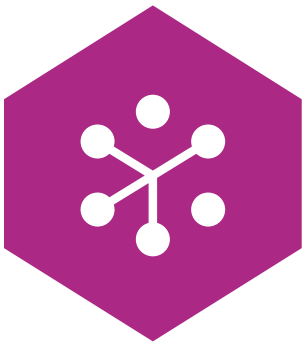

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MIR RABIUL ISLAM, VALERIE INGHAM, AND JOHN HICKS

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Flooding in Bangladesh: An In-Depth Analysis of Community Disaster Resilience Applying the "Production Model"

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Abstract: In a novel approach, this paper adapts the economic model of production and applies it to the production of community disaster resilience and psychosocial recovery. Utilising field data collected through in-depth interviews within three regions of Bangladesh, namely Sirajganj, Sunamganj, and Satkhira districts, we apply the "Production Model" to community disaster resilience and recovery, demonstrating that in the response phase local communities are almost entirely reliant on self-generated social capital. In the individual and community recovery phase, as with the preparation phase, the state is not relied upon to generate or organise adequate resources to rebuild communities. The proposed 'Production Model' demonstrates that an increase in state resourcing is necessary to better plan, respond and recover from flooding in Bangladesh. The model, in this specific case, clearly demonstrates that there is great potential for building community resilience through increasing the state disaster prevention activities, while the community contribution is already strained. Based on the field data, we conclude that in Bangladesh it is increasingly necessary to stabilise communities and build on their existing resilience strategies through greater government action, the provision of additional resources, and the development of strategies to ensure an integrated response by the government, NGOs, and the disaster-affected people.

Keywords: Human Environments, Sustainability, Bangladesh, Flooding

Introduction

The impact of flooding on life and livelihoods in Bangladesh provides the rationale to better understand and design improved systems to address the risks associated with seasonal flooding.

The literature on disaster management conceptualises disasters as comprising four phases: mitigation, planning/preparation, response and recovery, often shortened by collapsing mitigation, planning/ preparation into "preparation." Classifying disaster management into these phases was introduced by the National Governors Association in 1979 and has become the "platform" on which the study of disaster management has been built (McEntire et al. 2002; Rubin 2009). This classification has influenced overall approaches to disaster management and in doing so has raised wider questions about the theoretical assumptions upon which policies, systems and practice have come to be based. Approaching disaster management in terms of 'phases' has yet to be significantly challenged and despite some attempts at modifying this list, the phases of disaster have largely come to be regarded as "canonical" (Lettieri, Masella, and Radaelli 2009).

McEntire et al. (2002) caution against the use of a restrictive an interpretation of "the phases. For example, if the relevance of the phases was limited to the roles played by emergency managers, first responders and officials in the public sector" then the outcome would "be too restrictive and incomplete" (268). Reporting on Neal (1997), Lettieri et al. (2009) argued that the phases are "mutually inclusive and multidimensional because they are strongly interconnected" (126). Therefore, the phases can be regarded as interrelated and overlapping, so that, in effect, disaster management is ongoing and not confined to a particular hazard event, nor indeed, to a particular hazard. Viewed in this way we do not see the need to provide for additional phases such as strategy, learning and signalling as suggested by Lettieri et al. (2009) since such considerations can readily be incorporated in one or more of the existing phases of ongoing disaster response.

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Adopting a broader view of the phases of disaster management means that disaster management cannot be confined to a restricted set of actors. In each phase a range of "actors" participate in the processes of emergency management and help determine the outcome of the disaster or emergency event. In the broadest sense the range of actors covers all of society, but society, as actors, can be classified in many ways. McEntire et al. (2002) acknowledge the actors as coming from the public, private and non-profit sectors. Lettieri et al. (2009) choose to classify the actors into four roles in which they participate either directly (agents and researchers) or indirectly (population and media).

Although disasters can take many forms, the goal of the disaster management process must always be to ensure minimum harm to the threatened community, subject to the resource constraints of that community or made available to that community. That is, the resources available to the community for building resilience must be used to their best effect. On an ongoing basis, all of the actors (however classified) operate (for better or for worse) throughout all of the disaster phases to determine the social (including environmental) cost resulting from catastrophic events. The goal of the disaster management process is to minimise, subject to resource constraints, the social cost of disaster to the community. The extent to which the disaster management process is able to minimise social cost is a measure of the community's resilience. Put differently, increasing the community's resilience to disaster enhances the ability of the community to reduce the social cost of disaster.

The objective of this paper is to gain insight into policy for the building of community disaster resilience through the use of the production model from economics. Essentially we adopt the actor classification system of McEntire et al. (2002) and argue that disaster management response can come from the private (or social) sector, the public and non-profit (or institutional sector) or, more realistically, a combination of both. However, before building our production model of disaster resilience, we must spend some time defining the components of the model (disaster resilience, institutional disaster management response and social disaster management response) and placing these components into the real world context of our findings with respect to the response to flooding in Bangladesh.

