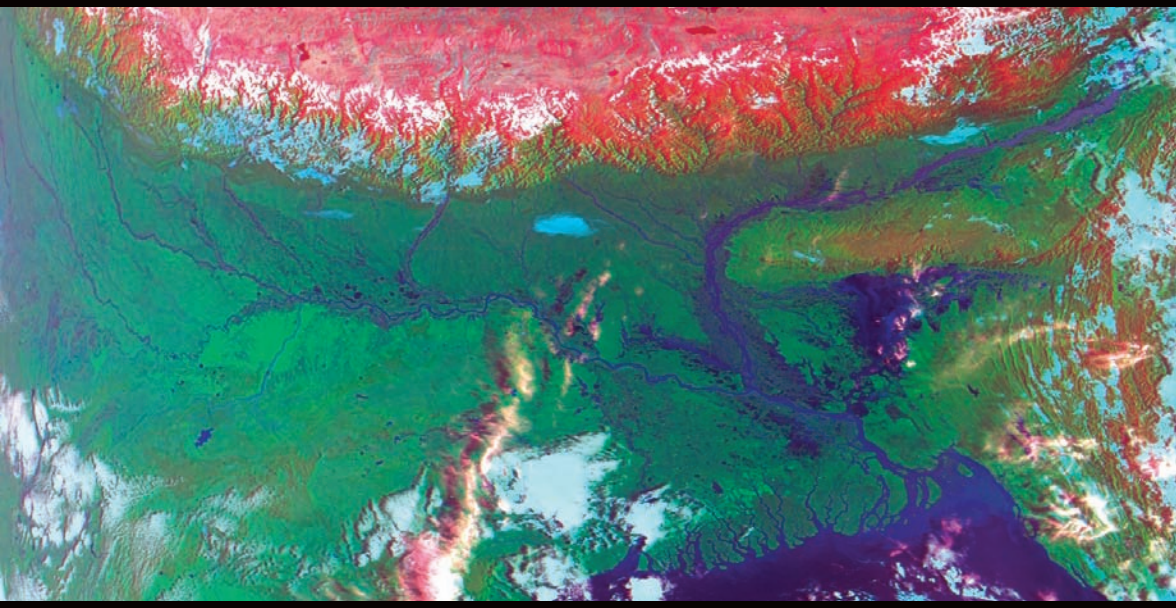
Floods in Bangladesh

History, Dynamics and Rethinking the Role of the Himalayas



Thomas Hofer and Bruno Messerli

Floods in Bangladesh: History, dynamics and rethinking the role of the Himalayas

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The project on Bangladesh floods: Background, framework and key questions

1.1. The theory of Himalayan degradation: Traditional understanding and emerging doubts

Almost every year during the monsoon season, floods in India and Bangladesh appear in the headlines of the media. The few examples quoted in Box 1.1 show that such news items are common in the national and international press as well as in international organizations. The headlines are noteworthy because they

- assume that the frequency and severity of flooding in Bangladesh have increased;
- state that there is a direct link between the hydro-meteorological processes in the Himalayas and the floods in the lowlands;
- state that it is the rapid forest removal in the mountains that is responsible for the intensification of the hydrological processes in the plains;
- accuse mountain people and other users of mountain forests of being responsible for the presumably increasing flood frequency in the surrounding lowlands; and
- state that floods are a key problem in Bangladesh that must and can be resolved.

