



Flood Knowledge and Management in Bangladesh: Increasing Diversity, Complexity and Uncertainty

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Abstract

The purpose of this paper is to review and discuss the relationship between government publications and academic studies of flood management in Bangladesh. The paper reviews these literatures while also emphasizing the assumptions, objectives and national issues that have influenced modern flood management. This approach aims to engage with the evolving knowledges used to inform and to criticize flood management in one of the most flood-prone nations on earth. The analysis suggests a disconnection between government and academic knowledge, particularly concerning the characterization of government objectives within the academic discourse. The paper is divided into four periods in which the objectives, methods and understandings were fundamentally reoriented, contributing to the current discrepancy between government and academic approaches to flooding and flood management. The paper concludes with discussion of three issues related to the competing assumptions of flood risk management in Bangladesh and raises the issue of growing complexity in relation to hazards management.

Introduction

Flood management in Bangladesh is of growing importance. Projections and research indicate an increasing vulnerability driven by a combination of evolving physical and social drivers. The Intergovernmental Panel on Climate Change identifies a probable increase in the variability and availability of monsoon precipitation and the resulting fluvial resources whereas simultaneous population and demographic changes are projected to increase hydrological demands (IPCC 2007). Although flooding and flood management have long been important for the region, the uncertainty embodied within the projections calls into question the ‘stationarity’ of the assumption: that future issues will resemble present issues and that past and present knowledge will be sufficient to inform future management (Milly et al. 2008). This paper does not seek to undermine present knowledge. Instead, it recognizes the need for an inclusive literature review in order to inform resilient decision-making.

This paper differs from traditional reviews by exploring contextual information alongside analysis of the literature. In this way, the assumptions, philosophies and assertions are understood within a complex system (Manson 2001; Manson and O’Sullivan 2006; O’Sullivan 2004) of flood events, national events (i.e. the dissolution of East-West Pakistan in 1971), ontological and epistemological evolution and the procession of Bangladeshi governance. It is grounded in the arguments of networks and assemblages in which context, history, materiality and positionality are recognized as key elements of knowledge-oriented research (Bennett 2005; Latour 1999; Law 1986; Li 2007; McFarlane 2009). In addition, the paper aims to update Paul’s (1997) analysis of flood research in Bangladesh by replicating and expanding elements of his discussion. The paper reviews

the period spanning 1954 to present and emphasises two bodies of literature: government publications¹ and academic publications. This distinction is premised on the need to recognise the different roles, priorities, resources and responsibilities of the two communities, a distinction that goes unaddressed within much of the flood management discourse. More specifically, there is a need to recognise the immediate responsibilities of government compared with the relative 'freedom' and experimentation available to academic authors.

This review is organised into four sections based on two rationales. First, I use the five most significant flood events (see Höfer and Messerli 2006, 71–72) to distinguish different periods of management and to provide a grounded schemata. This approach recognises that catastrophic floods have repeatedly provided the catalyst for fundamental change to both understanding and management practices while also appreciating Sultana et al.'s (2008b, 339) assertion that "exposure to natural disasters, whether floods, droughts, cyclones, or earthquakes, is probably [Bangladesh's] defining feature". Second, I use the paradigms of hazard management outlined by Smith and Petley (2009) to support temporally-based organisation. This format helps support the argument that flood management is growing increasingly complex as new conceptualisations emerge to challenge prevailing understanding. In addition, Smith and Petley's (2009) division also corresponds with the evolution of theory and practice within environmental hazards understanding more generally. Together, this combination of events with paradigms recognizes the importance of the 1954/1955, 1987/1988 and 1998 floods as well as a less rigid ontological and epistemological evolution. I suggest that this use of 'event-centred periods' strengthens the use of paradigms and exposes a fundamental disconnection between the government and academic knowledges, assumptions and priorities: differences that go unacknowledged in both bodies of literature. Ideally, the review will contribute to informed discussion within the wider context of growing complexity and uncertainty of environmental hazard and risk management.

This paper draws on Paul (1997), Chadwick and Datta (2000) and Höfer and Messerli (2006) for their analyses of the literature². The four periods discussed in this paper are labelled: the lead-up to 1954/1955, the engineering period, the behavioural period and the development period. The discussion outlines three themes running throughout the review that require further consideration: first, the growing complexity and uncertainty surrounding decision-making; second, the use of flood management as a vehicle for social development; and third, an increasingly common and uncritical reliance on victim and floodplain resident perception as the means of informing management.

