

BOOK REVIEWS

FLOOD STUDIES IN INDIA

(Edited by : V. S. Kale, Published as Memoir 41 of the Geological Society of India, Bangalore, 1998, pp. viii+256)

With a preface by Dr. B. P. Radhakrishna, President of the Geological Society of India, and an introduction by the author that throws some light on what to expect in the book, the volume contains twelve papers largely written by earth scientists and a few meteorologists, hydrologists and civil engineers. Intended to provide an overview of the field of flood hazard in India and some of the neighbouring countries, the volume does provide some insight into the causes and consequences of flood in major Indian river systems of North and eastern India.

The volume opens with the meteorological aspects of floods in Indian rivers. Authored by Dhar and Nandargi, the paper systematically outlines the causes and types of floods, flood prone areas in the country and the different meteorological situations that bring intense rainfall and flooding, accompanied by a table giving the highest flood levels of different gauge sites. In the same category could be placed another paper 'Flood Hydrology and Flood Management in India' by S. M. Seth, that summarises the policy of the Government of India and the work done by the National Institute of Hydrology, particularly the aspect of flood forecasting, dam-break flood, wave simulation, flood estimation and routing, and suggests direction for future research. R. G. Garde from the Central Water Power Research

Station, Pune, talks of engineering approach to floods and flood control and discusses different empirical models adopted to estimate the magnitude of the floods for the catchments of varying areas, as well as the estimation of the return period of a flood of a specific discharge. Different methods of flood control are also suggested.

Other contributors, particularly the earth scientists, have contributed flood studies of specific regions or rivers. Sinha and Jain talking of the flood hazards of the North Bihar rivers have examined the channel morphology, sediment load, besides flood characteristics of North Bihar rivers between Gandak on the west and Kosi on the east - all tributaries or sub-tributaries of the Ganga. Specially interesting is the discharge-load relationship of North Bihar rivers.

The 'Flood Regime of Brahmaputra and its Flood Hydrology' by D. C. Goswami starts with a general treatment of morphology and channel characteristics of the river including the natural levees and the development of marshes and goes on to interpret the hydrograph and deciphers the frequency and causes of floods. There is a hint of the impact of seismic activity particularly the severe earthquake of 1950 (8.7 on Richter) which seems to have caused a sudden increase in the

lowest flood level by about 3 m and a rise in suspended load of the river. Brahmaputra has one of the highest annual discharge per unit area of the catchment. Though the mean annual flood occurs every 2.1 years, the exceptional floods like the one of 1962 with a discharge of $72,748 \text{ m}^3 \text{ s}^{-1}$, could occur only after hundred years following Log-Pearson III type analysis. This could be just an exercise, as with the data of limited period, the prediction or even probability would not be very reliable. Besides heavy and intense rainfall, Goswami considers unique physiographic setting of Brahmaputra also responsible for severe floods.

Ellen Wohl et al, talking of flooding in the Himalayan mountains, introduce the subject with a review of the earlier work and concentrate on the Glacial Lake Outburst Floods (GLOFs) as noticed in the Sagarmatha region of Nepal in Dudhkoshi basin that has been the theme of study of the earth scientists from Colorado State University. The authors have used paleo-stage indicators, through the use of erosional or depositional features to infer flow depth and define water surface profile, and in turn to reconstruct the flood discharge by step-backwater method on the basis of certain assumptions. The authors suggest that step-backwater method can adequately model flow conditions of GLOF and SHEFF (Seasonal High Flow Flood).

'Floods in Sikkim Himalaya' by L. Starkel et al. concentrates more on the intensity of rainfall and the return period of rainfall of different intensity over one-day or three-day period. The hydrological regime of Tista and its discharge hydrograph for monsoon months, the change in the transverse and longitudinal profiles of the channel following floods showing aggradation during extreme floods and downcutting during normal floods are discussed. The authors present a graphic model for the management of alluvial fans.

Thomas Hofer tries to establish that changes in the landuse in the Himalayas are not responsible for floods downstream in the Gangetic plain or Bangladesh. Floods, as he says, have always occurred in history and their magnitude has not changed in recent years with the exception of 1987 and 1988. Hofer has quoted secondary sources like Choudhury and Kusler to support his hypothesis. A careful look at his analysis would not conclusively support his hypothesis. The only two stations, (Shimla and Kathmandu) would hardly give a correct and complete picture of the Himalayan rainfall. A clear coincidence between July 19-20, 1993 intense rainfall at Kathmandu and flood condition in Bengal five days later, is conveniently ignored by him. Talking of this flood which follows five to six days after the heavy rains at Kathmandu, this is what he says: "This situation may be interpreted as a result of the Nepal floods but can just as well be attributed to the intense local rainfall." This is a very tame statement and tantamounts to obfuscating the obvious. To look for a coincidence between the June-September precipitation of every year between 1955-1980, and the flooded areas of West Bengal, in itself, is an error of serious proportion. A flood lasts for a week or ten days and to interpret a large flooded area over a week or ten days as a result of three months total rainfall as shown in figure 8 (p. 134) is to say that the higher the total rainfall in a specific year, the greater the flood inundated area. This is a hypothesis born out of a very simplistic and even erroneous view of flood mechanism. The third case of coincidence between the rainfall at Cherrapunji and the flood in Bengal is only partly valid. Were the correspondence so direct, Bangladesh should have experienced maximum flood in 1974, as Cherrapunji rain was the primary reason as suggested by the

author. On the contrary, high rainfall in Cherrapunji in 1974, appears to coincide with the flood situation in Assam.