This line of thinking regarding the impact of human activities in the Himalayas on the hydrological processes in the lowlands is politically very sensitive, because the Ganga and the Brahmaputra are international river systems. The assumptions are based on the following traditional and superficially convincing understanding of the sequential processes:

Box 1.1 Media headlines referring to Bangladesh floods

- ''Nepal has lost half its forest cover within a thirty-year period (1950–1980) and by AD 2000 no accessible forest will remain.'' (World Bank 1979)
- ''The severity of the recent floods in Bangladesh has led the government to look for a flood plan which would, in the long term, provide a comprehensive and permanent solution to the recent flood problem and so to create an environment for sustained economic growth and social improvement.'' (World Bank 1989)
- ''Bangladesh in grave danger: deforestation in Himalayas aggravating floods.'' (*Bangladesh Observer*, 2 June 1990)
- ''When the Himalayas were covered in trees, Bangladesh suffered a major flood about twice a century; one every four years is now the average.'' (UNEP 1992)
- ''The severe floods in eastern India and Bangladesh are not the result of a natural disaster, but of a ruthless exploitation of wood which has been practised over centuries in the forests of the Himalayas.'' (*Basler Zeitung*, 15 September 1998)

population growth in the mountains → increasing demand for fuel wood, fodder and timber → uncontrolled forest removal in increasingly marginal areas → intensified erosion and peak flows in the rivers → severe flooding and siltation on the densely populated and cultivated plains of the Ganga and Brahmaputra. These conclusions have been subscribed to by some scientists, have been adopted by many politicians, and have been used to derive development strategies (Ives and Messerli 1984, 1989). For politicians, this supposedly scientific chain of events has been useful in times of flood-related crises to pin the blame on the peasantry of remote mountain areas. The mountain population, meanwhile, has been acquiescent in accepting the blame because bad science was presented to them as a ''fait accompli'', and also because development agencies funded reforestation programmes.

There is no doubt that the Himalayas and their forelands have undergone a dynamic change in land use in recent decades owing to rapid population growth. However, mainly in the scientific community, this ''theory of Himalayan degradation'' has been increasingly questioned (Ives 1987): Are the highland–lowland linkages really as simple as that? Do we have the scientific fundamentals needed to justify the politically explosive accusation that the mountain inhabitants are responsible for the apparently increasing flood processes in the lowlands? Furthermore, is it really true that the Himalayas are being deprived of their forest cover at a rapid

rate? And, is it confirmed by the affected people in the floodplains of Bangladesh that inundations are their most severe problem?

1.2. The highlands – and their lowland linkages: Twelve years of research on Himalayan ecology

In 1979, the University of Bern and the University of Boulder, Colorado, together with many other institutions and individuals worldwide, joined in this discussion with the aim of promoting a more serious scientific analysis with regard to the crucial questions outlined above. The overall concern of this research, which from 1979 to 1991 focused primarily on the highlands, has always been the impact of human activities on the environment, together with the ecological interaction between the Himalayas and the adjacent lowlands of the Ganga and Brahmaputra. Most of the work has been carried out under the ''Highland–Lowland Interactive Systems Project'' of the United Nations University (UNU), a programme that was initiated by Jack Ives and Bruno Messerli. The main research activity under this project was entitled ''Mountain hazards mapping in Nepal''. It had one test area in the Middle Mountains in Kakani near Kathmandu and a second in the High Mountains in the Khumbu region. The publications and maps that resulted from these project activities are still of great value and interest today: they document various processes and particularly the changes in landscapes and hazardous areas during the past 20 years (Ives and Messerli 1981; Kienholz et al. 1983, 1984; Zimmermann et al. 1986; Vuichard and Zimmermann 1987). During this period of fieldwork, a new contact of cooperation and friendship was established with the Canadian team of Hans Schreier, who was working in the Jhikhu Khola, 40 km east of Kathmandu, in a highly interdisciplinary and integrated project (Schreier and Wymann von Dach 1996; Schreier et al. 2000; Carver and Schreier 1995). These projects and the growing field experience created new ideas, which we began to explore with several master's theses: erosion and sediment transport in relation to land use (Lauterburg 1985); the discharge characteristics of Himalayan rivers (Hofer 1989); forest cover change and forest history. Some of these efforts were general or large-scale studies (Wyss 1988); others concentrated on specific areas or case studies. Although the focus was on the highlands, an attempt was made to relate the findings to the processes in the plains, for example to flooding and sedimentation. The results of all these research activities were discussed in three major publications (Ives and Messerli 1989; Messerli et al. 1993; Ives 2004), as well as in a number of articles (Messerli and Hofer 1992, 1995; Hofer 1993). The findings presented in these publications received considerable support and confir-

mation from other authors, including Goswami (1983), Hamilton (1987), Bruijnzeel and Bremmer (1989), Rogers et al. (1989) and Agarwal and Narain (1991). In summary, all these authors agree on the following basic key points:

1. Highland–lowland interactive processes exist and they are fundamental. Without the Himalayas there would be only very low precipitation, no permanent rivers and only low-potential land on the plains.
2. It has not been possible to find a significant correlation between human activities in the mountains (e.g. forest removal) and catastrophes on the plains (e.g. floods).
3. The impact of human activities on physical processes seems to be specific to different geographical scales: human-induced ecological changes can be proven in some specific examples at the local, small-scale level; in medium-sized catchments, high levels of intense rainfall and natural hazards are much more significant; in large catchments, finally, human influences are concealed by the overwhelming dimensions of natural processes. It is therefore not admissible to extrapolate results from a small watershed in the Himalayas to the scale of the entire Ganga-Brahmaputra basin.
4. Eroded material in the mountains is moved into temporary storages in river beds, valleys and intramontane basins. Sediments produced through human-made degradation over recent decades will not reach the floodplain immediately, but will take decades or even centuries to get there. Accordingly, human activities in the highlands do not have an immediate effect on the floodplain in the lowlands.
5. Statements on forest removal and its effects should not be generalized: in certain areas of the Himalayas, forest cover has increased over the past few decades. Forest removal does not necessarily lead to degradation of soil and water resources. If forests are replaced by well-maintained agricultural terraces or other adapted and sustainably managed land-use systems, erosion and runoff are not greater than in a forested area.

These important and challenging results were very often based on short-term series of measurements, a few experimental plots, or case studies. It became very clear that more effort was needed to further verify, quantify and document these tentative conclusions in favour of a long-term sustainable development in the greater Himalayan region.

1.3. The lowlands – and their highland linkages: Research on ‘‘Floods in Bangladesh’’

As a follow-up to the research activities between 1979 and 1991 in the Himalayan highlands, in 1992 the focus was shifted to the lowlands of

the Ganga, Brahmaputra and Meghna rivers. The most important and obvious objective was to verify the research findings in the highlands by focusing on the flood processes and flood history in the lowlands, and in Bangladesh in particular. However, there was a very important additional rationale: in 1988, Bangladesh was hit by one of the most severe floods of the twentieth century. This event aroused significant international concern and triggered the Bangladesh Action Plan for Flood Control (World Bank 1989; see also section 7.6). One important original objective of this plan was to control floods in Bangladesh by strengthening and expanding the embankment network along the main river courses. This approach, which today has fortunately been significantly modified, provoked vigorous debate and controversy between the various interested aid organizations and governmental institutions in the early 1990s (e.g. Adnan 1991, 1993; Adnan et al. 1992). Because of its strong commitment in Bangladesh, the Swiss Agency for Development and Cooperation (SDC) was confronted with this controversial discussion about flood management and was therefore particularly interested in obtaining more basic information on flood processes, on perceptions of floods by the affected people, and on their experiences with flood protection embankments. Accordingly, the resulting project document was a joint exercise between the University of Bern and SDC, in which R&D-oriented interests merged.

The overall approach of the project was to look at floods from different angles and perspectives (Figure 1.1), to satisfy both natural and social science enquiries and to accommodate, through this interdisciplinary approach, research as well as development interests. The analysis of flood processes and people's perceptions of floods were the core themes of the project. Based on an extended literature review, major knowledge gaps were identified for the following thematic areas:

- looking at Bangladesh floods on a broad geographical scale, in particular in the context of highland–lowland linkages;
- the thorough use of different historical sources and long-term records to understand the frequency of floods in Bangladesh;
- the investigation of different flood processes with the same methodological approaches in order to ascertain common or divergent key elements that lead to flooding.

