature of intellectual activity; quantitative histories of scientific development have tended to overemphasise those characteristics of science which most readily lend themselves to quantification. In addition, many of these approaches have too often accepted the products of science and taken them for granted in their subsequent analysis, *rather than attempting to account for their initial production*".

In this context, my approach aims to flesh-out the underlying knowledges that inform and contest flood management amongst decision making power-holders in Bangladesh. I do this not as an attempt to diminish the importance of expertise or raise the value of lay knowledge. Instead, this approach is, in part, a response to Cutter's (2003) call for innovative methods that challenge the prevailing form of knowing, contributing to the methodological diversity needed to extend knowledge of vulnerability. Additionally, the neglect of expert perception within flood, disaster and vulnerability research deserves remediation.

Recognition for the disproportional impact of power holding actants on the emergent properties of a system accepts a concentration of power (O'Sullivan, 2004; Manson and

O'Sullivan, 2006; O'Sullivan et al., 2006). For flood and disaster research in Bangladesh, an assessment of the general population, were it possible, would be useful and informative but would lack an appreciation for the power underlying the knowledges that inform policy and decision-making. As Brown et al. (2008: 9) explain:

> "systems composed of multiple agents that interact to create feedbacks can be very sensitive to the actions of a small number of agents that have particular characteristics. For this reason, understanding the actions of average agents is insufficient to explain observed patterns and it is important to understand the nature of heterogeneity among agents within a system".

In addition, Gell-Mann (1994: 17) argues that, within complex systems, an actant:

> "acquires information about its environment and its own interaction with that environment, identifying regularities in that information, condensing those regularities into a kind of 'schema' or model, and acting in the real world on the basis of that schema. In each case, there are various competing schemata and the results of the action in the real world feed back to influence the competition among those schemata".

Commenting on the development of such schemata and characterising them in terms of prevailing understanding, Doak and Karadimitriou (2007: 215) argue that schemata are:

> "institutionalized in the form of values, norms, practices, perceptions, rules and routines… once a schema like this sets in, it is very difficult to shake it off. It becomes embedded into corporate culture; employees are trained according to it. In a way it becomes self-fulfilling".

Together, expertise, the concentration of power and the formation of schemata founded on values, perceptions and routines, inform an emphasis on the flood and disaster managers who shape knowledge, policy and management in Bangladesh: what I have labelled an expert. I have implemented a research process predicated on exploring the 'values, norms, practices, perceptions, rules and routines' of power-holding actants. This approach not only aims to explore the prevailing, and possibly self-fulfilling, knowledges that shape water, flood and disaster management, but it also incorporates the beliefs, feelings, hunches and cultural and historical situatedness normally associated with studies of non-certified experts.

The decision to focus on experts owes a great deal to Said's 'Orientalism' thesis, particularly his comments on the development, perpetuation and inertia that a dominant or prevailing understanding can acquire. Furthermore, I utilise his argument that

prevailing understandings are "circumscribed by a series of attitudes and judgments that send the Western mind [or those interested in flood management], not first to Oriental sources for correction and verification, but rather to other Orientalist works" (Said, 1978: 67). While Said relied on textual sources to construct his criticism and expose the power of foreign knowledge and knowledge producers, I have chosen to juxtapose such textual documents with the interwoven views of power-holding experts. Rather than rely strictly on the government and academic documents that have contributed to flood management, I am equally interested in the views of the individuals actively engaged in the construction of the prevailing understanding, with the aim of exploring the relations between the prevailing and personal accounts of flood management in Bangladesh. This premise is a major impetus for the inclusion of experts working, living and responsible for management in Bangladesh. Identifying whom to include was a relatively easy task, once I determined the rationale. I used the proceedings from the 2004 National Water Workshop (Siddique and Hossain, 2006) to identify those involved in flood and disaster management in Bangladesh. The proceedings represent an internationally supported response to the catastrophic flood of 2004, listing the 900 participants, institutions and ministries involved (2006: 507-520). Additionally, the participants are divided into groups such as NGOs, government representatives, academics, dignitaries and foreign institutions, and include contact information. To supplement this design, upon completion of each interview, I asked participants to recommend individuals who might contribute to the research. This opened further routes to different groups of experts to complement the proceedings. Each of the fifty-two interviews was conducted face-to-face in the participant's office except one, which took place in a café. The interviews each followed a semi-structured interview format and averaged nearly one and a half hours, providing roughly 72 hours of conversation. Overall, the focus on decision-making experts provided an opportunity to explore flood management in Bangladesh from an original perspective. It does not argue that this approach should replace existing drives to integrate experiential or non-certified experts. Instead, with reference to the combination of complexity theory and expert knowledge, O'Sullivan et al. (2006: 616) shares my rationale:

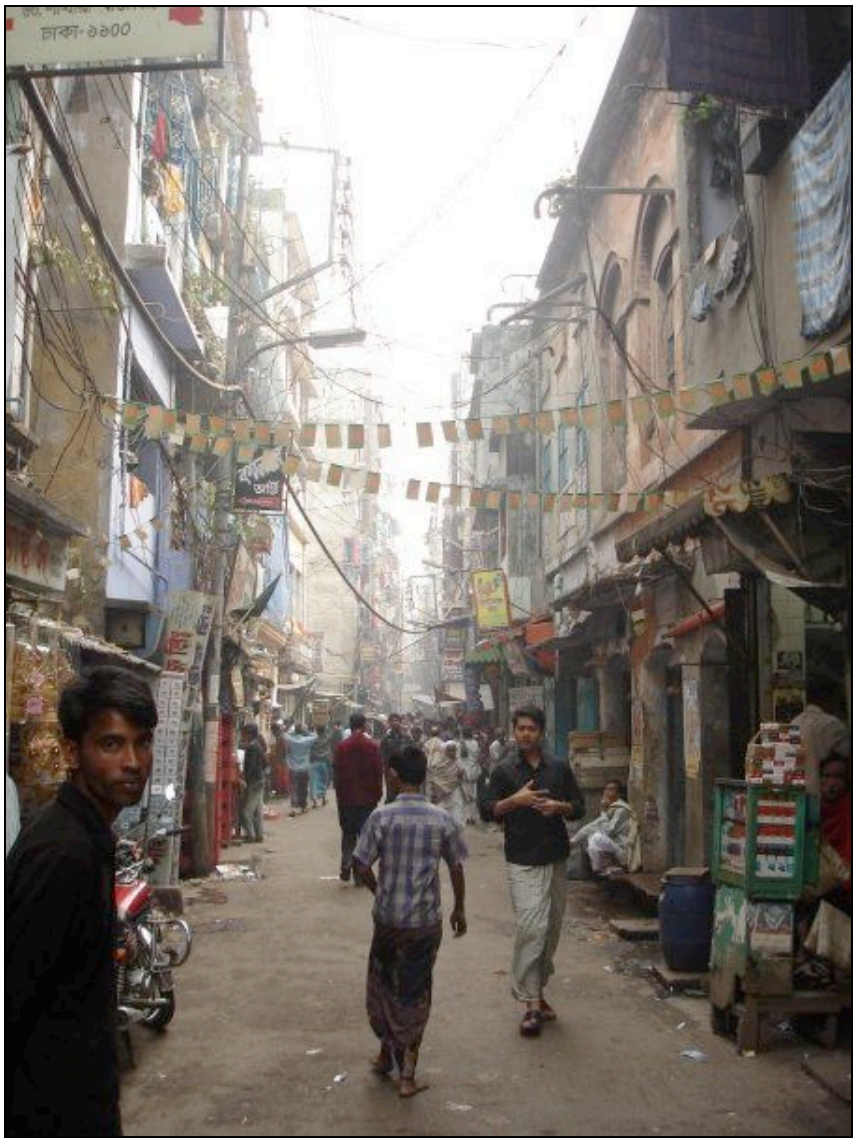
> "complexity can provide a new interpretative frame for qualitative methods. Given that the usual 'scientific' response to contexts not immediately

> amenable to current quantitative methods is the development of yet more complicated methods, this is an interesting development. Here, realising the complexity of the phenomenon at hand leads not to a dense forest of equations and multiplying variables but instead to the recognition that the human beings at the heart of the complex system under study may be best placed to tell its story".

The research context

In October of 2006, Bangladesh experienced a coup that led to the suspension of democracy and individual freedom. A caretaker government was established to oversee an anti-corruption drive and the re-establishment of democracy. In retrospect, this does not appear to have inhibited the research and several respondents indicated that security had improved significantly. The effects of military control were evident in nearly every discussion, though the degree to which it influenced responses is difficult to know. During my visit, the military was a constant presence in Dhaka, although as a foreigner I was left alone. During my travels, a taxi driver told me that the military took informal notice of the cars and drivers with foreigners. The reason for this was left implied. Additionally, the research context was influenced by the November 18th 2007 landfall of a category 5 cyclone (Paul et al., 2010), named Sidr. Striking the coastal mangrove forest, this event caused more than 3000 deaths but, more importantly to this research, it caused significant controversy, publicity and debate. It is probable that the occurrence of a natural disaster influenced responses by spurring consideration for disaster management and the role of individuals, groups, government and the international community. There is no doubt that disasters were fresh in the minds of the participants, although the frequency of disasters in Bangladesh suggests that this might be a regular state. During the course of the field research, several academics from Dhaka University were imprisoned for their criticism of the caretaker government. This caused some consternation among the participants and, while no one declined to be interviewed, some respondents made pointed comments early in the discussion about the lack of free speech.

Figure 7: Cityscape in Dhaka



Source: author (06/01/08)

All research is situated (Haraway, 1988; Haraway, 1991; Peet, 1998; Berg, 2009). Spatially, this research took place in the capital of Bangladesh (Figures 5 and 7), Dhaka, between November 2007 and February 2008. Dhaka is listed as a city of 7 million (Central Intelligence Agency, 2009), though the respondents suggest that informal estimates were closer to 15 million. The city is highly polluted and traffic congestion is notorious. Travel is primarily through rickshaw, taxi or hired car, with public transport discouraged for foreigners. Despite the extreme poverty, with children, victims of acid

attacks and the crippled begging at most corners, after living in the city for several months, I had built relationships with some vendors and beggars who worked in the areas through which I commuted. It was interesting to witness the informal economy, as an amputee would pay his fees for the right to beg on a particularly valuable corner. Dhaka is an enigma of poverty, wealth, clean parks and garbage pickers. The space in which this research took place has shaped the findings and analysis. It is an actant whose agency was not left behind or removed during the writing process; instead, it is a constant presence in this research and the communication of the findings. The research is also situated by my position as a Caucasian male researcher working in Bangladesh (Berg, 2009; Creswell, 2009). In many instances, this position shaped the research process and findings. For example, during the field research, I often would arrive at office buildings unannounced in order to introduce myself. This was a way of finding the location and assessing whether the potential participant still worked at the institution. It was a practical need given the unreliability of telephone and email contact. In practice, the arrival of a suited Caucasian often prompted assistants and secretarial staff to seek out the individual and reorganise schedules. The participants were unaccustomed with people arriving at their places of work and were very receptive to speaking, either right away or at a later date. Alternatively, given that all interviews are a mutual construction and subject to the interests and biases of those involved (Kitchen and Tate, 2000; Peet and Thift, 2001; Berg, 2009; Creswell, 2009), I must accept that my presence and position will have affected the content and my interpretation of the interviews.

Figure 8: Traffic and travel in Dhaka

Source: author (10/12/07)

Interviews

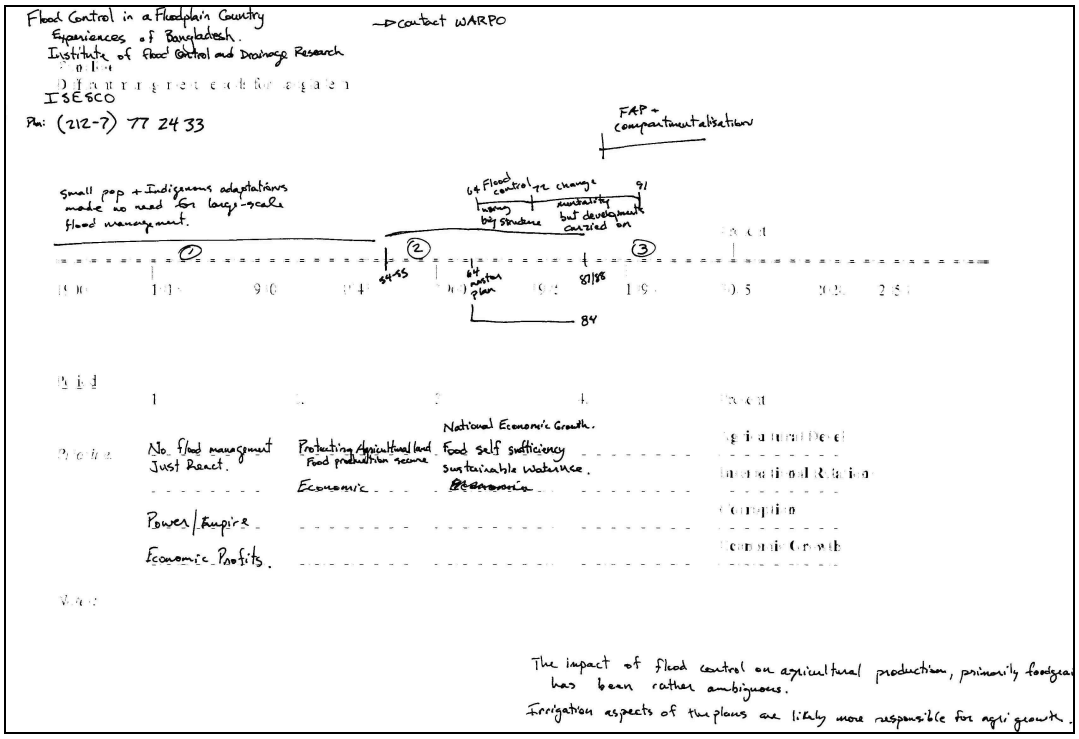
Prior to arrival in Bangladesh, the issue of anonymity was considered but left unresolved. It was deemed best to make this decision after consulting participants. Additionally, two Bangladeshi academics acted as advisors, agreeing to participate in a pilot study lasting roughly two hours followed by an hour of discussion. In addition to suggestions of themes and content, both recommended that the interviews be conducted anonymously. They suggested that anonymity would improve the quality of the

discussions and increase the number of people willing to participate, recognising the difficult position of managers and office holders in Bangladesh. Nearly every participant sought assurance that they would not be identified. Six of the fifty-two participants asked that the conversations not be recorded (see Appendix B). For these sessions, handwritten notes were taken, though their lack of detail makes comparison with transcribed records difficult. In each case, once the discussions were completed, the participants conceded that it would have been acceptable had they been recorded anonymously. Not surprisingly, three of these individuals were associated with international agencies and were conscious of negative publicity. Several participants noted that foreign journalists had begun posing as academics to circumvent the restrictions placed on reporters. It is likely that this caused some anxiety about digital recording.

Managers in Bangladesh, particularly from government agencies or those who depend on government funding, are aware of both explicit and implied censorship. Several participants discussed the difficult position of the Bangladeshi government as an internationally vilified entity. They suggested that academics and journalists profited by maintaining this negative characterisation. While the respondents did not endorse censorship, they acknowledged its value in terms of sensitive information. To explain this tension, one participant recounted the experience of a former superior at the Ministry of Agriculture who alerted the press to a potential food shortage following the 1998 floods. As a result, the superior was placed under house arrest until public sentiment and revision of the government's figures proved him correct. While his divulgence is thought to have prodded the government into action, his job and freedom were suspended. Flood management is similarly controversial. With billions of dollars of potential international funding, the negative publicity associated with flood disasters and the displacement of government by non-governmental organisations, research has a responsibility to those who provide candid information. Without anonymity, it was felt that the frankness of the conversations would be limited to official government positions.

Figures 9 and 10 show an early interview template. While interesting, it was determined that my emphasis on constructing a timeline[12] for each participant detracted from the discussion by over-emphasising the need to identify specific periods and events. I had envisioned a collection of 'histories' of flood management, with each participant dividing flood management into periods based on their views and beliefs. This act pressured participants in a way that was counter productive and took significant time to explain and discuss. I found that such timelines were a poor use of time and could be established while transcribing. As a result, a less structured interview format was adopted based on themes from the academic and government sources.

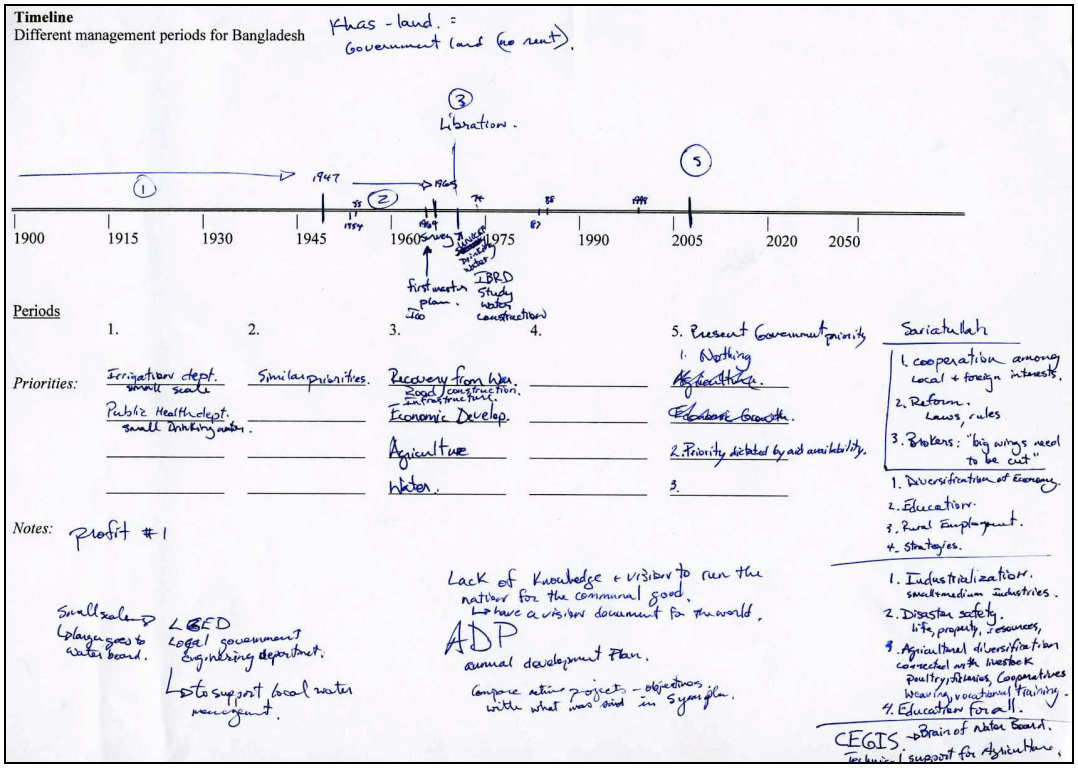
Figure 9: Example of pilot template



Source: author

Figure 10: Example of pilot template

[12] An early objective of the research was to collect multiple individual timelines that marked the periods of flood management. I aimed to elicit comments on the events that sparked change. This was difficult to explain and not fruitful in early discussions.



Source: author

The questions (see Table 2) used to elicit information evolved with each interview, though the themes remained consistent. Additionally, the wide range of experts included in the research (Appendix B) meant that certain themes were more or less relevant to different experts. It was found that a great deal of information could be acquired by first asking the participant to explain their job, their institution and their thoughts on disaster and flood management. These questions helped relax the participants and often addressed some of the research themes. When this happened, I adjusted the questions to probe their views, either immediately or later in the conversation. In this way, the structure of the interview was both malleable and directed. I asked participants where they were working during the 1987/88, 1998 or 2004 floods. I found that such questions jogged memories while encouraging respondents to consider whether their opinions had changed over time.

I chose semi-structured interviews to encourage participants to address related topics while retaining emphasis on the predetermined themes (see Table 2). I accept that this approach is subject to ambiguity but the reduced formality helped mitigate the imposition my preconceptions.

Table 2: Research themes and questions

	Theme: its purpose Example of the type of questions asked.
	General Introduction: put the participant at ease. Could you tell me about your organisation? What is your position? How long have you been at X? What is the goal of your organisation?
i	Floods in Bangladesh: set the tone and answer a key question of the research. Is flooding a problem in Bangladesh? What 'counts' as a disaster in Bangladesh?
ii	Periods, Paradigms and Dominant Knowledge: the evolution of flood management What are the priorities that dominate/influence flood management? Has this always been so? Can you remember times when different priorities were dominant? What issues shaped this management practice? How does past management compare to present? What about the future?
iii	Technology: what are the methods of flood management. What methods are now being used (most used) in flood management? Has this always been the case? 'No' – How have technologies changed? How do those technologies affect management, if at all? Social management? How are the two related? How are they compared or chosen?
iv	People: power and governance Who decides how flooding is managed? How do they make their decisions? What are the issues that shape the decision-making process?
v	People: victims, the vulnerable and those affected Who is affected by flooding? Benefited? Harmed? How is (each group) affected? Why are some groups more vulnerable than others?
vi	NGOs, Government and the International Community How do NGOs operate? What are their strengths/weaknesses? They are accused of looking after their own members? What is the impact of aid/relief?
vii	Development, Millennium Goals, World Bank and ADB: donors and funding How has the international community been involved in flooding? How does this affect flood management? Affect your organisation/job? How has this involvement changed over time?
viii	Poverty and Disasters: What is poverty in Bangladesh? What does it mean? What is the relationship between poverty and disasters? Recurrence? Resilience and exposure? The poverty line? How do poverty and disasters affect different groups?
ix	Corruption and Governance: How has the corruption drive affected Bangladesh? Could you explain if/how

	corruption has influenced flood management?

While I recognise that I am an active participant in this research, this format allowed me to reduce my 'voice' as much as possible. Again, I appreciate that my position as a white male, associated with a British university, visiting a Muslim nation and often viewed as a guest affected the process and the findings. To address bias, I echoed responses to assess consistency. Concerning the responses, I have maintained the comments in their exact form to preserve the intent and meaning. Undoubtedly, translating spoken word into text reduces the contextual, non-verbal and implied intent of the responses. For this reason, I have not corrected grammar and have left misused tenses, attempting to communicate the discussions as accurately as possible. While the participants were proficient in English, I have made no use of the [sic] term to identify phrasing which may be grammatically incorrect, preferring to not judge or cloud their intent any further.

The analysis and transcription process represented the first stage of formal analysis following the interviews. It allowed for an appraisal of each discussion and began the consideration of overarching themes and issues. My approach to data analysis was intentionally simple. After transcription, I collated the files into a word document and divided them into occupational groups (Appendix B). Rather than use software, I read and re-read the documents, taking notes and consulting the literature. Having become familiar with the transcriptions, I began associating and contrasting common themes. For example, I collected each of the opinions concerning whether flooding was perceived as a problem in Bangladesh. Once the opinions were grouped, I continued to read and compare the views, attempting to establish the range and strength of particular perspectives. This was an extremely difficult task. Originally, I had thought that I would make comments based on the number of participants who shared a particular perspective. As I progressed, this became a dubious objective because the participants are not a representative sample. Additionally, interesting data often rested in the unusual, more specific or detailed responses. Finally, grouping the responses according to

similarity reduced their value as they were generalised. I felt this act inserted too much of my voice and intent into the responses.

The methods adopted for this research were fluid and adaptive. There is a massive body of literature focused on flooding and flood management in Bangladesh, and so, the issue was not simply selecting a method but rather selecting a method that would encourage innovative findings. This might be described as a grounded method, though I would challenge any attempt to detach the author (Glaser and Strauss, 1967; Suddaby, 2006). Instead, I would prefer that the methods be understood as part of the learning I underwent as part of the research. As previously stated, the flood management controversy (problem designate) guided this research, not the methods. It was the themes born of the narrative, along with appreciation of the individuals, contexts and expertise, that produced the research.

CONCLUSIONS

Exploration of the controversy surrounding flood management in Bangladesh requires a methodology suitably adaptive, reflexive, inclusive and innovative. Alternately, such an approach cannot include everything of relevance, even if making such a list were possible. To confine the tendency to expand the scope of knowledge oriented research continuously, a problem designate approach was used to direct emphasis to the areas most relevant, according to the literature and to the experienced experts responsible for flood management. There is value in allowing the problem and the people involved to help direct not only the findings but also the structure and format of the research. I maintain that this approach, far from being radical, simply admits the influences and adaptations that take place in the field, in the office and in the moments of clarity that sporadically strike. Environmental hazards and flood research is increasingly reliant on perspectives and opinions, and this project is no different. I recognise the important

contribution of analyses of socially-constructed knowledge and its ability to expose the assumptions that privilege certain knowledges or practices. In contrast, I suggest that an over-reliance on social constructivism has resulted in a dematerialised tendency within environmental hazards research, one that I confront through the problem designate approach and by emphasising the role of material actants in shaping knowledge (for example, how an embankment influences people's knowledge and beliefs). Ideally, this approach will provide a countermeasure to the numerous examples of environmental hazards research that, for both understandable and inexcusable reasons, replicate established methodologies with the aim of generating innovative findings. Complexity theory is primarily an epistemology. Beyond the existence of systems composed of relating actants, it is concerned with exploring the world rather than developing explanatory theories and testing their applicability. As the basis of a methodology, then, complexity theory enables analysis of the actant relations that inform and sustain controversy. To strengthen its consideration of space and time, network analyses are adopted in order to subsidise consideration of the spaces in which relations occur and the messiness that characterises interactions. The move towards stakeholder, indigenous, local and/or lay knowledge represents an innovative and valuable means of challenging established, primarily scientific, knowledge and knowledge production. Alternatively, this move assumes that power is shared and that those in control value lay knowledge. In cases where power is concentrated, those with knowledge-power represent an important source of information, one that is currently absent from the flood and hazards management literature concerning Bangladesh.

As Whatmore and others argue, controversy provides an opportunity for generative research (Whatmore, 2009; Lane et al., in review). How can this maxim be operationalised? According to many authors, this aim is realised by challenging the concentration of knowledge-power and embarking on a collaborative project in which knowledge comes from those involved and where decisions are negotiated, distributing power and respect to knowledge of varying sorts. In effect, opposing understandings are brought to bear in order to collaborate and bargain a solution (Collins and Evans, 2003; Jasanoff, 2003a; Wynne, 2003). To accomplish such an objective on a national-scale or

in a context in which power is concentrated requires adaptation. Opposing knowledges are still the means of exploration, though the redistribution of power is less attainable and of less relevance given its present concentration. Instead, the prevailing understanding (entrenched, traditional, dominant or established) is reconciled with the understandings of those shaping management: the people making the decisions that sustain and produce flood management. To meet this aim, the following chapter describes the evolution of the prevailing understanding of flood management in Bangladesh, suggesting, oddly enough, that it is not evolving but accumulating understandings and becoming more complex.

THE 'EVOLUTION' OF THE PREVAILING UNDERSTANDING OF FLOOD MANAGEMENT IN BANGLADESH

3

> *When our population was within the safe range, like 50 million, then it was ok, but now we have 150 million. For traditional methods, those coping mechanisms will not work for 150 million people. So, in my childhood, we had low food production but now it is 4 or 5 times as much. Otherwise, it would not be possible to feed the people.*
>
> (Gov 2: 15/01/08)

System evolution is both sensitive to initial conditions and path-dependent. These complexity theory premises recognise that systems, in this case the assemblage of factors that sustain the knowledge controversy surrounding flood management in Bangladesh, are situated not only in space but also within space-time (Massey, 2001; Massey, 2005). As Ramalingam et al. (2008: 27) explain, "the interactions that are taking place at any moment in time have evolved from a previous moment in time, that is, all interactions are contingent on an historical process". Building upon this argument, the analysis of systems, particularly those deemed complex, must recognise that historical change is not free ranging. Instead, change is a product of actants and the evolution of knowledge over time. This premise "holds that a system's trajectory is a function of past states, not just the current state" (O'Sullivan, 2004: 285). Together, the premises acknowledge that history matters, though in addition to this appreciation for time I use the duplicity of the term 'matter' to emphasise the materiality involved in that change. This thesis is predicated on exploring the prevailing understanding of flood management in Bangladesh in relation to the different-yet-related understandings of flood management experts. To realise this objective, I require a description and analysis of the prevailing understanding that includes its lineage. This history provides a basis for contrasting the dominant or entrenched understanding with the values, beliefs and

feelings expressed by the experts responsible for management.[13] In so doing, this process helps identify the key issues that shape the controversy surrounding flood management in Bangladesh.

In this chapter, I present *an interpretation* of the history of flood management in Bangladesh as portrayed within academic and government sources. The narrative focuses on the knowledges, assumptions and contextual issues that have shaped decision making. The account is divided into periods associated with distinct versions of the prevailing understanding and management practices. For example, the engineering period is unified by domination from engineers and a tendency towards the physical control of the environment using technical structures. Alternately, the human development period is unified by efforts to promote resilience through livelihood development. The chapter begins with a description of the assumptions that shaped my historical narrative, explaining how I draw upon discussions of genealogies and combine them with an event focus and temporally linear format. Following the history, three discussions explore: first, an ongoing transition from realist to constructivist interpretations of flooding and flood management; second, recognition for a discrepancy between the government and academic priorities concerning agricultural development; and third, a cumulative interconnectivity between the competing knowledges that inform and contest flood management. Applying the complexity theory premises (Chapter 2), the tense assemblage of ideas, things, people and knowledges exposes three core issues that require further consideration, providing the entry points for the subsequent chapters and, ultimately, for the structure of this thesis.

Issues involved in constructing a historical narrative

Environmental management in Bangladesh is renowned for conflict and debate between or among opposing perspectives (Haque and Zaman, 1993; Rasid and Mallik, 1993;

[13] It bears repeating that this comparison of understandings is not one in which they are diametrically opposed; instead, while they are different they are also mutually informed and related.

Sillitoe, 1998a; Berz, 2000; Mirza et al., 2001; Haque and Etkin, 2007; Sillitoe and Marzano, 2009). The result, according to some, raises the possibility of an inability to overcome envisaged catastrophes fuelled by social, demographic and climate changes (Brammer, 2004; 2010). Alternatively, some argue that, in the face of such pressures, limiting the adoption of large-scale strategies has prevented the imposition of impractical and misguided measures (Islam, 1990; Ahmed, 1999a; Islam, 2001; Ahmad, 2003). The debate over flood management is populated by actants with fundamentally differing values, opinions, priorities, aims and assumptions, which not surprisingly lead to differing understandings and opposing views concerning adjustment strategies. As a means of approaching this assemblage, I combine numerous histories of flood and disaster management in Bangladesh, as well as more general accounts of flood and disaster management, in order to explore the evolution of the manner in which floods, flood management and vulnerability are understood.

There is a need to recognise the historical situatedness of flood management rather than ground judgments of the past in the present. With reference to a political ecology approach to understanding hazard and risk, Pelling (2003c: 11) explains the value of analyses that expose and explore historical narratives, declaring that:

> "[d]iscourse analysis is the favoured tool of this branch of political ecology and it has been ably deployed to unpack narratives… Less common are attempts to unpack narratives lying at the centre of natural hazards debates".

Historical perspective, then, does not aim to defend or justify past knowledge but to understand better the objectives and pressures that shaped decision-making, accomplished by exploring past goals, priorities, values and/or problems. However, prior to such analyses, a history of flood management is required to provide the basis for further analysis. To reiterate, a historical narrative represents a situated perspective of the world that is constructed by an author(s) and the product of innumerable influences. This history, then, is more a version of flood management than a grand or true reflection. Ramalingam et al. (2008: 27) explain this context, stating that "no single perspective can capture all there is to know about a [complex] system". In addition, a complete 'History' is an impossible objective given its situatedness and reliance on individual perspectives,

raising the question of whose history? In this instance, I have chosen to explore the prevailing understanding as portrayed within academic and government publications. I suggest that the competing histories, each an actant within the assemblage, obscure the contested nature of flood management knowledge and result in a powerful testament that shapes present understanding. The prevailing understanding, then, represents power, being the most prominent interpretation of flood and disaster management.[14] Following this rationale, the historical narrative presented in this chapter is an analytical devise that informs this analysis while also helping to expose the core issues that punctuate the controversy surrounding flood management in Bangladesh.

Genealogy

Rather than a teleological narrative, my historical construction represents a single situated interpretation of multiple understandings of flood management as a pseudo-chaotic product of countless interactions between actants across time, space and interests. Despite pronounced differences, this approach draws upon Foucault's discussions of genealogy, particularly his appreciation for the assemblages of 'minor' actants (Foucault, 1977; Said, 1978; Foucault, 1984 [1971]; Gutting, 2005). Illustrating this link between network-assemblages and genealogy, Gutting (2005: 46) explains that:

> "Foucault was skeptical of grand teleological narratives focused on [vague and general goals such as democracy or secularism] and proposed instead accounts based on many specific 'little' causes, operating independently of one another, and with no overall outcome in view".

In this sense, the proceeding narrative of flood management over time attempts to account for the assemblage of 'little' factors that incite change in the prevailing understanding. For example, the technological innovations, international relations or social, cultural, governmental, climate or economic changes. Genealogy is not only about language and how it shapes understanding but also about how it orients analyses towards the power within discourse, which in turn informs claims to authority rooted in knowledge. It is the entrenchment of the prevailing understanding that establishes its

[14] I use the word prominent because of the central role of the prevailing narrative. Even radical and critical accounts of flood management are related to the prevailing interpretation: to what is 'known'.

authority by disassociating it from its complex, contradictory and uncertain origins. It is this context that, I maintain, severs the prevailing from the expert knowledges, obscuring the uncertainty and debate underlying competing knowledges. By exploring the knowledges that provide the basis for the prevailing understanding, I seek an appreciation for the power that creates, establishes, confronts and perpetuates some knowledges over others (Foucault, 1977; Gutting, 2005).

My approach differs from a Foucaultian genealogy in that I emphasise the historical context in which competing knowledges form. While I also seek an understanding grounded in the present, this narrative accounts for the situatedness of knowledge. For example, the history is concerned with the context in which policies were implemented because such documents cannot be judged using present circumstances alone, particularly given the population, resource and agricultural changes that have occurred. Alternately, I share the aim of extending critical analysis to claims of authority that employ the prevailing understanding as justification (Foucault, 1977). A more definite difference between my construction of a flood management history and genealogical or network/assemblages research is the decision to follow a temporal structure (Law, 1992; Latour, 1996b; Murdoch, 1997a; b; Law, 2002; Li, 2007; Law, 2008). This distinction is critical. I have chosen a temporal presentation of the periods of flood management because of the importance of events, or more importantly a recurrence of events, in terms of understanding the development of knowledge. I argue that an understanding of flood management requires an appreciation for the cumulative and compounding effects of events over time, leading to another key aspect of my historical narrative.