Early period: lead-up to 1954/1955

English management of the Indian colony dominates the lead-up period. Chadwick and Datta (2000, 2) state that "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 that there was a lack of flood management (Brammer 1990a,b; Shaw 1989; Zaman 1993) but that, as Sillitoe explains, there was a different form of management based on the local governance and culture (Sillitoe 1998b, 2000; Sillitoe and Marzano 2009). Colonial management is described as disengaged from planning (Chadwick and Datta 2000; Chadwick et al. 2001) because its aim was to control the colony to enable resource extraction. It is important to recognize 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 (CIA 2009). This population increase differentiates the earlier period because high-risk land was unoccupied year-round, reducing the importance of flood management as a result of lowered exposure. Additionally, Höfer and Messerli (2006, 73) characterize the period between 1932 and 1954 as relatively flood-free. Combined, the increasing use of seasonal land and the cyclical nature of flood events fundamentally differentiate the early and 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 events in the 18th and 19th century were relatively more extreme as a result of the combination of earthquakes and shorter river courses. 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). Flood management during this period is characterized as reactive rather than pre-emptive, reflecting both the abilities and the perceived responsibilities of the rulers.

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. Also labelled the structural or technical period, the approach originated with the U.S. Army Corps of Engineers and was predicated on controlling hydrological resources using physical structures (Smith and Ward 1998; Wescoat and White 2003; White 1973, 1945). The period coincided with wider efforts by the western world to curb the spread of communism through strategic and economic partnerships (Chapman 2000; Gleditsch et al. 2006; Mustafa 2007; Wolf 1999). 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. Of critical importance was the predetermined need for the investment and technology transfer that accompanied such cooperation. The period also coincided with the modernization approach to development, particularly relating to the World Bank, Asian Development Bank and United Nations (Berger 2004; Picciotto 2004)³. Bangladeshi governance during this period is described as complex (Jahan 1972; SenGupta 2007) as a result of the impacts of the partitioning of India (1947), the Liberation war (1971), and the conflicts surrounding transitions between Sheikh Mujibur Rahman (1972–1975), Ziaur Rahman (1975–1981) and Hussain Mohammed Ershad (1982–1990).

The post-partition period is described as deficient of the experienced leaders and infrastructure required to develop a nation (SenGupta 2007). As a result, alongside the expected difficulties of a nascent country, Pakistan⁴ was a disorganized and highly divided nation physically, ethnically, economically and consciously (SenGupta 2007). During the period, East Pakistan experienced a number of disasters, including the successive floods of 1954 and 1955, initiating a disposition towards engineered management (Brammer 1990a, 2004; Rogers et al. 1989). The 1970 cyclone re-exposed Islamabad's neglect of disaster planning and is recognized as a key point in the disintegration of East and West Pakistan's allegiance (SenGupta 2007). Another result of the disorganization was the 1974 famine which, within living memory of the 1943 famine, fundamentally oriented the primary objective of flood management towards agricultural development and food self-sufficiency (Chadwick and Datta 2000; IECO 1964; Sultana et al. 2008b). In this sense, the famine

represents a defining moment for the Bangladeshi consciousness, shaping public expectations to the present (Boyce 1990; Brammer 1990a,b; Chadwick and Datta 2000; Faisal and Parveen 2004; Rasid and Paul 1987; Zaman 1993). For example, Amartya Sen's (1981) analysis of the famine, and later, Muhammad Yunus's (1999) advocacy of micro-credit, rely on this event: Sen arguing that famines are the product of social processes rather than decreased production, whereas Yunus argues that for-profit 'conscientious capitalism' can empower marginalised people by providing credit, ultimately combating food insecurity.