In the course of the project, the very dynamic shifting of the main rivers in Bangladesh was identified as a major hazard for the affected population and therefore a component on river morphology was added to the agenda of the project activities.

The official launch of the project was preceded by an extended preparatory phase during which the feasibility of the project ideas was assessed in terms of data availability. Some milestones of this preparatory period were:

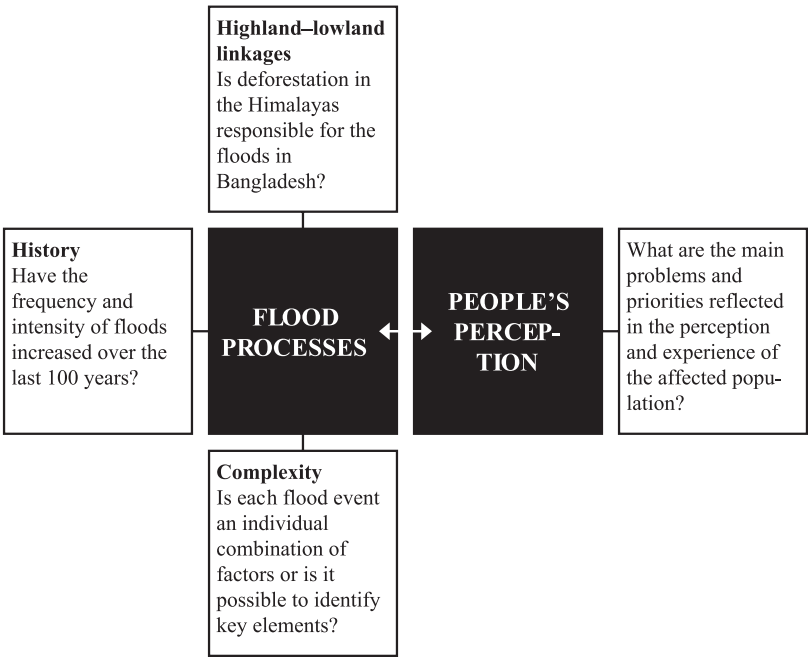

Figure 1.1 The ''Floods in Bangladesh'' project: The key questions.

- work at the East–West Center in Hawaii to establish important contacts and to collect key hydrological information for the Ganga–Brahmaputra basin;
- a visit to the NASA Space Flight Center in Washington DC, which provided access to an archive of NOAA Satellite images at the European Commission's Joint Research Centre in Ispra, Italy; and
- a visit to the India Office Library in London to collect historical rainfall data and flood descriptions in newspapers and maps.

The project officially started in July 1992 and ended in December 1996. Follow-up activities continued beyond the official project phase: the project synthesis was published in 1997 (Hofer and Messerli 1997) and the project was officially presented and discussed in Bangladesh in January 1998. Further data analysis for the updating of results and the inclusion of more recent flood events as well as editing work for the present publication continued steadily through mid-2004. During 2002 the editing process was delayed because of the International Year of Mountains, in whose implementation both of us were heavily involved.

The broad scope of the project goals, together with the approach of looking at flooding from different perspectives, imposed some important and interesting methodological challenges:

- Work had to be carried out at different geographical scales (Figure 1.2): for the investigation of Bangladesh floods in the context of highland–lowland linkages as well as for the analysis of flood history, the entire basin of the Ganga, Brahmaputra and Meghna rivers was taken into consideration (macro-scale); work related to the complexity of flooding and to river morphology focused on the territory of Bangladesh (meso-scale); the investigation of people's flood perceptions and of their indigenous strategies for flood management was carried out in three test areas located in the Bangladesh floodplains near the major river courses (micro-scale).
- The overall project objectives could be achieved only by applying interdisciplinary approaches. The combination of physical sciences for the investigation of the flood processes and social sciences for studies related to people's perceptions and experiences was particularly important. Similarly, the combination of both basic and applied research was of special importance as well.
- A variety of methodological approaches including statistical analysis, regionalization exercises, remote sensing, mapping and interview techniques had to be applied in the different project components. The investigation of floods in the context of highland–lowland linkages and of their complexity was based on case studies; the reconstruction of flood history was based on data series.
- In the framework of the research activities in the overall Himalayan area, fieldwork has always been a key component and accordingly was given high priority in this project. For almost two years, fieldwork in the three test areas within Bangladesh (Figure 1.2) was carried out with the specific intention of gaining an understanding of people's perceptions and experiences. A highlight in the final phase of the fieldwork was an expedition in September and October 1994 from the Darjiling Himalayas through Assam and the Meghalaya Hills down to the Bay of Bengal. During this expedition the entire project team had the unique opportunity to observe and discuss climatology, hydrology, geomorphology, floods and other hazards, agricultural systems, land-use techniques, indigenous strategies to cope with a dynamic environment, and so on, at the different zones and levels of the highland–lowland system. This lively outdoor seminar allowed every team member to develop the necessary overview and to rethink and integrate his or her highly specialized field of investigation into the complex and interdisciplinary framework of the whole project. The itinerary of the excursion is documented in Figure 1.3 (see also Hofer et al. 1996).

