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Assessment of shift in sowing and harvesting of the rice crop in district Larkana using field and remotely sensed data

Authors: Vipin Kumar Oad¹, Muhammad Salman Mohsin¹

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering & Technology, MUET, Jamshoro, Sindh, Pakistan

Abstract

The shift in monsoon rainfall, delay in availability of irrigation water and increase in the summer temperatures have altered the sowing and harvesting pattern of the rice crop in Larkana Division. The variations in climatic factors (Temperature and Precipitation) are affecting the sowing dates, crop period and temporal variations in crop water requirements in Larkana district. These climate changes are affecting the agricultural production of Pakistan and leading towards economic issues. Thus, the present study was conducted to quantify the delay in sowing and harvesting of the rice crop in Larkana district using field and remotely sensed data. The Landsat images of the study area for June, July and August 1994 and 2017 were acquired and analyzed in ArcGIS 10.3 using a supervised classification with maximum likelihood algorithm. The results of the study revealed that on July 20, 1994, the rice transplanted on 14.7% of the area of the district while it was only 7.1% of the area in the year 2017. Similarly, the area under rice crop in the 1st week of July 1994 was 18.3% compared to 8.15% during same period in 2017. Thus, showing delay/shift in the sowing of the rice crop. However, in 1st week of October 2017, the rice crop was standing on 46.8% of the area while it was on 34.6% of the area in the year 1994 during same date. This depicts delay in harvest of the rice crop. The present study quantified that there is a delay of 15-30 days in sowing and harvesting dates of the rice crop in the district might be due to late availability of irrigation water which is affected by climate change.

Keywords: Climate change, Water, harvesting, sowing, ArcGIS, irrigation.

Concentrations and source regions of light absorbing impurities in snow/ice in northern Pakistan and their impact on snow albedo

Authors: Chaman Gul^{1,2,3}, Siva Praveen Puppala², Shichang Kang^{1,3,4}, Bhupesh Adhikary², Yulan Zhang¹, Yang Li³, Xiaofei Li¹

¹State Key Laboratory of Cryosphere Science, Northwest Institute of Eco Environment and Resources, Chinese Academy of Sciences, Lanzhou 73000, China

²International Centre for Integrated Mountain Development (ICIMOD), G.P.O. Box 3226, Kathmandu, Nepal

³University of Chinese Academy of Sciences, Beijing, China

⁴CAS Center for Excellence in Tibetan Plateau Earth Sciences, Beijing, 100101, China

Abstract

Black carbon (BC), water-insoluble organic carbon (OC), and mineral dust are important particulate impurities in snow and ice, which significantly reduce albedo and accelerate melting. Surface snow and ice samples were collected from the Karakoram-Himalayan region of northern Pakistan during 2015 and 2016 in summer (six glaciers), autumn (two glaciers), and winter (six mountain valleys). The average BC concentration overall was 2130 ± 1560 ngg⁻¹ in summer samples, 2883 ± 3439 ngg⁻¹ in autumn samples, and 992 ± 883 ngg⁻¹ in winter samples. The average water insoluble OC concentration overall was 1839 ± 1108 ngg⁻¹ in summer samples, 1423 ± 208 ngg⁻¹ in autumn samples, and 1342 ± 672 ngg⁻¹ in winter samples. The overall concentration of BC, OC, and dust in aged snow samples collected during the summer campaign was higher than the concentration in ice samples. The values are relatively high compared to reports by others for the Himalayas and Tibetan Plateau. This is probably the result of taking more representative samples at lower elevation where deposition is higher and the effects of ageing and enrichment more marked. A reduction in snow albedo of 0.1–8.3% for fresh snow and 0.9–32.5% for aged snow was calculated for selected solar zenith angles during day time using the Snow, Ice, and Aerosol Radiation (SNICAR) model. Daily mean albedo was reduced by 0.07–12.0%. The calculated radiative forcing ranged from 0.16 to 43.45 Wm⁻² depending on snow type, solar zenith angle, and location. The potential source regions of the deposited pollutants were identified using spatial variance in wind vector maps, emission inventories coupled with backward air trajectories, and simple region tagged chemical transport modelling. Central, South, and West Asia were the major sources of pollutants during the sampling months, with only a small

contribution from East Asia. Analysis based on the Weather Research and Forecasting (WRF-STEM) chemical transport model identified a significant contribution (more than 70%) from South Asia at selected sites. Research into the presence and effect of pollutants in the glaciated areas of Pakistan is economically significant because the surface water resources in the country mainly depend on the rivers (the Indus and its tributaries) that flow from this glaciated area.

Keywords: Snow; Snow; Ice; glaciers; North Pakistan; Black carbon.

Mapping of soil salinity in the coastal areas of Sindh, Pakistan using geospatial techniques

Authors: Ghulam Shabir Solangi^{1*}, Altaf Ali Siyal², Muhammad Munir Babar²

¹Ph.D. Student, U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro, Pakistan

²Professor, U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro, Pakistan

Abstract

Soil salinity is one of the most widespread soil damaging processes in arid and semi-arid areas of the world, especially in river deltas. The present study was carried out to assess and map the spatial variations in soil salinity in the Indus delta, Sindh, Pakistan based on physicochemical analysis of 375 soil samples collected randomly from 125 locations of the study area. Physicochemical analysis of the soil samples revealed that for top 0-20 cm soil depth, about 67% of the soil samples had an electrical conductivity (EC), 72% had exchangeable sodium percentage (ESP) values beyond the FAO guidelines. Similarly, for 20-40 cm soil depth, 61% had EC, 72% had ESP values beyond the safe limits, and for last, 40-60 cm soil depth, 56.8% had EC, and 79.2% had ESP values higher than the safe limits. Based on results of physicochemical analysis of soil samples, spatial interpolation raster maps for various physicochemical parameters of soil viz. soil texture, dry density, pH, EC, and ESP were developed using ArcGIS 10.3 software. The final interpolated salinity maps revealed that more than 50% of the Indus Delta soils are salt-affected. The study also revealed that the salinity in the topsoil was higher than that in the subsoil indicating that the salts in the subsoil moved up and accumulated in the topsoil. Reduction in environmental freshwater flows below Kotri Barrage, and entry of saline water from the Arabian Sea into the delta might be the possible causes of soil salinity in the Indus delta.