The two most prominent government publications of the engineering period are the United Nations Krug Mission Report (Krug 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 (EPWAPDA). 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 ha. The organization was dominated by engineers and enjoyed both national and international funding for the large-scale projects favoured by donors (Boyce 1990; Custers 1992). The Master Plan is, to date, the most important government publication for understanding flood management in Bangladesh because it is responsible for the prevalence of engineered management (Chadwick 1999; 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, declaring 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, fertilizer, better farm practices, and adequate water for crop use. Embankments and positive drainage will minimize 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 other national priorities, for example, agricultural development was its primary focus alongside rural labourers, industry, power development and fisheries (IECO 1964). The Krug and IECO reports set a precedent for international involvement, supported by the universalist assumptions of flood management at the time (Hewitt 1983, 1997; White 1974). Although the plans advocate mixed methods and identify rural populations as the primary beneficiaries, they remain dedicated to the principles of the engineering approach. As Rogers (1994) explains, the implementation of the Master Plan prioritized structural adjustments such as polders and embankments regardless of mention of drainage and irrigation, fishing or other non-structural adjustments.

Early academic flood management was informed by Malthusian assessments of the carrying capacity of Bangladesh, primarily in relation to population health and growth (Blair 1985; Dodge and Wiebe 1980; Faaland and Parkinson 1976a,b; Mellor and Gavian 1987). For example, Faaland and Parkinson (1976a, 740) state that "the most crucial relationship for the future is that between population and the production of food, in particular the production of rice and other foodgrains". Broadly, the research is comparative, with a focus on female reproductive health, the impacts of poverty and cultural differences between Bangladesh and the developed world (Bongaarts 1980; Frisch 1978; Mellor and Gavian 1987; Udry and Cliquet 1982; Wyshak and Frisch 1982). A second group of early academic research can be characterised as scientific studies of the physical environment (Brammer and Brinkman 1977; Coleman 1969; Goswami 1985), though

the research shared few links with the flood management literature (Cook and Lane *forthcoming*). An important publication during this period was Montgomery's (1985) discussion of the historical context of the 1984 floods. This work is particularly important for its agricultural emphasis, recognition that the poor bear a disproportionate amount of the suffering that damages appear related to depth and that famines do not coincide with decreased rice production. This period also marked the beginning of a social interpretation of flood management that would later become dominant, for example, through the emergence of relief NGOs and the promotion of small-scale fast-return development projects.

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 research and with interest from geographers employing human ecology to criticize engineering-led strategies. Their arguments relied on a characterization of the government as one-dimensional advocates for technical solutions (Islam 1974). Paul (1984, 4) criticizes 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' (Chorley 1973; White 1945, 1973), particularly his book on the local, national and global nature of natural hazards (1974). Both Islam (1974) and Paul (1984) root their criticisms on 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 and Burton (1971) and Hewitt's (1983) Marxist critique of the 'traditional' understanding and his advocacy of more reflexive analyses of hazards as 'the product of human endeavours' (Hewitt 1983). These criticisms of the engineering period, along with methodological sophistication, laid the foundation for fundamental reorientation. The 1987 and 1988 floods provided the impetus.

The behavioural period 1987–1998

The behavioural period is characterized 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 'fuller' understanding of the decision-making process that included appreciation for *why people chose* to live in high-risk locations. Despite this shift, it retained the engineering period's orientation towards the event, and viewed the 'findings' as transferable to other contexts (Burton 1960; Penning-Rowsell 1994; White 1974).

The 1987 and 1988 floods represent the defining moments of the behavioural period in Bangladesh, along with the 1991 cyclone that killed more than 100,000 and is thought to have left ten million homeless (Dove and Khan 1995; Haque 1997a; Mushtaque et al. 1993). These flood events, the 3rd and 2nd most damaging (see Höfer and Messerli

2006, 71–72), reinvigorated the international community's interest in Bangladesh (French 1989; JICA 1989; Rogers et al. 1989). This interest coincided with recognition for continued population growth and was highlighted by comments attributed to the U.S. National Security Advisor's entourage characterizing Bangladesh as 'an international basket case'. In addition, Bangladesh received much attention as a result of Myers' (1993) discussion of the potential for regional destabilization as a result of environmental refugees. The floods and cyclone legitimized criticisms of the engineering period and forced an acceptance that the scale of natural hazards in Bangladesh was possibly beyond the scope of the 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 (Coles and Wallace 2005; Hanchett 1997; Hawkes et al. 1999; Paul 1999), the vulnerable (Custers 1992; Rasid and Mallik 1996) and the impoverished (Ravallion and Sen 1994; Sen 1981, 1999; Wahid 1994). Combined with flood management, water-related social development began to dominate discussions that had previously been limited to damage reduction.