What Hofer has demonstrated is the effect of rainfall in the plains on the floods of Bengal, but to say that the effects of the hydrometeorological conditions of the Himalyan and sub-Himalayan region is confined only to the foothills does not carry conviction.

A. Gupta's 'Geomorphological Effects of Floods in Indian Rivers' is a review of the work done on floods and paleo-floods related to Indian Rivers. He emphasises the changes in the channel morphology following large floods and the impact that severe floods would have on streams in various hydrological regimes ranging from equatorial / tropics to humid temperate. V. K. Baker talks of the inadequacy of the experimental theoretical approach which has only partial and limited validity and argues the case of direct study of the real nature of rare magnitude floods, and considers India an ideal region for interpreting natural indicators of floods. He thinks that the rivers of Peninsular India afford ideal opportunities for paleo-flood hydrology.

The volume closes with 'Monsoon Floods in India: A Hydro-geomorphic Perspective' by the author of the volume. He has compiled useful information on the catchment area, peak discharge and sediment load, as well as the discharge characteristics of important rivers of India. Equally useful is his collation of material on historic floods in Indian rivers, supplemented with a map showing flood prone zones of the country, outlining the hydrometeorological and geomorphic causes of floods. The geomorphic responses of large floods are discussed at length, and he relates the geomorphic response to the unit stream power, largely dependent on the mass of water and the discharge characteristics. The rivers

with low unit stream power, and low channel gradients and high values of width/depth ratio are incapable of producing major geomorphic responses. This he illustrates with North Indian rivers like Indus, Ganga, Brahmaputra and Yamuna. Here, Kale is not on an unassailable ground. A geomorphic response need not be erosive it could as well be, and often is, depositional and to say that rivers are incapable of producing major geomorphic responses, is to ignore the obvious. The paper touches almost every aspect of floods and flood geomorphology and carries a comprehensive bibliography. It is not a case study, is replete with observations of others working on flood, carries very useful tables on Indian rivers and floods, and is an effective summary of flood situation in India.

What is intriguing is the non-inclusion of any study of floods in peninsular India in the volume though there are many shown on the map (fig. 1) compiled by the editor, or even floods in Bangladesh, as the editor claims to provide 'an overview of the flood hazards in India and some neighbouring countries.' The second omission appears to be far more serious, coastal floods and those in the arid region of Rajasthan. But the noninclusion of a more significant aspect of research, for which the editor bears no responsibility, is the relationship between the pressure conditions, rainfall intensity and duration and the expected discharge. One wonders if the Indian meteorologists are able to predict the level of discharge for every pressure and humidity conditions at different isobaric levels of the atmosphere, to be able to predict the excessive discharge well in time to be of use.

The book on the whole gives a reasonably good idea of the flood studies in India, particularly the Ganga-Brahmaputra basin,

and a very useful addition to literature on the subject. The earth scientists may find in it a very useful text book that provides a general treatment of causes and consequences besides some interesting case studies.

The reviewer will recommend the book to students and teachers interested in flood studies, and to libraries that have interest in having on their shelves books on earth science, particularly hydrology.

—K. R. Dikshit

‘A RESOURCE ATLAS OF ARUNACHAL PRADESH’

(by Surendra Singh, published by the Government of Auranachal Pradesh 1999, xiii+161pp., price not stated)

For a state situated in the north-east corner of India, with its hilly terrain, reaching the Himalayan heights and snow covered peaks and often desolate stretch of land, the home of some of the civilised tribal communities, including the famous Apa-tanis, Arunachal Pradesh is on the upswing in resource exploitation and development, as is clearly reflected in this well brought out atlas of the State. Dr. Surendra Singh, the author of the atlas, who teaches geography at N. E. H. U. is eminently suited to have undertaken the work and produced an atlas which gives a fairly good idea of the resources of the State and their utilisation.

The atlas contains 58 plates, 26 illustrations, 27 tables with XXII appendices. Every plate is accompanied by a brief but concise note, tables and diagrams that help the interpretation of the maps and make them appear meaningful, imparting greater clarity. Another feature of the atlas is the maps based on derived values which have to be worked out from the given statistical sources. Maps showing water balance, soil losses, land capability classes and such other maps have been prepared after considerable work on the primary data. It is quite easy to read the drainage structure of the

region, not only from the plate, but equally from the diagram giving the trunk rivers and their tributaries indicated by certain code numbers which could be read in the appendix. The longitudinal profiles and the hypsometric integral add value to the relief map of the area. The climate section has not only rainfall, but also rainwater availability. The vertical cross section of the forests from the Assam alluvial plain right upto the highest snow covered peak combines both the relief cross section as well as the typology of forests as they change with altitude.

Landuse and land cover for each district or a combination of a few districts, with an advantage of increased scale, produces a clearer picture. The maps on population follow the usual pattern, though block diagram to depict size, density and growth of population is unusual. Distribution, density, growth, literacy and employment as attributes of population are shown. This is followed by maps showing delivery of services of development agencies. The atlas closes with a map of the resource regions of the State.

Appended at the end is a bibliography and some useful tables like soil losses for different