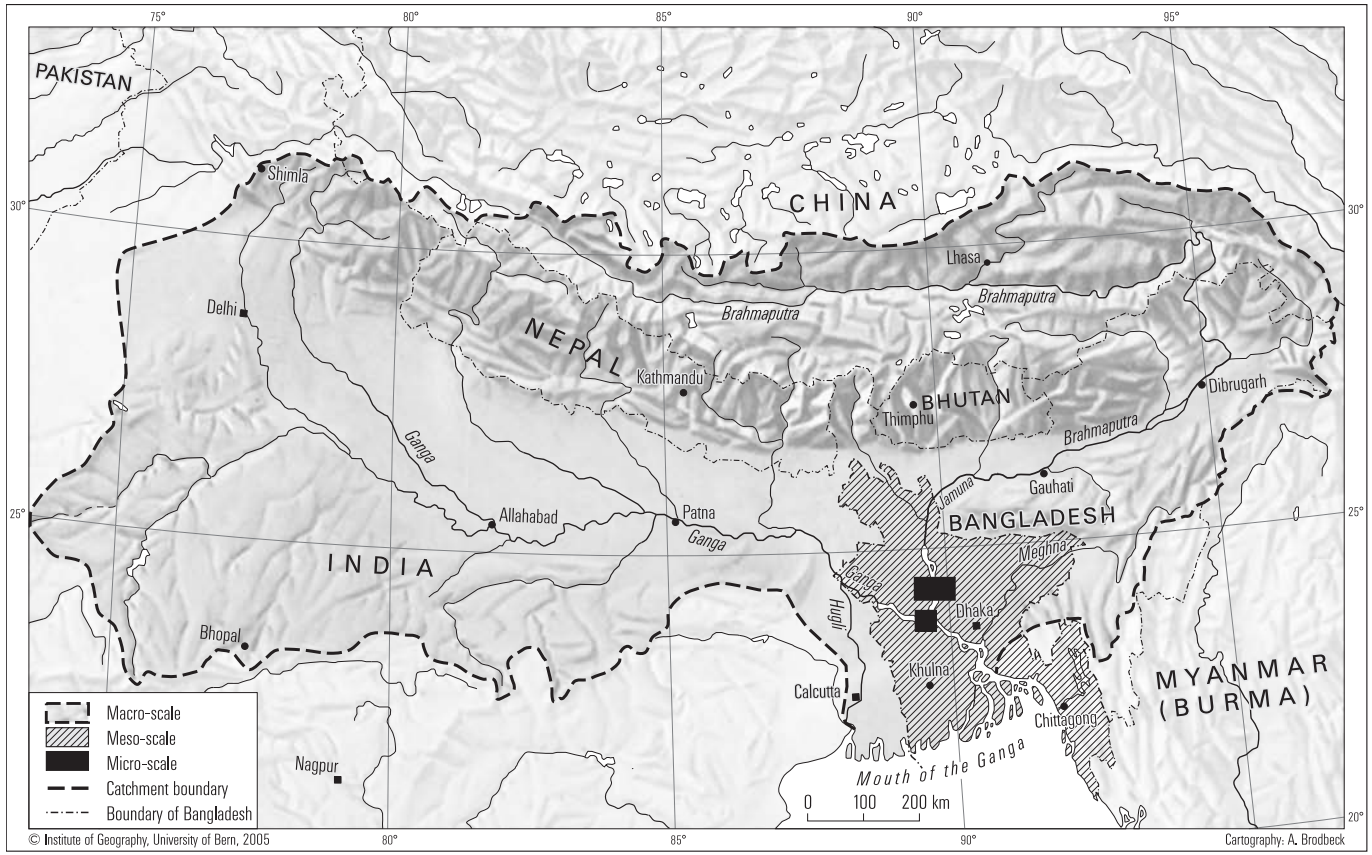

Figure 1.2 Three geographical scales of project activities.

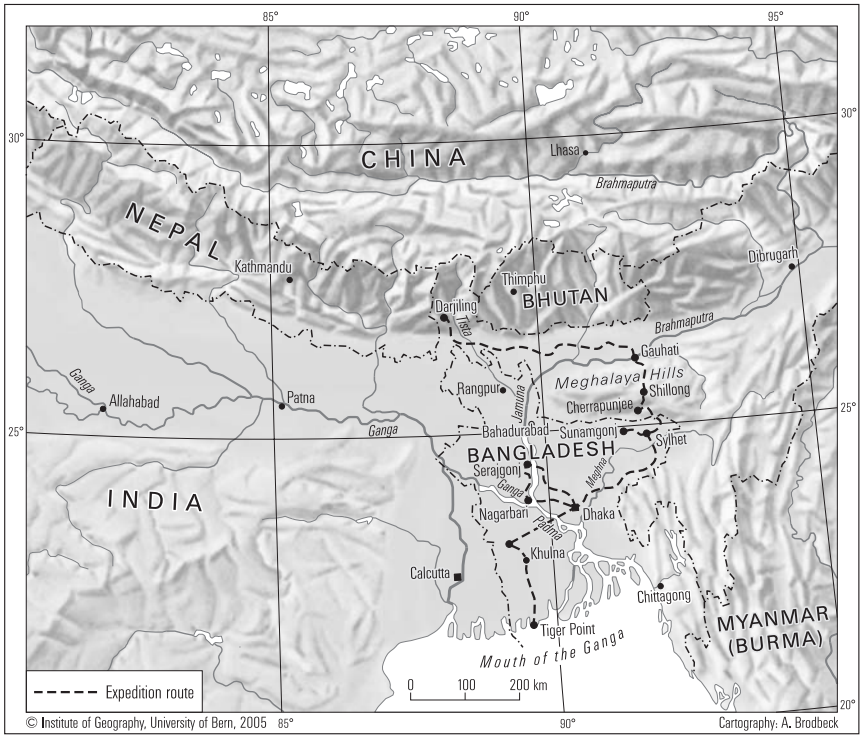

Figure 1.3 From Tiger Hill (Darjiling Himalayas) to Tiger Point (Bay of Bengal): The route of a fascinating ''seminar expedition'' in 1994 for all project collaborators.

