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BANGLADESH FLOOD ACTION PLAN

Ministry of Water Resources
Flood Plan Coordination Organization (FPCO)

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Annotated Bibliography on Environment

April 1995

Prepared by

Environmental Study

FAP 16

 **ISPAN**

IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST

Sponsored by the U.S. Agency for International Development



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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	i
TABLE OF CONTENTS	ii
PREFACE	iii
ENVIRONMENTAL POLICY AND ISSUES	1
CLIMATE CHANGE AND DISASTER MANAGEMENT	7
LAND AND WATER RESOURCES	9
FORESTS AND VEGETATION	11
ENERGY USE	15
FISHERIES AND WETLANDS	17
WILDLIFE	35
SOCIO-ECONOMICS	41
WOMEN AND ENVIRONMENT	45
ENVIRONMENTAL TRAINING	47
INDEX	49

PREFACE

Although extensive study of the natural resources has been carried out, bibliographic documentation of that work has not been compiled in an annotated form. There is, therefore, a need to have such an abstract available for environmental researchers, practioners, planners, development agencies, donors, and decision-makers.

This annotated bibliography on environment and development in Bangladesh has been prepared by FAP 16 (Environmental Study). It groups the environmental works under the following resource components:

- environmental policy and issues;
- water resources and environmental assessment;
- climate change and disaster management;
- soil and agriculture;
- forest and vegetation;
- biomass energy;
- fisheries and wetlands;
- wildlife;
- socioeconomics;
- women and environment; and
- environmental training.



The volume includes abstracts of published research works, papers, books, and reports on the environment. This compendium has been designed to serve the information/data requirements of scientists, researchers, planners, policy-and decision-makers and many other people associated with environmental activities in Bangladesh. It covers a wide range of materials which would be of interest and use to all involved in environmental studies and resource management.

It is particularly useful for EIA reviewers and practitioners, and was designed to be used as an instrucional aid during EIA training.

The successful completion of this document is the result of the time and effort given by the team members of FAP 16 in collecting necessary information from individuals, organizations, and institutions involved in environmental studies and resource management. The team was limited by time and there will of course be many important references left out.

This document should be treated as the baseline compilation of environmental information in Bangladesh. But, like the Training Manual and EIA Guidelines prepared by FAP 16, it is a living document. It will be necessary to regularly update it in order to include future works on the environment of Bangladesh.

ENVIRONMENTAL POLICY AND ISSUES

- 1 **Asian Development Bank (ADB). 1988. Environmental guidelines for selected industrial and power development projects. ADB, Dhaka.**

In Part A (Environmental Guidelines for the Project) of the two-part document, a complete set of guidelines for selected industrial and power development projects is presented. The need for such guidelines and the methods needed to prepare them are discussed. Part B (Supplemental Information) includes information on selected references of environmental agencies in developing member countries, and trial application of the guidelines to particular projects.

- 2 **Canadian International Development Agency (CIDA). 1989. The environment and development in Bangladesh: An overview and strategy for the future. CIDA, Canadian High Commission, Dhaka, Bangladesh.**

This report provides an analytical basis for the CIDA Country Program Review process. Literature on environment and development in Bangladesh is reviewed and strategies for sustainable development in the future are suggested. The report identifies the major natural and human resource features, as well as the major ecological concerns within the different sectors related to the environment.

- 3 **Danish International Development Assistance (DANIDA). 1989. Environmental profile: Bangladesh. DANIDA, Department of International Development Cooperation, Ministry of Foreign Affairs, Denmark.**

This report highlights major sectoral issues, cross-sectoral issues, and operational guidelines on

environment and development in Bangladesh. The document provides a comprehensive list of organizations involved in environmental and resource management, national policy on environment, Bangladesh national environmental legislation, and institutions for data collection and research.

- 4 **FAP 2 (Flood Action Plan). 1991. Interim report. North West Regional Study. Mott-Macdonald, Nippon Koe, Hydraulic Res. (HOC). Dhaka.**

Regional flooding and drainage systems, options and scenarios for development, impact analysis, and regional planning and development priorities are highlighted in this report.

- 5 **FAP 2. 1992. The regional plan—initial environmental evaluation. North West Regional Study Draft Final Report. Mott-Macdonald, Nippon Koe, Hydraulic Res. (HOC). Dhaka.**

The North West Regional study area includes the total catchment of three rivers systems namely the Ganges, the Atrai and the Brahmaputra. This report identifies and prioritizes the environmental impacts of the water development proposal for the study area, quantifying and valuing these whenever feasible. Detailed proposals for mitigation, resource management planning, monitoring, and plans for further investigation also are discussed.

- 6 **FAP 5. 1991. South East Regional Study. Initial environmental evaluation. Draft. Mott-Macdonald, Nippon Koei, HOC, Resource Development. Desh Upadesh, Dhaka.**

This initial environmental examination evaluates the environmental impacts of water resource

development proposals in the South East Region of the country. This report discusses the existing environment and its influence on regional and project planning, regional assessment of environmental impacts, management and mitigation, and monitoring, training and future studies. Extensive appendices address legislation relating to environment, and flora and fauna of Bangladesh, including threatened and endangered species. Appendices also include lists of common birds and mammals; economically important trees; and historically, archaeologically, and ecologically important sites in the southeast region.

- 7 **FAP 12. 1992. Flood Control Drainage/Irrigation (FCD/I) agricultural study. Final report. Vol. 3, appendices E-J. FCD/I Agricultural Study, Dhaka.**

This report discusses the impacts of various FCD/I projects on agriculture, fisheries, water-logging, and socio-economics. The report also addresses operational maintenance in existing FCD/I projects.

- 8 **FAP 12. 1992. Project impact evaluation of Chalan Beel Polder-D. FCD/I Agricultural Study. Hunting Technical Services, Sanyu, Bangladesh Institute of Development Studies (BIDS) and Technoconsult, Dhaka.**

This study assessed the impacts of the Chalan Beel Polder-D Project on agriculture, fisheries, livestock, infrastructure, communication, and socio-economics. It considers environmental and economic appraisals and makes recommendations for the future.

- 9 **FAP 12. 1992. Project impact evaluation of Meghna-Dhanagoda Irrigation Project. FCD/I Agricultural Study, Hunting Technical Services, Sanyu, BIDS, Technoconsult, Dhaka.**

This study assessed the impacts of the Meghna-Dhanagoda Irrigation Project on agricultural production, crop diversity, fisheries, and socio-economic issues of the project area. The report highlighted the adverse impact of the project on capture fisheries production and species diversity within the project area. A brief history of the project highlighting its weaknesses are also presented in the document.

- 10 **FAP 16/FAP 19. 1992. Compartmentalization pilot project: Environmental impact assessment case study. ISPAN, Dhaka.**

The study determined that the proposed project would aid agriculture, culture fisheries, homestead security, household income, and cereal-based nutrition. In contrast, it found that the proposed project would reduce agricultural crop diversity, capture fisheries production, subsistence fishing income, fish-based nutrition, while increasing environmental contamination with more agrochemical use. They study also recommends an Environmental Management Plan (EMP) to reduce or eliminate the adverse impacts of the project.

- 11 **FAP 16/FAP 19. 1993. Bhelumia-Bheduria Project, environmental impact assessment case study. ISPAN, Dhaka.**

The study addresses a small coastal project under consideration by the Early Implementation Project (EIP) of the Bangladesh Water Development Board (BWDB). Although potentially severe impacts for resources such as fisheries and for certain social groups (fishermen) were pointed out. The study suggested an environmental management plan (EMP) to reduce or eliminate the adverse impacts of the project on various resource components.

- 12 **Flood Plan Coordination Organization (FPCO). 1993. Guidelines for people's participation. FPCO. Dhaka.**

This Guidelines suggest a flexible approach to the integration of knowledge, experience, and insights of local people. It suggests that this cross-fertilization will strengthen the process of decision-making with regard to local needs assessment, project formulation and implementation, and long-term operation and maintenance. The process also will help minimize the negative effects of conflict of interest.

- 13 **Government of Bangladesh. 1991. Report of the task force on Bangladesh development strategies for the 1990s. Environment policy. Vol. 4: 265 p. University Press Limited, Dhaka, Bangladesh.**

This volume looks at environmental policy and critically evaluates development issues facing Bangladesh. It provides qualitative and quantitative information about the people and the economy, physical resources and environment, natural hazards, agriculture, and pollution. It examines the existing policies and suggests policy changes to achieve sustainable development.

- 14 **Ministry of Environment and Forests. 1992. Towards sustainable development: The national conservation strategy of Bangladesh. Ministry of Environment and Forests, Dhaka.**

This report analyzes the status of 20 sectors of environmental components such as soil, water, fisheries, forest, minerals, and other such resources with their conservancy issues. Formulated strategies and plans for sustaining development of the country's renewable and nonrenewable resources also is addressed.

- 15 **Ministry of Environment and Forests. 1993. National environmental management action plan (NEMAP). Environ-**

mental Resources Limited, London, U.K.

This document constitutes the national Environmental Management Action Plan of Bangladesh. Because the Ministry of Environment and Forests played a major role in preparing the document, it reflects the environmental views of the Bangladesh government. The report proposes a plan to reduce the rate of environmental degradation, conserve habitats and biodiversity, promote sustainable development, and improve the quality of human life.

- 16 **Rahman, A.A., Haider, R., Haq, S. and Jansen, E.G. (eds.). 1994. Environment and development in Bangladesh. 2 vols. University Press Limited, Dhaka.**

In two volumes, the authors explore some of the connections between poverty, population, environment, and development in Bangladesh. Discussion on land, water, nutrition, fisheries, biodiversity, industrial pollution, energy and mineral resources, sea-level rise, natural disaster, women-poverty-environment interaction, environmental awareness, and environmental activity are presented in 31 articles. The articles point out multifaceted problems, both man-made and natural, that exist in Bangladesh, and suggest inter-rating environmental concerns in all development activities.

- 17 **Rashid, H.E. 1991. Geography of Bangladesh. University Press Limited, Dhaka.**

This book, first published in 1977 and revised in 1991, covers all facets of the geography of Bangladesh. It provides more details on physiography, hydrography, climate, soil conditions and land use, agriculture, natural resources and industry, trade and commerce, history and economic development than any other regional book written about Bangladesh. The latest revision includes a new chapter on environmental issues.

- 18 **Research and Advisory Services (RAS). 1992. People's participation, NGOs and the Flood Action Plan: An independent review. RAS, Dhaka.**

This report attempted to cover a set of interrelated issues such as alternative approaches to people's participation, lessons from the experience of earlier flood protection projects, people's participation and the actual nature of effectiveness of people's involvement in the FAP implementation processes. The document also covers approaches to involve NGOs to take the strategic lead in certain activities which are aimed at supporting the views and interests of the affected people.

- 19 **Shamsuddin, S.D. 1992. An outline of policies and legislation related to environment in Bangladesh. ISPAN/FAP 16, Dhaka.**

This document compiles existing rules and legislations for conservation and sustainable management of various environmental resources such as fisheries, wildlife, forests, livestock, soils, and others. The aims of and major provisions of the policies and legislation which appeared to be relevant to EIA work have been briefly mentioned in the document.

- 20 **United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). 1990. Environmental impact assessment guidelines for agricultural development. ESCAP Environment and Development Series. United Nations, New York.**

The objectives of these guidelines were to: a) summarize general assessment methods presented in pertinent references, b) identify data collection and evaluation methods for assessing the quality of key parameters, and c) present the typical impacts related to agricultural development projects based

on secondary literature and special case studies. A number of reference documents were used in preparing the guidelines.

- 21 **U.S. Agency for International Development (USAID). 1990. Environmental assessment of the USAID/Bangladesh integrated food for development program. USAID, Dhaka.**

This USAID-requested environmental assessment of its food-for-work program in Bangladesh coincided with the joint USAID/CARE design of the new Integrated Food for Development program. An environmental assessment field review of the project was done by a joint team from KBN Engineering and Applied Sciences, Florida, USA-based Tropical Research and Development in association with House of Consultants, Dhaka. Team members included expatriate and host-country counterparts specializing in ecology and tropical forestry, agronomy, soil science, fish biology, land use planning, water resource engineering, human ecology, and sociology. The report suggested that the project implementing agency should conduct field research to quantify appropriate design strategies and labour and infrastructure requirements for a wide range of diversified component schemes. Special attention should be given to pond and wetland construction; tree nurseries and plantation; brick field construction; renewable facility construction (biogas digester); and canal and river channel desilting.

- 22 **World Resource Institute (WRI). 1990. Bangladesh environment and natural resource assessment. Draft. WRI, Center for International Development, Washington, D.C., USA.**

This report summarizes the findings and recommendations of a preliminary analysis made of

current environmental and natural resource management issues in Bangladesh and their relation to

the country's economic growth and development. The document presents an overview of the context of the country's economic development, environmental and natural resource management issues, institutional and policy framework, and recommended strategy and priority actions.



12

CLIMATE CHANGE AND DISASTER MANAGEMENT

- 23 Ahmed, Q.K., Warrick, R. A., Ericksen, N.J. and Mirja, M.Q. 1994. The implications of climate change for Bangladesh: A Synthesis. 17 p. Bangladesh Unnayan Parishad (BUP), Dhaka.

This report is the seventh in a set of seven briefing documents that address the various effects of climate change on Bangladesh. A synthesis of what is known, and what needs to be known, about possible effects of climate and sea-level change on Bangladesh are presented in this paper.