The event centred structure of the historical narrative

According to Sultana et al. (2008a: 339), disasters define Bangladesh. They argue that "exposure to natural disasters, whether floods, droughts, cyclones, or earthquakes, is probably its defining feature". This sentiment is shared more widely within the academic hazard literature, suggesting that catastrophic events are stimuli for significant social, economic and political change (Johnson et al., 2005; Johnson and Priest, 2008; Sultana

et al., 2008a; November et al., 2009). Referring to disasters, Adger (2006: 269) lends further support to the emerging importance of momentous events, explaining that "[i]n a world of global change, such discrete events are becoming more common. Indeed, risk and perturbation in many ways define and constitute the landscape of decision-making for social-ecological systems". Commenting on the developed world, Johnson et al. (2005) argue that floods represent an important catalyst for policy change, a finding replicated by Sultana et al. (2008a) in relation to Bangladesh, with added appreciation for the role of the international community and for power holders. With reference to the 2004 flood, Islam provides further evidence for the important role of flood events in shaping thought and action, stating that the "reaction to the impact of this year's flood in Dhaka was immediate and clear. The Prime Minister herself took the lead in a commitment to protect the capital from flooding". Flood disasters in Bangladesh result in significant pressure to change the policies and practices that have contributed to, or failed to prevent, a disaster. An instructive example from Bangladeshi disaster management policy states that:

> "[a]fter the floods of late 1980s and the devastating cyclone of 1991, the concept of acting only after the occurrence of a disaster has been replaced by the concept of total disaster management involving prevention, mitigation, preparedness, response, recovery and development" (Government of Bangladesh, no date).

In this sense, the 1956 Krug Mission Report and the resulting 1964 Master Plan respond to the 1954/1955 floods in the same way that the 1989-1995 Flood Action Plan responds to the 1987/1988 floods; likewise, in response to the famines of 1943 and 1974, there is a clear sentiment within the government literature that agricultural development and food self-sufficiency sparked a fundamental realignment of decision-making and policy (Chadwick, 1999b; Chadwick and Datta, 2000; Asian Development Bank, 2003; World Bank, 2006). Following from Johnson et al. (2005) and Sultana et al. (2008a), this review of flood management uses key disastrous events to provide structure, primarily using floods, cyclones and famines. In addition, the compounding impact and influence of disastrous events requires a sequential format able to demonstrate the ongoing, and I argue, escalating nature of impacts from disastrous events in Bangladesh over time. In addition to the event-centered structure, the discussion also incorporates governance alongside what Haque (1997), Chadwick (2000), Pelling (2003c), Adger (2006), Sultana

et al. (2008a) and Smith and Petley (2009) interpret as a progression of knowledge, often described in terms of paradigms. Together, the three formats contribute material, political and theoretical interpretations of the history of the prevailing understanding of flood management in Bangladesh.

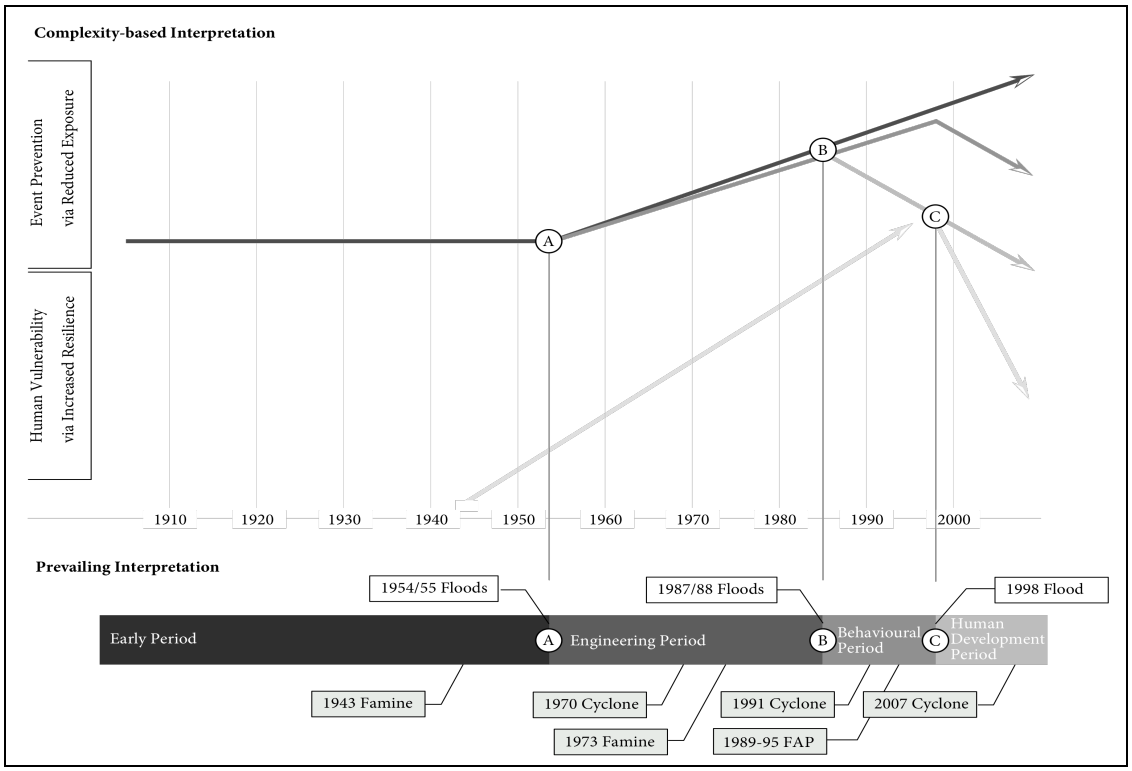
THE HISTORY OF THE PREVAILING UNDERSTANDING OF FLOOD MANAGEMENT IN BANGLADESH

This review differs from reviews that are more traditional in that it includes contextual information alongside scholarly accounts of flood management in Bangladesh. In this way the assumptions, philosophies and assertions are understood as a complex system of flood events, national events (for example, the dissolution of East-West Pakistan in 1971), ontological and epistemological evolution and the procession of Bangladeshi governance (Manson, 2001; O'Sullivan, 2004; Manson and O'Sullivan, 2006; O'Sullivan et al., 2006; Ramalingam et al., 2008). It is grounded in network and assemblages literature, in which context, history, materiality and positionality are recognised as key elements (Law, 1986; Latour, 1999; Law and Hassard, 1999; Bennett, 2005; Li, 2007; McFarlane, 2009). The discussion incorporates two bodies of literature: government[15] and academic publications. Reflecting prevailing divisions within the literature (Tobin and Montz, 1997; Pelling, 2003c; Wescoat and White, 2003; Adger, 2006; Sultana et al., 2008a; Smith and Petley, 2009), the discussion is divided into four periods of flood management, commonly known as ‘early’, ‘engineering’, ‘behavioural’ and ‘human development’. Figure 11, divided into upper (expert) and lower (prevailing) halves, is a heuristic visualisation of two interpretations of the history of flood management. The lower half shows a generalisation of the paradigms as described within the academic hazard and risk literature (Wescoat and White, 2003; Adger, 2006; Höfer and Messerli, 2006; Smith and Petley, 2009) while the upper half represents a generalization rooted in complexity theory and Kaufmann’s (1993) fitness of landscape theory. The paradigms within both the prevailing and complexity conceptualisations are loose representations

[15] The government documents include reports commissioned by the Bangladeshi government and some conducted by international agencies such as the World Bank and Asian Development Bank.

that mark where changes to the dominant form of flood management became apparent. While the paradigms overlap, it is also important that the role of catastrophic events be considered; the competing conceptualisations, while not wholly produced by disasters, manifest through controversies over management practice and logic. Despite examples of policy and literature that challenge the divisions between paradigms, both before a period and after its supposed passing, the timeline helps visualise the periods of management. Of note, the arrow coming from the base of the figure represents the external influence of development on flood management, emerging after the Second World War and becoming more formally incorporated following the 1998 flood event.

Figure 11: Periods of flood management in Bangladesh



Source: Haque (1998), Pelling (2003c), Adger (2006), Sultana (2008) and Smith and Petley (2009

Early period: lead-up to 1954/55

British management of the Indian colony dominates the early period (Shaw, 1989; Zaman, 1989; Brammer, 1990a; b; Zaman, 1993). As Chadwick and Datta (2000: 2) explain, "prior to the partition of the subcontinent in 1947 there had been no national-scale government-led water sector development in what is now Bangladesh". This claim

does not imply a lack of flood management, rather, as Sillitoe explains (1998b), there was a different type of management reflecting local governance and culture (see also Sillitoe and Marzano, 2009). Colonial management is described as disengaged from planning, reflecting its aim to control and extract resources (Chadwick and Datta, 2000; Chadwick et al., 2001). It is important to recognise two differences between this period and the three periods that follow. First, the population between 1870 and 1950 is thought to have increased from approximately 20 to 40 million; between 1950 and 2009 the figure increases to more than 150 million (Central Intelligence Agency, 2009). This population increase differentiates the early period, during which high-risk land was unoccupied year-round, reducing the importance of flood management due to lowered exposure. Additionally, Höfer and Messerli (2006: 73) characterise the period between 1932 and 1954 as relatively flood-free. Combined, the increasing use of seasonal land and the cyclical nature of flood frequency differentiate the early from later periods. Second, despite assertions that flood events have become more extreme, Höfer and Messerli (2006) find that events have long affected the region and that catastrophic floods in the 18th and 19th centuries were more severe due to the combination of earthquakes and more direct river courses to the Bay of Bengal. In addition, these events led to significant repercussions, including reference to a famine that killed one-third of the Bengal population following the 1769 flood or food prices rising by 300-400% causing a famine following the 1787 event (Höfer and Messerli, 2006). The prevailing understanding of flood management during this period is characterised as reactive rather than pre-emptive, reflecting both the abilities and the perceived responsibilities of those in power (Legg, 2006; 2007).

The engineering period: 1954 – 1986

Emerging following the 1954/1955 floods, the engineering period is characterised by an increased willingness to implement large-scale technical adjustments to physically control the environment. Sometimes known as the structural or technical period, the approach originated in the United States with the Army Corps of Engineers. It was predicated on the control of hydrological resources using physical structures (White,

1945; White, 1973; White, 1974; Smith and Ward, 1998; Wescoat and White, 2003). The period coincided with wider efforts by the western world to curb the spread of communism through strategic and economic partnerships and modernisation efforts, which saw increased confidence in the role of technology to overcome nature and improve livelihoods (Wolf, 1999; Chapman, 2000; Gleditsch et al., 2006; Mustafa, 2007). In this context, structural flood management, requiring significant investment, represented a method of enticement towards the American sphere of influence. With the entrenchment of the Cold War, flood management provided a vehicle for international partnerships by providing a pretence in which technological and economic resources and expertise were the currency of collaboration. Of importance was the predetermined need for investment and technology transfer. The period also coincided with the modernisation approach to development, particularly relating to the World Bank, Asian Development Bank and United Nations (Berger, 2004; Picciotto, 2004).[16] Bangladeshi governance during this period is described as complicated (SenGupta, 2007) due to the impacts of the partitioning of India (1947), the Liberation war (1971), and the conflicts surrounding transitions between Sheikh Mujibur Rahman (1972-75), Ziaur Rahman (1975-81) and Hussain Mohammed Ershad (1982-90).

The post-partition period is described as having a deficit of experienced leaders and effective infrastructure required to develop a nation (SenGupta, 2007). As a result, alongside the expected difficulties of a nascent country, Pakistan[17] was a disorganised and divided nation physically, ethnically, economically and politically (SenGupta, 2007). During this period, East Pakistan experienced numerous disasters, including the successive floods of 1954 and 1955, initiating the disposition towards engineered management using physical structures to control the environment (Rogers et al., 1989; Brammer, 1990b; 2004). The 1970 cyclone re-exposed Islamabad's neglect of proactive disaster planning and is recognised as a key point in the disintegration of the East and West Pakistan alliance (SenGupta, 2007). Another result of the disorganisation was the

[16] Two examples include the Green Revolution along with the funding and proliferation of large-scale dams.
[17] Then composed of East Pakistan (now Bangladesh) and West Pakistan (now Pakistan).

1974 famine that, within living memory of the 1943 famine, fundamentally oriented flood management towards agricultural development and food self-sufficiency (IECO, 1964; Chadwick and Datta, 2000; Sultana et al., 2008a). In this sense, the famine represents a defining moment for the Bangladeshi consciousness, shaping public expectations to the present (Rasid and Paul, 1987; Boyce, 1990; Brammer, 1990a; b; Zaman, 1993; Chadwick and Datta, 2000; Faisal and Parveen, 2004). For example, Amartya Sen's (1981) analysis of the famine, and later, Muhammad Yunus's (1999) advocacy of micro-credit, rely heavily on the event; Sen (1981) argues that famines are the product of social processes rather than decreased agricultural production while Yunus (1999) argues that for-profit 'conscientious capitalism' can empower marginalised people through the provision of credit, ultimately combating food insecurity.

The two most prominent government publications during the engineering period are the United Nations Krug Mission Report (UN, 1956) and the International Engineering Company Master Plan (IECO, 1964). The Krug report is important because it led to the formation of the East Pakistan Water and Power Development Authority. In 1972, this entity was reorganised and is now called the Bangladesh Water Development Board (hereafter BWDB). It is responsible for water development projects larger than 1000 hectares. The organisation was dominated by engineers and enjoyed both national and international funding for the large-scale projects favoured by government and donors at the time (Rogers et al., 1989; Boyce, 1990; Custers, 1992; Rogers, 1994). The 1964 Master Plan is, to date, the most important government publication for understanding flood management in Bangladesh because it is responsible for the current prevalence of physical structures designed to control the environment (Chadwick, 1999b; a; Chadwick and Datta, 2000; Chadwick et al., 2001). Following the U.S. example, the plan sought large-scale investment and development with the expressed objective of meeting the demands and aspirations of a growing population. For example, the Master Plan declares that:

> "in operation, the projects will enable farmers to control the supply of water to their lands and thus to achieve the full benefits possible from planting

> higher yielding crops, fertiliser, better farm practices, and adequate water for crop use. Embankments and positive drainage will minimise the hazards of excess waters, and irrigation will compensate for any deficiencies in rainfall" (IECO, 1964: 2).

The document, despite its flood management and damage reduction focus, justifies itself by citing national priorities; for example, agricultural development was its primary focus alongside rural labourers, industry, power development and fisheries (IECO, 1964). In addition to driving the engineering approach, the Krug and IECO reports also initiated the precedent for international involvement, informed by the universalist assumptions of flood management at the time (White, 1974; Hewitt, 1983; 1997). While the plans advocate mixed methods and identified rural populations as the primary beneficiaries, they remain dedicated to environmental control using physical structures. As Rogers (1994) explains, the implementation of the Master Plan prioritised structural adjustments such as polders and embankments regardless of mention of drainage and irrigation, fishing or other non-structural adjustments.

The engineering-dominated version of the prevailing understanding of flood management was shaped by Malthus-informed assessments of the carrying capacity of Bangladesh, primarily in relation to population health and projected growth (Faaland and Parkinson, 1976a; Faaland and Parkinson, 1976b; Dodge and Wiebe, 1980; Blair, 1985; Mellor and Gavian, 1987). For example, Faaland and Parkinson (1976a: 740) state that "the most crucial relationship for the future [of Bangladesh] is that between population and the production of food, in particular the production of rice and other foodgrains". Research from this period is comparative, with focus on female reproductive health, the impacts of poverty and cultural differences between Bangladesh and the developed world (Frisch, 1978; Bongaarts, 1980; Udry and Cliquet, 1982; Wyshak and Frisch, 1982; Mellor and Gavian, 1987). A second body of early academic research can be characterised as scientific studies of the physical environment (Coleman, 1969; Brammer and Brinkman, 1977; Goswami, 1985), though the research shared few links with the flood management literature. An important publication during this period was Montgomery's (1985) discussion of the historical context of the 1984 floods. This work is important for its agricultural emphasis, recognition that the indigent bear a

disproportionate amount of the suffering, that damages appear related to the depth of floodwaters and that famines do not coincide with decreased rice production. This period also marked the beginning of a social interpretation of flood management, primarily through the emergence of relief NGOs and the promotion of small-scale fast-return development projects, such as low-lift water pumps.

Until late in the engineering period, flood management research remained within the remit of government and international institutions. This situation changed with the growth of qualitative methods and interest from geographers employing human ecology to criticise the assumptions informing engineering strategies. Their arguments relied on a characterisation of the government as a unidimensional advocate for engineering strategies (Islam, 1974). Paul (1984: 4) criticises the economic focus of works such as the Krug Report and Master Plan, claiming that:

> "to better assess the complex problem of flood and flood control in Bangladesh, more attention needs to be given to the individual… [m]oreover, an understanding of how individuals have adapted to and are affected by floods may suggest new and less costly ways of reducing flood damages".

These social scientists were informed by Gilbert White and the Chicago School (White, 1945; Chorley, 1973; White, 1973), particularly White's book on the local, national and global nature of natural hazards (1974). Both Islam (1974) and Paul (1984) root their criticisms in the explicit and implicit assumptions of engineering-led strategies, the most important being that government managers perceive disasters as disruptions to an otherwise balanced human-environment relationship. This focus reflected wider methodological changes within the social sciences, particularly Hewitt's (Hewitt and Burton, 1971; Hewitt, 1983; 1997) Marxist critiques of the 'dominant' understanding and his advocacy of more reflexive analyses of hazards as the product of human endeavours (Hewitt, 1983). These criticisms of the engineering-dominated prevailing understanding of flood management, along with methodological sophistication, laid the foundation for a fundamental reorientation. The 1987 and 1988 floods provided the impetus.

The behavioural period: 1987 – 1998

The behavioural period is characterised by its focus on the human-environment relationship and is based on the premise that human and environmental systems are both suited to ecological analyses (Hewitt, 1983; Watts, 1983). The behavioural interpretation defined itself through criticism of the engineering period, particularly the universalist assumptions pertaining to human responses to natural hazards. The period employed a rational analytic interpretation that sought a more complete understanding of the decision-making process that included appreciation for *why people chose* to live in high risk locations. Despite this shift, this period retained the engineering period's orientation towards individual events and viewed its findings as universal (Burton and Kates, 1960; White, 1974; Penning-Rowsell, 1994). This transferability is critical, as flood researchers were willing to apply knowledge and experience globally, a disposition grounded in the laws that shape the engineering of structures, but is highly dubious in terms of cultural and social knowledge (White, 1974; Douglas and Wildavsky, 1982; Haraway, 1991; Douglas, 1992).

The 1987 and 1988 floods represent the defining moments of the behavioural-led version of the prevailing understanding of flood management in Bangladesh. In addition to these events, the 1991 cyclone, which killed more than 100,000 and is thought to have left ten million homeless, is also a critical event. These flood events, the second and third most damaging in recent Bangladeshi history (see Höfer and Messerli, 2006: 71-72), reinvigorated the international community's interest in Bangladesh (Consortium, 1989; JICA, 1989; Rogers, 2006). This interest coincided with recognition for continued population growth and was highlighted by comments attributed to the U.S. National Security Advisor's entourage characterising Bangladesh as 'an international basket case' (1971). In addition, Bangladesh received much attention as a result of Myers' (1993) discussion of the potential for regional destabilisation due to environmental refugees. The floods and cyclone legitimised criticisms of the engineering-dominated prevailing understanding and forced an acceptance that the scale of natural hazards in Bangladesh was possibly beyond the scope of human control. This debate further divided the flood management community, primarily over differing objectives and priorities. The period

also witnessed a surge in social issues and advocacy for minority and marginalised groups, specifically women (Hanchett, 1997; Paul, 1999; Hawkes and Hart, 2000; Coles and Wallace, 2005), the vulnerable (Custers, 1992; Rasid and Mallik, 1996) and the impoverished (Sen, 1981; Ravallion and Sen, 1994; Wahid, 1994; Sen, 1999). Overseeing water and flood management, vulnerability began to dominate discussions that had previously been limited to damage reduction and economic development.

This period of flood management was influenced by criticisms of the world order perpetuated by development through modernisation. For example, Arturo Escobar's (1995) account of development as a western application of power and his argument that the control of knowledge maintains a hierarchy that favours the developed world provided added criticism. Nevertheless, long-term projects initiated by the 1964 Master Plan continued to be implemented. Governance during this period is characterised as turbulent (SenGupta, 2007), with most of the period dominated by Hussain Muhammad Ershad (1983 - 1990) and a political transition to Prime Minister Khaleda Zia (1991 - 1996). In terms of flood management, Ershad was a proponent of grand design, characterised by projects like the Jamuna Bridge and the Flood Action Plan (hereafter FAP). In response to the growing controversy over government practices, particularly surrounding the FAP, flood management language was reoriented to reflect grassroots initiatives with fast-maturing benefits for rural and impoverished segments of the population (Chadwick and Datta, 2000). Another divisive theme during the period involved arguments for increased transparency, participation and empowerment, a shift reflected in the Flood Plan Co-ordination Organisation's guidelines for people's participation (FPCO, 1993). During this period, government reports struggled to reconcile governmental and popular priorities. The BWDB, responsible for the national-scale, remained convinced of the need for large-scale strategies to promote irrigation and agricultural development through the control of floodwaters (Government of Bangladesh, 1986; 1991; 1998). Despite this belief, most international organisations directed their support towards tubewells and low-lift pumps designed for the extraction of shallow groundwater, supporting the growing demand for the winter irrigation of

Boro[18] rice. The most important government documents of the period are the twenty-six FAP studies, the National Water Policy (Government of Bangladesh, 1999) and the Ganges Water Sharing Treaty with India (Government of Bangladesh, 1997).

The FAP is surrounded by both legitimate and hyperbolic controversy. It represents an unrivalled impasse that continues to influence debate over the objectives and methods of flood management in Bangladesh. Despite suggestions that what the government proposed and intended were inconsistent (Boyce, 1990; Custers, 1993), the plan eventually emerged as a study to establish baseline information and "to provide supporting technical, social, environmental and institutional information to feed into the planning components" (Brammer, 2004: 171). It was preceded by several publications, including an Agricultural Ministry study opposed to large-scale embankments (UNDP, 1989), a French study that advocated costly embankments recessed to five kilometres (Consortium, 1989), a Japanese-funded study that recommended staged embankments with sufficient flexibility to adapt to the environment (JICA, 1989) and the Eastern Water Study (Rogers et al., 1989), which argued that the weaknesses of past control efforts, along with institutional and maintenance costs, made the physical control of the environment using technical structures impractical.[19] It was within this period that the government heeded calls for stakeholder participation and promoted policies designed to empower local populations (for example the National Water Policy and Management Plan). It marks a significant shift that has been maintained to the present (Government of Bangladesh, 2001; 2004).

The behavioural period marked the integration of the social sciences into the prevailing understanding of flood management (Brammer, 1987; Rasid and Paul, 1987; Bingham, 1989; Shaw, 1989; Alam, 1990; Dalal-Clayton, 1990; Islam, 1990; Comments, 1992; Paul and Rasid, 1993; Hoque and Siddique, 1995; Paul, 1995; Rasid and Mallik, 1995;

[18] Boro is the name given to the winter rice crop. It is high yielding but intolerant to flooding.
[19] For further discussion and analysis of the FAP, see Boyce (1990), Rogers (1994) and Brammer (2004).

Hanchett, 1997). Building upon Paul's (1984) discussion of the cultural distinction between *Bonna* (abnormal flood levels with negative associations) and *Barsha* (normal flood levels with beneficial associations), researchers applied perception and survey methods to question the government's assumptions and practices (Rasid and Paul, 1987; Chowdhury, 1988; Islam, 1990; Rasid and Mallik, 1993; Zaman, 1993; Paul, 1995; Rasid and Mallik, 1996). These questions challenged the engineering-led prevailing understanding of flooding in two ways. The first sought to invalidate strategies predicated on the elimination of floods while the second argued that knowledge of flooding in Bangladesh was situated: was not universal and could not be applied out of context without significant reconsideration. Setting the precedent for subsequent social research, these works positioned their arguments in opposition to the prevailing wisdom of the engineering period, using fear of unbridled environmental and social destruction to undermine the legitimacy of the technical strategies they associated with the BWDB.

Emerging from this period was an appreciation for traditional coping mechanisms (Shaw, 1989; Brammer, 1990a; b; Islam, 1990; Haque and Zaman, 1993; Rasid and Mallik, 1993; Khalequzzaman, 1994; Paul, 1995; Rasid and Mallik, 1995). For example, the selection and propagation of flood tolerant rice varieties able to accommodate rising flood waters was a common argument (Islam, 1990; Custers, 1992), though few acknowledged its much lower yields (Thompson and Sultana, 1996). Within most of the publications during this period, human adjustments are explained in lists that highlight the ingenuity of indigent floodplain inhabitants. For example, Zaman (1993: 986) describes the flood-prone peasant in relation to floods as:

> "keyed to this predictable, normal, annual event that benefits their crop cycle and virtually rejuvenates their lives. The destructive impact of the flooding is usually limited by the adjustments that peasants inhabiting the floodplain regions have historically made, adapting their agricultural practices, cropping patterns, and settlements to the annual deluge".

However, this idyllic characterisation is punctured by his admission that floods also cause widespread destruction (Zaman, 1993). Haque and Zaman (1993: 102) found that the majority of residents sought to reduce the impact of flooding, including attempts "to reduce their loss to floods by selling their land, livestock or belongings; [while] some

moved housing structures, livestock, and family members to other safer places". This presentation is representative of the majority of studies; only Zaman (1989: 197) addresses the negative aspect of traditional coping mechanisms, describing the:

> "rise of violent *lathiyal* [police baton: that is, power enforced with violence] institution – a peasant-lord system to gain control over accretion land by the locally powerful *tulukdars* [mob boss] and *jotedars* [henchmen] using their patron-tied dependants".

Zaman also explains how gangs conscript the newly landless to battle for control of emerging *chars* (1989: 200).

The perception and opinion studies of this period rarely include discussion of the potential weaknesses of the approach, particularly the skewed emphases that result from victim- or perception-focused research (Cross, 1998; Pidgeon, 1998). In addition, criticism of top-down management is a foregone conclusion. Paul (1995) and Rasid and Mallik (1996) each find that a majority of floodplain residents support the control of the environment using large-scale physical structures, but disregard these opinions as ill-informed. Paul (1995: 304) explains his findings as 'contrary to expectation' and that:

> "the respondents of the study villages strongly support the construction of massive embankments along the rivers of Bangladesh…The near unanimous support of the respondents can be explained in a number of ways. One possible reason for this could be their recent experience with the catastrophic floods of 1987 and 1998… It may be that the responses of some of the heads of the sample households were influenced by local officials and leaders, who often blindly support government development programmes. In addition, the respondents might have thought that the construction of embankments would bring benefits at the individual, local, and national levels".

Paul also justifies his resolve in relation to 'unwarrantedly' high regard for western science and because the residents were unaware of cases where such strategies had failed (1995). This type of analysis raises important questions concerning the role and arbitration embedded within perception-based research. This tension between the desire for participatory knowledge and outcomes that contradict expectations is a trait within flood management research that continues to be neglected. Furthermore, with the increasing prominence of perception-informed studies, this is an issue of critical importance to management.

Another group to emerge during the establishment of a behavioural-led period sought to expose the FAP as a failed strategy due to its disconnection from the local population (Bingham, 1989; Boyce, 1990; Comments, 1992; Custers, 1992; 1993; Sklar, 1993). Boyce (1990) is representative of this interpretation, questioning the plan on economic, environmental, technical and ethical grounds. The discussion is problematic because it treats several different studies as one, equating the French plan with the FAP (Brammer, 2004). Closely related is the characterisation of managers and elites within the decision-making process. Governance is characterised as overly concerned with the potential investment that accompanies large-scale strategies rather than interest in the local impoverished population (Boyce, 1990; Custers, 1992; 1993). Experts are also presented as technophiles whose faith in western technology blinds them to the traditional adjustment strategies that have been implemented for generations (Bingham, 1989; Islam, 1990; Comments, 1992; Custers, 1993). It is interesting that, apart from these characterisations, elites and decision makers are excluded from perception-based flood management research, with the exception of Khan (1991).

During this period, due to interest generated by the floods (1987/1988) and the controversy surrounding the FAP, unparalleled interest was directed towards flood management research in Bangladesh from a diverse number of disciplines. Largely independent from earlier geographical research, anthropologists such as Sillitoe (Sillitoe, 1998a; Sillitoe, 1998b; 2000; Sillitoe and Marzano, 2009) and development oriented scholars like Blaikie et al. (1994), expanded the focus and methodologies applied to flood and hazards research, challenging and providing alternatives to the prevailing understanding. This diversification is a key aspect of the transition from the behavioural to human development period, culminating in Sen's exploration of development as freedom (1999).

The human development period: 1998 – Present

In terms of the developing world, Smith and Petley (2009) associate the current period or paradigm of flood management with human development, reflecting changes within the assumptions, objectives and knowledges driving the prevailing understanding (Tobin and Montz, 1997; Quarantelli, 1998; Cutter, 2003; Pelling, 2003c; Collins, 2009; Smith and Petley, 2009). As Collins (2009: 4) explains, following this understanding "[t]he typology of disaster is addressed based on their nature and impact on development. Ultimately, the definition of disaster is to do with human security". In Bangladesh, the human development understanding of flood management has its origins in the controversy that engulfed the FAP, which shifted the balance of power away from government and the physical control of the environment. In addition, the 1998 flood prompted critical reflection and criticism of the prevailing understanding and resulting management. Reflecting this exasperation with the recurrence of flood disasters, Ahmed (1999b: 3) explains that:

> "the worst floods in this century has come to inform us that regular activities and the long exhausted on-going pattern of thinking can hardly overcome the physical and social damages wrought by this deluge and the ones to come".

In the wake of the 1998 flood, the persuasive criticisms of the FAP exposed the assumptions underlying large-scale technical-centered projects while the United Nations Millennium Development Goals helped shift further interest towards human- rather than event-centered strategies. Additionally, between 1998 and 2006 Transparency International identified Bangladesh as one of the most corrupt governments in the world (TI, 2008), limiting the availability of foreign capital for infrastructure. This helped entrench NGOs as meaningful alternatives, toppling engineers and advocacy for physical management from their pedestal. The 1998 flood, the worst event in the period of discussion (see Höfer and Messerli, 2006: 71-72), exposed further technical and developed world adjustments as unsuited to the needs of Bangladesh, ushering a period in which human vulnerability was the primary concern. The human development period, then, is predicated on livelihood development and the reduction of vulnerability for the most disadvantaged members of society (Tobin and Montz, 1997; Enarson and Morrow, 1998; Quarantelli, 1998; Twigg and Bhatt, 1998; Lewis, 1999; Enarson and Chakrabarti, 2009; Smith and Petley, 2009).

As opposed to the engineering period, which focused on the physical event, or the behavioural approach, which emphasised the individual choices that lead to disasters, the human development understanding differs in two fundamental ways. First, it prioritises humans and human livelihoods, and second, it uses lived experiences and perceptions to criticise the macro economic and cultural factors that produce and entrench disaster-prone circumstances (Tobin and Montz, 1997; Quarantelli, 1998; Twigg and Bhatt, 1998; Lewis, 1999; Cutter et al., 2000; Pelling, 2003c; Collins, 2009; Enarson and Chakrabarti, 2009). The human development period of flood management is founded on the presumption that "environmental degradation, poverty and underdevelopment are [the] multidimensional conditions that underlie many of the world's major disasters" (Collins, 2009: 46). The most prominent example of human development understanding is the Millennium Development Goals (United Nations, 2008). As Collins (2009: 17) explains:

> "[p]overty, health, education, human rights, environment and good governance lie at the heart of the MDGs and these are also what lies at the core of reducing the risk of disasters".

Broadly, the human development period of flood management is characterised by an opening-up of considerations, extending interest to wider issues of development and poverty alleviation. This perspective orients management of flooding towards resilience and coping with the aim of improving human livelihoods (Haque and Burton, 2005; Pelling, 2006; Alam and Rabbani, 2007; Brouwer et al., 2007; Haque and Etkin, 2007; IPCC, 2007; de Chazal et al., 2008; Sultana, 2010). The predominant means of informing and implementing this framing is through the analysis of lived experiences using participatory research, primarily individual perceptions. Nazneen and Yasmin (1999: 15) provide a representative example of this logic, declaring that:

> "[s]ince Bangladesh is a floodplain country and severe floods are likely to occur every few years, it is high time that flood management mechanisms, institutions and strategies are developed based on [a] participatory process".

A key group of proponents of the human development approach in Bangladesh is non-governmental organisations. NGOs have evolved from radical community-based

advocates, to aid and relief delivery, to proactive involvement in the development agenda and, increasingly, to service delivery (Rahman, 1999; Matin and Taher, 2001; Amin et al., 2003; Mitlin et al., 2007). NGOs in Bangladesh emerged in response to the government's inability or unwillingness to address poverty, implement practices to aid marginalised segments of the population and as a means of encouraging innovative grassroots practices (Drabek, 1987; Matin and Taher, 2001; Mitlin et al., 2007). In this context, "NGOs have become key actors in a process of transformatory development" (Desai, 2002: 496). Despite numerous definitions within the literature, NGOs are united by the aim to improve the lives of the poor, disenfranchised or vulnerable within society. In Bangladesh, they have enabled civil society to circumvent the government apparatus, which is viewed as either unwilling or unable to address the plight of the indigent. This transfer of responsibility to NGOs reflects wider shifts towards the neoliberalisation of governance, often driven by the World Bank and the International Monetary Fund (Duffield, 2007), in which NGOs have been prompted to switch from radical community based agendas to service delivery (Matin and Taher, 2001; Ahmad, 2003; Ahmad and Ahmed, 2003; Duffield, 2007). For both governmental and non-governmental institutions, water is recognised as an integral element and is often used as a means of implementing policy (Matin and Taher, 2001; Ahmad, 2003; Brichieri-Colombi and Bradnock, 2003). In this sense, water is a vehicle for development. Despite the accolades associated with NGOs, criticisms are emerging that question their accountability, to either their donors or patrons (Lewis, 1998; Wallace and Lewis, 2000; Lewis, 2004), their ability to disempower (Duffield, 1993; Rahman, 1999; Develtere and Huybrechts, 2005; Ekers and Loftus, 2008), or as the imposition of a system that cannot cope with the Bangladeshi context (Rahman et al., 2001; Amin et al., 2003). NGOs in Bangladesh inhabit an important, if somewhat fluid, space in relation to water, flood, disasters and development through their advocacy of human development principles (Wallace and Lewis, 2000; Hanchett et al., 2003; Bebbington, 2004; Lewis, 2004; Mitlin et al., 2007).

The researchers and managers who support the human development period are critical of the behavioural interpretation for maintaining focus on the physical environment and for assuming that people *choose* to live in high-risk locations as opposed to being forced

there (Blaikie et al., 1994; Wisner et al., 2004). Despite such differences, the human development period has maintained and expanded emphasis on the perceptions, beliefs and values of victims (Wisner et al., 2004). The orientation is towards vulnerability and resilience with the aim of livelihood development, every-day lives and lived experiences. The means of realising these goals are predominantly through critiques of established understanding-management using grassroots voices to highlight the disadvantaged. The shift toward social explanations of hazards informs an emergent understanding of flood management in which the physical world acts as 'trigger', exposing already existing unequal power relations in an increasingly globalised world (Blaikie et al., 1994; Pelling, 2003b; Wisner et al., 2004). Additionally, the human emphasis has led to the promotion of coping or the ability to 'live with floods' (Shaw, 1989; Schmuck-Widman, 1996; Haque, 1997; Sultana, 2010). As Smith and Ward (1998: 348) explain:

> "the increasing criticism of engineering projects has led to the emergence of a so-called 'living with floods' philosophy. This can mean the adoption of a sophisticated package of management measures, as in the MDCs, but it also implies a more explicit reliance on the indigenous flood hazard-coping strategies which have been evolved by local communities".

