SAWAN

South Asia Water Analysis Network

Water Quality in South Asia: Issues and Status

Workshop Proceedings

June 29 – July 2, 2004, Kathmandu, Nepal

CMC

ICIMOD

Partnership Platforms 1/05

About the Organisations

ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure the future of the Hindu Kush-Himalayas. The primary objective of the Centre is to promote the development of economically and environmentally sound mountain ecosystems and to improve the living standards of mountain populations.

CMC

The Cooperative Monitoring Center (CMC) is located at Sandia National Laboratories in Albuquerque, New Mexico, USA and is primarily sponsored by the US Department of Energy. CMC promotes collaboration among scientists and researchers as a means of helping secure a peaceful world through technology. In order to promote regional cooperation on environmental research, CMC has initiated a project to measure and monitor environmental parameters in South Asia. This project is primarily funded by the US Department of State and the US Department of Energy. CMC and Sandia National Laboratories have significant technical expertise that can be applied to cooperative environmental monitoring projects, including high-resolution remote sensing, data transmission and security, computer modeling, data management, and decision support tools, and the infrastructure to support cooperative monitoring efforts. CMC works with other entities including the US Geological Survey, the Environmental Protection Agency, the Bureau of Reclamation, and numerous universities, as well as local and state governments.

USDS/REOSA

U.S. Department of State's Regional Environmental Office for South Asia
The Regional Environment Office for South Asia (REO, or "hub") promotes regional environmental cooperation by working with governments, public sector agencies, international organizations, business, NGOs, and others, to support transboundary efforts to address environmental problems that transcend national boundaries. Environmental degradation is a major cause of poverty and instability in South Asia. Political tensions have impeded regional cooperation to deal with it. The U.S. State Department established the Regional Environment Office (REO, or "Hub") in 1997 to work with the countries of the region – Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. Regional stability and confidence building are key goals.

Water Quality in South Asia: Issues and Status

Quality held from 29 June – 2 July, 2004, in Kathmandu, Nepal

Editors
Mandira Shrestha
Rajendra L. Shilpakar

Kathmandu, Nepal
and
Cooperative Monitoring Center, Sandia National Laboratories, Albuquerque, New Mexico, USA

with support from
US Department of State, Regional Environment Office for South Asia, Kathmandu, Nepal
and
US Department of Energy, Sandia National Laboratories, Albuquerque, New Mexico, USA

Published by
International Centre for Integrated Mountain Development
G.P.O. Box 3226
Kathmandu, Nepal

ISBN 92 9115 076 2

Editorial Team
Rosemary A. Thapa (Consultant Editor)
A. Beatrice Murray (Senior Editor)
Dharma R. Maharjan (Technical Support and Layout)

Printed and bound in Nepal by
Jagdamba Press
Kathmandu

Note: The affiliation and professional positions of the various participants were those current at the time of the meeting.

foreword

The mountains of the Greater Himalayan region are one of the largest storehouses of freshwater in the world and the source of many mighty rivers including the Indus, Ganges, Bramhaputra, Meghna, and Mekong. These rivers provide water for drinking and food production, and contain the potential for generating the hydropower that could improve livelihoods and support economic development throughout the region. Average annual rainfall is high over much of the area, and these rivers and their tributaries carry a huge volume of water annually – but access to clean water, and sufficient water, has become one of the major challenges for the people of the Himalayas and their downstream neighbours.

Surface water in the region is often contaminated with untreated industrial waste and domestic sewage, as well as other pollutants discharged directly into the rivers. Population growth, urbanisation, unplanned development, land degradation, and lack of infrastructure for waste disposal have all contributed to the rapid deterioration in water quality in the majority of rivers, streams, and lakes in South Asia. Poor water quality poses a threat both to the environment and to the health of the people in the region. Water is needed for the economic development of a country and is important for maintaining a healthy ecosystem. Nevertheless, the issue of water quality is generally neglected, efforts to counteract the problem are minimal, and the volume of pollutants draining into the rivers is increasing. Furthermore, the major rivers flow vast distances and the water they contain crosses major national and international boundaries, but there is little research into or study of the downstream impacts on water quality resulting from upstream activities.

The International Centre for Integrated Mountain Development (ICIMOD) has been concerned with issues of water management and disaster prevention in the HKH region for some twenty years, and has supported regional efforts to increase scientific and technical collaboration on water issues – from watershed management and micro-water harvesting to regional data sharing through the HKH-FRIEND project supported by UNESCO. Through the water quality group of HKH-FRIEND, ICIMOD has organised many training events including some on water quality monitoring. At the global level, the World Meteorological Organization (WMO) has been promoting regional cooperation in sharing hydrometeorological data and information leading towards the establishment of a regional flood information system, an activity that ICIMOD is furthering in the countries of the Greater Himalayas.

In 2004, ICIMOD joined with the Cooperative Monitoring Center (CMC) located at Sandia National Laboratories in the USA, in an initiative for collecting and sharing regional water quality information in South Asia – the South Asia Water Analysis Network (SAWAN). The initiative was started by CMC in 1999 under the name South Asia Transboundary Water Quality Monitoring (SATWQM) with the aim of focusing on activities that foster the regional sharing of water quality data along transboundary

sections of the Ganges and Indus rivers, and building confidence among the partners. Basic water quality parameters are monitored along selected stretches of the Ganges and Indus rivers and their major tributaries in Bangladesh, India, Nepal, and Pakistan using standardised techniques and equipment. The collaboration with ICIMOD is intended to broaden the scope of the cooperation in the Himalayan region and help extend the partnership of the project to government-level institutions.

As part of the collaboration, a 'Regional Integrated Workshop on Water Quality' was held in Kathmandu in June 2004 by ICIMOD and CMC with support from the US Department of State, Regional Environment Office for South Asia and the United States Department of Energy, Sandia National Laboratories, to build better understanding on water quality issues in the region. The participants included representatives from SAWAN's project partners; key government organisations; the HKH-FRIEND water quality group; international organisations; donor organisations; academicians; and non-government organisations from Bangladesh, India, Nepal, Pakistan, and the USA. ICIMOD now also hosts the project website which is linked to a database that houses the water quality data provided by partners.

This publication provides a detailed report of the meeting held in June 2004 with summaries of the technical papers and country reports. The full text of the papers will be published in a separate volume. The integrated workshop expanded the network, and data collection partners were trained to improve their data sharing capabilities, especially data transfer. The workshop identified priority areas for water quality in South Asia and four specific areas of long-term focus.

We hope that this initiative will both profit from and contribute to the other regional initiatives of ICIMOD, and contribute towards attainment of ICIMOD's vision of prosperous and secure mountain communities. The proceedings will be of interest to all those interested in transboundary activities and information sharing processes in the Greater Himalayan region in general, and water quality issues in particular. We hope that this publication will also help to stimulate interest in this particular project.

Dr. J. Gabriel Campbell
Director General
ICIMOD

acknowledgements

The authors would like to express their thanks to the US Department of Energy, Sandia National Laboratories, Albuquerque, New Mexico, USA; and the US Department of State, Regional Environment Office for South Asia, Kathmandu, Nepal for supporting the SAWAN project and the workshop. We extend our sincere gratitude to Dr. J. David Betsill, Dr. Gaurav Rajen, and other members of the Cooperative Monitoring Center, Sandia National Laboratories, for collaborating with ICIMOD on the SAWAN project.

We would also like to thank our partners in data collection for their steady support of this project – the Bangladesh Unnayan Parishad (BUP), Bangladesh; the Centre for Environment and Development (CED), India; the Environmental Biology Laboratory (EBL), Patna University, India; the Aquatic Biology Laboratory (ABL); Guru Nanak Dev University, India; the Environment and Public Health Organisation (ENPHO), Nepal; and the World Wide Fund for Nature-Pakistan (WWF-P).

This publication would not have been possible without the support of our colleagues from ICIMOD's Information and Knowledge Management (IKM) programme, in particular Dr. A. Beatrice Murray, Senior Editor, Mr. Dharma Ratna Maharjan, layout and design specialist, and Mr. Asha K. Thaku cartographer and artist. Our sincere thanks go to our colleagues Mr. Basanta Shrestha and Mr. Sushil Pandey, of IKM-MENRIS for their contribution to the development of the SAWAN project and their support during the workshop, and to Mr. Ritesh Gurung and Ms. Sardu Bajracharya, the workshop rapporteurs. Ms. Sarita Joshi, secretary in ICIMOD's Water, Hazards and Environmental Management (WHEM) programme deserves particular thanks for her patience and secretarial support.

Special thanks are also due to all the participants of the workshop for their invaluable contributions and active participation. We are grateful to all who have contributed directly or indirectly to the development of the SAWAN project and to the preparation of this report.

executive summary

The Hindu Kush-Himalayan (HKH) region is one of the largest storehouses of freshwater in the world, and its mountains are the source of major river systems that serve some 500 million people in South Asia. The theoretical water availability in these rivers is high, however access to clean water remains one of the major challenges for the region. Overall, inland surface water quality in the monsoon season is within tolerable limits with respect to the standards set by the countries concerned, but deteriorates during the dry season. Rapid growth of population, urbanisation, unplanned development, land degradation, and lack of infrastructure for waste disposal are common reasons for the rapid deterioration of water quality in the majority of rivers, streams, and lakes in the region. This poses a threat to both the environment and to people's health.

To address these issues a regional initiative called South Asia Transboundary Water Quality Monitoring (SATWQM), later renamed South Asia Water Analysis Network (SAWAN), was begun in 1999 to share regional environmental information as a means of building confidence and promoting regional cooperation in South Asia. The aim of the project is to focus on activities that foster the regional sharing of water quality data along transboundary sections of the Ganges and Indus rivers. Project partners have initiated the collection of basic water quality parameters from 18 stations in the Ganges and Indus rivers and their major tributaries. In April 2004, the Cooperative Monitoring Center (CMC), which is located at Sandia National Laboratories in Albuquerque, New Mexico, USA, started collaboration with ICIMOD to broaden the scope of cooperation in the HKH region and extend the partnership of the project to government-level institutions.

A Regional Integrated Workshop on Water Quality was held in Kathmandu from 29 June to 2 July 2004. The main objectives were to broaden the partnership and to build better understanding of water quality issues among the institutions involved in water quality in the region: SAWAN's project partners; key government organisations; members of the water quality group from HKH-FRIEND (Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data); international organisations; donor organisations; academic establishments; and non-government organisations (NGOs), from Bangladesh, India, Nepal, Pakistan, and the USA, participated in the workshop.

The participants discussed the progress of transboundary water quality monitoring in the Ganges and Indus rivers and their major tributaries; country-specific water quality issues in the participating countries of Bangladesh, India, Nepal, and Pakistan; the development of partnerships; and ideas for the further development of SAWAN.

Untreated industrial and municipal wastewater, runoff pollution from chemical fertilisers and pesticides used in agriculture, and high seasonal variability of flow are the major reasons for the degrading of water quality in the majority of the streams,

rivers, lakes, and other water bodies in the region. Many attempts have been made to protect the water sources. The Governments of Bangladesh, India, Nepal, and Pakistan have all formulated environmental legislation to address water quality issues, however, implementation lags far behind. All these countries have formulated quality standards for industrial effluents and municipal waste, but treatment facilities are inadequate.