- 24 Brammer, H., Asaduzzaman, M. and Sultan, P. 1994. Effects of climate and sea-level changes on the natural resources of Bangladesh. 31 p. BUP, Dhaka.

This document is the third in the set of seven briefing documents about climate change implications. It considers the possible impacts of global warming and sea level rise on Bangladesh's water, agricultural, forests, fisheries, and livestock resources.

- 25 Ericksen, N.J., Ahmed, Q.K. and Chowdhury, A.R. 1994. Socio-economic implications of climate change for Bangladesh. 37 p. BUP, Dhaka.

This report is the fourth in the set of seven briefing documents. The authors developed a model of the process that affects the green house phenomenon and suggests that the mean global temperature of Bangladesh may rise by 1.5 to 1.8 degrees Celsius by the year 2050. He also suggests that these changes would increase annual rainfall in Bangladesh. Climate changes such as these would affect plant and animal growth in Bangladesh. The socioeconomic implications of such climate changes are also discussed in this report.

- 26 Freestone, D., Farooque, M., Jahan, S. R. 1994. Legal implications of global climate change for Bangladesh. 21 p. BUP, Dhaka.

The fifth in a series of seven briefing documents, this report looks at the framework provided by both national and international law within which Bangladesh must develop strategies and policies to respond to likely environmental impacts precipitated by climate change. Legal issues have a bearing not only on the matter of responsibility for climate changes, but also on response strategies.

- 27 Kausher, A., Kay, R. C., Asaduzzaman, M. and Paul, S. 1994. Climate change and sea-level rise: the case of the coast. 36 p. BUP, Dhaka.

The sixth in the set of seven briefing documents, this book reviews the sensitivity, vulnerability, and resilience of Bangladesh's coastal zone to future climatic changes and rise in sea level. The implications for managing the coastal zone and the need for further research are discussed.

- 28 Rahman, M.M. and Haque, M. 1992. A study on global warming and environmental issues related to Bangladesh. Center for Human Development, Dhaka.

After describing the methodology and conceptual framework of this study concerning the impact of global warming on Bangladesh, the document reviews existing theories and views on the subject. International concerns about global warming, environmental degradation, and other issues related to sustainable development are highlighted. The current trends affecting development in Bangladesh are discussed. The views, resolutions, and recom-

26
mendations discussed in various regional and international forums are included in the report.

- 29 Warrick, R.A., Bhuiya, A. H. and Mirza, M. Q. 1994. The greenhouse effect and the climate change. 31 p. BUP, Dhaka.

This report is the first in a seven-part briefing document series that addresses various climate change issues in Bangladesh. Based on the review of literature concerning global warming and its possible affects, major areas for research in Bangladesh are suggested.

- 30 Warrick, R.A., , Bhuiya, A. H., Mitchell, W. M., Murty, T. S., Rasheed, K. B. S. 1994. Sea level changes in the Bay of bengal. 24 P. BUP, Dhaka.

The second in the set of seven briefing documents, this book is concerned about the future possibility of sea level rise in Bangladesh. The authors look at the causes of sea level change, and discuss current changes and future trends in global sea level rise. Sea level changes in the Bay of Bengal and the ways to address such changes are also discussed.

LAND AND WATER RESOURCES

- 31 **FAO/UNDP. 1988. Land resources appraisal of Bangladesh for agricultural development. Report 2: Agro-ecological regions of Bangladesh. Rome, Italy.**

This is one of a series of seven documents. It reports the results of a study on appraisal of land resources of Bangladesh. It is good reference material on agro-ecological conditions in Bangladesh and is designed to be used by specialists and nonspecialists alike. It provides information on agriculture, soils, forests, geography, and the effects of environmental factors on agriculture.

- 32 **Organization for Economic Cooperation and Development (OECD). 1985. Management of water projects: Decision-making and investment appraisal. Oxford and IBH Publishing Co., India.**

This publication analyses decision-making and appraisal in large-scale water management investment projects. It also examines the effects of such projects on the environment and society. The result of work undertaken by national teams nominated in most OECD member countries and an international team of multidisciplinary experts, the book lists various alternatives to problems, but does not provide any "ideal" solution. Instead, the book is a resource for policy makers and members of multi-disciplinary teams responsible for appraising projects. It provides the viewpoints of various scientific disciplines involved in the appraisal process, and guides the reader through the decision-making process involved in project appraisal. The book covers a broad range of situations and problems observed in various countries. It identifies project impacts, and develops global, long-term planning strategies. These are put in the context of institutional relations between government organizations and the various interests of the populations.

- 33 **Rashid, H.E. 1989. Land use in Bangladesh: Selected topics. Bangladesh Agriculture Sector Review, Vol. III. United Nations Development Programme (UNDP), project BGD/87/023, Dhaka.**

This working paper for the agriculture sector review discusses the major issues in land use and identifies the main geographical areas of concern with relevant tables and graphics. Statistics of land use are critically examined and new light is thrown on land use pattern in the villages, particularly on areas used for horticulture, and in the Hill Tracts. The second part of the paper examines environmental issues with regard to land use.

- 34 **Weber, Fred R. 1989. Rapid low-cost assessment of biophysical impacts of agricultural and rural development projects. AID Occasional Paper No. XX. U.S. Agency for International Development (USAID), Dhaka.**

This report describes 10 simple, practical indicators for assessing the biophysical impacts of development projects and suggests ways in which these indicators can assist USAID field personnel to monitor both the positive and negative impacts of project interventions on natural resources (soils, water, natural vegetation, and wildlife). It also discusses methods for collecting and using the indicators, while emphasizing reliance on locally available information and use of simple techniques. The paper briefly discusses using indicators for measuring impacts on areas of historical, religious, cultural, and scientific significance.

27

FORESTS AND VEGETATION

- 35 Alam, M.K. 1992. Some potential multi-purpose trees for homesteads in Bangladesh. Winrock International/Bangladesh Agriculture Research Council (BARC), Farmgate, Dhaka.

Homesteads in Bangladesh are integrated production systems and stable ecosystems. This publication recognizes the importance of the homestead vegetation and proposes homestead development through multi-layered plantations with species diversity. The author discusses the socioeconomic, ecological, and biological criteria for tree species selection as well as management practices and wood properties. The document also lists timber trees and details their uses, propagation, and properties.

- 36 Bangladesh Agriculture Research Council (BARC)/International Council for Research in Agroforestry (ICRAF). 1991. Agroforestry technologies for an encroached forest area in Dhaka division, Bangladesh. 95 p. BARC, Dhaka/ICRAF, Nairobi, Kenya.

This study was a collaboration between BARC and ICRAF to strengthen agroforestry research and development in Bangladesh. A diagnosis and design survey was carried out in Kaliakoir, Dhaka Division, a site selected for thana agroforestry practice and nursery project by the Forest Department. Historically, the site was a *sal* (*Shorea robusta*) forest, which has now become entirely denuded because most of the area has been settled by landless people. The Forest Department placed about 60 ha under its forestry development program and secured the participation of 50 to 60 landless households in the program. The BARC/ICRAF study then surveyed, diagnosed and designed an effective agroforestry development module for the area.

- 37 Champion, Sir Harry G. and Seth, S.K. 1968. A revised survey of the forest types of India. Forest Research Institute, Delhi.

Although this is an old document, it is the pioneer survey that ecologically classifies forests and vegetation in the sub-continent.

- 38 Choudhury, A.M. 1981. Wood and wood products. Forest Department, Banobhavan, Mohakhali, Dhaka.

This Bangladesh country paper on government policies and procedures for joint venture industries was prepared for the Economic, Social Commission for Asia and the Pacific (ESCAP) trade cooperation group venture. The main focus of the document is administrative classification of forests.

- 39 Das, U.K. and Gouranga, 1994. Beeldakatia: Farmers turn fishermen. Dhaka Courier Vol. 10: pp. 35.

According to the Bangladesh Water Development Board, Beeldakatia covers about 30,000 acres of permanently waterlogged land. The article pointed out that due to continuous water logging, the farmers have been compelled to change their profession from crop farming to fishing, and most of the plant species are effected in the area.

- 40 Hassan, M.M. and Mazumdar, M.H. March-April, 1990. An exploratory survey of trees on homesteads and waste land of Bangladesh. ADAB News Vol. 17, No. 2: pp. 26-32.

This document presents the findings of an exploratory survey of homestead trees conducted in different parts of Bangladesh. It reports on a

range of variables including climatic, hydrological, edaphic, and sanitary conditions. It also makes recommendations for increased homestead afforestation in Bangladesh.

- 41 **Hooker, J.D. 1872-1896 (rev. 1973 and 1975). Flora of British India. 7 vols. Bishen Singh & Mahendra Pal Singh, Dhera Dun, India/L. Reeve & Co. Kent, U.K.**

This historical document identifies the characteristics and importance of India's flora. Although the original survey was conducted over 100 years ago, the 1970's revision has updated the information. The book is considered as an important tool for plant scientists in the sub-continent.

- 42 **Huq, A.M. 1986. Plant names of Bangladesh. Bangladesh National Herbarium/BARC, Farmgate, Dhaka.**

This document lists the local and scientific names of Bangladesh plants and exotics. The local names of plants have been arranged alphabetically along with their scientific names.

- 43 **Kamaluddin, M. 1984. Forest ecology. Khanjan Maha, Chittagong University, Chittagong.**

This document describes the forest types of Bangladesh and species combinations of each type of forests. It also describes the biological characteristics and socio-economic and ecological importance of trees, shrubs, and other plants. The habitats of the different species of plants are discussed.

- 44 **Katebi, M.N.A. 1992. Forest resources of Bangladesh, present and future development activities. In Training Manual on Environmental management in Ban-**

gladesh (written in Bangla). pp. 52-73. Department of Environment, Dhaka.

This article provides up-to-date information about the forest resources in the country and about the Forest Department's development activities in forest resources management. The paper reports that 17 percent, or 5.92 million acres, of Bangladesh land is under forest. Of the 5.92 million acres, about 3.61 million acres are under the control of the Forest Department, 1.64 million acres are under the control of the District Commissioner, and the rest is homestead forest. The report classifies the Forest Department's acreages as reserve, protected, acquired, or unclassified. It also classifies forest types, such as hill, mangrove, plains, or homestead. It highlights current and future development activities of thana afforestation programs, plans for wildlife survey and conservation of projects.

- 45 **Khaleque, K. 1986. The importance and prospects of homestead forests in Bangladesh. ADAB News Vol. 13, No. 2: pp. 10-13.**

This article states that by the year 2000 there will be a shortage of 185 million cubic feet of fuel wood and 60 million cubic feet of timber in Bangladesh. It identifies research needs for the development of homestead forestry in Bangladesh. It also mentions that homestead forest provides 70% of the total needs of the country's fuel wood and timber.

- 46 **Khandakar, K. 1991. Homestead agroforestry in Bangladesh and its development. Bangladesh Forest Research Institute (BFRI), Chittagong.**

This document describes the systems, patterns, benefits, and limitations of homestead agroforestry. It also discusses the status of agroforestry development, research, education, and training. It identifies and prioritizes a number of

research areas for agroforestry in general and for homestead forestry in particular.

- 47 Prain, David. 1903 (rev. 1963 and 1981). *Bengal plants*. 2 vols. Bishen Singh & Mahendra Pal Singh, Dhera Dun, India/L. Reeve & Co. Kent, U.K.

This twice-revised book classifies all the plants of Bengal and lists their identifying characteristics. The book is being used as an important tool by the plant scientists in the sub-continent.

- 48 Rahaman, M.A.; Khandakar, K.; Ahmed, F.U.; Ali, M.O. (eds.). 1990. *Proceedings of the seminar on top dying of Sundri (Heritiera fomes) trees*, 96 p. BARC, Farmgate, Dhaka.

The *sundri* (*Heritiera fomes*) is the most important tree species in the Sunderbans, contributing to over 60 percent of total marketable timber. This species, however, has been affected by top dying, a disease that kills the foliage and twigs of one or more branches, including the main stem, then moves back down the tree to eventually cause its death. The document reports that about 45 million trees, or 18 percent of the total Sundri stand, are affected by top dying, and, of those, at least 20 million are seriously affected. The possible causes of top dying include: increased salinity due to reduced fresh water flows through the Sunderbans, alteration in the depth and duration of flooding, increased siltation, and an outbreak of pathogenic gall cankers on tree branches. The document recommends further research on possible causes of top dying.

- 49 Timm, R.W. 1981. *Forestry development and its impact on environment. Proceedings of the Third National Zoological Conference*, March 15-17. 315 p. Dhaka.

This document identifies forest areas in Bangladesh and points out that deforestation is causing the temperature to rise in summer, and is causing atmospheric humidity and soil moisture to decrease. Hill forests have been denuded, resulting in siltation and other problems. The paper concludes that political decisions and commitments to halt deforestation are crucial. The author suggests a massive afforestation program to combat the situation.

- 50 Tiwari, K.M. and Singh, R.V. 1984. *Social forestry plantations*. Oxford Publishers Co., New Delhi.

The principles and techniques of social forestry development are discussed in this document. The characteristics of trees, shrubs, and other plants are included in this document. This document can be used as a manual for the development of social forestry plantation.

- 51 Winrock International. 1990. *Homestead plantation and agro-forestry in Bangladesh*. Winrock International/BARC, Dhaka.