This period of flood management was influenced by criticisms of the world order perpetuated by development through modernization. Specifically, Arturo Escobar's (1995) account of development as a Western application of power, shows how control of knowledge maintains a hierarchy that favours the developed world. Despite such criticisms, long-term projects initiated by the 1964 Master Plan continued to be implemented. Governance during this period is characterized as turbulent (SenGupta 2007), with most of the period dominated by Hussain Muhammad Ershad (1983–1990) and a transition to Prime Minister Khaleda Zia (1991–1996). In terms of flood management, Ershad was a proponent of grand design, characterized 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 – grudgingly – 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 involves arguments for increased transparency, participation and empowerment, a shift reflected in the Flood Plan Co-ordination Organization's guidelines for people's participation (FPCO 1993).

During this period, government reports struggled to reconcile government and popular priorities. The BWDB, responsible for the national scale, remained convinced of the need for large-scale strategies that promoted irrigation and agriculture development through control of flood waters (GoB 1986, 1998; Ministry of Irrigation 1991). Despite this belief, most international organizations supported tubewells and low-lift pumps designed for the extraction of shallow groundwater to support the growing demand for the winter irrigation of *Boro* rice. The most important documents of the period are the 26 FAP studies, the National Water Policy (GoB 1999) and the Ganges Water Sharing Treaty with India (GoB 1997).

The FAP is surrounded by both legitimate and designed controversy. It represents an unrivalled impasse that continues to influence debate over the objectives and methods of flood management in Bangladesh. Despite suggestions that the government proposed and intended were dangerously inconsistent (Boyce 1990; Custers 1993), the plan was designed 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 (GoB 1989), a French study that

advocated costly embankments recessed to 5 km (French 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 measures, along with institutional and maintenance costs, made structural plans impractical⁵. It was within this period that the government heeded calls for participatory governance and promoted policies designed to empower local populations (e.g. National Water Policy and Management Plan). The implementation of the changed language is debatable, though it does mark a significant shift that has been maintained to present (GoB 2001, 2004).

The behavioural period marked the establishment of a social science approach to flood management (Alam 1990; Bingham 1989; Brammer 1987; Comments 1992; Dalal-Clayton 1990; Hanchett 1997; Hoque and Siddique 1995; Islam 1990; Paul 1995; Rasid and Mallik 1993, 1995; Rasid and Paul 1987; Shaw 1989). Building upon Paul's (1984) discussion of *Bonna* (abnormal flood levels with negative associations) and *Barsha* (normal flood levels with beneficial associations), researchers used perception and survey methods to question the government's rationale (Chowdhury 1988; Haque and Zaman 1993; Islam 1990; Paul 1995; Rasid and Mallik 1993, 1996; Rasid and Paul 1987; Zaman 1993). These authors questioned the fundamental assumptions of the engineering period in two ways: the first was to invalidate strategies predicated on the elimination of floods and, more importantly, to show that knowledge of flooding in Bangladesh was situated. 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.

An important contribution during this period was the valuation of traditional coping mechanisms (Brammer 1990a,b; Haque and Zaman 1993; Islam 1990; Khalequzzaman 1994; Paul 1995; Rasid and Mallik 1993, 1995; Shaw 1989). For example, the selection and propagation of flood-resistant rice varieties able to accommodate rising flood waters (Custers 1992; Islam 1990) was a common argument, though few acknowledged the much lower yields (Thompson and Sultana 1996). Within most of the publications, human adjustments are explained in lists that highlight the ingenuity of the floodplain resident. 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.

Though, this idyllic characterisation is punctured by recognition that floods can also cause widespread destruction (Zaman 1993, 986). Haque and Zaman (1993, 102) found that the majority of residents actively 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* institution – a peasant-lord system to gain control over accretion land by the locally powerful *tulukdars* and *jotedars* using their patron-tied dependants"; he also explains how gangs conscript the newly landless to battle for control of emerging *chars* (1989, 200).

The perception and opinion studies include no discussion for 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 large top-down management is a foregone conclusion. Paul (1995) and Rasid and Mallik (1996) each find that a majority of floodplain residents support large-scale 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 ... [or that] 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 programs. In addition, the respondents might have thought that the construction of embankments would bring benefits at the individual, local, and national levels.

Paul justifies his resolve in relation to an 'unwarrantedly' high regard for Western science and because the residents are unaware of cases where such strategies had failed (1995). This tension between participatory findings and outcomes that contradict the behavioural approach expectations is a trait within flood management research that continues to be neglected.