A strong need was expressed at the meeting for a regional-level water quality monitoring protocol to ensure uniformity in water quality assessment and the validity of the data compiled. Participants also expressed their continued interest in and commitment to fostering regional cooperation through water quality monitoring and data sharing. Improved monitoring and data collection along transboundary rivers, and ensuring the reliability and authenticity of data, were given a high priority.

acronyms and abbreviations

ABL	Aquatic Biology Laboratory (Guru Nanak Dev University, India)
ASSESS-HKH	Development of Assessment System to Evaluate the Ecological Status of the Rivers in the Hindu Kush-Himalayan Region
BOD	biochemical oxygen demand
BUP	Bangladesh Unnayan Parishad (Bangladesh)
BUET	Bangladesh University of Engineering and Technology (Bangladesh)
BWDB	Bangladesh Water Development Board (Bangladesh)
CBO	community-based organisation
CED	Centre for Environment and Development (India)
CMC	Cooperative Monitoring Center (USA)
COD	chemical oxygen demand
DHM	Department of Hydrology and Meteorology (Nepal)
DO	dissolved oxygen
DoE	Department of Environment (Bangladesh)
EIA	environmental impact assessment
ENPHO	Environment and Public Health Organisation (Nepal)
FRIEND	Flow Regimes from International Experimental and Network Data
GAP	Ganga Action Plan
GIS	geographic information system
GLOF	glacial lake outburst flood
GoI	Government of India
HKH	Hindu Kush-Himalayas
HKH-FRIEND	Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data
HMG/N	His Majesty's Government of Nepal
IAHS	International Association for Hydrological Sciences
ICIMOD	International Centre for Integrated Mountain Development
IHP	International Hydrological Programme
IWM	Institute of Water Modelling (Bangladesh)
IUCN	International Union for the Conservation of Nature
KU	Kathmandu University (Nepal)
MoPE	Ministry of Population and Environment (Nepal)

NGO	non-government organisation
NRCD	National River Conservation Directorate (India)
ORP	oxidation reduction potential
PARDYP	People and Resource Dynamics Project
PCRWR	Pakistan Council for Research in Water Resources (Pakistan)
RCM	regional climate model
RHDC	Regional Hydrological Data Centre
RO	reverse osmosis
SAGARMATHA	Snow and Glacier Aspects of Water Resources Management in the Himalayas
SAWAN	South Asia Water Analysis Network
SATWQM	South Asia Transboundary Water Quality Monitoring
SODIS	solar water disinfection
SNL	Sandia National Laboratories, USA
TDS	total dissolved solids
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UVR	ultraviolet radiation
WHEM	Water, Hazards and Environmental Management Programme (ICIMOD)
WQI	water quality index
WWF-P	WWF-Pakistan (formerly World Wildlife Fund, World Wide Fund for Nature)

contents

Participants in the Regional Integrated Workshop on Water Quality, 29 June - 2 July 2004, Kathmandu, Nepal

introduction

Background

Freshwater is a finite and vulnerable resource needed by multiple stakeholders for a range of purposes: domestic water supply, irrigation, hydropower, and industrial production. The Hindu Kush-Himalayan (HKH) region is one of the largest storehouses of freshwater in the world, and its mountains are the source of major river systems that serve some 500 million people in South Asia. These rivers not only provide water, they are also a major focus of religious and cultural life. However, access to clean water remains one of the major challenges for the region, despite theoretical water availability being high. It was estimated that in 2000 about 15% of the population in South Asia did not have sustainable access to improved water sources and 45% had no access to sanitation facilities (UNDP 2004). In Bangladesh alone more than 20 million people drink water exceeding the national standard for arsenic levels (UNEP 2001). This poor level of access to freshwater and sanitation is partly because of the seasonal nature of the water supply. Overall, inland surface water quality in the monsoon season is within tolerable limits with respect to the standards set by the countries concerned. However, water quality becomes worse in the dry seasons. The surface water in the region remains unprotected from raw industrial and municipal wastewater, runoff pollution from chemical fertilisers and pesticides, and oil and lube oil spillages from the operation of sea and river ports in coastal areas. In particular, population growth, urbanisation, unplanned development, land degradation, and lack of infrastructure for waste disposal are common reasons for the rapid deterioration in water quality in the majority of the rivers, streams, and lakes in South Asia. Deteriorating water quality poses a threat both to the environment and to the health of the people in the region.

To be able to formulate effective policies and to plan for the future it is necessary to have reliable data on the status and trends of a range of environmental indicators from the whole of a river basin. Since most of the large rivers in South Asia pass through more than one country, this means sharing information among and between countries. The severe shortage of reliable data on environmental indicators, and especially on water quality, is hindering attempts to address water issues in the region. A mechanism is needed for assessing river water quality and sharing this data and information across national boundaries. This could help identify potential problems before they lead to serious environmental and health effects, and could also contribute significantly to achieving the Millennium Development Goal, "to reduce by

half the proportion of the population without sustainable access to safe drinking water by 2015".

Regional experts in water resources and policy from India, Nepal, and Bangladesh discussed the issue of water quality in transboundary rivers during a meeting at the Cooperative Monitoring Center (CMC) of Sandia National Laboratories (SNL), Albuquerque, New Mexico, in 1998. The meeting led to the setting up of the CMC project 'South Asia Transboundary Water Quality Monitoring' (SATWQM), formally initiated at a workshop held in Kathmandu in September 1999. SATWQM was set up to share regional water quality information as a means of building trust and confidence and promoting regional cooperation. After a further workshop in February 2002, project partners from Bangladesh, India, Nepal, and Pakistan started water quality monitoring at 18 stations in the Ganges and Indus rivers and their major tributaries (Rajen et al. 2003). Basic water quality parameters such as pH, temperature, conductivity, salinity, dissolved oxygen, nitrates, iron, hardness, bacteria, and benthic organisms were included in the monitoring. Figure 1 shows the major river basins of the region and the approximate geographical locations of the monitoring stations. In some places, several sampling sites are located in close proximity to each other, for example upstream and downstream of a city or other point of interest.

In April 2004, CMC started collaboration with ICIMOD to broaden the scope of the cooperation in the HKH region and extend the partnership of the project to government-level institutions. This new development was based on the recognition of ICIMOD's ongoing activities in promoting regional cooperation and of the extensive water-related network already developed under initiatives like the Regional Flood project and the Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data (HKH-FRIEND). The SATWQM project was renamed the 'South Asia Water Analysis Network' (SAWAN).

As part of the collaboration, a Regional Integrated Workshop on Water Quality was held in Kathmandu from 29 June to 2 July 2004 by ICIMOD and CMC with support from the US Department of Energy, Sandia National Laboratories; and the US Department of State, Regional Environment Office for South Asia, to build better understanding on water quality issues in the region. This publication summarises the major findings, discussions, and conclusions of the workshop.

Workshop Objectives

The objective of the workshop was to broaden the partnership and to build better understanding of water quality issues among the institutions involved in water quality in the region.

The specific objectives of the workshop were:

- to discuss the activities and progress made on transboundary water quality monitoring;
- to discuss country-specific issues on water quality;
- to plan and receive guidance and input from SAWAN partners on the future development of the project; and
- to extend the partnership of the project.

Figure 1: Major river basins in South Asia and water quality monitoring stations under SAWAN

Participants

Representatives of the project partners, key government organisations associated with water quality, international organisations, donor agencies, academic establishments, and NGOs attended the workshop. The list of participants is provided in Annex 2.

Workshop Process and Structure

The workshop was organised in two parts. The first part (three days) consisted of presentations on supporting technologies and programmes, country-specific water quality issues, and the status of transboundary water quality monitoring conducted by partners of SAWAN. In this first part, discussions were held on the needs and priorities in the region on water quality, and on the sustainability of the SAWAN project. The second part of the workshop included a technical meeting and training on data transmission and retrieval, which was held at the ICIMOD training centre, mainly for the SAWAN partners collecting water quality data. An optional field trip to ICIMOD's Demonstration and Training Centre site in Godavari was also organised during the second part of the workshop.

The Report

This report has been prepared to provide a review of the activities and a summary of the presentations and discussions held during the regional workshop. The full text of the papers will be published in a separate volume. The report is divided into four chapters. Chapter One introduces the project and the objectives of the workshop; Chapter Two describes the opening and technical sessions of the workshop with a brief summary of the presentations; Chapter Three includes reports of the training and the field visit; and Chapter Four summarises the key achievements of the workshop. Annex 1 provides the programme agenda and Annex 2 the list of participants.

ENPHO

Foam from a paper mill in the Narayani river at Gaidakot – untreated industrial effluent is a major source of river pollution in the region

workshop proceedings

Opening Session

The workshop was inaugurated by the chief guest **Mr. Mohan Bahadur Karki, Secretary, Ministry of Population and Environment (MoPE), Kathmandu, Nepal**.

Ms. Janet Bogue, Charge d'Affaires, US Embassy, Nepal welcomed the participants. The SAWAN project began as a joint initiative of the US Embassy, Kathmandu, and CMC, Albuquerque, USA. The project collects and shares water quality data from several transboundary rivers in South Asia including the Ganges and its tributaries, such as the Bagmati and the Narayani (known as the Gandak in India). The efforts of the project partners involved in the collection of data have made the project a success.

A lack of adequate water quality data is a major hurdle to solving the problem of water pollution in the region. It is important for the countries of the region to come together to address this issue: SAWAN is an important project in this respect and has implications for other transboundary initiatives in the region. For example, Guru Nanak Dev University, India, and WWF-Pakistan are planning to assess and clean up the Hudiara drain, which flows from India to Pakistan. Ms. Bogue concluded her remarks by expressing the hope that ICIMOD's experience and outreach will help this network to develop as a leading forum for water quality analysis, information dissemination, and regional cooperation.

Dr. J. Gabriel Campbell, Director General, ICIMOD, welcomed the participants, extending his special greetings to the delegates from Bangladesh, India, Nepal, Pakistan, and the USA. Water is a shared resource, which is very important for the health and well-being of the individual as well as the community. Water is needed for the economic development of a country and is also vital for maintaining a healthy ecosystem. Regional and international cooperation as well as initiatives focusing on water quality are essential to meet the goal of VISION 21 adopted by the Second World Water Forum, "to provide everyone with a safe water supply and adequate sanitation services and hygiene by 2025" and the Millennium Development Goal, "to reduce by half the proportion of people without sustainable access to safe drinking water by 2015". However, the issue of water quality is generally neglected in this region and the amount of pollutants draining into rivers is increasing. It is also necessary to understand the impacts of upstream activities on downstream water quality.

ICIMOD was established in 1983 by the countries of the region and promotes the exchange of technical know-how and regional cooperation. ICIMOD is involved in various activities related to water such as HKH-FRIEND, Regional Cooperation for Flood Disaster Mitigation, and a Glacial Lake Outburst Flood (GLOF) Inventory. Dr. Campbell thanked Sandia National Laboratories and the US Department of State Regional Environment Office for South Asia, Kathmandu, Nepal, for their support to the project.

Mr. Mohan Bahadur Karki, Secretary, MoPE, Nepal, the workshop's Chief Guest, emphasised that the development of the region depends on the development of its natural resources. Globally, more than one billion people lack access to safe drinking water and about 2.4 billion do not have access to basic sanitation. Scarcity of water affects women and children the most. Lack of clean water is also a constraint to poverty alleviation, food security, and environmental protection.

At its 58th session, the United Nations General Assembly adopted a draft resolution, proclaiming the period between 2005 and 2015 as an 'International Decade for Action – Water for Life'. This calls for greater focus on water-related issues and obliges countries to achieve their water-related goals. People's access to basic natural resources such as water plays an important role in the development of poor countries and also helps to avoid internal conflicts. Raising awareness in terms of water is important for poverty alleviation. Efficient water use can have major environmental, sanitary, and economic benefits. The outcomes of recent conferences on water issues have highlighted the right to clean water. However, this information does not reach the grassroots level. Networking at various levels is needed urgently.

Mr. Karki expressed his hope that the workshop would be able to identify development strategies with a collaborative stakeholder approach. He reiterated the need for regional cooperation for improved water resources management in the region.

Ms. Mandira Shrestha, Executive Secretary, Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data (HKH-FRIEND), welcomed the participants. The HKH region poses a tremendous challenge due to its steep terrain, geographical setting, active geology, and climatic conditions. Together with its dependent downstream areas, it is also home to more than 40% of the world's poor. HKH-FRIEND was established in 1996 with the aim of promoting and undertaking research for optimal utilisation and better management of water resources in the HKH region and to promote the free exchange of data for research. It brings researchers, scientists, and hydrologists to a common platform where data and information as well as technical know-how are shared. Research activities are being conducted through its six research groups: the Database Group, the Flood Group, the Low Flow Group, the Rainfall Runoff Group, the Snow and Glacier Group, and the Water Quality Group.

HKH-FRIEND has made significant progress in improving hydrological processes in the region. It has established a strong network in the regional countries and seeks to improve and strengthen this network. HKH-FRIEND's Water Quality Group has been training its partners to build their capacity. ICIMOD serves as the Secretariat to the HKH-FRIEND network. The Regional Hydrological Data Centre (RHDC), HKH-FRIEND 's database, is also housed at ICIMOD. Ms. Shrestha ended by expressing her pleasure at the integration of HKH-FRIEND and SAWAN.

Dr. J. David Betsill, Environmental Project Manager, CMC, Albuquerque, USA, thanked the participants for attending, and ICIMOD for organising the workshop as well as for collaborating with CMC on the SAWAN project. Most of the environmental issues in the region are transboundary in nature and need regional cooperation to address them; this also leads to the building of trust between the countries concerned. The challenge that lies ahead of the South Asian region is its ability to provide its population with clean drinking water, reliable irrigation, cheaper energy, and flood protection. Water treaties should be innovative and should look beyond the conventional path of development. There should be initiatives to build institutional responses to meet the water and energy demand with minimum adverse effects on the economy and on the environment. To address the problem of water scarcity, programmes should focus on watershed management, water quality, and land and water interactions.