The 'living with floods' concept is interpreted both as a rival to the engineering approach and as an ideal compromise between the two strategies. Its contested definition provides an important entry point for the wider flood management debate (see Chapter 5).

Governance during this period has followed the pattern set since independence, with corruption, vote rigging, *hartals*[20] and boycotts from opposition parties common. More positively, the establishment of a caretaker government in late 2006 and its drive to limit corruption appears to have the public's support.[21] The most important government publications during this period include the National Water Management Plan (Government of Bangladesh, 2001), the National Policy for Arsenic Mitigation

[20] Sometimes violent strikes in which political parties take turns shutting down production and transportation to draw attention to their concerns.

[21] The caretaker government passed power to a newly elected government in December of 2009.

(Government of Bangladesh, 2004) and the forthcoming Bangladesh Water Act. These publications, policies and legislations mark a departure from the assumptions and understandings that informed the earlier Master Plan and FAP studies. For example, the National Water Management Plan (Government of Bangladesh, 2001: 2) states that "widespread consultation has been undertaken throughout the preparation of the plan. Efforts have been made to engage a wide range of stakeholders at each stage of the plan preparation". The policy document also includes recognition of the important role of traditional fisheries (2001: 26), gender equality (2001: 45) and the poor (2001: 69). Similar comments can be found throughout the National Water Policy (Government of Bangladesh, 1999).

The divide between the government and academic literatures within the previous two periods is significantly more complicated within the human development period. The government, following the emergence of the NGO community, has sought to re-establish itself as a viable leader. In addition to traditional geographical research (Haque, 1997; Mirza et al., 2001; Rasid and Haider, 2003; Haque and Burton, 2005; Paul, 2005; Paul and Rahman, 2006; Ali, 2007; Haque and Etkin, 2007; Rashid et al., 2007), interest in water and flood management has become divided among many interrelated fields.[22] Development studies is becoming an umbrella field integrating most water related research, hence the emerging orientation of many accounts of flood management (Cuny and Abrams, 1983; Tobin and Montz, 1997; Quarantelli, 1998; Lewis, 1999; Pelling,

[22] For example: gender studies (Coles 2005; Koppen 1996; Paul 1999; Bhuiya & Chowdhury 2002) transboundary politics (Ahmad 2003; Ahmad & Ahmed 2003; Dixit 2003; Brichieri-Colombi & Bradnock 2003), climate change (Brouwer et al. 2007; Faisal & Parveen 2004; Mirza 2002; Mirza et al. 2003; Mirza et al. 2001; Schipper & Pelling 2006), risk (Fewtrell et al. 2005; Black et al. 2003; Islam & Sado 2000; Cain 1981), fisheries (Rohde et al. 2006; Craig et al. 2004; Shankar et al. 2004; Halls et al. 1998), poverty alleviation (Younus et al. 2005; Yunus 1999; Bass & Steele 2007; Rigg 2006; Hulme 2000; Ravallion & Sen 1994; Wahid 1994), sanitation and health (Hawkes & Hart 2000; Hawkes et al. 1999; Wasserheit et al. 1989; Haider et al. 2000; Kincaid 2000), participation (Khan & Rahman 2007; Rogers 2006; Epstein et al. 2004; Rich et al. 1995; Sultana et al. 2007), arsenic and pollution (Atkins et al. 2007; Hassan et al. 2005; Hassan et al. 2003; Chowdhury et al. 2000; Nickson et al. 2000; Smith et al. 2000; Nickson et al. 1998) and the role of scientific knowledge (Cain 1981; Chowdhury 2005; Bijker 2007b; Bijker 2007a; Pinch & Bijker 1984).

2003c; Collins, 2009; Enarson and Chakrabarti, 2009). In this context, geographical research has been incorporated into a broader development perspective, particularly economic- and governance-centered research (Thompson and Sultana, 1996; Rahman, 1999; Ahmed, 2001; Bayes, 2001; Chadwick et al., 2001; Matin and Taher, 2001; Paul, 2003; Thompson et al., 2003; Chadwick, 2004; Faisal and Parveen, 2004; Develtere and Huybrechts, 2005; Sultana et al., 2008b). For example, the conceptualisation of disasters and the economic analyses used to tally flood impacts are criticised for failing to account for the long-term, cumulative impacts using human development as the measure (Benson and Clay, 2002; 2004). An important characteristic of this research is the acceptance that a battle with nature cannot be won in the long-term and that decision-making must reconcile development with the inevitability of flooding and flood damages (Abbasi, 1998; Chadwick, 1999a; del Ninno et al., 2002; Wescoat and White, 2003; Mallick et al., 2005; Smith and Petley, 2009).

The increased diversity of disciplinary opinions contesting the prevailing understanding presents researchers with a valuable range of knowledge, though the degree of crossover between the fields of expertise is debatable. This is particularly evident in terms of the physical and social sciences (Cook and Lane, 2010). Lack of cross-disciplinary communication is evident in the perpetuation of several arguments. For example, studies presume that highland-lowland relations and deforestation are responsible for increasing flood damages in Bangladesh (Gamble and Meentemeyer, 1996; Khan, 1996; Ali, 2007), though Ives (1991) and Höfer and Messerli (2006) have shown repeatedly that this connection is unlikely. A second example involves the notion of a bumper crop following extreme flood events (Montgomery, 1985; Mellor and Gavian, 1987; Brammer, 2004; Faisal and Parveen, 2004). This argument is used to contest flood control, suggesting that the benefits to national agriculture outweigh losses in flooded areas. A number of studies show that crop losses do not explain famines and that bumper crops, if they are in reality more than a product of increased acreage in the seasons following disasters, do not aid those affected or prevent price escalation (Sen, 1981; Mellor and Gavian, 1987). A third argument is the notion that floods deliver nourishing silt that improves agriculture (Shaw, 1989; Zaman, 1993; Younus et al., 2005). This

argument fails to appreciate that the majority of flooding in Bangladesh is rain induced and that sediment-laden waters are confined predominantly to the immediate floodplain (Brammer, 1990a; Zaman, 1993; Brammer, 2004).[23] In each case, the prevailing understanding among stakeholder-based research is in complete opposition to the prevailing understanding within the academic community, raising important questions over how to proceed with management. This is not an issue of convincing one side to admit their error (Höfer and Messerli, 2006), but of appreciating that each perspective holds value and is based on assumptions, knowledges, interests and beliefs that are relevant to research (Wynne, 1993; Wynne, 1996; Wynne, 2006; 2007).

THEMES EMERGING FROM THE EXPLORATION OF THE PREVAILING UNDERSTANDING(S)

From realist to constructivist assumptions

Within the wider hazard and risk literature, there has been a gradual shift from emphasis on the impacts and processes of a flood event (engineering period), to emphasis on the culturally-filtered understandings of the event (behavioural period) and, increasingly, to an appreciation for the cultural construction of the event (human development period) (White, 1945; Douglas and Wildavsky, 1982; Douglas, 1992; Lupton, 1999; Wisner et al., 2004; Smith and Petley, 2009). The transitions between these periods can be understood using the changing emphasis of the prevailing understanding. This trend is most evident in the emergence and popularity of Blaikie et al. (1994) and Wisner et al.'s (2004) 'at risk' argument, in which disasters are understood as triggers that expose existing social structures rooted in unequal power relations and access to resources. The narrative describes a similar transition with reference to the prevailing understanding of flood management in Bangladesh. As claimed in the methodology (Chapter 2) and shown in the narrative, water, flood and environmental management has undergone a broad shift from realist to constructivist understandings, privileging the perceptions, opinions and interpretations of stakeholders over predominantly realist scientific

[23] I experienced another such argument during this field research in relation to the Farakkah Barrage and the currently unfounded belief that India is to blame for a perceived increase in flooding and flood damages.

expertise. Many recent academic publications concerning flood or water management in Bangladesh exhibit this trend, for example: Sultana (2009), Ali (2007), Rasid et al. (2007), Paul and Rahman (2006), Hutton and Haque (2004) or Rasid and Mallick (1993). Broadly, the human development period, which I suggest is becoming dominant in Bangladesh, promotes the livelihoods and resilience of indigent and vulnerable communities as the primary objective of flood management. This framing is fundamentally distinct from the engineering and behavioural understandings in its emphasis on resilience and coping as opposed to event prevention or avoidance (Haque, 1997; Nasreen, 2004; Islam, 2005; Haque and Etkin, 2007; Khan and Rahman, 2007; Sultana and Thompson, 2007; Sultana, 2009; Paul et al., 2010). In addition, to inform this framing, researchers and managers gather perception studies from affected populations to contrast 'lived experience' with national policy. At present, the majority of the flood management literature focused on Bangladesh relies on flood-affected groups to inform the research, extrapolating knowledge from the local to national-scale and privileging the voices of sub-sets of the population as a form of criticism toward a perceived dominance by technically-driven understanding (Paul, 1984; Zaman, 1989; Alam, 1990; Paul, 1995; Rasid and Mallik, 1995; Paul, 1999; Dixit, 2003; Rasid and Haider, 2003; Paul and Rahman, 2006; Ali, 2007; Rashid et al., 2007). Rasid and Mallik (1993: 59) provide a telling example; referring to the scope of their research, they state that "[t]he choice of flood control techniques in Bangladesh is reviewed in the context of a case study on the impact of a small-scale polder". Without discussing the problems of scale or extrapolation, the authors use a local and small-scale example to challenge national-scale strategy. Furthermore, their analysis is predicated on impacts to a minority group within that local context, again extrapolated to other scales.

Broadly, the narrative illustrates how research and the prevailing understanding have moved from a realist to moderate constructivist presumption. More explicitly, the engineering understanding (realist, pragmatist and logical positivist) idealises objective analyses to inform their ability to shape the physical world; the behaviouralist understanding (realist and relativist) emphasises human adjustments and decision-making in response to the environment; and, increasingly, the human development

understanding (constructivist, postmodern and normative) argues that knowledge is constructed within situated contexts and is the product of global processes that distribute power and resources unevenly, with the purpose of improving the lives of the most disadvantaged. The shift from realist to constructivist preconceptions is evident within the narrative in two ways, each with important implications for the thesis. First, flood management research has shifted from analyses of events towards analyses of different understandings and perceptions of events. Second, this emphasis on the social constructions that shape understanding (Milton, 1996; Jones, 2002) disconnects the materiality of knowledge construction, neglecting that "to construct a material analysis is to 'collaborate' with the physical [world]" (Kearnes, 2003: 142). The emphasis on perception, language and semiotics inserts a break between the grounded realities that shape knowledge and that knowledge (Cross, 1998; Pidgeon, 1998; Anderson and Tolia-Kelly, 2004). More clearly, flood management researchers privilege what people think of a flood with decreased consideration for how the actual event contributed to those perceptions. DeLanda (2006: 4) summarises the impact of this type of framing with reference to understanding macro-scale issues, such as national-scale flood management:

> "the phenomenological individualism of social constructivism is also reductionist even though its conception of the micro-level is not based on individual rationality but on the routines and categories that structure individual experience. In neither one of these individualisms is there a denial that there exists, in addition to rationality or experience, something like 'society as a whole'. But such an entity is conceptualised as a mere aggregate, that is, as a whole without properties that are more than the sum of its parts. For this reason we may refer to these solutions to the micro-macro problem as 'micro-reductionist'".

Similarly, management is being oriented toward how people perceive impacts rather than on the actual impacts. Materiality, following this interpretation, is relegated to the role of trigger for a socioculturally informed prevailing understanding (Blaikie et al., 1994; Wisner et al., 2004; Smith and Petley, 2009). While the constructivist literature argues that materiality and lived experience are key determinants (Proctor, 1998; Woodgate and Redclift, 1998; Demeritt, 2002; Jones, 2002), in relation to flood management in Bangladesh, the result of constructivist research is that the material event is a contextual influence rather than a meaningful actant within the prevailing understanding.

There are three implications of the shift toward a socially-constructed understanding of flood management. First, reliance on perception to inform understanding of lived experience result in assertions of unknown applicability to the material event. For example, understanding how a minority group perceives flooding, while interesting and important, has unknown relevance for national flood management. Despite this uncertainty, authors extrapolate findings from such research to advocate for specific groups and lobby for national policy change (Paul, 1995; 1999; Rasid and Haider, 2003; Paul and Rahman, 2006; Quassem and van Urk, 2006; Alam and Rabbani, 2007; Ali, 2007; Haque and Etkin, 2007; Rashid et al., 2007; Sultana et al., 2007; Sultana and Thompson, 2007). This situation is problematic because the transition towards individual perception originated as a reaction to their perceived neglect within the engineering period and a biased selectivity within the behavioural period (Smith and Ward, 1998; Smith and Petley, 2009). This situation is worrisome because the argument that 'government policy does not incorporate the poor, vulnerable or disenfranchised' may inadvertently maintain this disconnection by failing to account for their fundamentally opposing assumptions. The prominence of victims, the vulnerable and other minority groups presents a partial understanding by assuming that 'what is best for the poor/vulnerable/victim is best for Bangladesh'. By not matching the concerns, assumptions or priorities of national policy to those with decision-making power, the human development understanding remains a critic rather than a part of the decision-making that shapes management. This position, as a critique of power, is valuable and helpful, but only when those in power share a frame of reference.

Reliance on perception to understand flooding and vulnerability has resulted in numerous relativist accounts of flooding, with little consideration for how such views might be compared or combined to inform decision-making. While moderate social constructivism does not suggest that all knowledges are equally valid (Demeritt, 2001; 2002; Jones, 2002), there is little appreciation for how even similar knowledges can be reconciled. For example, Paul (1984; 1999), Alam (1990), Koppen and Mahmud (1996),

Nanda (1999) and Ali (2007) each collect and analyse perceptions concerning water, flood or environmental management from different subsets of the Bangladeshi population (for example floodplain inhabitants, women, Southwesterners, rural villagers or flood victims). Their findings, each tailored to a particular group, expose the tragic hardships experienced by different people in Bangladesh, each implying the need for intervention without reference to the difficult choices facing national-scale decision makers. Another example that exposes this incongruity is Rasid et al.'s (2007) study of the perspectives of slum residents and Paul and Rahman's (2006) analysis of perspectives from coastal islands. In both cases, the authors explore the views and perceptions of groups in relation to hydrological hazards but, despite similar methods and topics, they do not engage with how their findings relate to national-scale needs or decision-making. The result of this context is multiple focused studies of different vulnerable groups each advocating intervention from government. In this case, extreme and widely distributed vulnerability leads to advocacy for those perceived to be most marginalised, an assessment that is difficult to establish nationally using local level examples based on perception. In addition, this focus in a nation such as Bangladesh raises the possibility of directing resources to those beyond help or of redirecting funds away from where they may produce more good. This argument in no way suggests that the indigent should not be aided, but it does question the value of intentionally focusing on the most vulnerable and using perception-based methods to argue that women, minority groups and the indigent require aid (Kates, 1987; Enarson and Morrow, 1998; Gilbert, 1998; Quarantelli, 1998; Twigg and Bhatt, 1998; Lewis, 1999; Enarson and Chakrabarti, 2009). The assumptions that inform the human development understanding are sustained by focusing on the vulnerable rather than on wider interests. By this, I do not suggest the indigent are not deserving of aid and consideration; on the contrary, the diverse range of stresses they experience requires broad consideration of the social, physical, cumulative and hybrid impediments that perpetuate their vulnerability. In the Bangladeshi context, the scope of vulnerability might best be addressed at a wider scale than with focus on the most disadvantaged extrapolated to the national-scale.

Finally, given the means of analysis and understanding, there is reason to question the disposition within constructivist analyses towards vulnerability and resilience relative to past efforts to physically control the environment using physical methods (Wisner et al., 2004; Sultana et al., 2008b). Perhaps not surprisingly, research predicated on human perception labels flooding as being beyond control and argues for social rather than engineered mitigation strategies (Chowdhury, 2005; Mallick et al., 2005; Paul and Rahman, 2006; Ali, 2007; Haque and Etkin, 2007; Khan and Rahman, 2007; Rashid et al., 2007). The prevailing perception-informed understanding orients analyses towards social flood mitigation by constructing understandings apart from the physical context (Milton, 1996: 54); in this case, a flood-prone environment is a socially-constructed hazard and, as such, requires social engineering to mitigate detrimental impacts.

The perceived failure of flood management and the agricultural priority

The shift toward a constructivist understanding of flood management is predicated on a perceived failure of physically oriented understanding, strategy and methods. Much of the present flood management debate involves the concepts of success and failure, though what exactly constitutes either is rarely, if ever, explained. Instead, the academic literature is replete with authors who describe tragic situations, such as flood impacts, cyclone damages or starvation, to imply that policies, aims and understandings have failed (Paul, 1984; Custers, 1992; Hoque and Siddique, 1995; Thompson and Sultana, 1996; Paul, 1997; Ali, 2007). In this sense, ongoing disasters represent proof of policy failure, supporting criticisms of past strategies. Perhaps the most telling example of this situation is the emergence and empowerment of the Local Government Engineering Department (hereafter LGED), which has supplanted the Bangladesh Water Development Board (BWDB) as the driving force behind flood management. The LGED tailors its planning process around participation, aiming to distribute decision-making power to stakeholders (Government of Bangladesh, 2009). The shift to the LGED is maintained by widespread agreement that past efforts have failed and possibly worsened the situation. Failure is of critical importance to this discussion, and to the thesis as a whole, because such opinions expose the situated assemblages of experiences,

values, aims, priorities and knowledges that inform perceptions and opinions; in effect, such judgments expose the assumptions that inform and sustain the human development understanding.

Flood management policy prioritises the improvement and expansion of agricultural resources with the stated aim of foodgrain self-sufficiency (IECO, 1964; Government of Bangladesh, 1986; 1996; 1999; 2001). Most recently, within the newly elected government's political manifesto, 2013 has been suggested as a goal (Brammer, 2010). The rationale for this focus is explained by an IMF-sponsored poverty reduction strategy paper (2005: 2), which states that "[s]ince independence, the overriding shadow cast over the strategic efforts of the nation and the household alike has been the fear of famine". With reference to the period between 1947 and 1988, Chadwick and Datta (2000: 2) support this interpretation, stating that:

> "[t]he orientation of all water sector development to this time was almost exclusively aimed at achieving the goal of increasing agricultural production to achieve national self-sufficiency. This bias towards agriculture meant that solutions tended to be in the form of flood control, drainage and irrigation (FCDI) projects. In reality, emphasis was placed on flood control mainly and much attention was given to the improvement of drainage and irrigation".

The ramifications of the agricultural priority is summarised in the National Water Management Plan (Government of Bangladesh, 2001: 1 italics added), which recognises that flood management policy (beginning in 1964 with the Master Plan and running through to the 2001 Plan itself) had resulted in an inconsistent collection of policies with:

> "*an excessive focus on the needs of the agricultural sector* (irrigation, drainage and flood protection) *to the detriment of other sectors* (water supply, sanitation, industry, fisheries plus environmental and other in-stream demands)".

The assertion of 'excessive focus' is an important example of historical detachment. It is critical that the rationale behind the agricultural priority be acknowledged. As mentioned, the famines of 1943 and 1974 are probably the single largest influences on Bangladeshi governance. As a researcher explains:

> "when there is a little food crisis, like now, the whole government is shaken. That is an area you don't want to touch. Governments fall if there is a shortage of food" (Res 3: 08/01/08).

In this context, recognition for the growing population and the need to increase agricultural yield has driven the adoption of physical flood mitigation strategies. In this context, the introduction of high yielding varieties (hereafter HYV) of rice was a necessity, despite their relative vulnerability to flooding. This situation can be summarised as: the agriculture required to avert famine required flood protection. More recently (mid-1980s to present), irrigated dry season rice (*Boro*) has helped meet the growing consumption demands, though production has recently levelled (Brammer, 2010). Its production during the dry season (October-March) requires irrigation instead of flood protection. This situation results in an intensification of rice production through HYVs, a redistribution of risk though the addition of a third rice harvest and, ultimately, a reduction in the need for costly protection measures. The perceived failure of flood management and criticism of the engineering understanding, then, is fuelled by agricultural developments that were unforeseen and are now being pushed to their limit (Brammer, 2010). This situation raises the interesting possibility that the failure of flood management may need to be again recontextualised as demand for food outpaces the current assemblage of production, thereby reconstructing the detrimental impacts of flood control in order to avert famine (Chapter 5).

In combination, the implicit and explicit assertions of failure within the academic literature, together with the agricultural emphasis within government policy, raise important questions concerning past management and future decision-making. Generally, the aims and assumptions within government policy suggest that flood management is part of a wider agenda and, perhaps, a vehicle for social as well as physical engineering. Alternatively, academic analyses of government policy exhibit the assumption that damage reduction is the top priority of flood management[24] and that damages represent a failure to deliver security from environmental hazards. Given the agricultural priority, this assessment begs the question of whether damages represent

[24] As is common in most developed world nations.

proof that flood management has failed? More specifically, it focuses attention on to the debate over interpretations of flooding and disasters (see Chapter 4) and over technical and social methods of flood management (see Chapter 5).

The growing complexity of the prevailing understanding

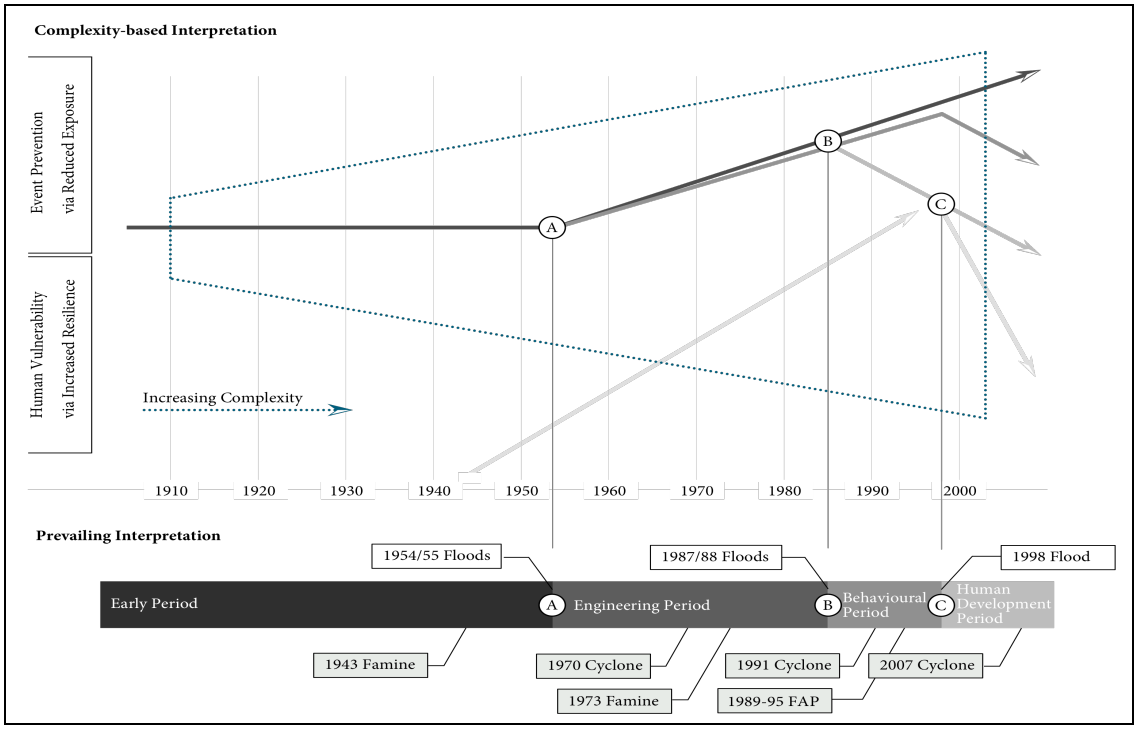
In relation to this discussion and to the thesis more generally, there is a need to acknowledge the distinctions between complication and complexity. Briefly, complex systems are not equal to the sum of their parts, while complicated systems are, regardless of the number of constituent elements (Anderson, 1972; Byrne, 1998; Manson, 2001; Ramalingam et al., 2008). In addition, complex systems are characterised by relations and feedback between actants that reverberate within the system. In contradiction to complicated systems, within complex systems such relations result in assemblages that regularly re-form and in which changes to one part of the system affect relations throughout, shaping the overall emergent system properties. Finally, and of critical importance to the prevailing understanding of flood management, relations within complex systems are characterised as dynamic, nonlinear and unpredictable. According to Manson (2001), supported by Manson and O'Sullivan (2006), Doak and Karadimitriou (2007) and Brown et al. (2008), nonlinearity is the defining characteristic of such complex systems. The nonlinearity premise challenges the assumption of proportionality: that response matches force and cause matches effect (Strogatz, 2003). In this way:

> "[t]he nonlinearity concept means that linear assumptions of how social phenomena play out should be questioned… Nonlinearity poses challenges to analysis precisely because such relationships cannot be taken apart – they have to be examined all at once" (Ramalingam et al., 2008: 24).

One way of interpreting the increasing complexity of flood management in Bangladesh is by discarding a paradigmatic or evolutionary assessment of the prevailing understanding. By collecting and exploring the histories of the prevailing understanding, it is clear that a conceptualisation of one dominant assemblage transitioning to the next does not reflect accurately the growing complexity or debates surrounding flood

management. Alternatively, the controversy can be explained through the accumulation of competing understandings founded on opposing assumptions and knowledges (see Figure 12). The diversification or fragmentation of perspectives connects knowledges grounded in fundamentally different assumptions and objectives, for example juxtaposing research aimed at poverty reduction, gender equality, damage reduction and environmental sustainability. The upper half of Figure 12 visualises the tendency of theoretical alternatives to be fractured by momentous events and to accumulate, as opposed to the development and replacement of prevailing understandings (lower half) characteristic of evolutionary or paradigmatic interpretations (Kuhn, 1996; Darwin, 2003 [1859]). Instead, following Kauffman's (1993) 'fitness of landscape' theory, emergent properties (in this case, the engineering, behavioural and development understandings of flood management) are created collectively through the interactions of the system actants. Modifying O'Sullivan et al.'s (2006: 613) argument, the 'relative fitness of different understandings is not measurable in absolute terms but only relative to the other knowledges present'. Following this argument, the engineering understanding was not replaced by the behavioural interpretation, but entered into an ongoing competition; this process was repeated with the emergence of the human development understanding. Rather than being disproved or replaced, formerly dominant versions of the prevailing understanding of flood management continue to contest decision making long after they are supposedly replaced by a new paradigm. Effectively, the prevailing understanding is less a reflection of a dominant understanding and more a reflection of an assemblage of competing understandings. This incremental bifurcation and accumulation of competing knowledge helps explain the growing complexity of the debate surrounding flood management, pointing to the need for improved recognition of the competing knowledges, assumptions and objectives that both explicitly and implicitly underpin different understandings.

Figure 12: A complexity-based interpretation of the periods of flood management in Bangladesh



Source: Haque (1998), Pelling (2003c), Adger (2006), Sultana (2008) and Smith and Petley (2009

The history of the prevailing understanding reflects the dominant format for describing the debate over flood management in Bangladesh, using evolution to explain transitions between paradigms (Rahman, 1994; Haque, 1997; Paul, 1997; Chadwick and Datta, 2000; Wescoat and White, 2003; Sultana et al., 2008a). In terms of the prevailing understanding, the narrative visualises the claim that catastrophic events spark innovative reconceptualisations of flooding, flood management and vulnerability, leading to an accumulation of competing understandings (Figure 12). This accumulation, I argue, helps explain the growing controversy surrounding flood management. Additionally, academic and government literatures suggest that disasters might be best understood as perturbations that provoke nonlinear relations. Following this rationale, flooding is not the product of incoming river water, precipitation, the water table, soil retention and attenuation, but neither is it these factors *as perceived* within mitigation strategies, experience, social relations or global structural constraints. Instead, floods materialise as the emergent property of these, and innumerable more, interacting or hybrid factors. As outlined in the history, the dissection of flood management into

disciplinary or thematic communities (for example, hydrology, geomorphology, sociology, history, development or engineering) produces knowledges which are pertinent and important, but whose incompatible assumptions inhibit understanding of the system. As Ramalingam (2008: 25) summarises:

> "if there are assumptions, aggregations and theories about the relations among different aspects of a specific situation, and these are not entirely appropriate when applied to the dynamics of a new local situation, then this perspective is unlikely to lead to a deep understanding".

In relation to the developing world, the human development paradigm is thought to be a growing influence on understandings of the impacts of environmental hazards and their management (Blaikie et al., 1994; Pelling, 2003b; Pelling, 2003a; Wescoat and White, 2003; Wisner et al., 2004; Collins, 2009). This shift away from the behavioural understanding is a critical issue when interpreting and comparing the views expressed by the experts. Smith and Petley (2009: 6) characterise the development understanding, explaining that it:

> "emerged largely because of the slow progress achieved in reducing disaster losses, especially in poor countries. It originated with social scientists with first-hand experience in the Third World who believed that disasters in [lower developed countries] arise more from the workings of the global economy and the marginalisation of poor people than from the effects of extreme geophysical events. Such events were seen as mere 'triggers' of more deeply-rooted and long-standing problems".

This interpretation shows the basis of the understanding that is emerging within flood and disaster management in Bangladesh. In addition, of importance to this thesis, this version of the prevailing understanding argues that:

> "economic dependency increased both the frequency and the impact of natural hazards. Human vulnerability – a feature of the poorest and the most disadvantaged people in the world – became an important concept for understanding the scale of disasters" (Smith and Petley 2009: 7).

The two citations display the assumptions that shape the emerging prevailing understanding, which in tandem with the earlier versions of the prevailing understanding, provide the basis for understanding and contrasting the expert perceptions, beliefs and knowledge.

Knowledge controversy as an emergent system property

Rather than a dominant form of understanding, historical change has resulted in an accumulation of knowledges applied to flood management in Bangladesh. Equally important, the attention generated by catastrophic events has resulted in a diversification of different and often opposing framings (Miller, 2000; Johnson et al., 2005; Sultana et al., 2008a). Following from the narrative and the subsequent discussion, the debate and conflict surrounding flood management in Bangladesh matches what Nowotny et al. (2001), Latour (2003) and Sarewitz (2004) describe as a knowledge controversy.[25] Drawing upon the complexity-based methodology, the controversy is an emergent property of the flood management system. This framing provides an opportunity for a generative analysis (Whatmore, 2009), comparing the experts' understanding of flood management with its characterisation within the academic flood management literature; in effect, relating two forms of understanding flood management in Bangladesh.

Wynne (1996), Nowotny et al. (2001), Whatmore (2009) and Lane et al. (in review) each argue that controversies emerge as a result of the public contestation of science, challenging the privileged position of expert knowledge. Broadly, they each suggest that the controversy is as much an opportunity for innovation as it is an inhibiting force and argue that controversy "can be positively harnessed in the practice of interdisciplinary public science" (Lane et al., in review). Controversy then, results from multiple interacting knowledges often founded on different assumptions and guided by different values, priorities and objectives. They have been seen traditionally as inhibiting phenomena that require expert adjudication (Collins and Evans, 2002). Given the modern context (increasing amounts of accessible knowledge, political abuse of power and lowered regard for scientific expertise), controversies appear to have become a constant presence within environmental management, resulting in advocacy for the redistribution of power among stakeholders (Wynne, 1993; Gibbons, 1999; Nowotny et al., 2001; Nowotny, 2005; Wynne, 2007; 2008; Whatmore, 2009). Given this context,

[25] While they use different language, the terms 'matters of concern' 'environmental controversies' and 'uncertain science' are each related to the 'knowledge controversy' concept, particularly as used by Whatmore (2009).

controversies surrounding the prevailing understanding represent an important theme and means of understanding flood management.

CONCLUSIONS

The prevailing understanding of flood management, rather than being one dominant view, is a tense assemblage of competing understandings, each vying for control. This interpretation challenges the paradigmatic and evolutionary understandings common to analyses of flood management in Bangladesh (Paul, 1997; Chadwick and Datta, 2000; Höfer and Messerli, 2006; Sultana et al., 2008a) and of hazard and risk more broadly (Hewitt, 1983; Blaikie et al., 1994; Oliver-Smith, 1996; Smith and Ward, 1998; Bankoff, 2003; Smith, 2004; Adger, 2006; Smith and Petley, 2009). Additionally, this conceptualisation accommodates the fractures caused by catastrophes, constructing an understanding in which the socio-physical context does not return to a natural state or order, but is permanently altered by events such as famines, cyclones and floods. The periods described in the narrative represent a rough division, facilitating a discussion of the changing assumptions, objectives, governance and issues that have shaped the prevailing understanding of flood management. It is worth repeating that this division is imposed to facilitate analysis rather than as firm 'lines in the sand'. The history suggests that the prevailing understanding has moved from realist to moderate constructivist (relativist) assumptions, leading to a privileging of perception-based studies focused on specific groups, often those most vulnerable to potential disasters or those already subject to disaster impacts. The move away from expert-informed technical management is founded on multiple criticisms, which can be summarised as a perceived failure to eliminate damages and the ongoing vulnerability of much of the Bangladeshi population.

The event-centered narrative presents one interpretation of flood management. I do not claim that this is the only interpretation but I do suggest that it enables an innovative analysis of the issues that continue to contest and to influence management. By presenting a temporal narrative punctuated by key events, and by conceptualising flood management as a complex system, the discussion points to at least three controversies that require further analysis. These issues provide the basis for the following three chapters, which contrast the prevailing understanding with the views, knowledges, beliefs and feelings expressed by the flood management experts. The three issues include competing understandings: of flooding, disasters and vulnerability (Chapter 4); of technical and social forms of flood management (Chapter 5); and of emerging and contested views of development (Chapter 6). These chapters are followed by a more general conclusion and summary (Chapter 7).

COMPETING UNDERSTANDINGS OF FLOODING, DISASTERS AND VULNERABILITY

4

> *If you talk to the people living in the areas, they will always tell you that they want protection. These days, with the cyclone, a lot of people were there for help. Many of the people who were standing in lines said that they didn't want relief they wanted WAPDA, that is the power authority that builds the dykes. The people name the embankments WAPDA and they want more. There are problems with them with water logging, but this can be solved. It is not a problem of the embankment, it is a problem of management because we could not provide the regulators because of funding, not the engineering.*
>
> (Gov 2: 15/01/08)

There is considerable debate over flood management in Bangladesh, much of it the result of competition between different understandings[26] of the issues that inform and influence the decision-making process. One issue among this assemblage is the contested and multiple understandings of a flood, with specific attention to when flood impacts constitute a disaster and how such impacts affect vulnerability. Rather than a minor disagreement, depending on the context and the observer, floods are understood as anything from a catastrophe to a blessing, resulting in situations where a disastrous flood to some is considered a blessing by others. More precisely, rather than a dualism, perceptions of floods traverse a range between beneficial and detrimental, contributing to widespread disagreement between different understandings, what Barry et al. (2008) label 'logics' or 'modes of knowing'. Not surprisingly, this context results in irreconcilable assumptions and knowledges informing irreconcilable understandings that, ultimately, result in advocacy for irreconcilable mitigation strategies. I

[26] To reiterate, 'understanding' is being used to describe the combination of knowledge, culture, history, experience, values, interests and other relevant issues that contribute and influence an individual's frame of thought and rationale. This is relative to the 'prevailing understanding', which is an assemblage of competing understandings often characterised by a dominant view (engineering, behavioural or human development).

conceptualise this situation as a knowledge controversy (see Chapter 2 and 3). In this context, the following chapter explores the multiple competing understandings of flood disasters in Bangladesh, addressing questions concerning how floods, disasters and vulnerability are understood among the experts that shape, and are shaped by, national-scale flood management. This discussion, then, asks and explores their answers regarding 'what disasters are and how they are understood?', 'what flood impacts are and how they are understood?' and 'who, in this context, is vulnerable to disastrous flood events?'