Disaster Resilience

This paper is primarily concerned with the production of community resilience to disaster. The work of Manyena (2006, 437) speaks directly to this. Manyena (2006) reminds us that the definitions of resilience are "diverse, reflecting the complexity of society and thinking on society and disasters." Recognising the need for a definition to ensure effective communication amongst social scientists, Manyena (2006) points to the fact that resilience has generally been defined as either an outcome or as a process that leads to an outcome. Manyena views disaster resilience as "a deliberate process" (238) because this "places emphasis on the human role in disasters" (238). We certainly empathise with the desire to highlight the human role, however, Manyena's discourse results in the following statements:

> Disaster resilience is seen as a quality, characteristic or result that is generated or developed by the processes that foster or promote it…resilience is a goal that we should strive to achieve or a quality that we should try to attain. (2006, 238–9)

To the economists in our research team, these lines describe a production process that results in disaster resilience defined as an output or an outcome.

> Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need. (https://www.unisdr.org/we/inform/terminology)

Taking the approach of resilience as an 'outcome' and in conjunction with the UN statement, it is the building of disaster resilience that is the crucial aspect of the disaster management process. The absolute level of resilience is, from the perspective of policy and action, largely irrelevant to decision-making (although it will, of course, determine the aggregate social cost from a disaster). What is important from a policy perspective is what can be changed, through action or inaction at the margin.

Institutional Disaster Management (State Organisational Disaster Management)

Disaster management literature has been built upon practice which has arisen from the state as the primary source of disaster management. The role of the state is grounded in a legitimate responsibility to protect life and property. There is a concomitant legitimate authority vested in the state through government to give effect to that responsibility. This is overlayed by the reasonable assumption that natural disasters require extraordinary powers and methods of management in the sense that authority takes forms that are deemed to be more directive and enforcing than are their roles in non-emergency situations, even if these are at the expense of the established rights of citizens. Thus, there are the theoretical elements of bureaucracy, assumptions as to the efficacy of authority and formal structures and processes associated with militaristic models of control, and a predisposition to technological determinism, all of which have come to comprise the foundation of disaster management (Alexander 2002; Lindell, Perry, and Prater 2007; Phillips 2010).

In broad terms these state organised disaster management approaches enshrine the goals for improving disaster management without compromising the theoretical approach or the authority and rationality of organisations which deal with the practicality of disasters. In practice, disaster management organisations, charged with fulfilling the principal function of protecting life and property, behave as institutions. This practice-driven approach and the attendant literature, remains dominant in terms of the politics behind disaster management, including resourcing, training and application of ideas. This remains its strength. One branch of the literature, not uncritically, deals with extensions of the approach in order to accommodate adaptations to managing the inevitable and unpredictable disasters incorporated in practice [e.g., enhanced technological systems (Islam and Chik 2011), identification of flood-prone regions (Pielke 2000), improvement in management systems including human resource development (Haque 2003), flood hazard mapping (Osti, Tanaka, and Tokioka 2008) and the economics of flooding (Crompton and McAneney 2008; Freebairn 2006; Prosser and Peters 2010)]. That this overall approach continues to be the basis for practice was reflected in the aftermath of floods in eastern Australia in 2011. The Queensland State Government established an inquiry to identify lessons learnt and improvements in planning. The approach was reflected in the terms of reference, in particular:

> measures taken to inform the community and measures to protect life and private and public property, including
> - immediate management, response and recovery
> - resourcing, overall coordination and deployment of personnel and equipment
> - adequacy of equipment and communications systems; and
> - the adequacy of the community's response. (Holms 2012; http://www.floodcommission.qld.gov.au/about-the-commission/terms-of-reference/)

However, much of the emergent literature is critical of the approach, at least as it stands, beginning with Hewitt's (1983) human ecology critique (see for example, Alexander 2002; Cannon 2000). As a result a more broadly-based approach to disaster management in which the role of social capital gains relevance has emerged.

Social Disaster Management Response (Social Capital)

The established literature on social capital reflects a widespread argument that modern society has become more segmented in terms of a normative order and less cohesive in terms of its values. In general, social capital refers to the structures, processes and cultures that generate and maintain trust, cooperation and cohesion. Such characteristics of any society, while they take different forms, tend to include formal and informal organisations, are participatory and voluntary - as opposed to purely market-based - and are network-based rather than within established and orthodox functional structures. There is now an established foundation of social capital within sociology with a contingent theoretical and empirical development of the concept (Portes 1998).

One significant assumption is that social capital is collective by nature, and as such is intrinsically of more value in building and maintaining a normative order because of the underpinning of agreement, while institutions have to be underpinned by authority. However, there is also "bad" social capital, particularly in organisational forms such as authoritarian decision-making, exclusionary practices (e.g., sexist and racist closure) and illegitimate objectives and behaviour (e.g., organised crime). To some extent, the literature implies that social capital has untapped potential and is "good." Institutions, by contrast, were once "good" but have become weakened to the extent that they lack equivalent potential. Overall, a foundation for the efficacy of social capital has been cast in relation to developing countries through its role in economic development (Woolcock and Narayan 2000).