Keywords: Coastal areas; GIS; Interpolation; Physicochemical parameters; Soil salinity

A review of changing climate & rising population impacts on agriculture produce: challenges for water & food security and sustainable development

Authors: Muhammad Younas¹, Muhammad Yaseen¹, Naveed Farah², Muhammad Arfan-ul-Haq³ and Shahid Mahmood Khan²

¹Institute of Soil and Environment Sciences, University of Agriculture, Faisalabad 38000, Pakistan

²Department of Rural Sociology, University of Agriculture, Faisalabad, 38000, Pakistan

³Ayub Agricultural Research Institute, Faisalabad, 38000, Pakistan

Abstract

An intensive review of contemporary literature was conducted to understand the link of climate change & population growth on human life with particular reference to water and food security. Over the years, many developing countries, including Pakistan, have been failed in protecting their natural assets. After the industrial revolution, human life faced various health hazards and humans started to deplete and demolish their natural environment. Resultantly, various developing countries are facing exponentially growing problems of water scarcity, climate change, population increase, excessive groundwater pumping and low recharging, agricultural yield decline and industrial effluents mismanagement. Even the "green revolution" could not ensure sustainable agriculture and at the same time aggravated the concerns of environmental pollution through the extensive use of chemicals and pesticides and their residual effects. In Pakistan, several issues including water and environmental complications are affecting farm yield. The farmer's economic development is vulnerable due to multiple factors. According to FAO, there is need of more increase in produce of food up to 70%. In near future, the urban and rural population will become equal and the agricultural land will decrease. In this context, the final measure is to shift from open environment cultivation into controlled farming (green house, vertical farming, hydroponics, aeroponics and pink farming etc.) for next generation. The ultimate benefit of controlled farming is water and food security and sustainable development. Healthy food can be produced through controlled environment. The major advantages are use of no or little soil, heavy machinery, labour, pesticide and small land area. It can be practiced in urban areas. There is dire need of natural resource use policy and its implementation. Moreover, a globally agreement for peace and

integrated approach is needed to ensure nature and environment in the best interest of the world with a slogan; Stop War for Nature & Humanity.

Keywords: Climate change; population; sustainable development; water; food security

Current Health Care Waste Management Practices in Selected Hospitals of Hyderabad and Jamshoro

Authors: Talha Latif¹, Yamna Tariq¹, Sandarah Ashraf¹, Fida Hussain Siddiqui²

¹Institute of Environmental Engineering and Management, MUET, Jamshoro 76062, Pakistan

²Department of Civil Engineering, MUET, Jamshoro 76062, Pakistan

Abstract

Mismanagement of health care waste (HCW) is being reported constantly due to improper attention of paramedical staff and administrations of healing facilities in Pakistan. HCW is classified on its prospect of disease transformation as hazardous, toxic even lethal in some cases. This threatens the environment and public health. Removal and disposal of HCW from hospitals is extremely necessary for environment to sound safe. The study demonstrates current circumstances of HCW, segregation, transportation and management practices in selected hospitals of Hyderabad and Jamshoro. Visits and investigations were carried out to measure their control criteria of waste management. The practices were also compared with international standards and Sindh hospital waste management rules, 2014. Current research study covered informal site visits, formal and informal interviews, questionnaire survey for data collection and direct observations. It was evident that no such on-site segregation, isolation and separate treatment of multiple wastes were carried out. The staff was found unaware of hazardous waste handling procedure. No personal assurances were taken by sweeping and cleaning staff. Though separate bins were provided but found ineffective and multiple types of wastes were treated equally. Correct administration strategy of HCW must be implemented to safeguard health of patients and society.

Keywords: Clinical Waste Management, HCW Disposal, HCW Management Practices, Health Care Waste, Medical Waste.

Copper nanoparticles as colorimetric sensor for detection of Arsenic³⁺ in Drinking water

Authors: Gul Naz Laghari Baloch^{1*}, Sirajuddin¹, Syed Tufail Hussain Sherezi¹, Muhammad Raza Shah^b, Mohammad I. Abro^c

¹National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro-76080 Pakistan

^bInternational Centre of Chemical and Biological Science, HEJ Research Institute of Chemistry University of Karachi,

^cDepartment of Metallurgy and Materails Engineering, Mehran University of Engineering & Technology, Jamshoro-76080 Pakistan

Abstract

Arsenic contamination in drinking water and groundwater is becoming a serious worldwide threat to human. It is associated with a number of diseases such as skin damage or problems with the circulatory system and high risk of getting cancer. In this Present research work represents an environmentally friendly synthesis of copper nanoparticles (Cu NPs) in the aqueous medium without provided inert environment. The UV-Visible (UV-Vis) spectroscopy was employed to monitor the Localized Surface Plasmon Resonance (LSPR) band of functionalized copper nanoparticles (Cu NPs) based at 573 nm. The X-ray diffraction (XRD) studies indicated that the resulting functionalized Cu NPs were highly crystalline with face-centered cubic geometry. The Atomic Force Microscopy (AFM) was used for the size and morphological characterization. The average size of Rano-Cu NPs was found to be 40 ± 2 nm was recorded. Copper nanoparticles (Cu NPs) demonstrated highly sensitive and selective colorimetric detection of As³⁺ in the linear range of 3.3×10^{-7} to 6×10^{-6} mol/ L based on the decreased in intensity with the R² value of 0.989 by UV-Vis spectrophotometer. The color change of Cu NPs with different concentrations of As³⁺ could make it convenient to be observed by the bare eyes. The resulting sensor is highly economical, simple compared to other sensors and sensitive to detect As³⁺ with a detection limit down to 1.6×10^{-8} mol/ L. In addition, the Cu NPs sensor also selectivity in the presence of potentially interfering compounds. Finally, such simple, convenient, cost-effective, highly selective and sensitive sensing assay was successfully applied in the detection of As³⁺ in groundwater samples. The developed sensor will give new opportunity for the applications in health safety as well as environmental monitoring.

Keywords: Copper nanoparticles, Ranolazine, Colorimetric sensor, Arsenic, Localized Surface Plasmon Resonance and Health safety.

Author name: Gul Naz Laghari Baloch,

Tel: +923363566167

E-mail: gulnaz.laghari@yahoo.com

Assessment of Pesticides Contamination in Water and other Resources and associated Human health in Agricultural area of Gujrat

Authors: Amna Khatoon, Gull Fatima, Muhammad Qasim, Sehar Jamshaid Dar, Abdul Rehman, Sana Arooj, Saif Ullah

Department of Environmental Sciences, University of Gujrat, Gujrat

Abstract

Pesticides are used in excessive amounts in agricultural fields to kill pests and increase crop production. This activity is mostly carried out in developing countries like Pakistan. Although these chemicals lessen pests and other microorganisms but at the same time they have severe bad effects too on health of workers and rest of community. Water and its all types i.e. marine, ground and surface water, is necessary for lives, but the contamination of these water resources is frequent and leads to the altered drinking water standards and health problems and majorly cause by waste coming from industries, domestic sector and agricultural sites. This study was done in the city of Gujrat and its surrounding areas with 300 field farmers as participants. The purpose of this study was to evaluate health problems to workers due to pesticide exposure. Most of the farmers were used to breathe in ambient air and consume polluted water with pesticide residue without the use of any precautionary measures. Results showed that most and frequent health issues were cough, flue and skin irritations, 75.3% of workers were reporting these problems with 51.3% of workers along confirmed medical reports. Among the respondents, about 41% workers were having cough problem and 60% with flue. Besides this, 15% people from them were experiencing the severe skin allergies and rashes. This study reveals that extreme application of pesticides have headed to the acute problems in workers which may grow to chronic one and this practice stays continue without any pause. For reducing the pesticide exposure to farmers and minimizing health related problems, a proper guide is require making the workers aware about hazardous effects of pesticides.

