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WATER SECURITY & SUSTAINABLE GROWTH
23rd ~25th AUGUST 2016, ISLAMABAD

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Invited dignitaries

Professor Ahsan Iqbal
Federal Minister
Planning, Development & Reforms
Government of Pakistan

Mr. Fazal Abass Maken
Federal Secretary
Ministry of Science & Technology
Government of Pakistan

Mr. Walid Abu Ali
Ambassador of Palestine
Islamabad, Pakistan

Mr. Jononovo Sherali
Ambassador of Tajikistan
Islamabad, Pakistan

Mr. Nisar Memon
Former Senator
Government of Pakistan

Prof. Dr. Anis Ahmad
Vice Chancellor
Riphah International University,
Islamabad, Pakistan

Prof. Dr. Nasser Ali Khan
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IG Forest
Ministry of Climate Change
Government of Pakistan
Mr. Ali Salman
Executive Director
PRIME, Pakistan

Mr. Naseer Gilani
Chief
Water Planning Commission of Pakistan
Government of Pakistan

International Guest Speakers

Ms. Dena Marshall JD
Cert. Water Conflict Management Advisor,
Oregon State University, USA

Professor Dr. Jalaluddin Qureshi
Professor of Geology, Texas Southren University (TSU)
President / CEO
International Water Saver Environmental Services (Iwses)
USA

Professor Dr. Sami ullah Bhat
Limnology & Ecology Professor
University of Srinagar, Kashmir

Dr. Asif Saeed Khan,
University of Auckland
New Zealand

INAUGURAL COMMENTS

Mr. Ahsan Iqbal
Federal Minister
Planning, Development & Reforms
Government of Pakistan

Water is the key element for the socio-economic development of any country. This is not only the challenge of Pakistan it's a challenge of whole planet as well. Our food, energy and other life aspect directly revolve around water. We should develop strategies on all issues as we highlighted in vision 2025. There should be trice collaborative model of government, private sector and academia, where government responsible to enable working environment, private sector work for mobilization of resources and academia use to provide research. We should focus on "K to D model", which is "knowing to Doing".

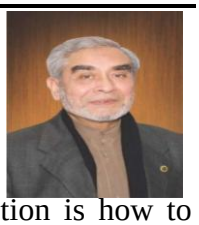
Mr. Fazal Abass Makan
Federal Secretary
Ministry of Science & Technology
Government of Pakistan

He said we are living in age of technology development, which has enhances freedom and more towards crossing different frontiers, therefore it all requires a sustainable development. The important challenge of this era is now sustainable development issue. Water is now more polluted as past due to this rapid technological development, around water Pakistan is also lacking in water cleanliness and other related issues. We can say it as the vulnerable position a per climate change aspect. He mentioned that water policy draft is being prepared. He assures to incorporate the recommendations of the conference to integrate them in water policy.

Prof. Dr. Nasser Ali Khan
Vice Chancellor
University of Haripur
Khyber-Pakhtunkhwa
Pakistan

He presented statistics regarding growth ratio of different countries. He mentioned that 80% of the population lived below poverty line in world. In 1960, South Korea GDP was 1000$ and now after concrete planning it is 37,000$, while Pakistan GDP is 1300$ and still struggling for more. In 1960 the combine export of Philippine, Malaysia, Thailand and Singapore was less than Pakistan but now they have more than it. South Korea has 98% access to education as compare to Pakistan having 8% population has accesses to education. The issue is not the scarcity of resources; it's the issue of scarcity of planning in Pakistan in every aspect, including water related issues. Water security is directly related to food security, so there is dire need to develop public awareness through dialogue and present conference will be a milestone for this cause.

Dr. Anis Amhad
Vice Chancellor
Riphah International University
Islamabad



He said water management is not a matter of academicians; however the question is how to change the mind set of society. We have to filter down these concepts regarding the use of water by a lay man or society. This mind set can be done only if seriousness shown in this aspect. It's a matter of commitment. We must have simple and native solution for these issues as societies can easily accept the applicable solutions rather than to adopt other cultures solutions. We should have water conservation solutions projects in our universities. He pointed out the research funding deficiency in Pakistan which is not appropriate as per need. Universities Research deal with the national requirement first. He said we should have clear vision as a nation. We are unable to explore the vision of Mr. Jinnah due to the various political and social issues. We should develop a national vision as where we want to see the graduates of Pakistan for upcoming years, we have not framework for the future of students. He said funds can be generated if we have solid ideas.

Mr. Nisar Memon
Former Senator
Government of Pakistan

He said Pakistan is a custodian of 7500 glaciers and river Indus, currently we have big challenge regarding climate change and we must view sustainability as a problem of science, engineering, or economics as well as need and future perspective. A Comprehensive consensus oriented National Water Policy is the need of time to pursue an effective water strategy considering climate change factor which is a serious threat to Pakistan's water supply system. Water crisis is a major issue of Palestine and Middle East now days. In Palestine, 1 liter water is available to citizens as compare to 70 liter water is available for an Israeli citizen. Jordon, Syria, Gulf and Lebanon are facing same water crisis which may lead towards future war.

Dr. Muhammad Ashraf
Chariman PCRWR,
Islamabad, Pakistan

He presented major water issues as Water shortage, Recurring floods (2010, 2011, 2014) ≈ 90 MAF, Inadequate water harvesting and storage facilities, Reduction in storages capacities of the existing reservoirs due to sedimentation (0.2 MAF/year), Low system efficiency (less than 40%), Conventional methods of irrigation: unlevelled basins, improper size of furrows and Low land and water productivity

List of Abstracts

Radioactive health hazards from drinking water sources of Haripur, Pakistan.

F. Khan: Department of Geology, University of Haripur, KPK- Pakistan.

Abstract

Radon is a naturally occurring radioactive alpha (α) particle emitting gas, produced as a result of the alpha-decay of 226Ra which itself belongs to the decay series of 238U. Radon gas is found anywhere in soil, air and water. The level of radon varies in different types of water (spring, borehole and lake water). Monitoring of radon concentration in natural water is very important both for assessing radon related health hazards in a region as well as for getting important geological information including discovery of hidden uranium and hydrocarbon deposits. The present survey was carried out in Haripur region, Khyber Pukhtun Khawa Province(KPK), Pakistan. The measurements are made on Pylon system that is based on the radon gas measurement with Lucas cell. A total 59 samples were collected which comprise of 14, 30 and 15 of surface, borehole and spring water respectively. From 59 samples in the equilibrium state between radon and its progenies, the level of concentration is measured. The result show that the radon concentrations are ranging from 5.8 t0 15.3 kBq/m3, from 9.5 to 25.4 kBq/m3 , from 4.5 to 10.2 kBq/m3 in spring, bore and surface water respectively. The respective mean values in these sources are 9.4±2.7 kBq/m3, 16.3± 4.8 kBq/m3, 6.7±1.8 kBq/m3. The average for all types of drinking water is 12.3±3.2 kBq/m3. The average value in all types of drinking water is high than the safe limit recommended by various agencies, so proper precautions must be taken before to use the water for drinking of the area.

Keywords: Radon; Radioactivity; Equilibrium; Geological Characteristics.