Prior to engagement with the experts' perceptions and opinions, I review the assumptions, arguments and methods that inform this chapter. Following the thematic grouping and presentation of the expert opinions, the chapter switches to three discussions that integrate the perspectives with ongoing academic debate. First I argue for an appreciation for *transitionary vulnerability,* in which individuals undergoing significant socio-economic change are perceived to be exceptionally vulnerable to flood disasters; second for *generational disasters*, a term that uses the dual meaning of 'generation' in that management generates disasters, but also that such events are a generation removed from the preceding issue; and third for recognition of a disaster 'logic', applying Barry et al's (2008) analytical tool to highlight the irreducible and inseparable assemblage of competing disaster understandings among the experts who inform this thesis. Applying the complexity-based conceptual framework (Chapter 2), I explore how the numerous competing and interacting understandings of flooding and vulnerability contribute to the emergence of the flood management knowledge controversy.

Assumptions and interpretations of vulnerability in relation to hazard and risk

Traditionally, the physical environment was prioritised within the prevailing understandings of hazard and risk, guided by the assumption that disasters were caused by a combination of extreme events and unprepared populations (White, 1945; Burton and Kates, 1960; Mileti, 1999; Benson and Clay, 2002; 2004). Broadly, the emphasis is

on exposure. In this context, famines are the result of exposure to drought, drowning the result of exposure to flooding and building collapse the result of exposure to seismic activity. Vulnerability, then, is understood as:

Physical Extreme + Exposure = Vulnerability

Following this understanding, one way in which vulnerability can be improved is through the reduction of exposure. This assumption, primarily associated with the engineering and behavioural[27] periods, is criticised for its willingness to shape unsustainably the natural environment, construct uneconomical technological structures, encourage environmental destruction and exacerbate unequal power relations (Hewitt, 1983; Watts, 1983). These criticisms have led to a reconceptualisation of vulnerability founded on resilience (Blaikie et al., 1994; Pelling et al., 2002; Bankoff, 2003; Bankoff et al., 2004; Wisner et al., 2004; Smith and Petley, 2009).

Generally, criticisms of 'vulnerability rooted in exposure' follow three presumptions: first, that physical extremes are necessary but insufficient explanations of disasters, which are instead the product of social relations; second, that the physical environment 'triggers' disasters that are already present within the context of unequal power and access to resources; and third, that disasters result from structural processes that concentrate wealth, resources and power within a small percentage of the population at the expense of the majority (Blaikie et al., 1994; Blaikie, 2000; Wisner et al., 2004; Blaikie, 2006). These criticisms inform the human development-focused version of the prevailing understanding (Blaikie et al., 1994; Blaikie et al., 2002; Wisner et al., 2004; Adger, 2006; Smith and Petley, 2009). Building on these presumptions, the development understanding of flood management follows three arguments: first, that natural events do not automatically result in disasters because people are capable of mitigating impacts. This premise is used to promote social adaptation, such as education, avoidance and

[27] The behavioural understanding argues for an equal appreciation for the socio-economic factors that shape the human behaviours that lead to exposure (see Chapter 3).

warning as a means of coping. Second, that people are active within the contexts that cause disasters. This premise characterises society as complicit, countering their characterisation as passive in earlier understandings. Third, that impacts and the ability to cope are a product of wealth. Blaikie (2002 p. 300) explains this premise, stating that:

> "[t]he rich seldom suffer from the impact of a disaster as much as the poor. Most frequently, it is women (rather than men), the very old and very young, those of low social status, those of ethnic and religious minorities who are discriminated against by the majority, those with poor access to appropriate resources and reserves and those who cannot draw upon a supply of social capital (i.e. trust and support networks) who fare the worst and fail to recover".

As a result of these premises, the human development understanding interprets vulnerability as:

Poverty + Exposure = Vulnerability

A critical principle of this understanding is the assertion that attempts to limit exposure failed (Blaikie et al., 1994; Benson and Clay, 2002; Pelling, 2003b; Pelling, 2003a; Benson and Clay, 2004; Wisner et al., 2004; Pelling, 2006; Blaikie, 2008), leaving poverty as the most viable lever with which to shape vulnerability. This conceptualisation is part of a wider shift towards social management in response to the perceived failure of technical management focused on exposure (see Chapter 5). Overall, vulnerability is the crux at which development and hazard and risk overlap (see Chapter 6): as a debate over reducing exposure to improve resilience compared to improving resilience in order to reduce the impacts of exposure.

In part, the shift from physical (realist) to social (relativist) explanations of disasters (as discussed in Chapter 3) is predicated on the claim that event-focused knowledge fails to account for the social, individual and temporal variability of risk (Oliver-Smith, 1996; Lupton, 1999; Lupton and Tulloch, 2002; Bankoff, 2003; Cutter, 2003; Oliver-Smith, 2004; Cutter and Finch, 2008). Increasingly, following this argument, disasters are conceptualised in relation to human vulnerability: to an individual or group's ability to anticipate, cope, resist and recover from disasters (Blaikie et al., 1994; Wisner et al.,

2004; Adger, 2006; Smith and Petley, 2009). Alternatively, vulnerability is defined as being:

> "a powerful analytical tool for describing states of susceptibility to harm, powerlessness, and marginality of both physical and social systems, and for guiding normative analysis of actions to enhance well-being through reduction of risk" (Adger, 2006: 268).

It is sometimes used as an economic measure used to connect socio-economics and the environment. Typically, in this form, it gauges and ranks the type of disaster, likelihood of occurrence and the human context (for example, some collection of wealth, population density, economy, infrastructure and other considerations) likely to be affected (Benson and Clay, 2002; 2004). Vulnerability is also used as a critique of such economic analyses, arguing that they overvalue the physical event, are too quick to advocate large technical solutions and fail to acknowledge that hazards are natural while disasters are social (Cannon, 1994). Eakin and Luers (2006: 366) argue that at its heart, "vulnerability conveys the idea of susceptibility to damage or harm" while Bankoff et al. (2004: 2) define it as a means of "placing the people who experience disasters, whether sudden or slow-onset ones, at the centre of research and policy agendas". In terms of present understandings, Adger (2006) distinguishes two prevailing traditions, each with distinct but overlapping lineages. Broadly, he divides vulnerability into the 'vulnerability, adaptation and resilience of social-ecological systems' and 'sustainable livelihood and vulnerability to poverty' perspectives. The key difference between the two traditions, in terms of this analysis, is the degree of materiality. The social-ecological perspective, with its origins in natural hazard research, seeks integrated accounts of the human-environment interface while the sustainable livelihoods "tends not to consider integrative social-ecological systems… [and that] Vulnerability in this context refers to the susceptibility to circumstances of not being able to sustain a livelihood" (Adger, 2006: 272).

The linearity implicit within resilience and exposure relative to vulnerability

Embedded within conceptualisations of vulnerability are the issues of exposure and resilience. In most cases, the degree of resilience dictates whether exposure is mitigated

or has an overall detrimental effect on the actant. Following this rationale, Smith and Petley (2009: 15) define resilience as the ability to withstand and recover from the negative impacts of exposure to disasters. Bankoff et al. (2004: 2 italics added) provide a human-centered interpretation, stating that:

> "the nature of disasters, then, is an appreciation of the ways in which human systems *place people at risk in relation to each other and to their environment* – a relationship that can best be understood in terms of an individual's, a household's, a community's or a society's vulnerability".

Other interpretations attempt to balance social and physical considerations, though exposure is still key. For example, Cutter and Emrich (2006: 103 italics added) explain that "[vulnerability] is defined as the *susceptibility of social groups to the impacts of hazards*, as well as their resiliency, or ability to adequately recover from them". Nelson et al. (2007: 396) also define vulnerability in terms of exposure and resilience. In terms of mitigating negative impacts, they argue that:

> "[e]fforts to respond to these changes [external undesirable changes] frequently entail reducing vulnerability and enhancing the capacity to adapt, in effect, to enhance the resilience of people and places, localities, and ways of life".

Finally, Adger (2000: 348) provides a more concise definition, this time in terms of social vulnerability, defining the concept as "the exposure of groups of people or individuals to stress as a result of the impacts of environmental change". Perhaps the most important accounts to consider this relationship are Blaikie et al. (1994) and Wisner et al.'s (2004) pressure and release model. Critically, Blaikie et al. (1994: 21 italics added) explain that the social production of vulnerability "is that the risk faced by people must be considered as a *complex* combination of vulnerability and hazard [meaning exposure]". Whether this reference to complexity entails nonlinearity is unclear. What is clear, are the associations between exposure and vulnerability. For example, they go on to argue that:

> "[d]isasters are a result of the interactions of both; there is no risk if there are hazards but vulnerability is nil, or if there is a vulnerable population but no hazard event" (Blaikie et al., 1994: 21).

Summarising the pressure and release model, the authors make a relationship between vulnerability and exposure explicit while leaving the exact nature of that relationship implied. They state that the basis of the model "is that a disaster is the intersection of

two opposing forces: those processes generating vulnerability on one side, and physical exposure on the other" (Blaikie et al., 1994).

The mirror to this emphasis on exposure is an understanding that uses people's ability to adapt as evidence that exposure strengthens resilience (Dove and Khan, 1995; del Ninno et al., 2002; Haque and Burton, 2005; Brouwer et al., 2007; Haque and Etkin, 2007). Adger (2006: 274) describes this situation as 'the two faces of vulnerability', contrasting the harm and detriment caused by exposure with "recognition of the ability of social-ecological systems to adapt to changing circumstances", a situation that promotes resilience. In each case, this interpretation of vulnerability orients research and management towards emphasis on the indigent because of their presumed status as 'most vulnerable', either to mitigate exposure or to encourage the development of further resilience. Rooted in political economy, the indigent are characterised as most vulnerable because they are most exposed, having been forced to inhabit high-risk locations (Hewitt and Burton, 1971; Hewitt, 1983; Watts, 1983; Hewitt, 1997). Compounding their vulnerability, the indigent are also conceptualised as lacking resources, access to the means of production and political empowerment, though, they are also characterised as resilient due to their repeated exposure and experience with disasters (Adger, 2000; Dixit, 2003; Adger, 2006; Folke, 2006; Gallopin, 2006; Janssen and Ostrom, 2006; Brand and Jax, 2007; Vogel et al., 2007; Cutter et al., 2008).

In relation to disaster research generally, and evident within flood management research specifically, the 'vulnerability-exposure-resilience' relationship has resulted in two influential assumptions. First, with less exposure, people are less vulnerable; and second, with more resilience (typically attained through affluence) people become less vulnerable[28] (Blaikie et al., 1994; Cutter, 1996; Messerli et al., 2000; Cutter, 2003;

[28] This discussion raises an important issue for the thesis as a whole, and particularly for the findings and discussions that follow from this discussion of vulnerability. Simply put, the question is how to discuss groups within society without over-generalizing or neglecting their heterogeneity. For example, the experts and the hazard literature use terms such as 'poor', 'ultra-poor', 'impoverished' and 'destitute' interchangedly, with

Pelling, 2003b; Wisner et al., 2004; Pelling, 2006). In this context, vulnerability and resilience are assessments of the relative abilities of people in relation to their socio-economic, cultural and material context while exposure is an absolute measure of impact. At the conceptual level, these premises suggest an understanding of vulnerability that is linear. While the competing understandings of exposure, either as detrimental or as inducing resilience, are not necessarily mutually exclusive, their conceptualisation as linear, or neglect of the nature of the relationship, represents an important assumption. Whilst the literature uses terminology like 'dynamic', 'irregular', 'unevenly distributed' and even 'complex' to describe vulnerability, the relations are implicitly linear, as is evident in the earlier description of the 'pressure and release' model (Blaikie et al., 1994; Wisner et al., 2004). The relations are made to fit into linear formula despite widely held recognition that linearity in both human and environmental systems is unusual (Adger, 2006). As one of the few examples to consider nonlinearity in relation to vulnerability explains:

> "vulnerability is often implicitly or explicitly equated with an outcome of a relatively linear analysis that begins with characterising a stressor and then moves to determining impacts and potential adjustments" (Eakin and Luers, 2006: 369)

and that, in terms of models of vulnerability:

> "the nature of the interaction, the relative importance of distinct stressors for particular systems at any given time, and the possible nonlinear responses of a system to multiple stressors remain elusive" (Eakin and Luers, 2006: 379).

Overall, vulnerability is a prominent concept within the hazard and risk literature. Despite some subtle differences and interpretations, it generally refers to some product

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the terms 'vulnerable', 'hazard-prone' and 'high-risk' closely related. Additionally, terms like 'elite', 'ruling class' and 'powerful' are used to describe the top echelon of society, usually in economic terms. This division leaves the 'middle class' term to represent those in-between. These labels are highly problematic and loaded with both implicit and explicit intent and assumptions. Furthermore, the numerous definitions and usages complicate comparison. Overall, I use the term 'indigent' to represent the lowest segment of the population, incorporating consideration of wealth and perceived status, 'low' and 'middle class' to refer to those above the poverty line (another problematic concept) and 'elite' to describe those with extreme wealth or power. Of critical importance, I apply these concepts as relative terms, replicating the usage evident in the expert opinions and explanations.

of exposure and resilience. Of interest to this analysis, these calculations imply linear relations, avoiding the problems that nonlinearity raises.

EXPERT PERCEPTIONS OF DISASTERS, FLOODING AND 'WHO' IS VULNERABLE

A broadened and inclusive understandings of what constitutes a disaster

In each of the interviews that inform this thesis, Bangladesh is described as a nation afflicted by numerous evolving and interwoven disasters. An NGO manager describes this context, stating that "Bangladesh is a disaster-prone area. Almost every year we experience various types of natural disasters such as: flood, drought, cyclone and tornadoes, river erosion, strikes, excessive rainfall" (NGO 6: 13/01/08). This quote is representative of an understanding in which the concept of disaster is diversifying. Importantly, the comment is also representative of the tendency to group social and physical events as disasters. In general, the broadened and inclusive understanding is supported by the opinion that the political process not only exacerbates but also causes disasters. This includes an academic working for an NGO who states:

> "we are a victim of disaster when the government changes. This is another type of disaster in our country. The previous policy either becomes redundant or useless. When the new government comes, there are always changes in the priorities" (AcaNGO 1: 05/02/08).

Other respondents refine this view, suggesting that it is the corruption and patronage dominating governance that causes disasters. As the head of a government ministry explains:

> "there is a basic problem in our country with corruption. Also, with coordination and lack of integration. There are a lot of problems, structural problems, that hold Bangladesh back. In many cases we know what we should do but we are not doing that because there are a lot of leakages in our system: mismanagement, lacking good governance" (Gov 3: 16/01/08).

An engineer uses the allocation of resources to contextualise a similar perspective of governance in relation to disasters, explaining that:

> "there are various solutions proposed for various sections of the country. So, our central government decides which section should get the funding. Again, it is unequal. That is why after so many years we are still suffering. Whether

> it is poverty or natural disasters, we are still at the same stage. We still hear people crying out" (AcaEng 1: 15/12/07).

The experts blur any distinction between natural and social disasters while emphasising the role of management. They perceive management not only as an exacerbating actant, but also as the cause of further, and often different, disasters. For example, an NGO manager uses the Southern polders as an example, stating that when:

> "the river rises and overtops the embankments then the sluice gates, which are supposed to drain the area when the water overtops the embankments, the sluice gates managers switch them off to stop the water from getting out.
>
> BC: Why?
>
> It is ridiculous why. It is because the people in charge of sluice gates are involved in fish culture. So they allow the water come into the embankment area, make it stagnant and make their grass crops. When the water comes in, that is the very vegetative state of Aman, and it is great for fish. So the managers engaged in fish culture let the water in so that their fish will have more access to the Aman-based feeding. Water is stagnant for a couple of months. The vegetative Aman feeds the fish while people are in horrendous conditions" (NGO 4: 08/01/08).

In this case, flood management enables intentional water logging, agricultural disruption and health hazards. Other examples include irrigation canals blocked for aquaculture (Aca 2: 08/12/07), agricultural lands flooded with salt water to support shrimp production (AcaNGO 3: 03/01/08) and local officials who, by taxing fishermen, facilitate the destruction of a reservoir. In this example, according to a consultant, government managers are said to be addressing poverty and famine by promoting aquaculture, but do so at the expense of the reservoir:

> "these people are restricting the areas of the reservoir. So what happens, the reservoir was used for the agriculture but now it is going to become a land area made up of ponds owned by individuals. The reservoir now no longer functions in aid of agriculture. In the meantime fisheries are escalating and there is now a conflict between fisheries and agriculture" (Cons 1: 26/01/08).

In each case, the understanding of disaster extends beyond the physical and social realm to include mixtures and feedback between numerous phenomena, including the mitigation strategies that aim to solve the perceived problem.

The diversification of events and relations understood as disasters is closely related to the suggestion that disasters are increasing in number and that their impacts are

increasing in severity. A consultant associates these changes in relation to urbanisation, explaining that "now you have cities of millions of people and structures that are not suitable for floods, so flooding is now a big problem" (EngCons 1: 01/01/08). An engineer supports this perspective by contrasting two flood events, explaining that:

> "even with the 30% [area of Bangladesh inundated] flood from this year, the damages are quite high compared to, for example, past floods when 70-80% of the area was flooded. So damages are similar though the flood was not nearly as big" (AcaEng 1: 15/12/07).

Despite personal involvement, the engineer blames past management for the growing number and severity of disasters. A second engineer provides a similar view, explaining that:

> "it seems that the frequency of the floods are becoming more common. But who do you blame? I think it is us, it is all the things that we did. You interfere with the landscape and it has consequences. I have analysed the flow of the Ganges, it is changing, yes, there is some support for that claim, but it is very recent. There is a difference in flood behaviour but it is more likely that it is our behaviours that is changing the perception" (AcaEng 2: 15/12/07).

With reference to the changing hydrology, the first engineer states that "I do not think that the flow is going down, but the damages have gone up" (AcaEng 1: 15/12/07) while a senior UNDP manager, speaking about his home village in the Northeast, supports the premise that disasters are evolving and becoming an important challenge. He explains that:

> "there is more increasing of the economic loss. If you see, the more exposure to the economy. We have reduced the life risk – look at the 1970 cyclone, the 1991 cyclone, the 2007[29] cyclone – but if you look at the same picture in terms of economics they have gone up as steeply as the lives lost have gone down" (Inter 4: 29/01/08).

The duplicitous nature of flooding as simultaneously beneficial and detrimental

Bonna and barsha

The broadened and more inclusive understanding of disasters, outlined in the previous section and in the historical narrative, informs and is a product of debate over 'how

[29] Estimated death tolls for these three events are: at least 224 000 (1970), 138 000 (1991) and 5 000 – 10 000 (2007) (Paul and Rahman, 2006; Paul et al. 2010).

floods affect Bangladesh?' As with disasters, perspectives concerning the nature flooding are diverse, marked by widespread use of the *bonna* and *barsha* concepts. *Bonna* and *barsha* are socially-constructed measures of the relative impacts of floods in Bangladesh. They provide a judgment regarding flood impacts, though their calculation and criteria are reflections of individual understandings. The director of a research institute provides a representative definition of the terms,[30] declaring that to understand flooding:

> "you have to know the difference between *Bonna* and *Barsha*. *Barsha* is common, Bangladesh is a floodplain and so it needs the *Barsha* for soil and agriculture. But if it exceeds the limit, then it becomes *Bonna*" (Res 2: 06/01/08).

An NGO manager expresses a similar understanding, stating that:

> "floods of a serious magnitude are a serious problem for Bangladesh. So those which have 5-7 years recurrence, those with a return period of more than 25 years, those are truly disasters. They damage our crops, they damage the road and communication and they have a long-term impact on the people, for whom it takes a long time to return their economy to its pre-disaster condition.
>
> BC: Is this the *Bonna* and *Barsha* differences?
>
> Yes" (NGO 3: 08/01/08).

These responses support an interpretation of flooding that incorporates positive and negative considerations simultaneously. An academic consultant working for an NGO exhibits the inexact nature of *bonna* and *barsha* by explaining that:

> "normal flooding, we need that flood. This flood we need, if we do not have those floods our ecosystem will collapse, our agriculture will collapse, our fisheries will collapse. Extreme floods are very damaging to us" (AcaNGO 1: 05/02/08).

An academic engineer provides another example that distinguishes catastrophic and beneficial floods, stating that floods are necessary:

> "for the ecology of the floodplains, recharging the aquifer and for the marshlands. They release water back into the rivers in the dry season, that is very important function. The beels, they drain water after the flood period and hold it when we have a lot. It is the catastrophic floods are the problem" (AcaEng 2: 15/12/07).

[30] A definition that I adopt throughout the thesis.

A consultant hired by a bilateral donor shares this perspective of flooding. He uses the resilience of the Bangladeshi population to contextualise flood impacts, explaining that:

> "people know how to fight it, or even to make use of the floods, to utilise it. That is why, after every flood, there is a bumper crop due to the soil moisture and fine sediment. Everywhere there is an agricultural extension that leads to a bumper crop" (Don 4: 22/01/08).

The intricacy of this understanding is made evident by a follow-up question posed by a superior: "so what you are saying, is that because it is such a recurring event, people have adapted their livelihoods to a large extent" (Don 3: 22/01/08) and the response: "unless it is a catastrophic event" (Don 4: 22/01/08). This interaction shows how the *bonna* and *barsha* concepts are informative, but also unsettled actants within the debate over flooding.

Interpretations of flooding as either beneficial or detrimental

Many of the respondents interpret flood impacts as predominantly beneficial, with their opinions based on the benefits accrued to agriculture. An economist working for a donor agency expresses a view that is representative of this understanding, stating that:

> "I don't think that, well, floods don't generally affect the economy in a negative way. They affect the crop season, force people to use stock. But in terms of value-added crops later in the year, they generally lead to bumper crops, the Boro crops" (Don 2: 17/01/08).

Another respondent characterises floods as a type of baptism for Bangladesh, flushing waste and pollution from the lakes and beels towards the Bay of Bengal. He states that:

> "floods are not a burden to Bangladesh. Imagine a Bangladesh without floods. Have you been to the Buriganga?[31]
>
> BC: Yes
>
> If there were no floods in Bangladesh then all the rivers would be like the Buriganga. So, in one sense I think we are lucky to have a free washing" (Don 4: 22/01/08).

[31] The Buriganga is a highly polluted river that passes through Dhaka (see Figure 13).

Figure 13: The ferry dock on the Buriganga River in downtown Dhaka

Source: author (07/12/08)

Following a similar rationale, an NGO manager explains that:

> "as an individual, I do not see floods as a problem… we do not need to do many things for the protection from flood. Here you see that if we can have better planning, construction of our roads, bridges, culverts, that can help with the frequency. That has to be done by other departments. The other thing is that while the floods are causing damages they are also helping. So the land becomes more fertile, a lot of bad things are flushed away" (NGO 1: 30/01/08).

As one academic respondent working for a research institute succinctly explains: "normal river floods are, so to speak, beneficial to the people of Bangladesh" (Res 1: 06/01/08). Other respondents frame beneficial flood impacts in relation to their inevitability and 'naturalness', stating that:

> "floods are a regular occurrence. It is very natural for our country. So, flood is very regular. When you go to the flood-prone areas you see that the people know how to cope, it is not a disaster" (AcaNGO 3: 03/01/08).

This perception was most common among the NGO and academic respondents and is closely related to the assertion that the negative impacts are relatively minor or quickly dissipated. According to a social scientist:

> "disaster is an issue and a lot of intellectuals ask 'what it is we can do?' I am not trying to discredit it as a factor. Instead, I would say that it is not the whole factor. You come back after 6 month, you will be amazed at how they [disaster victims] have recovered" (Aca 4: 02/01/08).

While the experts recognise the beneficial elements of flooding, there is also a large amount of uncertainty and appreciation for the detrimental impacts, even within some of the responses. Many of these understandings draw upon the broadened conceptualisation of disaster to emphasis long-term or secondary impacts. For example, an economist highlights the tragic and gendered circumstances of food shortages following flooding, explaining that:

> "when children cry for food it is to the mother. So, the mother cannot go without feeding her child. If there is no employment for the husband then she has to arrange something. Maybe a loan, or in the Southeast, in the water logged areas of Jessor, many women are going to brothels for prostitution. They are compelled to, because these are women-headed households, they have the responsibility with no help" (AcaNGO 3: 03/01/08).

An NGO manager emphasises secondary impacts, suggesting that the cumulative and knock-on effects are even more significant than the initial event. He explains that floods are:

> "serious because every year we lose crops. We train our people to focus on fish cultivation and they are washed away by the floods. Our farmers lose their land, the crops and it affects the prices of things. Now, all the food prices are going up due to the flood, cyclone and landslides" (NGO 6: 13/01/08).

Collectively, the comments illustrate the precipitous nature of existence in disaster-prone contexts and of how long-term perspectives increase the number and complexity of impacts. Interestingly, those who employ historically informed interpretations tend to judge flooding as beneficial while those who employ population and development, that is future-oriented interpretations, tend to characterise flooding as detrimental.

Many of the respondents do not perceive flood impacts in dichotomous terms. Instead, floods are always detrimental and beneficial, returning this discussion to the unsettled nature of *bonna* and *barsha*. Many of the respondents recognise their internally-contradictory views of flooding, a trait that is acknowledged by an academic who states that:

> "as a non-academic, it is not a problem because out of floods we get good harvests. As a technical person, I say floods are a problem because of the population and urbanisation" (Aca 2: 08/12/07).

The head of an international NGO also shows how multiple opinions can be held simultaneously. He explains that:

> "being an NGO worker, of course [flooding] is a problem, no question about this. But also, without floods, Bangladesh may not survive without the benefits to agriculture. Without floods the agriculture sector will be destroyed" (NGO 2: 01/02/08).

This statement is representative of the conflicting opinions and factors that structure the competing understandings, both internally and between different experts. For the Prime Minister's advisor, this shaded understanding is related to a failure to consider the spatial and temporal context of flood management. He points out that:

> "our focus on food security – food meaning rice only – has created a problem for fisheries, transportation, biodiversity, the environment, recreation, everything. But I can talk about those things now that I have some kind of food security" (Res 4: 15/01/08).

This statement is representative of the respondents who believe the benefits of flood management have been overshadowed by the perception of negative impacts. This is evident in an explanation provided by the head of a research institute, who states that:

> "for agriculture, there was control of water levels. And it really worked; I know this because I belong to that part of Bangladesh. And there were some side effects. What happened, the fish population declined, the white fish. Other things were not monitored. How much we were gaining and how much we were losing was not monitored, was not studied" (AcaNGO 1: 05/02/08).

Competing perspectives concerning who is vulnerable to flooding and disasters

The respondents use vulnerability to contextualise their views concerning who is most affected by flooding. For example, an engineer uses the occupation of marginal lands to explain how vulnerability has changed. He explains that:

> "during the British period, even though there were floods and cyclones, people were not as vulnerable because they could take to the high or woods lands. Marginalised lands were not occupied then. The density was low, so they could move to the safer lands" (GovEng 1: 24/01/08).

Alternatively, a UN manager responsible for disaster reduction explains that:

> "we identify the vulnerabilities from a location point of view. You are structurally more vulnerable if your house is built in such a way that you cannot cope with the environment. If your agricultural system is vulnerable if you do not know how to choose the right crop, you don't know how to make a shift of the crops, or aware of pest vulnerabilities, soil vulnerabilities. All of these things are identified under the gamut of the vulnerabilities" (Inter 3: 29/01/08).

An NGO manager working on the gendered impacts of disasters exhibits a more relativist interpretation of vulnerability. She states that:

> "if there is inundation, our people know how to swim, the US people do not know how to swim, but we know how to swim. So the US might be more vulnerable to the flood than we are because we know how to cope. So the same rainfall, the same level of water logging or flooding can have different impacts" (AcaNGO 3: 03/01/08).

The Prime Minister's advisor describes a similar cultural understanding of vulnerability by emphasising local adjustments. Expanding the context of vulnerability, his description addresses secondary impacts. He explains how the cropping pattern exacerbates vulnerability when the timing is disrupted by disasters.

> "[Farmers] have planted Robi [vegetable] crop that will need more time than they will get with [before] the floods. They are going to plant a Boro crop after the mustard crop. This will shift everything and will eventually push the crop into another zone where it will be lost. And then people have increased their vulnerability because of the changing processes and relations at play" (Res 4: 15/01/08).

In each of these understandings, vulnerability is associated with the exposure of indigent, predominantly rural, farmers and their ability to withstand the negative impacts of exposure.

In relation to the indigent, the respondents characterise life as very difficult and made worse by floods and other disasters. For example, in response to the question 'who is most affected by disastrous floods?' a government manager explains that "those in the chars, the poor" (Gov 3: 16/01/08), while an NGO consultant states that those:

> "just outside the embankment, the very poor people, are living in these fringe areas. So when the flood waters come in, they cannot boil the water so there are lots of problems like diarrhea" (AcaNGO 3: 03/01/08).

A second NGO manager characterises the indigent as miserable, summarising the impacts of repeated disasters.

> "This year we have had floods in the North and Cyclone in the South. All areas have been affected and this is why we are now having the food crisis. Our rice is 45 taka when it should be 15 taka.
>
> BC: How do the poor and ultra-poor survive?
>
> They have survived but with a miserable life. They sometimes, they eat just vegetable with no meat. It is hard because all commodities have gone up, not just the rice" (NGO 6: 13/01/08).

An engineer is representative of the experts who distinguish between those living inside and outside protected areas, explaining that:

> "because of the encroachment or embankments or polders, risk has been shifted to other areas. Through that process, the poorest of the people have suffered. They live in those areas that are not protected" (AcaEng 1: 15/12/07).

At the same time that the poor are perceived to be negatively affected by floods, they are also seen as being subjugated by flood and disaster management. A social scientist explains the impacts of relief. Placing himself in the role of the poor, he explains that it is the:

> "opportunity for relief that makes me idle, which makes me poor longer. I never try to do anything. I now have food and blankets in my house, now, because of relief, then I suddenly drop because of a disaster or when the aid leaves" (Aca 3: 28/12/07).

The respondents often characterise NGOs as businesses that profit from the poor. The most common criticism is that NGOs do not help the poor and instead focus on the relatively wealthy segments of the lower class because the indigent, as the most vulnerable, are beyond help. In response to this criticism an NGO manager explains:

> "we can only help people who have assets, not in the negative [people with nothing]. That is why people will be a little upset; we only encourage people who have a small piece of land.
>
> BC: You are only dealing with the mid-to-upper low class?
>
> Because this is the pilot, and because the donor.
>
> BC: When you say donor, who are you talking about?
>
> Let's say, DFID, they are talking about poverty, not from here [extreme poverty with zero assets] they are talking about here [mid poor] those with some lands" (NGO 3: 08/01/08).

Many of the experts argue that the system endangers the indigent through micro-credit by placing assets at risk. In the event of a disaster, this situation leaves the indigent further indebted and ultimately more vulnerable. As one NGO manager explains, following a disaster the poor "are forced to sell their land, their cows their assets to pay the loans. Or another thing is that they take another loan to pay the first loan" (NGO 6: 13/01/08). The head of a consultancy firm supports this interpretation, explaining that:

> "the problem is that they are getting loans and are investing. If their investment is lost in a flood, how are they in a position to repay the money? They do not have the resources to do that" (Cons 1: 26/01/08).

An academic addresses this issue in relation to the popularity of the Grameen bank initiative (Yunus, 1999) and the numerous organisations that mimic its micro-credit schemes:

> "he [Yunus] did bring about a very radical change to the NGO community but the ultra poor are still not included in this system. The way that it operates, the groupings that keep some groups, like fishermen, excluded" (Aca 2: 08/12/07).

Interwoven with the understanding of relief-disasters exacerbating vulnerability, numerous experts also argue that aid disempowers the indigent. An academic consultant provides a representative understanding, explaining that:

> "there is no compulsion for [the indigent] to go anywhere; schooling is not something they are looking for. So, the NGO schooling is fine. They are just going to go back into the paddy fields" (Aca 4: 02/01/08).

The respondent elaborates on the claim, stating that:

> "it doesn't take much to recover, they don't have a library, they hardly have anything in the first place. For them to recover they just need a little help

> from here and there. They will just put their shacks back together with whatever they can get and carry on" (Aca 4: 02/01/08).

This understanding of the poor is common among the experts. As within much of the academic flood management literature, resilience is understood to be a direct reflection of poverty.

Experts identify the upper portion of the indigent and lower portion of the middle class as a highly vulnerable segments of the population, even if they are not as exposed as the poor or ultra-poor.[32] This understanding is supported using several arguments. For example, concerning the middle class, that they provide the majority of the government's revenues and are, therefore, squeezed financially; that they represent the civil society that provides the informal support for the poor, using their own resources; and that, despite some stability, they lack the resources to overcome catastrophic or repeated impacts. In the context of disasters, a social scientist explains that:

> "the rich, they do not feel any hardship, they have the money to avoid taxes and do not give anything. The middle class, they give the most, they try to help with what they can and they pay taxes. The middle class people are the ones that carry the population" (Aca 1: 08/12/07).

The perception that not only the indigent are vulnerable is supported by the head of an international donor organisation:

> "talking about the middle class and above, if a disaster strikes, and it can be a natural or social disaster, a father dies or sick family member, that kind of cost, they can usually absorb that. It is only when it becomes very frequent that this will affect their standing in terms of poverty" (Don 3: 22/01/08).

There is a sense that disasters affect the middle class in a distinct way but that there is little 'evidence' to support the belief. The head of an NGO communicates this suspicion by stating that:

> "I think the middle class people are not doing as well as you might think. There is a certain percentage of middle class, maybe 5% of that 20%[33] are crossing over to the poverty level".[34]

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[32] Again, these labels are problematic and rife with connotations that are not exactly clear. For this research and argument, the relative hierarchy is important.
[33] The overall percentage of the population thought to be middle class.
[34] Dropping below the poverty line.

> BC: And how many people from the poor category are able to reach the middle class?
>
> "Very little, maybe 1%" (NGO 1: 30/01/08).

This assertion is in direct opposition to the assumption that wealth increases resiliency and reduces vulnerability. Alternately, an international donor suggests that wealth improves resilience, though he recognises that data for such statements are problematic, explaining that:

> "I don't have the data but my gut tells me that this process is happening. Supposing that it does, then I can see that when you increase the middle class – lift more people out of poverty, increase the financial resilience of the people at large – then the ability of the nation to recover [from disasters] will be raised" (Don 3: 22/01/08).

This comment is further complicated by his follow-on comment that "right now it [security for the middle class] is not there but it may be heading that way" (Don 3: 22/01/08).