Keywords: Pesticides, Agriculture, Pests, Contamination

Variability in Cotton Yield, and Soil Salinity Effects by Practicing Deficit Irrigation Technique under Raised-Beds

Authors: Nageena Makhdoom¹, Dr. Munir Babar¹, Nazar Gul², Dr. Allan Andales³

¹Hydraulics Irrigation and Drainage, USPCAS-W, MUET, Jamshoro

¹Hydraulics Irrigation and Drainage, USPCAS-W, MUET, Jamshoro

²Drainage and Reclamation Institute of Pakistan (PCRWR), Tando Jam, Pakistan

³Soil and Crop Science Colorado State University, Fort Collin, USA

Abstract

During 2013-2014 Pakistan's cultivation of cotton was 12.8 million bales from 2806 thousand hectares. Pakistan's cotton products accounts, nearly 60% earnings from the national exchange. To boost up the economy of the country by the export of textile, production of cotton is essential. Due to limited water resources, the challenge for the agriculture sector is to get the maximum production by applying the minimum amount of water. Around the world, scientists are researching different irrigation water management techniques to get the maximum yield per drop of water. In the present study, field experiments were conducted to record the response of cotton crop by practicing deficit irrigation technique under raised-beds. The study was performed at the field of Drainage and Reclamation Institute of Pakistan, Tando Jam. To carry out the experiments, the field was designed according to the principle of Randomized Complete Block Design. Four treatments T1 (40%), T2 (50%), T3 (60%), and T4 (70%) of soil moisture depletion levels with three replications were designed. To practice the deficit irrigation technique under raised-beds water was applied according to the irrigation scheduling. To determine the soil salinity effects on soil before and after the experiment, soil samples were analyzed, and the results were verified statistically by using SPSS software. The yield was recorded from each treatment in the trends as: 3193.2, 3532.9, 3116.5, and 3039.8 kg/ha from T1, T2, T3, and T4 respectively. Soil salinity parameters such as EC, pH, SAR, and ESP were determined, and the maximum EC was recorded at 40% depletion level. The maximum yield i.e. 3532.9 kg/ha was recorded at 50% depletion level with 8.52% savings of water by putting 40% depletion level on the reference. All the recorded data were normally distributed, and according to the co-relative statistical analysis, all treatments were not significantly different ($p > 0.05$) before and after the experiments.

Keywords: deficit irrigation, cotton, variability in yield, raised-beds, soil salinity, water savings

Assessment of Menstrual Hygiene Management and Knowledge of Girls in Urban schools of Hyderabad

Authors: Pashmina Iffikhar¹, Aneela Yasmin^{1,2}, Jamil A. Soomro¹, Rasool Bux Mahar¹

¹US-PCASW, Mehran University of Engineering and Technology, Jamshoro, Pakistan

²Sindh Agriculture University, Tandojam, Pakistan

Abstract

Menstruation is a part of normal reproductive life of females. In Pakistan this normal phenomenon is a taboo and not discussed openly, consequently, menstruation is unhygienically managed. This also effect the knowledge and awareness of young girls negatively about menstruation followed by un-effective menstrual hygiene. This study is aimed to evaluate the level of awareness related to menstrual hygiene management (MHM) and WASH facilities with particular reference to MHM were assessed among school going young girls. This cross-sectional study includes 10 co-educational schools in Hyderabad that were randomly selected. The school attendance registers were used to randomly select 10 students (age range 10 to 19 years) from each school. Structured questionnaires and personal observations were done for collecting the data. Results revealed that the all schools have separate washrooms for girls however only 61% of washrooms were functional. Further students reported that these functional toilets were very small and having issues of cleanliness. Majority of the schools have only 1-2 hand washing areas (76%), 94% of hand washing facilities were outside the toilet, without soap (82%) in very poor (9%) or poor (24%) conditions respectively. Due to unavailability of dustbin and proper cleanliness of toilets in schools 91% of girls wait to go back home and dispose the pads there. 63% girls felt that menstruation interfere with their school performance, 83% never go to toilet during menstruation period. However 85% girls come to school during their periods. The knowledge of girls about menstruation facts and hygiene attitudes was very poor. Only 7% of girls know that this bleeding is discharged from Uterus. Personal observation was also done which revealed very poor condition of toilets in schools. Government has no policy or plan regarding menstrual hygiene management for girls in schools; neither there are separate rooms for girls to change pads in privacy nor a room where they would rest if they feel sick due to menstruation. Functioning toilet with menstrual hygiene management facilities are necessities that should be in school at all times if gender equality and girls empowerment is to be achieved.

Keywords: menstruation; school girls; gender friendly toilets; menstrual hygiene; knowledge and awareness; Hyderabad, Pakistan

Generating Curve Number Grid for Left Bank Outfall Drain (LBOD) Catchment using GIS and Remote Sensing

Authors: Muhammad Nauman¹, Dr. Kamran Ansari², Daniyal Hassan¹, Moazzam Ali Rind¹, Abdul Basit¹, Sumaira Zafar³

¹MS Student, U.S.-Pakistan Centers for Advanced Studies in Water, MUET, Jamshoro

²Professor, U.S.-Pakistan Centers for Advanced Studies in Water, MUET, Jamshoro

³Lecturer, Institute of Space Technology, SUPARCO, Karachi

Abstract

Determination of soil Curve Number (CN) in the Soil Conservation Service (SCS) method is essential to determine the runoff potential of any catchment. The method of SCS-CN and the values of CN were developed in the USA in 1954. CN values can easily be obtained from SCS-CN tables which are based on the hydrologic soil group (HSG), land use land cover, hydrologic conditions, and land management practices. Currently, Geographical Information System (GIS) and Remote Sensing (RS) techniques have augmented to a large degree the conventional methods used in the hydrologic analysis. In this research, SCS-curve numbers for Left Bank Outfall Drain (LBOD) catchment was generated using GIS tools and RS data. Maps of land use land cover showing six types (irrigated, forest, urban, barren land, natural vegetation, and water) and HSG were employed in the analysis. A CN grid was developed combining these maps in HEC-GeoHMS, a hydrology tool of popular GIS software ArcGIS 10x, and SCS-CN table. For accuracy assessment of the results, simulated peak flows using CN values were compared with the gauge data at the outlet of the catchment that happened to be in a good agreement verifying the accuracy of CN values.