This document presents summary proceedings of a workshop on "Homestead Plantation and Agroforestry in Bangladesh". The workshop, attended by representatives from 17 national and international organizations and the first of its kind in Bangladesh, assessed existing homestead plantations and agro-forestry practices. It identified research needs and directions on homestead plantation and agro-forestry development in Bangladesh. This document is a useful guide for researchers, policy makers, development workers, and politicians who set national development priorities.

ENERGY USE

- 52 Ahmad, A.J.M.U.; Hossain, Md.; Mian, M.H.U.; and Hossain, Md. Alamgir. 1986. Energy crisis in a Bangladesh village. Rural Development Academy, Bogra, Bangladesh.

This document focusses on the fuel problems of rural areas and their impact on various social classes. It reports that the rate at which trees are cut exceeds the rate of tree planting. The paper suggests that by changing cropping patterns it would be possible to increase fuel supply. *Dhaincha* could be grown to meet the fuel shortage and to improve soil fertility.

- 53 Chowdury, N. 1985. Agricultural residues as sources of biomass and their utilization through bioconversion. Proceedings of the Seminar on Biomass Production, 15-18 April 1986, Dhaka, Bangladesh.

Since agricultural and agro-industrial residues which constitute potential sources of biomass cannot be used as food directly, they can be effectively utilized through bioconversion to fuel, feed, and food. While starchy residues can easily be converted into useful products, the lignocellulosic residues constituting the majority of agricultural and agro-industrial residues are recalcitrant to normal utilization modes. Cellulose, hemicellulose, and lignin, the major components of residual biomass can be separately and collectively converted into useful products through bioconversion. The paper summarizes the seminar proceedings and explains the steps involved in such processes as pretreatment, enzyme production, saccharification, and fermentation.

- 54 Das, S.; Davidson, J.; Khan, S.A.; Latif, M.A.; Jashimuddin, M. 1986. Research on biomass production in Bangla-

desh with special reference to tree crops. Proceedings of the seminar on biomass production, pp. 64-73. Ministry of Energy resources, Dhaka.

The document presents the summary proceeding of biomass production in Bangladesh. Biomass of individual trees, annual yield of biomass and ratio of stem weight to weight of leaves and branches are determined. Comparison of biomass production between the best and worst provenances (seed sources) were made to show the differences due to origin of genetic material. Among these exotic species, *Eucalyptus Camaldulensis* has the highest production of biomass when it is cultivated in suitable sites as in Charaljani.

- 55 Government of Bangladesh. 1991. Physical Resources and Environment: Energy use and resources, In: report of the task force on Bangladesh development strategies for the 1990's, Vol. Four, Part II, pp: 52-60. The University Press Limited, Dhaka. Bangladesh.

The article discusses the energy balance for the year 1990 and shows that per capita energy consumption was 5.98 GJ (140 Kg OE) of which commercial energy was 1.61 GJ (37.71Kg OE) or 29.9 percent of total per capita energy consumption. The remaining 73.1 percent came from traditional biomass fuel. With these figures Bangladesh is one of the lowest users of energy, (commercial energy in particular) in the world. Even among the 40 countries classified as low income countries (other than China and India) by World Bank, Bangladesh's commercial energy use stands less than 31 percent of the average of these countries (122 Kg OE).

- 56 Haq, Lutful. 1986. The role of biomass in Bangladesh economy. Proceedings of

22

the seminar on biomass production.pp. 51-61. Ministry of Energy resources, Dhaka.

This paper reports that biomass production has gained newer and greater significance in ensuring human welfare. The traditional sources of fuel such as fire, cowdung, bagasse, jutestick and the like account for more than two thirds of the fuel consumed annually in Bangladesh. Fast growing indigenous and exotic plant species hold a promising future for fuel wood supply.

The plant survival rate was 96 percent. At 5 years of age the plants attained an average height of 11.54m and an average diameter (dbh) of 11.64-cm. The yield of fuel wood, including bark and branches, was 139.1 t/ha at 12 percent moisture content. The results show good prospects for increasing fuel wood plantation of the provenance in rural waste and marginal lands.

- 57 Islam, M.N. 1992. Energy crisis-dimension of the problem and its bearing on sustainability of environment quality. In: Training manual on environmental management in Bangladesh, pp.105-131. Department of Environment, Dhaka.

The paper gives an overview of (a) the energy situation in Bangladesh and the various issues and options related to the energy development program; (b) environmental issues related to energy crises have been discussed; (c) institutional management of environmentally sound sustainable energy development programs in Bangladesh; (d) investment in energy development program in the Fourth Five Year plan. Some observations were made on the national technological capability in planning, development and management of energy sector.

- 58 Kamaluddin, M. and Bhuiyan, M.K. 1986. Growth and fuelwood yield of Petford provenance *Eucalyptus camaldulensis* Dehan grown in rural marginal land in Bangladesh. Paper presented at the Seminar on Biomass Production, 15-18 April 1986, Dhaka, Bangladesh.

Petford provenance of *Eucalyptus camaldulensis* Dehan was planted on the banks of rural ponds with a spacing of 1.6m x 1.6m to assess its growth and fuel wood yield under rural site conditions.

FISHERIES AND WETLANDS

- 59 Agüero, M., S. Haq., A.K.A. Rahman and M. Ahmed, eds. 1989. Inland fisheries management in Bangladesh. Department of Fisheries, Bangladesh; Bangladesh Center for Advanced Studies (BCAS), Dhaka; International Center for Living Aquatic Resource Management (ICLARM), Manila, Philippines.

This book is a compilation of articles presented in the Workshop on Experiments in New Approaches to the Improved Management of Open-water Fisheries in Bangladesh held in Dhaka in January 1989. The articles deal with various issues related to fishing activities in Bangladesh, including fisheries ecosystems and fishing communities. It discusses the biological, ecological, social, and economic factors of fishing activities.

- 60 Ahmed, A.T.A. 1994. Biodiversity and the role of Zoologists. Souvenir, 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper defines biological diversity in the context of habitat and ecosystem and highlights the state of biodiversity in Bangladesh, emphasizing the aquatic resources. It points out some impacts of Farraka Barrage on the agricultural and fisheries resources in the context of surface water flow and salinity intrusion. It also suggests research needs and covers management aspects of biodiversity.

- 61 Ahmed, R.; Hirst, Stanley M.; Livingston, Ron D.; and Pooley, Michael R. 1993. Considerations for a national wetland inventory. In *Freshwater wetlands in Bangladesh: Issues and*

approaches for management, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 245-253

This paper discusses how land and water resource development activities have caused significant reductions in Bangladesh's wetlands. It suggests that conservation of the remaining wetlands and their sustainable management requires accurate and updated inventory information. It also discusses the need for a national inventory to establish and monitor the conservation and management status of wetlands. It suggests that a national inventory would require the establishment of a group with the full capability for remote sensing, image analysis, a geographic information system to manage the database, a number of field survey teams to collect relevant ecological and land use data, a national committee to coordinate and review the progress and products of the inventory, and sufficient budget to maintain the activities for an initial period of at least one year. The paper recommends the need for a pilot study to develop appropriate methodologies and institutions for the main inventory.

- 62 Akhtaruzzaman, M. 1988. A Study on the production of kio-fish (*Anabus testudineus*) under semi-intensive culture system. *Journal of Zoology*, 3:39-43.

The study discussed the monoculture of *Anabus testudineus* (Bloch) under semi-intensive culture system. Fingerlings (average wt. 8-9g) were stocked at a density of 16,000/ha in three 0.028ha ponds. They were fed six days per week with a mixture of rice bran, mustard oil cake, and fish meal at a ratio of 3:1:1. Feed was given daily at the rate of 5-6% of the estimated body weight of the stocked fish. The study found that after five months the average yield was 450 kg/ha and average survival was 78%.

- 26
- 63 Akhter, J.N.; Halder, G.C.; and Majid, M.A. 1994. Development of pen culture technology in irrigation canals. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper presents the result of the trials of pen culture of carps in canals of Chandpur Irrigation Project (CIP). The stocked species were *rui*, *mrigel*, *catla*, silver carp, and common carp at a ratio of 30, 20, 10, 10, and 30%, respectively, with densities of 10,000 (970kg), 15,000 (100kg), 20,000 (140kg) per ha. The results of three treatments after six months of rearing were 1.27, 1.69, and 2.68 tons/ha. In the authors' opinion there are prospects for fish production in irrigation canals within FCD/I projects.

- 64 Ali, M.L. 1989. Survey and data collection in rural fishing communities for fisheries resources management in Bangladesh. In *Inland fisheries management in Bangladesh*, M. Agiiero, S. Huq, A.K.A. Rahman and M. Ahmed, eds. Department of Fisheries, Dhaka, Bangladesh; Bangladesh Center for Advanced Studies, Dhaka, Bangladesh; and International Center for Living Aquatic Resources Management, Manila, Philippines. pp. 61-70.

This paper describes the existing survey and data collection system in the fisheries sector of Bangladesh. It reports that a frame survey followed by regular catch assessment survey are being carried out by the Department of Fisheries (DOF) through the FAO/UNDP-supported Bangladesh Fisheries Resources Survey System Project initiated in 1979. The paper adds that more detailed environmental, technological, biological, and socioeconomic data are being collected in 12 sites through the project "Experiments in New Approaches to the Improved Management of Open-water Fisheries in Bangladesh" since 1986. The paper makes recommen-

dations for improving and strengthening of the fisheries statistical system in Bangladesh.

- 65 Ali, M.Y. 1989. Environment, conservation and fishery resources in Bangladesh. In *Inland fisheries management in Bangladesh*, M. Agiiero, S. Huq, A.K.A. Rahman, and M. Ahmed, eds. Department of Fisheries, Dhaka, Bangladesh; Bangladesh Center Advanced Studies, Dhaka, Bangladesh; and International Center for Living Aquatic Resources Management, Manila, Philippines. pp. 36-52.

This paper highlights the importance of the floodplains during the monsoon season in the continuation and sustenance of the stocks of a large variety of fish species as the inland fishery production system, consisting of rivers, floodplains, beels, and estuaries, is a single integrated system. It discusses the impacts of some flood control, drainage and irrigation (FCD/I) projects on the fish production system. The impacts of submersible embankments on the aquatic production system and species diversity in *haor* areas are discussed. It also discusses the withdrawal of irrigation water from large water bodies such as the oxbow lakes of the Jessore area and perennial *beels*. The effects of this on the fishery production system are indicated. The fish and prawn resources of the inland water fishery are discussed. The paper also addresses the possible industrial and chemical pollution impacts on fisheries, particularly those caused by agricultural pesticides. It also discusses conservation measures to sustain the populations and stocks of various fish species, as well as the enforcement of those measures.

- 66 Ali, M.Y. 1994. Fisheries and Environment. *Environment and Development in Bangladesh*, vol. 2. A.A. Rahman, S. Haq, R. Haider, and E.G. Jansen, eds. University Press Limited.

20

This section of the book has elaborate description of fisheries resources (capture and culture), constraints, potentials, and some aspects of the biology of floodplain species in Bangladesh.

- 67 Ali, S. 1984. Marine Resources of Bangladesh. Proceedings of the 4th National Zoological Conference, Bangladesh. Dhaka. p. 121.

This paper gives an overview of fin fish, shell fish, and turtle and plant communities in the Bay of Bengal. It recommends carrying out intensive investigation of marine resources of Bangladesh.

- 68 Bangladesh Center for Advanced Studies (BCAS). 1991. Floodplain Production Monitoring Initial Study Report. Third Fisheries Project. Department of Fisheries, Government of Bangladesh.

The methods and techniques monitoring floodplain capture fisheries are described in this report. The methods cover both the households and gear-dependent monitoring systems for estimating production. The socioeconomic survey method for fishing households is also described.

- 69 Bennett, S.L., Anisuzzaman, K., and S.M.A. Rashid. 1993. Potential initiatives for wetland management in the north eastern region of Bangladesh. In Freshwater wetlands in Bangladesh: Issues and approaches for management, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. PP 255-261.

This paper documents the initiatives that have been formulated for inclusion in the regional water management plan (presently under preparation) covering the northeastern region of Bangladesh. It is suggested that development of a regional water

management plan requires an understanding of all water-related aspects of regional development including hydrology, sedimentation, agriculture, fisheries, and wetland ecosystem. The initiatives recommended include community-based management of rotating bird sanctuaries, community-based resource management for wetland sites, afforestation of economically important swamps, monitoring of wetland sites of ecological importance, farming of highly valued wildlife, restoration of endangered plant species, water quality management, and strengthening institutional support. It also recommends potential initiatives in agriculture and fisheries.

- 70 Chowdhury, Z.A.; Sada, N.M.; and Khan, M.G. 1994. Exploitation of fish and shrimp by beach seine fishery at Teknaf, Cox's Bazar. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

The paper reports the major research findings of a year-long study conducted from March 1988 to February 1989 in two stations where high concentrations of beach seine nets were operated. The study recorded a total of 78 species of fin fish and shell fish of which seven were penaeids, four carideans, sergestid, Alpheid shrimp, crab, squilla and 32 species/groups of fin fishes. The dominant species at sampling station-I (Teknaf seacoast) were *Hilsha filigera*, other clupeids, engraulids, *Johnius dussumerii*, *Lepturacanthus savala*, and other fish and shrimp. At sampling station-II (Naf river estuary), the predominant species were *Johnius bengeerii*, *Otolithoides pama*, engraulids, and clupeids. These were followed by *Metapenaeus brevicornis*, *Acetes indicus*, *Liza tade*, *Pomadasys hasta*, *Palaemon styliferus*, *Lepturacanthus savala*, *Parapenaeopsis stylifera*, *Penaeus indicus*, *Metapenaeus monoceros*, and other organisms.