When asked about the segments of the population affected by floods, many of the respondents contextualise their views using the Bangladeshi elite, showing the disproportionate impacts and characterising the system as unjust. These respondents frame their understanding around control of the economy and the exploitation of government privilege. A social scientist is representative of this understanding, explaining that:

> "the whole picture is not there because, as I say, much of the growth thing is that it does not trickle down. So, when it doesn't trickle down the people below become more vulnerable when the disasters come. So the growth is not pro-people [and] it is not pro-disaster, it is pro-elite. Now, so with this growth, or even with a higher growth, yes the richer would be better off because they can go and live elsewhere during the floods. So what has happened is that those vulnerable people have to live in the high-risk areas and that they cannot move" (Aca 4: 02/01/08).

Supporting this understanding, an engineer states that the elite "are doing even better in times of disasters" (AcaEng 3: 23/01/08) because of their control of the NGOs, construction firms and government ministries, raising further questions about how flood impacts affect different segments of the Bangladeshi population.

THEMES EMERGING FROM THE EXPERT PERCEPTIONS OF DISASTERS, FLOODING AND VULNERABILITY

The experts hold a wide range of opinions concerning disasters, flooding and vulnerability. These views, as a whole, confirm and contest assumptions within the prevailing understanding. For example, as is becoming accepted in the academic hazard and risk literature, the experts describe how flooding can be a benefit to Bangladesh in many contexts. Alternatively, they provide a more detailed description of the different groups that are affected by floods and how these impacts are mitigated. Collectively, the opinions provoke further consideration of three related issues: the relationship between wealth and vulnerability, the impact of management on disasters and the distinct interpretations of disasters, more generally, that confront the more rigid, definite and measurable understandings evident within the flood and hazard management literature.

Individuals transitioning out of poverty are uniquely vulnerable to disasters

There is an assumption within the academic literature that the indigent are the most vulnerable segment of any population to disasters (Hewitt and Burton, 1971; Cuny and Abrams, 1983; Hewitt, 1983; Watts, 1983; Blaikie et al., 1994; Hewitt, 1997; Smith and Ward, 1998; Bankoff et al., 2004; Smith, 2004; Wisner et al., 2004; UNDP, 2006; 2008; United Nations, 2008; Smith and Petley, 2009; UNDP, 2009a; b). The argument is rooted in Marxist criticism of the socio-economic forces that compel poor, disempowered and marginalised people to inhabit high-risk locations. Vulnerability, following this interpretation, is the product of exposure to disasters mediated by social, technical and economic resilience. The interpretation is distinctly geographical, contextualising vulnerability in terms of global and individual pressures such as economics, culture, history and space-time (Blaikie et al., 1994; Wisner et al., 2004). The premise is intuitively persuasive and compelling. As such, following Hewitt's (1983) elucidation, it has become implicit within disaster and flood understandings, shaping both management and research (Tobin and Montz, 1997; Quarantelli, 1998; Pelling, 2003c; Collins, 2009; Cutter, 2009; Enarson and Chakrabarti, 2009; Smith and Petley, 2009). There is little doubt that the premise reflects the high exposure experienced by indigent populations in Bangladesh. Furthermore, it explains the cyclic

feedback that entrench the unequal relations that contribute to vulnerability, including the lack of resources, access to the means of production, political power and social services such as education and health facilities. Overall, the premise explains the origins and perpetuation of vulnerability for the indigent. In the Bangladeshi context, this group is composed primarily of those living in high-risk flood-prone locations.

Simultaneously, there is an unexplored tension within the literature in relation to resilience, which is defined as the ability to resist exposure to disasters (Eakin and Luers, 2006; Janssen and Ostrom, 2006; Brand and Jax, 2007; Nelson et al., 2007; Cutter et al., 2008). Along with their assumed vulnerability, disaster-prone indigent populations are also characterised as highly resilient: able to cope effectively and mitigate the impacts of disasters (Blaikie et al., 1994; Bankoff et al., 2004; Wisner et al., 2004). Often used as a critique of large-scale, developed-world technical management (Boyce, 1990; Custers, 1992; 1993; Rogers, 1994; Rashid, 2000; Rashid et al., 2007), the resilience premise diminishes the importance of exposure by suggesting that disasters develop and hone victims' knowledge, enabling them to mitigate and capitalise on disasters (Adger, 2000; 2006; O'Brien et al., 2007). In effect, knowledge and experiential expertise is afforded to the indigent as a result of their exposure. They are, according to this assumption, resilient because experience, often accumulated over generations, has taught them how to accommodate the environmental perturbations that are considered disastrous in other contexts. The premise is evolutionary, suggesting that the indigent can cope, learn to coexist and profit from disasters through adaptation. The tension, then, lies in the simultaneous characterisations of the indigent as extremely vulnerable and highly resilient as a result of exposure.

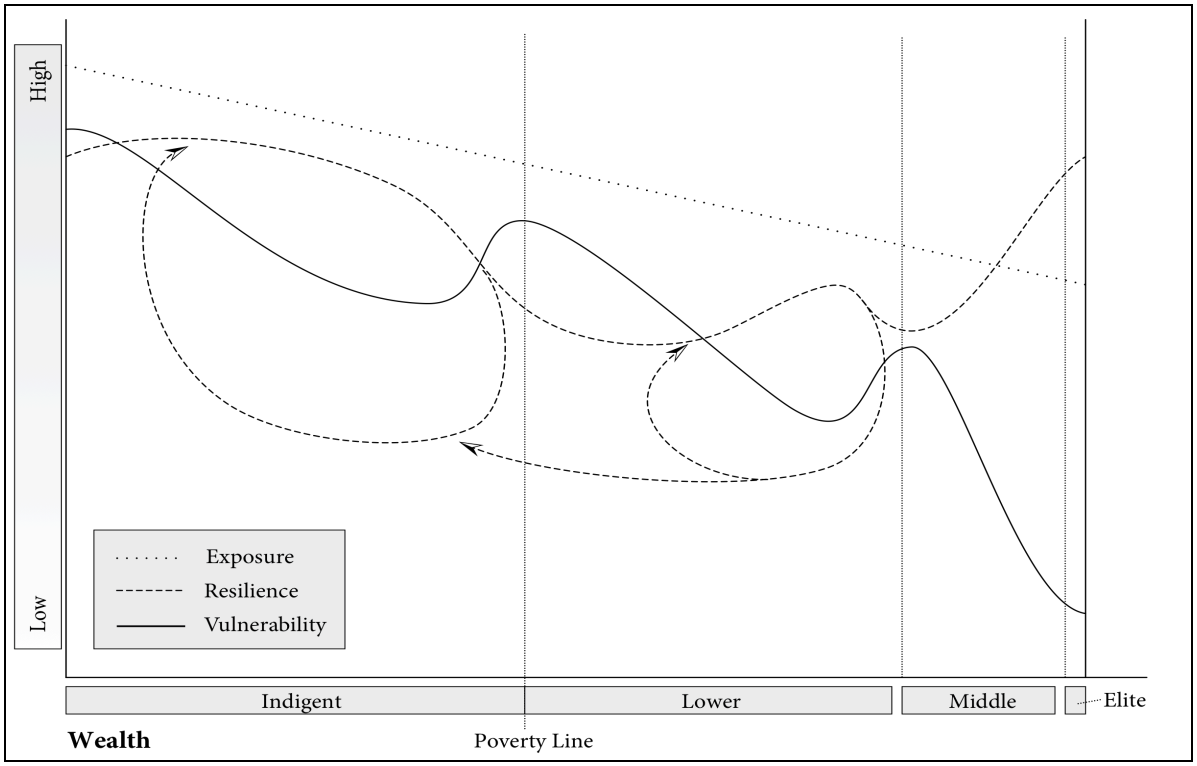
Without diminishing the plight of the indigent, the interviews with flood management experts suggest that those in transitionary states are also highly vulnerable to disasters, but for different reasons. The experts base resilience on tangible losses. Furthermore, resilience is predicated on the reestablishment of economic and socio-cultural pre-disaster conditions following exposure, judgments that are relative rather than absolute.

The resilience of the indigent, then, is facilitated by their impoverishment and destitution prior to exposure. If able to survive, an indigent existence is comparatively easy to maintain because the disaster has not resulted in profound tangible losses, but only because the indigent victim had virtually nothing before exposure. This interpretation does not necessarily upend the prevailing understanding of vulnerability, but it does call attention to the assumptions informing the exposure-resilience relationship. Through their views, the experts focus attention on those straddling the poverty line, judging them as vulnerable due to their investment in wealth generating activities and relative affluence (broadly their accumulation of assets). Following this argument, those who have invested are exposed with the added detriment of possessing assets to lose. In addition, those assets are acquired through micro-credit debt that, unlike material assets, is not washed or blown away by disasters. The emphasis on losses is a reflection of the tangibility built into the prevailing understanding of disasters (Smith and Petley, 2009); whether engineering-led or human development-led, tangible and direct impacts remain the underlying focus (Elkan, 1995; Meier, 2005; de Haen and Hemrich, 2007; Toya and Skidmore, 2007; Field and Field, 2009; Noy, 2009), potentially under-representing the psychological, emotional, secondary, compounding or intangible impacts and disaster-prone contexts (Benson and Clay, 2002; Pelling et al., 2002; Pelling, 2003b; Benson and Clay, 2004).

In relation to vulnerability, this argument has two implications. First, the expert responses question the presumption that resilience is best measured through direct tangible losses. Their views suggest that vulnerability is not as closely or directly linked to resilience as is assumed within the academic literature (Cutter, 1996; Messerli et al., 2000; Bankoff et al., 2004; Oliver-Smith, 2004; Wisner et al., 2004; Adger, 2006; Pelling, 2006). Rather, it appears connected to pre-disaster position and wealth. Someone with nothing is resilient but not well off. This understanding questions judgments of vulnerability founded on resilience, which effectively idealises the status quo and the return to pre-disaster conditions. Second, by recognising the indigent as well as those in transitionary positions, the experts describe collectively a nonlinear understanding of vulnerability. Following their interpretation, vulnerability is

contextually associated with assets and exposure (see Figure 14). This context suggests that indigent resilience, or perhaps the appearance of resilience, may be a product of impoverishment rather than a finely-tuned relationship between those exposed to recurrent disasters and their environment. Resilience, according to many of the experts, is a product of wealth. This assumption compliments the human development-oriented prevailing understanding, which emphasises wealth generation to combat poverty to improve vulnerability. As a result, characterising the indigent as resilient to disasters misrepresents their existence, perpetuating the assumption embedded within the prevailing understanding that wealth improves resilience. In effect, the measurement of vulnerability collapses into a measure of relative poverty and the associated (in)abilities to mitigate impacts. Figure 14 visualises the experts' assertion that, with assets and exposure, resilience dips and the individual becomes more vulnerable. In addition, it suggests that such dips occur near the divisions between societal groupings, particularly those at or near the poverty line. Specifically, those attempting to overcome poverty, under the current system and understanding, must accumulate wealth-generating assets (such as fishing nets, cows and poultry or vegetable gardens) to enable the wealth generation needed to improve resilience. The experts view this state as highly vulnerable to disasters, in essence increasing the risk of loss by increasing the amount of assets exposed to disasters. In cases where assets are accumulated and lost to disasters, the experts suggest that the individual and family suffer a setback in terms of their wealth, cycling back within the socio-economic group due to the burden of debt and the loss of wealth-generating means (dashed lines with arrows), visualising NGO 1's (30/01/08) claim that "Very little, maybe 1%" of the indigent are able to overcome the poverty line.

Figure 14: Generalisation of Expert Interpretations of vulnerability and resilience to floods over time according to wealth



Source: author

Disaster management changes disasters, producing second generation events

Within academia, hazard, risk and disasters are recognised as phenomena that ripple through the environment and society: a cyclone contributes to famine, which exacerbates poverty that sparks genocide. Despite this appreciation, hazard and risk understanding, research and policy divide these events into independent, thematic and, often disciplinary, communities. This process represents an analytical format predicated on cause and effect, linear relations and predictability. For example, an analysis of a disaster would explore the cause, the exposure, the impacts, the mitigation, the adjustments, the refinements and the re-exposure, initiating and cyclical reproduction of conceptual and practical processes founded on scientific method, falsification and the reduction-aggregation of knowledge (Latour and Woolgar, 1979; Latour, 1987; 1993; 1996a; 1999; Manson, 2001; O'Sullivan, 2004). The key premise of this analytical construct is the presumption of linearity; it is of such prime importance that nonlinear phenomena are forced into this framework rather than admit the imprecise,

unpredictable and chaotic nature of many human and environmental processes or relations. I argue that linearity represents the prevailing and entrenched conceptual basis for the prevailing understanding of hazard and risk. Whether in reaction to the difficulties or as a way of shielding itself from nonlinear relations, the prevailing analytical framework orients disaster understanding, management and research toward single events rather than repeated, varied and interwoven processes from multiple, diverse, social and physical phenomena. The experts exhibit and justify an alternate framework grounded in more inclusive accounts of the feedback that continuously (re)shape and (re)form disasters, leading to understandings that transition into other, often fundamentally different, phenomena.

Rather than the prevailing understanding, in which, for example, a flood may cause a famine or a cholera outbreak due to poorly envisioned or constructed infrastructure, the experts connect these events as part of the same disaster. This broadened understanding is most evident in relation to the tendency of management to spark or initiate the transitory process, resulting in what the prevailing understanding would classify as an entirely separate event. I have labelled these events generational disasters because they are generated through the efforts of management and because they are perceived to result in reformed disasters that are a generation removed from the original issue or event. Through intervention, and because of nonlinear relations reverberating throughout the system, a series of feedbacks result in often unforeseen impacts with consequences wholly different from the original event or management. In effect, the management becomes a part of the disaster. This understanding challenges the detachment embedded within the prevailing understanding. Rather than being a reaction to the cause, management is understood as part of a new cause-reaction.

An illustrative example raised by nearly every expert is the Dhaka-Narayanganj-Demra (hereafter DND) agricultural project. The experts emphasise the unplanned and unexpected conversion of the project following the construction of flood defences. The project was designed to protect roughly 5000 ha of land from seasonal flooding (Rasid

and Mallik, 1993) but enclosement of the area resulted in a large amount of urbanisation, which in turn reduced the viability of agriculture and undermined the infrastructure. In particular, the agricultural objective did not provide for the drainage required in urban areas, resulting in large areas becoming subject to stagnant and highly-polluted water (Rasid and Mallik, 1993). As a government manager involved in the project explains:

> "the DND, was once a very famous irrigation project. It is no longer an irrigation project because it has become a city. And now people are suffering every year because it was not designed for that. So the system is not adequate, the drainage canals are enclosed, so the water does not reach the pumps. It was designed for agriculture but now is urban" (Gov 2: 15/01/08).

This view is supported by a consultant who explains that:

> "you just cannot have something for the short term, like the DND. It was made thinking just of agriculture, and it was working perfect for an agriculture thing. But who knew that so many people would rush to the area and start building houses haphazardly?" (EngCons 3: 21/01/08).

The DND example helps to explain the generational nature of disasters relative to management. Furthermore, it hints at an understanding, much like risk (Burby and French, 1981; Douglas, 1992; Oliver-Smith, 1996; Lupton, 1999; Pielke Jr, 1999; Pelling, 2003b; Althaus, 2005; Cutter, 2009), in which disasters are transformed and displaced rather than eliminated. The understanding also mirrors the complexity theory premise in which systems are shaped by nonlinear relations, reducing the ability to predict beyond the short term due to unforeseen relations and system change. In relation to the prevailing understanding, the experts exhibit and communicate knowledge in which management is part of a broader definition of disasters, which stretches the conceptual, spatial and temporal considerations of the human-environment interface. In relation to the example, the disaster is at once an agricultural deficit, a flood management plan, water logging, over-urbanisation and an example of failed management, all within the context of the DND. The tendency of the experts to incorporate repeated exposure from a multitude of diverse social, physical and generational disasters challenges more focused spatial, temporal and thematic understandings of disasters and vulnerability. For example, the tendency to separate knowledge, research and policy pertaining to floods and famines (Sen, 1981; Clay, 1985;

Montgomery, 1985; Mellor and Gavian, 1987). Instead, the experts view such events as part of the same process rather than as a product of the original event. Building upon this rationale, vulnerability is multi-dimensional, considering numerous hazards simultaneously. This understanding challenges the prevailing understanding of flooding and hazards, which divides and allots vulnerability into constituent threats and assigns them to relatively disconnected, expertise, policy and management communities.

An unsettled, undefined, partial and contextual understanding of disasters

Combined, the two preceding discussions along with the expert opinions more generally, suggest an understanding of disasters and flooding that expands and deepens accounts of the prevailing understanding within the academic literature (discussed in Chapter 3). The views and opinions expressed by the experts: challenge the assumption of linearity between vulnerability and exposure; and present a broadened understanding of disasters that includes not only social and physical relations but a more reflexive appreciation for the generative nature of governance within the assemblage of flood management. Additionally, much as Sultana et al. (2008a) characterise the Bangladeshi identity in relation to disasters, the experts present understandings in which disasters are a constant, shaping how the human-environment interface is understood. Generally, the experts share a set of rationales and assumptions that shape their understanding of flood disasters. As opposed to the prevailing understanding, the experts interpret disasters as irreducible and inseparable from one another. In this sense, replicating Barry et al.'s (2008) argument, the prevailing understanding and the understanding presented by the experts represent competing disaster 'logics'. In terms of disasters, then, the Bangladeshi experience appears unsuited to deconstructed and reassembled understandings. Rather, for the experts, disasters fulfil expectations and serve as explanations for the functioning of the assemblage: they explain the perturbations and nonlinear relations that confront and contradict expectations founded on the prevailing understanding. In this context, the debate and controversy surrounding management is shown not just as a disagreement over particular issues, but as deeper differences between the assumptions and knowledge that inform competing logics-understandings.

The disaster logic is a means of characterising the experts' willingness to confront the application of an incompatible (scientific, linear, reductionist-aggregate) understanding with their knowledge and experiences grounded in Bangladesh. An illustrative outcome of the competition between these logics is provided by a manager at an international donor agency. His response, in every way but the terminology, describes a context in which two differing logics are forced to interact. In this case, the political-economy that empowers the prevailing logic requires an NGO manager – who, it is implied, knows that the prevailing logic is inapplicable – to adjust his grant proposal in order to appease entrenched knowledge and format. In response to a question about whether the donor perceives any similarities between colonial rule and present donor-Bangladesh relations, the manager answers:

> "sometimes, yes, I feel that it is not always easy to work in the government. Maybe not really colonialist, but yes there is a small element of this. We do try to dictate our principles; it is difficult to work on such projects, sometimes. So, yes, this is one of those issues. For donors and embassies, sometimes there are really highly qualified people who come and tell us what to do. I remember the comment of a director of one NGO – they are very patient, these people working in development in Bangladesh – he said, 'we listen to donors, dictating, telling us what is right what is wrong'. And he said, 'look, just tell me what to write on the forms.' [pause] Yes, this is a tendency. It is not really colonialism. But there is this idea that we really are the master of everything, we know the right way of doing things, and we want this country to do what is correct" (Don 1: 16/01/08).

The findings and discussion in the context of the hazard and risk literature show that the experts understand flooding and disasters more generally, as partial, contextual, ill-defined and unsettled. In the wider commentary concerning the debate and knowledge controversy surrounding flood management, the disaster logic challenges the assumptions that inform the prevailing understanding, including the implicit and explicit aim to produce more structured, defined and definite knowledge. In addition, the desire to find lasting solutions and the assumption that management sits apart from future disasters is problematised. This tension is best exhibited by the unsettled and contextual nature of *Bonna* and *Barsha* relative to prevailing measures of flood intensity that rely

on absolute measures, primarily flow and depth (Smith and Ward, 1998). With the broadening of what counts as a disaster, many more issues and factors are drawn into conceptualisations of management or as having disastrous implications for segments of the population. This less-exact definition, then, is a strength. It is its unsettled nature that enables the term to be used to contest not only the prevailing understanding but of the way the prevailing understanding is informed. This difference creates an opportunity to challenge, innovate and reconceptualise events and management. While not conducive to management following the traditional developed world model, the disaster logic reflects more accurately the material realities of an ever-changing socio-physical context. Viewed from this perspective, the controversy results from a struggle between logics, some grounded in the material realties of disasters and others that seek the idealised and more manageable formats and structures associated with developed world science, understanding, policy and management.

CONCLUSIONS

The expert opinions, assumptions and knowledges inform competing understandings of disasters, floods and vulnerability. These 'logics' (Barry et al., 2008) contribute to the interdependent assemblage of people, things and ideas that produce and contest management, sustaining a controversy and debate that is both a result and a driving influence on flood management. The expert perspectives challenge and elucidate the assumptions that inform the prevailing understanding of flood management. In particular, the assumption that the indigent are most vulnerable is questioned on the basis that segments of the population are considered vulnerable as a result of their accumulation of assets, suggesting a transitionary vulnerability for those situated around the poverty line. As well as identifying a group that is vulnerable to disasters, the argument that they are made vulnerable because of their accumulation of assets (often in order to support livelihood generating activities such as seeds, cows and goats for dairy or fishing equipment) challenges the linearity embedded within the assumption that

wealth improves vulnerability. The experts share the predilection within the academic flood management literature towards a broadened and inclusive understanding of disasters (see Chapter 3), leading to recognition of generational disasters, which are the product of unforeseen ramifications of disaster mitigation and governance. In direct opposition to a characterisation of management as an objective observer apart from disasters, the experts explain how management transforms disasters rather than eliminate them. The discrepancy between the experts' understanding and the prevailing understanding, not only in terms of different interpretations of the system but in relation to fundamental assumptions, suggests a disaster logic among the experts. This understanding promotes a partial, contextual and unsettled view of flood disasters that reflects more accurately the material realities of the complex and ever changing socio-physical interface in Bangladesh. Within the academic flood management literature, the debate and controversy that characterises flood management in Bangladesh is presented as a collision between competing interests. For example, engineering firms seeking profit are cast against the grassroots organisations seeking to improve livelihoods. Regardless of the exact characterisations, the context for this production is presumed to be shared by both sides; by this, I mean that it is assumed that the debate is between different interpretations of the same system. The disaster logic suggests that, in addition to disagreement over interpretation of the same issues, experts in Bangladesh understand flooding, disasters and vulnerability in a fundamentally different way to the understanding prevalent within the academic flood and hazards literature. Whereas the prevailing understanding idealises and aims to establish definitive, exact and repeatable findings, the experts express a broadened and inclusive understanding that admits uncertainty, accepts unpredictability and emphasises context.

This understanding of flooding and disasters in relation to exposure and vulnerability, leads into consideration of how exposure is accounted for. The discussions of vulnerability explained how exposure plays a central role in vulnerability, either as the physical threat or as the trigger that exposes unequal social relations. This debate is informed by judgments concerning the methods of flood management. Physical structures have been used historically to reduce exposure, thereby enabling human

development. More recently, constructivist interpretations of flooding and flood impacts suggest that poverty is a more opportune lever with which to address vulnerability, negating the need to reduce exposure through physical control of the environment. In this way, a debate over how to construct safety, either through the construction of physical structures or through a reconstruction of knowledge, has emerged, fuelling the controversy over flood management in Bangladesh and providing a second entry point for this research.

SOCIALLY AND PHYSICALLY CONSTRUCTING SAFETY

5

> *Over here, global politics is important. The international river network and others, who speak against embankments, are part of a large controversy. That is the starting point. Yesterday I shouted at one reporter, one journalist, and I said 'look, don't mix up a dam and an embankment. A dam is a structure perpendicular to the river flow, which creates a reservoir while an embankment is a structure that is parallel to the river flow and it does not create any reserve'. Now many of the people, so called experts, on flood management or disaster management or development of Bangladesh have no clue about it. Look into cyclone Sidr. If the coastal embankments were not there the number of deaths would have gone from 3 000 to at least 300 000.*
>
> (Res 4: 15/01/08)

Technical flood management, sometimes referred to as structural or engineering, is a material manifestation of knowledge. For example, the construction of embankments, polders, river training or the placement of erosion control gabions is based on a perceived need, the belief that nature should be managed and knowledge of how this aim can be accomplished. Physical structures realise human ambition. They are produced in particular space-time contexts and are the product of countless constituent factors, including: available resources, actants, knowledge, objectives, values, biases, interests and understandings. The historical narrative (Chapter 3) described the bifurcation of the prevailing understanding over time; it presented an interpretation in which the prevailing understanding has proceeded from technically-dominated to one in which the application of technical methods has become contested (Höfer and Messerli, 2006; Sultana et al., 2008a). Juxtaposing academic and government literatures with the perspectives of flood management experts, Chapter 4 explored the different-yet-entwined assemblage of knowledges, beliefs, objectives and values that inform different understandings of flooding, flood management and vulnerability. It described a tension between what I

have labelled the prevailing understanding, which is entrenched in practice and confirmed in the hazard and risk literature, and a disaster logic, which reflects the situated experiences and expertise of the experts who inform this research. As opposed to mere differences between interpretations of the same system, I use the tension between expert and prevailing understandings to suggest that irreconcilable assumptions sustain the knowledge controversy surrounding flood management in Bangladesh. This chapter explores a critical issue that emerges from the competition between logics: the debate over technical flood management. This debate provides a lens with which to explore the underlying power, knowledges, beliefs, objectives and understandings that have led and, within the current human development understanding, oppose the construction of technical structures. The debate over technical management provides a second entry point for further analysis of the wider flood management knowledge controversy.

Before analysing the expert opinions and perceptions concerning technical flood management, this chapter begins with a brief review of the relevant points from the preceding chapters. It explains how the academic flood management literature has focused on technical methods and their social alternatives rather than explore the knowledges that guide the implementation of either approach. This fixation on method is also shown to result in a continuum-based understanding, with technical and social management set on opposing poles to be negotiated along a sliding scale. The second section summarises the opinions expressed by flood experts concerning the debate over technical management, supporting, confronting and expanding on aspects of the prevailing understanding within the academic flood management literature (see Chapter 3). Two themes concerning the technical flood management debate emerge. First, despite widespread agreement that a compromise between technical and social management is required, there is a subtle difference between the *integration of methods* exhibited within the prevailing understanding and the *sensitivity* to *context* expressed by the experts. Furthermore, building on the contextually grounded understanding and recalling that the competing knowledges are socially-constructed (see Chapter 2), the experts emphasise the materiality of context. Second, the contextually- and materially-

reflexive understanding results in an appreciation for the temporal situatedness of technical methods and, more importantly, of the knowledges shaping management. Confronting the disposition within the prevailing understanding towards lasting and transferable solutions, the appreciation for change over time results in an understanding of flood management that passes through phases in which complete technical or social management may be applicable; this understanding is best displayed by the compromise interpretation of the 'living with floods' (hereafter LwF) concept.

The tangible/technical focus of the flood management debate

One way in which the controversy over flood management has emerged is through debate over the methods of management. In effect, different understandings of the world influence perceptions concerning how it should be managed. Competing understandings (discussed in Chapter 4) inform a parallel debate between technical and social forms of management. Technical methods include physical structures such as embankments, river straightening, dams, polders and barrages, uniting each of these methods is an understanding of flood management predicated on preventing disastrous events by limiting human exposure. Social methods include insurance, zoning, land use planning, evacuation plans and education campaigns,[35] uniting each of these methods is an understanding of flood management predicated on the strengthening of human vulnerability through increased resilience.[36] On a more abstract level, the disagreement can be rendered to one over the nature of control: whether to change the environment to suit human needs (technical management) or to shape human behaviour to accommodate the natural world (social management). The current debate over technical management is traceable to the disastrous floods of 1954 and 1955. In the aftermath, Bangladesh implemented a flood management strategy that aimed to control the environment using physical structures (see Chapter 3). Whilst there was opposition from the outset, the controversy peaked with debate over the 1989-1995 Flood Action Plan (FAP), in which

[35] The terminology for these concepts is diverse. Technical is often referred to as structural or engineering while social is labeled non-structural or non-technical.
[36] I use these understandings throughout the discussion: technical = event prevention, social = increased resilience.

technical methods were criticised for their economic, social and environmental impacts. Since then, the debate has smouldered.

The debate over technical management is sustained for a variety of reasons. Briefly, the bifurcations and increasing complexity of flooding and flood management create a situation in which a growing number of interpretations contest management, inhibiting consensus and encouraging compromise to overcome disagreement. In addition, the debate over technical management is characterised by extreme presentations of opposing views and dichotomous discussions framed as 'either-or' arguments (Custers, 1992; Rasid and Mallik, 1993; Choudhury et al., 2004; Chowdhury, 2005; Rashid et al., 2007). Second, technical methods have a long history as the means of implementing development through modernisation and, until recently, were the primary means of implementing food-for-work schemes. Their association with autocratic modernisation and wasteful largess, at the expense of more economical and local ventures, continues to shape perception of flood management methods (Boyce, 1990; Custers, 1993; Haque, 1997; Rasid and Haider, 2003). Third, until recently, the steadfast emphasis on food security and self-sufficiency (see Chapter 3) required protection from flooding to ensure agricultural production and expansion. Specifically, the need for high-yielding varieties of rice to feed the growing population required protection from inundation (Sultana et al., 2008a; Sultana et al., 2008b). Technical measures are the only method for realising this objective. Fourth, the shift from exposure to resilience has reconfigured the nature of vulnerability (Kelly and Adger, 2000; Wisner et al., 2004; Adger, 2006), affecting the perceived need and role of technical flood management. Specifically, past efforts to improve vulnerability by reducing exposure were accomplished using technical methods while current efforts focus on poverty alleviation. Fifth, technical methods remain the primary form of existing flood management in the developed world. Such measures reflect what is known and what is expected by donors and the international community; they remain the consensus solution according to many experts (Smith and Ward, 1998; Haque and Etkin, 2007; Smith and Petley, 2009). Finally, and of critical importance to this discussion, technical methods represent a tangible emergent property of the flood

management debate. They provide the concrete materialisations on which the knowledge controversy rests.

A fixation on method and a continuum of management strategies

Hazard and risk research has been accused of being ontologically blind. This situation has resulted in questions of 'how the world is' being left implicit, focusing instead on methods of flood management rather than on the knowledges that inform different understandings (Hewitt and Burton, 1971; Burton et al., 1978; Hewitt, 1983; Watts, 1983; Hewitt, 1997). In this way, emphasis on technical structures and their social alternatives neglects the knowledges and assumptions that guide both forms of management. The emphasis on method emerges in a number of forms: directly, as a debate between technical or social strategies; and indirectly, as the basis for perception studies (for example interviews concerning the applicability of certain management methods) (Rasid and Mallik, 1993; Paul, 1995; Rasid and Mallik, 1995). Technical and social methods represent the building blocks of flood management, which increasingly aims "to reduce human vulnerability to flooding rather than to rely exclusively on physical confrontation with flood events" (Smith and Ward, 1998: 293). This citation illustrates how the knowledge controversy over management emerges as a debate over methods.

At present, the emphasis on methods frames the debate around the adoption and implementation of participatory management (Koppen and Mahmud, 1996; Nanda, 1999; Sillitoe, 2000; Sultana et al., 2008b). This debate, like the earlier focus on competing technical methods (Rasid and Mallik, 1993; Rasid and Mallik, 1996; Bayes, 2001) and the coupled debate over social methods (Hyder, 1996; Sillitoe, 2000; Allison and Ellis, 2001; Bhuiya and Chowdhury, 2002; Dixit, 2003; Pelling, 2003b; Thompson et al., 2003; Coles and Wallace, 2005; Haque and Etkin, 2007), contrasts top-down and bottom-up approaches, maintaining a focus on methods rather than on the rationale supporting a specific approach. This fixation carries important implications for the analysis of flood management. In particular, the dichotomy contributes to the

construction of a continuum in which technical and social management occupy the extremes. For example, Rashid et al. (2007) contrast various social mitigation strategies to determine which are most appealing to slum residents in Dhaka only to conclude that many would prefer technical methods. Additionally, by placing technical and social methods at opposing extremes, the authors conclude that the middle ground is optimal, disregarding the perceptions of victims to advocate a compromise. Chowdhury (2005) provides another example of this interpretation. His analysis situates physical structures against social management, creating a rather loose binary and advocating a mixture of the two. This situation results in widespread advocacy for the integration of social and technical methods, an additive understanding based on ideal or intuitive interpretations of flood management. While the exact composition of the compromise is typically left unspecified, it is implicitly located towards the middle ground between the two poles of management, advocating a mixture of technical and social management. In terms of flood management, this rationale has emerged in numerous forms: as integrated management, as basin planning and as interdisciplinarity or holistic approaches. Regardless of the label, the argument is the same: to combine competing methods by compromising between extreme alternatives. It is in response to this range of opinions and interpretations of management that the experts were asked about their views on technical and social forms of management.

EXPERT PERCEPTIONS OF THE DEBATE OVER TECHNICAL FLOOD MANAGEMENT

The technical management controversy

Changing perspectives concerning the applicability of technical management

The debate over technical management is contentious, with a wide range of competing views. In response to a question regarding the state of the debate, an independent scholar states that "I think you are ten years late. You come on the backdrop of history that has come and passed" (Res 3: 08/01/08). Alternatively, many of the experts state that the debate is ongoing and remains relevant. Likening the situation to a pendulum swinging between technical and social extremes, an academic engineer declares that "we have

gone from one extreme to another" (AcaEng 3: 23/01/08). Describing the current situation, the Prime Minister's advisor states that "the debate in Bangladesh is very polarised. There is the structural group and the non-structural group" (Res 4: 15/01/08). Summarising the debate's current form, a researcher at an independent institute explains that:

> "the structural approach is, by now, obsolete. I mean that as far as small projects are concerned. This means that they must be accompanied by other things, by social, by economic concerns: the holistic approach" (Res 1: 06/01/08).

Recognising the implications of this change, and referring to the national-scale, the head of an independent university concludes that "there is no flood management programme at work right now. What we have now, is we just look at individual embankments and repairing old" (Aca 2: 08/12/07). An expert working for the UN provides an explanation for this claim, stating that "90% of bilateral donors, like all the European donors except the Dutch,[37] are now not interested in being involved in any type of structural management" (Inter 4: 29/01/08). His colleague expands on the point, stating that "most of the embankments were made past the last 10 years. In the last ten years there have been no huge projects from donors or water development board" (Inter 3: 29/01/08). With respect to this shift, some of the experts were resentful, explaining that the transition away from technical management had left Bangladesh with a legacy of intermittent degrading structures. As the director of a government agency explains:

> "we need help maintaining these things because we do not have sufficient funds for that. The donors should help us with these embankments that they helped us construct and which we now rely on" (Gov 3: 16/01/08).

The experts often associate the changing understanding of flooding and flood management (discussed in Chapter 3) with a transition from technically led management to small-scale and socially focused initiatives. For example, the head of an NGO explains that the implementation of technical measures was once the metric for measuring the success of flood management, with a near complete disregard for the social practices that are the current focus. He explains:

[37] A meeting with the Dutch representative for Bangladesh found that this had recently changed to be more in-line with a European perspective.

> "15 years back, say 10 to 15 years back, the process for water and sanitation was only for hardware delivery. This means infrastructure, tube wells, latrines and hand pumps. Capacity building, community empowerment, sustainability, hygiene education, those were not the concern. How many tube wells you installed per year, that was the target and how you measured achievement" (NGO 1: 30/01/08).