While much of the disaster literature has moved in the direction of social capital or socially constructed approaches (see for example, Hewitt 1983; Norris et al. 2008; Tierney 2007) which enhance community as the primary source of anticipated, credible and valued practice and possibly theory as opposed to the state, this emphasis is not unproblematic. The existence of state and community as actors in disaster management gives rise to a diversity of relationships which can be complementary, substitutional and conflictual. Some of the literature is attempting to move away from the state-community, and "technocratic-socially constructed" dichotomies towards integration, as approaches to disaster management (Gopalakrishnan and Okada 2007) and as a wider context of economic development (Woolcock and Narayan 2000). This means that the optimal approach to building disaster resilience will engage both the institutional and social approaches.

Bangladeshi Research Context and Research Method

The goal of the research undertaken in Bangladesh was to understand how respondents perceived their community's reaction to flood events in terms of institutional response (state response or NGO response), social (community) response or an integrated response utilising elements of both. The research, therefore, required an understanding of the region and the major flood related issues, which was drawn from secondary data. The next phase of the research involved a field expedition to Bangladesh where data was collected based on a qualitative, interpretivist methodology in recognition of the fact that a variety of interpretations of events and of their underlying causes was possible. The research team was conscious that in developing countries, such as Bangladesh, peoples' views are formed and maintained intersubjectively through collective social interactions and experiences. Thus, our approach necessitated the development of a rapport between the researchers and the respondents. Therefore, the interviews were conducted with the participants (often villagers and village elders) in the village and in the presence of the community. Such an ethnographic approach enabled responses to be contextualised through the use of independent notes taken by the researchers. The open-endedness of the research instrument also permitted the research direction to evolve. As this was a qualitative research project, semi-structured interviews were utilised to gather data from three regions which were selected for their broad differentiated geographical features (flash flooding, river erosion, and coastal flooding). The initial interview questions were devised from the relevant literature, in particular, the key concepts of substitutional,

complementary and conflictual relationships. To this were added questions seeking clarification, identification of causes and effects, patterns of facts and interpretation of meanings and the significance of these. The follow-up questions were unstructured and sought to add data about the process of flooding, particularly the different phases and approaches to managing floods as a process.

The aim of this selection was to identify differences and similarities of geographic, economic and social characteristics and community approaches to flooding. Twelve villages were selected with at least two villages in each region. In all, approximately thirty interviews were conducted. Since interviewees were drawn from government and community organisations, villagers, and people employed by or having experience with non-government organisations (NGOs), there was in some cases an overlap (an individual may have been interviewed as a villager and as an NGO employee, for example). The structure of the government disaster response hierarchy is depicted in Table 1.

Table 1: Structure of the Bangladesh disaster response hierarchy

Government Level	***Prime Person***	***Members***
National	Secretary (SEC)	Government, NGO's and civil society
District	District Commissioner (DC); the DC has responsibility for about four UNO's	Government, NGOs and civil society
Upazila	Upa-zila Nirbahi Officer (UNO)	Govt, NGOs and civil society, led by government
Union Council (sometimes called Union Parishad, or UP)	UP Chairman (sometimes a woman); this is a community elected position	No government people are on this council, although according to Mustafa the chairman, by virtue of their administrative position, belongs to local government (elected directly by people)

Source: Constructed from 2010 data collection.

Qualitative research was undertaken in twelve villages within three geographically diverse regions of Bangladesh: the northern plains at the foothills of the Assam Mountains in India's Meghalaya state, the central lowlands area and the southern coastal area (While there has been some research into flooding in Bangladesh and into relevant aspects of economic, political, and social life which have implications for how communities and institutions address flooding (Brouwer et al. 2007) this project contributes to the inventory of data and subsequent analysis from a multidisciplinary disaster management perspective. The research utilises the expanding literature which is developing the three phase approach to disaster management (preparation, response and recovery) and sociological literature exploring institutional (or organisational) and social capital literatures (Ingham et al. 2012).

The data was collected by the first two authors, one of whom is fluent in Bengali, the native language of the participants. Responses to questions were recorded (translated when necessary) and then transcribed by the researchers. A separate record of observations by the researchers was kept as notes for later referral as is appropriate for ethnographic research. This practice of memoing also served to ensure that an appropriate iteration of the data was undertaken as the data was reviewed, assisting in the verification of findings.

The transcripts and researchers' notes then underwent a process of data reduction with similar topics being coded so that similarly coded passages, by the same respondent and across respondents, could be considered at the same time. Once coded, responses underwent a process of abstraction in order to combine categories that appeared to belong together, and of comparison in order to understand the similarities and difference occurring in the responses. Selective coding was

used in order to build information on our three themes of preparation, response and recovery. The verification of the data relied, to a large extent, on this iterative process. However, emic validity was also important to the extent that different groups interviewed were asked to discuss findings derived from previous interviews with other participants and allowed the qualitative investigative procedure to evolve. In addition, an element of triangulation was possible as each of the five researchers (from different research backgrounds) independently analysed the data and the data was drawn from respondents with quite varied backgrounds. The reflections of the researchers, particularly the two researchers who undertook the field work, were regarded as an invaluable source of data. Table 2 provides a summary of the district locations and dates of interviews.