Keywords: GIS, HEC-GeoHMS, HSG, Remote sensing, Runoff, SCS-CN

GIS Based Approach for Estimation of Area under Wheat and Other Major Rabi Crops in District Ghotki and Corresponding Irrigation Water

Authors: ¹Shoukat Ali Shah, ²Altaf Ali Siyal

¹Institute of Water Resources Engineering & Management (IWREM), Mehran University of Engineering and Technology, Jamshoro, Pakistan

²USPCAS-W, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Abstract

Accurate and reliable information about crop acreage, yield, and water requirements immediately after sowing is desirable for the local, regional and international agricultural markets to predict the grain prices well in advance. The present study was thus carried out to estimate the area under major Rabi crops and the corresponding irrigation water requirements for district Ghotki using GIS and Remote sensing tools. The field and historical data were gathered and analyzed statistically while satellite data was classified using ArcGIS 10.3 software. Based on satellite data, it was estimated that wheat was a major Rabi crop of Ghotki district during 2016-17, which was cultivated over an area of about 123427 ha, occupying about 19.39% of the total geographical area of the district. While, the sugarcane was second major Rabi crop, which was cultivated over an area of about 49116 ha in 2016-17, occupying about 7.72% of the total geographical area of the district. A good linear and positive relationship between the wheat crop yield and the NDVI with a coefficient of determination of $R^2 = 0.90$ was observed. A good relation between historical cultivated area and the total production of the wheat and sugarcane with $R^2 = 0.85$ and $R^2 = 0.97$ respectively was observed. The total irrigation water requirement for the district during Rabi season 2016-17 was estimated as 0.962MAF while the irrigation water distributed by the SIDA to the Ghotki district for the Rabi period was 0.72 MAF at the field. Thus, a shortfall of 0.242MAF (or about 25.1%) might have been supplemented from groundwater. Based on the present study it is recommended that Remote sensing and GIS tools should be used for timely, accurate and reliable cropped area estimation and yield forecast of agricultural products as well as irrigation water requirements in other districts of Sindh.

Keywords: Wheat; NDVI; Crop water requirement; GIS; Remote Sensing.

Absorption Epidemiological Assessment of Air Pollution of Gujrat with Using GIS for Mapping.

Authors: Maria Shafi, Maham Noor, Rabia Aslam, M. Haroon Asghar, Muhammad Qasim

Department of Environmental Sciences, University of Gujrat.

Abstract

Environment is considered as the most crucial part of this Earth. According to WHO 50% of the global chronic Respiratory diseases are totally linked with air pollution. Different kinds of Risk Pollutants like Ozone, PM 2.5, PM 10, Ozone, NO₂ are creating alarming situation on Health of Road side Vendors. People are suffering from different respiratory diseases such as disfunctioning of Lungs, Laziness, Fatigue, Cough and Asthma. Traffic is increasing day by day which causes harmful impacts on Road Side Vendors. The data is collected from Road Side Vendor of Gujrat City, Pakistan. The main objective of this study was to check the effect of pollutants which alter the functioning of bodies of Road Side Vendors. The theoretical framework also used to explain that vehicular emission effects the health of human beings when it enters in the human body. The statistical analysis concluded that increase in number of vehicles will ultimately increases the percentage of Air emissions which will effects the quality of life. It is need of an hour to control these emissions. It is only possible when we create awareness among people about their health. Occupational Health and safety studies should be given by arranging seminar, workshops etc. Deforestation should be prohibited. Trees should be plant along each road to lesser the level of air pollution and improve the quality of Air. This data is very helpful for Government and NGO's Department.

Keywords: Epidemiological, Assessment, Air Pollution, GIS, Mapping.

Evaluation of the Influence of Different Rates of Super Absorbent Polymer on Soil Properties and Yield Components of Sesame Crop with Desert Soil

Authors: Mukhtiar Ali, ME-Student IWREM MUET, Shafi Muhammad Kori, Rajesh Kumar Soothar

IWREM, MUET, SAU Tandojam

Abstract

This study was based on complete randomized block design which comprising four treatments for control and super absorbent polymers (SAP) (T0 = control without SAP, T1 = apply SAP 6 kg ha⁻¹, T2 = apply SAP 9 kg ha⁻¹ and T3 = apply SAP 12 kg ha⁻¹) with three replication and all treatments were arranged in pot experiments. The designed pots were filled with loamy sand soil, and soil samples were collected from suburban area nearby Mithi, Tharparkar. Sesame crop was selected in the experiment because it was the most popular and commercial crop in this region. Results indicated that the soil dry bulk density and porosity, and water holding capacity was significantly affected and soil holding capacity was increased from 24 % to 35 % with the application of SAP. Similarly, pH and EC of the soil was significantly decreased with the increased SAP application. Moreover, crop yield and water use efficiency were slightly increased along with the increase of SAP application as compared to control. The statistical analysis of results shows that the plant height was significant at $\alpha=0.05$ and other growth components like as stem girth, numbers of the capsule, length of capsules and test weight were non-significant at $\alpha=0.05$. As concern to climate change projection, the application of SAP dose at 12 kg ha⁻¹ is appropriate for sesame production in desert soil. Future research is necessary to increase the level of certainty regarding the effects of SAP application on soil properties, crop growth components and performance along with the effect on the soil-plant and water regime under pitcher irrigation method.