Expressing an alternate understanding, a manager for an international donor states that the technical rationale remains dominant within the Bangladeshi government. Recounting his negotiations with ministry officials regarding a water management project, he states:

> "I remember when the project was submitted to the government for approval. It was clear that they were very disappointed because they could find no infrastructure or hard kind of work in the project. They said 'only capacity building? Only governance? What is the use for that?' So the [Bangladeshi] government has a clear stance that a good project involves infrastructure" (Don 1: 16/01/08).

Lending support to this claim, an NGO manager explains how the system perpetuates this bias towards technical management. He states:

> "supposedly education is the number one priority, but if you see the distribution of resources [within the education ministry budget], probably the construction of facilities would take 80%, the teachers' salaries would take 10%, and the human resource development would take 10%. Outwardly, it looks good. 'Oh look we are giving priority to education, 500 crores of taka have been allocated to education'. But outside the box, you will see that these party thugs are getting the construction work, these party thugs are supplying the benches, these party thugs are supplying the roofs; so, the material gain is being redistributed to these people. Only this much [20%] is being enjoyed by the poor students. Every area has that same drama" (NGO 5: 13/01/08).

Past technical management strategies failed, therefore floods cannot be stopped

A majority of the experts relates their opinions of technical methods and management to an assertion that extreme floods in Bangladesh are beyond human control. They present an understanding in which technical measures are capable of controlling only beneficial floods (*Barsha*) and that the scale of water and sediment in the Ganges-Brahmaputra results in a socio-physical context in which no amount of engineering could eliminate catastrophic events (*Bonna*). An expert working for the UN contextualises this

perspective in relation to past attempts to eliminate floods using technical methods. He states:

> "I'm talking about floods being the reality, we cannot eliminate floods. This is for sure. History teaches use that we failed to eliminate the flood. There is no single evidence in Bangladesh's history that suggests that we could eliminate the flood" (Inter 3: 29/01/08).

A project director at a research institute communicates a similar perspective, emphasising the potentially negative consequences of complete flood control. He states:

> "we cannot protect ourselves from flood because protection of flood has all sorts of negative factors. For example, if I want to protect an area from floods, we will have to sacrifice the environment, that costs also sectors like fisheries. If I give an embankment, the people will be protected, undoubtedly, but there will be negative consequences such as stagnant water, loss of moisture in ecosystem, soil degradation and so forth" (Res 1: 06/01/08).

In response to this understanding, the director of a government ministry responsible for technical water management provides an alternative explanation, suggesting that the inability to deliver complete protection is a result of finances rather than technical ability. For him, "we just pick the most vulnerable areas, depending on the available of money. But there is not enough money for all the areas. Total flood protection is impossible" (Gov 6: 05/02/08). A senior researcher at an independent institute helps contextualise this understanding of technical management; referring to the developed world, he states that "they have given most attention to insurance, forecasting and warning because they know that structural measures do not solve things, other than cause other problems" (Res 1: 06/01/08). A foreign consultant supports this understanding, emphasising the lack of maintenance. He explains that:

> "there are cases here, where because of the lack of maintenance, result in operational failure and that structures that require regular upkeep and maintenance and if they do not get it they break down. It is also common for the people living in those areas, after it breaks down, to question the value of the original project" (EngCons 4: 21/01/08).

The perception that technical methods have failed is often described as a misinterpretation of their feasibility. Many of the experts assert that technical management is unreasonable in Bangladesh. An expert working for a UN agency addresses this issue:

> "let's think about how the water comes into Bangladesh. It is not possible to control this because of the volume and because of the amount that comes from outside of Bangladesh. Also, the volume is focused on two points that could never be managed" (Inter 4: 29/01/08).

The executive director of an independent research institute supports this opinion, though he also hints that it is as much the social as physical context that is to blame for the inability to implement technical management. He states that:

> "we construct an embankment and they are not maintained or built to proper specifications and this has caused a lot of misery for the people. But embankments are there in many different countries, providing support, so why should Bangladesh not have them as well? This can be done" (Cons 1: 26/01/08).

The contexts of technical and social flood management

Rural and urban

Typically, the experts situate their understandings of technical management using some combination of rural, urban, agricultural or industrial contexts. In terms of urban and rural locations, the experts often present a hierarchy that associates methods of flood management to specific contexts. A senior researcher at an independent institute provides a representative example, stating that "urban floods are more important because the people suffer much more in urban areas. Rural floods are mostly beneficial" (Res 1: 06/01/08). Supporting this view, a government manager explains that:

> "urban needs protection, or in areas where there is some heritage. Urban protection we need it. We make the road, very expensive roads, to connect the cities. If the flood comes and we lose the road it is very expensive" (Gov 4: 16/01/08).

An engineering consultant supports this understanding of technical measures, stating that:

> "we know that the cities have to be protected. We do not need to protect the whole country. It is useless but we have to protect strategic points, whatever the costs" (EngCons 3: 21/01/08).

Lending further support, an independent scholar explains:

> "our rivers are 10/15 kilometres wide at some points. At those points you cannot think about embankments and bridges, you simply have to do the best that you can. And of course, you have to protect the human infrastructure

> and the urban centres where there are corporate investments" (Res 3: 08/01/08).

For the majority of the respondents, the maintenance of technical structures is a crucial consideration, particularly when discussing urban management. A government manager argues:

> "peripheral structural interventions like the Western Embankment are very much needed. The IMF and the WB should help us to maintain and build up these structures. Otherwise, they will not survive. Within the country, all the other infrastructure (e.g. roads and houses) they are under the protection of many of these past structures. Now, the idea that we do not need more structures is ok for now, but they do need to help with the ones we already depend on" (Gov 3: 16/01/08).

Exhibiting the agricultural emphasis described in the historical narrative (discussed in Chapter 3), an engineering consultant explains that donors and the Bangladeshi government have had to reorient management in response to the changing context. He explains:

> "they are realising that in this part of the world, China, South Asia, etcetera, is that the investments they've been doing for the last 20 years have been agriculture based and primarily in villages. But now the majority of the population is living in urban areas and they will now need more investment. And this kind of investment is different from investments in villages where you have more big projects like dykes and embankments. Instead, you have smaller projects like drainage systems, which have a lot more components to them, they are more complex. This shift is more realistic about what is going on in the region" (EngCons 1: 01/01/08).

Some of the experts link their understanding of technical measures to recent government policy changes. For example, an academic engineer states that:

> "the national plan, and I agree with it, says that in rural areas [embankments] should be maintained but that the people should also be encouraged to cope, to raise their homesteads, and their other problem is the roads and highways. They have to be above the high water mark, and provide for flow" (AcaEng 2: 15/12/07).

A senior researcher shares this interpretation of rural and urban contexts, stating that the national policy "discourages any more structural measures in rural areas. As far as I know, they only advocated for the protection of towns and urban sites" (Res 1: 06/01/08).

Agricultural and industrial

Interwoven with the urban-rural division, the experts relate their understanding of technical and social management to industrial and agricultural contexts. Broadly, their knowledge of flood management is shaped by the perceived resilience of the agricultural sector and the vulnerability of the industrial sector. The agricultural sector is recognised as the foundation of the Bangladeshi economy. As one researcher explains:

> "urban towns should be protected. It is not exactly true that this is where the growth comes from in Bangladesh. Here, wealth comes from agriculture, wealth is concentrated in the urban areas" (Res 1: 06/01/08).

For many of the experts, there is a clear distinction between agricultural and industrial contexts. For example, an agronomist states that "during the recent floods I made a speech defending structural management. I said that you can do it to defend a city [or] industry, but not to protect agricultural lands" (Res 5: 17/01/08). This perspective is shared by the head of a research institute. He states that:

> "if you look at the damages, you can see that 57% to 65% of the flood losses occur in the non-agricultural sectors – I refer to the whole national flood loss, like in 1998, 2004 and 2007 – most damages occur to non-agriculture businesses, industry and housing; housing especially and infrastructure" (Res 1: 06/01/08).

He goes on to argue that:

> "the non-agricultural damages are most important because damages to the agricultural sector can be recouped and adjusted for within the same season with some extra efforts or in the immediately following season. At the end of the day, agricultural losses are practically insignificant" (Res 1: 06/01/08).

The experts relate technical management to agricultural development with reference to its associated requirements. Generally, traditional agriculture can be exposed to flooding while modern high-yielding varieties require protection from extreme weather events. The Prime Minister's advisor explains this perspective, stating that "if I want to grow high-yielding varieties [of rice] over here I need structural protection because the crop cannot withstand inundation" (Res 4: 15/01/08). Reconfirming the agricultural priority of flood management, the director of a government ministry explains the shift away from technical management in relation to agricultural needs. He states that following the 1954/55 floods:

> "the Krug Mission was the result. That was not a little plan, it was an outline plan. On the basis of that outline was the 1964 Master Plan, from the

> EPWAPDB, this IECO Master Plan prepared a list of some big projects. Very structural, after about 10 or 20 years it was found that these big projects were not actually helping us for quick food production. This is why the 1972 was the shift to meet food production. We would have to do small-scale efforts" (Gov 3: 16/01/08).

The head of a United Nations agency also contextualises the shift from national to local-scale flood management in relation agriculture, stating that:

> "this country was built on Food For Work and large community projects. Gradually, the large projects, basically food aid, has diminished so food for work has gone down. I don't think that this is specifically related to Bangladesh, it is related to the world. The other thing that has happened is that there has been a lot of work gone into evaluating these large-scale aid projects…so everything was scaled down in the 90s towards more community projects, smaller scale with a smaller amount of food aid arriving into the country. So that, in a nutshell is what has happened" (Inter 1: 22/01/08).

Alternatively, industry is characterised as important for economic development, which in turn justifies physical flood protection from flooding using technical methods. The director of an NGO explains that the government is now responsible for ensuring that industry can function despite the flood-prone context. He states that they:

> "cannot ignore that so many men and women, especially the women, in the last 20 years have been working in and around Dhaka city in the garment sector all of a sudden become jobless and we can still sustain the nation. That's one major thing" (AcaNGO 2: 03/01/08).

Summarising the impacts of the changing context and the ramifications of industrialisation, an engineering consultant argues that flooding:

> "was not a problem when this was a country of only 20 or 30 million people but now things are different. Also, our lifestyles are different from 50 or 60 years ago. Before, flooding would not affect your lifestyle the way it does now. There was no mechanization, industry, etcetera but now we have this and it does not survive a flood, people depend on these resources now" (EngCons 1: 01/01/08).

The experts characterise urban and industrial contexts as deserving of technical methods while rural and agricultural contexts are not. Alternatively, several respondents question the validity of such labels. For example, a social scientist explains that due to:

> "the population density, there is actually nothing but city. Sure, the signs change but the number of people is so high that it is essentially the same.

> Right in the heart in the city, you can see people who live as if they were in a village and when you go out into the villages, you can see people living with all of the amenities associated with the city, all the modern things. This dichotomy, that you see in the west, here, the lines are blurred" (Aca 4: 02/01/08).

The responses suggest an understanding of technical management linked to context. In this sense, a majority of the experts communicate understandings in which urban and industrial locations require complete protection, rural and traditional agricultural areas require none, and modern agriculture some degree. In these instances, as opposed to the compromise displayed within the academic literature, context determines the form of management.

Competing interpretations of the 'living with floods' concept

The experts invoke repeatedly the 'living with floods' (LwF) concept to explain and situate their interpretations of the debate over technical flood management. While the experts define LwF in numerous ways, the understandings can be divided into two broad categories: one in which the concept is a foil to technical management; and a second, which defines LwF as an ideal compromise between technical and social management.

LwF as a critique of technical management

For many of the experts, LwF is understood as a critique of technical management. In this form, it challenges a fundamental assumption of the engineering strategy and understanding: that floods can be controlled. This situation helps explain the passionate responses from some of the experts. Describing the general context of the debate, the head of a research institute argues:

> "I would say that flooding is a problem. But I can see it from the other point of view. The people who are critical of the large dam or large structures with their negative social and environmental impacts. To counter that point of view, some people argue that we should learn to live with flooding" (Res 2: 06/01/08).

An academic engineer provides a representative description of how LwF is used to criticise technical methods, particularly past strategies that neglected the social

dimension. Referring to the dominance of engineers, he explains that "we need to consider the human psychology everywhere. Too many of our decisions are based on a very few people's opinions" (AcaEng 3: 23/01/08) and goes on to explain that the debate surrounding LwF and technical management reflects a fundamental shift in priorities. He states that:

> "there was a complete paradigm shift after the FAP. There was so much criticism at that time, directed at engineered structural solution to the flood problem" (AcaEng 3: 23/01/08).

The head of a research institute also contrasts technical management with LwF. He explains:

> "you have to go for a balance of things. You don't go for the massive engineered management to try to control all of the waters from India. That would be a huge investment with massive environmental consequences, probably impossible. On the other hand, I do not like the idea that we should just accept things and learn to live with floods" (Res 2: 06/01/08).

In response to the criticisms directed towards technical management, several experts are critical of the LwF ethos, suggesting it is more ideal than practicable. For example, an academic engineer declares that:

> "my argument against 'living with floods' is very simple, ask the people if they want to live with floods and they say that they do not, simple. How can you force them to live with that, just to apply a concept?" (AcaEng 3: 23/01/08).

The Prime Minister's advisor also emphasises the desire for protection among locals, stating that:

> "when you go to the local community and ask the people 'do you need this dyke?' of course they do. There is no other choice in a delta by which you can keep the water out. So it is fashionable for, I will give the names: [Aca 2] and [Eng 3] to criticise embankments but they do not understand the environment or the problem. They live in a protected area. If the flood embankment protecting Dhaka city was not there, two-thirds of the city would have been under water in 2007, and we are talking about 16 million people. It is not a matter of a few" (Res 4: 15/01/08).

A closely related criticism of LwF is that its human emphasis distracts from the physical realities of flooding in Bangladesh. For example, a foreign engineer, contextualising his response in relation to urban and rural areas, explains that:

> "I think [LwF] has some good qualities, as far as agricultural areas in particular. The marine biology and so on, it makes a great deal of sense. You can have very low paddy areas that can be flooded and then you will not lose very much, provided that the crops are spaced out. But the living with floods in urban areas, I just cannot go along with, it is not practical" (EngCons 4: 21/01/08).

Supporting this understanding, the director of an NGO summarises the difficulties he faces due to widespread ignorance concerning how most Bangladeshis live. He characterises those who advocate LwF and traditional coping strategies as:

> "'innocent extremist' because their belief. They live in big houses that are totally flood free and are not affected by this kind of phenomena. They preach about keeping flood plains as flood plains. I used to go all around Bangladesh, and the people who are living there [I] asked them 'what are their aspirations' and they'll say 'I want to live like you', very straightforward, 'I don't want, I don't like to live only in a raft made of planks, why should I do that?' This is ridiculous to think that those people will face flooding forever and ever and for generation after generation" (AcaNGO 2: 03/01/08).

The executive director of a research institute provides an example of a more 'enlightened' engineering logic to counter this extreme interpretation of LwF. He suggests that participatory planning and genuine collaboration will convince the local population that engineers have learnt from past failures, and that there is no longer a need to live with floods. He states that:

> "if you are sharing information with them, participating with them, sharing the decision-making, I am sure that they will not take flood in a way that says 'let us live with floods'" (Cons 1: 26/01/08).

LwF as a compromise between technical and social management

Many of the experts understand 'living with floods' as an ideal compromise between technical and social management rather than as a strict or oppositional counter to technical management. In many instances, LwF is understood as an attempt to grapple with the need to protect important locations with the certainty that catastrophic flooding will reoccur, alongside an appreciation that floods in Bangladesh are probably beyond human control. This perspective is best summarised by a social scientist who interprets LwF as a combination of technical and social methods, stating that "when we say non-

structural, we never mean that there will never be any structural measures" (GovEng 2: 24/01/08) and goes on to explain that:

> "when we say non-structural measures, people sometimes misunderstand. They think we mean that you cannot do anything and that people will just have to suffer. To my mind, non-structural measures mean we need to increase people's coping capability. Through limited structures, limited knowledge, limited technology. Where you need better technology, you use it. Non-structural means knowledge-based enhanced coping power to increase coping ability" (GovEng 2: 24/01/08).

This understanding is supported by other experts who perceive past technically dominated strategies to have unbalanced the environment, requiring a social emphasis to overcome the discrepancy. For example, an expert working for the UN argues that all methods are useful but that the past bias towards technical management requires a strategy able to restore balance. He argues:

> "there was dominance of the structure and less priority on the social, so we need to bring together the social and the structural. That is our position. We are not only talking about only the social dimension. We believe that it was a forgotten thing, like a sort of discrimination, and we need to stop the discrimination. That, because there is already a dominance of structures, we need to have a positive inclusion of the social aspects" (Inter 4: 29/01/08).

Couching this perspective, he warns:

> "don't go [away] with the misconception that we are proponents of the 'living with floods'. This is a concept that emerged due to the predominance of the structural solution. So, the two brothers should go ahead, making sure that they compliment each other" (Inter 4: 29/01/08).

The director of a government ministry lends further support to this interpretation, arguing that technical methods should no longer dominate strategies, but that there remain situations in which they are necessary. He states that:

> "we do not accept this view [that embankments are bad]. We need embankments. We are a riparian country. Whatever we do, we must protect our people. You see, we are not doing any more FCD [flood control and drainage] projects for food production, but we are doing FCD projects to protect cities and economic centres. This is needed. You see our exports in jute, they must be protected. And this is why we need some embankments, some river training and some erosion efforts" (Gov 3: 16/01/08).

Returning to the inevitability of flooding, a government planner explains that compromise is needed because:

> "flooding has both positive and negative aspects, that is why they want to live with it. If we try to avoid floods by confining them to certain areas, then that would cause certain problems, that is true. But that does not mean that we have to manage in such a way that it hampers our development" (Gov 1: 09/01/08).

A senior fellow at a research institute summarises this 'ideal versus real' understanding of the LwF debate by explaining that:

> "living with floods does not mean you have to do nothing. Living with floods includes good preparedness, good warning systems… So, the living with floods concept must include many aspects, warning, insurance, land use planning, and so on and so forth. Living with floods means some actions, other than structures. At the same time, the big rivers, like Brahmaputra, Meghna, must be embanked" (Res 1: 06/01/08).

THEMES EMERGING FROM THE EXPERT PERCEPTIONS OF TECHNICAL FLOOD MANAGEMENT

The expert opinions concerning technical management are wide ranging and, as opposed to the prevailing understanding, rooted in experience with flood management in Bangladesh. The experts describe and relate technical management to social alternatives by situating their uses in the context of Bangladesh's needs. The experts display pragmatic understandings of technical management, choosing to discuss the aim and objective over ideals that are more abstract. Leading from these opinions, the compromise between social and technical management, often labelled holistic or integrated within the prevailing understanding, is challenged on the basis that context should supersede concept. Furthermore, this context-specific understanding suggests an extension of the temporal scale in which the flood management strategy is able to evolve through phases rather than establish a lasting solution. The living with floods concept provides an informative example of these perspectives, suggesting that the refusal to 'nail-down' an exact and transferable definition enables the concept to be shaped to the conditions in which it is needed.

Constructed compromises: physical structures or knowledge?

Recent flood management research has elevated the social nature of flooding, flood management and vulnerability (see Chapter 3). The experts, in addition to this assumption, present a reflexive sensitivity to the role of the physical world in shaping socially-constructed knowledge. In this sense, appreciation for context is as much an appreciation for the physical context as it is for the social context. The experts express an understanding in which flood management knowledge and flood management methods are mutually formative. More simply, knowledge of flooding and flood management are socio-material rather than social constructions. Furthermore, it is not only the physical context but also the legacy of technical management, and the associated knowledge controversy, that influence knowledge construction. While within the flood management literature there is some recognition that technical structures influence understanding (Paul, 1984; Alam, 1990; Paul, 1997), it is predominantly a one way process – it is of how people understand physical structures rather than how the two inform understanding of flooding and flood management.

Concerning the debate over technical management, the differences between the prevailing and expert understanding are subtle. The flood management literature and the experts agree that technical and social management are both required components of management and that a compromise is required. The historical narrative (Chapter 3) explains that within the academic flood management literature the compromise is more literal. Following an integrative rationale and a fixation on methods, the prevailing understanding interprets compromise as a mixture of technical and social methods. This understanding locates best practice in the middle-ground between technical and social methods. Complicating this understanding, the contested nature of both technical and social management suggests that the poles themselves are shifting, resulting in a rather arbitrary compromise. While perhaps obvious, it is worth noting that compromises are often morally, intuitively and functionally effective means of overcoming disagreement (Murdoch, 1997a; b). In terms of technical flood management, the middle ground between opposing poles, then, provides a semblance of balance and communicates an appreciation for the range of competing beliefs, interpretations and knowledges.

Furthermore, within a context of debate and controversy, such an understanding is likely to be accepted by a wider range of stakeholders. Alternatively, the socially-constructed nature of the understandings suggests that the resulting management may appease competing interests rather than accommodate material realities. Effectively, the prevailing logic privileges socially-constructed knowledge, or, more specifically, compromises between socially-constructed knowledges, leaving connection to the material context implicit or assumed.

Explaining their perceptions using their experiences, the experts situate their compromise between technical and social management spatially, emphasising the various contexts in which different methods are applicable. For the experts, the compromise represents a sensitivity to context, whether rural, urban, industrial, agricultural or some form of hybrid. Rather than debate the location of the compromise on an abstract continuum between two extremes, the experts describe the socio-material contexts in which either or both should be applied. This is a very subtle, but important, distinction between the competing understandings. Rather than criticise the prevailing understanding, the experts refine the debate over technical management by retaining the full range of available methods, structuring the compromise around the contexts in which methods should be applied. Collectively, the experts suggest an understanding in which complete social or technical approaches can be applicable. Generally, they associate urban centres with the need for complete flood protection, high-yielding rice with considerable and traditional forms of agriculture and rural settings with none; this is a compromise, but not following the integrative rationale prevalent within the academic flood management literature.

As discussed in the historical narrative (see Chapter 3), hazard and risk research has been accused of being retarded in terms of theory because of its fixation on impacts and debate over the technical and social methods enacted in response (Hewitt and Burton, 1971; Hewitt, 1983; Watts, 1983; Smith and Petley, 2009). Perhaps justifiably, the field emphasises method while neglecting knowledge, choosing active engagement with

hazard management as opposed to theoretical engagement with the competing assumptions and understandings. Additionally, this fixation on events and methods is couched within criticisms that accuse hazard research and management of being reactive (Cannon, 1994; Mileti, 1999; Mallick et al., 2005). Proaction requires the ability to understand and predict the future, abilities that are improbable within complex systems characterised by nonlinear relations (discussed in Chapter 2). The result is that flood management is expected to deliver knowledge that, in all probability, is impossible. This is the crux of the controversy surrounding technical management. Returning to the underlying differences between the prevailing and expert logics (see Chapter 4), a contextual understanding is incompatible with the knowledge requirements of the prevailing understanding or developed world flood management. Because of their situated understanding, the experts resist the structure, conformity, generalisation, transferability, replicability or reapplication that are the essence of a prevailing understanding. Overall, the expert opinions suggest that the perceived failures of technical management lie as much in the rigidity of the knowledge informing its application as in the rigidity of the structures. Following this interpretation, technical management failed because it disregarded the social context; it continues to fail because it does not account for different socio-material contexts.

The phases of flood management

In addition to being socio-materially situated, the experts provide understandings that are also time sensitive, recognising that mitigation strategies and methods may become more or less effective over time. This historical sensitivity helps to construct an understanding of flood management that transitions through different phases. For example, an engineering consultant, reflecting on the debate over technical and social flood management, suggests that opposing methods are applicable at different times. He states that:

> "maybe the best solution is for anybody to suggest [is] that non-structural solutions are great if they are based on some kind of structural one. It makes sense metaphorically, if you want a nice façade you need a strong foundation" (EngCons 1: 01/01/08).

Providing another example of a periodised understanding, an agronomist suggests that technical methods have been implemented prematurely, disrupting the ideal order of management. He asks rhetorically:

> "my real question is whether there has been any justification for the structural intervention. That is my question. There has been much more justification for improving the drainage channel, much more for adjusting the cropping patterns, for living with floods, for technological intensification, adaptation, and then only in places where floods are very severe should your last option be to implement structural solutions. So, you have many options. So, with your health, you go to the doctor then to the expert and then to the surgeon. You do not go straight to the surgeon. He is the last one that without the operation you will die" (Res 5: 17/01/08).

Following the 'phases' interpretation, flood management is not necessarily a compromise between technical and social methods. Instead, it is an evolving set of responses to socio-material contexts that shape and are shaped by the changing assemblage of methods, strategies and knowledges.

The sensitivity to both space and time distinguishes the logic exhibited by the experts from the prevailing understanding. Implicit within the academic flood management literature is an assumption of stationarity (Milly et al., 2008). This argument challenges the assumption that the future will resemble the present. This argument is pertinent given social and environmental change in Bangladesh. Leading from this premise is an assumption that, with enough or proper study in the present, the correct knowledge can be uncovered, enabling a lasting solution. In effect, there is an assumption that improved understanding of the human-environment interface will inform sufficiently future management. As opposed to 'uncovering the right understanding' and 'applying the correct plan', the experts exhibit a pliant logic able to adapt as the socio-material contexts change. In terms of the technical and social continuum, the experts suggest an understanding in which the solution slides back and forth between extremes over time. While this is very similar to a more forgiving reading of the prevailing understanding, the sliding understanding responds to the context rather than to an abstract or ideal compromise between technical and social methods. Alternatively, arguing that this reconceptualisation is part of a cyclical pattern, a government engineer states that:

> "the fashion to go after large-scale infrastructure comes and goes, and now it is going south. But I would say that now the World Bank is slowly going back towards large-scale infrastructure projects. It comes in waves" (GovEng 1: 24/01/08).

This argument carries significant implications for the implementation of long-term flood management because the feasibility of methods such as embankments, land-use planning or dams changes with time: there is no universal strategy and further study is unlikely to uncover an approach that can be applied and forgotten, as is assumed within prevailing understanding of flood management (Smith and Ward, 1998; Smith and Petley, 2009). The prevailing understanding focuses on the identification and solution to a problem with the aim of achieving a lasting strategy. Alternatively, the experts seek a logic able to accommodate changing needs and contexts. This is particularly evident within discussions concerning the living with floods concept.

Living with floods

The contextually informed understanding of management is perhaps best understood using the experts' references to the living with floods (LwF) concept. While some of the experts interpret LwF literally, as a welcoming of floods into a home, a majority of the experts defines the concept as an ideal compromise between the competing approaches to flood management. LwF is not only recognition of different contexts, it is also an appreciation for how unsettled, transitory and productive contexts influence knowledge construction. The concept is defined individually, resulting in competing interpretations of the same event or process. It represents a relative understanding that contradicts the absolute form of knowledge idealised within the prevailing understanding. As such, it is less generalisable, less transferable and less easily defined or described, challenging the prevailing understanding, which requires generalisable information, standardisation, rules and protocols to facilitate and conform to decision-making needs. The transience of LwF is summarised by an academic engineer who recognises that management must evolve with context, referring to different periods dominated by different assemblages of people, things and ideas. Overall, LwF replaces the rigid understanding with a logic that

accepts evolving and, according to respondents, incremental stages of management. He explains:

> "I think that concepts like the 'living with floods' can be successful once the people have attained a certain living standard. Only then you can put forward those arguments, but as I said, our standard of living and our poverty are so extremely difficult that we cannot afford the luxury of living with floods" (AcaEng 3: 23/01/08).

Overall, the distinction between LwF and the prevailing logic marks an example of 'lost certitude' – what was described in the historical narrative (Chapter 3) as an evolution towards more complex understandings, which are less defined, secure or transferable. Regarding the competing understandings of LwF, despite their fundamental opposition, they are both enabled by its unsettled nature. In some respects, this is a drawback because, as the responses suggest, it can be appropriated by those seeking to present a definite, extreme, universal, linear or generalisable interpretation. Because it can be shaped to suit different needs, it can be shaped to suit the prevailing understanding, helping to explain its seemingly contradictory duality as ideal compromise and foil to technical management.

CONCLUSIONS

Drawing on Bingham's (1996) and Murdoch's (1997) discussions of binary relations, I challenge the prevailing characterisation of the debate between technical and social management. Furthermore, attempts to move beyond such dichotomous understandings towards a middle-ground compromise have reasserted the dichotomy rather than challenged its applicability. I suggest that a 'phases' conceptualisation is more representative of the expert opinions enabling the debate to build upon the technical versus social dichotomy by challenging the implicit assumptions and potentially-opposing objectives. The debate over technical management is a ramification of the multiple competing understandings of flood management. As opposed to the prevailing understanding, in which knowledges inform management, the experts suggest that social

constructions and, in this instance, physical constructions, are mutually formative and constantly (co)evolving. They are a symptom of the knowledge controversy surrounding flooding in Bangladesh – emerging from the multiple understandings or what I have characterised as differences between the prevailing understanding and the experts' logic. Furthermore, they offer an understanding of management that is sensitive to the changing context, allowing flood management to progress through phases rather than seek a lasting solution. Additionally, the experts suggest that the competing understandings are engaged reflexively with their ramifications. More simply, the different understandings are shaped by their impacts on the socio-physical environment. Following this argument, there is a concurrent, rather than consequential, relationship between flood management as conceived and as practiced. The relationship between context and knowledge is neither linear nor simple. Just as the competing logics are entwined and mutually formative across time and space, so too are those logics with their material products (the technical methods). The materialisations of flood management feed back into flood management knowledge, shaping and shaped by the competition between understandings. Following this argument, technical structures are important actants within the assemblage of flood management. Furthermore, the structures are involved in constructing knowledge (Bingham, 1996; Wynne, 1996; Murdoch, 1997a; Whatmore, 2002) rather than passive or contextual props that enable human understanding. As Kearnes (2003: 149 italics in the original) explains:

> "the significance of matter is defined by the expressive action of matter – its signifying and representative capacity…There must be a valorisation of the ways in which matter *acts* independently of and upon the subject".

The opposing logics (discussed in Chapter 4) are only one aspect of the knowledge controversy. It is equally important to consider the physical emergence of the flood management debate and its central role in shaping the knowledges that (re)frame understanding.

The debate over technical flood management carries important ramifications for Bangladesh's long-term economic and social development. Not only in terms of the specific methods available for mitigating flood impacts, the debate surrounding technical

methods represents a fulcrum on which the wider knowledge controversy hinges. On a more abstract level, the disagreement over methods of management can be rendered to one over the nature of control: whether to change the environment to suit human needs (technical management) or to shape human behaviour to accommodate the natural world (social management). This difference represents a critical embedded assumption that, generally, distinguishes competing understandings of flood management in Bangladesh. In addition, these opposing views situate technical management against human development. While such dichotomous constructions are loathed within academic discussions, the reality in Bangladesh (that of limited resources, schools of opposing understandings and the impetus for action of any sort) suggests that the stock assumption that 'the best management strategy probably lies in the middle' may be of less value than a wholehearted adoption of either approach. Compromises between such opposing views are by nature more pleasing to those involved, but such judgments have little implication on the overall effectiveness of the approach. This situation leads into a discussion of development and the development paradigm of flood and disaster management. Arguably, the prevailing understanding is undergoing a transition to a period in which development assumptions shape the decision-making process, leading to the before-mentioned compromises between technical and social management in order to improve human development.

THE EMERGENCE OF A 'HUMAN DEVELOPMENT UNDERSTANDING'

6

> *Look at [Bangladesh Rural Advancement Committee], they have 3000 employees. They are building a new hotel and conference centre in the city, but for the poor they are giving a few chickens and goats, that will not affect poverty. Spending millions on the university, using that money they could have helped millions of people. They are not working to end poverty, they are trading on poverty, and it has become a business in Bangladesh.*
>
> (Aca 2: 08/12/07)

The prevailing understanding within the hazard and risk literature has undergone several articulations, often described as a transition from engineering, to behavioural, to development paradigms (discussed in Chapter 3). Despite this lineage, within the hazard and risk academic literature, there is disagreement over which methodology is currently dominant, reflecting the paradigmatic assumptions that frame hazard and risk research (White, 1945; Burton and Kates, 1960; White, 1974; Burton et al., 1978; Cuny and Abrams, 1983; Blaikie et al., 1994; Smith and Ward, 1998; Wescoat and White, 2003; Bankoff et al., 2004; Wisner et al., 2004; Adger, 2006; Smith and Petley, 2009). Rather than debate which individual analytical framework or paradigm is dominant, I have interpreted the situation as one of growing complexity in which competing understandings contribute to what Kauffman (1993) labels a 'fitness of landscape' (see Chapter 2). The prevailing logic, then, is not a distinct evolution from one dominant understanding to another, but a growing assortment of competing, relating and co-evolving knowledges that have more or less influence over management. At present, development appears to hold growing influence (Cuny and Abrams, 1983; Tobin and Montz, 1997; Smith and Ward, 1998; Pelling, 2003b; c; Wescoat and White, 2003;

Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009). This emergence reflects the increasing influence of development-oriented assumptions, knowledges, objectives and methods within hazard and risk research following the switch towards proactive social management (Blaikie et al., 1994; Wisner et al., 2004; Adger, 2006; Smith and Petley, 2009). Ideally, an exploration of how managers and experts understand and characterise the establishment of this understanding may help enlighten the knowledge controversy that continues to shape flood management in Bangladesh.

Within the academic flood management literature, the current period is characterised as shaped by human development (Cuny and Abrams, 1983; Blaikie et al., 1994; Tobin and Montz, 1997; Smith and Ward, 1998; Pelling, 2003b; c; Wisner et al., 2004; Adger, 2006; Collins, 2009; Smith and Petley, 2009). The following chapter explores how the experts interpret, support and criticise this framework in relation to flooding, flood management and vulnerability in Bangladesh. Within the preceding chapters, I constructed a comparative framework, exploring the tension between the expert understandings and experiences with the prevailing or entrenched understanding within the academic hazard and risk literature. This discussion outlines their perceptions and characterisations of that prevailing understanding in the context of development. To contextualise the expert opinions, the chapter briefly explains the development paradigm of flood management. In addition, it outlines the distinction between 'Development' as a form of intervention that is practiced in the developing world and 'development' as a set of global values and knowledges informing 'Development' (Hart, 2001). Emerging from the expert perceptions is an understanding in which the 'development understanding of flood management' is characterised as a foreign construct and as a foreign imposition. The experts are critical of an understanding that privileges development theory, objectives and methods, arguing that such knowledge neglects the disaster-prone context of Bangladesh.