Another group to emerge during the behavioural period sought to expose the FAP as a failed strategy as a result of 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 and technical grounds. His discussion is problematic because it treats several different studies as one, equating the French plan with the FAP (Brammer 2004). Closely related is the characterization of managers and elites within the decision-making process. Governance is characterized 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). They 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; Comments 1992; Custers 1993; Islam 1990). Interestingly, apart from these characterizations, elites and decision makers are excluded from flood management perception research, with the exception of Khan (1991).

During this period, as a result of interest generated by the floods and the controversy surrounding the FAP, unparalleled interest was directed towards flood management research in Bangladesh from an increasingly diverse number of disciplines. Largely independent from earlier geographical research, anthropologists such as Sillitoe (Sillitoe 1998a,b; 2000; Sillitoe and Marzano 2009) and development-oriented scholars like Blaikie et al. (1994), expanded the focus and methodologies applied to flood research. This growth is a key aspect of the transition from the human ecology to the development period, culminating in Sen's exploration of development as freedom (1999).

The development period 1998–present

The controversy surrounding the FAP altered the balance of power in Bangladeshi flood management. The persuasive criticisms exposed the assumptions underlying large-scale projects, whereas the United Nations Millennium Development Goals helped shift further

interest towards human-centred 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. This helped entrench non-governmental organizations (*hereafter* NGOs) as meaningful alternatives, toppling engineers and technical management from their pedestal. The 1998 flood, the worst event in the period of discussion (see Höfer and Messerli 2006, 71–72) further exposed past adjustments as poorly suited to Bangladesh's needs and ushered a period in which human vulnerability was the primary concern.

The development period is critical of the behavioural period for accepting the engineering period's focus on the physical environment and in the assumption that people *choose* to live in high-risk locations as opposed to being forced there (Blaikie et al. 1994; Wisner et al. 2004). Despite the differences, the development period has maintained and expanded the behavioural period's emphasis on the perceptions, beliefs and values of victims (Wisner et al. 2004). This shift toward social explanations of hazards has resulted in an understanding of flood management in which the physical world acts as a 'trigger', exposing already existing 'unequal power relations in an increasingly globalized world' (Blaikie et al. 1994; Pelling 2003; Wisner et al. 2004).

Governance during this period has followed the pattern set since independence, with corruption, vote rigging, *hartals* 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 support⁶. The most important government publications during this period include the National Water Management Plan (GoB 2001), the National Policy for Arsenic Mitigation (GoB 2004) and the forthcoming Bangladesh Water Act. These publications mark a departure from the earlier Krug, Master Plan and FAP studies. For example, the National Water Management Plan (GoB 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 discussions also recognize the important role of traditional fisheries (p. 26), gender equality (p. 45) and the poor (p. 69); similar comments are found throughout the National Water Policy (GoB 1999).

The divide between the government and academic literatures in the previous two periods is significantly more complicated within the development period. The government, following the emergence of the NGO community, has attempted to re-establish itself as a viable leader in water and disaster management. Alternatively, specialization within the academic field has significantly increased as a result of the continued interest of academics, governments and international organizations in water, flood and development. In addition to traditional geographical research (Ali 2007; Haque 1997b; Haque and Burton 2005; Haque and Etkin 2007; Hutton and Haque 2003; Mirza et al. 2001; Paul 2005; Paul and Rahman 2006; Rashid et al. 2007; Rasid and Haider 2003), interest in water and flood management has become divided among many interrelated fields⁷. Development studies have emerged as an umbrella field integrating most water-related research. In this context, geographical research has been co-opted as aspects of a broader development perspective, particularly economic and governance research (Ahmed 2001; Bayes 2001; Chadwick 2004; Chadwick et al. 2001; Develtere and Huybrechts 2005; Faisal and Parveen 2004; Matin and Taher 2001; Paul 2003; Rahman 1999; Sultana et al. 2008a; Thompson and Sultana 1996; Thompson et al. 2003). For example, the conceptualization of disasters and the economic analyses used to tally flood impacts are increasingly criticized for failing to account for the long-term, cumulative and human impacts (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 1999; del Ninno et al. 2002; Mallick et al. 2005; Smith and Petley 2009; Wescoat and White 2003).