The objective of the workshop, its expected outcomes, and the workshop programme were then presented. The workshop was organised in two parts, the main workshop and a training on data transmission to and retrieval from the SAWAN web site. The expected outcome of the workshop is the wider dissemination of the results and findings of the ongoing transboundary water quality monitoring efforts and the uptake of these results by the water users, planners, and managers of the region. Dr. Betsill concluded by expressing his hope that the network will serve as a platform for discussion on regional water quality issues and the sharing of knowledge among the participants.

Session 1: Integration of HKH-FRIEND and SAWAN

Chair: Prof. Suresh Raj Chalise, KARUNA-Nepal

The first session provided a general overview of the work of the Cooperative Monitoring Center, SAWAN's project history and activities, ICIMOD's water-related activities, and HKH-FRIEND's work.

Introduction to the Cooperative Monitoring Center, Overview of the SAWAN Project, Expectations, and Next Steps

J. David Betsill, CMC

Established in 1946, CMC aims to enable international technical cooperation on strategic issues and focuses on working towards the prevention of weapons proliferation, supporting arms control programmes, and building regional stability. Providing their assistance to humanitarian programmes, CMC has been working in the areas of natural resources management, air and water pollution, commerce and trade, emergency planning and responses, and energy. CMC is also involved in a number of global and regional activities, including regional security programmes in South Asia.

The SAWAN project, originally called SATWQM, was recommended as needed during the South Asia Water Resources Workshop held in June 1998 in Albuquerque, USA. The next workshop, held in September 1999 in Kathmandu, Nepal, was able to identify the sampling points as well as start the data collection process. A web site was also developed to share the data generated by the project. Coordinated water quality monitoring began in the second phase. The partners collect basic water quality data from selected transboundary sections of the Ganges and Indus rivers

and their major tributaries using in situ water quality monitoring equipment: the Hydrolab Minisonde and the Sechhi disk. Additional parameters are analysed using the Jal TARA Kit, and colour-changing paper strips. The data collected is uploaded onto the project web site on a regular basis.

In its third phase, the SAWAN project will be extended to government institutions, the database will be integrated with HKH-FRIEND's Regional Hydrological Data Centre (RHDC), and some new activities and project components will be initiated.

Discussion

Participants enquired about CMC's activities in coastal management, the beneficiaries of the SAWAN project, and the importance of biological monitoring.

CMC was not conducting any project on coastal management at present, however, CMC considers it an important aspect of environmental management and would be interested in working in this area provided the financial resources were available. The SAWAN project aims to promote regional cooperation and the data generated by the project would be useful to both government and the non-government agencies. The data would also be useful for assessing the river quality of the region. Biological monitoring could be included as one of the project components if the project partners are interested.

ICIMOD's Regional Water Projects

Mandira Shrestha, ICIMOD

The Water, Hazards and Environmental Management (WHEM) programme of ICIMOD focuses on shared information and knowledge on water, hazards, and ecosystem health in the HKH region through regional collaboration, as a contribution to ensuring a safer mountain habitat for all. Although WHEM is a comparatively new programme, ICIMOD has been involved in various regional activities related to water quantity and quality since its inception. Due to the spatial and temporal variability of flows, there is an abundance of water during the monsoon and a scarcity in other months. About 80% of total precipitation falls during the four monsoon months from June to September. In many parts of the region, freshwater has become a scarce resource due to the increase in population, growing urbanisation and industrialisation, and changes in lifestyle.

There are different water-related regional projects implemented by ICIMOD. HKH-FRIEND is a regional network established in 1996. It is one of the eight regional groups under the FRIEND projects of the International Hydrological Programme (IHP) of the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The network provides a platform for the researchers, scientists, and hydrologists of the region. Similar to the SAWAN project, it promotes data and information sharing. Research for the network is being conducted through its six research groups. ICIMOD has also initiated a regional project to reduce flood disasters in the region with the support of the World Meteorological Organisation. The project, 'Regional Cooperation in Flood Disaster Mitigation in the HKH Region', aims to reduce flood vulnerability by providing access to the real-time information needed to make timely and accurate flood forecasts. The US Department of State, Regional Environment Office for South Asia and the US Agency for International Development, Office of Foreign Disaster Assistance, support the project. A three-year

ENPHO

Children playing in the Bagmati river at Sundarijal – water quality is in pristine condition in the headwater region

ENPHO

The Bagmati river near Tilganga – effluent from a dyeing factory

project, 'Snow and Glacier Aspects of Water Resources Management in the Himalayas' (SAGARMATHA), was initiated in 2001 by the Centre for Ecology and Hydrology in the United Kingdom and ICIMOD. The aim of the project is to assess the long term and seasonal variations in the snow-fed rivers of the Himalayas, and the development of adaptation strategies to cope with the impact of deglaciation. The project has recently been completed and the final report is being published.

In addition, ICIMOD is in the process of implementing a regional project, the 'Development of an Assessment System to Evaluate the Ecological Status of the Rivers in the HKH Region' (ASSESS-HKH), which evolved from the activities of HKH-FRIEND. This project aims to assess the ecological status of the rivers in the HKH region through biological monitoring, using benthic macro-organisms as indicators.

Discussion

The participants enquired about the type of model that was developed by the SAGARMATHA project. Some queries were also raised regarding ICIMOD's funding sources and collaboration with CMC.

The Regional Climate Model (RCM) of the Hadley Centre was used for the modelling. Actual data was collected and the model was developed in a 20 x 20 km grid. Collaboration between CMC and ICIMOD began early in 2004 to transfer the technologies developed by CMC to the region and to expand the SAWAN project to include HKH-FRIEND and government institutions.

The eight member countries of the region and five European countries contribute the core funds of ICIMOD. In addition, there are about thirty-five project donors. Funding is also received through bilateral and multilateral collaboration agreements.

Brief Introduction to HKH-FRIEND and the Water Quality Group

M. Fazlul Bari, Bangladesh University of Engineering and Technology (BUET) and Subodh Sharma, Kathmandu University (KU)

HKH-FRIEND is one of the eight regional FRIEND projects of UNESCO's International Hydrological Programme (IHP). The objective of this network is to promote and undertake research for optimal utilisation and better management of water resources in the HKH region, and to promote the free exchange of data for hydrological research through its database, the RHDC, which is housed in ICIMOD. HKH-FRIEND has a total of six research groups including a Water Quality Group. It has conducted a number of training sessions and workshops since it was set up in 1996. The Water Quality Group has conducted two regional training sessions on surface water quality monitoring. The first in 2001 in Islamabad, Pakistan, focused on physico-chemical analysis to assess surface water quality; the second in Dhulikhel, Nepal, in 2003, focused on biological assessment of surface water quality.

A three-year regional project, ASSESS-HKH – a follow up to the 2003 water quality training – is in the final stage of approval. The project has four European and six Asian partners. The overall aim is to develop a biological assessment tool to assess the ecological status of the rivers of the region. The project will classify the rivers in seven categories based on their ecological status, which will be assessed using physical, chemical, biological, and microbial diagnosis.

Discussion

Some questions addressed the future activities of HKH-FRIEND and the demarcation between HKH-FRIEND and SAWAN. The Water Quality Group is also interested in conducting training workshops and research but is constrained by a lack of funds. Although SAWAN and HKH-FRIEND are two different regional networks promoting regional cooperation and data sharing, they will be working together in the near future.

The biological monitoring will need detailed research since the region contains different ecological systems. A need was expressed to identify indicator species for each system and to develop protocols for biological monitoring for the entire region. Biological monitoring should be used as a process for screening for river classification. Indices will be developed for each eco-region. It is also possible to develop a protocol for the entire region.

Regional Water-related Data Sharing Initiatives in the HKH Region and On-line Demonstration of SAWAN Web Site, Database, and Website Transfer

Basanta Shrestha, ICIMOD, and Jason R. Coombs, CMC

A web-based data sharing mechanism would be a very effective way of fulfilling the urgent need to share data and information in the region. Such a system would provide a platform for data sharing as well as making the data more accessible. ICIMOD has initiated a number of activities that enable the sharing of water-related data, including the Regional Hydrological Data Centre (RHDC). The RHDC of HKH-FRIEND maintains an archive of data and metadata and can be accessed via the Internet. ICIMOD is also involved in the sharing of information on glaciers, glacial lakes, and GLOFs. Other similar ICIMOD initiatives include the sharing of hydrological and meteorological data for flood disaster mitigation, data on natural resources generated by the People and Resource Dynamics Project (PARDYP), and geographical information system (GIS) related data. It was proposed that an HKH Water Data Portal be established to share data and information as well as to develop regional collaboration.

The SAWAN web site contains information about the project, project partners, data generated by the project, and other related documents. The web site requires a log-in name and a password to view the database; these can be acquired by filling out a registration form available on the web site. The web site also contains relevant information on other environmental issues. A separate page has been designed to enter data into the database. The page has been designed to minimise the chance of human error.

Discussion

The participants enquired about the process of entering data in the database by non-project partners. The non-project partners could enter data into the database by providing their information through a registration form.

Chair's Remarks

Prof. Chalise expressed his satisfaction that the regional countries are initiating activities on the sharing of data and information. The sharing of data is a very sensitive issue in this region and much research work is severely constrained because of the lack of available data. HKH-FRIEND is among the few initiatives that promote

regional cooperation in data sharing. Nepal is now sharing all types of hydrological data; this culture should be promoted in the region and other similar activities to promote regional cooperation encouraged. The work done by HKH-FRIEND will also be helpful to SAWAN.

Session 2: Supporting Technologies and Programmes

Chair: Dr. J. David Betsill, CMC

Session 2 was concerned with the technologies that are needed for the sustainable use of water resources, particularly for improving water quality.

Sandia Initiatives in Water, Agriculture, and Renewable Energy – A Brief Overview

Ronald C. Pate, Sandia National Laboratories (SNL)

The activities of Sandia National Laboratories (SNL) on water, agriculture, and renewable energy were explained. SNL has initiated activities to promote safe, secure, and sustainable use of water resources. Focusing on these issues, research is being conducted in the field of treatment technology, infrastructure risk, real-time water quality monitoring, decision support modelling, and interdependency analysis. To achieve this, SNL is working together with various government agencies, NGOs, and universities. SNL has been involved in developing desalination and arsenic removal techniques and has also developed an instrument called μChemLab, which can analyse chemical, toxic, biochemical, and biological parameters.

In the field of renewable energy, SNL started the Mexico Renewable Energy Programme to promote the use of appropriate and sustainable renewable energy technologies in Mexico. Renewable energy has a wide variety of applications in the field of agriculture, which include refrigeration, ice making, livestock and ranch potable water supply, a drip irrigation system, electric fences, milk cooling, greenhouse effects, ranch lighting, water purification and desalination, and fish farming. SNL also promotes greenhouse techniques for agricultural purposes, which enable a reduction in water and land requirements without affecting productivity.

Multi-system, Whole-basin, and Multi-basin Water Resources Modelling

Howard D. Passell, Sandia National Laboratories (SNL)

SNL conducts various modelling projects. They include Rio Grande Modelling, Rainy River Flood Management Modelling, Modelling Water Transfers from Agriculture to Urban, Modelling Central Asian Municipal Water Systems, and Global Water Interdependencies Modelling. Basic assumptions for these projects include the following:

- that freshwater scarcity threatens economic and political security;
- that technical approaches for monitoring, treatment, and conservation outpace technologies for planning, integrated management, and stakeholder education; and
- that the best planning and management strategy for water resources is whole-basin, multi-system, transboundary, and complex.

Various components are used as variables for the modelling, such as agriculture type, vegetation, and precipitation. The models are used to simulate the different scenarios

that can be achieved by changing the values of the variables. The models are user-friendly and are used by policy makers, planners, and the public. Some of the models are international models that cover large transboundary basins. SNL is trying to develop a model for each individual component; these models could be combined to form a larger and more complex model. This would reduce the time and cost required to develop models for new basins.

Discussion

The participants addressed the issue of data availability and data reliability for the purpose of modelling. Questions were also raised on the primary users of the model and also its benefits to downstream communities.

To develop a model requires a significant amount of data. If there is only a limited availability of data or if data is unavailable, it is only possible to design the principle of the model. The model should be validated by cross-checking with actual data, and suitable changes should be incorporated where required. The primary users of the models are stakeholders and planners. Modelling also benefits the downstream communities in a number of ways such as flood forecasting and water quality assessment.

Some participants informed the workshop that detailed and advanced modelling is carried out in Bangladesh covering all the country's river systems. The models help in flood forecasting as well helping to develop long-term water resources management strategies. Efforts are also being made to expand the models to model the upstream areas.