Comparative status of water quantity and quality in relation to vegetation cover in Himalayan Moist Temperate Forests of Galliyat-Pakistan

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Abstract

This paper examines impacts of deforestation on water quality and quantity in and around Ayubia National Park-Galliyat- Pakistan. Streams from three vegetation zones namely HDZ (high density vegetation zones, completely protected, Ayubia National Park), MDZ (moderate density vegetation zones, reserve forest-partially protected) and LDZ (Low density vegetation zones, Guzara forest-unprotected forest) were selected for comparative analysis. Altitude, slope and aspects (southern and northern) of three sites were kept constant whereas deforestation was taken as the only variable. Significant differences in discharge rates of various streams in relation to vegetation cover were observed during 2010-11. Average discharge rates determined during winter and summer of 2010-11were found highest for HDZ streams [QBR (0.011 m3/sec and 0. 1241 m3/sec) and QAR (0.0128 m3/sec and 0.1287 m3/sec)] followed by MDZ streams [QBR (0.0106 m3/sec and 0. 1218 m3/sec) and QAR (0.0126 m3/sec and 0.1284 m3/sec)] and lowest [QBR (0.0045 m3/sec and 0.0157 m3/sec) and QAR (0.0140 m3/sec and 0.01284 m3/sec)] for LDZ streams. Similarly, pre and post rainfall variations in discharge rates was recorded highest in LDZ (0.06 m3/sec), moderate in MDZ (0.0045 m3/sec) and lowest in HDZ (0.0032 m3/sec). Analysis of variance at 0.05 significant level for water quality parameter like pH, NO2, NO3 revealed insignificant variations in relation to vegetation cover where as significant variations for alkalinity [HDZ (67 mg/l), MDZ (81 mg/l) and LDZ (98 mg/l)], total dissolved solids[HDZ (233 ppm), MDZ (450 ppm), LDZ (528 ppm)], conductivity [HDZ (57 µs/cm, LDZ (72 µs/cm), LDZ (94 µs/cm)+ and hardness *HDZ (71.5 mg/l), MDZ (111.5 mg/l), LDZ (297 mg/l)] were observed. The study concluded that vegetation cover has close correlation with water and deforestation has significantly influenced water quantity and quality in the study area.

Keywords: Deforestation, Water Quantity, Water Quality, Vegetation zone, Watershed.

Impact of Climate Change on Waterborne Diseases

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Abstract

Climate change is a reality. The data from the last two decades indicates that there is a rise in temperature of + 0.10 ± 0.05 per decade in lowest 8 kilometer of atmosphere. This rise in temperature has manifested by change in global weather pattern. There is increase in floods, drought and heavy storms. These changes have not only challenged the availability but also safety of water. The likelihood of water borne diseases will be enhanced. The continental type of climate of Pakistan, diverse demography and poor infrastructure may change the epidemiology of water borne diseases.

Keywords: Climate Change, Waterborne Diseases, Environmental Changes

High Incidence of Helicobacter pylori infection in Haripur city: Contaminated Drinking Water as Potential Source of Transmission.

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Abstract

Helicobacter pylori (*H.pylori*) infection is probably the important etiological factor mostly associated with the development of human peptic ulcer disease and gastric cancers which is quite high in developing countries like Pakistan. This study was proposed to investigate the sero-epidemiological pattern and its association with water source and sanitation system in Haripur city of Khyber Pakhtunkhwa province. In this cross-sectional investigation was carried out with those who were willing to enroll in this study. Blood samples and data of age, gender, source of drinking water were collected from enrolled subject visited gastro outpatient department of District Headquarter Hospital Haripur after taking informed consent. Anti-*H. pylori* antibodies were detected in serum isolates of all suspects by using standard diagnostic procedure of antigen bounded immune-chromatographic technique with strict quality control procedure. An overall sero-prevalence of *H. pylori* infection was 542 (54 %) in 1012 subjects (mean age, 41.3 ± 15.1 years). This infection was found quite higher in male subjects with sero-positivity of 338 (62 %) and 204 (38 %) in females. Among all age groups, maximum positive cases of 26 % were observed in 31-40 years. High incidence of *H. pylori* infection (52 %) was observed in patients using Tap water as a source of drinking water or for household use [OR=0.535 (95% CI) =0.422-0.678, p values =<0.05]. In case those subjects who use stream water, incidence rate was 50 % [OR=1.028 (95% CI) =1.028-0.816, p values =0.408]. Subjects use well water, *H. pylori* was 48 % (44.31-52.43). Comparatively, low infection was observed in individual who use boring water 35 % [OR=0.378 (95% CI) =0.298-0.479, p values =<0.05]. In conclusive, the current study revealed high rate of infection in subject using tape water for drinking with *H. pylori* infection but there are many other risk factors associated with this bacterial infection. So this study suggest that implementation of proper water purification system must be ensured and proper awareness program for use of boiled water should be lunched in Haripur district in order to decrease the incidence and of *H. pylori* transmission.

Keywords: Helicobacter Pylori, Seroepidemiology, Haripur, Pakistan.

Assessment of Land Use pattern in District Abbottabad through Geographic Information System and Remote Sensing (1990 to 2015)

Sajid Ali[1], Zia Ur Rahman[1], Tariq Khan[1], Salman Khan[1], Wajid Ali[2] & Arshad Iqbal[3]
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Abstract

The research was conducted to assess and analyze the degree and rate of changes in land use pattern at district Abbottabad between 1990 and 2015 using Geographic Information System (GIS) and Remote Sensing (RS). Freely available Land Sat 5 TM and Land Sat 8 ETM + imagery for the same season was acquired from USGS GLOVIS for the years 1990 and 2015 respectively. The selection of the images was based on availability and quality of the data. The images were subjected to Band Rationing (i.e. NDVI, NDSI), geometric correction and Tasseled Cap Transformation for good results and ease in classification. The images were classified into six land cover-land use classes i.e. Agricultural land, Barren land, Range land (all grazing land including, shrub lands and grass lands), Built-up land, Forest cover/land and water bodies. The results of the study suggest significant decrease in barren land (18%) and Agricultural land (10%), on the contrary significant increase in forest cover (12%), Range land (8%) and Built-up area (8%) with no significant changes in water bodies. The decrease in the barren land and agriculture with consequent increase in forest cover and built-up area could be linked with mass plantation and the increase in population of the study area. Another important factor is strict policy implementation of Abbottabad forest division with mandate for environmental conservation. The 2005 earth quake and establishment of number of well reputed educational institutions attracted communities from most parts of the KP to study area. Further studies are needed to establish a link between the decreasing trend observed in Agriculture and increasing population. Abbottabad is an ideal place for conducting such studies due to its diversified land use; therefore, it is recommended that further studies with high resolution imageries on ecosystem level shall be carried out in the area.

Keywords: Land Use Change, Geographic Information System & Remote Sensing

Dual role of algae: algal biomass production and waste water treatment

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Abstract

Waste water treatment is dire need to ensure water security for the growing population. Algal biomass determines the survival efficiency in waste water while using them as potential candidate for treatment of waste water. Texile industries are leading producers of waste water bear very large amounts of total N and P concentration. Waste water from these texile industries is ideally suited for growth of algae. A laboratory experiment was conducted to investigate the effect of texile waste water on algal growth compared with Bristol medium. Four different types of algal samples from well surface, well depth, fresh water and well side were grown in Tape water and 5, 10, 15, 20% textile industry waste water for production of algal biomass and also their potential for waste water treatment. Results showed that waste water from textile industry had significant impact on growth of algae in terms of algal biomass. The highest increase in algal growth was observed for 20% dilution for well side algae that was 35% followed by 33% biomass by well surface algae grown in 15% diluted water compared to control. The biomass from well depth algae in Bristol media was 31% more compared to control. Minimum algal growth in terms of biomass productivity of all four types of algae was observed at 0 h while maximum was at 144 h. No significant difference was observed in algal biomass at 24, 48, 72, 96 and 120 hours. Based on results obtained suggested that algal biomass proved to be good player for the treatment of textile waste water and for bioethanol production.