The increased diversity presents researchers with a valuable range of knowledge but also isolates specialties with little cross-over. This is particularly evident between the physical and social sciences. Lack of cross-disciplinary communication is evident in the perpetuation of several arguments. For example, studies often argue that highland-lowland relations and deforestation are responsible for increasing flood damages in Bangladesh (Ali 2007; Gamble and Meentemeyer 1996; Khan 1996), though Höfer and Messerli (2006) and Ives (1991) have repeatedly shown that this connection is highly unlikely. A second example involves the notion of a 'bumper crop' following extreme flood events (Brammer 2004; Faisal and Parveen 2004; Mellor and Gavian 1987; Montgomery 1985). This argument is used to contest flood control, suggesting that the benefits to national agricultural outweigh losses in the flood zones. A number of studies show that crop losses do not explain famines (Mellor and Gavian 1987; Sen 1981) and that bumper crops do not aid those affected or prevent price escalation. A third argument is the notion that floods bring 'nourishing' silt that improves agriculture (Shaw 1989; Younus et al. 2005; Zaman 1993). This argument fails to appreciate that the majority of flooding in Bangladesh is rain-induced and that sediment-laden waters are predominantly confined to the immediate floodplain (Brammer 1990a, 2004)⁸.

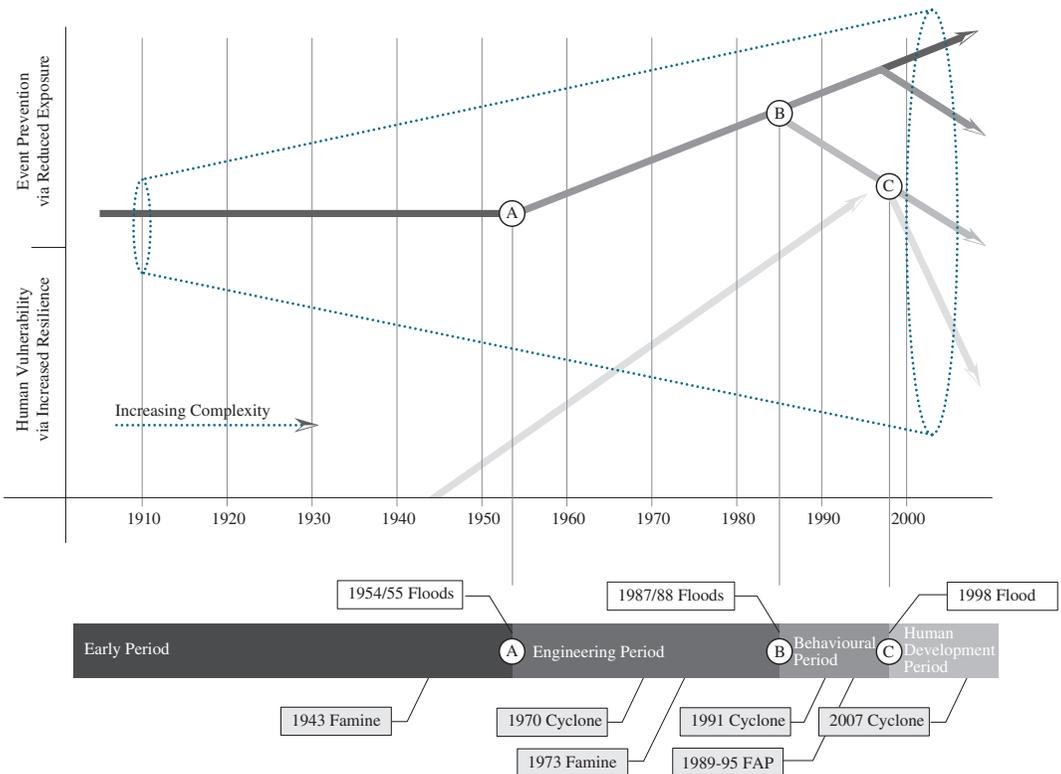


Fig. 1. Growing diversity of knowledge.