Table 2: Activity Chart of Data Collection, Bangladesh*

District	***Activity***
SUNAMGANJ (low lying northern floodplain)	28 November – 4 December 2010
SIRAJGANJ* (flash floods and river erosion)	6 December – 9 December 2010.
SATKHIRA (MUNSINGANJ) (coastal flooding)	December – 16 December 2010

* two further follow-up visits to Sirajganj were also made in 2012 and 2015 to validate the data.

The findings from this research, to be discussed below, were then used to contextualise the development of our theoretical production model of the production of community resilience to disaster.

Findings

The research approach and broad categorisation of findings and analysis follow the disaster management cycle of Prepare, Respond, Recover, and lastly we comment under Adaptation.

Preparation

Content analyses of the interviews and researcher notes indicated that the preparatory phase involved the principal issues of warnings, minimising flood levels through embankment-building and dredging, and provision for evacuation and post-evacuation periods. Warnings may take various forms and derive from various sources. They include official warnings from state authorities such as meteorological forecasts and announcements through broadcasting. In general, and despite access to electricity (including battery sources), official warnings coming through communication systems were regarded as not being disseminated widely, not timely and not reliable in each of the three regions studied.

The predominant effective form of warning in all areas derived from local experience and an understanding of weather, the sky, wind and the level and velocity of water. There was also evidence, in all three regions, of a failure of cooperation between the villagers and the Government. The established state (national and/or district) communication systems were often treated with scepticism by the villagers and the Government often used the warning systems for their own purposes. For example, during Cyclone Aila in 2009, a level 4 warning was issued in order not to panic the public (stay and defend) and was issued as Level 7 (evacuate) way too late—the place was flooded by then and over 300 lives were lost. Thus, in terms of our model, social capital predominated with respect to warnings (as illustrated by the shape of the production functions in Figure 4) and the resources available for institutional response were often wasted (suggesting that the country was operating at a point inside its available opportunities for building resilience).

In all areas, government officials who were interviewed consistently referred to the existence of government plans for flooding events. However, many also admitted that their implementation

depended on the provision of scarce resources. In the villages and surrounding areas in this study, the principal forms of preparation were dredging rivers and constructing embankments to prevent flood waters from invading and damaging and destroying crops, stock, and buildings. In some case, embankments were built by villagers out of bamboo but, regardless of the material, maintaining the strength of embankments was seen to be difficult. For this, government assistance was required and this was frequently not forthcoming. Exacerbating this problem was the fact the when government did act, it was reluctant to take the advice of locals, who, although lacking the resources to undertake the building of sophisticated infrastructure, considered they had experiential understanding of the best places for barriers to be constructed. As with the warning system, preparing the community for a flooding event was largely left to a social response, whereas a greater institutional response would have significantly increased the effectiveness of flooding preparation (as illustrated by the movement outward of the production function in Figure 4).

Reliance on social capital was also evident in other significant aspects of preparation. There was little evidence of extensive evacuation planning. However, in some villages there was the expectation that boats would be used to evacuate people to higher ground. There appeared to be a community body of knowledge, based upon experience as opposed to extensive government planning, that there were exit routes by road to reach higher ground, particularly sections of roads where people then lived for weeks or months. A related aspect of preparation is the provision of buildings, particularly public buildings such as schools, for shelter until flood levels recede. In a few cases, these were accompanied by community, government and NGO provision of stored food. However, other material, particularly firewood for cooking food, cooking pots, clothes and livestock, seemed in the main to be moved and distributed by the people and then assisted by government and NGOs after the flooding.

In the National Disaster Plan all NGOs have to 'filter' their plans and funding through at the national level, but we found that some NGOs were frustrated with the delays caused by this process and were initiating strategies and providing funding from the ground level, and that local villagers had more trust in the NGOs engaged in this practice rather than the national filtering system, which siphoned off funding and somehow lost impetus in the journey down to the grass roots level. Overall resilience could clearly be enhanced by eliminating the waste and corruption inherent in the application of institutional capital—which can also be illustrated by the movement outward of the production function in Figure 4.

Response

Regardless of the forms and extent of preparation, the response phase of disaster management starts at the time of initial disaster impact. Clearly, determining this point precisely is a matter of judgement, but it involves moving from a state of preparation to an acceptance that a disaster has begun or is inevitable, triggering an active response. One should keep in mind the fact that the concept of preparedness in Bangladesh does not match that in the West. The forms that response takes are in part influenced by preparation structures, systems and practices. In Bangladesh, preparation is very basic and the requisite features of western style preparation do not exist in forms which permit viable responses. Our research findings suggest that the imminence of a flood induces immediate decisions by people acting together to protect buildings, equipment, livestock, crops and life and/or to evacuate to safer areas. There is virtually no institutional response.