Keywords: Algal biomass, waste water treatment, water security, bioethanol prodcution

Performance evaluation of FAB and BSR Sewage Treatment Plant Technologies around Dal Lake, Kashmir Valley

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Abstract

Wastewater is a major burden for water bodies and improper disposal of sewage leads to oxygen demand, increased nutrient concentration and promotion of toxic algal blooms leading to a destabilized aquatic ecosystem. The entry of the untreated sewage discharged from cities and towns is the primary cause for degradation of our aquatic environs. A workable solution to this issue not only requires bridging the ever widening gap between sewage generation and treatment capacity but also calls for continuous monitoring of the efficiency of sewage treatment facility technologies like Fluidized Aerobic Bed (FAB) and Bed Sequence reactor (BSR) to divert the treated sewage after meeting the prescribed discharge standards. By and large, the State Governments in India have failed to recognize its importance during the last 40 years. It is a matter of grave concern that due attention is not paid to operation, maintenance and evaluation of existing sewage treatment facilities by State Governments and as a result, 45 of the 115 sewage treatment plants studied by Central Pollution Control Board failed to achieve the prescribed discharge standards. Keeping the above mentioned scenario under consideration, it was thought worthwhile to evaluate the performance of these waste treatment technologies in order to save the receiving aquatic environs. Since the famous Dal lake in the Kashmir Valley faces the brunt of all this sewage, there is an urgent need to continuously monitor the efficiency of such treatment facilities placed around the Dal lake. Very recently two attempts in this direction were carried out during 2013 focusing on inlet and outlet characteristics of sewage Treatment facility and 2015 with emphasis on removal efficiency at different stages ranging from inlet, FAB- 1, FAB-2, Clarifier and outlet. A perusal of the data from 2013 study on four STPs revealed the order of reduction/removal efficiency in the order of BOD5>COD>Conductivity. Raw sewage showed insignificant ($p>0.05$) variation in some of the physico-chemical features and microbial load in these STPs. Similarly, effluent also showed insignificant ($p>0.05$) variation in some of the physico-chemical features and microbial load, except conductivity which was found to be removed relatively at better efficiency. In the recent study focused on only one STP at Hazratbal but sampling being conducted at different stages like inlet, FAB- 1, FAB-2, Clarifier and outlet, it was found that the parameters like conductivity, total hardness and alkalinity remain largely unaffected while passing from inlet to outlet in the treatment facility. The dissolved oxygen concentrations displayed the improvement from the concentration of 1.74mg/L at inlet to a level of 4.90mg/L at outlet. Further, it was observed that percentage reduction of ammonia and nitrate was about 48.20% and 54.29% again indicating the poor performance. Phosphorus which is the key limiting factor for triggering havoc in the form of eutrophication in the aquatic system was found to show very less percentage reductions of about only 24.30% for ortho- phosphorus and 20.45% for total phosphorus.

A perusal of data on BOD5 reveals the removal efficiency of 27.68% wherein the BOD5 level at inlet was reduced from 62.85mg/L to about 45.45mg/L which is exceeding the standard of 30mg/L recommended for receiving inland waters. Further, BOD5 trend had witnessed a decreasing trend in the removal efficiency during the months of January and February (winter) possibly due to the decline in the microbial populations due to low temperatures. Although the removal efficiency in terms of COD values is almost within the permissible limits of 250mg/ L recommended for receiving inland waters yet the removal efficiency was found to be about only 45.66% with a highest concentration of 472mg/L being reported at inlet which went to a concentration of about 256.50mg/L while being treated through various stages of treatment.

Keywords: Sewage, Performance evaluation, aquatic environs, Kashmir Valley

Assessment of climatic variation and its impacts on water resources of Pothwar region

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Abstract

Water resources of Pakistan play an important role in its development. Arid regions of the country need proper management for the water resources as climatic changes are bringing severe problems for their sustainability .Pothwar area is the most essential in this regard. The constantly rising temperature has adversely impacted the rainfall patterns, water quality, quantity and ground water aquifer depletion problems. A constant monitoring of the water resources of the Pothwar area is carried out and the impact of climatic change on these resources has been visualized. 30 years data (1981 - 2010) of precipitation, temperature and discharge from various observatories across the Pothwar Plateau was collected from several departments. The outcomes were obtained by analyzing the data graphically as well as statistically by incorporating different software such as Stata 13.0. An increase in temperature during the past decade is observed at different observatories. The precipitations trends are irregular representing both the scenarios of flash floods and the droughts. The discharge of River Haro and River Soan has been decreased throughout the last decade. The impacts may be harsh on the productivity of the soil of Pothwar plateau. Generally it can be concluded temperature for the Pothwar area is rising, which is posing a threatening challenge to the future of the water resources of this area. Many modern techniques in irrigation and agriculture trends should be adopted to protect the future of the Pothwar area from future extreme situations related with the climatic changes.

Keywords: water resources, climatic variation, river discharge.

Pricing Water for Conservation and Sustainability

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Abstract

Provision of safe, clean water is considered a basic human right, which makes its commoditization seemingly unjust. However, as Segerfeldt (2005) argues, when more than a billion people lack access to clean and safe water and so many of them die due to water borne diseases, there has to be something lacking in this philosophy. Pakistan is the third most water-stressed country of the world with the fourth highest rate of water use and the highest intensity rate (the amount of water, in cubic metres, used per unit of GDP). This crisis exists not because Pakistan has a lack of natural water sources, but due to the negligence in its management. The current 'system' of provision of drinking water in Pakistan is fragmented, poorly maintained and is largely ineffective. Government constructs new water supply schemes each year, however, majority of these schemes have ended up dysfunctional soon after their commissioning – largely owing to lack of sustainability since there is no cost recovery or community ownership of these water schemes. Therefore, rational pricing for water conservation is not just an option but a necessity in a country like Pakistan. Owing to intermittent supply of water, informal water markets do exist where communities have to rely on private tankers, leaving buyers of water vulnerable to exploitation given the nature of water necessity. There is also increasing evidence that suggests that people are willing to pay more for access to safe drinking water as long as it is reliable and regularly available. In fact, at several locations across the country, people are already paying monthly charges for getting uninterrupted supply of water in their homes. The model developed by Changa Pani Programme at Bhalwal and several schemes in Chakwal under an ADB sponsored programme offer clear evidence of a strong willingness to pay in rural population. In light of these issues, this paper discusses the water crises Pakistan is currently facing and how appropriate pricing of water can avert this dreadful situation. Rational water pricing can lead to partial cost recovery which can at least ensure better management and sustainability on the suppliers end and increased water conservation on the consumers end.

Keywords: water scarcity, water conservation, water pricing, water sustainability

Socio-economic impact of drought and farmers coping strategies: Evidence from Balochistan

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Abstract

This study aims to appraise the impact of the current drought on the socio-economic condition of rural inhabitants in Balochistan. More ever, it also examines the farmers' perceptions about the causes of drought and the local adaptive practices to address the problem. The results showed that the drought has affected the economy of the area and livelihoods of rural inhabitants by adversely affecting the agriculture and livestock sectors. The average farm area under various crops and fruits enterprises and their productivity has decreased significantly. The average number of small ruminants (sheep and goats) has decreased, while the value of large animals has also dropped significantly. As a result, the income losses due to losses in agriculture & livestock are enormous, and hence have caused the losses of livelihood sources and employment. The social losses due to drought are also significant. The forced sale of household assets (land, car, jewelry etc.), malnutrition & decrease in health conditions, increase in crimes rate, migration and a rise in the miseries of women and children was also reported. Farmers reported several reasons for the current drought. To minimize the adverse effects of drought, farmers have adopted certain measures.