- 71 Cooper, G.P. 1977. Development of Fisheries in the Chandpur, Muhuri and Karnaphuli (Halda and Ichamati) Irrigation and Flood Control Projects. Working Document no. 4. Directorate of Fisheries. Snell Environmental group INC., Michigan, USA.
- families observed in the rivers and swamps of Mymensingh and Tangail districts.
- 75 Dugan, Patrick J. 1993. Wetland management: An international perspective. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp 263-273.

This document highlights the results of the socio-economics and catch assessment data in the Chandpur, Muhuri, Halda and Ichamati project areas.

- 72 Department of Fisheries (DOF), Bangladesh. 1983-84, 1984-85, 1985-86, 1986-87, 1987-88, 1988-89. Fish Catch Statistics of Bangladesh. Dhaka.

These annual publications of the DOF include fish catch data (yield) by habitat, species group, fishermen, area (district) in Bangladesh. They also include data on carp spawn production in hatcheries and the natural spawn collected from river sources.

- 73 De Silva, S.S. 1987. Reservoir Fish Management and Development in Asia. Proceedings of a workshop held in Kathmandu, Nepal, 23-28 November, 1987.

This publication covers the state of reservoir fisheries research in Asian countries, including Bangladesh. The topics covered include: existing state of fisheries, limnological, biological, and management aspects of reservoir management in Asian countries.

- 74 Doha, S. 1973. Fisheries of the districts of Mymensingh and Tangail. *Bangladesh Journal of Zoology* 1(1):1-10.

This paper provides a detailed checklist of 106 species of fish belonging to 68 genera and 34

Throughout the world, wetlands have been degraded by draining, dredging, and filling as dams have been built and water diverted, and as wetlands have been converted into agricultural land. This paper briefly reviews the areas of major wetland loss all over the globe. In recognition of the importance of wetlands and the environmental, social, and economic consequences of wetland loss, a growing number of countries have initiated national programs to address wetland conservation needs. National programs are being developed in many countries. This paper reviews the approaches taken by Canada, Uganda, and Vietnam. It also presents an overview of international conventions and efforts discussing the provisions of the Ramsar Convention, World Heritage Convention, Bonn Convention, and Biological Diversity Convention. It summarizes international experiences, initiatives, and lessons learned upon which a wetland management approach for Bangladesh may be built. The salient points of these are recognition of their economic value and preparation of a national program based on a national policy that ensures that inter-sectoral concerns will be addressed and rural communities will be consulted.

- 76 FAO. 1996. Aspects of the Management of Inland Water for Fisheries. FAO Fisheries Technical paper no. 161. FIRS/T 161.

This document outlines the effects of changes in water quality on fisheries as well as impacts of

various types of water management/control structures on fisheries.

- 77 **FAP 2. 1992. Agriculture and fisheries. North West Regional Study Draft Final Report, Vol. 12. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report outlines the present status of agriculture and fisheries resources and practices in the area by water depth, land and wetland types, project options, and impacts on resources components.

- 78 **FAP 3.1. 1993. Final Feasibility Report: Main Report. Jamalpur Priority Project Study. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report has a section on fisheries that includes a fisheries assessment methodology, the present state of culture and capture fisheries resources in the project area (habitats, production, and management). It also analyzes the impact of the proposed project on fisheries and suggests a fisheries development plan.

- 79 **FAP 6. 1993. Fisheries specialist study. Northeast Regional Water Management Project Draft Final Report. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report has detailed descriptions of fisheries resources (habitats, biodiversity, production, some aspects of biology of floodplain species), flood control projects, fisheries mitigation measures, etc. in the Northeast Region of Bangladesh.

- 80 **FAP 6. July 1994. Northeast regional water management project: Fishpass Pilot Project implementation plan, final draft. Report prepared by Shawinigan**

Lavalin Inc., Northwest Hydraulic Consultants, CIDA.

This document describes the loss of floodplain fisheries production and species diversity within the Manu river flood control project in Moulvibazar district. A detailed design of an appropriate fish pass is described in the paper and a feasibility of installing the fish pass on experimental basis in the Manu river project is also discussed.

- 81 **FAP 17. 1992. Inception report: Phase 1. Fisheries Study, Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report outlines the project background, scope of work, study approach, and the basic principals of fish population dynamics in floodplain ecosystems. It also predicts the impacts of flood control structures will have on capture fisheries and on the different communities of people.

- 82 **FAP 17. 1994. Final report (Draft): Main volume. Fisheries Study, Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report summarized the findings of fisheries studies and socio-economic studies conducted in different regions of the country over 18 months. The fisheries studies include catch monitoring in the primary (Ganges-Padma and Jamuna-Brahmaputra), secondary and tertiary rivers, floodplains, and canals. The report compares fish production in the wetlands inside and outside of some FCD/I projects. The socio-economic studies cover the issues like impact of flood control projects on fisheries production and ichthyodiversity, fisheries access, professional fishing communities, part-time and subsistence fishing families. Information on fish consumption was collected and fisheries impact and economics of flood control were assessed.

- 27
- 83 **FAP 17. 1994. Final report (Draft): Supporting volume 1. Fisheries Study, Tangail Compartmentalization Pilot Project. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report presents the major research findings of an 18-month long study on monitoring fish catch in rivers, beels, canals and floodlands both inside and outside of the proposed Compartmentalization Pilot Project in Tangail. Comparative analyses of catch effort, species diversity and production inside and outside the project is made.

- 84 **FAP 17. 1994. Final report (Draft): Supporting volume 2. Fisheries Study, Satla-Bagda Polder 1. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report presents findings of an 18-month long fisheries monitoring program conducted within the Satla-Bagda FCDI project located in the south west in between Gopalganj and Madaripur. The study monitored fish catch in various wetlands within the project and made comparisons with that outside the project. It found that the catch effort and catch rate are higher outside than inside the FCDI project. The study found lesser number of species within the project with greater dominance of floodplain species over the migratory species.

- 85 **FAP 17. 1994. Final report (Draft): Supporting volume 3. Fisheries Study, Chatla-Fukurhati Project. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report documents the findings of an 18-month long study on monitoring fish catch in rivers, beels, canals and floodlands both inside and outside of Chatla-Fukurhati FCD project located in the south west in between Faridpur and Madaripur. Comparative analyses is made of catch effort, species diversity, production, water quality inside and outside the project. The study identified

kua fishing as an important fisheries activity in the area.

- 86 **FAP 17. 1994. Final report (Draft): Supporting volume 12. Village Study, Pabna Irrigation and Rural Development Project. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report presents the findings of village studies conducted in Chalan Beel Polder B located in Natore and Bogra districts. It describes the impacts of FCDI projects on fishing communities, distribution of fisheries benefits, seasonal variation of fisheries activity, access regulation and the agriculture-fisheries controversy. The study also dealt with livelihood in general within the project.

- 87 **FAP 17. 1994. Final report (Draft): Supporting volume 13. Village Study, Pabna Irrigation and Rural Development Project. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report documents the results of village studies conducted within the Pabna Irrigation and Rural Development Project. The study produced the site specific output on issues like impacts of FCDI projects on fishing communities, distribution of fisheries benefits, seasonal variation of fisheries activity, access regulation, and the controversy between agriculture and fisheries.

- 88 **FAP 17. 1994. Final report (Draft): Supporting volume 14. Village Study, The Kai Project and Dekker Haor. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report discusses the findings of socio-economic studies conducted in haor area in Sunamganj district. Data and information on impacts of submersible embankments on fisheries resources were collected for study. Impacts of submersible

embankment on both the professional and subsistence fishing communities, fishing pattern, livelihood and dependence on fisheries resources, and access rights were assessed. The agriculture-fisheries controversy was discussed.

- 89 **FAP 17. 1994. Final report (Draft): Supporting volume 15. Village Study, Chatla-Fukurhati Scheme. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report discusses the findings of village studies conducted in Chatla-Fukurhati Beel Drainage scheme of BWDB located in Bhanga thana under Faridpur district. Data and information were collected on the impacts of beel drainage scheme on fisheries resources, traditional fishing communities, changes in fishing pattern, dependence on fisheries, access rights and agriculture.

- 90 **FAP 17. 1994. Final report (Draft): Supporting volume 16. Village Study, Satla-Bagda Polder 1. Bangladesh Flood Plan Coordination Organization, Dhaka.**

This report documents the results of a village study conducted inside and outside the Satla-Bagda Polder 1: an FCDI project of BWDB located in Gopalganj and Barisal districts. Data and information were collected on the impacts of the project on fisheries resources. Changes in fishing profession, access rights, and dependence on fisheries for livelihood were assessed..

- 91 **FAP 17. 1994. Final report (Draft): Supporting volume 23. The use of passes and water regulators to allow movements of fish through FDC/I structures. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.**

This report discusses losses of fish due to water control structures in the typical FCD projects in Bangladesh and suggested for installation of fish friendly structures in order to facilitate fish migration through structures. The report also described some suitable fish-friendly structures with detail design.

- 92 **FAP 17. 1994. Final report (Draft): Supporting volume 24. Investigation of Pesticide residue levels in Floodplain fish in Bangladesh. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.**

This report presents the findings of the investigation on the pesticide residue in fish tissue. The sample fish were collected from beels in Tangail in March and April 1992. The study revealed low levels of DDD and DDE, metabolites of DDT, and also dieldrin in fish tissue. The result indicated slight organochlorine pesticide pollution in floodplain ecosystem.

- 93 **FAP 17. 1994. Final report (Draft): Supporting volume 25. Nature and extent of NGOs participation in Fisheries Resource Development in Bangladesh. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.**

This report presents the findings of the investigation on the Non-Governmental Organizations (NGOs) who are working in the fields of aquaculture and fisheries development in Bangladesh. A comprehensive list of NGOs is provided. Their area of activities, nature and types of aquaculture, fisheries program and projects, skilled and non-skilled man power in fisheries sector, and program coverage in terms of area and beneficiary groups, program cost, etc. have been given in the report.

- 94 FAP 17. 1994. Final report (Draft): Supporting volume 26. An Annotated Bibliography (1940-92) on the River and Floodplain Fisheries Biology and Production in Bangladesh and South Asia. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.

This bibliography includes published and unpublished information on fish and prawns. Most references listed in the bibliography concern studies undertaken in Bangladesh. The bibliography is indexed using document numbers by species and by subject to facilitate reference to the relevant literature.

- 95 FAP 17. 1994. Final report (Draft): Supporting volume 27. Review and Bibliography of Nutrition in Bangladesh. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.

This report presents the findings of the review of literature on nutrition by the project team. Also included is an annotated bibliography of nutrition in Bangladesh. The report also discusses the issues associated with nutritional status of people in rural Bangladesh, impact of FCDI projects on nutrition, impacts of fish consumption, dietary diversity and household food security.

- 96 FAP 17. 1994. Final report (Draft): Supporting volume 28. An Annotated Bibliography of the Quality and Limnology of Inland Freshwaters in Bangladesh. Overseas Development Administration, U.K. Bangladesh Flood Action Plan. Dhaka.

This document presents 185 annotated citations on the quality and limnology of inland freshwaters in Bangladesh. The bibliography is indexed using

document numbers by subject to facilitate reference to the relevant literature.

- 97 FAP 20. 1992. Interim report (Draft), Annex 3: Fisheries and aquaculture. Compartmentalization Pilot Project, Tangail. Bangladesh Flood Plan Coordination Organization, Dhaka.

This report highlights the biological characteristics of the fish community in Bangladesh, the present status of capture fisheries resources in the project area, and the possible impacts of different project options on capture fisheries in the project area.

- 98 FAP 20. November 1993. Hatchling migration in the Lohajong River: Preliminary results of the special fisheries study (draft). Compartmentalization Pilot Project, Tangail. Working paper CPPWP-93/04. Bangladesh Flood Plan Coordination Organization, Dhaka.

This report discusses fish hatchling migration pattern in the Lohajong river and describes migration timing, daily abundance, diurnal/nocturnal variation, variation at different depths, etc. The study results are based on daily sampling at selected points along the Lohajong River from June to October 1992 and June to October 1993.

- 99 Farooque, M. 1993. Laws on wetlands in Bangladesh: A complex legal regime. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 231-237

This paper briefly reviews the present legal status of wetlands in Bangladesh and highlights the serious legal limitations to their conservation. There is a need to revise the existing legal frame-

work and pertinent rules and regulations. The policy and legislative or regulatory issues that are responsible for destruction or degradation of wetlands should be identified first. Wetlands for conservation should be selected on the basis of an inventory, and all wetlands may not be targeted for such action. Sustainable development should be the aim for those not targeted. The legal status (including ownership, possession, and record of right status) and institutional authority of the wetlands need to be ascertained and existing provisions may then be reviewed. Legislative measures should be under a single regulatory framework, which must be effective and workable. The paper also presents a brief historical overview of the regulatory framework of wetland management.

- 100 Karim, M. 1994. Shrimp seed resources exploitation and utilization. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh, held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper analyzes the seed demands of the country's 115,000 hectares of shrimp farms and finds that most of them are collected from natural sources by poor people living in the coastal area. Due to a lack of technical knowledge and awareness, huge quantities of seed are wasted every year. The author suggests in-depth study of this issue to reduce damage and to sustain the natural population of shrimp.

- 101 Master Plan Organization (MPO). 1985. Fisheries and flood control, drainage and irrigation development, technical report no. 17. Dhaka.

