

FOREWORD

The last century saw phenomenal growth in the use of water. While the world population tripled, the water use for human purposes multiplied sixfold. Currently, there are many signs that water is running out- or at least getting a lot less plentiful in more places as population and per capita water use grow. The water availability in densely populated regions of Asia, Central and South Europe, and Africa is within 1.2-5 thousand m^3 per year. In the north of Africa and on the Arabian Peninsula, it is as much as 0.2-0.3 thousand m^3 per year. It is worth mentioning that water availability of less than 2 thousand m^3 per year per capita is considered to be very low, and less than 1 thousand m^3 per year catastrophically low. This scarcity of water is due to many reasons. At many places, rainfall and river runoffs occur in large amounts during very short periods, such as during the monsoon season and are not available for human use unless stored in aquifers, reservoirs, or tanks. So, even though people use only a small fraction of renewable water resources globally, this fraction is much higher – up to 80-90% - in many arid and semi-arid river basins where water is scarce.

Taking base year 1995, the global total water withdrawal comprised about 3790 km^3 /year and consumption was - 2070 km^3 /year (61% of withdrawal). In the future the total water withdrawal will be growing by about 10-12% for every ten years, and by 2025 it will reach approximately 5240 km^3 /year (a 1.38-fold increase). Water consumption will be growing somewhat slower and the increase will be by 1.33 times. At the present time about 57% of total water withdrawal and 70% of global water consumption fall on Asia, where the major irrigated lands of the world are located. During the next decades the most intensive growth of water withdrawal is expected to occur in Africa and South America (by 1.5-1.6 times), the smallest in Europe and North America (1.2 times).

Against this background, it is evident that the natural resources are under tremendous stress, not only due to ever-increasing population, but also due to other reasons like wastage, pollution, unplanned development and poor management practices. The increasing biotic pressure has called upon the need for evolving suitable methodologies for optimum management with minimum environmental impact for sustainable development in the future. Watershed is an ideal unit for multidisciplinary approach to the resource management for ensuring continuous benefit on sustainable basis. Since water resources are the primary inputs for any development in any watershed, an integrated approach of water resources management for the problem would therefore be prerequisite. In India nearly 80% of people below poverty line are in rainfed rural areas. The Government of India and the World Bank have, therefore, launched many programs in a big way for poverty alleviation and equitable distribution of resources.

The sustainable supply of water, the quality of which is also good enough to meet requirements of people, is an enormous challenge to the governments of many countries, especially in the developing world, because that is where in many cases the existing water shortage had increased and is at the root of many socio-economic problems. These problems include among other things the rising costs of tapping new water reserves, the wasteful use of those already made available, soil degradation in irrigated areas, the overuse or exhaustion of groundwater resources, the release of harmful substances into the water with negative effects on the health of water users and massive subsidies for providing water, which act against the sustainable use of water resources.

It is now widely recognised that India runs the grave risk of being burdened by a major shortage of water in the coming years which could disrupt many social welfare schemes. Indeed, the market in some ways has already begun to reflect this scarcity; bottled mineral water today costs only a little less than milk in major Indian cities! The sheer perversity of this outcome in a country with a large population is indeed disturbing. It is also worrying for what it portends for the future, especially as resentments grow along with the disparities in living standards.

In the next few decades, significant advances in the field of Hydrology with appropriate R&D inputs are needed to transform the course of water resources planning, development and man-

agement to cater to multiple uses and needs: irrigation, drinking water, hydropower etc. There is need for preparation of suitable action plans to deal with various hydrological problems that confront the water sector. It is important to emphasize the need for having a proper vision and prepare a long term perspective plan for tackling the various hydrological problems related with water resources development and management with due consideration of environmental, social, economic and political factors.

The best way to accomplish is through closer interaction and exchange of ideas, knowledge, understanding, application and team spirit amongst the field personals, engineers, scientists, academicians and most important the people. The conference is one such forum, which provides such an opportunity. In pursuance of this objective National Institute of Hydrology, an apex autonomous body under the Ministry of Water Resources, Government of India, is organising an international conference on "Integrated Water Resources Management for Sustainable Development" in New Delhi during December 19-21, 2000.

The aim of the conference is to provide a platform to the hydrologists and water resources engineers of different countries to interact, share and disseminate the knowledge, methodologies, current practices and experiences in their related fields amidst the environmental threats arising out of the growing population, urbanization and industrialization. This would also draw attention on the future challenges and their possible remedies. The ultimate aim, however, is to summarize the current knowledge and evolve a viable plan for future for sustainable development.

The proceedings of the International Conference on Integrated Water Resources Management for Sustainable Development (ICIWRM-2000), which are presented in three volumes contain 133 technical papers presented under 8 different themes and cover a wide spectrum of integrated water resources development & management, the key note papers, theme papers etc. The present volume is the third in the series and covers theme papers, rapporteur's report and addresses of delegates, key note & theme paper speakers and rapporteurs of the Conference

It becomes my sacred duty to acknowledge and express my humble gratitude to all those organizations: Ministry of Water Resources (MoWR), Government of India, New Delhi; Indian National Committee on Hydrology (INCOH), Roorkee; United Nations Educational, Scientific and Cultural Organizations (UNESCO); Hydrology Project, India; International Atomic Energy Agency (IAEA), Austria; International Centre for Integrated Mountain Development (ICIMOD), Nepal; Water and Power Consultancy Services (WAPCOS) India Ltd., New Delhi; Council of Scientific and Industrial Research (CSIR), New Delhi, Indian Council of Agricultural Research (ICAR), New Delhi and Department of Science and Technology, New Delhi for their sponsorship and financial supports and International Association of Hydrological Sciences (IAHS), Wallingford, UK; World Meteorological Organization (WMO) and the Institution of Engineers (India) for co-sponsoring without financial support.

I firmly believe that the proceedings of the conference, deliberations and discussions, both at the panel session and technical sessions will go a long way for promoting integrated planning, development and help in evolving a holistic approach for management of the water resources and watersheds in as a whole.

During the last one year all members of the organizing committee have worked very hard with good understanding, co-operation and dedicated team spirit to make this important international event meaningful. I take this opportunity to express my sincere gratitude to all those who have been involved and have helped directly or indirectly to make the conference a success.

Date: 7th December 2000
Roorkee

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