Keywords: Socio-economic, impact, drought, livelihood, agriculture, livestock, coping strategies

Quantitative and Qualitative Assessment and Utilization of Rain water harvesting; in District Abbottabad

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Abstract

Rooftop rainwater harvesting at household is one of the most traditional, adaptable, and sustainable alternative method. This research ensures the sustainability of Rain water harvesting system (RWHS) through assessing some water-quality parameters of collected rainwater and estimates the potential of rainwater harvesting techniques for Abbottabad district. A number of parameters were included in the analysis, pH, total dissolved solids (TDS) electric conductivities (EC), turbidity, total coliform and *E.coli* .The least square means value of pH in tanks was, first flush diverter (FFD) 5.4 in storage tank one (T1) 6.5 and in storage tank two (T2) 7.2. TDS value in FFD 338.72 PPM in T1 160.40 PPM T2 75.25PPM value of EC in FFD 55.51 µs/cm T1 92.45 T2 125.16 and the value of Turbidity in FFD 7 NTU T1 3.4 NTU T2 1.4 NTU.FFD is very effective part of rain water harvesting system for enhancing the quality of harvested water. Turbidity controlled through introduction of first flush diverter and pH value was within admissible limit (6.5 to 8) in storage tanks but little low (acidic) in FFD tanks. Flushing off the first rainfall controlled both turbidity and pH. Average rooftop area of surveyed households was 1200sft square feet. With this catchment area a household with 80% efficiency rate can collect 29603.73 gallon/year and 2466.97 gallons/month of rain water it can remove demand and supply variation. Biological contamination found mainly because of birds droppings and small insects. The value of coliform *and E.Coli* was detected in tanks. *E.Coli* value in FFD was 13.30 CFU/100ml, T1 6.602 CFU/100ml T2 4.046 CFU/100ml and coliform was detected in FFD 139.53 CFU/100ml T1 89.935 CFU/100ml and T2 60.907 CFU/100ml.The microbiological quality of the harvested stored rainwater depends upon the storage and handling process by users of the rainwater it has been observed maximum rain water user in project area did not flush FFD after every rain fall it also deteriorate the harvested rain water quality. So every user should wash / flush FFD after every rain fall .The following treatments methods are suggested for improvement the water quality, chlorination, use of filters / sand filters / biosand filters, boiling and sun lighting.

Keywords: Rain water harvesting, Rain water potential, water quality, Rainwater tanks

Water repellent coatings as a way to reduce water wastage in urban domestic applications

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Abstract

Water sustainability has come to become one of the most pressing challenges of the 21st century. Even in a water rich country like Pakistan, availability of water for domestic usage remains a luxury in most remote areas of Pakistan which is now extending even to urban populations. This paper investigates a new approach towards water sustainability through the application of water repellent coatings on porcelain and ceramic based sanitary items used in urban areas of Pakistan. Coatings were applied on cured and already installed sanitary basins and water requirement for cleaning of coated and uncoated basins was investigated. Replica technology was used to investigate porosity before application of coating in each surface coupled with Atomic Force Microscopy. Waste was introduced on both the surfaces and allowed to dry, after which water requirement to clean each surface was carefully recorded through the use of standard chemical laboratory glassware and weighing balance. A comparison has been drawn to show the efficacy of the coated surface against the uncoated surface in relation to the amount of water we can save in an urban area that can result its pertinent usage for other applications.

Keywords: water repellent coatings, water wastage, replica technology, atomic force microscopy, water sustainability

Double-edged Sword: Pakistan's Water Vulnerability and Food Security Challenges

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Abstract

Water scarcity and water-related vulnerability are widespread in Pakistan. Climate change, i.e. growing temperatures and uneven rainfall etc., is likely to increase climate variability, further aggravating water-related stresses, especially in lower income communities. The process of rapid urbanization poses additional challenges to communities and water mangers as it brings increasing competition for scarce water resources. In Pakistan, water resources are scarce and demand is rising and new water resources are difficult to develop. The paper focuses on water users' priorities and seeks an understanding of how climate changes impact food security situation in Pakistan. My research pinpoints critical water strategy engagements as an important contributor to food policy challenges in the country

Keywords: Water vulnerability, food security, water resources

Drinking water quality assessment in Vehari, Punjab Pakistan

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Abstract

The present study was carried out to evaluate the physicochemical and microbial quality of drinking water in district Vehari, Punjab, Pakistan. Forty one water samples were collected for physicochemical and microbial analysis from various areas of district Vehari. In all the sampling sites pH, phosphate (PO4), sulfate (SO4), magnesium (Mg), Iron (Fe), Copper (Cu), Zinc (Zn) and manganese (Mn) were found under World Health Organization (WHO) limits. Microbial contamination of *Eschrichia coli* and coliform were found in water samples of F-Block, D-Block and C-Block. Results revealed that the values of certain parameters like electrical conductivity (EC), total dissolved solids (TDS), sodium (Na+), Calcium (Ca2+), potassium (K+), chloride (Cl1-) and nitrate (NO3) exceeds WHO limits in various areas of district Vehari.

Keywords: Chloride; Electrical conductivity; Microbial contamination; Nitrate; Water quality,

Water borne diseases: Need for policy development

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Abstract

Access to safe drinking water is known as one of the basic human rights and essential for healthy life. Globally water related health problems are known as major concerns for researchers, health workers and policy makers. In developing countries, including Pakistan, India and others, water contamination is a major threat for population health. Various agro-chemicals, contamination through sewage and industrial effluents cause bacterial and metal concentrations to far high level from what WHO and local standards mentioned as to be safe. Consumption of such contaminated water, result in various water born diseases in humans, including gastroenteritis, dysentery, diarrhea, viral hepatitis, malaria and acute respiratory infection. Such infections results in death of thousand of infants and adults every year. There is strong need to develop and implement water related polices through government and also to bring awareness about water related issues, in masses.

Keywords: water borne diseases, water policy, contamination

Suitability of groundwater consumption for human and irrigation: a case study of Fatehjang, Punjab

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Abstract

This study was conducted to find out the quality of drinking water in the premises of wastewater from exploration and production. The main sources of drinking water are wells, pressure pumps and hand pumps in the study area. Representative water samples were collected from different sources in order to determine the heavy metal concentrations which are effected by wastewater. pH of all samples was determined on the spot. Heavy metals including chromium (Cr), manganese (Mn), cadmium (Cd), zinc (Zn), cupper (Cu), lead (Pb), nickel (Ni) and iron (Fe) were analyzed through Atomic absorption spectrophotometer (Perkin-Elmer model 700, USA). The values of heavy metal levels are above the World Health Organization (WHO) permissible limits. On the basis of findings, it is concluded that drinking water of the study area may pose a serious threat to the health of the users near exploration and production activities. Environmental Protection Agency (EPA) should banned the practice of dumping of industrial effluents on land especially in residential areas and such activities must be stopped immediately by strict imposition of national environmental quality standards.

Keywords: Wastewater, drinking water, heavy metals, Fateh Jang, exploration and production

Trans-boundary Water Sharing Issues: A Case of Chile and Bolivia

Dena Marshall

Abstract

The Silala is a clean, abundant water source running overland at approximately 200 liters per second from Quetena, Department of Potosi in the southeastern corner of Bolivia into the Antofagasta region of Chile. Chile uses the water for mining operations and a railroad. Bolivia plans to run a trout hatchery, water bottling plant and a hydroelectric project. Bolivia says the waters belong wholly to Bolivia and Chile should pay for its downstream uses; Chile says the Silala qualifies as an international river and that its use of the waters is authorized under a 1904 Treaty and subsequent 1908 Concession. On June 7, 2017 Chile initiated a lawsuit in the International Court of Justice against Bolivia over the use of the waters. The region in question is one of the most arid regions in the world, classified as a global highly water-stressed area. This short presentation will review the history of the conflict over the waters of Silala, provide an analysis of the current status of conditions between Chile and Bolivia through the Treaty of 1904, Concession of 1908, Pre-Agreement of 2009, and pending litigation in the Court of International Justice, and will offer considerations for seeking resolution in transboundary waters between two countries with a long history of strained diplomatic relations.