Keywords: Super Absorbent Polymer, water holding capacity, Thar desert soil, water use efficiency, sesame crop

Grey water Generation, treatment and its Utilization for Plantation in Educational Institutions

Authors: Agha Danish Ilyas^{1*}, Syeda Sara Hassan¹, Manzoor-Ul-Haq Rajput²

¹U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology (MUET), Jamshoro, 76062, Sindh Pakistan

²Chemical Engineering Department, Mehran University of Engineering and Technology (MUET), Jamshoro, 76062, Sindh Pakistan

Abstract

Fresh water has become scarce in most countries of the world. The trend is shifting towards utilization of reclaimed water for non-potable purposes. Greywater generation is estimated by observing the grey water generation in Abdul Qadeer Khan Afghan Hostel present in Mehran University. It is found to be 60 liters/capita/day from washbasins and bathrooms. There are 12 hostels under the administration of Mehran University. Total numbers of residents in Mehran University are 1890, which collectively produce 113 m³ grey water per day. It is a huge resource which can be utilized for irrigation purpose, and for watering trees in a semi-arid environment. For grey water treatment, Green Roof Water Recycling System (GROW) along with UV disinfection has tested. These types of treatment systems rely on attractive plants and natural microorganisms to treat the water so that it can be safely re-used. The removal efficiency of the GROW system was total coliform 85.77%, E. coli >82%, COD 46.9%, phosphate 67.3% and nitrate 64%. The UV-disinfection system is suggested to use in line with the GROW system to reduce the microbial contamination for safe use. In this research Moringa Oleifera (Native name, Suhanjna) trees are suggested to plant in the Jamshoro campus of Mehran University. It will help in sequestering carbon dioxide (CO₂) and generating biomass, which can be utilized as a fodder crop. It can also be used for edible purposes. The estimated landscape area was 5.5 acres can be irrigated through the greywater. About 2473 trees can be irrigated with the greywater, with the 3*3 m² distance between the trees. It would cause a significant increase in a plantation at Mehran University. Greywater reuse is suggested in other educational institutions as well, to increase plantation and CO₂ sequestration. Greywater reuse would be one of the auspicious sustainable solutions towards the issue of water scarcity and in achieving SDG-6.

Keywords: Greywater; generation; plantation; Sustainable; CO₂ sequestration

Impacts of soil salinity on organic matter decomposition rate: Laboratory incubation

Authors: Samina Muhammad Akram Awan¹, Saeed Akhtar Abro, Rabia Asma Memon, Sanam Naz Junejo, Muhammad Nawaz Kakepoto and Aijaz Ali Otho

Plant Ecology and Environmental Biology Laboratory, Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan

Abstract

Saline soils are commonly reclaimed by adding organic amendments particularly cattle dung mixing in soil at various rates. The effectiveness of organic manures in reclamation is dependent on how fast and effective they decompose? To assess the rate of organic matter decomposition rates under saline conditions, a laboratory incubation experiment was conducted with natural saline soil [ECe 8.04 dS/m, pH 8.4 and TDS 4020 mg/l] along with non-saline normal soil [pH 7.9, ECe 0.22 dS/m, TDS 110 mg/l]. The soil was incubated in columns made with polyvinyl pipes with 2% cow dung with 50% constant moisture at room temperature for 84 days. The cow dung was mixed in soil at P1= top 2 inch soil layer, P2=mixed throughout column and P3= at bottom 2 inch soil layer. The CO₂ produced through respiration during organic matter decomposition was trapped in beakers containing 50 ml solution of 1M NaOH which was titrated with 0.5 M HCl. The CO₂ was measured after 3, 7, 14, 28, 42, 56, 70 and 84 days of incubation. Results suggest that there was a significant difference for CO₂ evolution between saline and non-saline soils. The CO₂ evolution was lower during the initial and final days of decomposition while it was highest after 14 days of incubation.

Keywords: Saline sodic soil, CO₂ evolution, Decomposition rate, cow dung

Growth response of leafy vegetable Purslane (*Portulaca Oleracea* L.) to soil applied NaCl stress

Authors: Sanam Naz Junejo 1, Saeed Akhtar Abro, Rabia Asma Memon, Muhammad Nawaz Kakepoto, Samina Muhammad Akram Awan and Aijaz Ali Otho

Plant Ecology and Environmental Biology Laboratory, Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan

Abstract

Soil salinity is one of the biggest crop growth and yield limiting abiotic stress around the world. Only halophytes or crops with sufficient salt tolerance may withstand this stress without growth and yield losses. The present study was conducted to evaluate the tolerance level of common leafy vegetable Purslane to soil applied NaCl salinity. A pot experiment was conducted with soil applied NaCl stress at 50, 100, 150 and 200 mM levels along with non-saline control. About 06 seeds of Purslane were sown in each pot when they grew to two leaf stage the NaCl salt solution prepared in respective concentrations was applied. The plant growth, in the form of above ground shoot length, number of branches and number of leaves was recorded weekly to analyze the growth rate of plant. The results suggested that there was a significant decrease in growth rate of Purslane under salt stress as compared to normal control. The salt treatment effects were 200 mM > 150 mM > 100 mM \pm 50 mM > Control.

Keywords: Salt stress, NaCl, Salt tolerance, growth rate, Purslane, leafy vegetable

Use of saw dust and sugarcane bagasse to lower TDS levels in brackish water

Authors: Ghulam Farooque Soomro¹, Saeed Akhtar Abro¹, Aijaz Ali Otho¹

¹Plant Ecology and Environmental Biology Laboratory, Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan

Abstract

Brackish water can be made suitable for agriculture irrigation when its TDS (total dissolved salts) levels are brought under the limits of safe levels. Use of organic sorbents to remove impurities from aqueous solutions as well as polluted water is a safe and promising technique. The present study is a preliminary assessment of effectiveness of two organic wastes i.e. saw dust and sugarcane bagasse to lower TDS levels in brackish water. Three gravity filters were prepared in glass burette (each 60 x 02 cm) filled with Saw dust, sugarcane bagasse and a layering of saw dust and sugarcane bagasse (with 0.5-2.0 mm and 2.0-4.0 mm particle sizes respectively). Each burette filter was filled with washed gravel (2.0-2.5 mm particle size) at bottom 3.0 cm. Above gravel layer 28 cm of saw dust alone, 28 cm of sugarcane bagasse alone and 20 cm of each saw dust and sugarcane bagasse were placed to prepare three separate filters. The brackish water collected from RBOD (right bank outfall drain) was stored in adjustable separating funnel and an adjusted amount of liquid was passed through the filters with constant flow rate. The TDS levels of original and filtered water were analyzed. The filtrate passed through gravity filters made with saw dust, Sugarcane bagasse and a mixture of both showed final TDS of 5600, 9600 and 2510 mgL⁻¹ respectively. Therefore the saw dust alone, Sugarcane bagasse alone and a mixture reduced 60.83%, 32.86% and 82.44% TDS respectively out of 14300 mgL⁻¹ initial TDS value.

