SESSION-10 :

GROUNDWATER MANAGEMENT, QUALITY, CONJUNCTIVE USE

14th National Symposium on Hydrology with focal theme on "Management of Water Resources under Drought Situation", 21-22 December, 2010, Organized by National Institute of Hydrology, Roorkee and Malaviya National Institute of Technology, Jaipur at Jaipur, Rajasthan

GROUND WATER QUALITY ASSESSMENT AND IDENTIFICATION OF SOURCE OF POLLUTION IN THE METROPOLITAN CITY OF VADODARA, GUJARAT, INDIA

M K Sharma and V K Choubey
National Institute of Hydrology, Roorkee – 247 667, Uttarakhand, India

ABSTRACT

Metropolitan city of Vadodara is 16th largest town in India (population wise) and the third in the state of Gujarat. The city witnessed a sudden spurt in industrial activity with the establishment of Gujarat Refinery, Indian Oil Corporation. It is the industrial nucleas of the Gujarat State. Vadodara is no exception the city and the surrounding areas are today humming with industrial activity. Vadodara is no exception the city and the surrounding areas are today humming with industrial activity. The mixture of different kind of untreated/partially treated/treated industrial waste is being discharged through a number of drains passing in and the city. Further, the surface runoff caused by rainfall and spills from loading of oil tankers also contribute to the ground water contamination. In the present study, the ground water samples from in and around city and wastewater samples from drains were collected and analysed for physico-chemical parameters. The physico-chemical data of ground water was processed as per BIS and WHO standards to examine the suitability of ground water for drinking purpose. The degraded water quality zones and specific parameters not conforming to water quality standards were identified. Chemical characteristics of different drains/rivers were also studied. Correlation between chemical characteristics of different drains/Rivers and ground water was evaluated and chemographs were developed for different seasons for the identification of pollution source. From chemographs, it was observed that Gujarat Refinery drain, GIDC drain and rivers Jambua and Vishwamitri have direct proportionate influence over the groundwater quality at all sampling locations in terms of bicarbonate, chloride, sulfate and nitrate concentration. The effect is also observed for sodium concentration. Further chemistry of the ground water of the study is mainly governed by the chemistry of rivers Jambua and Vishwamitri.

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STATISTICAL ANALYSIS OF GROUNDWATER QUALITY DATA OF HARIDWAR AND DEHRADUN DISTRICTS

Omkar Singh, M.K. Sharma, V.K. Choubey, R.D.Singh
National Institute of Hydrology,
Jal Vigyan Bhawan, Roorkee-247 667, India

ABSTRACT

In general, the quality of ground water being considered good in comparison to surface water resources. However, this fact has rapidly changed upon getting deterioration in ground water quality at large due to enormous pressure on land & water resources coupled with the population explosion, rapid industrialization without adequate treatment facilities and agricultural revolution promoting use of chemical fertilizers and pesticides for growing food & forage from high yielding varieties. Therefore, the increasing threat to groundwater quality due to human activities has become a matter of great concern. A water quality management program requires information including the existence of water quality, and criteria for the present and planned uses. In many instances, this information can be generated only from a record of long term water quality data and past experience of use of water of known quality for various purposes. Since, the regular water quality investigations may not possible due to higher cost of sampling and analysis. The base line studies data of the area could be used to study the pattern of water quality in the area. Based on the proposed program, only those influencing parameters may be monitored and which become cost effective also. In the present study, a statistical method (principal components analysis) has been applied to find inter-relationship between different water quality variables affecting the water quality pattern using previously monitored ground water quality data.

In the present paper, ground water quality data pertaining to shallow open wells as monitored by National Institute of Hydrology under the studies entitled "Groundwater Quality Monitoring and Evaluation in District Hardwar (CS-AR 198)" and "Groundwater Quality Evaluation in Doon Valley (CS/AR 10"has been utilized for statistical analysis. The Principal Component Analysis (PCA) of ground water quality of Haridwar District has shown that first principal component (weight: 54.6%) could be designated as salinity Component, the second principal component (weight: 15.6%) as phosphate component, the third principal component (weight: 9.7%) as pH component, respectively. The majority of ground water samples in both the Districts were reportedly found to represent Calcium-Magnesium-Bicarbonate hydrochemical facies. However, U.S. Salinity classification has shown majority of water samples of Haridwar District under high salinity low SAR and of Dehradun under low to medium salinity & low SAR categories during pre monsoon period. Various anthropogenic activities including industrialization are emerging as great risk of ground water quality deterioration in this area. Further, investigations are needed to assess possible impacts of anthropogenic activities including industrialization on ground water quality for proper planning and management of ground water resources of this area.