Keywords: Transboundary conflicts, water stress

Impact of Groundwater Recharge on Arsenic geochemistry in Lahore and Kasur Aquifers using Stable (δ D and δ 18O) Isotopic Approach

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Abstract

Environmental stable isotopes (δ D and δ 18O) and geochemical composition of groundwater in present study have been used to delineate the impact of recharge on groundwater arsenic concentrations. For this purpose, 4 different sites (Samada, Sarai Chimba, Kot Maiga and Chah Fatehwala) along the Ravi River transect had been selected. Hydro-geochemical data suggests that majority of groundwater samples from Samada and Sarai Chimba to be Na-Cl type while Kot Maiga and Chah Fatehwala had Na-HCO3 type dominant groundwater. The difference in groundwater types indicate varying paths for hydro-geochemical evolution. The ratio of (Ca + Mg) to (SO4+HCO3) indicate silicate weathering to be the major chemical process controlling groundwater chemistry. High concentrations of SO4-2 (24.7-510.8 mg/L) and NO3- (1-94 mg/L), along with high pH (7.3-8.8) and Eh (113-402 mV) values suggest prevailing oxidizing conditions within aquifer. The concentration of arsenic in groundwater for present study ranged between below detection levels (2 µg/L) to 547.76 µg/L with 59% samples exceeding WHO permissible limit (10 µg/L) and 31% having higher concentrations than national drinking quality standard (50 µg/L). The plot between δ 18O and δ 2H indicate meteoric origin of groundwater recharge with slight effect of evaporation. The values for δ 18O and δ 2H in groundwater showed variations between -9.14 to -5.51‰, and -56.57 to -39.5‰ respectively. The nonlinear trend observed between δ 18O and arsenic in low and high arsenic groundwater specify the effect of vertical and lateral mixing of groundwater within aquifers. Based on geochemical and isotopic composition of groundwater, desorption of As from metal surfaces under oxidizing conditions due to lateral inflow of groundwater is the major process controlling groundwater arsenic enrichment within study area.

Keywords: River Ravi, Groundwater evolution, Arsenic, Stable Isotopes

Evalvation of drinking water quality and sanitation in rural areas of district swat

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Abstract

The study was conducted in rural areas of District Swat. The aim of study was to evaluate the drinking water quality and sanitation of the study area. Representative water samples were collected from four union councils of Tehsil Babuzai, District Swat. Random water samples were collected from different water sources and analyzed for physical and chemical parameters like pH, temperature, turbidity, electrical conductivity, Cd, Cr and Pb. In biological parameters total coliform and fecal coliform analysis was performed. Drinking water samples showed variable concentration of physicochemical and biological concentration. Electrical conductivity of drinking water samples ranged from 201 µs/cm to 807 µs/cm. PH of water samples ranged from 6.8 to 7.92. Temperature in water samples ranged from 18.1∘C to 20.2∘C. Turbidity of water samples ranged from 0.08 FTU to 2.9 FTU. Total coliform ranged from 0 to 60 CFU. Fecal coliform ranged from 0 to 27 CFU. Cd ranged from 0.001 mg/l to 0.009 mg/l. Cr ranged from 0.010 mg/l to 0.017 mg/l. Pb ranges from 0.01 mg/l to 0.61 mg/l. 70% water samples were found free from total coliform and 30% were contaminated from it. Maximum concentration was found 60CFU. About 36.2% of water samples were found to be contaminated by total coliform. Results of the study indicate that Cd, Cr, Pb, total coliform and fecal coliforn are higher than permissible limits of WHO. Water samples of union council Islampur and Manglor were more polluted as compare to Sangota and Odigram. Questionnaire survey was performed from 240 households in the study area. Results of questionnaire survey showed that situation of water and sanitation is bad in UC Islampur and Manglor as compare to UC Sangota and Odigram that justifies the poor water quality of the area. Awareness among respondents of UC Sangota and Odigram was high as compare to respondents of Manglor and Islampur regarding water, garbage and its connection with diseases. Residents of the study area were suffering from many health problems and diarrhea was the most common disease which may be due to drinking of contaminated water. Study concluded poor drinking water quality and sanitation of the study area. Detail investigations are suggested for the sources of water pollution and its health effects in study area.

Keywords: Water quality, sanitation, diseases

Reducing Biorisks and Productivity Losses in Livestock Entrepreneurship through Water Management under Dairy Science Park

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Abstract

Water is essential for livestock production and maintenance of hygienic environment at farms and pastures. However availability of water for livestock has always been an issue. At the peri urban dairy farm the cost of land, fodders and labor is comparatively higher than the rural areas. Hence the livestock, especially the dairy cattle and buffaloes are kept in a congested manner with very low space availability per livestock head. Conditions of these densely populated farms further deteriorated by restricted water supply for drinking of animals and washing of floor and animals' bodies. The limited water provided for drinking purpose cannot meet the physiological demands of the animals and various body functions, including lactation are affected, adversely. It also reduces the feed intake and digestive process, decreasing the livestock growth, productivity and fertility. Dairy Science Park has come up with a proposal to overcome this impediment through applied research, technology transfer and installation of solar water pumps and tube wells; as the frequent power failures in these areas make the use of tube wells and water pumps energized by the electric companies is not reliable. In addition the water supply lines of these companies are not kept in an appropriate hygienic status and mixing of drainage water with the clean water supplies has been reported frequently. The cost of installation will be borne by the Park initially, and will be recovered back in easy installment under Islamic leasing guidelines. Sheep and goats are kept in the rural areas, mostly in arid regions or hilly and mountainous terrains in the province of Khyber Pakhtunkhwa and FATA. The availability for animals' drinking and pastures maintenance is scarce. Lack of information about the availability of water, pastures and services facilities to the shepherds affect the animals' health and farmers' profit, adversely. The continuous walking of animals and shepherds deplete their energy further. These movements are also the cause of transmission of diseases. Due to lack of qualified veterinary practitioners and good quality medicine, the shepherds depend upon low quality and costlier medical services. Resultantly the fertility, health and survival of animals become at risk. The national policy and networks of veterinary services provided by livestock development, Extension Wing, lacks any formal support for taking care of small ruminants. The movements get extended beyond the national boarders, up to Afghanistan and may cause trans-boundary diseases. Due to their remote locations these shepherds do not have direct access to the consumers for sale of animals and a major share of the profit goes to the middleman. Dairy Science Park has suggested academic support to these shepherds comprising applied research, training, inputs supplies, animals' procurement and products processing through business incubation centers and satellites business facilitation centers.

Keywords: Biorisks, Productivity Losses, Livestock, Entrepreneurship, Water Management, Dairy Science Park

Water Conservation through Floods: With Special Reference to Pakistan's 2010 floods

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Abstract

Fresh water is essential for us but under normal circumstances Pakistan receives insufficient and unreliable amount of precipitation and even experiences drought. In contrast, since last 43 years it had experienced 20 floods of various magnitudes where 2010 flood had been assessed as the most horrible flood of its history. It occupied 1/5Th part of the country, affected 20 million and killed 1985 people. It affected 17,553 villages, also damaged 1.6 million houses and resulted in economic losses of US$ 10,000 million. This water had been essential for people, agriculture and to fight against energy crisis. Lack of planning, mismanagement and poor economy of the country are responsible for floods as well for loss of precious water. Both of the problems could be addressed by the Construction of new dams and reservoirs, remodeling of existing dams and modernizing early warning system, de-siltation of water bodies, forestation and lining the canals.

Keywords: precipitation, horrible flood, mismanagement, remodeling of dams and de-siltation.

Water as blue economy for sustainable growth in Pakistan

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Abstract

Water as blue economy is a viable and prudent use of oceanic and other water bodies for the economic development of a country. Pakistan's blue economic growth is heavily dependent on; aquatic life, agriculture, industry, forestry, mining, desertification, biotechnology, energy, health and recreational sector. Agricultural sector comprises of 21 % of Pakistan's GDP, similarly other sectors also play a tangible contribution in economy of the country. However there exist several challenges in context with blue economy in various areas including overexploitation as well as underutilization of marine resources, lack of awareness, bungling of water consumption practices in agriculture by using traditional irrigation methods and technology, deterioration of water quality and quantity, dearth of consistent water polices, underutilization of the available renewable resources for generating electricity, low reservoir capacity, transboundary water disputes and depletion of water ecosystem. The aim of this research is to analyse the relationship of blue economy i.e. water resources in Pakistan with respect to the other sectors and to analyse water as precious commodity in blue economy

Keywords: blue economy, sustainable, water resources, growth, GDP

L-co2- the Super Critical Solvent to replace the Organic Solvent for better results of extracted essential oils

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Abstract

The study is motivated by the difficulty in extracting essential oils from seeds using organic hydrocarbon solvents which are not only damaging the environment but also these solvents are flammable and are imported by spending millions of dollars every year which can be saved. L - CO2 is seen as most viable solvent also called **green solvent**. It is non – flammable and relatively inert. It provides many chemical advantages that enhance the green credentials by reducing the waste and cost and improves the quality of end product. It is used for essential oil extraction of various seeds and essence from flowers its use is growing in the developing countries and has replaced the hazardous chemicals which are injurious to health and environment. Extraction machines using L-Co2 are also available.
L-Co2 "is a byproduct of ethanol distilleries in Pakistan. CO2 is generated during fermentation and is purified (99.99%).CO2 is then supper cooled to make it "liquid" under pressure. Awareness about its use and availability on affordable rate can revolutionize our essential oil manufacturing and reduce the water consumption besides being environmental friendly.