Keywords: Brackish water, Saw dust, Sugarcane bagasse, TDS, Organic sorbents

Effectiveness of Raised-Bed Irrigation in Comparison to Conventional Techniques for Growing of Cotton Crop

Authors: Uroosa Memon¹, Muhammad Munir Babar², Nazar Gul³ and Allan Andales⁴

¹U.S.-Pakistan Centre for Advanced Studies in water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

²Drainage and Reclamation Institute of Pakistan (DRIP), Tando Jam, Sindh, Pakistan

³Colorado State University Fort Collins, CO, United States

Abstract

A field experiment was conducted in the Tando Jam region of Pakistan to evaluate the effect of three different irrigation techniques i.e. raised-bed (T1), ridges (T2), and flat-bed (T3) on the chemical properties of soil, yield, agronomic parameters, water used, and water productivity of cotton crop. Results showed there was a very small change after harvesting in the chemical parameter of soils, i.e. EC_{se}, pH, SAR, ESP. Statistically, results showed that non-significance ($p > 0.05$) difference between the treatment before and after harvesting in the soil parameter. Total irrigation water was applied to the treatment T1, T2, and T3 (527.5 mm, 755.8 mm, 820.8 mm) respectively. Water saved for the T1 treatment was 36% compared to T3 and 30% with T2. Statistically results indicated a significant difference ($p < 0.05$) found in the water applied between T1-T3 treatment, and a non-significant ($p < 0.05$) difference was found under the T1-T2 treatment. As a result, we also found a higher water productivity for T1 (0.74 kg/m³) compared to T2 (0.46 kg/m³) and T3 (0.32 kg/m³). A statistically significant difference ($p < 0.05$) was found in water productivity between the T1-T3 treatment but there was a non-significant difference ($p > 0.05$) found between T1-T2 treatments. The yields obtained for T1, T2, and T3 treatment were (3890.01, 3228.97, 2623.85) kg/hect respectively. Except for biomass, Monopodial, Sympodial, Plant Height, Bolls (Nos. plant⁻¹) were observed maximum for T1 treatment compared to conventional irrigation techniques i.e. T2 and T3. The irrigation water applied was of a good quality for each treatment throughout the experiment. Therefore, raised-beds would be put in practice to save water to achieve higher water productivity without any impact on the yield in water scarce areas. Future study will be needed to evaluate the salinity appraisal between the treatments using sufficient data availability.

Keywords: Raised bed, conventional irrigation techniques, cotton crop, yield, water productivity

Assessment of Water, Sanitation and Hygiene (WASH) Facilities, Accessibility and Functionality in Primary Healthcare Centers of District, Hyderabad

Authors: Sumra Arain, Rasool Bux Meher, Jamil Soomro

US Pakistan Center for Advanced Studies in Water MUET, Jamshoro, Sindh Pakistan

Abstract

The Adequate drinking water, proper sanitation and good hygiene are important aspects to consider in healthcare settings, for the delivery of improved healthcare services to patients and also to prevent associated healthcare infections. A descriptive cross-sectional study was conducted in public primary health care centers (PHCCs) of Hyderabad, Pakistan, with objectives to assess the accessibility, functionality and quality of water, sanitation and hygiene (WASH) facilities in public PHCCs of Hyderabad and to measure satisfaction level of patients with regard to WASH facilities offered in PHCCs. Two closed-ended questionnaires were used for data collection, to assess WASH facilities, and to measure the level of satisfaction of patients concerning WASH facilities. The data was collected from randomly selected 29 PHCCs registered with the District health department. Patients voluntarily participated in the study, which selected from each healthcare center using systematic random sampling. A pre-structured validated questionnaire was designed to interview Head of PHCCs and randomly selected patients. Our study shown that the majority of the PHCCs were using surface water, i.e., 20 (69%), groundwater was being used by 6 (21%) health care centers, 2 (7%) have both sources of water for other uses but 1 (3%) reported that there is no water source in facility. More than half, i.e., 16 (55%) of facilities encountered water breakdown for more than three days in last six months. Out of 29 PHCCs 6 (21%) PHCCs' in-charge reported that the drinking water is unavailable for patients. However, 16 (55%) centers were using direct tap water as drinking water without any treatment. Hand-wash basin and soap facility were found missing in 8 (28%) PHCCs. 14 (48%) PHCCs were not separating infectious, non-infectious and general waste by source. Results of percentage of patients' satisfaction responses resulted that (42.9%) responded for extremely dissatisfied for drinking water quality of PHCCs and (52.1%) responded satisfied for the walking time to reach drinking water point. Whereas, (44.3%) patients responded extremely dissatisfied and (35.7%) responded dissatisfied for the cleanliness of whole PHCC. Also, (27.1%) patients responded extremely dissatisfied and (31.1%) patients responded dissatisfied for sanitation of toilet. Likewise, (21.1%)

patients responded extremely dissatisfied and (26.4%) patients responded dissatisfied for accessibility of waste containers in PHCCs. Based on our findings, we presume high risk of hospital-acquired infection in our study population. The decision makers should consider hospital WASH on their high agenda and use health care facilities as a place to promote WASH.

Keywords: Primary; healthcare; water; sanitation; hygiene; patient; satisfaction

Evaluating the Effectiveness of the Linear Anionic Poly-Acrylamide (LA-PAM) to Reduce the Hydraulic Conductivity of the Soil

Authors: Nadir Nizamani, Munir Babar.

United States Pakistan Center for Advanced Studies in Water, MUET, Jamshoro

Abstract

The Linear Anionic Poly-Acrylamide (LA-PAM) is tested in the laboratory to reduce the hydraulic conductivity of the soil. The objectives of this paper were to examine the effects of different LA-PAM concentrations along with the total suspended solids (TSS) on the saturated hydraulic conductivity of the soil. The falling head method and constant head method were used to calculate the hydraulic conductivity of the soil. The LA-PAM concentrations of 5mg/l, 20mg/l, 50mg/l, and 100mg/l and the TSS values of 4mg/l, 379.5mg/l, and 759mg/l were used in the experiments. The results indicated that with a constant TSS value and with the LA-PAM concentrations of 5mg/l, 20mg/l, 50mg/l, and 100mg/l, the percentage reduction in the saturated hydraulic conductivity was observed 60%, 64%, 82%, and 91%. The saturated hydraulic conductivity with a constant value of the LA-PAM and with the TSS values of 4mg/l, 379.5mg/l, and 759mg/l was decreased to 74%, 82%, and 80%. The results showed that higher the LA-PAM concentration, greater is the reduction in the saturated hydraulic conductivity of the soil and there is a small effect of TSS on the saturated hydraulic conductivity of the soil. This study guided that the reactivity of the LA-PAM depends on the amount of the mineral composition present in the water e.g., sodium, calcium, and magnesium, not on the increase percentage of the total suspended solids.