1.4. The structure of the book

This volume is structured as follows:

- Chapters 1–3 provide an introduction to the project, the basic characteristics of the study area, and the data situation.
- Chapters 4–5 are the key sections of the book in which the main research contributions of the project are presented. Flood history (Chapter 4) and Bangladesh floods in the context of highland–lowland linkages (Chapter 5) are the two issues in which the project has made the most important contributions to the discussion and the understanding of flooding in Bangladesh.
- The processes related to erosion, sediment transport and deposition in the large highland–lowland system and the uncertainties in understanding these processes were raised again and again as important issues, particularly during the presentations of the project results. Chapter 6

is dedicated to these very complex questions as well as to the very dynamic river morphology within Bangladesh.
- As discussed above, the human dimension of flooding was an important element of the project activities in the test areas. However, since there is a substantial literature on flood perception, Chapter 7 provides only a summary of some of the major issues and focuses on the highly divergent flood perceptions of different stakeholders.
- Chapter 8 provides a synthesis, takes a look at major flood events in other river basins and looks ahead to emerging issues of flood management and research priorities.

Floods have a large number of different facets and it would not be possible for this book to provide a complete understanding of their complexity. We focus strongly on the large-scale dimension of flooding, and intend neither to provide an understanding of location-specific flood processes nor to make specific recommendations for site-specific flood mitigation measures. This publication is targeted at different stakeholders, such as development authorities, politicians, journalists, scientists and engineers. It discusses research results and related development issues, which can be used both as background information and as useful tools for decision-making.

1.5. An important contribution to the International Year of Mountains

In 1992, during the United Nations Conference on Environment and Development (the Earth Summit) in Rio de Janeiro, sustainable mountain development received special attention, which is reflected in Chapter 13 of *Agenda 21* (''Managing fragile ecosystems – Sustainable mountain development''). In November 1998, the United Nations General Assembly declared 2002 as the International Year of Mountains (IYM) and designated the Food and Agriculture Organization (FAO) of the United Nations as the lead agency for the preparation of this event. One of the main objectives formulated for the IYM was to ''[i]ncrease awareness of, and knowledge on mountain ecosystems, their dynamics and functioning, and their overriding importance in providing a number of strategic goods and services essential to the well being of both rural and urban, highland and lowland people, particularly water supply and food security'' (FAO 2000a: 9). With its strong focus on the understanding of the flood processes in the context of highland–lowland linkages, this publication about ''Floods in Bangladesh'' is of global importance by providing a case study from one of the world's most impressive highland–lowland interactive systems.

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Floods in Bangladesh: History, Dynamics and Rethinking the Role of the Himalayas

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Is it really true that deforestation and the land use practices of the Himalayan farmers are to blame for the recurring and devastating monsoon floods in the plains of the Ganga and Brahmaputra? The validity of this paradigm has been increasingly questioned. This book presents new evidence resulting from a research project on floods in Bangladesh in the context of highland–lowland linkages.

Massive floods have occurred regularly before man's impact on the large river basins began. There is no statistical evidence that the frequency of flooding in Bangladesh has increased during the 20th century. There is indication however, that the inter-annual variation of floods and the areal extent of big events have increased since 1950. This trend can be related to similar trends in rainfall and discharge patterns.

The hydro-meteorological processes in the Himalayas are not the main causes for floods in Bangladesh. The combination of simultaneous discharge peaks of the big rivers, high runoff from the Meghalaya Hills, heavy rainfall in Bangladesh, high groundwater tables and spring tides leads to large-scale flooding. Lateral river embankments and the disappearance of natural water storage areas in the lowlands seem to have a significant impact on the flooding processes.

Accordingly, the myth about deforestation creating big floods and the habit of blaming mountain dwellers for the flood catastrophes must be abandoned. However, this does not relieve the mountain inhabitants of their responsibility to use and manage the environment sustainably.

Whereas politicians and engineers perceive monsoon floods as the main problem for Bangladesh, the flood-affected people are more concerned – besides the devastating tropical cyclones – with lateral river erosion, landlessness and economic survival problems.

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