Keywords: Supercritical solvent, nonflammable, environment, fermentation

Hydro Geochemical Zonation and its Implication for Arsenic Mobilization in an Area with a Sizable Anthropogenic Input: A study of District Gujrat Pakistan

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Abstract

The present study was conducted to evaluate the impact of industrial contribution towards As contamination. Sampling was done from various environmental matrices (groundwater and soil-surface and subsurface). Industrial effluents and solid waste were also collected from the pronounced industrial zones (Textile, Electronics, Pottery and Ceramics, Furniture and Control site) and analyzed for arsenic content. The analysis was performed using UV visible spectrophotometer and Atomic-Absorption Spectrometer (Hydride-generation for As). To interpret and represent the data various statistical tools were employed such as SPSS, PHREEQ C, Piper plot, PCA/MLR, HCA. Spatial distribution of the As was made by using Arc GIS 9.3.
The physicochemical parameters of groundwater and industrial effluents were compared with World health organization (WHO) quality standards (2010). Piper plot classified the groundwater into three major groups, Na-Cl, Na-Ca-HCO3- and Na-HCO3. Groundwater As content lie within the national environmental quality standards (NEQs) of 50 µg/l but it exceeds the WHO limits (10 µg/l). All the water samples show the uniform pattern of As except those collected near industrial effluents or where solid waste was dumped which clearly indicates the contribution of industries in increasing the arsenic content while the uniform pattern in rest of the samples including the control suggests that As is naturally present but anthropogenic activities are enhancing the arsenic concentrations. Under the Oxic and alkaline environment As shows slightly positive correlation with Fe and SO42- and negative correlation with Mn suggested the oxidation mechanism. The low content of arsenic as compares to other areas of Punjab is due to the soil type of the area with a pronounce clay content which shows adsorption behavior towards. As and other heavy metals decreasing the As content in water and increase in soil.

Keywords: Arsenic, Heavy metals, Groundwater, Soil, PCA-MLR Receptor Model

Assessment of Arsenic and Essential metal Ion concentrations in the Quality of Groundwater left Bank of River Indus Sindh, Pakistan

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Abstract

Two hundred forty three groundwater samples were collected from Sakrand, Kazi Ahmed, Daulatpur and other villages of near at river Indus in District Shaheed Benazirabad, Sindh and were analyzed for their physico-chemical parameters to check their suitability to be used for drinking and agricultural purposes. The physico-chemical parameters were observed in the ranges; pH 6.75-8.32; EC 560-14740 µS/cm, TDS 358-9433 mg/L, Total Hardness 119-2125 mg/L, Alkalinity 50-583 mg/L; Nutrients o-PO4-P 0.085-0.150, t-PO4-P 0.113-0.235, NO2-N 0.02-1.10, and NO3-N 0.040-2.24 mg/L respectively; Sulfate 60-1556 mg/L and Chloride 30-1360 mg/L respectively and metal ions were found in the ranges of (Na 28-745 mg/L, K 4-568 mg/L, Ca 22-538 mg/L and Mg 10-315 mg/L and As 0-150 µg/L respectively. Permeability index (PI), sodium adsorption ratio (SAR) and the contamination index (Cd) was calculated to check the suitability of water for irrigation and total amounts of contaminants in the water body. The Cd ranged between 0 and 27.6. Only 48 samples were observed to be fit for drinking purpose and 118 samples were fit for irrigation based on SAR and PI values and 54 groundwater samples were contaminated with arsenic respectively.

Keywords: Physico-chemical parameters, Essential metal ions, Groundwater, Arsenic and Sodium absorption ratio.

Hydro-Meteorological Characteristics of River Swat

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Abstract

This Paper reveals trend of variation in mean minimum Temperature (Tminmean) and mean maximum Temperature (Tmaxmean) and its impact on River Swat mean discharge (Rdismean). In hydro-meteorological parameters mean minimum temperature (Tminmean oC), maximum temperature (Tmaxmean oC), rainfall (Rmean mm) and rate of River discharge (Rdismean m3/s) were analyzed during the period of 1985-2014. Study period was divided into two Periods, 1985-1999 and 2000-14 annually and on monthly basis. Increased trend of rainfall were caused much increase in the Rdismean. In climatic variables Tminmean, Tmaxmean and Rmean were computed through descriptive statistics, and student t-test on SPSS software. In the decadal trend variation was recorded (0.7 oC) in Tminmean as compare to Tmaxmean. Tminmean was increased in the second decade. Trend of Rmean was increased with increase in temperature. During the study period in the study area extreme flood events were found in 1995 (Rdismean 2379.32 m3/s), in 2001 (Rdismean1740.91 m3/s) while super flood was recorded in 2010 (Rdismean7787.13 m3/s). Rmean was found increased in the last decade (93.81 mm) of the study period. This paper also recommends the formation of effective adaptation and mitigation polices and strategies to minimize the impact of climate change on existing water resources and irrigation.

Keywords: River Discharge, Mean annual minimum temperature, Mean annual maximum temperature and Rainfall

Arsenic Concentration in Drinking Water and Health Risk Assessment in Lahore, Pakistan

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Abstract

The study was conducted to determine the arsenic concentration in groundwater used for drinking purpose (*n*= 465) in Lahore city of Pakistan which has been reported as an arsenic rich area since a decade. In the study area, groundwater is the only source of drinking water for the population of around 10 million. Representative samples from groundwater sources were collected from the study area and arsenic was determined by using atomic absorption spectrophotometer. The results revealed that; out of 465 collected water samples, 93 % exhibited the arsenic level between 11-50 ppb thus violating the WHO safe water limit (10ppb), while 3.6% were in the range of 51-100 ppb and in two samples arsenic concentration was more than 100ppb. Only 3 samples (less than 1%) were found safe as per WHO guidelines. The study concluded that the ground water of the area used for drinking is the health risk for the consumers. This paper will discuss the Health Risk Index in terms of Average Daily Dose, Hazard Quotient, and Carcinogenic Risk. Thus the city apparently seems to be at a risk due to prolonged use of arsenic contaminated water, which calls for an immediate attention to provide alternate sources of water or its proper treatment to save the people at risk. This study will provide baseline to analyze change in exposed risk and fill the data availability gap over a period of time.

Keywords: Arsenic, Groundwater, Health Risk Index, Lahore, Pakistan

Assessment of Water and Sanitation system in comparison to the WASH Sphere standards at Afghan Refugee Camp Panian-1

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Abstract

The current study was conducted at Afghan refugee Camp Panian-1 for the purpose to evaluate the water sanitation system and compare it with the set water sanitation and hygiene-WASH sphere standards. For this purpose mix methodology of qualitative and quantitative data analysis methods were used like questionnaire survey, FGD with relevant stakeholders followed by drinking water quality analysis were carried out for biological parameters. Study revealed that the existing sanitation conditions such as water use facilities, Solid waste collection and disposal, Access to water quality, Excreta disposal i.e. access to and numbers of toilets are alarming and are not as per the minimum WASH sphere standards. Moreover, water quality of the study area also showed biological contamination which is an indication of risk to the community health. Fecal and total coliform contamination was detected in water samples. Total coliform was detected in 52% of the total samples analyzed which showed its population range from 1-50cfu/100ml while E.Coli was detected in 56% of the total samples having colonial population range from 1-50cfu/100ml. Residents of the area are exposed both directly and indirectly to health risks posed by the existing sanitation system.