Discussion

Flood management is increasing in complexity, but it is equally evident that flood research has undergone a similar process. This complexity is in part explained by the accumulation of competing understandings (see Figure 1). In this sense, the growth of differing perspectives introduces knowledges founded on fundamentally different assumptions and objectives, for example, juxtaposing poverty reduction, gender equality, damage reduction and environmental sustainability. Figure 1 visualises the tendency of theoretical alternatives to fracture and accumulate, as opposed to the emergence and replacement of dominant understandings. Following this logic, I suggest that the engineering understanding was not replaced by the behavioural interpretation but entered into an ongoing competition; this process has been repeated with the emergence of a development perspective (Smith and Petley 2009). Rather than being disproved or replaced, conceptual frameworks and practices continue to contest management long after they have supposedly become obsolete. This incremental bifurcation and accumulation of competing interpretations helps explain the growing conflict, controversy and complexity surrounding flood management, pointing to the need for improved recognition of the competing knowledges, conceptualizations and objectives that underpin different interpretations. It is certain that the emergence of integrated and holistic analyses has broadened the scope of water and environmental management but, following this argument, it is equally important to extend this inclusiveness to the different conceptualizations, objectives and values influencing the issue.

A second finding drawn from this review is recognition that government-led flood management in Bangladesh has never prioritized damage reduction in the way that academic analyses presume. Instead, flood management has been used as a vehicle for both physical and social engineering⁹. Furthermore, despite the emphasis on deaths and damages within the academic literature, agricultural development has always been presented as the primary objective within government publications. This difference is fundamental as the two bodies of knowledge appear to be engaged without appreciation for the other's objectives or priorities; this is less a disagreement and more an example of 'talking past' one another. In addition, government literature is heterogeneous, with competing ministries and agencies advocating different objectives.

Third, in relation to methods, there is an unacknowledged, uncritical and growing acceptance of perception research in Bangladesh. In addition, the worldview that results from such victim-centred studies has gone unexamined in relation to the majority or national interests. The prominence of victims and minority groups presents a partial understanding and implicitly endorses the view that 'what is best for the poor/victim is best for Bangladesh'. There is no doubt that the poor experience disproportional hardships but debate is needed over the emphasis and direction of limited flood management resources.

Conclusion

This review has attempted to outline the important trends in flood management research in Bangladesh using key flood events to deepen the more common use of paradigms or periods. Upon reflection, this division represents a helpful tool for framing the discussion while also presenting difficulties. It is clear that the government literature is much more stratified, reflecting the pragmatic and grounded nature of government reports. Not surprisingly, in the case of disasters in Bangladesh, catastrophic events demand govern-

mental change. Alternatively, within the academic literature, the transitions are less apparent. Arguments take time to gain influence and the contested nature of peer-reviewed publication results in a climate of numerous opposing views, compared with one dominant interpretation, suggesting value in additional taxonomically-organised analyses. Although possibly self-evident, this represents a significant difference between the two bodies of knowledge, a difference that is rarely acknowledged within flood management research. I suggest that this disconnection requires that researchers acknowledge the differing priorities, objectives and knowledges rather than grouping flood research under a single banner.

The growing complexity and diversity of the literatures ensures that any attempt is partial. I hope that this discussion will prompt further debate in order to inform future management, particularly given the likely geographic and demographic changes and the probability of another catastrophic flood event.

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Short Biography

Brian Cook's research uses knowledge and knowledge controversies to analyse flood and water management in Bangladesh, Canada and Portugal. His current research focuses on the economic impact of floods on Bangladesh, the debate over technical and non-technical management, development and disasters and the numerous framings adopted to understand and contest management practices. Brian holds a BA from the University of Victoria (Canada), a MA from the University of Western Ontario (Canada) and is nearing completion of his doctoral degree at Durham University (UK).

Notes

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¹ 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.

² For excellent descriptions of Bangladesh's geography and climate see Brammer (1987), (1990) and (2004).

³ Two examples include the Green Revolution along with the funding and proliferation of large-scale dams.

⁴ Then composed of East Pakistan (now Bangladesh) and West Pakistan (now Pakistan)

⁵ For further discussion and analysis of the FAP see Boyce (1990), Rogers (1994) and Brammer (2004).

⁶ The caretaker government passed power to a newly elected government in December of 2009.

⁷ For example: gender studies (Coles and Wallace 2005; Koppen 1996; Paul 1999; Bhuiya & Chowdhury 2002) transboundary politics (Ahmad 2003; Ahmad & Ahmed 2003; Dixit 2003; Bricchieri-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 (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).

⁸ This author experienced another such argument during his 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,

⁹ For example, as an economic driver, an agricultural spark, a wealth distributor or a power solidifier.

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