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INTEGRATED WATER RESOURCES MANAGEMENT- A SPECIAL EMPHASIS ON DRINKING WATER QUALITY AND HEALTH ISSUES

A. B. Gupta,
Civil Engineering, Malaviya National Institute of Technology Jaipur,
Jaipur 302017, India.

ABSTRACT

The seventh Millennium Development Goal (MDG) aims to ensure environmental sustainability, with its first target being the integration of principles of sustainable development into country's policies and programs and the reversal of the loss of environmental resources. With respect to water resources, the World Summit on Sustainable Development at Johannesburg in 2003, resolved to include the formulation of national plans for Integrated Water Resources Management (IWRM) and for water use efficiency in this target. IWRM has a special component on drinking water quality. As per a United Nations analysis, clean, safe water can be brought to the 1.4 billion people around the world without it for as little as $50 per person, which can prevent many of the 3.35 billion cases of illness and 5.3 million deaths caused each year [1]. Generally the attention of the public health engineers is focused on diseases caused either directly by infection through the consumption of contaminated water or indirectly by disease-carrying organisms (vectors), such as mosquitoes, that breed in water. The ecology of typical arid areas like Rajasthan is normally better off in terms of microbiological quality of drinking water as the groundwater, which is the major source of drinking water, is deep and hence nature's protection is available for eliminating biological contamination. However, deep water table gives rise to different issues of water quality, which are related to its chemical contamination. This paper intends to describe two specific issues, namely, fluorosis and nitrate toxicity related to water qualities, which are of high relevance to Rajasthan. The occurrence of these chemicals in drinking water sources; their impact on human health; and management of these problems with inputs at appropriate technological and individual levels have been described in details.

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TIME SERIES MODELING OF WATER TABLE FLUCTUATIONS IN A WATERSHED

Sanjay Kumar, L.N. Thakural, Rakesh Kumar, D.S. Rathore, R. P. Pandey
National Institute of Hydrology, Roorkee

ABSTRACT

The excessive use of groundwater for domestic, industrial and agricultural needs has resulted in increased fluctuations of water table in many watersheds. It is therefore important to model groundwater fluctuations for better planning, development and management of groundwater resources in these areas. In the study, approach based on time series analysis has been used to model the water table fluctuations of observational wells in a watershed of Bhima basin. At each well site four observations are available for each year i.e. two observations for pre-monsoon and two for post-monsoon. These observations are available for a period of about five years for each site. The Box-Jenkins univariate models have been developed for the well sites, wherein the water table fluctuations are modeled as a function of its past values only.

The study performs a preliminary examination of data for each site initially. The time series plots for each site show seasonal patterns in data. The Autocorrelation Function (ACF's) and Partial Autocorrelation Function (PACF's) are evaluated for each site. Based on ACF's and PACF's the structure of potential time series has been identified for each well site. The model parameters have been estimated using least squares method. The diagnostic checks have been performed on the developed models to check their adequacy. The fitted and observed values of water table fluctuations and their errors are plotted. Forecasted values of water table fluctuations and their 80% confidence limits are also shown. The results show that Box-Jenkins univariate model perform reasonably well and can provide an alternative method for modeling water table fluctuations in the study area. However, it might be possible to model the variation in water table fluctuations in a better way if information about other independent variables such as rainfall, infiltration, groundwater withdrawal etc. is available.