Keywords: LA-PAM; Total Suspended Solids; Hydraulic conductivity of the soil

Concentration of heavy metals in fish species in the Keenjhar Lake, Pakistan

Authors: Raima Mehmood¹, Uzma Imran¹, Asmat Ullah¹

¹U.S.-Pakistan Centers for Advanced Studies in Water, Mehran University of Engineering & Technology, Jamshoro, Pakistan

Abstract

The aquatic environment of Keenjhar Lake is being polluted by heavy metals. The main sources of these heavy metals are untreated effluents from the industrial sector, domestic wastewater, and agricultural runoff. The heavy metals accumulate in the tissues of different organs of aquatic organisms, especially in the fish species. Commonly consumed fish by local people i.e. fishes (Cyprinus Carpio, Solea solea, Siluriformes, Anguilliformes and Cirrhinus cirrhosus) were collected from three distinct locations from the lake and metal concentrations were analyzed. Muscle and liver tissues were dissected and kept in freezer at -4 °C temperature. Later, frozen dissected tissues dried for overnight at 105°C in an oven. Then, all dried muscles and livers were crushed, grinded and sieved to get the homogenized material. A microwave digester (CEM MARS 6) was used to digested fish samples. Atomic Absorption Spectroscopy (AAS) were used for analyses of metals such as cadmium (Cd), copper (Cu), nickel (Ni), and chromium (Cr). Chromium and copper were found in the fish tissue in concentrations of 4.9 and 6.9695 mg/kg, respectively, which is above permissible limit of US EPA.

Keywords: Heavy metals; Chromium; Copper; Fish; Keenjhar Lake; Aquatic environment.

Impact Assessment of Combined Effluent Treatment Plant on KB Feeder Canal

Authors: Ahsan Latif^{1*}, Uzma Imran¹

¹US Pakistan Center for Advanced Studies in Water
Mehran University of Engineering and Technology Jamshoro

Abstract

This study highlights the spatial and temporal variation of quality of water and sediment in K.B Feeder canal which is affected by the effluent released from combined effluent treatment plant Kotri. In water quality parameters physical and chemical parameters including few metals were analyzed i.e. pH, Temperature, Turbidity, Dissolved Oxygen, Electrical Conductivity, Total Dissolved Solids, Lead, Copper, Cadmium, Iron and Chromium, Arsenic. Only metals were analyzed in sediment. Water and sediment samples were collected from seven different locations starting from Kotri barrage to the Kotri city downstream of the combined effluent treatment plant. Two samples of influent and effluent were collected from the CETP that treat the effluent of most of the industries located in Kotri. The physical parameters were analyzed at site and metals' samples were filtered, acidified and digested using nitric acid in the laboratory. Atomic Absorption Spectrophotometry was used to analyze metals concentration. According to obtained results, it is observed that the physical parameters were in range before the treatment plant but near the treatment plant the concentration increased due to mixing of treated effluent from treatment plant. Metals results were varying on different location in water and sediment. Some parameters are in higher concentration at the effluent as compare to influent that affect the fresh water canal whose water is used for agriculture, drinking and domestic purpose. People and live stocks are affected directly or indirectly by using contaminated water. The spatial and temporal variation of results were represent using MS-Excel tool and risk exposure assessment of metals were identified using mathematical modeling tool.

Keywords: CETP; KB-Feeder Canal; Heavy metals.

System Dynamics Modeling for Domestic Water Management: A case study of Hyderabad City Sindh, Pakistan

Authors: Uzma Jabeen, Rakhshinda Bano

US- Pakistan Centers for Advanced Studies in Water, Mehran University of Engineering and Technology

Abstract

Hyderabad is the second largest city in Sindh with a population of 2.199 million people. It leads the country in population density per km². Filter plants have the capability to supply 60 MGD (Million Gallons per Day) as annual average but demand on water supply system is so massive that the total amount of water supply does not fulfill the requirement of the city. Factors such as population and urbanization are contributing to water supply shortage and the unavailability of the water supply is emerging as the greatest risk. In this study, a computer simulation tool known as Stella is used to develop casual loop diagram and stock flow diagrams through (SD) System Dynamics modeling from 2007 to 2030. Causal loop diagrams are developed to describe connections between population and water consumption sectors with feedback loops. Thus, the novel System Dynamics modeling is used to identify impacts of various population growth rates on water consumption and water deficit through scenario analysis. Three population growth rate scenarios (baseline, high population growth rate and low population growth rate) are considered with different values. Consequently, the model simulation results of annual water consumption in 2030 are 0.13 km³/yr, 0.18km³/yr, and 0.1km³/yr, correspondingly, water deficit under these scenarios are -0.04km³/yr, -0.09km³/yr and -0.01km³/yr respectively. The coefficient of determination ($R^2 = 0.99$) which shows a positive linear relationship between the variables. Therefore effective measures should be taken for ensuring sustainability of the future domestic water supply in Hyderabad City.

Keywords: System dynamics, scenario analysis, water consumption, water deficit

Temporal Variation in the Surface Area of Ghamu Bhar Glacial Lake Using Geospatial Techniques

Authors: Imran Khan, Dr. Asmat Ullah, Dr. Arjumand Zaidi, Vengus Panhwar

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

Glacial lake outburst flood (GLOF) is the sudden release of high volumes of water from a glacial lake. Often initiated by the collapse of the dam holding the glacial lake, GLOFs result in catastrophic damages downstream within no time. The rising global temperature has enhanced the melting of glaciers, resulting in the expansion of existing and formation of new glacial lakes and ultimately exacerbating the frequency and magnitude of GLOF. In this study, satellite data is used to map the variations in the surface area of Ghamu Bhar glacial lake in district Ghizer, Gilgit-Baltistan. LANDSAT satellites images from 2000 to 2016 were studied for lake area change detection. Supervised classification was applied to extract the area of the glacial lake. The area of the lake was mapped using ArcGIS software for various years during the study period. The area of the lake in each year was plotted against the average temperature in the corresponding year. Results of the study show that the lake area in 2016 is more than 400% of that in 2000, which is a significant increase. In 2000 the area was 0.0252 km², which became 0.1314 km² in 2016. Since the surface area is greater than 0.1 km², Ghamu Bhar falls in the potentially dangerous glacial lakes. Also, there is a direct correlation between the surface area of the glacial lake and the average annual temperature of corresponding years. The increasing surface area of the glacial lake is an indicator that the threat of a GLOF from the lake is also increasing. Therefore, continuous monitoring of the lake is necessary to reduce the vulnerability of the people by informing them about the lake condition.

Keywords: ArcGIS, ENVI, GLOF, potentially dangerous, remote sensing.

Waterborne diseases, Healthcare Cost and Health seeking Behavior of Urban Slum in Hyderabad

Authors: Imdad Ali Nizamani, Jamil Ahmed, Aneela Yasmin, Muneer Qazi

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

Urban slum are illegal settlements, where people live in a congested population, having poor excess to potable water and sanitation facilities. Due to the poor WASH services Slums carries high burden of communicable diseases. Since they are mobile population so the general population is also at great risk.