Renewable Energy for Water Quality Improvement

Bikas Raj Pandey, Winrock International-Nepal

This paper focused on the status of drinking water in Nepal and the various energy-consuming water treatment techniques adopted in the country. About 75% of Nepal's population has access to a basic water supply, however there is almost no good quality supply, neither in urban nor in rural areas. People either drink untreated water or treat the water they drink themselves.

Chlorination is the traditional technology for water treatment adopted by municipal or private systems because of its low cost, because it is easy to control, and because it is generally safe to use. Chlorination effectively kills many disease-causing bacteria, but it requires transport, storage, and proper use of the chemicals, which is difficult for communities in rural areas. Non-chemical and non-energy based treatment technologies like slow sand filtration could be a very good option for both urban and rural systems. However, they require space and good quality sand.

Among the energy consuming techniques, boiling is the most common method adopted in Nepal to treat water. Boiling is inefficient and expensive as it consumes a substantial amount of energy. Other alternative energy-consuming water treatment techniques for small quantities of water include solar water disinfection (SODIS), ultraviolet radiation (UVR), reverse osmosis (RO), and ozonation. Treatment of drinking water using UVR consumes the least amount of energy. Although SODIS utilises only solar energy, it cannot be used on a large scale. Treatment of drinking water using RO is very cost effective but the process generates large amounts of waste water.

The least costly methods like SODIS and UVR can be good alternatives where public treatment facilities are not available.

Discussion

Participants discussed the efficiency of boiling and SODIS. Both methods are equally effective, but treatment efficiency depends on the quality of the raw water, the length of time it is boiled, and the types of organisms present. Boiling takes the most energy and is the most expensive option per litre of water treated. SODIS requires an exposure of six hours to solar radiation under normal conditions; in the case of extreme solar radiation combined with higher temperatures the time taken for disinfection can be as short as one hour. Triple-stage filters are available in Nepal but are used by individual households. The cost of treatment can be reduced by serving a large community with technologies such as UVR.

SolAqua: Clean Water from the Sun

Gaurav Rajen, CMC

The 'Sol Aqua Solar still' uses the natural evaporation and condensation process to remove impurities such as salts and heavy metals, as well as eliminating microbiological organisms, to give potable water. Solar stills can be used successfully anywhere around the globe where the sun shines and is highly effective in removing impurities to provide safe drinking water. Better tasting water is also possible using a solar still. It is an extremely simple technology that works well and is also cost effective since it only uses solar energy.

The operation and maintenance of the solar still is very simple as there are no moving parts. The solar still has a long life and the lifecycle cost is low. Studies are still being conducted on the potential carryover of volatile organic compounds in the distilled water.

Discussion

The distillation process removes the smallest of particles. Even contaminated river water can be treated and the distillate would be drinkable.

Chair's Remarks

Dr. Betsill stated that there are important technologies available to enable the better management of water resources. These technologies should be used in the planning and development of strategies to better manage our water resources.

Session 3: Programme Development and Sustainability

Session 3 dealt with the identification of the needs and priorities in water quality in the region and the sustainability of SAWAN. Dr. J. David Betsill, CMC, and Ms. Srabani Roy, Programme and Project Development Specialist, ICIMOD, moderated the discussion.

Various issues such as biological monitoring, the application of IT tools, monitoring at headwaters, and the development of regional standards for the classification of rivers were discussed during the session. During the discussion, the participants identified the following needs and priorities to improve the water quality situation in the region.

ICIMOD

Water quality information and knowledge sharing

ENPHO

In South Asia rivers also have religious and cultural values

Needs

The needs identified by the participants were:

- to extend transboundary water quality monitoring in the major river systems, including other in-country rivers;
- to include more parameters for water quality analysis;
- to conduct bio-monitoring assessments to determine river water quality;
- to conduct monitoring at river headwaters;
- to conduct studies on water quality and its implication for public health;
- to initiate public awareness and capacity building programmes;
- to develop river water quality standards for river classification;
- to classify rivers based on their water quality status;
- to develop a data sharing mechanism;
- to develop river water quality models and decision support systems to support policy makers;
- to initiate catchment area development programmes;
- to assess the minimum flow requirements in specific river stretches;
- to initiate studies on arsenic contamination;
- to further improve tools for analysis;
- to identify low-cost technologies to improve water quality;
- to conduct studies on the effects of climate variability on river water quality;
- to conduct an economic valuation of water resources; and
- to conduct a river corridor survey.

Priorities

On the basis of the needs identified, the participants agreed to initiate the following activities for the sustainability of the SAWAN project.

- Continuation and planning of next steps for transboundary water quality monitoring
- Assessment of river water quality using bio-indicators
- Application of IT (information technology) tools for modelling the quality of the transboundary rivers in the region
- Training, capacity building, and development of protocols for water quality standards and river classifications for the region

Session 4: Water Quality Issues and Status – I

Chair: Mr. Mir Sajjad Hossain, Director, Joint River Commission, Bangladesh

Session 4 consisted of the first presentations of country papers highlighting current issues and the status of water quality. Papers were presented by Nepal and Bangladesh.

Water Quality Issues and Status in Nepal

Keshari Bajracharya, Department of Hydrology and Meteorology (DHM)

The physiographic situation and the water resources potential of Nepal were highlighted. Although Nepal has a high potential in water resources, the supply is inadequate in terms of quantity and quality due to the uneven distribution of resources and a lack of

treatment facilities. In addition, the management of water resources in Nepal is shared among the Ministry of Population and Environment (MoPE), the Ministry of Water Resources, the Ministry of Agriculture, and the Department of Hydrology and Meteorology (DHM) under the Ministry of Science and Technology. Major water quality issues in Nepal include the imbalance in supply and demand; growing pollution from domestic waste, industrial effluents, and agrochemical contamination; inefficient and inadequate treatment facilities; weak policy implementation; lack of storage capacity; groundwater depletion; and arsenic contamination. The country also suffers from budget constraints which hamper the further expansion of the water supply network as well as water quality management programmes.

Efforts to conserve water resources through legal measures started in the 1960s with the commencement of the water sector laws in the Civil Code. Major pieces of legislation that have provisions relevant to maintaining water quality are the Environmental Protection Act (1996) and the Environmental Protection Rules (1997) and their Amendment (1999). Other legislative provisions to conserve and manage water resources include the Water Resources Act (1992) and the Water Resources Regulations (1993); the Solid Waste Act (1987) and the Solid Waste Regulations (1993); the Soil and Water Conservation Act (1982); and the Aquatic Animals Protection Act (1965).

For the integrated development and management of Nepal's water resources, the Water and Energy Commission Secretariat developed a Water Resources Strategy for Nepal in 2002, which aims to significantly improve the living conditions of the people through water resources management. It also aims to provide water to meet domestic and agricultural demands as well as for hydropower generation. The strategy has short-term, medium-term, and long-term goals. Many efforts have been made to protect water resources. MoPE has enacted sewage and industrial effluents standards, but implementation is weak. Most of the wastewater treatment plants established around the Kathmandu valley are not functioning, mainly because of the high cost of operation. The Bagmati Area Sewage Plant is the only fully operational treatment plant within the Kathmandu valley. Very few industries treat their effluents before releasing them in the rivers.

The DHM is the mandatory organisation monitoring water quality in Nepal. The main objectives of the department include setting up a framework for a National Water Quality Database and developing and implementing a diagnostic survey of the water quality features of major rivers, lakes, and reservoirs for identifying and reporting on hot spots and issues of critical concern. Currently, DHM is monitoring water quality regularly from several stations in the Kathmandu valley and the Pokhara valley. In addition, water quality is being measured on a local scale by several NGOs for specific project purposes, mainly for drinking water. The Environment and Public Health Organisation (ENPHO) is one of the leading NGOs in the field of water quality monitoring and analysis in Nepal.

Discussion

Questions were raised regarding the role of civil societies such as NGOs in water quality monitoring in Nepal. Participants asked if the government was aware of the ongoing rainwater harvesting programme in Nepal. They also asked about the quantity of industrial effluents, the types of pollutants entering the Bagmati river, and the ongoing programmes for the river in the Kathmandu valley. There were concerns about the existence of legislation on effluent discharge and the

implementation of this legislation. The participants had further queries about the obstacles hindering the improvement of sewage treatment in the Kathmandu valley.

Legislation exists for controlling industrial effluents and municipal waste, but the enforcement mechanism is weak, there is also a lack of awareness among the general population. Many NGOs are campaigning to improve the water quality in the Bagmati river. 'Friends of the Bagmati', an NGO, is trying to improve the water quality in the river and are also involved in the development of sewage treatment plants.

There was discussion about the many NGOs like ENPHO who have been monitoring water quality at their own stations, but where monitoring is not conducted regularly. There has been a tremendous effort made by NGOs in rainwater harvesting. ICIMOD has also been involved in developing technology and promoting rainwater harvesting in the region.

Water Quality Issues and Status in Bangladesh

M. Fazlul Bari, Bangladesh University of Engineering and Technology (BUET) and Mr. Sheikh Mahbubur Rahman, Institute of Water Modelling (IWM)

The quality of surface water in Bangladesh is within tolerable limits in the monsoon season but there are severe problems during the dry season, especially in the industrial areas around Dhaka city. The main issues concerning water quality include increasing pressure on the main ecologically sensitive areas, surface water pollution due to untreated industrial effluents, and the significantly low capacity to treat domestic and industrial sewage from cities, which at present is discharged directly into the river systems. Over the last year the concentration of ammonia in the water has increased significantly. There is also an increase in the amount of domestic and industrial sewage generated. Pollution is also caused by the use of agrochemicals and from shipping vessels and oil spills. Withdrawal of water in the upstream reaches of the Ganges has caused major environmental impacts such as salinity intrusion, especially in the dry seasons. The arsenic contamination of groundwater is also a serious problem; some 25% of the population is estimated to be affected by arsenic contamination. In addition, groundwater in most parts of Bangladesh contains high concentrations of iron, manganese, boron, phosphorous, phosphates, and nitrates.

A number of policies have been formulated in Bangladesh to address the issue of total quality management and maintenance of ecosystems. The National Water Policy (1999) contains over 50 clauses of relevance to the protection, restoration, and enhancement of the water environment. The National Policy for Safe Water Supply and Sanitation (1998) ensures nationwide access to safe drinking water and sanitation services at an affordable cost. The National Environment Policy (1992) highlights the need to maintain the ecological balance and to achieve overall development through the protection and improvement of the environment. It seeks to identify and regulate activities that pollute and degrade the environment to ensure environmentally sound development in all sectors. The Environment Conservation Act (1995) is a comprehensive legislative framework for protecting the environment through responsible behaviour by industry, government agencies, city corporations and municipalities, local authorities, and individuals. This act gives power to the Ministry of Environment and Forest to frame rules and guidelines for managing the environment, and designates the Department of Environment as the responsible body for enforcing environmental impact assessment (EIA) procedures. The Environmental Conservation Rules (1997) provides wastewater effluent standards for industries and

selected surface water uses. The EIA Guidelines for Industries (1997) provides more specific mandatory regulations and procedures for environmental impact assessments both for industrial projects as well as for other water resources development projects. Attention should be paid to the implementation of existing laws and regulations rather than the formulation of new ones to improve the water environment in Bangladesh.

There are a number of institutions responsible for environmental management in Bangladesh. The Department of Environment (DoE) is the principle institution responsible for pollution control, and monitors effluents, sets water quality standards, and declares the areas where the ecosystem has been degraded to a critical state as 'environmentally critical'. The Water Resources Planning Organisation, in collaboration with DoE, develops environmental standards and guidelines, raising environmental awareness of water-related issues. However, due to the lack of institutional capacity, application of the standards has largely failed. Several other government and non-government organisations such as the Department of Forestry, the International Union for the Conservation of Nature (IUCN), the Bangladesh Environmental Lawyers Association, the National EIA Association, the International Centre for Living Aquatic Resources Management, and the Bangladesh Centre for Advanced Studies are also working in environmental protection. Several agencies, including the DoE, the Bangladesh Water Development Board (BWDB), and the Department of Public Health Engineering are conducting water quality monitoring at different scales. This data is available from the agencies at a nominal cost for study and research. Bangladesh has also signed a number of international and multilateral agreements related to the environment.

There is a need for water quality assessment and enforcement of regulations rather than the formulation of new policies. Regional and scientific cooperation for the exchange of knowledge and to increase education and knowledge dissemination also needs to be improved.