A clear priority was to make food supplies continuing, as in severe conditions home-based food preparation facilities (availability of cookers, fire wood and raw materials) are hampered. This was important, regardless of staying in or near the village or evacuating. Food aid was provided in some cases and the sources were government, NGOs, 'rich people' and union officials who seemed to be in positions of authority in relation to distribution. However, across all three regions, the main assistance was provided by the people themselves. When evacuation was necessary, it was primarily organised by the people and was by boat or foot to shelters, particularly

schools or other buildings provided by the government, or to the houses of relatives. Again, food was viewed as critical and was either taken with the evacuees or provided, in very limited amounts, in shelters or through government or NGOs. The range of time in shelters was two to twelve weeks. To the extent that there was evidence of officially organised responses, it appeared to be coming mainly from union committees.

Recovery

In the aftermath of flooding, the recovery phase consists of rebuilding private physical assets and public infrastructure. In developed countries, rebuilding is generally understood as the most important aspect of recovery, particularly so that people can return to their homes and public goods and services are repaired and/or replaced so as to return life to pre-flooding conditions. Rebuilding also re-establishes livelihoods.

In Bangladesh we found that rebuilding houses was largely the responsibility of the people. There were some sources of assistance, mainly through provision of building materials. These primarily arrived through NGOs, either directly to villagers or distributed through union councils. Provision of food, clean drinking water and medicines came from government or NGO sources. Some buildings were replaced while others were not.

A key aspect of rebuilding when disasters take the form of floods and earthquakes is that the land may no longer exist. This is a frequent occurrence throughout the three regions studied in Bangladesh. Land becomes inaccessible for many years while it lies under water, and typically ownership issues arise because of the loss of documentation during the intervening years. Clearly, livelihoods were interrupted, sometimes for months, because flood waters did not always recede quickly and people who had been evacuated are unable to return to their villages and farms. People reported that Government and NGO payments and food distribution assisted in sustaining people until they could resume their work. In re-establishing livelihoods, NGOs were also involved in the supply of seed, fertilizer and small loans. People could also receive support from relatives and sell assets.

Adaptation

One of the key findings of the research was the evidence of how the people, over time, have been adapting in a variety of ways to their experience of flooding and the resulting changing nature of the Bangladeshi economy. Given the geography of Bangladesh, the frequency of flooding and the damage done to life and livelihoods, recovery in the forms of constructing or repairing homes and other buildings and re-establishing farms to the point where they can produce at sufficient levels to sustain producers and provide a platform for local economies, may be temporary. Therefore, in pursuit of a more reliable basis for their livelihoods, it was found that people adapt, principally by changing what they produce and by migrating to other areas of Bangladesh. For farmers, this tended to be as “day labourers.” Earlier research found that people were seeking to increase income by shifting from farming to other occupations which involved internal and external migration (Nargis and Hossain 2006). In addition, Khandker (2009) argues that improvements in infrastructure, access to micro-credit and increased mobility in labour markets, has reduced the seasonal fluctuation in rural income. Diversity of income sources seems to provide a more consistent income flow and Khandker argues should be supported by an extension of a range of infrastructure and transfer payment policies.

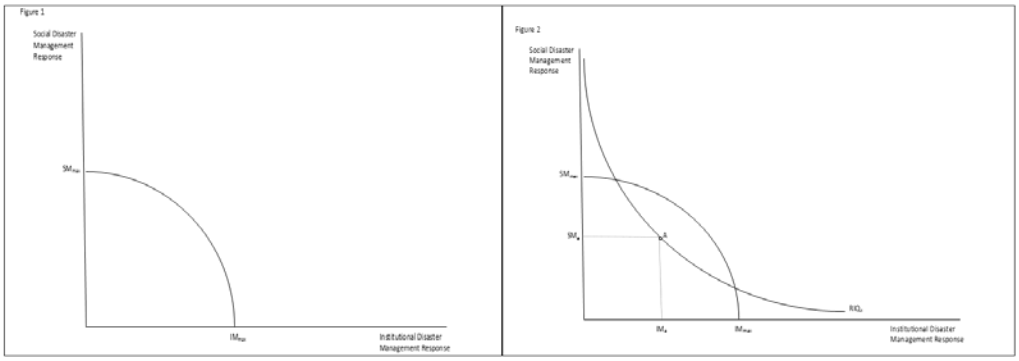
Apart from migration, the other form of adaptation to emerge from the research was shifting from crops and livestock to farming shrimp. Alauddin and Hamid (1999) note the “remarkable expansion of shrimp farming” but also its social and environmental costs. While it was recognised by those interviewed that, unlike rice farming, shrimp farming was certain to produce a result, there was clearly a cost. Although shrimp farming moved land usage from subsistence agriculture to a market oriented activity, it created a number of problems. The first was that the ability of the

population to feed itself was reduced—subsistence crops were not being grown. The second was that the processes of shrimp farming—which involved putting holes in the levies to provide access to water (necessary for the survival of the shrimp)—weakened the integrity of the levies and made them more liable to collapse in time of flood. Thus the shrimp farms were seen by many local officials to be against the short-term interests of the non-shrimp farmers but also, in the long-run, against the interests of the shrimp farmers themselves.