This report discusses some biological aspects of selected floodplain fishes and highlights the impacts of flood control, drainage and irrigation (FCD/I) projects on capture fisheries production and species diversity in the inland open waters of Bangladesh.

- 102 Government of Bangladesh. 1991. Task force report on Bangladesh development strategies for the 1990's. Environment policy, vol. 4. University Press Limited. pp. 91-107.

This report contains a fisheries section which discusses fisheries resources, living aquatic resources, and production of fish by species, by habitat, and by location. It also assesses the impacts of various anthropogenic interventions on aquatic habitats and capture fisheries production and biodiversity, water quality degradation, and pollution.

- 103 Habib, M.A.B.; Ahmed, M.; Islam, M.A.; and Haque, A.K.M.A. 1984. Seasonal variations in benthic fauna in relation to chemical condition of bottom soil in two selected ponds. Proceedings of the 4th National Zoological Conference, Bangladesh. Dhaka. 121 p.

This paper reports on the considerable monthly and seasonal variations observed in the chemical characteristics of soil and its effect on the growth and abundance of bottom fauna in ponds. Fluctuations of benthic fauna were found to be partially related to pH, organic carbon, total nitrogen, exchangeable K, Mg, and Na and inversely related to nitrate-nitrogen in ponds.

- 104 Hamidur, Rahman Khan. 1993. Water development activities and their impacts on wetlands. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 23-31

This paper presents an overview of water development activities in Bangladesh and their impact on wetlands. The development imperatives of the recent past have guided the activities and invest-

ments in the water sector toward the objective of increased food grain production. Consequently, improvements in water resources management have taken place in water level control in the monsoon season and in expanding water supply for irrigation in the dry season. Flood control and drainage projects have been built consisting of embankments, river closures, excavation of drainage channels, and the construction of drainage control structures. Embankments stop overbank flooding from rivers and the control structures prevent back flow from high river levels into low-lying areas. This results in the reduction of wetland areas. Such lowering of flood water levels is intended to increase the intensity of agricultural activities in lands which used to be subjected to medium and deep flooding. The irrigation consists mainly of small manual and power pumps to lift surface or groundwater with earthen distribution systems constructed by the farmers. The exploitation of surface water by low-lift pumps during dry season dried up small rivers and natural water bodies (*beels*, *haors*, and *baors*). Large groundwater withdrawals also lowers groundwater levels in the dry season which reduces the availability of dry-season surface water in wetlands. In other words, large-scale utilization of surface and groundwater has greatly reduced wetland areas.

- 105 Haque, A.K.M.A. 1989. Environment, conservation and management of fishery resources in Bangladesh. In *Inland fisheries management in Bangladesh*, M. Agiiero, S. Huq, A.K.A. Rahman and M. Ahmed, eds. Department of Fisheries, Dhaka, Bangladesh; Bangladesh Center for Advanced Studies, Dhaka, Bangladesh; and International Center for Living Aquatic Resources Management, Manila, Philippines. pp. 24-35.

This paper points out the key requisite for the efficient management of fishery resources is management of the environment, which contributes to the sustainability of fish populations. Pollution of the aquatic environment of Bangladesh is

already causing concern among fisheries people. This paper suggest an urgent need to know the nature and effects on fish stocks of all industrial, agricultural, and medical chemicals. There is also a need to understand the physiology and nature of responses fish have to various environmental stimuli.

Mere enactment of legislation is not enough; there has to be an effective mechanism to enforce legislation. The estuarine area and Kaptai Lake call for special treatment so as to reap the maximum benefit from their vast potential. There should be a system for easy flow of information and experience, and easy interaction among government agencies, NGOs, scientists, fish culturists, and the fishing population. The latest satellite imagery technology may be of help in tacking many fish management problems.

- 106 Hossain, S.M. Altaf; Ali, M.M.; Dewan, Somen; and Islam, M.S. 1988. Rice-fish culture: An adoptable technology for Bangladesh. *Bangladesh Journal of Extension Education*, 3(1): pp 39-45.

Experiments on rice-fish culture were carried out in farmers' fields in the of village Kazirshimla (Trishal Upazila, Mymensingh District) and at the Agronomy Field Laboratory, Bangladesh Agricultural University, during 1985-1987. In this study, fish fingerlings of *rui* (*Labeo rohita*), *catla* (*Catla catla*), *mrigal* (*Cirrhina mrigala*), silver carp (*Hypophthalmichthys molitrix*), *bagna* (*Cirrhina reba*), mirror carp (*Cyprinus carpio*), and Thai *sarputi* (*Puntius gonionotus*) were stocked in different combinations, compositions, and densities. Of all these species, mirror carp showed the highest average growth at the Agronomy Field Laboratory, followed by Thai *sarputi*. In the farmers' fields, Thai *sarputi* showed the highest average growth.

The net income obtained at the Agronomy Field Laboratory and farmers' fields in 1987 were Tk.4,094/ha and Tk.2,672/ha, respectively.



Mirror carp and Thai *sarputi* were found the best for rice fish culture in the country's existing environmental conditions.

- 107 Huq, Md. Fazlul. 1993. Institutional aspects of wetland management in Bangladesh. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*. A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 213-229.

This paper reviews the existing institutional arrangements and capabilities for wetland management in Bangladesh. Discussion on the administrative resources including institutions, policies, laws, research organizations and NGOs have been included to highlight the present status of management capabilities. Management issues have been identified and alternative strategies suggested for sustainable management. Basic steps for drawing up a management plan for wetlands in Bangladesh have been discussed in brief. An action plan recommendation have been suggested with proposed outlines for an integrated and improved institutionalized approach to wetland management.

- 108 Huq, S.M. Imamul and Kamal, Golam Monowar. 1993. Characteristics and dynamics of wetlands soils. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*. A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 33-59.

This paper discussed wetland soils types in Bangladesh. Out of a total 483 soil series, around 416 have developed under aquatic moisture regime. Most of Bangladesh's mineral soils contain less than 3% organic matter which is the standard for wetland soils of tropical Asia. The pH of mineral wetland soils is around 7.0 becoming acidic or alkaline on drying depending upon parent material while the

organic wetland soils are acidic. The CEC of mineral wetland soils ranged between 10 and 20 meq %, while that of organic wetland soils, because of the presence of high clay content, is relatively higher. The organic wetland soils are deficient in some micro nutrients. A substantial change occurs in the influx and efflux of various nutrients including the organic matter turn over in the wetland soils which is mostly controlled by the source of water, the positional situation of the wetlands and the parent materials. The nutrient dynamics of a few wetland soils and water of Bangladesh are also discussed.

- 109 Islam, A.K.M. Nazrul. 1993. Ecological characteristics of freshwater wetlands. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 65-73

This paper presents a conceptual framework for the role of hydrology in wetland ecosystems and classifies wetland systems based on a hydrodynamic energy gradient. The physical parameters of three freshwater wetland ecosystems (marshes, *baors* and *haors*) are evaluated.

- 110 Islam, A.K.M. Nurul, 1993. Limnology and pollution of wetlands. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 123-145.

This paper discusses the limnological characteristics of freshwater wetlands of Bangladesh. Reviewing the historical transformation of these wetlands, it shows that a complex interaction of man and natural processes—river bed evolution, extensive flood control and irrigation works, and excessive pollutants—have caused changes in wetland fea-

98

tures and rendered them ecologically fragile. The productivity and trophic status of freshwater wetlands in Bangladesh and their adjacent areas is discussed using various case studies. Phytoplankton productivity in some *beels* was found to convert only 5-21% (or 15-30%) of energy and a major contributor was found to be macrophytes. Major pollution sources, both point and non-point, that cause environmental hazards in the wetlands are identified. These are mainly chemical and biological in nature. These pollutants have caused as many as 32 waterborne diseases, including cholera, dysentery, diarrhoea, typhoid, and shigellosis. Many diseases of fish, waterfowl, cattle, and other animals are related to eutrophication and pollution of the wetlands. Freshwater wetlands of Bangladesh exceed the limit of natural purification. a number of recommendations are made to mitigate eutrophication and pollution problems. Population, poverty, pollution, productivity (biological), politics, progress, and prejudices constrain the conservation of the wetlands.

- 111 Jyotirmoy, Talukder. 1993. Socio-economic issues in management of freshwater wetlands in Bangladesh. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 187-197.

This article examines the socioeconomic and administrative issues related to the management of *jalmahals* to develop an understanding of present-day conflicts in land use management. Social conflicts resulting from *jalmahal* management are also highlighted. The paper reviews human settlement patterns and the process of resource tapping from the *haors*. It proposes an approach for sustainable management of *haors* through effective involvement of local people on a "community-based management" methodology. This paper is based on two monographs—one on Kaliagota Haor and the other on Shanir Haor—produced by the Socio-Anthropological Team of FAP 6.

- 112 Karim, A. 1993. Plant diversity and their conservation in freshwater wetlands. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh pp. 75-104.

This paper discusses the conservation of plant diversity in freshwater wetlands in Bangladesh. It documents and discusses the different life forms and communities in the wetlands and describes their distribution in six ecological zones. About 158 species belonging to 49 families are identified. The changing condition of the landscape due to geotectonic change within a very short period of time and increasing human intervention disrupt the patterns and processes of vegetation development in wetlands. *Aldrovanda vesiculosa* and *Rosa involucrata* have been identified as locally threatened species, and freshwater swamp forest consisting of *Barringtonia acutangula*, *Pongamia glabra* and *Crataeva nurvala* is the most threatened vegetation due to over-exploitation and sedimentation. The paper points out that deep tillage for cultivating HYV in the wetlands disturbs the natural seed bank and that leads to loss of plant diversity. Conservation of wetland plants is recommended. Immediate protection measures for the Tanguar Haor system and Bara Haor in the northeast region is also recommended. Adoption of a policy and legal framework, integrated conservation management, and research are identified as essential for the restoration of threatened plants communities.

- 113 Khan, A. Ali. 1993. Freshwater wetlands in Bangladesh: Opportunities and options. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim. IUCN—The World Conservation Union, Bangladesh. pp.1-8.

This paper contains an account of the state of wetlands in Bangladesh. While recent rapid expansion of physical infrastructure in the floodplains and wetlands yielded two beneficial effects—increased food production and improved road communication—their adverse effects on fisheries, wildlife, and the ecosystem have had far-reaching consequences. The paper recommends urgent action to arrest further degradation of wetlands due to human interference. It suggests three distinct, though not mutually exclusive, strategies for preserving the wetlands of Bangladesh. These are: a moratorium on development in at least a few ecologically sensitive wetlands, inclusion of environmental mitigation components in all development projects in the wetlands and rehabilitation of critically essential degraded wetlands. The success of such an approach is contingent on continuous research and monitoring of wetlands.

- 114 Khan, Y.S.A. 1984. Marine fisheries resources of Bangladesh. Paper presented at the 4th Zoological Conference of the Zoological Society of Bangladesh, March 15-17 1984. Dhaka

This article discusses the territorial area (1 million ha) of the Bay of Bengal and the richness of its aquatic life. It also reviews the work of surveys done on different aspects of the bay ecology. Some examples of demersal and pelagic fish and shrimps are given. Causes of pollution and environmental alteration in the coastline are also discussed.

- 115 Molla, Atiar Rahman and Islam, S.M. Fakrul. 1986. Development of fisheries in Bangladesh. Bangladesh Journal of Aquaculture, 8(1):25-35.

This paper points out that there exists a tremendous potential for increasing fish production in Bangladesh. It also discusses the broad objectives of fisheries development, natural endowments of fisheries resources, socio-economic constraints on fish pro-

duction, trends of fish consumption, and future demand. The document also points out the fisheries consequences of grain-biased food production strategies in Bangladesh. On the basis of available data, the authors have recommended some policies and strategies for the development of fisheries resources in Bangladesh.

- 116 Mustafa, M.G. and Dey, M.P. 1994. The effects of environmental factors in the ecosystem of the Bay of Bengal, Bangladesh. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper describes the results of an oceanographic survey during a long-term systematic program of bottom and shrimp trawling in the territorial waters of Bangladesh. The Bay of Bengal is characterized by river discharge from the mainland. This dynamic character involves changes in the ecosystem, stability of depth, and water quality. This study reveals the responses of the bay to seasonal variations in temperature, salinity, and turbidity.

- 117 Nishat, A. 1993. Freshwater wetlands in Bangladesh: Status and issues. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 9-21.

This paper examines the definition of wetlands adopted at the RAMSAR convention and the classification of wetlands as developed by IUCN. The paper argues that *haor* areas, which offer a complex ecological, hydrological, and geomorphological landscape system, contain all the elements of freshwater marshes, floodplains, swamp forests and lakes. The study covers all issues related to the conservation and sustainable manage-

ment of freshwater wetlands. The paper describes the characteristics of wetlands in Bangladesh and identifies various causes of their degradation. Present-day development activities in *haors* are directly linked with agricultural practices and cropping seasons. There are two distinct approaches. One provides protection against early monsoon flood with the help of submersible dikes to save *boro* crops. The other protects against the main monsoon flood and requires high embankments. The paper evaluates the negative and positive impacts of these activities and finds that submersible dikes are more acceptable to local people.

- 118 Nuruzzaman, A.K.M. 1991. Effects of environmental modifications on riverine fisheries in Bangladesh. Paper presented at World Fisheries Congress held in Athens, Greece, 14-19 April 1991.

This paper highlights the effects of various human actions, flood control and drainage projects, and pollution and sedimentation on fisheries resources.