Discussion

The participants addressed questions on salinity intrusions and the major sources of pollution in Bangladesh. They suggestd that salinity intrusion could be partly a result of over-drafting in coastal areas. Concerns were raised about pesticides and the chemical pollution of surface water as well as the contamination of groundwater by arsenic. The role of DoE and the enforcement of legislation governing industrial waste discharge were also discussed

The minimum flow in rivers to prevent salinity has been determined, but it is difficult to maintain the flow during the dry season. The groundwater also contains arsenic, making it unsuitable for agricultural purposes. Pollution is caused mainly by the release of untreated effluents from point sources. Pesticide pollution was within permissible limits. Hazardous chemicals and heavy metals were detected in some rivers. DoE has a water quality monitoring network but monitoring is not being carried out at a regular intervals. The standards for effluent discharge need to be enforced.

Chair's Remarks

Mr. Hossain reiterated the importance of countries coming together to address the issue of transboundary river quality.

Session 5: Water Quality Issues and Status – II

Chair: Prof. Dr. Syed I. Hasnain, Vice-chancellor, University of Calicut, India

Session 5 continued the presentations of country papers with papers presented by India and Pakistan. The session began with a guest presentation by the Chairperson on the 'Impact of Glaciers on Himalayan Water Quality'.

Impact of Glaciers on Himalayan Water Quality

Syed I. Hasnain, Vice-chancellor, University of Calicut

The Himalayan Institute of Glaciology, Hydrology, Ice, Climate, and Environment is conducting research on glaciers and related issues. There are about 15,000 glaciers in the Himalayan region; the glaciers are of different types. In the Eastern Himalayas, both snowfall and melting takes place during the summer. The glaciers at lower elevations are larger than the glaciers at higher elevations. The International Commission on Snow and Ice is one of the oldest agencies looking after glacial programmes globally; they have established a database on selected glaciers throughout the world. Jawaharlal Nehru University, India, has developed a database for the Chhota Shigri, Gangotri, and Dokriani glaciers. Many changes in glacier systems have been noticed between 1994 and 2002 with much chemical weathering and denudation taking place in the glacier systems. Glaciers with debris cover have more chemical weathering and more solute content than those with less debris cover. Rivers originating from these glaciers represent the chemical composition of the glaciers. Therefore, research on glacier composition would be useful for determining the composition of river water.

Water Quality Issues and Status In India

Manotosh Sengupta, National River Conservation Directorate (NRCD), and Rooprekha. Dalwani, NRCD

India's approach to maintaining water quality status was highlighted in this paper. India faces acute water stress due to pressure from various sectors ranging from agriculture to industry. The country's capacity to treat wastewater is not sufficient at present. It was projected that the situation would worsen because of increasing urbanisation and rapid industrial growth. The major water issues are pollution due to organic pollutants and heavy metals, uncontrolled discharge of industrial effluents, leachates from landfill sites, eutrophication, salinity intrusion, and water scarcity.

There is legislation in India which aims to prevent water pollution and to preserve the environment. India has a vast water quality monitoring network. Agencies like the Central Pollution Control Board, the State Pollution Control Board, the National River Conservation Directorate (NRCD), the Central Water Commission, the State Ground Water Agencies, and the Central Ground Water Board are all concerned with water quality monitoring and pollution control in India. All the historical data from these organisations is being converted into individual databases operated and maintained independently, resulting in the compartmentalisation of water quality data. The Government of India initiated the Ganga Action Plan (GAP) in 1986 for pollution abatement of the river Ganges. Based on the experience gained during the implementation of GAP, the Government of India has initiated programmes to clean other rivers and lakes. The need for networking between the relevant agencies was highlighted.

CED

Surface water quality affects health, especially of women and children

ENPHO

The Bagmati river at Sundarighat – municipal waste dumped on the river bank

There is a large database on the water quality of rivers and groundwater in India; efforts are being initiated at the government level to fulfil the need of data sharing among the institutions. The application of new technologies for better management practices to meet future challenges was also emphasised.

Discussion

There were questions that addressed issues concerning inter-state pollution transport and conflict in water sharing in the country, and the existence of legislation to address these issues. Concerns were also raised about the pricing of groundwater for irrigation and the steps being taken to control pesticide pollution.

Inter-state water sharing is an important issue for which memoranda of understanding have been drawn up between the riparian states. There is a nominal pricing for the water used for irrigation. The industries are checked regularly for water consumption. The water cess (a tax/levy on consumption) collected by the government is distributed to state regulatory agencies working on water pollution related issues. There has been a phasing out of pesticides, mainly controlled by the Ministry of Agriculture. The use of organochlorine pesticides has been banned; however, DDT (dichlorodiphenyltrichloroethane) is permitted in the health sector in a controlled manner. In several states of India, specific state-level, binding legislation has been passed for rainwater harvesting. State-level efforts for watershed management through NGOs have started in the Himalayan stretch. The role of civil society in the regular monitoring and implementation of water quality programmes was also discussed. A directory of all the NGOs working in the water quality sector has been prepared for networking among the organisations.

Water Quality Issues and Status in Pakistan

Hammad N. Khan, WWF-Pakistan

Pakistan is confronting various water quality issues, including municipal discharge, untreated industrial effluents into freshwater bodies, lack of treatment facilities, salinity intrusion, contamination through extensive use of agro-chemicals, and non-implementation of regulations and legislation. Although there has been a significant reduction in water availability in Pakistan, the total water available for agricultural purposes has increased, after serious attempts to improve on-farm water management. A number of water reservoirs have also been established, and existing reservoirs have been enlarged. Pakistan has highly developed technologies in the field of water management, but the widespread dissemination and adoption of these technologies has failed because of a lack of public awareness and education on water conservation. The paper also commented on Pakistan's limited research on ice and snow hydrology.

Most existing industries do not comply with Pakistan's National Environmental Quality Standards. The Pakistan Council for Research in Water Resources (PCRWR) has been actively engaged in conducting, coordinating, and promoting research and development activities in various water resources-related fields, including water quality, since 1985. The current research areas of PCRWR are water conservation, water quality monitoring, rainwater harvesting, and drainage reclamation. A permanent water quality monitoring network has been established under the National Water Quality Monitoring Programme of Pakistan. The ongoing water quality research studies are mainly focused on arsenic monitoring and removal technologies.

Discussion

There were queries on the means of combating waterlogging and salinity. Participants displayed concern about the high value of the biological oxygen demand (BOD) in the Ravi river. They also enquired about the reason behind the lack of research in snow and glacier hydrology.

The National Drainage Programme is involved in the prevention of waterlogging and salinity. The high BOD level in the Ravi river is caused by the discharge of municipal sewage and industrial effluents into its tributaries. Several institutions have mandates to carry out research in snow and hydrology: PCRWR has already started working on this.

Chair's Remarks

Prof. Hasnain reiterated the need to share data in the region and underlined the importance of a regional network like SAWAN to address such issues.

Session 6: Transboundary Water Quality Data Network: Overview and Status – I

Chair: Dr. Gaurav Rajen, CMC

Session 6 was the first of three sessions with presentations made by the data collection partners in SAWAN on their water quality monitoring activities, data collected, information, and current status of data. It included presentations from Bangladesh and one of the partners in India.

Transboundary Water Quality Monitoring in the Padma/Ganges River in Bangladesh (September 2002 – May 2004)

A.Z.M Zalal Uddin, on behalf of Khalilur Rahman, Bangladesh Unnayan Parishad (BUP)

The SAWAN project focused mainly on the River Ganges in Bangladesh because of the alarming rate of pollutant discharge into the river. Sampling was done at three stations – Godagari, Rajshahi, and Paksey. The Hydrolab was the first instrument used for water quality monitoring, with water quality test strips being introduced recently.

The results of the study show that the dissolved oxygen (DO) was following a degrading trend. The concentration of total dissolved solids (TDS) is slightly high in Godagari. Results also indicate the alkaline condition of the rivers. The variation of the oxidation-reduction potential (ORP) ranged from 400 mV to a minimum of 280mV. Higher turbidity was recorded in April and lower turbidity in August and September at all three sites. The major problem faced during the period of investigation was the malfunctioning of the Hydrolab.

Discussion

Participants asked whether the data obtained was validated. Concerns were also raised regarding the accuracy of the Jal TARA Kit and the low values for DO content of the rivers.

The Hydrolab was calibrated before conducting the analysis. The Jal TARA Kit is a cost-effective instrument that gives accurate results. Regarding the error in the data of DO levels, the participants recommended the calibration of instruments and also

data validation. The participants agreed that the data should be validated before sharing it with partners.

Transboundary Water Quality Monitoring in the River Ganges, India

A.K. Ghosh, CED

The Centre for Environment and Development (CED) is working towards the generation of authentic environment-related data for use in development projects. In terms of the catchment area, the River Ganges is the largest river basin in the entire subcontinent. The Ganga Action Plan (GAP) has been implemented in India to prevent pollution in the Ganges. As part of the SAWAN project, CED has been analysing samples from two stations: Dhulian and Lalgola.

The results of the study showed that the average annual mean DO level was about 8-9 mg/l in the Indian segment of the Ganges, compared with 4 mg/l or less in the Bangladesh segment. An increasing trend of specific conductivity was noticed during the monsoon and a decreasing trend in the summer. DO, salinity, and TDS have displayed a declining trend. The salinity level in Bangladesh was higher than on the Indian side. The pH values were high in the year 2003 compared to other years. The oxidation reduction potential (ORP) was higher during winter and lower in summer. Dr. Ghosh suggested that a socioeconomic survey be conducted around the sampling sites to understand the factors affecting water quality in the river and its impact on local livelihoods.

Discussion

Instrument calibration procedures were highlighted to address queries on the high level of DO. Because the Hydrolab malfunctioned, data was generated through laboratory methods during the past few months. This might be the cause of the high values for levels of DO. Participants suggested that a Data Quality Working Group be formed to evaluate the data generated before dissemination.

Wrap-up

Chair: Dr. J. David Betsill, CMC

The purpose of the session was to summarise the river water quality status of the member countries as well as to identify further needs in the region.

Discussion

The first priority should be to develop a concept note based on the identified needs and priorities in the region. The development of a proposal outline was discussed. Such a concept note should include identification of a potential donor, the schedule to meet that agency's funding cycle, and basic budget planning. It was suggested that a writing team be formed to put the outlines together.

Participants suggested including problem trees, objectives, outputs, and a detailed work plan in the concept note, to be followed later with a log frame and budget. The concept note, or outline, would be followed by a fully-fledged proposal. A facilitator would be needed to come up with the desired output within a short space of time.

Participants asked if a consolidated, comprehensive concept paper could be prepared instead of different concept papers, as all of the priority topics (see

Session 3) are components of a single project. It was suggested that the project must involve multiple parties to make it robust; different institutions could take the lead role for some parts and individual experts might carry out others. The future direction of the search for funds also needs to be mapped out if the project is to be sustainable.

Questions were also asked about the future role of indirect working partners such as IUCN. The basic philosophy is to open up and expand the project so that it becomes a truly South Asian data analysis and collection network. The future role of CMC was also discussed.

Session 7: Transboundary Water Quality Data Network: Overview and Status – II

Chair: Dr. Rooprekha Dalwani, National River Conservation Directorate, India

Session 7 continued the presentations from Session 6 with presentations from Pakistan and the second partner in India.

The session began with a guest presentation on, 'One Hundred Years of Glacier Retreat in Central Asia' by Prof. Syed Iqbal Hasnain.

The Himalayan glaciers are affected by the easterly and westerly monsoons. There has been a shrinkage in the accumulation zones in the Himalayas since 1958. Many glacial lakes have developed in the Everest/Khumbu region, posing a threat of a GLOF. Remote sensing techniques and satellite imageries give a regional picture but are not accurate. The Gangotri is the only glacier in India that has been monitored since 1970. Most of the glaciers in Asia have had a negative balance since the Little Ice Age.

Transboundary Water Quality Monitoring: A Case Study of the River Ravi, Pakistan

Hammad Naqi Khan, WWF-Pakistan

The River Ravi is thought to be the most polluted river in Pakistan. The main sources of pollution are municipal sewage discharged from Lahore and the two transboundary effluent drains, Hudiara and Satiokatla, from India. There are two sampling locations in the river, Ravi Syphon and Ravi Baloki (downstream). The parameters were mostly analysed with the Hydrolab. The present status of the River Ravi is being monitored by WWF-Pakistan in collaboration with the Directorate of the Land Reclamation, Irrigation and Power Department, the Government of Punjab, Pakistan.

The results of the study showed that the pH values in the River Ravi were within the permissible limits at both points. The specific conductivity values were higher at the Baloki monitoring point due to the heavy load of effluents from Lahore. The BOD and chemical oxygen demand (COD) values were also higher at Baloki, indicating that most of the pollution load enters downstream of Syphon from Lahore and its surrounding areas.

