

Integrated Water Resources Management

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There are 20 papers for presentation during the above session. The Rapporteur report in the general format as prescribed by the organizers is as under for various papers:-

1. Essential characteristics and integrated management strategies of water resources in the arid and semi-arid North West of China by *Gouzhang Feng*

The author in his paper has highlighted the various issues including the beneficial and adverse impacts of water resources development, which had taken place in the arid and semi-arid North West Continental river region of China. The activities had induced the socio economic development in the region but simultaneously had also created severe water related environmental issues. As such, the author felt that water resources development process should consider and include environmental aspects / issues like optimal utilisation of water for industrial and other uses, inter basin transfer, water saving technologies, protection of lakes and natural environment etc. But they may be feasible only through an authoritative management system since water management resources system is governed by several government agencies. The author propagates "one dragon" water resources management to "multi-dragon" system.

The suggestions made by the author are worth consideration and may be helpful for sustainable water resources development. The theme has been covered lucidly.

2. Sizing of Storage Tanks for Roof-Rainwater Catchment Systems by *U.S. Panu & R. Rebneris*

A methodology for estimating the optimal size of storage tanks for harvesting roof rainwater to meet the demands of the crops (lawn grass) on weekly basis has been suggested in the paper considering the stochastic nature of rain water (supply) and the demands. Certain assumptions have been made while assessing the size of the storage tank which may not be true in real life situation or when the principle is extended to utilise the harvested water for meeting the municipal and industrial demands (M & J from urban catchment. A few of the assumptions made are:-

- (i) Lawn grass can sustain for a week without water, M & I demands cannot sustain without water for a week.
- (ii) The total weekly demand of water assessed is only 3.2 cm for lawn grass.
- (iii) Rainfall is occurring as a single event and not series of events of smaller duration.

A recursive approach to maximise the irrigated area choosing water budget analysis have been used. The authors though have estimated a saving of 0.73 million dollars annually from a small town of 1.14 lakh inhabitants in Canada. The efficacy of the benefit needs more detailed analysis for use in urban catchment since the land cost, construction cost etc., increases exponentially with (larger) size of storage tanks needed to harvest rain-water from places like stadiums, parks and roads etc.

3. Environmental Sound Management of Lake Erhai and the Xier River Basin : a UNEP-IETC presentation

It is not a research paper but provides the details of investigations, analyses and synthesis carried out by various agencies on the lake Erhai in China. The paper can serve good purpose for taking up comprehensive studies on lakes in other countries.

4. Integrated Water Resources Management – Role of Research & Development in Hydrology by S.M. Seth

The paper highlights the urgent need of reliable hydrological database, its collection and R&D for ensuring sustainable development. The research needs should be oriented towards integration of technical results with non-technical factors like societal behaviour and must be compatible with the resource crunch. The author through his paper suggests that sustainable water resources development should incorporate multi-disciplinary team of professionals, planners, policy makers and general public for weighing pros and cons of the activities so as to ensure optimal utilisation of resources.

5. Water for Mountain Households in the Hindu Kush-Himalayas by S.R. Chalise and Saleem A Sial

The author in his paper has tried to highlight the problem experienced by people residing in the Hindu Kush-Himalayan region. Though plenty of water is available during rainy season in the region which unfortunately brings miseries to the residents, yet people of the region also experience shortages of water during lean period. Several studies have been made earlier to reduce the miseries of the masses yet there is a need for R&D to evolve practical methods and models as applicable to the areas. The findings could help the local people to harvest the rainwater for their future needs. It will ensure meeting the challenges of water crisis in the region. The recommendations in the paper are worth consideration.

6. Some Hydrological Characteristics of the Australian Arid Zone by I. Cordery & James Fraser

The authors have analysed the stream flow and rainfall data of 30 years in the arid regions of western New South Wales of Australia and concluded that in the region spatial uniformity exists between monthly, annually and storm rainfall unlike pattern being observed elsewhere in the world. It may be due to storms and rainfalls are produced by convective cells in the arid zones of Australia. This needs further examination.

The findings of the authors are based on the observed data of the western NSW region and probably cannot be generalised to other regions of Australia.