- 119 Patra, R.W.R and Azadi, M.A. 1985. Hydrological conditions influencing the spawning of major carps in the Halda River, Chittagong, Bangladesh. Bangladesh Journal of Zoology 13(2):63-72.

This study concludes that the spawning of major carps is favored by a combination of some environmental factors that stimulate the biological process. The following possible environmental factors are described in the paper: 1. abrupt rise of water level due to monsoon flooding; 2. increasing current velocity and turbidity; 3. decreasing water temperature, DO, and conductivity; 4. slight acidic water. Interactions of all these factors trigger carp spawning in the Halda River.

- 120 Rahman, A.K.A. 1993. Wetlands and fisheries. In *Freshwater wetlands in Bangladesh: Issues and approaches for*

management, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 147-161.

The paper highlights causes of disappearing wetlands in Bangladesh. It also documents that the Inland fisheries cover an area of 4.3 million ha, 94% of which is open-water capture fisheries supporting about 260 species of freshwater fish. The paper identifies a host of man-made stresses, such as large-scale water abstraction for irrigation; construction of embankments for flood control; siltation and soil erosion resulting from deforestation in the catchment zones; water pollution from industrial, agricultural, and municipal wastes; and over-exploitation and destructive fishing practices. It evaluates the potential of fisheries in paddy field wetlands and recommends its introduction in Bangladesh. It outlines an integrated management approach for inland open-water fisheries.

- 121 Rahman, A.A., et al., eds. 1994. *Environmental aspects of surface water systems of Bangladesh*. University Press Limited, Dhaka.

This book is a compilation of articles on water resources issues from different disciplines. The articles covers such diverse disciplines as the natural and biological sciences, engineering, health, and social sciences.

- 122 Rahman, A.K.A. 1989. *Freshwater fishes of Bangladesh*. Zoological Society of Bangladesh, Dhaka.

This book is the outcome of research on freshwater fish species diversity in Bangladesh. The book provides scientific descriptions (diagnostic characteristics with some aspects of biology) of 260 species under 145 genera and 55 families. It can be used as a guide to work on fish taxonomy and biology.

- 123 Rahman, M. Mokhlesur. 1994. Community-based management of wetland resources in Bangladesh. Paper presented at the 15th Annual Meeting of the Society of Wetland Scientists, May 30-June 3, 1994, Portland, Oregon, USA.

The paper points out the richness of wetland resources in Bangladesh which cover an area of 4.3 million hectares, providing habitats for 400 vertebrate species, 300 plant species, and a wide variety of invertebrates. It discusses people's interactions with wetlands. More than 1.1 million people are estimated to be involved in commercial fishing and 73% of rural families are engaged in part-time subsistence fishing. In addition, wetlands provide water for irrigation, navigation, and other household uses. Millions of rural people depend for their livelihood on wetlands. The paper highlights the declining trend of wetland resources in Bangladesh and outlines a long-term environmental management plan for sustaining wetlands and their biodiversity. It focuses on the importance of a community-based resource management approach for the restoration, conservation, and management of wetlands. It also highlights the possible ways of educating and involving community people in management processes, giving due consideration to their perceptions and traditional beliefs.

- 124 Rahman, S.M. 1989. Fishing activity and distribution of benefits in Bangladesh. In *Inland fisheries management in Bangladesh*, M. Augero, S. Huq, A.K.A. Rahman, and M. Ahmed, eds. Department of Fisheries, Dhaka, Bangladesh; Bangladesh Center for Advanced Studies, Dhaka, Bangladesh; and International Center for Living Aquatic Resources Management, Manila, Philippines. p. 102-117.

This study analyzes the economics of fishing activities in four river sites in Bangladesh. The analytical framework provides a basis for computing the costs and returns of various types of

fishing gear used by fishing units in these sites. Also provided are estimates of the catch per unit of effort (CPUE) and catch rate for all four fishery sites. The economic analysis reveals significant economic rents and profits in all four sites. The profitability of fishing is higher in the two sites under the management of the Department of Fisheries (DOF) compared to the other two fisheries, which are under traditional management. The study does not provide a causal explanation of these differences. From implicit wage rate computations the study finds that fishing is relatively more remunerative than alternative income-generating opportunities in and around the fishery site.

- 125 Rasid, H. and Mallik, A. 1993. Poldering vs. compartmentalization: The choice of flood control techniques in Bangladesh. *Environmental Management* 17, No. 1:59-71.

This paper is based on a case study of the impact of the Dhaka-Narayanganj-Demra (DND) project. The study found that the project alleviated flooding but induced considerable environmental degradation due to stagnation of water, structural instability of embankments, etc.

- 126 Reza, R. 1993. Wetland policies rules and regulations in Bangladesh. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN-The World Conservation Union, Bangladesh. pp. 199-211.

This paper recognizes that wise application of sustainable development principles to wetland conservation will bring about multifarious benefits to any country that has wetlands. The present thrust of development activities in the wetland areas of Bangladesh, has mainly aimed to meet demands emanating from increasing demographic pressure, and there is a lack of concern for manag-

ing them in an ecologically sound manner. To ensure the sustainable use and management of this country's wetlands and promote development of their ecological and socioeconomic functions and for the long-term benefit of the people, the paper proposes effective enforcement of existing rules and regulations.

- 127 Sada, N.M. and Chowdhury, Z.A. 1994. Seasonal abundance and diversification of species in the estuary at Kumira, Chittagong. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper presents the results of a year-long study (December 1989-November 1990) of the estuarine fauna of Kumira, Chittagong. A total of 35 species were recorded, of which the dominant were gobbies followed by crab, bombay duck, jaw fish and other carideans. The catches peaked in March.

- 128 Sarker, A.L. 1994. Fish species diversity for sustainable aquatic environment. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper discusses the various ways in which the environment is being degraded, and altering natural fish production both in terms of quantity and species diversity. Steps need to be taken to ensure a sustainable environment for the sustained development of the fisheries resources. Mitigation measures as well as the prospects for the compensation of fisheries losses and enhancement of fisheries resources are also suggested.

- 129 Sarker, S.U.; Roy, P.C.; and Sarker, N.J. 1994. Biodiversity in the resources

of Hail Haor and their environmental impact and conservation. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University, 26-28 January, 1994.

This paper documents the results of a study on biodiversity of Hail *haor* (wetland) during the period from June 1992 to December 1993. The authors identified 98 species of birds, 54 species of fishes, 11 species of mammals, 5 species of amphibians, 9 species of reptiles, 16 species of invertebrates, and 37 species of aquatic vegetation. About 22 species of animals and plants in the wetland are found to be endangered. The author suggests that the *haor* resources should be protected and be included on the Ramsar Convention list as a wetland of international significance.

- 130 Sarker, S. Uddin. 1993. Faunal diversity and their conservation in freshwater wetlands. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*. A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 105-122.

This paper discusses the status, distribution, and conservation of wetland fauna in Bangladesh. Of the avifauna listed, 78 species are migratory and 129 are resident water birds that frequent the wetlands. Among them ducks, lapwings, plovers, cormorants, herons, gulls and terns are important. Twenty-five species of resident and migratory water birds are endangered and threatened and the rest are vulnerable. The number of ducks in each roosting site ranges from 2,000 to 5,000, and there are about a hundred such sites in and near the wetlands. Thousands of waders and other waterfowl also visit the wetlands every winter. Seasonal distribution shows that migrants begin to arrive between mid-August and mid-November, reach optimum in December-January, and begin to return between February and May. Resident

waterfowl breed in wetlands and nearby woodlands in small groups. Large breeding colonies are rare even in the Sundarbans. Breeding success is very low owing to human disturbances and habitat destruction. Ever-increasing human population, hunting, trapping, lack of awareness, and absence of wetland sanctuary and agro-chemical residues are the main problems in conserving wetlands and waterfowl in Bangladesh. In spite of a ban on the trapping and hunting of waterfowl, such activities happen frequently due to a lack of agencies to enforce the law. The paper suggests undertaking a detailed survey of wetland fauna and a the development of a conservation and management plan for the ecologically significant wetlands. It suggests that Hakaluki, Hail, and Tanguar haors and some suitable areas of the Jamuna River be declared wetland sanctuaries for the protection of wetland fauna.

- 131 Sharafuddin, A.M. 1993. Awareness and public participation in wetland management. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 239-243.

For sustainable wetland management, the participation of local communities and creation of awareness among all concerned is essential. This paper stresses the need for making full use of all the channels of formal and informal education in the country to raising public awareness of wetland management. Key actors in the conservation of wetlands are the rural poor living in and around the wetlands whose cooperation is of crucial importance. Special attention therefore must be given to raising awareness among the rural poor. The paper recommends the inclusion of conservation issues in school curricula, effective utilization of media, and arranging of social debates. It also suggests the involvement of NGOs, utilization of religious institutions in developing environmen-

tal ethics, and the involvement of women in community programs.

- 132 Tsai, Chu-fa; Ali, L.M.; Hasan, S.O.; and Kasem, S.H.M.B. 1985. Carp spawn fishery and implementation of fishery regulation. *Fisheries Information Bulletin* FRSS/Vol. BGD/79/015.

This document describes the state of the carp spawn fishery in the Ganges, Brahmaputra, and Meghna rivers in Bangladesh. It describes natural spawn collection methods, gears used, type of people involved, costs and income, collection points, etc.

- 133 Zafar, M. 1994. On the occurrence of milk fish *Chanos chanos* larvae in the mangrove ecosystem of Kutubdia Channel, Bangladesh. Paper presented at the 9th Zoological Conference of the Zoological Society of Bangladesh held at the Department of Zoology, Dhaka University. 26-28 January, 1994.

This study records the occurrence of milk fish larvae in Bangladesh costal waters during the rainy season (June to September) and found a positive correlation between larval density and rainfall and an inverse relation to salinity.

- 134 Zahir, Sadeque S. and Islam, M. Aminul. 1993. Socio-economic characteristics of freshwater wetlands in Bangladesh. In *Freshwater wetlands in Bangladesh: Issues and approaches for management*. A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds. IUCN—The World Conservation Union, Bangladesh. pp. 179-186.

The unique socioeconomic features of the wetlands of Bangladesh pose challenging issues for their sustainable management and conservation. This

paper attempts to understand the interaction between the social and physical dynamics of freshwater wetlands. All wetlands are flood-prone; hence, agricultural practices have been adjusted to minimize the risk of flooding. Human settlements are of two types: densely populated clustered settlements on high ground, which remain above water during the monsoon, and elongated linear ones along natural levees. The social organization of these areas is unique as the geo-social units are clearly demarcated in the wet months. These areas have a larger than national average of Hindu population (17%); the rest are Muslims. Occupational patterns follow religious lines: Muslims are farmers and Hindus are in fishing and services (teaching, medical, and legal professions). The resolution of social disputes and the leadership hierarchy transcend these occupational patterns. Management practices of *jalmahals*, which often lead to conflicts, are discussed. The paper recommends mass education in the wetland areas.

WILDLIFE

- 135 Ahsan, M.F. 1989. Occurrence of crab-eating mongoose (*Hetpestes urva*) in Sylhet, Bangladesh. Bangladesh Journal of Zoology 17(1):pp. 87-88.

This scientific note indicates the presence of three species of mongoose in Bangladesh. It includes a detailed description of the morphology, food habits, and distribution of these animals in Bangladesh as well as in the region.

- 136 Ali, S. and Ripley, S.D. 1983. A pictorial guide to the birds the Indian Sub-continent. Bombay Natural History Society. Oxford University press, Bombay, India.

This is one of the best pictorial guidebooks for identifying the birds of Bangladesh. It helps to identify almost all the birds of the country. It also contains taxonomic information and some biological details.

- 137 Ali, S. 1992. The Book of Indian Birds. Bombay Natural History Society. Bombay, India. 187 p.

This book since its first publication in 1941, has been a close companion of the bird watching enthusiasts as well as of the seasoned ornithologists in South Asia. It illustrates in colour and tersely describes the habits and habitats of 296 of the commoner birds of the plains and foothills, and of the wetlands and sea coast. It also contains taxonomic information of birds. This is an indispensable field guide.

- 138 Asmat, G.S.M.; Ahmed, B.; and Rahman, M.M. 1985. Avifauna of the Chittagong University campus. Bangladesh Journal of Zoology 13(2):23-29.

This study found 79 species of birds belonging to 32 families on the campus of Chittagong University from April 1982 to November 1984. Of these, 48 were passerine species and 31 were non-passerines. Sixteen birds were migratory and 63 were resident. The paper also outlines and provides reasons for the regular and irregular occurrences of birds in the area.

- 139 Azadi, M.A. and Hossain, M. 1984. Studies on the biology of the tree frog, *Rhacophorus maculatus* with special reference to the limnology of the rearing grounds and the rearing aquarium. Proceedings of the 4th National Zoological Conference, March 15-17. Dhaka. 121 pp.

This paper discusses the biology of tree frogs in the context of selected limnological parameters including temperature, DO, free CO₂, pH, and conductivity of the rearing ground and rearing aquarium. The study finds that high pH values had a detrimental effect on the rearing of tree frog larvae. The tree frogs lay eggs on trees on or near water. The paper also discusses the breeding biology of tree frogs which has a strong association with rainfall.

- 140 Bhuiyan, M.H.R. and Khan, M.A.R. 1981. Population and breeding activities of pariah kite *Milvus migrans* (Boddaert) in greater Dacca, Bangladesh. Paper presented at the 3rd National Zoological Conference, March 15-17, 1981. Dhaka.