The problems encountered while using the Hydrolab and while uploading the data onto the web site were described in detail. The data collected will be used for the development and implementation of a water quality management plan. A combined

wastewater treatment plan is one of the solutions to the problems of river pollution in Pakistan. Environmental monitoring and transboundary mitigation measures should be adopted to reduce pollution in the River Ravi.

Discussion

Participants enquired about the availability of discharge data from the Chennab River. Questions were also raised regarding the role of the United Nations Development Programme-Pakistan (UNDP-Pakistan) and United Nations Development Programme-India (UNDP-India) in cleaning up the transboundary drains. There were queries about whether wastewater was being used for irrigation in Pakistan, the amount of total municipal waste being generated, and the treatment system practised in the country. The issues of sampling procedures and the involvement of the government in the project were also mentioned.

Pakistan does not have river water quality classification standards and there is an urgent need for these. A data sharing protocol is needed for all the countries, and water quality standards should be developed. Since the government is the repository of all the information in the country, government involvement and support is necessary for such transboundary projects. Data collected should be consistent and data authenticity is also vital. UNDP-Pakistan and UNDP-India were keen on funding the programme to clean up the transboundary drains, and invited SAWAN to work on the project. The direct use of wastewater in irrigation systems is not recommended. However it could be used after primary treatment of the sewage. There is a sampling schedule and sampling methodologies prescribed under the SAWAN project.

Transboundary Water Quality Monitoring of the River Ravi (as Assessed from the Water Quality Index) at Madhopur, India

Anish Dua, Guru Nanak Dev University

The River Ravi is a transboundary river between India and Pakistan which originates in Himachal Pradesh on the northern side of the Rohtang Pass at an elevation of 4116 masl. The river has great economic importance, being used for irrigation and hydropower generation. It passes through the Dhauladhar and Pir Panjal ranges and later through the Chamba and Dalhousie hills of Himachal Pradesh. It emerges from the foothills at Madhopur in Gurdaspur district.

On the Indian side, samples were collected from Madhopur town in the state of Punjab. The sample site is located on the left bank of the river approximately 5 km upstream from Madhopur. The site is characterised by fast flow with aquatic vegetation in the shallow areas on the banks. The submerged vegetation includes plants of Hydrilla verticillata and grasses, mainly of *Polygonum barbatum*, *P. lanigerum,* and *Typha angustata*. The bank is slightly degraded. The river flow is fast, as this is the area where the river enters from the hills to the plains. The river bed has gravel and boulders; the meandering course and the fast flow causes erosion of the banks. There are no industrial units in the vicinity of the sample site.

Physio-chemical parameters were assessed using the Hydrolab and through volumetric analysis. A water quality index (WQI) was calculated using the Indian Council for Medical Research and Central Public Health and Environmental Engineering Organisation standards. The monitoring and analysis results showed that there was only a slight variation in water quality. In general, the water of the River Ravi at this sampling site is clean and free of any pollutants.

CED

Fishing in the Ganges – rivers are a source of income, particularly for marginal people

CED

The CED sampling team

Discussion

The possibility of developing a uniform WQI was discussed. The participants suggested taking into account corresponding experts' suggestions for developing a uniform WQI. There were queries regarding the reason for the river being pollution free, and on the area covered by the project.

The river is very clean because there are no sources of pollution in the area around the sampling sites. About half of the catchment area is being monitored by the project. It was suggested that the bicarbonate measurements should not be carried out in laboratories; auto titration should be used for the analysis.

Chair's Remarks

The countries of the region have been collaborating through the HKH-FRIEND network. The initiatives under the SAWAN project would be operating under the same platform with ICIMOD as the coordinating agency. The presentations of the session as well as the previous sessions showed that there is a need to develop regional protocols for water quality monitoring as well as for validating the data generated by the project.

Session 8: Transboundary Water Quality Data Network: Overview and Status – III

Chair: Dr. M. Sengupta, Adviser, National River Conservation Directorate (NRCD), India

Session 8 was a continuation of the presentations made in Sessions 6 and 7, and included presentations from Nepal and the third partner in India.

Monitoring of Transboundary Rivers – the Bagmati and the Narayani

Roshan Raj Shrestha, Environment and Public Health Organisation (ENPHO) (Nepal)

Two transboundary rivers, the Bagmati and the Narayani, are being monitored in Nepal. The results show that the water quality has changed, both spatially and temporally. The main causes of pollution are municipal and industrial effluent discharge in the Bagmati River, and agricultural runoff and industrial discharge in the Narayani. The Hydrolab was mostly used for in situ measurements of basic water quality parameters; but analysis of most of the parameters was done in the laboratory.

More than 50 million litres a day of wastewater are generated in the area, about 95% of it domestic waste. There was very little seasonal and spatial variation in the value of the pH in the Bagmati River, but there was marked seasonal and spatial variation in the values of TDS, DO, ORP, and COD. The nitrate values are also high near the Indo-Nepal border. The quality of the Bagmati River improves before crossing the Indo-Nepal border because of self-purification and the low level of human interference downstream of the Kathmandu Valley. There was very little spatial or temporal variation in the pH and ORP values in the Narayani River, but other parameters showed variations with time or space or both. The Bhrikuti Paper Mill contributes a significant amount of waste to the river.

There are three partially operating waste stabilisation ponds in Nepal; only the waste treatment plant established in the Pashupati area is fully operational, but the operating cost of this plant is very high.

Funding gaps should be identified if the project is to be sustainable. Data generated should be analysed prior to dissemination and there should be networking among the partners.

Some wetlands have been constructed by ENPHO to help clean the river systems. The government is planning to install similar wetlands in eight municipalities. A faecal sludge treatment system has already been set up in Pokhara and another will be established in Kathmandu. ENPHO is promoting an ecological sanitation concept in which faeces and urine are separated and used separately as fertilisers.

Discussion

Participants voiced their concern regarding the number of beneficiaries from the Bagmati Area Sewerage Plant and its maintenance cost. There were also questions addressing the use of the treated effluents.

About 50,000 people benefit from the Bagmati Area Sewerage Plant. The Pashupati Temple is of religious significance and hence the beneficiaries are all the people who visit the temple. Cost recovery would be implemented to make the project sustainable; the treated effluent is being used for different purposes such as irrigation and toilet flushing. A treatment plant was installed recently at Hetauda Industrial Estate, which is located upstream of the sampling site on the Rapti River. Wetlands are one of the best alternatives to conventional treatment plants.

Participants commented that the construction of wetlands is one of the best methods of cleaning wastewater and of maintaining river ecosystems. It should be more widely promoted in different countries.

Water Quality Monitoring of the Gandak River at Hajipur and the Gandak-Ganges Confluence at Patna

Ravindra K. Sinha, Patna University

The water quality monitoring of the Gandak River at Hajipur and of the Gandak-Ganges (Ganga) confluence at Patna was carried out using three different techniques: the Hydrolab, an automatic monitoring device, and the Jal TARA Water Analysis Kit. The water was mildly polluted in terms of physico-chemical characteristics, but the bacterial load was beyond permissible limits. The discharge of untreated domestic sewage is the main reason for this high load of bacterial contamination.

The highest air temperature was in March 2004 and the lowest in December 2003. In general, the DO content was high in winter and low in the monsoon. The Gandak had high values of suspended solids and low TDS, resulting in low specific conductivity, whereas the Ganges had low values of suspended solids, except during the monsoon months (July to September), and high TDS, resulting in higher specific conductivity. Seasonal variation was observed in water salinity. The river water at both the sites was alkaline and the pH within permissible limits. The Secchi Disc Transparency value was low in the monsoon months, when the river is laden with suspended solids, and high in the summer.

Discussion

The performance of the Hydrolab was questioned. There were also questions on ways to improve the DO level in the system. Participants enquired about the background of

the selection of parameters for monitoring and the purpose of selecting oxidation reduction potential (ORP). There were questions regarding the Bagmati River not being monitored. Participants wondered if the inclusion of catchment behaviour would make it easier to understand the water quality status. Monitoring of the Bagmati has not yet been initiated because of resource constraints.

There was a discussion about common effluent treatment plants, which can be operated only if industrial units are in a cluster. Regarding the malfunctioning of the Hydrolab, it was noted that it was only the pH probe that was creating problems. It was recommended that the manufacturer of the instruments should provide the users with some additional guidelines for coping with such difficulties. Sets of parameters for the river system also need to be modified. A review is necessary on parameter selection, instrument calibration, and data validation techniques.

Chair's Remarks

Dr. Sengupta emphasised that the data presented in the session will be useful for various research purposes. The presentations showed that most of the parameters monitored by the project are interrelated, and that the parameters selected need to be reviewed. The instruments used for water quality monitoring also need to be standardised.

Session 9: SAWAN Sustainability, Joint Proposals, and Next Steps

Session 9 discussed the role of ICIMOD and CMC and the next steps to ensure SAWAN's sustainability. ICIMOD would be the lead agency for the implementation of the project for the third phase, while CMC would remain associated with the project providing technical guidance. The project also intends to expand its network to include other government and non-government agencies.

It was agreed that a concept paper for the sustainability of SAWAN be prepared based on the needs and priorities identified by the participants during the third session of the workshop and covering the following agreed initiatives.

- Continuation and next steps of transboundary water quality monitoring
- Assessment of river water quality monitoring using bioindicators
- Modelling of water quality of transboundary rivers in the region
- Development of protocols for water quality standards for the region

Four working groups were formed to prepare concept papers on each project component; these have since been completed.

training and field visit

Training on Data Transmission and Retrieval

The SAWAN web site and database system was designed and built at Sandia National Laboratories, USA, in conjunction with other environmental monitoring projects. The goal was to design a core data storage and processing system that could handle diverse and disparate semi-structured data from various sources in one consistent and manageable format.

Since 2002, the water quality data collected under SAWAN's transboundary water quality monitoring programme has been uploaded directly to the system using Internet technology. The users reported several problems encountered in the system while uploading and viewing the data. A hands-on training in online data transmission and retrieval were organised to enhance partners' know-how of the technical details of the SAWAN web site and database system, and thus help avoid such problems in the future. The data collecting partners, CMC, and ICIMOD participated in the session.

The structure and operational details and other technical aspects of the web site and database system were described. The SAWAN database is designed to run on the SQL 2000 Server. The database schema comprises five major types of object. The relationship between them is shown in Figure 2.

- Elements: an element represents a single data value such as a measurement
- Collections: a group of elements associated with a given time
- Sources: represents the source of the data
- Element types: helps consistently define the types of data stored in the elements
- Source types: helps consistently define types of sources

As a first step towards the complete transfer of the web site to ICIMOD from CMC, a test bed (http://sawan.icimod.org.np) was created on the ICIMOD server. Web interfaces were provided that use Active Server Pages (ASP) with Python as the scripting language. Supporting software packages and some modules like Python 2.3 or later, Win32all (Win32 modules for Python 2.3 version 2001) or later, and Microsoft XML 4.0 were installed on the ICIMOD server.

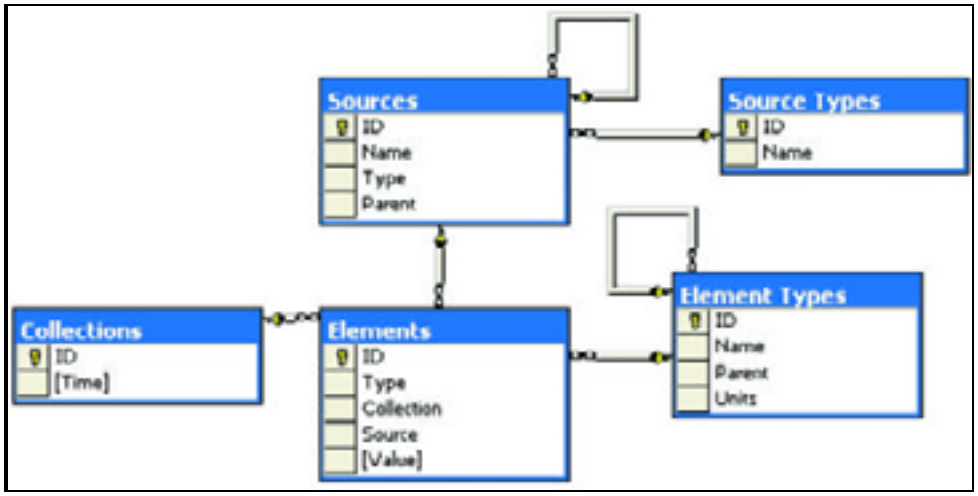

Figure 2: **SAWAN database objects relationship**

The partners used the test bed for hands-on exercises in data transmission and retrieval in the web site. Major issues discussed during the session included:

- changes required in data display,
- edit/delete option for submitted data to be possible only through webmaster,
- submitted data requiring proper validation at source when there is no restriction on, submitting data for any location by a registered user.