Introducing the "Production Model"

Building on the foregoing analysis, we now build our theoretical model of the production of resilience to disaster. It is possible to view both institutional and social responses to disaster management as inputs for generating resilience. If we assume that all of the resources available to an economy for disaster management response are applied to institutional disaster management response, the maximum level of institutional disaster management response achieved will be IM_{max} as shown in Figure 1. Alternatively, if the same available resources are all applied entirely to generating social disaster management response, the maximum level of social disaster management response will be SM_{max}. The concave curve joining these two points represents all of the various combinations of institutional disaster management response and social disaster management response that can be achieved with the given level of resources available for disaster management response. As with any production possibility frontier, convexity reflects the fact that, as you switch resources from producing one form of disaster management response in order to increase the production of the alternative form of disaster management response, the resources transferred become less efficient at producing the latter. In terms of generating resilience, this disaster management production possibility frontier determines the maximum possible inputs of institutional disaster management response and social disaster management response available for the generation of resilience. Thus our production possibility frontier for disaster management represents our budget constraint for the creation of resilience.

Resilience is created by combining institutional and social disaster management activities. Any given level of resilience will exhibit a mixture of both institutional and social disaster management responses. As shown in Figure 2, this can be represented by a point on an iso-quant such as point *A* on iso-quant RIQ_x which provides the level of resilience represented by iso-quant RIQ_x through an input of SM_a social disaster management response and of IM_a institutional disaster management response. The iso-quant RIQ_x depicts a given level of resilience that can be attained by the range of combinations of social disaster management response and institutional disaster management response given along this curve. As is normal, iso-quants above RIQ_x depict the combinations of the two inputs that produce higher levels of resilience and iso-quants below RIQ_x represent lower levels of resilience.



Figures 1 and 2: Introducing the "Production Model" depicting community and institutional inputs.

Figure 3 combines both diagrams for our hypothetical community. As depicted, this community, if operating at point A, is not making use of all of the resources available to it for the building of resilience. For example, without impacting on the level of institutional response, the community could increase its social response and move to point B. Alternatively, without impacting on its level of social response, the community could move to point C by increasing its institutional response. For convenience we depict both changes as bringing us to the same, higher, level of resilience as depicted by the iso-quant RIQ_y. Thus, the first issue that needs to be addressed for any disaster prone community is whether or not the community is utilising all of the resources available to it for the building resilience? However, at B or C, despite the fact that the disaster management resources of the community are fully utilised, the community has still not maximised the level of resilience attainable by the community. Only by operating at point D, where RIQ_z can be attained with inputs of SM_b and IM_b can the community's resilience, attainable with its existing resources, be maximised. Thus, the second issue we must address in relation to a given disaster prone community is whether the best use of all of the resources available to the community is being made.

Our primary interest is in actions to enhance resilience. The foregoing discussion has considered two possibilities (i) fully utilising all of the resources that are available and (ii) efficiently utilising all of the resources that are available. However, we can go further. The budget constraint itself can be changed as actions are taken to increase the resources available for both institutional disaster management response and social disaster management response. Increased resources for the production of both types of response can be derived from a number of sources. For example, as the benefits of increasing resilience become increasingly recognised, resources may be moved from other uses; as economies grow, increased resources will be made available for all uses—including the building of resilience; increased education levels of the community may give rise to an increase in both types of response and, for poor countries, international aid can raise the level of resources available to enhance resilience while improved transparency in public decision making can enhance the effectiveness of institutional responses. In terms of the model constructed, such changes will result in a shifting out of the budget constraint given by the production possibilities curve and result in the potential attainment of a higher iso-quant reflecting a higher level of resilience. Thus the third approach to increasing resilience is to produce an increase in the resources available.

However, communities (and countries) will differ substantially in the resources they can bring to bear in building resilience. Western economies, with substantial infrastructure and well-functioning political and administrative systems, are likely to be in a position where their ability to produce institutional inputs for building resilience is relatively greater than building social responses. Poorer countries, such as Bangladesh—the country this study addresses, are likely to show greater relative dependence on social disaster management responses in achieving their much lower level of resilience. For example, when aggregating our major themes explicated under 'Findings' we can hypothesise that resilience building in Bangladesh is represented by Figure 4 where, if the country were operating efficiently, input of social disaster management response would be relatively much greater than the institutional disaster management response. The level of resilience attained would be given by the RIQ_a. If, as our model suggests, this is the case for Bangladesh, then future policy should concentrate more on building institutional disaster management response. This is illustrated in Figure 4 where a doubling of institutional disaster capacity would result in a much higher level of resilience being attained (RIQ_b) than would a similar increase in the maximum level of social disaster management response which would bring us to RIQ_c.