This paper reports the findings of a year-long study of pariah kites in Dhaka. The study revealed that more than 80% of the pariah kites in Dhaka are migratory and the resident population breeds from September to April when migratory birds are present. Both sexes took part in nest building,

82
incubation, and parental care and breeding success was 57.1%. The immigration of pariah kites peaked in November and the population size remained unchanged until mid-February. Emigration started the last week of February and all birds were completely gone by the last week of April. The paper concludes that Dhaka supports both the resident and migratory populations, having 880-950 pariah kites over an area of 31 square kilometers. The resident population was eight times higher than the migratory population. The migratory kites mostly feed on slaughterhouse refuse, while the resident birds prefer kitchen refuse waste from roadside dustbins.

- 141 Daniels, J.C. 1983. *The book of Indian reptiles*. Bombay Natural History Society.

This handbook is very useful for the field identification of reptiles. It consists of color and B&W photographs of reptiles, taxonomic information, and some biological details.

- 142 Fugler, C.M. 1984. *The commercially exploited chelonia of Bangladesh: Taxonomy, ecology, reproductive biology and ontogeny*. Fisheries Information Bulletin 2(1):52 p.

This paper is based on a comprehensive study of the chelonia of Bangladesh. It includes biological descriptions, assesses the commercially important species, and recommends sustainable exploitation of the population. The paper evaluates the feasibility of establishing hatcheries for artificial reproduction and stocking in places where the species is depleted.

- 143 Harvey, W.G. 1990. *Birds in Bangladesh*. University Press Limited, Dhaka.

This is one of the best lists of the birds of Bangladesh, covering almost all the birds of the country.

It also contains taxonomic information and some status and distribution information, including sighting reports by bird-watchers.

- 144 Hiremath, I.G. and Hiremath, G.G. 1986. *Catching of wild frogs vis-a-vis ecological imbalance—some considerations*. *Proceedings of the First World Conference on Trade in Frog Legs vis-a-vis Environmental Considerations*. Calcutta, April 10-11. Vol(1). pp. 53-56.

This paper discusses the pros and cons of catching wild frogs and makes suggestions for the systematic survey of the status of frogs. It emphasizes frog culture for sustaining the frog leg industry in India.

- 145 Huq, A.M. and Mia, M.K. 1991. *Madhupur National Park: A survey report*. Bangladesh POUSH, Dhaka.

This report discusses the geographical location and area of the Madhupur National Forest, its topography, human population, and makes some general observations about its plant resources and wildlife.

- 146 Husain, K.Z. 1981. *Development activities and their impacts on the terrestrial fauna of Bangladesh*. Paper presented at the 3rd National Zoological Conference, March 15-17, 1981. Dhaka.

The paper emphasizes the impacts of agriculture, industry, embankment, roads, etc. on terrestrial fauna in an underdeveloped country like Bangladesh and compares them to developed countries. It investigates the environmental impacts of development projects. Among the losses indicated are: rhinoceros, wild buffalo, peafowl, pinkheaded duck, gaur, etc. The paper also discusses the country's most threatened species.

- 147 **Hussain, K.Z. 1991. Report on the survey of the diversity of wildlife and its habitat in the Cox's Bazar-Teknaf area. Bangladesh POUSH, Dhaka.**

This document, based on an exploratory survey of the Cox's Bazar-Teknaf area, reports that at least 19 forest species have become extinct in Bangladesh within this century. More than 70 species are endangered or threatened and the ranges of other forest and wetland species have declined considerably, mainly due to the shrinking of their natural habitats. The decrease of biodiversity is closely correlated with the increase in monoculture plantation. Exotic species like eucalyptus, as well as indigenous species like garjan, jam, and jarul are used as monoculture plantation. The document found that it is vital to protect the remaining natural forest to sustain biodiversity and also to maintain indigenous original genetic material for posterity. One species of a plant may support more than one animal species in a given area, but not all species. The greater the diversity in the floral composition of an area the larger the number of animal species there.

- 148 **Islam, M.A. and Husain, K.Z. 1981. Activities of age-sex groups of the capped langur *Presbytis pileatus* of the Madhupur National Park. Paper presented at the 3rd National Zoological Conference, March 15-17. Dhaka.**

This paper presents the findings of a study, conducted from December 1977 to July 1987, on the behavioral patterns of the capped langur. The paper discusses the time spent by different age and sex groups of capped langur on sitting, resting, moving, playing, and grooming. The paper also defines and explains each of the activities studied.

- 149 **IUCN. 1990, et seq. 1990 IUCN red list of threatened animals. IUCN—The World Conservation Union. Gland, Switzerland.**

This book contains the global list of endangered and threatened animal species. It also contains the criteria for categories.

- 150 **Khan, M.A.R. 1982. Wildlife of Bangladesh: A checklist. Dhaka University, Dhaka.**

This book reports that Bangladesh has one of the richest wildlife fauna of the Indian sub-continent. The country has 119 species of mammals, while the sub-continent has 500 species; 578 species of birds against 1200 for the region. Likewise 124 species of reptiles and 19 species of amphibians are present in the country. This book is a checklist of wildlife from amphibian to mammal.

- 151 **Khan, M.A.R. and Ahsan, M.F. 1981. The group structure, composition and age-sex relationship of primates of Bangladesh. Paper presented at the 3rd National Zoological Conference, March 15-17. Dhaka.**

The paper discusses a survey of primates, conducted from December 1970 to March 1971, in the forested and non-forested areas of Bangladesh. It describes the group structures, group composition, and age-sex relationships of different species of primates.

- 152 **Khan, M.A.R. and Saha, S.N. 1981. Birds of the natural and artificial vegetation of the Botanical Garden, Mirpur, Dhaka: A case study. Paper presented at the 3rd National Zoological Conference, March 15-17. Dhaka.**

A 12-month study, conducted in 1979-80, found 128 species of birds belonging to 37 families. Of these, 60 (46.8%) species were found only in natural vegetation, 8 (6.4%) in artificial vegetation, and 60 (46.8%) in both. Of the species found in natural and artificial vegetation, 39 were com-

mon in natural vegetation and 21 were common in artificial vegetation. The paper also discusses the reasons birds were found in particular types of vegetation.

- 153 Pandian, T.J. and Marian, M.P. 1986. Production and export of frogs: An ecological view. Proceedings of the First World Conference on Trade in Frog Legs vis-a-vis Environmental Considerations. Calcutta, April 10-11. Vol(1). pp. 33-48.

This paper discusses the harvesting of frogs in India and evaluates the issue relative to pest control by frogs, ban on frog leg export, and emphasized culture of frogs.

- 154 Paranjape and Ghate, H.V. 1986. Frogs and frog legs: Socioeconomic and ecological perspective. Proceedings of the First World Conference on Trade in Frog Legs vis-a-vis Environmental Considerations. Calcutta, April 10-11. Vol(1). pp. 59-64.

This paper discusses the socioeconomic status of the people involved in the frog leg industry. It emphasizes regulation of the industry so that the primary catchers are not exploited by traders. The paper also highlights the ecological importance of frogs and their role in the natural food chain. The overuse of frogs for research work is also discussed and some recommendations are made toward improving the sustainability of frog species in nature.

- 155 Pillai, R.S. 1986. Diagnosis, distribution and bionomics of the edible frogs of India. Proceedings of the First World Conference on Trade in Frog Legs vis-a-vis Environmental Considerations. Calcutta, April 10-11. Vol(1). pp. 49-52.

This paper discusses the abundance and distribution of Indian frog species. It describes the diagnostic characteristics and some biological details (i.e., habits and breeding).

- 156 Prashad, B. 1986. Role of frogs and toads in environment with special reference to agriculture. Proceedings of the First World Conference on Trade in Frog Legs vis-a-vis Environmental Considerations. Calcutta, April 10-11. Vol(1). pp. 57-58.

This is an overview of the role of toads and frogs in controlling agricultural insects. The paper emphasizes frog culture for sustaining population balance.

- 157 Prater, S.H. 1980. The book of Indian mammals. Bombay Natural History Society. Bombay. India.

This is one of the best pictorial guidebooks to the mammals of Bangladesh. It helps to identify almost all the country's mammals and also contains taxonomic information and some biological details.

- 158 Raana, H. (ed) 1992. A follow-up study, cyclone '91 revisited. Bangladesh Center for Advanced Studies. Dhaka. p 144.

This book is based on a study of the coastal area of Bangladesh after the cyclone of April 1991. It briefly discusses the situation of wildlife fauna in the cyclone-prone area and the condition of the population and community following the 1991 cyclone.

- 159 Sarker, N. and Parveen, M. 1986. Food habit of whitetailed shrew. Bangladesh Journal of Zoology 14(1):97-100.

89

This paper on a study of the eating habits of whitetailed shrews (*Suncus muriuns*) reports on the food contents of the stomachs of 40 study animals. The contents consisted of animal food (62%), plant food (29%), and miscellaneous food items (9%). Insects were consumed in higher numbers during the monsoons.

267

SOCIO-ECONOMICS

- 160 Ahmed, B. and M. Rahman. 1990. Local organizations and adaptations of irrigation technology. In Saleemul Huq *et al.* (eds.), *Environmental aspects of agricultural development in Bangladesh*. The University Press Limited (UPL). Dhaka. pp. 159-171.

The paper discusses the role of local organizations and bureaucracy in water resource management in Bangladesh. The author uses examples of community based irrigation programs involving small scale tubewell irrigation as well as canal irrigation to explain how the government and local organizations manage the relevant activities.

- 161 Ahmed, N. 1990. Temporal changes in agricultural land use in Bangladesh. In Saleemul Huq *et al.* (eds.), *Environmental aspects of agricultural development in Bangladesh*. The University Press Limited (UPL). Dhaka. pp. 87-95.

Using Agricultural Census Reports and other Bangladesh Bureau of Statistics (BBS) data, this paper describes the present agricultural land-use in Bangladesh and the changes that have occurred over time. The paper also presents some case studies indicating the nature of changes which have occurred in spatial land use within the country.

- 162 Barbier, E. B. 1993. Valuation of environmental resources and impacts in developing countries. In R. Kerry Turner (ed.), *Sustainable environmental economics and management: principles and practices*. Belhaven Press. London. pp. 319-337.

This paper shows the crucial role of natural resource management for the developing countries of the world by citing examples from the real life. In

understanding the contribution of natural resource management to development, it indicates the importance of valuation of welfare gains and losses. The paper emphasizes that natural resource management in the developing world need not be viewed as counter to development efforts; in fact there is a complementarity between natural resource management and sustainable development.

- 163 Bateman, I. J. 1993. Valuation of the environment, methods and techniques: Revealed Preference Methods. In R. Kerry Turner (ed.), *Sustainable environmental economics and management: principles and practices*. Belhaven Press. London. pp. 192-265.

This paper is based on the premise that the evaluations of individuals of environmental goods can in certain cases be revealed by what these individuals purchase from the basket of the marketed goods associated with the consumption of those environmental goods. The author shows how the Travel Cost Method (TCM) attempts to estimate the recreational value of a site by analyzing the travel costs incurred by visitors to that site. The Hedonic Pricing Method (HPM), as explained in the paper, attempts to put a price on an environmental good by analyzing the effects that the presence of such a good may have on a relevant market priced good. The author, however, cautions that since both the techniques capture only 'use values', there is a chance of under-estimation of the economic values of the environmental goods to the extent that these have 'non-use values' as well.

- 164 Bateman, I. J. and R. K. Turner. 1993. Valuation of the environment, methods and techniques: the Contingent Valuation Method. In R. Kerry Turner (ed.), *Sustainable environmental economics and management: principles and prac-*

tics. Belhaven Press. London. pp. 120-191.

The Contingent Valuation Method (CVM), as explained in this paper, is an expressed-preference survey technique. While the authors feel that this technique can be applied to a wide range of environmental goods, they at the same time recognize that it may be subjected to biases. Thus, CVM has not been proposed as a 'non-expert technique'. The paper has suggested various means of avoiding pitfalls in the empirical application of CVM.

- 165 **Chadha, S. 1989. Managing projects in Bangladesh. The University Press Limited (UPL). Dhaka.**

In discussing the institutional environment of development projects in Bangladesh, this book analyzes the factors affecting project schedules, costs and success. It discusses the costs of delay, ways of calculating such costs, and their effect on decision-making. The book presents ten case studies of projects covering different sectors of the economy.

- 166 **Conway, G. R. 1990. Agriculture and the environment: concepts and issues. In Saleemul Huq *et al.* (eds.), Environmental aspects of agricultural development in Bangladesh. The University Press Limited (UPL). Dhaka. pp. 9-26.**

The paper discusses modern agriculture against the backdrop of how it originated at the first place. It dwells on agricultural productivity and its sustainability. The paper also discusses certain equity issues in agriculture and puts forward the concept of agro-ecosystem.

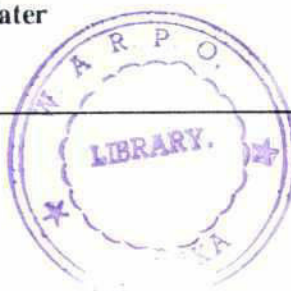
- 167 **FAP 14. 1992. Flood response study. Flood Plan Coordination Organization (FPCO). Ministry of Irrigation, Water**

Development and Flood Control. Government of Bangladesh. Dhaka.