It was agreed to upgrade the system based on these issues and suggestions.

Field Trip to ICIMOD's Demonstration and Training Centre Site

A field trip to ICIMOD's Demonstration and Training Centre Godavari site was organised on the last day of the workshop. The site is located on the southern slopes of the Kathmandu Valley. It covers an area of 30 hectares with an elevation ranging from 1550 to 1800masl. The main purposes of the site are to test, select, and demonstrate different technologies and practices useful for integrated mountain development, natural resource management, and sustainable farming practices; to train farmers and those who work with them; and as a repository for plant germplasm resources. Current activities at the site include vegetation and soil management; water management; income generation through high-value cash crops, horticulture, and beekeeping; livestock; biodiversity; renewable energy technologies; community outreach; scientific research; and training and dissemination.

Water management and conservation techniques that have been tested at the site include water collection reservoirs and gravity sprinkler irrigation; natural spring water harvesting; rainwater harvesting; stone-lined and grass-lined waterways; shelter/protection belts; contour hedgerows of nitrogen-fixing plants to reduce runoff and soil loss; and drip irrigation. Sustainable harvesting of water, including rainwater, can contribute markedly to resolving the challenge of water scarcity for hill and mountain households.

The participants were very interested in the appropriate technologies that were demonstrated, particularly the water harvesting techniques for water conservation.

conclusions and key achievements

As in other regions, the surface water in South Asia is poorly protected from untreated industrial and municipal wastewater, runoff pollution from chemical fertilisers and pesticides used in agriculture, and oil and lube oil spillages from the operation of sea and river ports in the coastal areas. This poses a threat both to the environment and to the health of the people in the region. Reliable data is needed on the status and trends of a range of environmental indicators from an entire river basin in order to formulate effective policies for integrated water management and plan for the future. The assessment of river water quality can help to identify potential problems before they cause serious adverse health effects.

The SAWAN project, originally called SATWQM, was initiated in 1999 with the aim of establishing a regional network for sharing water quality information, and as a means of building trust and confidence and fostering regional cooperation. Since 2002, SAWAN partners from Bangladesh, India, Nepal, and Pakistan have been carrying out monthly monitoring of basic physical, chemical, and biological water quality parameters from 18 stations in the transboundary sections of the Ganges and Indus rivers and their major tributaries.

The limited monitoring that is being conducted under the project is a first step towards initiating a full-scale well-coordinated regional monitoring programme. It is expected that the project will bring significant benefits to each of the countries involved with regards to understanding the sources of possible contamination and establishing appropriate monitoring programmes. The transboundary nature of the SAWAN project allows the assessment of river water quality in entire river basins, rather than simply of an area limited by a country's political boundaries. The SAWAN project database is unique because of its transboundary and regional focus, and is likely to become an important part of other current or future South Asian water resources studies.

The Regional Integrated Workshop on Water Quality brought together key institutions and professionals working in water quality issues from the region. The participants noted that significant attempts have been made by the governments of Bangladesh, India, Nepal, and Pakistan to formulate environmental legislation and effluent standards in order to address country-specific water quality issues; however, they are far behind in terms of implementation. The participants expressed their continued interest in and commitment to fostering regional cooperation through water quality

monitoring and data sharing. They made the following comments and recommendations based on the discussions held during the workshop.

- There is a need for a 'regional level' protocol for water quality monitoring and data sharing among participating countries through nodal agencies, which has approval from the respective governments.
- To ensure the reliability and authenticity of data, it is necessary to introduce data validation and a detailed analysis of data for error detection and removal (flagging) of outliers.
- There is a need for a methodology for the classification of water bodies based on their existing quality and the desired water quality.
- The laboratories/institutions selected and involved in the water quality monitoring projects should be accredited.
- To avoid duplication, the SAWAN project should be linked to other similar regional and global initiatives.
- There is a need to relate the socioeconomic dependence of stakeholders to river systems.
- There is a need to work on improved river basin management with other partners.
- Both headwater areas/sources and downstream locations need to be monitored to enable correlation of data and for better understanding.
- It was suggested that an inventory be prepared of the biodiversity resources related to rivers being studied along a particular stretch.
- Education programmes should be initiated to increase awareness at different levels including schools and universities.
- It was suggested that a directory of NGOs and community-based organisations (CBOs) working in river water quality-related areas be prepared for all participating countries as a basis for establishing better government/civil society partnerships.

The workshop also expanded the network by including government organisations and other academic and research organisations. The data collection partners have been trained and their data sharing capabilities improved, particularly the uploading of data and information onto the website.

The workshop identified priority areas in water quality in South Asia, in particular four specific areas important for the sustainability of the SAWAN project: continuation and next steps of transboundary water quality monitoring; assessment of river water quality monitoring using bioindicators; modelling of water quality of transboundary rivers in the region; and development of protocols for water quality standards for the region. Concept notes have been prepared for each topic. Funding for the continuation of SAWAN will be sought from donors.

The project web site has been completely transferred to the ICIMOD server from CMC. The SAWAN web site and the database system are being upgraded to improve the user interface. The geographic information system (GIS) and other decision

support tools will be incorporated into the current web site and database system to demonstrate the use and value of sharing water quality data and information at the a basin level. The GIS integration could lead to an improved understanding of water quality issues by enabling correlation of data and demonstration of water quality trends along the various geographic stretches of the rivers concerned.

As envisaged from its inception, the SAWAN project is expected to enhance the technological capabilities of each country's national river water quality monitoring programmes by increasing the sophistication of the technology used, improving the quality and comparability of the data collected, and building trust and confidence between and among countries.

CED

Water for all

WWF-Pakistan

Untreated sewerage and industrial effluents discharged directly into a river

WWF-Pakistan

Waste water is being used as a reliable source of irrigation in Pakistan

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annex 1: workshop agenda

Day 1: Tuesday, 29 June 2004

8:30 am – 9:00 am *Registration*

9:00 am – 10:15 am **Opening Session: Introduction and Objectives**

Moderators Ms. Mandira Shrestha, ICIMOD, and Dr. J. David Betsill, CMC

- Welcome by moderators and self-introduction of participants
- Opening remarks by Ms. Janet Bogue, Charge d'Affaires, US Embassy, Nepal
- Opening remarks by Dr. J. Gabriel Campbell, Director General, ICIMOD
- Remarks by Chief Guest – Mr. Mohan Bahadur Karki, Secretary, Ministry of Population and Environment, Nepal
- Remarks by Ms. Mandira Shrestha, Executive Secretary, HKH-FRIEND
- Workshop Objectives and Agenda by Dr. David Betsill, CMC

10:15 am – 11:00 am *Group Photograph and Tea Break*

11:00 am – 12:45 pm **Session 1: Integration of HKH-FRIEND and SAWAN**

Moderator Prof. Suresh Raj Chalise, KARUNA-Nepal

- Introduction to the Cooperative Monitoring Center and Overview of the SAWAN Project, Expectations and Next Steps by Dr. David Betsill, CMC
- ICIMOD's Regional Water Projects by Ms. Mandira Shrestha, ICIMOD
- Brief Introduction of HKH-FRIEND's Water Quality Group by Prof. M.F. Bari and Dr. Subodh Sharma, HKH-FRIEND's Water Quality Group
- Regional Water-related Data Sharing Initiatives in the HKH Region by Mr. Basanta Shrestha, ICIMOD
- On-line Demonstration of SAWAN Web Site, Database, and Web Site Transfer by Mr. Jason Coombs, Software Technology Engineer, CMC

12:45 pm – 2:00 pm *Lunch*

2:00 pm – 3:10 pm **Session 2: Supporting Technologies and Programmes**

Moderator Dr. David Betsill, CMC

- Sandia Initiatives in Water, Agriculture, and Energy: A Brief Overview by Dr. Ronald Pate, Sandia National Laboratories
- Multi-system, Whole-basin and Multi-basin Water Resources Modelling by Dr. Howard D. Passell, Sandia National Laboratories
- Renewable Energy for Water Quality Improvement by Mr. Bikash Pandey, Winrock International, Nepal
- SolAqua: Clean Water from the Sun. Presented on behalf of Mr. Greg Vogel of SolAqua, Inc. by Dr. Gaurav Rajen, CMC

3:10 pm – 3:30 pm *Tea Break*

3:30 pm – 5:00 pm **Session 3: Initial Joint Proposal and Further Development of Integrated Project**

Moderators Dr. David Betsill, CMC and Ms. Srabani Roy, ICIMOD

- Needs
- Ideas
- Priorities
- Working group formation

5:00 pm – 5:15 pm **Wrap-up, Day 1**

Moderator Dr. David Betsill, CMC

Day 2 – Wednesday 30 June 2004

9:00 am – 11:00 am **Session 4: Regional Country Paper Presentations on Water Quality Issues and Status – I**

Moderator Mr. Mir Sajjad Hossain, Joint River Commission, Bangladesh

- **NEPAL**
  Ms. Keshari Bajracharya, Department of Hydrology and Meteorology

- **BANGLADESH**
  Prof. M.F. Bari, University of Engineering and Technology, and Mr. Sheikh Mahbubur Rahman, Institute of Water Modelling

11:00 am – 11:15 am *Tea Break*

11:15 am – 1:15 pm **Session 5: Regional Country Paper Presentations on Water Quality Issues and Status – II**

Moderator Prof. Syed I. Hasnain, University of Calicut, India

- Guest Presentation: Impact of Glaciers on Himalayan Water Quality, Prof. Syed Iqbal Hasnain

- **INDIA**
  Presented by Dr. M. Sengupta, and Dr. R. Dalwani, National River Conservation Directorate, Ministry of Environment and Forests

- **PAKISTAN**
  Presented by Mr. Hammad Naqi Khan, WWF-Pakistan on behalf of Dr. Mohammad Akram Kahlown, Pakistan Council of Research in Water Resources

1:15 pm – 2:30 pm *Lunch*

2:30 pm – 4:30 pm **Session 6: Transboundary Water Quality Data Network - Data Collection, Project Partner Overview and Status – I**

Moderator Dr. Gaurav Rajen, Sandia National Laboratories (SNL)

- **BANGLADESH**
  - Presented by Mr. A.Z.M Zalal Uddin, Bangladesh Water Development Board, on behalf of Mr. Khalilur Rahman, Bangladesh Unnayan Parishad

- **INDIA**
  - Dr. A.K. Ghosh, Center for Environment and Development, Kolkata

4:30 pm – 5:00 pm **Wrap-up**

Moderator Dr. David Betsill, CMC

Day 3 – Thursday 1 July 2004

9:00 am – 11:00 am **Session 7: Transboundary Water Quality Data Network – Data Collection, Project Partner Overview and Status – II**

Moderator Dr. R. Dalwani, National River Conservation Directorate, India

- Guest Presentation: 'One Hundred Years of Glacier Retreat in Central Asia, Prof. Syed Iqbal Hasnain

- **PAKISTAN**
  – Dr. Hammad Naqi Khan, WWF-Pakistan

- **INDIA**
  – Dr. Anish Dua, Guru Nanak Dev University, Amritsar

11:00 am – 11:15 am *Tea Break*

11:15 am – 1:15 pm **Session 8: Transboundary Water Quality Data Network – Data Collection, Project Partner Overview and Status – III**

Moderator Dr. M. Sengupta, National River Conservation Directorate, India

- **NEPAL**
  – Dr. Roshan Raj Shrestha, Environment and Public Health Organisation

- **INDIA**
  – Dr. Ravindra Kumar Sinha, Patna University, India

1:15 pm – 2:15 pm *Lunch*

2:15 pm – 4:30 pm **Session 9: Working Groups – SAWAN Sustainability, Joint Proposals and Next Steps**

Moderators Dr. David Betsill, CMC, and Ms. Mandira Shrestha, ICIMOD

- Open discussion
- Summary of needs and priorities identified by the participants
- Working groups for writing concept paper

4:30 pm – 5:00 pm **Wrap-up, Closing Session**

Moderators Dr. David Betsill, CMC and Ms. Mandira Shrestha, ICIMOD

- Summary of key outcomes by Ms. Mandira Shrestha, ICIMOD
- Remarks by Dr. David Betsill, CMC
- Remarks by participants
- Remarks by Dr. J. Gabriel Campbell, ICIMOD
- Vote of thanks by Ms. Mandira Shrestha, ICIMOD

Adjournment (except for hands-on training participants, i.e., data collection partners and other interested parties).