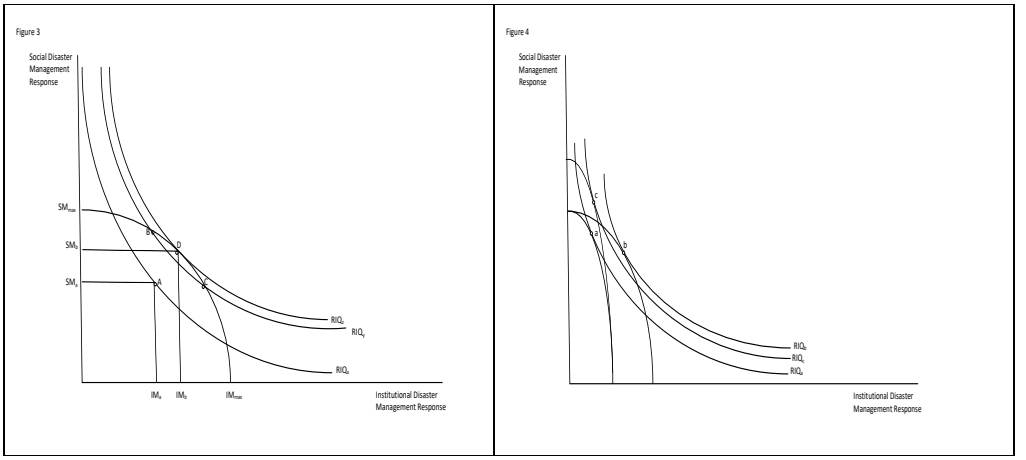


Figure 3 and 4: Hypothesising resilience building in Bangladesh.

Where there is a relatively even spread of activity between the two constructs, we would expect that the interaction between the two would be dominated by complementary relationships. Where activity is strongly biased to either the institutional or the social, we might expect either substitutionary or conflictual relationships to dominate. Further, it might reasonably be expected that relationships will change over time along with changing circumstances and responses to them. Where the relationships are complementary, and therefore reinforcing, we would expect the quality of activity to improve overtime. Where relationships are substitutionary or conflictual, the effectiveness of action may well show a decline over time and lead to a decline in resilience.

Thus, in terms of our current research we can ask three questions: (1) What is the extent of the integration between state, NGOs and community in the response to flooding in the case of Bangladesh in each of the three phases of preparation, response and recovery? (2) To what extent can the activities of each group be seen to be complementary, a substitute or creating conflict in any existing integrated relationship? (3) How is the ongoing adaptation to flooding impacting on response, and therefore on the maintenance, of resilience?

Analysis and Discussion

Our research results indicate that the state purports to play a role in all phases of flooding. However, notwithstanding the preparation and documentation of flood plans, the stated intentions of the national government fail to be implemented at lower levels because of both a lack of understanding of the functions expected at each level and a lack of resources necessary for flood plan implementation. The main deficiency during the preparation phase is the lack of infrastructure provision. Where infrastructure is provided, there is a marked lack of cooperation and coordination between government organisations and locals to ensure that any infrastructure provided is located to the best advantage. NGOs endeavour to provide assistance to villagers, but they are also restricted in what they can do both by lack of funding and by government regulations. Thus, preparation is poor and largely restricted to activities villagers can undertake using their own resources. We consider that preparation for disaster will be significantly enhanced by increasing institutional capital. This will then feed and increase the available social capital for building community capacity. As illustrated in Figure 4, in Bangladesh a rise in social capital has relatively less impact than a similar increase in institutional capital. Further, it is apparent that preparation is hampered by the failure to make full use of the available resources provided for institutional capital

because of inefficiency and corruption. Eliminating either would shift the constraint on building resilience to the right in Figure 4.

Similar issues arise with respect to the response during a flood which are highlighted in other contemporary research in Bangladesh (e.g., Dewan 2015). For example, there is a lack of infrastructure to evacuate people from the most threatened parts of the country. State organisations such as the armed forces, police or a specific disaster management organisation do not appear to be able to evacuate people by roads and rivers on a widespread and consistent basis. Thus the principal form of response is collective, with villagers assisting each other to evacuate. This generally involved transporting people by boat and walking in groups to higher ground to get to roads which were likely to be elevated and thus safer. It was clear that there was sufficient trust and established relations between families to organise and engage in evacuation. In a few cases, this was supplemented by village leaders and union council members organising evacuation routes and arranging for buildings to be made available for shelters. In this sense, the clear line between state disaster management organisation at the village level and social capital emanating from within villages to respond to floods was to some extent blurred – although any response was clearly dependent on the latter. However, in general, placing greater emphasis on finding the resources to augment the institutional response would do more to raise resilience than increased reliance on social capital (as illustrated in Figure 4).

In general, the evidence we gathered suggested that social capital was especially prominent during the response phase compared with the preparation and recovery phases. Indeed, this was necessary given that there was certainly less state disaster management organisation in the response phase than in the other phases. That is, in the response phase, there was little in the way of structures, systems and resources from government. The provision of this institutional response would greatly enhance the building of resilience.

This is equally true in the recovery phase. The government's role in recovery was also significantly flawed. Apart from some repair and rebuilding in relation to infrastructure and replacement of lost resources necessary for farming, particularly seed, the government's role was virtually non-existent in the recovery phase. The evidence indicates that in recovery, villagers were largely left to their own devices and to any assistance that could be provided by NGOs. Throughout the disaster phases, our findings confirmed that unlike some developed countries where disaster management is largely, if not totally, conducted by government and government-funded voluntary organisations, disaster management in Bangladesh was primarily a social response with some of the 'gaps' created by the failure of government to act being covered by NGOs. Notwithstanding the assistance of NGOs, building resilience will be more quickly achieved through increasing the level of institutional capital.