Keywords: Sanitation, Sphere standards, Refugee camp.

Environmental Stable Isotopic and Geochemical Study to Understand the Process Controlling Recharge Mechanism and Fluoride Release in Groundwater in Lahore & Kasur, Pakistan

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Abstract

Stable environmental isotope (δ18O & δD) and hydro-geochemical methods were integrated to delineate the contamination of fluoride in groundwater and impact of recharge on fluoride enrichment. Four sites (*Samada, Sari Chimba, Kot Maiga and Chah Fatehwala*) were selected along the River Ravi transect. Hydrochemical data suggests that dominating water types were NaCl and NaHCO3, where Na+ and HCO3- were major ions and groundwater geochemical evolution was probably due to combination of mineral dissolution, mixing processes and evapotranspiration along groundwater flow paths. Different stoichiometric ratios reflect the weathering of silicate minerals influencing hydrogeochemistry. More than 70% of the total samples had fluoride concentrations above the WHO provisional drinking water guideline (1.5 mg/l) having range between 0.54 mg/l to 17.5 mg/l. Saturation indices determined that 100% samples were saturated with respect to calcite and 96% samples were under-saturated with respect to fluorite indicating influence of calcite precipitation on fluoride enrichment. Positive correlation was observed between fluoride with pH, Na+ and HCO3- confirming that high fluoride concentrations were the result of weathering of silicate minerals and exchange of OH- on clays surface under alkaline pH conditions. High fluoride concentrations (average 7.09 mg/l) were associated with NaHCO3 type groundwaters. The stable isotopic analysis indicates meteoric origin of groundwater with some evaporative effects. The values for δ18O and δD in groundwater ranged within -9.14 to -5.51 ‰, and -56.57 to -39.5 ‰ respectively. Evaporation was prevailing phenomenon affecting geochemistry, also imparting partial effects on fluoride levels. Effect of recharge revealed that lateral groundwater flow was major process controlling fluoride enrichment while vertically infiltrated groundwaters had negligible effects on fluoride in groundwater.

Keywords: Groundwater contamination, Fluoride, Stable Isotopes.

Water quality, interventions and its relation with diarrhoea in Pakistan: a systematic review

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Abstract

We systematically reviewed the information about quality of drinking water; interventions carried out to improve quality and any evidence of improvement in the health outcomes (particularly diarrhea) in Pakistan. We included articles published since 2001 and identified reports in indexed local and international journals, which had at least an abstract in English and which described primary epidemiological research concerning the above research questions. We interrogated four electronic databases i.e. PubMed, Cinahl, Ovid and Science Direct. All literature was collected through to 1st May 2016, using the combination of search terms set out for individual research question. References in the bibliographies of included documents were also systematically searched for full-text articles. Each stage of the process after the initial electronic search was carried out independently by the two authors with resolution of discrepancies by discussion. A total of 17741 articles were obtained. After removal of 1342 duplicates, 16399 titles and abstract were reviewed. A total of 211 were selected for full text which was agreed upon by both authors. Majority of literature on water was related to water quality regarding heavy metals (lead and arsenic, fluoride and other toxic chemicals.). High total dissolved solids were found in several studies on underground water. Only few interventions, of small scale, were identified. However, there was no information about improvement in diarrhea with any of the intervention studied. All but very few studies have indicated poor water quality, related to biological and chemical toxicity. Studies related to contamination with heavy metals and arsenic is commonly available. Small scale interventions have been designed to improve water quality. Nonetheless, diarrhea being a major burden among children has not been studied for its relation with the quality of water in Pakistan. There is urgent need to design and evaluate interventions for water quality improvement in Pakistan.

Keywords: Water quality; interventions; diarrhea; Pakistan; systematic review.

Precipitation Trend Analysis in Pakistan using TRMM 3B42 Product (2001-2015)

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Abstract

Globally climate change is influencing the patterns of natural processes and thus the lives of the communities; it is evident from different disastrous events like glacier melting, consecutive floods & droughts, storms & cyclones, loss of habitat and natural ecosystems. Climatic Change has significantly influenced the precipitation events in Pakistan. This study aimed at analyzing the precipitation trend in Pakistan since last fifteen years that is from the year 2001 to 2015 using (TRMM 3B42 daily product V7). Tropical Rainfall Measurement Mission (TRMM) satellite data was collected from different websites affiliated with National Aeronautics and Space Administration (NASA). Analysis was carried out using Microsoft Excel by plotting time series for both monthly and annual precipitation. Time series revealed insignificant changes in annual precipitation whereas significant changes in monthly precipitation events. Monsoon season, the raining season in Pakistan normally lies between June and September but in the flooding years in Pakistan that are 2003, 2006, 2007, 2010, 2011, 2012, 2014 and 2015, it was found that the monsoon season is shortening whereas its intensity is increasing. Highest amount of rainfall is available within a less time period, so collective load of rainfall runoff and river waters along with low storage capacity of Pakistan exert immense pressure on the existing water infrastructures of the country which ultimately leads to severe floods resulting in heavy socio-economic losses.

Keywords: Climate Change, Precipitation, TRMM, Floods

Effects of Septic tank discharge to the Ground Water

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Abstract

Ground water is the gift of God to the human beings, animals and plant species. This study is focused upon the underdeveloped area, Bakhar Jamali town, which is situated at 100 km from Hyderabad city. As underdeveloped area, water supply line and drainage system is not available in the town. The people of Bakhar Jamali are heavily depended upon the ground water. Since last few years, there were some diseases erupted in the people, so the quality of ground water must be evaluated on account of its septic tank discharge. Total 30 samples are collected from different villages of Bakhar Jamali, their physical, chemical and biological parameters are determined through atomic absorption, ultraviolet spectrophotometer The obtained results expressing that the overall ground water quality of Bakhar Jamali is not aesthetic for the drinking purpose because of excessive concentration of tds in the range of 1200 to 2960 mg/l, chlorides ranges to 250 mg/liter to 1200 mg/liter, pH values ranges is 7.04mg/l to 7.53mg/l, arsenic ranges from 0.01 to 0.015 mg/liter, fluoride ranges up to 0.8 mg/l to3.2 mg/l, sodium ranges up to 190 to 761 mg/l. the coli-form colonies in range of 10 to 55 colonies. These high values are the result of septic tank seepage through permissible layer of soil and infiltrated to the ground water which depletes the overall ground water quality. The results suggesting that the ground water of village Pahar Jamali and Ghulam Ali Jamali can be used for drinking purpose, on the other hand villages Dhingano Jamali, kehir Jamali, Ali Murad Jamali, Shahdad Jamali is not suitable for drinking purpose. In last, under the consideration of obtained results, some remedial measures which includes, reverse osmosis plant, desalinates are suggested to improve the ground water quality of Bakhar Jamali town.

Keywords: Ground water, TDS, septic tank

CONCLUSIONS AND RECOMMENDATIONS

1. **Water Efficiency and Productivity;** 94% of water is being used in Agriculture and there is a need to improve Water Efficiency and Productivity by reducing the conveyance losses in the irrigation system and Improving the water application in the filed through; Precisely leveling the fields, Using efficient irrigation methods (bed planting, sprinkler, drip etc., Proper irrigation scheduling (when to apply and how much to apply water to crops) and Dissemination and capacity building of the stakeholders (farmers, agricultural service providers, professionals, policy makers, academia etc.)