Day 4 – Friday 2 July 2004

Technical Discussion and Training on Data Transmission and Retrieval

9:00 am – 9:30 am **Briefing on Data Transmission and Retrieval**

Mr. Jason Coombs, CMC, and Dr. Gaurav Rajen, SNL

9:30 am – 11:00 am **Training on Data Transmission to SAWAN Project Web Site**

Moderators Mr. Jason Coombs, CMC, Dr. Gaurav Rajen, SNL, and Dr. David Betsill, CMC

11:00 am – 11:15 am *Tea Break*

11:15 am – 1:00 pm **Class Training and Questions and Answers – Data Transmission and Retrieval; and Next Steps**

Moderators Mr. Jason Coombs, CMC, Dr. Gaurav Rajen, SNL, and Dr. David Betsill, CMC

1:00 pm – 2:00 pm *Lunch*

2:00 pm – 5:00 pm **Field trip to ICIMOD's Demonstration and Training Centre Site at Godavari**

Guides: Mr. Rajendra Shilpakar and Mr. Suraj Thapa, ICIMOD

annex 2: list of participants

BANGLADESH

M. Fazlul Bari
Professor of Water Resources Engineering
Bangladesh University of Engineering & Technology
Civil Engineering Building (6th floor)
Dhaka-1000, Bangladesh
Email: bari@wre.buet.ac.bd
Tel.: +880-2-9665631, 9665650/Ext. 7403
Fax: +880-2-8613046/8613026

Mir Sajjad Hossain
Director
Joint Rivers Commission
House 13, Road 4, Dhanmondi
Dhaka-1205, Bangladesh
Email: jrcb@citechco.net
Tel.: +880-2-9669935
Fax: +880-2-9668646

S.M. Mahbubur Rahman
Head, Water Resources Planning Division
Institute of Water Modelling (IWM)
House 476, Road 32, New DOHS, Mohakhali
Dhaka-1206, Bangladesh
Email: smr@iwmbd.org
Tel.: +880-2-8824590-1, 8822105-6
Fax: +880-2-8827901

A.Z.M. Zalal Uddin
Sub-divisional Engineer
Surface Water Processing Branch
Bangladesh Water Development Board
72 Green Road, Dhaka-1205, Bangladesh
Email: Zalal786@yahoo.com
Tel.: +880-2-9118735
Fax: +880-2-9889594, 8822319

INDIA

Rooprekha Dalwani
Additional Director
National River Conservation Directorate
Ministry of Environment and Forests
Paryavaran Bhawan, CGO Complex, Lodi Road
New Delhi 110003, India
Email: r_dalwani@yahoo.com
Tel.: +91-11-24364789/24362842
Fax: +91-11-24360009, 24364789

Salil Das
Senior Research Associate
Centre for Environment and Development
329 Jodhpur Park
Kolkata 700 068, India
Email: salil_das@sity.com
Tel.: +91-33-24731519, 24734838
Fax: +91-33-24132627

Anish Dua
Sr. Lecturer
Aquatic Biology Laboratory
Department of Zoology
Guru Nanak Dev University
Amristar Punjab, India
Email: anishdua@hotmail.com
Tel.: +91-183-2258802-9 Ext. 3399
Fax: +91-183-2258819, 22558820

Asish Kumar Ghosh
Director
Centre for Environment and Development
329 Jodhpur Park, (Gr. Floor)
Kolkata 700 068, India
Email: cedkolkata@sify.com
Tel: +91-33-24731519, 24149801
Fax: +91-33-24132626

Syed Iqbal Hasnain
Vice-Chancellor
University of Calicut, Kerala
P.O. Thenhipalam, Malappuram
Kerala-673635, India
Email: iqbalhasnain@hotmail.com
Tel.: +91-0494-2400241, 2401144
Fax: +91-0494-2400361

Kriteswar Prasad
Professor
Department of Geology
Patna University
Patna, India
Email: rksinha_54@Sancharnet.in
Tel.: +91-612-2662587
Fax: +91-612-2688801

Ravindra Kumar Sinha
Professor
Department of Zoology
Patna University
Patna, India
Email: rksinha_54@Sancharnet.in
Tel.: 91-612-2670086, 2688801
Fax: 91-612-2688801

Manotosh Sengupta
Adviser
National River Conservation Directorate
Ministry of Environment and Forests
Paryavaran Bhawan, CGO Complex, Lodi Road
New Delhi 110003, India
Email: msen2k@lycos.com
Tel.: +91-11-24360734/24369629
Fax: +91-11-24360009

NEPAL

Keshari Bajracharya
Senior Divisional Chemist
Department of Hydrology and Meteorology
Ministry of Science & Technology
P.O. Box 406, Kathmandu, Nepal
Email: keshari538@yahoo.com
Tel.: +977-1-4262374, 4248808
Fax: +977-1-4262348

Khem Raj Bhandari
Electrical Engineer
Lotus Energy Pvt. Ltd.
P.O. Box 9219, Kathmandu, Nepal
Email: info@lotusenergy.com
Tel.: +977-1-4418203
Fax: +977-1-4412924

Suresh Raj Chalise
KARUNA-NEPAL
Jawalakhel, Lalitpur
P.O. Box 4965, Kathmandu, Nepal
Email: chalise@mos.com.np
Tel.: +977-1-5523307

Kanchan Dixit
Coordinator
Nepal Water Conservation Foundation
Patan Dhoka, Lalitpur
G.P.O. Box 2221, Kathmandu, Nepal
Email: nwcf@wlink.com.np
Tel.: 977-1-5528111, 5542354

Yadav R. Gurung
Programme Manager
Himalayan Light Foundation
Baluwatar
G.P.O. Box 12191, Kathmandu, Nepal
Email: yadavg@hlf.org.np
Tel.: +977-4226792, 4222232
Fax: +977-1-4412924

Ghanashyam Joshi
M.Sc. Student – Kathmandu University
Dhulikhel, Nepal
Email: gs_joshi@hotmail.com
Tel.: +977-11- 664519

Mohan Bahadur Karki
Secretary
Ministry of Population and Environment
Singha Durbar, Kathmandu, Nepal
Email: info@mope.gov.np
Tel.: 977-1-4245367/8
Fax: 977-1-4242138

Dilip Khatiwada
Mechanical Engineer
Ministry of Population and Environment
Singha Durbar, Kathmandu, Nepal
Email: dilip@mope.gov.np
Tel.: 977-1-4245367/68/69
Fax: 977-1-4242138

Anjali Manandhar
Research Officer
Environment and Public Health Organisation
P.O. Box 4102, Kathmandu, Nepal
Email: enpho@mail.com.np
Tel.: +977-1-4493188, 4468641
Fax: +977-1-4491376

Bikash Raj Pandey
Country Representative
Winrock International, Baneswor
G.P.O. Box 1312, Kathmandu, Nepal
Email: bpandey@winrock.org.np
Tel.: 977-1-4467087, 4476101
Fax: 977-1-4476109

Shyam Sundar Ranjitkar
Senior Irrigation Specialist
The World Bank
Hotel Yak & Yeti Complex
Kathmandu, Nepal
Email: sranjitkar@worldbank.org
Tel.: +977-4226792, 4222231
Fax: +977-1-4225112

Subodh Sharma
Associate Professor
Department of Environmental Science & Biological Sciences
Kathmandu University
Dhulikhel, Kabhrepalanchowk, Nepal
Email: kuhimal@ku.edu.np
Tel.: +977-11-661399
Fax: +977-11-661443

Juna Shrestha
Asst. Research Officer
Environment and Public Health Organisation
P.O. Box 4102, Kathmandu, Nepal
Email: enpho@mail.com.np
Tel.: +977-1-4493188, 4468641
Fax: +977-1-4491376

Rojina Shrestha
Programme Officer
Clean Environment & Partnerships
World Conservation Union (IUCN)
P.O. Box 3923, Kathmandu, Nepal
Email: rojina@iucn.org.np
Tel.: 977-1-5527781, 5528781
Fax: 977-1-5536786

Roshan Raj Shrestha
Executive Chairman
Environment and Public Health Organisation
New Baneshwor
P.O. Box 4102, Kathmandu, Nepal
Email: rshrestha@mos.com.np, enpho@mail.com.np
Tel.: +977-1-4493188, 4468641
Fax: +977-1-4491376

PAKISTAN

Hammad Naqi Khan
Director Freshwater and Toxics
WWF-Pakistan
P.O. Box 5180, Ferozepur Road
Lahore 54600, Pakistan
Email: hnaqi@wwf.org.pk
Tel.: +92-42-5862360, 5869429, 5882069
Fax: +92-42-5862358

Muhammad Tariq Yamin
Project Officer, EPU
WWF-Pakistan
P.O. Box 5180, Ferozepur Road
Lahore 54600, Pakistan
Email: tariqyamin@hotmail.com
Tel: +92-42-5862360, 5869430, 5882069
Fax: +92-42-5862358

US DEPARTMENT OF STATE, NEPAL

Janet Bogue
Charge d'Affaires
US Embassy, Kathmandu, Nepal
Tel.: +977-1-4411179
Fax: +977-1-4419485, 4419963

Jay Pal Shrestha
Regional Environmental Affairs Specialist
US Embassy, Kathmandu, Nepal
Email: ShresthaJP@state.gov
Tel.: +977-1-4411179
Fax: +977-1-4419485, 4419963

SANDIA NATIONAL LABORATORIES, USA

J. David Betsill
Environmental Projects Manager
Cooperative Monitoring Center
Sandia National Laboratories
P.O. Box 5800, Albuquerque
NM 87185, USA
Email: jdbetsi@sandia.gov
Tel: +1-505-8449578
Fax: +1-505-2845055

Jason R. Coombs
Software Technology Engineer
Cooperative Monitoring Center
Sandia National Laboratories
P.O. Box 5800, MS 1371 Albuquerque
NM 87185-1371, USA
Email: jaraco@sandia.gov
Tel.: +1-505-2846700
Fax: +1-877-7882136

Ronald C. Pate
Principal Member of Technical Staff
Water, Agriculture & Energy Initiatives
Sandia National Laboratories
P.O. Box 5800, Albuquerque
NM 87185-0720, USA
Email: rcpate@sandia.gov
Tel.: +1-505-844 3043
Fax: +1-505-844 2348

Howard D. Passell
Water Resources Ecologist
Sandia National Laboratories
P.O. Box 5800, MS 0735, Albuquerque
NM 87043, USA
Email: hdpasse@sandia.gov
Tel.; +1-505-284 6469
Fax: +1-505-844 6023

Gaurav Rajen
Consultant
Cooperative Monitoring Center
Sandia National Laboratories
P.O. Box 5800, Albuquerque
NM 87185, USA
Email: grajen@sandia.gov
Tel.: +1-505-2849051
Fax: +1-505-2849040

ICIMOD

ICIMOD
Khumaltar, Lalitpur
P.O. Box 3226, Kathmandu, Nepal
Tel.: +977-1-5525313
Fax: +977-1-5524509, 5536747

J. Gabriel Campbell
Director General
Email: gcampbell@icimod.org.np

Rajan Bajracharya
Data Management Assistant – MENRIS
Email: rbajracharya@icimod.org.np

Ritesh Gurung
Rapporteur – SAWAN Workshop
Email: rgurung@icimod.org.np

Richard Heggen
Senior Associate Scientist
Email: rheggen@icimod.org.np

Sarita Joshi
Admin. Assistant – WHEM
Email: sarjoshi@icimod.org.np

Vijay Ratan Khadgi
Web Person – Flood Project
Email: vkhadgi@icimod.org.np

Pradeep Mool
Remote Sensing Analyst
Email: pmool@icimod.org.np

Srabani Roy
Programme & Project Development Specialist
Email: sroy@icimod.org.np

Rajendra L. Shilpakar
Assistant Coordinator – SAWAN
Email: rshilpakar@icimod.org.np

Basanta Shrestha
Division Head – IKM/MENRIS
Email: bshrestha@icimod.org.np

Mandira Shrestha
Water Resources Expert
Email: mshrestha@icimod.org.np

Suraj B. Thapa
Farm Manager/Horticulturist, Godavari
Email: suthapa@icimod.org.np

International Centre for Integrated Mountain Development (ICIMOD)
Khumaltar, Lalitpur
GPO Box 3226, Kathmandu, Nepal

Tel: + 977 1 5525313
Fax: + 977 1 5524509 / 5536747
Email: distri@icimod.org.np
www.icimod.org

The Cooperative Monitoring Centre (CMC)
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185
Tel: + 505 284 5055
www.cmc.sandia.gov

ISBN 92 9115 076 2