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CONJUNCTIVE USE OF SURFACE AND GROUND WATER IN DISTRICT SAHARANPUR OF UTTAR PRADESH

Shiv Kumar, Yogendra Kumar, H.C. Sharma
Irrigation & Drainage Engineering, College of Technology
G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand

ABSTRACT

The ground water inventory for district Saharanpur was prepared for the year 2007 to obtain the stage of ground water development in the district. To develop the ground water inventory, the recharge and discharge components were estimated. The cropping pattern was suggested on the basis of net profit to the farmers with the constraints of water availability and cultivable land, the water requirement of the major crops has been estimated using the data of crop coefficient and potential evapotranspiration. The cropping pattern in district Saharanpur has been suggested on the basis of maximum net profit and net profit was calculated as: Net profit = Y × (MSP - C_p) × A ,Where, Y = Yield of the above crop in quintal/hectare, MSP = Minimum support price of the crops in Rs/quintal, C_P = Cost of production of the crops in Rs. /quintal, A = Area under crop (hectare). Objective function was maximize as:Max $Z=\sum_{i=1}^{n}(yi.bi-ci)xi$, Where, Z = total net return from the study area in Rs, yi = yield of i^{th} crop in quintal/hectare, bi = Sale price of i^{th} crop in Rs/quintal, ci = Cost of cultivation of i^{th} crop in Rs/hectare, xi = Area under i^{th} crop in hectare. Aggregate irrigation water requirement for various crops grown should not exceed the available canal water supply and ground water recharge therefore, $\sum_{i=1}^{n} Wi.xi \leq Wt + GWt$ Where, I = irrigation requirement of i^{th} crop in a month (m),xi = Area under i^{th} crop (ha),Wt = total water available from canal (ha-m),GWt = total ground water available for irrigation in study area (ha-m). The surface water availability was calculated from the roster of canal network in the district Saharanpur. The surface water from canal system and net recharge to ground water was considered as available water

The ground water inventory of district Saharanpur for the year 2007 revealed that overall stage of development of district Saharanpur as a whole was 35.36 per cent, under safe category of ground water utilization stage.The study of development stage in district Saharanpur also revealed that the blocks Sadauli Qadeem, Ballia Kheri, Muzaffarabad, Sarsawan, Rampur Maniharan, Nanauta, Nagal, Gangoh and Puwarka of the district were under safe category of ground water utilization while Deoband and Nakur were under critical and semi critical category respectively. The existing cropping intensity of the crop in district Saharanpur was 116 percent which has been found to be increased to 188 percent under the proposed scheme without use of ground water recharge and 132 percent when fifty per cent of ground water recharge was considered to be used along with the surface water. The total profit in the district increased to Rs. 809.52crores under the proposed cropping pattern as compared to a net profit of Rs 634.44 crores under the existing cropping pattern in the district. Thus the

profit under the proposed cropping pattern increased by Rs. 175.08 crores i.e. an increase of 27.6 per cent in net profit.

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ASSESSMENT OF GROUNDWATER RESOURCES OF PUBLIC PLACES AT MORADABAD, UTTAR PRADESH AND EFFECT OF MONSOON ON QUALITY

Gaurav Kumar Rastogi
Department of Applied Sciences & Humanities,
Sunderdeep Engineering College, Ghaziabad-201001, India

D.K.Sinha
Department of Chemistry, K.G.K. (P.G.) College, Moradabad-244001, India

ABSTRACT

Pollution of environment is one of the most horrible ecological crises to which we are subjected because of population explosion and tremendous industrialization. Comprising over 70% of the earth's surface water is undoubtedly the most precious natural resource that exists on our planet without the seemingly invaluable compound comprised of hydrogen and oxygen, life on earth would be non-existent. It is essential for everything on our planet to grow and prosper. Although, we as humans recognize this fact, we disregard it by polluting it. Subsequently we are slowly but surely harming our planet to the point where organisms are dieing at a very alarming rate. In addition to this water has become greatly affected as is our ability to use water for recreation purposes. In order to combat water pollution, we must understand the problem and become part of the solution.

Five different ground water samples for pre-monsoon and after onset of monsoon were collected from different India Mark II hand pumps of extensively used different public places at Moradabad district of Uttar Pradesh. Samples were collected and analysed quantitatively for both the period following standard method and procedures of sampling and estimation. Ground water quality with reference to estimated physico-chemical parameters was found to be poor at almost all the sites of study. The water is alkaline, hard or very hard and full of chemical contaminants and contaminants are above the recommended drinking water standard. Ground water shows some improvement after onset of monsoon, however, water quality is still very poor. People dependent on this water are prone to health hazards of polluted drinking water and water quality management is the need of hour.

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GROUND WATER POLLUTION AT PALI-HISTORICAL PERCEPTIVE AND FUTURE RESEARCH NEEDS

Vijai Singhal
Rajasthan Pollution Control Board, Jaipur.