2. **Flood Management;** there is a need to Improve Legislative and Legal Framework, establishment of independent Wetlands Management Authority , Incorporate Flood Plain management t in NFPP IV Integrated Flood Protection Plan IV, to organize Training and Capacity Building (Wetlands and Floodplain Management, flood control management) and Technical Support for greening CPEC, flood Control and floodplain management is much required.

3. **Water Pricing;** the water supply system can be upgraded through appropriate water pricing policies. This can play an important role in the provision of improved services and expansion, through the utilisation of generated revenue. The current 'system' of provision of water for domestic use in Punjab is fragmented, poorly maintained and is largely ineffective. Politics is a biggest hurdle in rational water pricing. Rational water pricing = conservation + improved water quality and services + sustainability. Hence Effective water pricing is much needed.

4. **Climate Change**; Recognizing the importance of Paris Agreement 2015 on climate change and realizing the need and commitment of Pakistan for its implementation and country's vulnerability, the Information System and actions are needed about changes in climate change and variability which is required to better anticipate potential impacts of climate change on the water resources, agriculture, energy, economic, health, industrial and private sectors to address the climate change concerns in scientific, ethical, professional and systematic way.

5. **Water Blue Economy;** The Water as precious commodity to be considered as blue economy as the factors contributing for blue economy growth depends on; agriculture, energy, aquatic life, oceans/seas, renewable resources, transboundary. The Water to be consider in term of GDP and its value to be determined accordingly. A more quantitative research data base in blue growth can assist in future water policy frameworks.

6. **Awareness:** Keeping in view the prevailing water situation in Pakistan and the wasteful water use practices, there is an immense need on educating water users that the water resources are not an inexhaustible entity and have a value. A comprehensive awareness program to be launched across the country among water users to put a stop to the wastage and propagate conservation

methods to increase water availability, particularly when it is feared that the future drought cycle may be longer than recently experienced.

7. **Agriculture productivity:** 40 to 50 percent of the water that is delivered through water course networks is lost. The main causes of these losses are; seepage, spillage, and side leakage from the water course banks. There is urgent need to enhance agricultural productivity through efficient management of scarce water resources and is designed to augment adaptation under different climate change scenarios. This may require various approaches, methods and interventions: (a) water courses improvement to upgrade the efficiency of delivery in the field; (b) precision land leveling to improve the applications in the field where flood irrigation will remain prevalent; (c) High Efficiency Irrigation Systems – drip irrigation for orchard, vegetables, flowers, other high value row crops.

8. **Marine Environment:** Pakistan should consider, gathering all industrial and water affairs with regard to marine environment under one multidisciplinary authority, since it will reduce the governing institutional and coordination issues. In ocean based industries, GDP share have to be compiled into one category to evaluate the cumulative value of blue wealth.

9. **Municipal Wastewater Treatment:** The water treatment technologies to utilize the sewage water and cope with the future water scarcity challenges are crucial hence viable technologies for Sewage-treatment or domestic wastewater, viable technology based treatment may be adopted for removing contaminants. Further integration of indigenous **micro algal cultivation** with wastewater can be economically feasible and environment friendly technology for waste water treatment which may be account far.

10. **Glaciers and Climate Change** : In Pakistan glaciers in northern areas act as a source of life by feeding more than 60% to the flows from Upper Indus Basin and due to climate change these water bodies can release millions of cubic meters of water and debris which can cause catastrophic devastation and flooding thus effecting downstream hence various measures to prevent and mitigate the same may be undertake including; reducing its impacts by adaptation, rehabilitation and reconstruction, Mapping of potential areas threatened by the phenomenon, Continuous monitoring of the glaciers and glacier lakes, building capacity of stakeholders and measures to control the phenomenon, Establishment of Early Warning System, Sharing of information between different stakeholders, Preparation of national and provincial level Contingency Plans and Standard Operating Procedures (SOPs).

11. **Water Quality**: Drinking water quality is poorly managed and monitored. Pakistan ranks at number 80 among 122 nations regarding drinking water quality. The quality of water is assessed by evaluating the physical, chemical, biological and radiological characteristics of water. Water for drinking and food preparation must be free from turbidity, color, odor and objectionable tastes, as well as from disease-causing organisms and inorganic and organic substances, which may produce adverse physiological effects. There is urgent need to map national drinking water quality of various regions and comprehensive data to be collected for water quality assessment for taking under taking appropriate actions at policy planning and programs level. Further Water

pollution is one of the major threats to public health in Pakistan. It is estimated that annual national income loss of approximately 0.6-1.44 percent of GDP due to water born diseases hence special emphasis must be given on major pollutants, sources of pollution and the consequent health problems and extensive public health program to address the issue must be undertaken.

12. **Sanitation and Hygiene**: More than 40 million people in Pakistan do not have access to a toilet, forcing them to defecate in the open, which in turn is a major contributor to sanitation and hygiene issue in the country. The problem can spread disease and lead to intestinal infections, which can contribute to stunting in young children. Protection of water sources accompanied by sanitation and hygiene promotion programs can improve the hygiene quality of water sources particularly in rural areas where disinfection is not feasible. There is a lack of policy on water, sanitation and hygiene (WASH) in Pakistan ─ and where it exists, it tends to be poorly informed and often implemented without consulting local people. There is a need to take holistic intervention to address the challenge at all the tiers by taking all stakeholders at board.

13. **Plantation:** Pakistan needs to raise its forest cover from 5% to 25% to meet its economic, employment and green environment. There is need to conduct mass tree plantation in villages, towns, cities. Further there is also a need to plant trees at new avenues like along roads, highways, streets for green coverage and to control the land erosion. For erosion control various technical prevention measures should also be used like; extensometers, gabion walls or retention walls through indigenous materials. The environment had become a big sector of life and needed more attention and funds from government are much needed.

14. **Transboundary:** There is a need for extensive coordination among River Basin Organizations to facilitate comparisons of experiences and enhance the implementation of the international law principles of transboundary water governance. Further experts on transboundary freshwater law must articulate the implications of various treaties, conventions and governance formworks. There is a need for interdisciplinary research on emerging issues of transboundary water law and governance, such as the challenges presented by climate change, and integrated governance of surface and groundwater. There is immense requirement to treat the subject as technical instead of political one.

15. **Groundwater**: Pakistan's major groundwater resource is in the irrigated areas of the Indus Basin, while the second source lies in the areas outside the Indus Basin. Excessive use of groundwater has resulted in secondary salinization and its depletion. Groundwater quality in the region is highly dependent upon local geology and land use. The Naturally occurring contaminants include arsenic, fluoride and heavy metals. Anthropogenic contaminants include nitrate, bacteria, viruses, as well as endocrine disrupting compounds. There is need to manage the demand of water/groundwater and efficient utilization of water must be emphasized. A groundwater regulatory framework should be introduced and implemented for the sustainability of groundwater use and Recharge of groundwater and its quality may be addressed accordingly.

16. **Environmental Law Enforcement**: Even when there are relevant laws in the country like PEPA 1997, their enforcement is extremely weak. Strong law enforcement and compliance is necessary for the protection of freshwater resources.

17. **Water Policy**: Although relevant policies like; Climate Change Policy-2012, National Drinking Water Policy, 2009. Safe Drinking Water Act 2007, National Sanitation Policy-2006, and Draft National Water Policy etc, however comprehensive National Water Policy is much needed in consensus with the provinces and other stakeholders. Further a practical strategy needs to be defined to implement the policy framework.

18. **Rainwater Harvesting**: Rain Water Harvesting provides the best possible alternative and supplementary source of water in a situation where existing water sources are depleting and fail to fulfill the needs of a growing population. The water which is commonly wasted through ducts installed on the roofs of the residential, commercial or any other structure is commonly and mostly wasted through ducts and drains off without any usage and suitable advantage. According to an estimate no less than 32,000 gallons with 90% efficiency could easily be collected every year from a house comprising 2-3 rooms with an area of roof 100 sq m. Urban planning may be carried out with the provision ofrainwater harvesting systems at least to meet the domestic requirement of water.


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