7. Water Use Alternatives for the Bukhara region of Uzbekistan and Water Distribution in the Zerafshan River Basin by Iskandar Abdullaev

The author has suggested a methodology for optimal allocation of water from different sources to a region, considering the economic and environmental aspects in the aral sea zone. Among the 3 alternatives identified for the supply of water, the author concluded that increasing the reuse of drainage water and corresponding ground water use is an optimal solution to supply the water among the three identified scenarios, since it has the least detrimental environmental impact.

The methodology enumerated in the paper would be useful for quick identification of optimal alternative among competing demands and may help in conflict resolution.

8. Advances in Groundwater Research for Integrated Resource Management and Sustainable Development by P.S. Datta & S.K. Tyagi

The paper is based on the studies conducted by the authors and their findings on assessment of ground water recharge with radioactive isotopes and their impacts on ground water quality in Delhi region. The authors have concluded that ground water contamination to different degrees exists in Delhi and is defused both temporally and spatially. It is mostly due to slow infiltration of agricultural and urban surface run off, indiscriminate use of agro-chemicals and disposed of wastes on land. Due to inhomogeneity and complexities of ground water system, the authors felt that there is an urgent need of ground water quality monitoring and surveillance system together with the impetus on R&D to assess the hydro-geology characteristics and pollutant dynamics in the ground water under natural and exploited conditions.

The suggestions made by the authors for R&D, improvement in the monitoring system and training of beneficiaries are very pertinent.

9. Assessment of Water Harvesting Structures (Case Studies in three different parts of Iran) by Nasrollah Kalantari

The paper is based on the results of the study in respect of three rainwater harvesting structures in different parts of Iran, which does not receive enough precipitation. The

precipitation is uneven and several areas experience acute shortage of water. Excessive ground water utilisation has resulted in serious environmental hazards due to low recharge. The author through the paper has suggested that ground water recharge is necessary and the economic life of recharge system depends upon the infiltration rate and sedimentation. They are affected by the geological and watershed characteristic of the region. For sustainability, the authors suggest that emphasis should be laid down on design criteria during construction and operational stage. Turbidity in flood waters could be controlled through terracing, check dams, contour bunding, gulli controlled structures etc., for effective recharge.

The findings of the case studies in three different parts of Iran suggests that harvesting structures could be self supporting if entry of silt-laden water is controlled.

10. Integrated Management of Water Resources in the Sahel Countries : Relevance, Constraints and Ways of Improvement. Case study of Senegal by Aissatou Thioubou

The author has highlighted the water issues in Sahel countries based on the Senegal experience where water resources are unevenly distributed and over exploited, bad management practices, sectoral approach, planning, inadequate legal and institutional framework have resulted in the degradation of water resources. They pose a threat to the development process also.

The author through the paper suggests that there is an urgent need for Sahel countries to reexamine their water policies, failing which, there is a risk of degradation of water resources in the region. The suggestion made by the author are useful for sustainable development in the region.

11. New Perspective of Urban Water Systems: Meeting the Sustainability Challenge by Pratap Raval and Tom Donnelly

The author through his paper suggests that there is a need for fresh thinking on holistic basis for design, planning and implementation of urban water system, as the earlier technology of 19th century is not suitable now. Several environmental implications of the current system necessitates rethinking so as to include water catchment, transfer and disposal of wastes, recycling of water while planning for urban water system. The transportation of waste through water needs to be relooked and alternatives needs to be identified as water is becoming a scarce commodity. The author in his paper suggests that there is a need for changes in social habits, policies, education system and management of water so as to ensure sustainability of urban water system.

12. Geostatistics : A Brief look at its application in Drainage Management by Moustafa M. Moustafa

The author through geostatistics techniques had tried to correlate the soil properties and its variation with the (horizontal) distance. Since management and design of drainage system depends up on the reliability of field measurements of soil water properties, such

information, being made available through geostatistics would be helpful to drainage engineers for development of optimal management plans in an unexploited area based on information of adjacent area with reliability.

13. Agricultural Database for the sustainable use of water in the Ojos Negros Valley, Baja, California, Mexico by *V.M.Ponce and H.L. Hernandez*

The author had highlighted the impact of excessive ground water pumping in the Ojos-Negros Valley, Baja, California, Mexico which is basically an agricultural economy for the last three decades. The excessive ground water pumping had resulted in lowering of ground water table in the region thereby involving high pumping cost. The locals are shifting from agriculture due to low profit margins (high pumping cost for ground water) and renters have started making business due to greater funds availability with them. The renters are deriving higher margins. The author suggestions that this drain needs to be curtailed through aquifer regulation for sustainable use of water.