Rohit Goyal, Sumit Khandelwal, Nivedita Kaul, A.B. Gupta
Malaviya National Institute of Technology, Jaipur

ABSTRACT

Pali has been identified as one of the most polluted areas in the country because of indiscriminate disposal of the industrial effluents generated from the textile industries. The industrial effluent contains high Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Dissolved Solids (TDS) resulting into pollution of the ground water in parts of Pali, Jodhpur and Jalore districts. Due to disposal of untreated/partially treated effluents in to river Bandi, the area has witnessed rise in total dissolve solids, Chlorides and Sodium which has rendered the ground water unfit for potable use. Many isolated studies have been carried out by different organizations from time to time which have been reviewed in the present paper. It is concluded that there is a need to develop ground water flow and transport model to study the fate and transport of the pollutants in and around Pali.

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A MODEL FOR CONJUNCTIVE USE OF WATER RESOURCES IN AN IRRIGATION SYSTEM

M. K. Goel
Scientist, NIH, Roorkee

ABSTRACT

Introduction of canal irrigation facilities in a command area sets in new hydrological regime with revised conditions of groundwater recharge and withdrawal. There is a need to analyze the spatial and temporal impact of such large scale water transfers on the hydrology of the region so that sustainable balance between the water availability (supply) and demands (consumption) could be achieved. If the water is not utilized as per the developed plan or if there is significant difference in the demands and supply, an imbalance is created in the ecosystem that can lead to deterioration of the system. Over-utilization of surface water, especially in the upper and middle reaches in most part of the canal commands, have given rise to deleterious effects like water logging and salinity resulting in general degradation of arable land and deterioration in crop productivity. Further, the tail-end regions often complain about the poor availability of canal water resulting in groundwater mining. Conjunctive use of canal water and groundwater can prove to be effective antidote for these problems.

To help in the scientific and rational management of irrigation water from canal and groundwater resources, a model has been developed for real-time conjunctive operation of a canal system in an irrigation command. The model is linked to GIS database for utilizing the spatially distributed data of different variables (rainfall, soil type, crop type, groundwater depth etc.) and provides the results in GIS environment for easy visualization and interpretation. The model carries out the analysis at weekly time step. Based on the irrigation demands (computed by the model), canal water availability and groundwater conditions during a week, the model allocates the surface water and groundwater while maintaining the environment. Application of the model requires real-time flow of multi-disciplinary data (like rainfall at different gauging sites, evaporation depths, groundwater depths at various observation wells, supply of water in different canal segments) to the control centre. At present, the optimization criteria adopted in the model is based on the minimum energy requirement for pumping groundwater in the canal command while also maintaining the groundwater table within permissible range. The model presents the results in form of maps which can make the general public more informed and can involve them in decision-making process. The effect of adopting various efficiency enhancement measures or other system modifications on the overall system performance can be analyzed by the model. The model will be briefly described and its application will be demonstrated for a canal command under the Madhya Ganga Canal System in U.P. State, India.

ABOUT NATIONAL INSTITUTE OF HYDROLOGY (NIH) ROORKEE

The National Institute of Hydrology was established in 1978 as an autonomous organisation under Ministry of Water Resources, Govt. of India, to conduct basic, applied and strategic research in the field of hydrology and water resources development. The Institute is located at Roorkee, District Haridwar, Uttarakhand. Main objectives of the Institute is to undertake, aid, promote and coordinate systematic and scientific work on all aspects of hydrology and to cooperate and collaborate with other national and international organizations inthe field of hydrology. Please visit website: http://www.nih.ernet.in for more details.

ABOUT MNIT, JAIPUR

The Malaviya Regional Engineering College, Jaipur was established in 1963 as a joint venture of the Government of India and the Government of Rajasthan. It is spread over 325 acres of lush greenery, the campus of the Institute enthralls and inspires students for high learning. Institute was granted the status of a Malaviya National Institute of Technology (MNIT) on June 26, 2002. The Institute is flourishing under the dynamic leadership of Shri Mukul Kasliwal, Chairman S. Kumars Ltd., who is Hon'ble Chairman of Board of Governors and Prof. P.K. Saxena, Director MNIT Jaipur. Please visit website: http://www.mnit.ac.in/ for more details.

Printed by : R.K. Printers, Roorkee # 9897276995