It appears that the key manifestations to managing floods in Bangladesh reflect a patchwork of complementarity, substitution and conflict—but with the latter two tending to predominate. Where government provided some of the infrastructure, for example large projects such as building roads, embankments and dredging, it theoretically served as a complementary form of the state-community relationship. However, this was inadequate and the complementarity became or remained thin. Local knowledge of weather patterns is substituted for state warning systems, social capital substitutes for the provision of state infrastructure, resources from NGOs substitute for resources from state authorities. Indeed, the state-NGO relationship was predominantly substitutional because villagers viewed the state and NGOs as alternative sources of disaster management. Substitution may well be a viable form of relationship, but beyond clear roles there still needs to be coordination within a planning and operational framework. Increased cooperation, even without any additional resources being brought to bear on the situation, would substantially raise community resilience through the increased institutional capital that it would generate.

In connecting state and NGO organisational disaster management to social capital within communities, the findings here indicate that the relationship at times became conflictual. This seemed to arise because of distrust of the state and it came through the interviews in various forms

and particularly through all disaster phases. To the extent that such a conflictual relationship exists, institutional capital is reduced, lowering community resilience.

That people in communities have developed a sufficiency of trust, building networks outside of disasters and reciprocity was evident and could reasonably be said to have assisted in established social capital such that it was activated especially during the response phases of flooding, that is to say when it was most needed. However, this did not appear to be a static situation.

As migration and changes to agricultural practices continue as part of the villagers' adaptation to flooding, they are resulting in a decline in community resilience which, in the past, has depended on relationships and cooperation between neighbours. One implication of this is the questioning of the potential for social capital to remain in forms which are compatible with mutual assistance when confronted by floods.

Exacerbating this trend is the fact that in the light of the costs of dealing with flooding in the extensive, frequent and repetitive forms that it takes in Bangladesh, it is tempting for governments to support relocation or changes to land use rather than attempt to minimise flooding effects through the expenditure on large embankment and dredging projects. It is here that the relationship between the state and local communities can be expressed in conflictual terms.

Conclusion

The findings of this study highlight the importance of considering the nature of the inputs into the generation of flooding resilience so that future planning can target those inputs that will have the greatest impact on building resilience. Further, our results indicate that there is explanatory value in following flooding as a process of the three broad phases of disaster management: preparedness, response and recovery. There is also value in comparing the relative importance of state organisational disaster management with that of a socially constructed approach which emphasises the role of social capital. The introduction of the "Production Model" provides an initial representation of community and institutional inputs. The strength of the model lies in its visual demonstration of the consequences when inputs are changed, in this case when overall institutional inputs are increased. We acknowledge that this "visual demonstration" provides only a general sense of "input-output," as technically speaking we have not quantified our themes and cannot state by exactly how much resilience would be enhanced by a greater focus on the institutional approach to building resilience. In Bangladesh, and in the preparation phase, the evidence indicates a deficiency of government in economic, but probably also political, resources to construct, maintain and repair necessary infrastructure, particularly embankments and dredging. There is also a significant weakness in warning systems and government evacuation planning. To some extent this is mitigated by community preparation assisted by NGOs as a substitute for government action, although to a limited extent, there is a complementary provision of minor services by the government. However, in the response phase, the state is frequently absent with the local communities almost entirely reliant on the existence of social capital in their battle against flooding. In the recovery phase, there is again some mixing of approaches in practice, but as with the preparation phase, the state does not generate and organise adequate resources to rebuild communities. While the people can do some of the necessary recovery themselves, they are very dependent on the complementary role of the NGOs which substitute for government.

Our research also established that there is a process of adaptation occurring throughout all the disaster phases, importantly in terms of developing resilient livelihoods. This is reflected in migration to areas where new or extended livelihoods can be practiced and made less susceptible to risk. It may involve resettlement, such that people do not return to their villages. Where people remain in or near their villages, the adaptation may involve changing to different farm products, methods and different types of occupations, which to some degree seems to diversify yet also make less volatile their income. The adaptation in livelihoods also came at a cost. Diversifying work roles appears to break down the social capital that has been built up in certain areas.

Even at a generalised level across the sources of data collection, particularly villages in the three different regions, we could only record a diversity of relationships between government organisations on the one hand and people on the other. These were reflected in episodes of complementarity where cooperation and coordination were apparent, but more often there appeared to be gaps (i.e., steps missing from processes) or bottlenecks (i.e., an excess of planning but unconnected to implementation). This was exhibited in substitution as a type of relationship, where people provided the missing step which ideally could have been provided by government. The other dimension to this was the substitution of government disaster management by NGOs. At times, it appeared that the government, people and NGOs became entangled in conflict without resolution because of the inadequacy of resources to establish a sustainable relationship. In Bangladesh, this calls for greater government action, the provision of additional resources and the development of strategies to ensure that the integrated response of government, NGOs and the people is increasingly complementary, rather than substitutionary or conflictual.

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