This report discusses flood response at the household and institutional levels in different 'flood environments'. Using primary data collected from fifteen *thanas*, it explains how people in different flood environments try to prepare for floods, face floods and rehabilitate themselves after flood waters recede. The problems faced by people at each of these stages are documented. Attention has been devoted to point out gender-specificity of some of the issues. Part of the report is devoted to an exposition of how farming is adjusted to different flooding environments and what the lingering problems are. The report also discusses the roles of different government and non-government institutions in assisting the people to respond better to flooding events so that disruptions and damages are minimized.

- 168 **Government of Bangladesh. 1991. Making changes toward sustainability. In Report of the Task Forces on Bangladesh Development Strategies for the 1990's. Vol. Four. Environmental Policy. Part VI. The University Press Limited (UPL). Dhaka. pp. 187-250.**

This part of the report discusses the sustainability of the food production system. It traces the nature and extent of malnutrition, food requirements, crop agriculture potential, fish production potential and livestock as it relates to food supply. It also discusses sustainable forestry development, emphasizing the importance of the sector, its development potential, relevant technology, and certain constraints. In discussing conservation of biodiversity, emphasis is put on both education/ information dissemination and action programs. Energy issues (including conservation) and sustainability of water supply are also discussed. A number of recommendations are put together at the end.



- 169 **Government of Bangladesh. 1991. Physical resources and environment. In Report of the Task Forces on Bangladesh Development Strategies for the 1990's. Vol. Four. Environmental Policy. Part II. The University Press Limited (UPL). Dhaka. pp. 28-60.**

This part of the report discusses the land resources and agro-ecological zones of Bangladesh. Basic information is provided on physiography, soil, land levels (in relation to flooding), climate and crop cycles. The dynamic nature of the river system and the sedimentation and land build-up potential are also discussed. The water resources of the country are assessed in terms of surface water availability, ground water development potential and gross water requirement. Energy resources and their use are also discussed.

- 170 **Islam, M. A. 1990. Environmental perceptions and agriculture. In Saleemul Huq *et al.* (eds.), Environmental aspects of agricultural development in Bangladesh. The University Press Limited (UPL). Dhaka. pp. 154-158.**

This paper takes up the incidence of flooding as a major environmental factor, and discusses the choices of farming practices open to the farmers of Bangladesh. In pursuing the analysis, the author uses the perceptions of the farmers themselves. The nature of environmental risks which affect agriculture are discussed at some length.

- 171 **Jalal, K.F. December 1993. Sustainable Development, environment and poverty nexus. Occasional Papers. Number 7. Asian Development Bank. Economics and Development Resource Center. Manila.**

The working paper discusses the depletion of natural resources, the poverty situation that exerts extra stress on existing natural resources and the

failings of many development projects in paying proper attention to environmental considerations in the Asia-Pacific region. By using tools like the Environmental Kuznets Curve, the paper argues for alleviating poverty to resolve environmental problems that can lead to sustainable development.

- 172 **Kafiluddin, A.K.M. 1991. Disaster preparedness for Bangladesh floods and other natural calamities. Padma Printers and Colour Ltd. Dhaka.**

The author in this book suggests certain measures for the protection of human lives, livestock and crops in the face of natural disasters like floods. Issues concerning public health during such disasters are also discussed. The study points out the need for coordination among local, bilateral and international agencies.

- 173 **Masum, M. 1994. Population-environment interaction: a case study of Bangladesh. In A. Atiq Rahman *et al.* (eds.), Environment and development in Bangladesh. Vol. I. The University Press Limited (UPL). Dhaka. pp. 259-275.**

The paper contends that the current population of the world exceeds its optimal carrying capacity, resulting in ecologically unsound exploitation of resources. The population-environment interaction is first discussed at the general level, and then followed up with an analysis of the situation in Bangladesh. The author points out the strain on environmental resources resulting from population growth in Bangladesh. However, the paper also stresses that erroneous public policies have contributed to the problem. In this context, deforestation caused by making forestry products available to industries at rather low prices and degradation of fisheries resources caused by implementing Flood Control, Drainage and Irrigation (FCDI) projects without proper environmental impact assessment are discussed.

- 174 Pearce, D. 1993. Sustainable development and developing country economies. In R. Kerry Turner (ed.), *Sustainable environmental economics and management: principles and practices*. Belhaven Press. London. pp. 70-105.

The paper recognizes the importance of analyzing the conditions under which optimal growth is also sustainable growth. It argues for decoupling growth from its environmental impacts which requires that the amount of waste per unit of economic activity is reduced. The paper shows the importance of attempts to value environmental functions. In terms of priority areas the problems of deforestation, soil erosion and pollution impacts are identified. The paper discusses the role of price incentives and various fiscal measures in protecting the environment from degradation.

- 175 Rahman, A.A. and S. Huq. 1994. Environment and Development Linkages in Bangladesh. In A. Atiq Rahman *et al.* (eds.), *Environment and development in Bangladesh. Vol. I. The University Press Limited (UPL). Dhaka. pp. 1-37.*

The paper discusses the problems posed to environment by mass poverty, poor resource availability, institutional weakness, poor information base etc. It describes the main environmental issues and problems in the context of population growth, natural hazards, land issues (including agricultural land), forestry, fishery and industry. The linkages among population, development and environment are analyzed. The paper emphasizes the need for public and community awareness. It also points out the urgent need for an institutional set up that can embrace relevant efforts of government agencies, non-government organizations, the private sector, academic institutions and community groups.

- 176 Redclift, M. 1993. Environmental economics, policy consensus and political empowerment. In R. Kerry Turner (ed.), *Sustainable environmental economics and management: principles and practices*. Belhaven Press. London. pp. 106-119.

This paper emphasizes the role of social commitment in extending and refining the work in environmental economics. It argues for an appreciation of cultural differences among communities, and against a search for universal models for addressing diverse environmental problems. Besides, the cumulative social impact of individual choices has been highlighted in the paper. It also stresses the need for the developing countries of the world to take into account the links between environmental knowledge and power.

- 177 UNDP and UNFPA. 1990. *Proceedings of the seminar on people and environment of Bangladesh*. Dhaka.

This volume contains six different papers highlighting policies and programs necessary for protecting the environment of Bangladesh from further degradation. A discussion on the threats posed to Bangladesh due to its geographical location is undertaken in the proceedings. Natural calamities like floods, cyclones, riverbank erosions and droughts, and the consequent environmental problems are discussed. Besides, the possible effects of anticipated sea level rise are discussed. An attempt has also been made to relate the environmental problems of Bangladesh to population pressure and mass poverty.

WOMEN AND ENVIRONMENT

- 178 **Khurshida-Khandakar. 1992. Women in resource management. In Training manual on environmental management in Bangladesh, pp.309-322. Department of Environment, Dhaka.**

This document describes the role of women in the management of land, water, animal, and forest resources. These resources are used to generate production, and women play a crucial role in the process. The article discusses the effect of illiteracy on resource management. It points out that the literacy rate of women is (12%) lower than that of men. This has an important impact in efficient management of resources. The paper suggests the formulation of an integrated program for the management of resources and the development of conservation strategies for uneducated women.

- 179 **Khurshida-Khandakar. 1991. Role of women in the advancement of science. Science and Women. No. 5: 11-14, Bangladesh Association of Women Scientists (BAWS), Dhaka.**

This paper discusses that women constitute approximately 50 percent of the country's population. Although 50 percent of what is published in education, basic and applied research, health and hygiene, food habit, and communication is contributed by women, little is known about women's contribution to science. This paper recommends that women should be actively involved in communication, in the media, in the writing of books, journals, and papers which should be published at national and international levels.

- 180 **Khurshida-Khandakar and Nilufer Hye Karim. 1991. Women and Environment. Proceedings of the workshop on Women and Environment. Women in Science**

and technology in South Asia Region (WISTER) - Bangladesh, Dhaka.

The document highlights the relationship among women and environmental components and identifies constraints and opportunities for the development of women, and to the development of the environment. The paper suggests that provisions should be made so that rural women receive better education and training, extended health care and family planning services, and a greater share of parental property.

- 181 **Women for Women. 1978. Women and education. Women for Women, 148pp, Dhaka.**

This book is the first ever published exclusively about women in education in Bangladesh. The book is broadly divided into three parts. Part I deals with the social attitudes towards women's roles and status and the resultant types of formal and informal education received by Bangladeshi women. Part II deals with the various stages of formal education and the participation of women in these stages both as students and teachers. Part III discusses on women and non-formal education.

- 182 **Najmir Nur Begum. 1987. Pay or Puhdah: Women and income earning in rural Bangladesh, pp.172. Winrock International / BARC, Farm gate, Dhaka.**

This document reports that poor and destitute women in Bangladesh have always worked to maintain themselves and their dependent children. They are mostly engaged in rice processing, handicraft making or in rich landowner's households as domestic servants. A few work as agricultural laborers, but are hardly seen working alongside

men outside their homes or villages. The book discusses that the employment of women as wage earners is a relatively new phenomenon in rural Bangladesh. Women constitute about 48 percent of the total population of Bangladesh. 90 percent live in rural areas. Their economic, political, social and cultural conditions present a gloomy picture. Their lives are dominated by men to a great extent.

Irrespective of their religious beliefs, Buddhist, Christian, Hindu and Muslim women are subject to patriarchal control.

183 United Nations Development Program (UNDP). 1989. Bangladesh agriculture sector review: Women's role in agriculture—present trends and potential for growth. UNDP, Dhaka.

One of the six major themes of the Bangladesh Agricultural Sector Review completed in 1988 was "Women in Agriculture". The monograph consists of four chapters which discuss women's role in food production, the institutional bases of rural women and their access to credit, the implication of this in agricultural research, and programs.

ENVIRONMENTAL TRAINING

- 184 Department of Environment (DOE). 1992. Training manual on environmental management in Bangladesh. Department of Environment, Dhaka.

This document is a compilation of lectures by distinguished and well-known resource persons of environmentally concerned disciplines. Their subjects include natural calamities and the greenhouse effect, natural resources management, pollution control, and population explosion. The lectures stress that development today must discard the older model of resource exploitation, which discounted the ultimate cost in terms of pollution, depletion of biodiversity, and exhaustion of non-renewable resources. The lectures give an overview of the principal environmental problems and some suggestions for solving them.

- 185 FPCO/ISPAN 1994. Environmental Impact Assessment Skills Training Workshop. Trainers Manual. Vol.1: Training Procedures. FPCO/ISPAN. Dhaka.

This trainer's manual is to assist those who will be engaged as trainers in EIA skills training workshop designed to improve the skills of engineers, social scientists, environmental scientists, and other specialists working in the field of natural resources who perform and/or review environmental impact assessments. It accompanies the EIA Guidelines developed by the Irrigation Support Project for the Asia and the Near East (ISPAN) as part of the USAID-funded Eastern Water Initiative (EWI) in collaboration with the Flood Plan Coordination Organization (FPCO) and the Department of Environment (DoE). The trainers manual is designed for a four-week long workshop. The workshop focuses on the process outlined in the EIA Guidelines. The subject matter is divided into 8 modules, each module reflecting a stage in the process, plus an introduction to the workshop and introduction to the methodology.

18

INDEX

- agriculture
 - agro-ecological zones 9
 - agronomy 4, 26
 - boro 30
 - crop cycle 15, 30
 - extension 46
 - food grain 29
 - homestead 11, 13
 - HYV 28
 - residues 15, 33
 - soil 3, 4, 9, 13, 15, 25, 27
- amphibians
 - frogs 36, 38
 - tree frog 35
- biodiversity 18, 25, 28, 30, 32, 37
- biology 11, 17, 18, 24, 25, 30, 36, 38
- birds
 - kites 35
 - migratory 32, 35
 - resident 32, 35
 - water birds 32
- case study 4
- coast 19, 29
- conservation 3
- disasters
 - cyclone 3, 38
 - flooding 3, 30, 34
 - tornado 3
- ecology 1, 11, 17, 33, 36, 38
- EIA 1, 2, 4, 9, 18, 21, 25, 31
- endangered species 2, 32, 37
- fish
 - biology 4, 24, 25
 - catch 20
 - hatchlings 20, 24, 36
 - migration 24
 - population 21, 26
 - production 2, 17-21, 25, 29, 32
 - rice fish 26, 30
- fisheries
 - capture 2, 19, 21, 24, 25, 30
 - culture 2, 18, 26
 - reservoir 20
- fishermen 11
 - professional 31
 - subsistence 2, 31
- flood control
 - embankments 18, 31, 36
- FCD 18, 25, 30
- FCD/I 18, 25
- maintenance 3
- operation 3
- flora
 - exotics 12, 37
- forestry 37, 45
 - afforestation 12, 13
 - agroforestry 12, 13
 - deforestation 13
 - forest type 11, 12
 - homestead 12, 13
- GIS 17
- hazards
 - global warming 7
- health
 - nutrition 2, 3
- historical sites 9
- IEE 1
- industry 1, 3, 11, 15, 18, 26, 36
- legislation 33
- limnology 20
- mammals
 - mongoose 35
 - primates 37
 - shrew 38
- methodology 19
- monitoring 9
- north east region 19, 21, 28
- north west region 21
- policy 4, 11, 29
- pollution
 - agro-chemical 2, 15, 18, 33
 - industrial 3, 15, 18, 26
- population 3, 33, 34, 36, 47
- rare species 2
- review of literature 1, 4
- sanitation 12
- south east region 1
- threatened species 2, 28, 32, 36, 37
- vulnerable species 32
- water
 - drought 3
 - hydrography 3
 - hydrology 12, 30
 - irrigation 2, 18, 25
 - surface water 30
 - waterlogging 2, 11, 31