The locals are finding it increasingly difficult to cultivate the land and there is an urgent need for controlling such economy.

14. Emerging Information Technology for sustainable water resources development in India by *H. Chowdhary, S.K.Jain and H.J.M. Ogink*

The authors have drawn the attention of poor hydrological data availability in the country. Data are being collected by several Central and State agencies. No proper data support and retrieval system exists in the country. This aspect is being debated by one and all and the authors felt that the Information Technology can help in this direction. World Bank assisted hydrology project in the country is making a break through in this direction in eight States. It will ensure an up-to date hydrological database and improved / realistic information on hydrology of the area.

The advent of Information Technology and well designed comprehensive hydrological linked geographical database if made available will result in improvement and efficiency of the water sector through easy availability of data.

15. Hydrological Characteristics of arid zone drainage basins in Western Rajasthan, India by *M.A. Khan and V.P. Gupta.*

The paper indicates the findings of the studies by the authors in the arid zone drainage basin in western Rajasthan. The authors have developed empirical formulae based on their studies in nine sub- basins for assessment of run off, peak flow, sediment flow and opined that reasonable accurate results can be obtained for ungauged arid basins.

It is felt that more detailed studies are needed in other arid zone before being adopted on regular basis.

**16. Hydrological Modelling of a Major Irrigation Command using MIKE SHE by
*Ms. M.L. Sreevidya, A.K. Mishra, R. Singh and N.S. Raghuvanshi***

The authors have used MIKE SHE model to stimulate the hydrological canal command of right bank process in the Kangsabati irrigation project, West Bengal. The authors have validated the model based on pre monsoon ground water levels and stimulated the post monsoon ground water levels through the model. The observed and stimulated values of ground water table depths are in close agreement. The result of sensitivity analysis revealed that hydraulic conductivity (Ks) is more sensitive than the exponent component (n) in the RBMC, Kangsabati command.

17. Optimal Estimation of Storage-release alternatives for management of surface waterlogged area by *A.K. Lohani, C. Chatterjee, N.C. Ghosh and Rakesh Kumar*

The paper by the authors is the outcome of the study undertaken by NIH, Roorkee on surface waterlogging over a depressed land in Bihar known as Mokama Group of Tals. Non-linear optimisation model has been used to assess and maximise the cultivable area in the Tal so as to yield maximum benefits and also to reduce waterlogging. The authors through the use of optimisation model had inferred that restricting the monsoon inflow into the Tal area by utilising the water upstream of the Tal for agriculture, it may be possible to reduce the waterlogged area up to 87%. The results of the model are useful for decision making and may help in reducing the menace of waterlogging in the region.

**18. Planning for irrigation using Reservoir yield and crop planning models by
*Tamrat W. Gebriel, W. Mariam and D.K. vastava***

The authors have demonstrated through a case study that yield models – stochastic linear screening models could be useful for realistic assessment (optimal) of reservoir yield with a given storage capacity. The optimal reservoir yield thus can be used for devising/ planning an optimal cropping pattern so as to maximise the net returns. The results of the study by the authors revealed that 75% dependable annual reservoir yield with an assured supply of 80% annual reservoir yield during failure years works better in Morand reservoir of Madhya Pradesh.

The yield models thus provide reasonable estimate of annual reservoir yield for planning purposes from a reservoir project for initial screening.

19. Spatial and Temporal variation of rainfall and rainwater harvesting potential for Kutch district – A case study by *Sh. M.K. Khandelwal, Sh. K.C.B. Raju, Sh. M.V. Kanzariya and Sh. A.M. Sheikh*

The authors in their paper have analysed the rainfall data of 25 years for 9 talukas of Kutch district of Gujarat. The analysis includes (rainfall) storm duration varying from 1-7 days and have concluded that on an average, in Kutch region, two dry spells usually

during monsoon. The rainfall surplus from 3-4 wet spells occurring during monsoon could be harvested up to 523 mm and can be made available for use subsequently.

20. Water resources and Water Management in North Western Indian Himalayas
by T.N. Dhar

The author through his paper has highlighted the problem of Northwestern Indian Himalayas and had suggested issues that need to be addressed urgently. It includes storing of water in soil profile vegetative cover, trees, aquifers and user participation at micro level for water harvesting etc., to improve the well being of poor people residing in the Himalayas.