The development paradigm within environmental hazards research

Development is a nebulous term with countless contested definitions. Adding to its ambiguity, within the environmental risk and hazards field, development is also used to identify a paradigm of research and management (Burton and Kates, 1960; White, 1974; Cuny and Abrams, 1983; Smith and Ward, 1998; Smith, 2004; Smith and Petley, 2009). The development understanding, then, is an assemblage of people, assumptions, knowledges and practices used to interpret and manage environmental hazards, so named for its perceived association with international development. It emerged in response to the application of the behavioural understanding in the developing world (see Chapter 3) and is shaped by criticisms that mirror debates within the development field (Pieterse, 1998; Schuurman, 2000; Hart, 2001; Nustad, 2001; Bass and Steele, 2007). For example its advocates accuse those who perpetuate the prevailing understanding of promoting a western construct, of idealising the transfer of technological quick-fixes from advanced to developing nations, for emphasising individual choice at the expense of wider global structural influences and for disregarding indigenous knowledge and context (Blaikie et al., 1994; Smith and Ward, 1998; Wescoat and White, 2003; Smith, 2004; Wisner et al., 2004; Smith and Petley, 2009). The development understanding, then, originated as a critique of the prevailing understanding of flood and disaster management. This criticism was founded on a recognition that the behavioural understanding privileged knowledge rooted in the developed world and neglected the unique experiences of individuals in the developing world (Smith, 2004; Wisner et al., 2004; Smith and Petley, 2009). By emphasising the marginalised, the development understanding orients research and management towards what Blaikie et al. (1994) and Wisner et al. (2004) define as 'human vulnerability'. As Smith and Petley (2009: 7) explain, the development paradigm focuses "attention on the needs of the most disadvantaged members of society". Most recently, the human development understanding is thought to be in the process of replacing the behavioural-led understanding. This reorientation towards human experience and perception is critical for understanding flood management in Bangladesh and for contextualising the experts' perceptions.

Development: big 'D' versus little 'd'

Despite criticisms and accusations that development practices are ignorant of developing world knowledge, culture and values, the field of development studies is purposefully and reflexively engaged with its assumptions, impacts, knowledges and practices (Elkan, 1995; Escobar, 1995; Blaikie, 2000; Curry, 2001; Hart, 2001; Hill, 2003; Briggs and Sharp, 2004; Coles and Wallace, 2005; Gasper and Truong, 2005). In this sense, development, particularly analyses informed by post-development and postcolonialism (Escobar, 1995; McEwan, 2009), are invaluable means of engaging with the development-minded assumptions that, it is argued increasingly (Smith and Ward, 1998; Pelling, 2003b; Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009), shape the implementation and conceptualisation of hazard and risk theory and management. The distinction between development as practice and development theory is elaborated by Hart (2001), who differentiates 'Development' as the intentional interventions in the developing world and 'development' as an immanent, capitalist process that influences the knowledges, practices and values that inform 'Development'. Drawing upon Gore (2000), this understanding is situated within a shift from "explanations and evaluations of Development… cast in the national frame of reference, and informed by an implicit or explicit historicism" to a partially-globalised ahistorical "normative economic internationalism with a methodologically nationalist form of explanation" (Hart, 2001: 651). More simply, the normative aims and agendas that inform Development are globally-constructed and imposed within a development-shaped system. Additionally, assessments and explanations for the successes or failures of Development focus on the national or local scale factors. This tension between Development as developed world interventionism and development as the capitalist-informed basis of the system in which flood managers operate, emerges continually within the discussions with flood management experts. However, it is not always evident to which D/development the experts refer. Despite this hindrance, it is important to recognise that the two concepts are entwined and that 'flood management influenced by D/development' or what is labelled the 'development understanding' is the focus of this analysis.

D/development has undergone significant change since the Second World War. While originally associated with the expansion of post-war reconstruction to underdeveloped nations, it was consolidated as part of cold-war competition between US and Russian spheres of influence (Schuurman, 2000). In both its capitalist and communist forms, between 1949 and the 1980s, D/development aimed to modernise underdeveloped nations through the transfer of governance, technology and knowledge. In both instances, the developed nation was characterised as superior, providing the model for underdeveloped nations to emulate. Modernisation-based Development is criticised for its misapplication of theory and technology, adventurism and self-serving economic relations (Escobar, 1995; Sen, 1999; Schuurman, 2000). As part of modernisation, structuralist interventions focused on the institutional conditions that inhibited the type of growth valued in the developed world. Critical of modernisation and structuralist efforts, dependency theory was used to challenge the domination and self-interest that accompanied D/development (Escobar, 1995; Blaikie, 2000; Blaikie et al., 2002). Arguing that D/development perpetuated unequal relations, dependency theory characterised Development interventions as corruptive endeavours that facilitated exploitative colonial-like partnerships (Pieterse, 1998; 2000; Schuurman, 2000; Roberts, 2004; Mitlin et al., 2007).

By the 1980s, D/development had undergone a succession of internal and external criticisms, many challenging the nature of western involvement in the developing world, including research. Labelled the 'impasse' because of the failure of both modernisation and leftist alternatives to provide solutions to global inequality and poverty, critics argued that Development had failed to improve the lives of developing world citizens, essentialised and assumed a homogenous developing world and was over-reliant on the nation state as a means of understanding a globalised world (Blaikie, 2000; Schuurman, 2000; Nustad, 2001). Postmodern examinations of the implicit, unexamined and unrecognised power embedded within development theory, language and practice continues to sustain debates over the nature, aims and methods of D/development. Broadly, postdevelopment has emerged as a means of integrating the criticisms of D/development, including its normative aims, Eurocentrism and disregard for local

knowledge and practice. Postdevelopment focuses on the notion of progress (Pieterse, 1998; Blaikie, 2000; Pieterse, 2000; Schuurman, 2000; Hart, 2001). In particular, it explores the different meanings of progress, who is empowered or marginalised and the methods through which progress is attained (Blaikie, 2000; Hart, 2001; Ziai, 2004; 2009). While postdevelopment is by no means accepted universally, it encourages a critical and reflexive consideration for both Development and development (Pieterse, 2000; Hart, 2001; Ziai, 2004; Sidaway, 2007). As Hart (2001: 654) explains, postdevelopment authors are:

> "united by antagonism to Development as a normalising, deeply destructive discursive formation emanating from 'the west'; by firm rejection of any sort of reformist tendencies; and by faith in new social movements or what Esteva and Prakash (1998) call 'grassroots postmodernism'".

Despite postmodern interpretations of development, in response to the perceived failure of normative and modernisation development, neoliberal policy has become a primary form of government-sponsored Development (Schuurman, 2000). Neoliberalism emphasises market and trade reforms, aiming to improve access and competition while integrating international trade to increase mutual dependency. Its emphasis on the economy and indifference towards individuals, specifically the disenfranchised, is founded on the belief that direct intervention is rarely successful on the national-scale and that a growing economy will result in opportunities trickling-down to all citizens. The entrenchment of neoliberal policies within government-sponsored Development has prompted consideration of D/development as a reassertion of colonial power (McEwan, 2001; Briggs and Sharp, 2004; McEwan, 2009). Sharing many similarities with postdevelopment, postcolonial theory enables analysis of the overlap between D/development, power and knowledge. Postcolonialism aims to 'problematise the way the world is understood' in order to expose the Euro-American worldview, culture and values embedded within dominant discourses, including D/development (McEwan, 2001). This interpretation of postcolonialism focuses on the knowledges that sustain D/development, arguing that the developed world's domination of policy and practice both explicitly and implicitly drive a normative agenda that disregards alternate knowledges, values or understandings. The focus on knowledge is premised on the link

between knowledge and power (Said, 1978; Foucault, 1981; 1986). Specifically, knowledge-power exposes the developed world's socially-constructed understandings of the developing world. More directly, postcolonial critics argue that prevailing D/development amounts to geographical imaginations of the developing world, which are founded on biased knowledge and historical caricatures rooted in colonial conquest (Said, 1978; Gregory, 1994a).

Without doubt, human development is a contested concept, applied with multiple purposes following multiple meanings. Its use in hazard and risk research further complicates its usage. Simultaneously, those involved in development studies are more reflexive than is common within hazard and risk research. In particular, the post-development and post-colonial criticisms of development provide opportunities to situate the differences between this version of the prevailing understanding and the views expressed by the experts.

EXPERT PERCEPTIONS OF DEVELOPMENT RELATIVE TO FLOOD MANAGEMENT

Changing priorities: a shift towards development

Among the experts, water is recognised as a critical issue that links flood management with development. As an academic engineer explains:

> "all of the development activities, in all countries, including Bangladesh, are directly or indirectly related to water. So unless you manage it, you won't have your desired development goals" (AcaEng 2: 15/12/07).

The head of a private university shares this perspective, stating that:

> "flood management is part of total development. A very important component of development. It has such an important impact on agriculture and economic growth" (Aca 2: 08/12/07).

Expanding on these claims, the head of an NGO explains that the connection between flooding and development, at present, is absent. He states that "the realisation that disaster and development is intrinsically connected, I think that understanding is, at least at some level, is yet to come" (NGO 5: 13/01/08). For the experts, development is

associated with social flood management, often in opposition to technical measures (Chapter 5). For example, the director of a government agency states that:

> "our priority has now been changed. We will have to remember, in the name of development, we cannot make more and more structural interventions. Not just that, we shall have to manage our people. So, we shall have to focus our attention on to our people, focus on the basic needs so that they can understand the problem, so that they can cope with the changing world" (Gov 3: 16/01/08).

The experts situate the shift from environmental exposure to social resilience, situating hazards within a wider context of development. A social scientist explains his interpretation of this situation, emphasising that education and health are the two ideal priorities for flood management and disaster mitigation. He explains that his understanding:

> "is related to human resource development. If you can give education and you can ensure health facilities for all the people. If people are healthy and educated, they can find their way" (Aca 1: 08/12/07).

Supporting this understanding, an academic engineer explains that social engineering will succeed where technical engineering has failed "by raising the capabilities and coping capacity of the people. And that, ultimately, allows you to reach your development goals on a long-term" (AcaEng 2: 15/12/07). An NGO manager provides another perspective. Contrasting past and present disaster management at his institution, he explains that:

> "we have [now] been organising institution building. Previously it was the development section who used to have this social organisation, this social mobilisation. But our disaster group now understands that it must also be involved" (NGO 5: 13/01/08).

The expert goes on to distinguish between developed and developing world interpretations of hazards, explaining that:

> "disaster management, to me, there has not been much attention, unless for this climate issue. There has been Hurricane Rita and floods in America… while the poor countries, that is the Asian countries and sufferers, have been crying for this for a long time… over here they [donors] seem to be coming gradually to the reality. Of course, with their own emphasis on the type, like CO_2" (NGO 5: 13/01/08).

The director of a government agency summarises the shift in priorities towards development by explaining that:

> "nowadays, actually, our country's carrying capacity is now overburdened, you see, with population and all these things. So, traditional flood management is not the immediate concern of the government and policy makers, from resource allocation point of view. It is now, very very, priority is electricity, education, social issues, things like that" (Gov 3: 16/01/08).

The priority on poverty and marginalised segments of the population

Reflecting the shift towards a development-informed understanding of flooding, flood management and vulnerability, there is wide agreement among the experts that poverty alleviation is the top priority. For example, an academic engineer identifies poverty as the core element of flood management, stating that:

> "Bangladesh is so poor and poverty levels are so high that the basic necessities are so dominant. So the environment is the least of their concerns" (AcaEng 3: 23/01/08).

The director of a government ministry shares this understanding, characterising government and donor priorities as "for the benefit of the poor and jobless people" (Gov 6: 05/02/08) while a UN manager explains that:

> "I think we can all agree that if you want to do anything, you have to do something about poverty. Yeah, so it is no good having little isolated community initiatives without some overarching national programme to reduce poverty" (Inter 5: 30/01/08).

The superseding importance of poverty is summarised by the head of a research organisation. He explains that:

> "the World Bank is coming up with a huge project again. They focus on poverty alleviation and development of enterprises. Empowerment based on the Millennium Goals, everybody is thinking of empowering people" (AcaNGO 1: 05/02/08).

A social scientist shares this understanding, declaring that:

> "the government's agenda is the governance issue. By governance, I mean, all theses things: democracy, and transparency, and legislation, empowerment of the people, women and poor, and the development of leadership" (Aca 1: 08/12/07).

Finally, a donor also associates flood management with a development-informed understanding, explaining that no matter the field or objective, every funding initiative they support must be oriented towards poverty alleviation. He states that:

> "poverty eradication is our top priority, so all of our programmes have this as the goal. Also, development is about poverty eradication. This is what this is, following the MDGs, this is what we are about" (Don 1: 16/01/08).

Building upon the poverty emphasis, and recalling the transitional vulnerability argument (Chapter 4), the experts orient flood management initiatives towards the indigent, implicitly directing national management to compensate those marginalised by the system. For example, the director of a government agency explains that women in Bangladesh are the most vulnerable group. He states that "in our country, the females are very unfortunate, especially in the lower classes" (Gov 3: 16/01/08). The head of a private university identifies an alternate group, explaining that fishermen are most vulnerable because of exclusion. He states that:

> "in rural areas, in particularly the fishermen and the charlands, these are the most vulnerable and they are the people that need the help but do not have access" (Aca 2: 08/12/07).

A UN representative identifies children. He explains that they are the most vulnerable segment of the population because of their physical, economic and social attributes, emphasising their lack of options or services. He states that:

> "children are least likely to be able to cope with what is happening. In the most extreme scenario, they are the least likely to be able to swim, they are more prone to drowning and that is what we see happen. They are not in a position where they can move to another area, where they can go and get a different job, they are not able to change their circumstances. So they are, arguably, most vulnerable" (Inter 5: 30/01/08).

Helping to situate the difficulties associated with focus on the vulnerable, an NGO manager outlines how his organisation's past emphasis on women has been replaced by emphasis on indigenous Bangladeshis, which he explains represent one or two percent of the population. He states that:

> "in any analysis of poverty, the most marginalised people are the poor. So in Bangladesh, women, even though 50% of them are socially and structurally behind, we found that the indigenous people, even though they are small in number, they are the most vulnerable people" (NGO 5: 13/01/08).

In each case, the experts understand the shifting priorities of flood management as a move towards human development, oriented towards the most marginalised and aiming to reduce vulnerability by mitigating the impacts of poverty.

Donor priorities and flood management in Bangladesh

The experts associate the shift towards a development-guided understanding of flood management using comparison with foreign understandings, aims and objectives, which have a direct impact on flood management in Bangladesh. A government planner describes the evolving relationship between the Bangladeshi government and international donors by explaining that:

> "we still speak to [donors] individually but they are not interested in bilateral projects anymore, but are still willing to be a part of multilateral projects. The group of donors will collect their funds and do something. They feel more comfortable when the World Bank or the ADB are leading the negotiations" (Gov 2: 15/01/08).

The director of a research institute provides an alternate interpretation of shifting donor priorities. He states that:

> "the donor partners, having their own agendas, do not like to share their resources with others… they come up with a lot of enquiries and waste a lot of time. All during that time people are suffering and people remain at the same level" (Cons 1: 26/01/08).

The range of donor priorities is summarised by the manager of a research institute. When asked about donor priorities concerning flooding and disasters, he suggests that

> "DFID is the environment, and by that they mean human adaptation, livelihood affected by disaster. Poverty alleviation is one of the major issues: to eliminate poverty. What causes poverty? Is it disaster? Because all of Bangladesh is a disaster-prone area, flood, drought, cyclone, coastal surge, saline intrusion.
>
> BC: So DFID is poverty and the environment. Can you tell me another?
>
> CIDA is also environment, poverty and irrigation.
>
> BC: The Dutch?
>
> They focus on the water sector, a water priority and agriculture.
>
> BC: The Japanese?
>
> The Japanese, they also have priority in investment enterprises with objectives surrounding poverty alleviation. All of them focus on developing people's livelihoods. Like about 30% of our people live below the poverty line " (AcaNGO 1: 05/02/08).

Responding to such characterisations, the head of a donor agency explains that prescriptive, top-down methods are no longer acceptable. He states that:

> "the method of the [redacted] government changed from one where the developed world nation would come with very advanced technologies to do some sort of work for Bangladesh, to the point of actually having [our] engineers designing and supervising the projects, to one where the Bangladeshi government was put in charge" (Don 3: 22/01/08).

In response to a question about 'how donors identify priorities' another donor explains:

> "we have a criteria for how we fund projects, we call them 'cross-cutting issues'. We have to always take them into consideration when we prepare a project, more or less. We have a policy where we suggest some intervention. In preparing a project in the time of identification; one aspect is programming, in this time of formulation we make an identification of the important issues. For us these are environment, gender, governance, for these we have some guidelines to follow. How much, well we have to be professional. Sometimes we have to [pause] so we have to include all of these issues into all of our projects. That is about all I can say on this issue" (Don 1: 16/01/08).

The experts communicate a wide range of understandings concerning the impacts of changing donor priorities and involvement in flood management in Bangladesh. For example, the head of a private university states that "the donors have a tendency to dictate the government policy in a way. Also, other international groups do the same" (Aca 2: 08/12/07). An equally certain position is evident within the following excerpt with the head of flood management at a research institute:

> "BC: You mentioned the donors. I am very interested in them, could you tell me some of your thoughts on the donors, their involvement, their role, if there is one?
>
> What we see is that the money that is coming, the funding, they dictate the terms completely.
>
> BC: Completely?
>
> Completely. Whatever they think they want to do, they will fund. Whatever the [Bangladeshi] government wants, they do not care. That is not how they decide what to fund" (EngCons 3: 21/01/08).

Alternatively, the head of water planning at a research institute states that with Agenda 21 and the emergence of integrated water management in the 1990s, that:

> "donors' policies started changing because, probably, because of the international movements. That also, those are not actually the main reason for the change of mindset in Bangladesh. The global changes, all those changes, were coming to us like prescriptions from donors [and] foreign institutions" (Cons Two: 10/01/08).

The experts use their perceptions of developed world values and priorities to colour their understandings of the influence of development on flood management. Several respondents indicate that the conditions attached to funding were unrealistic given the Bangladeshi context. The head of a donor organisation addresses the imposition of donors' conditions. The following excerpt shows that the donor is aware and struggles with the issue:

> "BC: Can I be a little controversial?
>
> [nods]
>
> BC: Europe has a long history of coming to the developing world and telling people how to behave. Do you see any similarities with what you do now?
>
> Sometimes, yes, I feel that. It is not always easy to work in the government. Maybe not really colonialist, but yes there is a small element of this. We do try to dictate our principles; it is difficult to work on such projects sometimes. So, yes. This is one of those issues" (Don 1: 16/01/08).

Summarising the evolution of donor priorities, the head of a government agency states that:

> "they are not only concerned with the engineering, as they were in the past, but they also give a lot of thought to the poverty projects with gender strategy projects and they are very concerned with the environment. With the environmental impact assessment, the social impact assessment as well" (Gov 6: 05/02/08).

The climate change 'distraction'

The experts repeatedly invoke climate change to exemplify their explanations of the relationship between foreign donors and flooding, flood management and vulnerability in Bangladesh. Without undermining the importance of climate change, a number of experts argue that they are forced to engage with climate change despite its relative unimportance to Bangladesh. The director of a government agency explains that his agency has had to alter proposals in order to appeal to this priority. He states that:

> "the issues of most importance is the Millennium Goals and flooding. The climate change issue is not of importance to Bangladesh, or if it is, it is from the point of view of the victim because we are at the end of a delta river system. So the climate change issue, and in fact, any of the studies that are done here on this issue are driven by the donors. Our interest for working in that field is so that we can get some of the benefits but we cannot protect

> from climate change. It is a problem of the developed world" (Gov 2: 15/01/08).

This statement links foreign interests and priorities with environmental management in Bangladesh, though there is an undercurrent of dissention suggesting that this rephrasing may be semantic in nature. The head of an NGO provides an example of differing priorities and understanding, explaining that it is the impacts that are important, not the causes. He states that:

> "climate change, of course it's a big issue. The saleable rice, of course is a big issue. But for us, the ground reality issue is how the poor farmer will grow his or her crop with the minimum water available. That is for us the development issue" (NGO 5: 13/01/08).

The head of planning at a government agency shares this perspective. With reference to foreign donors and NGOs in Bangladesh, he argues that:

> "they are getting funds from some international agencies and different countries. But they also get directions from their agencies, like the environment and climate change. In our country, these are a problem but they are not 'the problem'. We have to face how to grow more food, how to educate our people, how to create jobs for the people, these are our challenges" (Gov 2: 15/01/08).

Within the discussions, there is a sentiment that the developed world is fickle, flitting between issues without appreciation for the problems facing Bangladesh. For example, a professor of engineering, in response to a question concerning donors, states that:

> "the biggest worry is that after the disaster happens, after a few months, people forget, and the initiatives are not followed through. Like for the 1991 cyclone master plan. Obviously, there is resource constraint, there are needs in other areas and that is where the money for more 'pressing' issues will come from. The international agencies come in the immediate aftermath but are quickly called off to the next disaster" (AcaEng 3: 23/01/08).

The director of an NGO shares this view. With reference to the inconsistency of donors, he argues that:

> "my experience, what I see, is that they do not consider the long-term impacts of their investment. For example, building a bridge may create a disaster in 15 or 20 years and construction of roads in many places my cause water logging or increase flood risk. Those sort of long-term perspectives are not being given consideration by donors" (NGO 1: 30/01/08).

The emergence of foreign knowledge-power: NGOs and micro-credit

The preceding sections showed that the experts characterise the prevailing understanding of flood management as shaped by development assumptions, knowledge and practices. In addition, the experts suggest that this form of understanding and management is prone to foreign influence and that its application is shaped by foreign interests. For many of the experts, the imposition of this new form of the prevailing knowledge-practice is accomplished through NGOs and micro-credit. A social scientist explains the prominent role and responsibilities of NGOs, with particular emphasis concerning their effectiveness and relationship with donors. He states that:

> "the NGOs, what role should they play? You know that in our country much of the funding from the developed world comes through NGOs. Development functions are done mainly with the donor agency's funds. But unfortunately the money is funded through NGOs and government channels and this money in many cases, I should not say all, does not reach the poor people that the money was meant for" (Aca 1: 08/12/07).

Given this context, many of the experts identify NGOs as the agents of a foreign understanding. Despite their origins in opposition to government and hegemonic forms of international development, the experts characterise present NGO operations as an arm of foreign-guided development. Contrasting this present state with the historic emergence of NGOs, the head of an NGO explains that they had no choice but to detach themselves from the abuses and patronage of the government system but that the relationship is changing. He states that:

> "[NGOs] needed to take on certain roles, because of government negligence as partners. So, that relationship still is not smooth. It's only very recently, again it is externally pushed, to change the mindset of the bureaucracy and government mechanism" (NGO 5: 13/01/08).

While the majority of the experts express a positive view of NGOs, they also list worrisome implications about their relationship with donors, government and the indigent. The NGO managers were aware of and reflexive concerning such criticisms, particularly the dangerous precedents of foreign influence and local dependence. In response to a follow-up question about NGO patronage, the manager states that:

> "we have experienced this and why it happens, let me tell you. Even at [NGO name] we had to face this, and we are still facing this because the understanding of the whole vulnerability, it is sorry to say, with the NGOs probably wrongly created the notion of clientele" (NGO 5: 13/01/08).

A different NGO manager, reflecting on this situation, explains that it is the size of the organisation that dictates the problems, suggesting that small local organisations are close enough to the field to ensure proper management, not being involved with influential donors. He argues that:

> "when you are big there are lots of problems. Small can be manageable but big have so many different problems: local problems, international pressure, big brothers, all this makes it very difficult" (NGO 1: 30/01/08).

Summarising the troubles that development efforts can cause, the head of an NGO states:

> "I can say that the conclusion is that they are not the victims, we are the victims. If we provide them with the proper timing, ideas, opportunities, then they will look after themselves, but if you do not, then they will rely on the NGO and it will be a difficult situation" (NGO 5: 13/01/08).

The experts suggest that NGOs are undergoing a fundamental reconceptualisation in response to the success and support for micro-credit, both from users and from donors. Referring to their emergence following the war for independence (1971), the head of an NGO explains that:

> "if you go through the history and literature of the NGOs at that time, you'll find the NGOs were much more busy with conceptualisation and these things, no micro-credit, no 'Taka talk'[38]. Nowadays if you go around with an NGO on your shirt, people will say 'give us a loan' and then forget, 'we know how to do it'" (NGO 5: 13/01/08).

The establishment and dominance of micro-credit is supported by the head of a UN agency when he states that "micro-credit has taken over and that has been the rage. So obviously donors have grabbed onto that" (Inter 1: 22/01/08). A social scientist provides a more detailed interpretation of its impact on the rural population, particularly for those excluded from the system. He states that:

> "these people, the poor people, they did not have any access to the credit institutions in the past. So, these needy people used to take loans from neighbours or loan people, which is much more vulnerable. Also, people would simply have never considered getting credit. Micro-credit has broken this old system, almost entirely" (Aca 2: 08/12/07).

[38] Taka talk is a mobile phone initiative from the Grameen Bank organization. It aims to connect poor and rural communities to improve their knowledge, particularly concerning commodity prices at market.

Despite these views, this expert does recognise the problems caused by micro-credit, particularly the systematic abuse of the vulnerable. He states that "the problem is that the amount of interest you impose is still very high. Much higher than on a million taka loan" (Aca 2: 08/12/07). An NGO manager also acknowledges the problems associated with micro-credit. He is concerned with the potential abuses of the system, stating that "in the name of micro-credit, some of the NGO leaders and many NGOs, are building up their own and things like that" and goes on to highlight the ongoing friction between government and non-governmental actants, stating that "we belong to this land, and we are not your competitors, let us work together. As partners [with government]" (NGO 5: 13/01/08).

The experts associate micro-credit with control of the vulnerable and as a tool for social engineering. Many of the experts are critical of micro-credit and development for its inability to overcome the poverty cycle; in relation to this belief, the experts liken credit to a release valve for the frustrations of the indigent. The head of an NGO is representative of this view, stating that:

> "personally, I do not believe that micro-credit can create a better impact on our economy. Rather, it is a method to stop our people from making some sort of big noise. That way, they will have just enough food. They will take a loan and then pay it off and take another one but it is not a good sort of life, it is not a solution" (NGO 1: 30/01/08).

A social scientist, referring to Muhammad Yunus's 'Banker to the Poor' thesis, summarises this understanding while emphasising the economic rationale underpinning the system. He states that:

> "so [Yunus] has developed the capitalist system but if he really wants to help the people he needs to focus on breaking the poverty cycle… You have to reduce the interest and increase the amount because the amount you are giving can help him survive, but will not improve. Now, you can say, they are improving themselves a slight amount but not escaping poverty" (Aca 1: 08/12/07).

A less forgiving interpretation is shared by a UN representative working on hazard and risk in the context of development. He states that "I am a big critic of the micro-credit movement. So when they say that it is an empowering, I say it is a disempowering tool" (Inter 4: 29/01/08). His colleague adds that the disaster-prone context is forgotten,

stating that "it is empowering if nothing goes wrong" (Inter Two: 29/01/08). Returning to who is vulnerable, the experts are critical of the application of micro-credit because it does not reach the most marginalised. For example, the head of planning at a government agency states that NGOs are beneficial, but that:

> "their initiatives are not countrywide. So, they work with just some people who benefit but not for everyone… they are supporting something, obviously they are doing good work, but their initiatives are often not countrywide. BRAC is doing something to support new initiatives but their efforts are not for the whole country" (Gov 2: 15/01/08).

The head of a private university shares this perspective. He explains that systemic functions exclude the vulnerable and that "the ultra poor are still not included in this system. The way that it operates, the groupings that keep some groups, like fishermen, excluded" (Aca 2: 08/12/07). This perception is expanded upon by a social scientist. He states that:

> "the poor are the most vulnerable section of the people because they have very little bargaining capacity, purchasing capacity. They cannot store anything in order to bargain" (Aca 1: 08/12/07).

He goes on to explain that:

> "even Grameen and BRAC and the other NGOs, they still don't provide loans to the poorest. They [the poor] are still outside the system. These are the two critiques. The poor are surviving but not escaping the [poverty] cycle" (Aca 1: 08/12/07).

THEMES EMERGING FROM THE EXPERT PERCEPTIONS OF DEVELOPMENT

Development-influenced flood management: an application of foreign power

Postcolonial and postdevelopment authors emphasise the cultural hegemony that can accompany development (Hart, 2001; McEwan, 2001). As one of the experts succinctly states, "when they [donors] send money they also send the cultural values" (Aca 4: 02/01/08). The experts perceive the developed world as having disproportionate influence over D/development and, as a result, over flood management. The head of an NGO provides a representative example of this understanding. He states that:

> "for a project of 20 million pounds, maybe 5 million pounds is being paid to international consultants. This is a big portion of money that comes back to their consultants. These are short-term consultants. That is, they come in

> business class, have two weeks work and then leave. And then the donors send their staff to be national level advisors in this country. So they send their people who do not know the society or culture but they are very powerful" (NGO 1: 30/01/08).

This relationship is labelled abusive by a social scientist who states that "the development agencies, they are using Bangladesh as a research country" (Aca 1: 08/12/07) while the head of a private university declares that:

> "donors cut out the local people. They make their decisions sitting in some office in Dhaka…they have views, there are a lot of people with ideas, but they do not understand the issues" (Aca 2: 08/12/07).

Expressing exasperation with this unequal relationship, a researcher working for an NGO/advocacy organisation explains that, additionally, the foreign influence does not reflect the scale of the contribution. She rhetorically asks:

> "why should we care what the World Bank thinks or is loaning us when Bangladesh is contributing the vast majority of the money. Almost 70-80% of our [Annual Development Programme] is funded by our people, but they have a very little voice…the West does not know the problem and the policy makers are happy with the World Bank cheques" (AcaNGO 3: 03/01/08).

A government official also declares that the relationship between donors and Bangladesh is unjust, explaining that:

> "they tell us which consultants to hire and how to do it. But this is the only way for us to get the money, we have to obey. We need the money, we need the development. That is why we have to follow their rules" (Gov 6: 05/02/08).

In describing and criticising development-influenced flood and disaster management, the experts characterise development knowledge as less applicable and shaped by dubious interests. When asked about donors, the experts suggest that they replace the Bangladeshi context with assumptions and understandings rooted in the developed world. With reference to flood management, a social scientist explains the scope of this influence, stating that "most of our policy makers have had their schooling in the west, and they have a western way of looking at embankments" (Aca 4: 02/01/08). An academic engineer lends further support to this understanding, stating that:

> "I will blame the Dutch and American governments, they did not know the environment of the country. They don't know the people of the country. Their plans explain the problems in their countries" (AcaEng 1: 15/12/07).

The head of a research/advocacy organisation provides a supporting example. He outlines the debate over technical management and explains that the criticisms are rooted in the developed world and applied to Bangladesh. He states that:

> "this is the wrong interpretation or understanding of criticisms of embankments in the Western world. That has been transferred and applied over here. Furthermore, it is done by people who do not understand the physicality of the problem or the factors involved" (Res 4: 15/01/08).

Revisiting the context-dependent understanding of the debate over technical and social management (see Chapter 5), the experts associate development knowledge with foreign power in order to characterise the prevailing understanding as decontextualised. The experts argue repeatedly that development fails to accommodate the unique socio-material context of Bangladesh, with particular emphasis on its disaster-prone nature. Overall, by disregarding the context, shaping the understanding and controlling the funding, the experts associate development-influenced flood management with a foreign imposed development logic. This logic, according the experts, is a developed world understanding, re-raising characterisations of flood management as an application of an unequal power relationship. Regardless of whether the developed world has appropriated the development paradigm or if the development logic is simply a reincarnation of developed world power, the experts suggest the basis of the prevailing understanding currently lies outside of Bangladesh.

Prioritising the indigent and vulnerable at the expense of wider considerations

A founding principle of development is to improve the lives of the most vulnerable members of society (Sen, 1999; Schuurman, 2000; Hill, 2003; Radcliffe, 2004; McKinnon, 2006). This presumption orients Development (as practiced) toward those who are marginalised by the majority. While the potential hegemony of development is recognised (Escobar, 1995; Li, 1999; Nustad, 2001; Hill, 2003; Bankoff et al., 2004), the emphasis on the most vulnerable appears to be accepted within both the development and hazard and risk academic literatures. Some of the experts challenge this assumption, noting that, in the Bangladeshi context, vulnerability is not limited to the indigent (see Chapter 4). There is no doubt that some people are more vulnerable and that they are

predominantly poor, structurally disempowered and with few options. But in a nation with a yearly potential for 80% flood coverage, a population density of roughly 1000/km^2 and extremely limited resources, it is worth considering whether emphasis on the indigent is the most effective assumption to guide flood management. The head of a UN agency recounts a discussion with one of his economist colleagues to elaborate this context. He states that:

> "I was told by a development economist, he said 'unfortunately at the end of the day, there will always be a poor segment of the population, in every country all over the world, including the States'. You know, relative indicators. You talk about the poverty here. There is always going to be a disenfranchised struggling poor class, that is the way things are, unfortunately" (Inter 1: 22/01/08).

The head of a private university relates this understanding to the assumptions that guide donors, explaining that:

> "they put more emphasis on poverty alleviation but they fail to look at the causes of poverty such as flooding. Now they focus on the small-scale and it is very short-term thinking" (Aca 2: 08/12/07).

The development logic is oriented towards the interests of the marginalised. This understanding is logical when the marginal are a minority, but in cases where this is not the case, such a premise deserves critical reflection, particularly in contexts where disasters are persistent.

The experts suggest that the development logic orients flood management towards the indigent. This trend is evident within their criticisms of past methods for their negative impacts on the indigent, despite benefits at other scales and in other contexts. A social scientist exhibits this tendency, privileging the negative impacts on the indigent to criticise national policy. He states that:

> "when we have an embankment we say 'this embankment will save 30,000 acres of land from flood vulnerability' but there are lands and people on the other side of the embankments. And you are not considering them. In one place they are safe, in another they are more vulnerable" (Aca 3: 28/12/07).[39]

[39] I witnessed this type of argument at the first annual Foreign Nationals Conference (28/12/07). There, a proposal to protect Dhaka with a 'ring' embankment was criticised

One interpretation of this argument implies that development cannot negatively affect the indigent or the vulnerable regardless of the benefits accrued to the majority. An academic engineer presents an example of this criticism of past, exposure-oriented, management. Despite acknowledging that the strategy resulted in a '30% to 40% increase in rice production and averted famine', he judges it a failure because of its impacts on the indigent. He states that:

> "because the flood plains are surrounded, it has consequences. Floods are more common and higher because there is a reduced area for storage, mainly the water area rises. Basically, the risk was transferred. That is what happened. The flood risk has not been reduced it has just been transferred because of the encroachment or embankments or polders, [the] risk has been shifted to other areas. Through that process, the poorest of the people have suffered. They live in those areas that are not protected" (AcaEng 1: 15/12/07).

Bangladesh is a democracy[40] and its government is a representative for its people and their interests. Competing opinions concerning who is the most vulnerable prioritise a minority of the population despite the vulnerability of the majority. This understanding is not suited to the Bangladeshi context. As an NGO director explains, in Bangladesh "it's not them and we. It's all we. Society needs to accept this reality and try to build protection for everyone" (AcaNGO 2: 03/01/08). The population density and disaster potential suggests that emphasis on the indigent orients management towards minority groups – changing with each person's opinion – rather than to where it will have the greatest benefit.[41] The near-universal emphasis on the indigent and the vulnerable within the prevailing understanding raises questions over the assumptions driving development and this applicability for flood and disaster management.

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for the potential negative impacts on the local farmers. In this case, a city of 16 million was being shaped by the interests of a small number of potential victims.

[40] Even during the period of the caretaker government, the goal was to facilitate and strengthen the democratic system in Bangladesh.

[41] 'Greatest benefit' can be measured in any way, as economic, as reduced vulnerability or as the number of people affected.

The 'development' of a debt-society

The experts associate Development in Bangladesh with non-governmental organisations and the application of micro-credit. Collectively, they are critical of the negative ramifications of micro-credit, in conjunction with a disaster-prone context. The head of a research institute provides a representative example of this perspective, stating that:

> "the problem is that they [the indigent] are getting loans and are investing. If their investment is lost in a flood, how are they in a position to repay the money? They do not have the resources to do that. The question is, with the micro-credit, we have to ensure that the investments are safe. Micro-credit is popular, it should be and it should continue. But I would like to see that micro-credit should also include a safety net so that when people invest they do not lose everything by a sudden flood, or cyclone or drought" (Cons 1: 26/01/08).

This perception is common amongst the experts. The experts interpret micro-credit as sparking development by increasing assets and enabling livelihood initiatives such as vegetable gardens, dairy, small shops or fishing nets. Simultaneously, these assets are characterised as exposed to disasters. A researcher/advocate working for an NGO situates this understanding in relation to the Bangladeshi context. She states that:

> "you have to keep in mind that we are a disaster-prone country, that must be a consideration for those giving out the loans. [We are giving credit knowing that] he is investing in a risky situation" (AcaNGO 3: 03/01/08).

Broadly, the criticisms of 'Development founded on micro-credit' emphasise the debt that results from lost assets. A government manager explains how repeated disasters and their negative impacts are unequally experienced by the indigent, stating that:

> "if another disaster comes it would be twice as bad. Sometimes they say they would then have to kill themselves. No way out. You know. So in that, the loan, whatever I get, maybe she buys a cow or goats, everything is lost in the disaster" (Gov 4: 16/01/08).

The director of an NGO highlights the ramifications of this situation, stating that:

> "at that point they are forced to sell their land, their cows, their assets to pay the loans. Or another thing is that they take another loan to pay the first loan" (NGO 6: 13/01/08).

The experts suggest that the application of micro-credit combined with ignorance of the frequency of disasters is a means of institutionalising debt among those who are already vulnerable. This criticism is often associated with the business interests that shape the

implementation of micro-credit, suggesting that the drive to create a market of the indigent (Duffield, 1993; Yunus, 1999) results in the entrenchment of debt. Research in Bangladesh shows that the drive to eradicate famine has resulted in widespread malnourishment (Clay, 1985); the creation of persistent debt in the drive to eradicate poverty appears to follow a similar pattern. In both cases, the disaster and disaster management combine to create a second-generation disaster, requiring fundamental reconsideration of the context and mitigation strategy (discussed in Chapter 4). The vulnerability created by a combination of credit and exposure raises again the debate between exposure and resilience. The disaster-prone context of Bangladesh endangers assets purchased with credit, leading many people to use multiple loans to fend off the weekly debt collectors (Amin et al., 1998; Rahman, 1999; Develtere and Huybrechts, 2005). The experts express general dissatisfaction with the impacts of micro-credit on disaster-prone populations, suggesting that the system increases their vulnerability. The head of a research institute is representative of this perspective, explaining the compounding impact of natural and economic disasters on the already vulnerable. He states that:

> "for example, the recent cyclone. That has particularly hurt the small businesses. They have taken out micro-credit loans, have started business, and then in one night, everything is gone. They are now beggars" (EngCons 3: 21/01/08).

An academic engineer summarises the tension between D/development and disasters in his discussion of the contexts in which micro-credit is and is not applied. He states that:

> "many NGOs favour or advocate the 'live with flood' but if you go to the flood control areas, that is the only locations that they offer micro-credit. If you go to flood-prone areas, we very rarely see micro-credit offers because it is too risky for them. This is an example of the differences between what is argued and what is done. For example, in the coastal polders, there is only micro-credit inside the polders, not on the coast" (AcaEng 3: 23/01/08).

The head of a private university shares this dissatisfaction with the system, pointing out that NGOs and donors are aware of the weaknesses built into the system but refuse to address the problems. He states that:

> "the NGOs are putting a lot of emphasis on micro-credit and they charge a very high interest, 18 %. When you have a disaster like flood or cyclone, there should already be methods in place to cope. You should not have to restart that process with every disaster" (Aca 2: 08/12/07).

This emphasis on personal debt is ironic given criticisms of the engineering understanding (Chapter 3), in which technical ventures were criticised for over-burdening developing nations with debt. It appears that one ramification of the switch from technical to social management is a transfer of debt from the state to the indigent.

CONCLUSIONS

The experts understand the emergence of the development paradigm as an application of foreign knowledge-power: as grounded in developed world knowledge, values, ideals and contexts. In summary, the development understanding: influences how flooding, flood management and vulnerability are understood, framing what knowledge counts; shapes the aims and objectives that inform decision-making, establishing the ideals to which managers aim; and dictates how flood management is funded, shaping how management is applied. Revisiting postcolonial and postdevelopment criticisms of D/development, the influence of the development understanding over flood management is akin to earlier forms of development, particularly colonial and modernisation efforts that aimed to re-cast the developing world in the developed world's image. This situation raises important questions concerning characterisations such as the development paradigm within the hazard and risk field and beyond (Kates, 1987; Kasperson and Kasperson, 1996; Tobin and Montz, 1997; Quarantelli, 1998; Cutter and Emrich, 2006; Collins, 2009; Smith and Petley, 2009). Furthermore, recalling that within the academic flood management literature (Chapter 3), the development paradigm originated as a grounded, pro-local and indigenous response to the foreign and hegemonic behavioural and engineering understandings, its characterisation as yet another reincarnation of imposed power-knowledge is disheartening. It is worthwhile re-considering the implications of paradigmatic understandings. It is possibly the act of establishing or labelling a logic as dominant that marks the point at which – to meet academic and developed world expectations – it has decreasing value to managers in Bangladesh.

The debate over development and its application in Bangladesh returns this analysis to the issue of where and how to intervene in flood management. The question of 'if' intervention is optimal is irrelevant, as the developed world is clearly active and invested in shaping environmental management in Bangladesh. Development, or more accurately the implementation of human development-influenced flood management, provides an interesting alternative to technical flood management that, until recently, has been the entrenched method, if not the most popular. Additionally, as part of these competing objectives, there is a wider issue of wealth, poverty and exposure in relation to vulnerability. Rather than suggest coping and living with the impacts of floods, as some portray the living with floods argument, there is a sense that repeated disasters are incompatible with sustained or sustainable growth, either economic of human. Given the population and area, the shift away from large-scale physical forms of flood management to support agricultural self-sufficiency will likely receive reconsideration, if not because its characterisation as a failure is dubious then because circumstances appear to be heading in a direction where needs will trump ideals.

CONCLUSION

> *In the Bangladesh situation, there are four types of NGOs. One group, and this group is very vocal, they are consultants who do not like to pay income tax. This is a loophole. 'What do you do? I run an NGO and research centre'. They are a business for making money. So, this is a group. Where does their money come from? Not from the government of Bangladesh. Their money comes from international donors, multilateral agencies and international NGOs who have a passion for something. The second group of NGOs is even more dangerous. They are set up by a very senior person. Each minister has an NGO, each secretary has an NGO, and each big shot has an NGO. Suppose I am the secretary of education and I know that the ministry is going to implement a lot of non-formal education programmes. I give the decision that this new policy must be implemented through NGOs. So, my NGO puts in a bid and I know that 100 NGOs will be selected. I set up an NGO with my Nephew as chief. So, I get half a million taka, not a massive amount. I keep one hundred thousand as my fee, very quietly, and 200 000 taka goes to my nephews and nieces to give them some employment and the final 100 000 taka is spent in the field. This process is very very common. The donors know it, the ambassadors know it but they keep quiet about it. The third group of NGOs are a kind of franchise. They are the local outlet of a larger international NGO. They employ a lot of local people who say whatever they are saying in the international forum. Like Greenpeace, they have an objective in Bangladesh. Internationally, Greenpeace opposes any development projects but when they come here, they start doing it. Like action aid. We need our development and they want to develop. This third group is also related to religion. The fourth group is kind of self-sustaining. Somehow, they have grown big, like BRAC or Grameen Bank or Brushika, they have become institutions but none of them have their own money. So, they are dependent on their sponsors for sustaining themselves and that decides what they say.*
>
> (Res 3: 8/1/08)

How do those in power understand flood management? Perhaps more importantly, on what basis do those in power frame or inform what they know? This research aimed to explore the assumptions, knowledges and priorities that shape flood management in Bangladesh. I felt that, given their lack of representation within the academic flood management literature, there was a need to engage with those making management

decisions. As the epigraph illustrates, accounting for the individual knowledges that inform understanding enables a unique perspective of the assemblage of considerations that are normally hidden behind the prevailing understanding. In addition, given the controversy that inhabits the debate over flood management, there is a need to explore the knowledges that support and contest the competing understandings. A key problem, given this objective, is the relativist nature of the expert understandings, each shaped by countless material, historical, experiential, cultural and personal factors. The relations between competing knowledges raise the critical issue of the basis on which they can be understood or compared? To answer this question, I have collected and combined numerous accounts of flood management in Bangladesh, constructing an interpretation with which to relate the expert perspectives. Together, these histories of flood and disaster management document the prevailing interpretation of the prevailing understanding, presenting a sequence that transitions from engineering, to behavioural, to human development periods. The narrative is an assemblage of histories that are simultaneously rooted in and detached from experience and expertise, such as that of the experts who contribute to this project. Of importance to this research and its findings, despite the generalisation, simplification and decontextualisation that characterises accounts of the prevailing understanding, it is a powerful actant that influences flood management. The prevailing understanding shapes the characterisation of Bangladesh in the developed world (IECO, 1964; Asian Development Bank, 2003; IMF, 2005; World Bank, 2006; IPCC, 2007; United Nations, 2008). This in turn, influences government, non-government and donor policies and, as a whole, the international forces that produce flood management. The prevailing understanding is the primary means of situating ongoing research within the academic flood and disaster management field. It is an actant that shapes what is known. By separating the prevailing understanding from the uncertain, contested and subjective expert knowledge claims, I hope to have cultivated a more nuanced appreciation for the embedded and implicit actants that populate the flood management controversy in Bangladesh.

This conclusion begins with a brief summary of the thesis arguments, describing the controversies that provided the starting points for each discussion and chapter. I begin

with a description of the methodology and historical narrative before reviewing each of the three themed chapters. Following the summary, I return to the research questions that initiated this project in order to contextualise the findings and relate the individual arguments to the wider question of *how an emphasis on knowledge and competing ways of knowing can inform an analysis of the debate surrounding flood management in Bangladesh?* Finally, I consider the implications of my approach and discuss the relevance of the findings in relation to the issues surrounding flood management in Bangladesh.

Summary of themes and arguments

The historical narrative (Chapter 3) presented my interpretation of the prevailing understanding of flood management in Bangladesh and identified three core issues that punctuate the debate, suggesting that they are, and contribute to, a wider knowledge controversy. Mimicking the linear presentation of flood management over time, the narrative illustrates the value of complexity-based analyses, suggesting an accumulation of competing understandings rather than distinct paradigms. The core issues provide the entry points for the analyses that structure the thesis (Stengers, 2000; Whatmore, 2009). I developed a conceptual framework (Chapter 2) able to accommodate the socio-material nature of knowledge, emphasising the assemblages of people, things and ideas that, through their relations, produce the flood management debate. The narrative described an accumulation of theories and knowledges used to conceptualise disasters, suggesting that understanding and management have grown more complex due to fundamentally opposing assumptions. For example, event centered interpretations that quantify direct impacts caused by the physical environment have been criticised, though not necessarily replaced, by those that emphasise social inequalities and human development using perception-based research (Douglas and Wildavsky, 1982; Blaikie et al., 1994; Lupton, 1999; Bankoff, 2003; Bankoff et al., 2004; Wisner et al., 2004). In Bangladesh, the result of this change is a wide array of competing understandings, which are composed of assumptions, knowledges, environments, biases, objectives, histories, predictions, interests, arguments and beliefs. The context for disaster research, then, is one in which

understandings can differ because of specific disagreements, but also because they are founded on a fundamentally different assemblage of considerations. As opposed to the prevailing interpretation of history, in which understanding evolves from one paradigm to the next (Kuhn, 1996; Darwin, 2003 [1859]), I argue that opposing understandings coexist, producing and sustaining debate. Following Kauffman's (1993) 'fitness of landscape' hypothesis, an analysis of such a system requires an appreciation for the relations between actants, including knowledges and understandings, rather than a privileging of the established or dominant paradigm. In terms of this thesis, by accessing the different understandings of flooding, disasters and vulnerability, I have attempted to explore how relations produce the core debates that shape the flood management controversy. To realise this objective, the perceptions and knowledges of a diverse collection of experts inform the research. These participants, including government and non-government managers, policy makers, academics, engineers and international donors, contribute both expertise and experience to the analysis of floods, disasters and vulnerability in Bangladesh.

There are many distinctions between the prevailing understanding and the perceptions, perspectives, knowledges and understandings exhibited and verbalised by the experts, raising the distinct possibility of being overwhelmed. Flood management is an extremely large and complex body of knowledge, requiring a means of directing the analysis. I adopted a two-fold method to constrain the research (Chapter 2): the first used the problem to designate the topics being considered while the second used key debates from the academic literature as entry points. This format allowed the project to circumvent disciplinary boundaries and follow the issues that influence management without spiralling out of control.

One of the most immediate debates within the academic flood management literature is disagreement over the nature of flooding, as either an overall benefit or detriment to Bangladesh's population and/or economy. This debate is indicative of the controversy surrounding flood management: how can management be effective when stakeholders

hold such fundamentally opposing knowledge? The academic flood management literature is replete with arguments chastising those who project the developed world's connotation of flooding onto Bangladesh (Islam, 1990; Khalequzzaman, 1994; Hoque and Siddique, 1995; Haque, 1997; Islam, 2001; Nasreen, 2004; Islam, 2005; Haque and Etkin, 2007). As within the literature, the experts recognise that floods carry both beneficial and detrimental effects; unlike the literature, they exhibit and justify a less definitive understanding to accommodate the diverse nature of impacts on a diverse set of individuals and contexts. In effect, the literature confronts the assumption that all floods are negative phenomena all of the time while the experts build upon this argument by describing the contexts in which flood disasters materialise. For the experts, rather than argue that flooding is beneficial or detrimental, they use vulnerability and exposure to show that flood impacts are nonlinear. In this way, the experts challenge the presumption that wealth produces security, pointing to those on the cusp of the poverty line as particularly vulnerable to exposure due to their accumulation of assets. Relative to management in the developed world, the experts' acceptance of uncertainty challenges the certitude on which scientific or modern environmental management is founded. This framing reflects the Bangladeshi reality. The incompatibility of developed world flood management is further exposed through the association of management with second-generation disasters. Rather than locate management apart from disasters and their impacts, the experts fuse management with disasters to help explain knock-on, cumulative and compounding impacts. Again, the academic disaster literature would not claim its actions sit apart from disasters, but its disregard of such considerations, choosing to instead discuss future management as if it were to take place on a clean slate, oversimplifies the context of flooding, disasters and vulnerability in Bangladesh.

A second debate prominent within the academic flood management literature focuses on the implementation of technical flood management methods. These measures, such as embankments, dams and polders, are contrasted with social management, such as education, warning, zoning and poverty eradication. The debate is cast as a failure to control the environment to suit human desire (decrease exposure) versus an admission

that the environment is beyond human control, requiring that people adapt their desires to suit the environmental context (increase wealth-resilience). Within the academic flood management literature, it is only rare and extreme accounts that advocate either complete technical or social management (IECO, 1964; World Bank, 1989-1995; Islam, 1990; Islam, 2001; 2005). Instead, reflecting the usefulness of both approaches, a middle-ground compromise is expressed in an idealistic frame (Rasid and Mallik, 1993; Paul, 1995; Haque, 1997; Paul, 1997; Government of Bangladesh, 1999; 2001; Rasid and Haider, 2003; Siddique and Hossain, 2006; Rashid et al., 2007; Sillitoe and Marzano, 2009). The experts challenge the idealisation of compromises that mix objective/methods, choosing to identify the contexts in which complete technical or social management is applicable. They explain that a universally adopted compromise is poorly suited to modern agriculture, to rural development, to industrial needs or to urban centres. Instead, while recognising the negative impacts associated with either extreme, such locations are associated with either complete social or technical forms of management. In addition, the experts recognise changing needs, advocating phases in which social management may be optimal, followed by the adoption of technical measures and then a re-adoption of social management to supplement the strategy. This understanding is prominent within the debate over the 'living with floods' concept, which has been transferred and adopted internationally (Shaw, 1989; Zaman, 1993; Schmuck-Widman, 1996; Ahmed, 1999a; Samarakoon, 2004; WWF, 2004; Younus et al., 2005; Sultana, 2010). Interestingly, having originated in relation to Bangladeshi flood management (Rogers et al., 1989), LwF's adaptive and unsettled nature has enabled its transfer to developed world contexts and appropriation by those who characterise the concept as an extreme version of social management. Its elasticity, while allowing application in numerous contexts, also makes it vulnerable to being co-opted, an issue of relevance when such less-settled understandings are juxtaposed against more formal, scientific or quantified knowledge.

Leading from the debate over technical and social management, a third core debate focuses on competing understandings of development and the adoption, and possible entrenchment, of a human development emphasis within hazard and flood management

(Pelling, 2003b; Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009). Like the living with floods concept, development is a nebulous term with multiple competing and internally contradictory interpretations and objectives. As opposed to the ideal of empowering and helping those in the developing world, many authors question its legitimacy and objectives, characterising D/development as an aggressive act perpetrated by the developed world to ensure its interests and maintain its power (Duffield, 1993; Hart, 2001; Bebbington, 2004). In terms of the academic flood management literature, the development paradigm emerged in response to the universal application of previous understandings, arguing that the developing world differed to such an extent that assumptions nested in the developed world were inapplicable (Cuny and Abrams, 1983; Tobin and Montz, 1997; Pelling, 2003b; c; Collins, 2009). More recently, criticism of the behavioural and engineering understandings have been applied in the developed world (Kundzewicz, 1997; Kundzewicz and Takeuchi, 1999; WWF, 2004; Kundzewicz et al., 2005), suggesting a similar inapplicability and increasing support for a wider application. The human development understanding, in this context, has provided the means of criticising the prevailing understanding to the point where it has altered the balance of knowledge-power (Blaikie et al., 1994; Wisner et al., 2004; Collins, 2009; Smith and Petley, 2009). The experts exhibit an understanding founded on many principles associated with the human development paradigm. In particular, they share the assumption that management ought to focus on the most vulnerable segments of the population and that participation is the optimal means of overcoming the growing conflict and uncertainty. Despite such agreement, the experts are also critical of many of the assumptions underlying development, particularly those they interpret as the imposition of developed world power and knowledge. Despite the origins of the human development understanding as a way of ensuring developing world interests, the experts suggest that development and human development-influenced flood management re-assert the uneven relationship between Bangladesh and the developed world. In particular, the experts use the popularity of NGOs and micro-credit as exhibits to demonstrate this imbalance. They argue that, as opposed to past situations in which the developed world was comfortable to direct and control developing world governance openly, the present form of development maintains a less evident but effectively similar

relationship. By controlling the NGOs, encouraging micro-credit and shaping the knowledges and aims of development/flood management, the developed world reasserts its power in the Bangladeshi context. Furthermore, by incorporating disaster management into the development sphere, the importance of exposure and damage reduction, already problematic, have been shunted and laid aside in exchange for human development.

These findings, as a whole, suggest that a knowledge-focused exploration of flood management can expose the often hidden uncertainty of knowledge claims and thereby of the subsequent authority. My use of expert knowledge challenges the aim of present flood management research, of 'speaking truth to power' (Foucault, 2001), by asking what power 'knows' or imagines to be true? While the findings offer potentially innovative interpretations and contribute a better understanding of the controversy surrounding flood management in Bangladesh, the research opens as many doors as it has attempted to pass. Drawing this thesis to an end, I consider the significance of my approach, the relevance of the findings and some of the questions that have emerged.

The significance of a complexity, assemblage and historical approach

My methodology has enabled an exploration of the context surrounding flood and disasters management in Bangladesh. This perspective, particularly the emphasis on historical situatedness, highlights the importance of conceptualising disasters as transformative. This understanding – in which an earthquake increases sedimentation, which exacerbates flooding, which causes rice speculation, which leads to widespread malnutrition or famine – questions the assumption that the knowledges of multiple specialised framings can be aggregated (for example, of seismologists, sedimentologists, hydrologists, agronomists and nutritionists). There is no doubt that the constituent elements of complex issues can be better understood by breaking them into pieces that are more accessible. Unfortunately, the flood experts suggest that the ability to combine these knowledges is at best problematic. The assertion that disaster research must expand its scope is a common argument within the literature (White, 1974; Smith and

Ward, 1998; Pelling, 2003b; Wescoat and White, 2003; Cutter, 2009; Smith and Petley, 2009). What my research shows is that the assumed ability to 'bolt-together' knowledge presents significant problems beyond the constitution of that knowledge which is to be bolted together. By this, I mean that combining different disciplinary knowledges will no doubt be difficult, but there is also a need to recognise the fundamentally different assemblages (including assumptions, objectives, methods and interests) that produce those knowledges.

Running throughout this thesis, the underlying objective has been to compare competing expert perspectives and relate these views with the prevailing understanding within the academic literature. Such labels are simplifications of what is actually an interwoven and often tense assemblage of knowledges. Despite this generalisation, there are clear distinctions not only between 'what' is known but also between 'how' it is known and justified. A composite of complexity and network-assemblage theories allows an original interpretation of flood management by extending consideration to the knowledges, assumptions, actants and historical contexts that sustain competing understandings. A knowledge controversy is more than a difference of opinion or a different measure of the same environment; rather, it is a dynamic and complex system of relations that produce circumstances that are non-reducible to their constituent elements. More simply, knowledge controversies surrounding environmental governance require consideration of the people, things and ideas involved. While it is easier to divide environmental debates and controversies into periods and paradigms, there is a need to confront the complexity that shapes decision making. In this thesis, I have attempted both. The historical narrative decontextualises and disassociates the contexts and origins of flood management knowledge; none-the-less, it is a powerful actant that influences knowledge and management. The accessible and transferable claims that inform meta-narratives sustain the caricatures and the processes that shape understanding (Said, 1978; Rabinow, 1984). While such accounts are non-reducible to any specific document or person, they hold an influence because of their relative simplicity and decontextualisation. Despite the difficulties involved in exploring this actant, it is imperative that flood management confront the power of such pervasive

discourses. I argue that the experts and experienced individuals working in the field provide one avenue with which such interpretations can be explored. Collectively, these findings emphasise the difficulties that accompany research of knowledge and of what is known. Though with regards to an alternate disaster, Atkins et al. (2007: 2709) summarise the importance of knowledge focused research and the admission of uncertainty, arguing that it "be essential to admit what we do not know and to incorporate a discussion of this uncertainty into future policy prescriptions".

Use of experts and perceptions

This research was conceived as a means of exploring the knowledges and understandings of those with decision-making power. Despite a concentration of power within the Bangladeshi context, the views of experts and policy makers are absent within the academic flood management literature, raising important questions concerning their priorities, assumptions and understandings. As far back as Paul (1997), it has been recognised that managers have been excluded from the flood management literature. Instead, managers and policy makers have been labelled as self-interested technocratic pawns, driving an agenda that neglects the indigent in a misguided attempt to emulate the developed world. At present, participation, local and indigenous knowledge and empowerment are gaining prominence within the academic environmental management literature (Collins and Evans, 2002; Pelling, 2003b; Collins, 2009; Enarson and Chakrabarti, 2009), making the neglect of power-holding experts more pronounced. The move towards participation and perception recognises the inhibiting influence that controversy has had on decision making and management (Demeritt, 2001; Sarewitz and Pielke, 2001; Sarewitz, 2004; Demeritt, 2005; Clarke, 2006; Sarewitz, 2006; 2008; Demeritt, 2009; Sarewitz, 2009), though it is increasingly being recognised as an opportunity to promote innovative and opportunistic forms of research and management, confronting the prevailing negative connotations of controversy (Wynne, 1993; Collins and Evans, 2002; Jasanoff, 2003b; Wynne, 2006; 2007). This trend has emerged in response to the assumption that analyses of modern hazards require appreciation for

experience as well as expertise and decision making power (Beck, 1992 [1986]; Wynne, 1996).

Despite my incorporation of multiple histories and my aim to account for material influences on knowledge construction, this thesis is almost as dependant on perception as those that I have criticised. In effect, just as the majority of researchers exploring flood management in Bangladesh emphasise the poor, vulnerable or disenfranchised, I have emphasised those with decision making power. To repeat a claim from the methodology, I have not sought to replace the current approach to flood management research. Instead, I have attempted to deepen the overall understanding by accounting for the individual perceptions of decision makers relative to the prevailing understanding and the characterisation of Bangladesh within the academic flood and disaster management literature. In addition to traditional criticisms of perception-based research (see for example Cross, 1998 or Pidgeon, 1998), an unacknowledged problem within the flood management context rests in what is described as the 'unfamiliarity principle' (Barkmann et al., 2008) or what is often termed 'unknown unknowns' (Whatmore, 2009). When reliant on perception, researchers are subject to the scope of understanding of the participants. This premise is pragmatic, in the sense that people will act on what they know, but it neglects potentially important elements that rest outside the participants' frame of reference. The experts, despite and perhaps because of their focused knowledge, are as prone to unfamiliarity as lay or non-certified experts. This is a weakness of the research, but one that is confronted through the diversity of the respondents and one that is confronted in the wider sense with the inclusion of managers to the debate.

Implications of the research

The findings of this research extend into many fields and contexts, reflecting the scope of those involved and the growing complexity of flood and disaster management. Without overstepping the contribution of this research, it is worthwhile mentioning briefly the implications of some of the findings and of the research more generally.

First, the methodology and findings suggest that knowledge of disasters, particularly that founded upon perceptions, are a product not only of events and experiences (Cutter, 2003), but also of policies, histories, structures and interests. While the transition from realist/positivist to perception-based analyses has exposed the veil of privilege that accompanies entrenched knowledge claims, there remains a need to build upon relativist research of flood and disaster management to address the complex assemblages of relations that shape knowledge production and maintenance. This methodology is one example of how assemblages and complexity can expand the scope of consideration without becoming overwhelmed by the scale of the research. Second, best exhibited by the Millennium Development Goals (United Nations, 2008), there is a presumption that the ideal way to improve resilience to disasters is through poverty eradication. Without doubt, increased wealth and livelihood development will enable people to withstand better the impacts of disasters, but this assertion is partly a product of the tendency to analyse disasters individually. In situations with periodic extreme events, wealth generation will improve resilience. Due to the diversity and recurrence of disasters in Bangladesh, this research challenges the applicability of this assumption. With particular emphasis on the use of micro-credit loans to support development, the aim of wealth generation within a disaster-prevalent context increases the amount of assets exposed to extreme events. This finding poses a fundamental challenge to the shift away from exposure oriented management towards human development in disaster-prone contexts, raising important considerations about how best to support human development. Third, the implicit idealisation of lasting solutions to environmental problems distracts managers, citizens and researchers from the reality of complex assemblages. This research has shown that managers appreciate the need to continually adapt to a continually adapting socio-physical environment. There is no answer to the flood management problem or controversy, but this is, perhaps, not a negative characteristic. Instead, this research suggests that accepting the perpetuality of environmental problems and controversies allows managers and researchers to accept and address reality. Additionally, by accepting the need to adapt management over time, the experts show

the value of tailoring management to specific contexts rather than idealising compromise between competing understandings.

Finally, this research reinforces the assertion that knowledge is an application of power and that, in the context of flood management, that power rests in the developed world. Whether directly, through World Bank funding or donor organisations choosing to fund particular issues, flood management emerges as a highly constrained exercise. This situation is perhaps best understood in terms of the agricultural priority that has, for the most part, shaped understanding and management of water in Bangladesh since the partitioning of India. The recent orientation towards human development is an interesting emergent concern, but, harkening back to the Malthusian arguments that informed earlier periods (Faaland and Parkinson, 1976a; Faaland and Parkinson, 1976b), ongoing population growth, resource depletion and cultural expectations present a real possibility that the agricultural needs will again outweigh the environmental and social development agenda. This research has exposed an interpretation of physical flood management that does not hold the same negative connotations evident within the academic flood management literature. Given the current disposition of donors away from physical management alongside looming population and resource demands, further consideration of the assumptions and understandings that inform and contest management and decision making are required.

Emerging Questions

This research has sparked numerous questions, most of which will require further methodological as well as analytical development. To conclude, I highlight some of the issues that this research identifies as in need of further consideration.

It is not surprising that the realist-relativist issue was a constant presence during this research. An emphasis on knowledge and power could not proceed without consideration for the poststructural and postmodern criticisms of realism (Sayer, 1989;

Gregory, 1994b; Parker, 1998; Peet, 1998; Reed, 2008). That said, the prevailing turn towards participatory research, in terms of environment and flood management in Bangladesh, requires further critical reflection concerning how the material context shapes and is shaped by knowledge. An important aspect of such a reflexive approach will be appreciation for competing knowledges and the construction of caricatures, particularly those perpetuated within broad or generalised discourses relative to more material assessments. As Hossain et al. (1992: 1) declare:

> "no one can write about Bangladesh without reference to disaster and poverty. However, development literature often overlooks the region's historical role in world trade, its prosperity before it became a part of colonial British India and post-partition Pakistan. Media images of a teeming humanity under stress depict a continuing catastrophe. But Bangladesh is also a portrait of a people's struggle. What is needed is a more reasonable assessment, to put into perspective, how, since its emergence, as an independent state, the people of Bangladesh have faced disaster".

In relation to this participatory turn, there is need for further consideration of the mechanisms used to measure and value the benefits and harms that characterise the human-environment interface (Benson and Clay, 2002; Pelling et al., 2002; Cutter, 2003; Benson and Clay, 2004; Pelling, 2006). With reference to flood and disaster management, there remains a need to assess ecosystem services without the negative connotations that normally accompany such classifications (Costanza et al., 1997; Turner et al., 2003). In part, this reconceptualisation of the human-environment relationship is needed as part of a wider shift towards inclusive appraisals. Conversely, the lack of consideration for the difficulties that accompany such calls for integrated or transdisciplinary research remains pressing.

Perhaps the most important question is how modern environmental managers can plan for an increasingly uncertain future within an increasingly contested context? In terms of infrequent yet high-impact events, this question is even more complex given competing needs and understandings on how best to manage society. To answer the overarching research question concerning the application of a knowledge-oriented analysis, I suggest that the extension of consideration to the assemblage of actants mirrors the growing consensus for holistic appraisals of environmental issues. While not without its

drawbacks, accounting for the people, things and ideas that shape what is known helps confront unjustified knowledge claims thereby deflating the controversy by admitting uncertainty. I hope that such interpretations will allow for better communication and more empathetic understandings to emerge from such complex and controversial issues.

APPENDICES

APPENDIX A

See attached CD for three examples of transcribed interviews.

APPENDIX B

Number	*Category*	*Title and Organisation*	*Date*	*Record*
1	Academic	Professor Geography, leading University in Bangladesh	08/12/2007	11
2	Academic	Professor and Pro-Vice Chancellor, leading University in Bangladesh	08/12/2007	10
3	Academic	Professor of Geography, leading US University	28/12/2007	7
4	Academic	Professor of International Relations; leading University in Bangladesh	02/01/2008	17
5	Academic / Engineer	Professor; leading University in Bangladesh	15/12/2007	18
6	Academic / Engineer	Associate Professor; leading University in Bangladesh	15/12/2007	36
7	Academic / Engineer	Professor; leading University in Bangladesh	23/01/2008	30
8	Engineer / Consultant	Principal Water and Sewerage Engineer	01/01/2007	29
9	Engineer / Consultant	Engineer Consultant	10/12/2008	21
10	Engineer / Consultant	Principal Specialist & Head of Flood Management Division	21/01/2008	27
11	Engineer / Consultant	Team Leader	21/01/2008	24
12	Engineer / Consultant	Water Resources Engineer	02/02/2008	8

13	Government / Engineer / Consultant	Additional Chief Engineer (planning); Government of Bangladesh	24/01/2008	39
14	Government / Engineer / Consultant	Technical Assistance Advisor; Government of Bangladesh	24/01/2008	39
15	Government / Engineer / Consultant	Team Leader; Government of Bangladesh	24/01/2008	39
16	Consultant	Executive Director; water research consultant	26/01/2008	12
17	Consultant	Head, GIS Division; water research consultant	13/12/2007	no recording
18	Consultant	Principal Specialist & Head of Water Resources Planning Division; water research consultant	10/01/2008	1
19	Research Organisation	Senior Research Fellow and Project Director; leading research organisation	06/01/2008	35
20	Research Organisation	Director General; leading research organisation	06/01/2008	26
21	Research Organisation	Director; leading research organisation	08/01/2008	5
22	Research Organisation	Senior Advisor, leading research organisation	15/01/2008	2
23	Research Organisation	Chairman; leading research organisation	17/01/2008	23
24	Government	Principal Scientific Officer; Government of Bangladesh	09/01/2008	28
25	Government	Director of Planning; Government of Bangladesh	15/01/2008	4
26	Government	Director; Government of Bangladesh	16/01/2008	25
27	Government	Principal Environmental Officer; Government of Bangladesh	16/01/2008	33
28	Government	Senior Scientific Officer; Government of Bangladesh	16/01/2008	33
29	Government	Director General; Government of Bangladesh	05/02/2008	15

30	Donor	Programme Manager; Donor Organisation	16/01/2008	13
31	Donor	Resident Representative; Donor Organisation	17/01/2008	19
32	Donor	Senior Project Donor Organisation	23/01/2008	no recording
33	Donor	Infrastructure Advisor; Donor Organisation	01/02/2008	no recording
34	Donor / International Consultant	First Secretary Water Sector; Donor Organisation	22/01/2008	34
35	Donor / International Consultant	Advisor IWRM; Donor Organisation	22/01/2008	34
36	International	Resident Representative; International Organisation	24/01/2008	9
37	International	Chief Technical Advisor & Team Leader; International Organisation	29/01/2008	16
38	International	Team Leader; International Organisation	29/01/2008	16
39	International	National Expert; International Organisation	29/01/2008	16
40	International	Chief of Water & Environmental Sanitation Section; International Organisation	30/01/2008	31
41	Academic / NGO	Head of Centre for Water and Environment; leading NGO	05/02/2008	37
42	Academic / NGO	Executive Director; leading NGO	03/012008	20
43	Academic / NGO	Advisor; leading NGO	03/012008	38
44	NGO	Director; leading NGO	30/01/2008	6
45	NGO	Programme Manager; leading NGO	01/02/2008	32
46	NGO	Director, leading NGO	07/02/2008	no recording

47	NGO	Deputy Team Leader; leading NGO	10/02/2008	no recording
48	NGO	Senior Regional Manager for leading NGO	12/02/2008	no recording
49	NGO	Associate Executive Director; leading NGO	08/01/2008	22
50	NGO	Central Manager of Disaster Management Programme; leading NGO	08/01/2008	22
51	NGO	Development Director; leading NGO	13/01/2008	14
52	NGO	Director of Disaster Management & Development; leading NGO	13/01/2008	3

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