Our study aimed to carry out slums mapping, assess water sanitation and hygiene (WaSH) facilities and identify the prevalence waterborne diseases, healthcare cost and health seeking behavior in urban slums of Hyderabad. We used Health Department Social Map to find out slum settlements. We identified 17 slum locations, while three houses taken randomly from each slum area and finally we assessed 51 houses. The water samples from each house were also analyzed for fecal contamination.

A structured questionnaire was designed & validated. The questionnaires include socio demographic indicators, information on WASH related diseases and health seeking behavior. The slums mapping was done using GPS coordinates. The data was analyzed on SPSS version 23. Our findings revealed that Wash facilities are not appropriate in slum settlements; majority of population is using ground water (68%) which is fecally contaminated (60%) and mainly reported to causes diarrhea (56%). We also found that the drinking water quality as well as sanitation facilities are not appropriate in majority of the slums. Due to increase prevalence of WASH related diseases among slums the morbidity and mortality in our slums is too high on one hand, whereas on other hand the healthcare cost leading to extreme poverty in the end. Interventions focusing diseases prevention such as the provision of improved drinking water supply, better sanitation can be initiated at subsidized rate by the government may result in the reduction of diseases and improvement in the quality of life of slum.

Keywords: Wash facilities, waterborne diseases; Microbial analysis; Healthcare cost

Performance Evaluation of Solar Tube wells for Waterlogged and Salt-affected Soil in District Shaheed Benazirabad

Authors: Aqeel Ahmed^{1*}, Abdul Latif Qureshi², Shafi Muhammad Kori³

¹MS student Hydraulics Irrigation and Drainage, USPCAS-W, MUET, Jamshoro

²Professor Hydraulics Irrigation and Drainage USPCAS-W, MUET, Jamshoro, Pakistan

³Professor Department of Civil Engineering, MUET, Jamshoro, Pakistan

Abstract

Some soluble salts are always present in the soil, when these salts exceed certain limits, they adversely affect crop growth and crop yield. The present study was conducted to evaluate the impact of solar tube wells installed at the waterlogged and salt-affected soil in district Shaheed Benazirabad. Four sub-sites of the selected district were chosen for the study such as; (1) Village Saleem Jalbani, (2) Makhdoom Farm, (3) Village Qazi Ilyas, and (4) Balu Ja Quba, where the Government of Sindh installed the solar tube wells to lower the groundwater levels and to improve salt contaminated soil. The soil samples were collected two times; first on 20th September 2017 and second on 25th December 2017 after three months interval at the depth of 0-15.24 cm and 15.24-30.48 cm from the selected sites to assess the tube wells water extraction effect on possible change in the soil. To check the performance of these tubewells, four piezometers were installed to monitor the water table periodically. The results indicated that waterlogging is reducing temporarily by extracting the saline water. The Physico-chemical analysis of the soil samples was conducted for the parameters such as; pH, E_{Ce} (electrical conductivity), TDS (total dissolved solids), Chloride, and SAR (sodium adsorption ratio) in the soil and Water laboratory of US-PCASW MUET Jamshoro. After comparing the soil analysis (September 2017- December 2017), it became clear that the salts existing in the water remain in the soil, and the salinity of the soil increases temporarily by the capillary action of soil and the extraction of saline water such as; pH varies from 8.11 to 8.27, E_{Ce} 3783-3834 mS/cm, TDS 2450-2492 mg/L, Chloride 297-345meq/L, and SAR 10.37-10.48. Water level has been decreased an average of about 85 cm in 03 months duration i.e. from December 2017 to March 2018. The results suggest that after extracting enough saline water, the soil reclamation is needed to remove the salts present in the soil.

Keywords: Water table monitoring, solar tube wells, Salt-affected soil, Physico-chemical properties, district Shaheed Benazirabad.

Keywords: Water table monitoring, solar tube wells, Salt-affected soil, Physico-chemical properties, district Shaheed

Water quality and health risk assessment of harvested rainwater at Tharparkar

Authors: Kanwar Malhi, Kamran Ansari, Muneer Ahmed Qazi, Jameel Ahmed Soomro

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

Water scarcity is a burning issue not only for Pakistan but for the entire world as well. Tharparkar is an arid region and source of water is only ground water. However ground water of Tharparkar is heavily contaminated with fluoride and arsenic. In such circumstances, people harvest rainwater and consume it for their livelihood. Storage time and structure affects the quality of rainwater. This study is based on the assessment of water quality and health risks of rainwater. Fifteen locations from district Tharparkar were randomly selected. Samples were collected after every twenty days from the same locations and analyzed in the lab. It was found that, with the passage of time, quality of water decreased from good to the worst condition. Mean turbidity value increased from 25.71 NTU to 41.42 NTU and 68.47 NTU respectively. Mean pH value increased from 7.71 to 7.74 and 7.85 respectively. Mean TDS value increased from 588 ppm to 650 ppm and 820 ppm respectively. Results also indicated that roof harvested water had the lowest turbidity of 2.91 NTU, whereas Nadi pond had 26.61 NTU and Dam had 63.91 NTU. Mean pH value of roof harvested water was found to be 7.83 whereas that of Nadi pond and dam was 8.57 and 8.92 respectively. Mean TDS value of roof harvested water, Nadi pond and Dam was 230.33 ppm, 587.33 and 1387.44 ppm respectively. The presence of microorganism in water carries risk to health of the consumers. The hospital statistical data on study settings, also supplemented our findings that the waterborne disease like diarrhea and gastro were common in the area, where rainwater was used as a drinking water source. Water quality results also indicated that mean value of total coliforms increased from 19.733 CFU to 51.6 CFU and 75.6 CFU respectively. The mean value of Fecal Coliform also increased from 6.2 CFU to 19.46 CFU and 38.86 CFU. Therefore, rainwater cannot be drunk without treatment. Alum should be used to lower the value of turbidity and water should be boiled in order to kill the harmful pathogens.

Keywords: Tharparkar, rainwater harvesting, storage structure, water quality, health risk

Future projections of temperature in Pakistan using high resolution downscaled simulations

Authors: Mehran Sattar¹, Ghulam Hussain Dars¹

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

Climate change is an established fact and its adverse consequences in Pakistan are well known. Even though Pakistan is among the least contributors of green-house gases, it is one of the most vulnerable countries. Since, it is ranked as the 8th most effected country on the global climate risk index (CRI, 2016). This study aims at downscaling 08 global climate models (GCMs) under two representative concentration pathways (RCPs) i.e. RCP 4.5, RCP 8.5 for projecting annual mean temperature for whole Pakistan for the period of 2040-2070 relative to the historic period of 1960-1990. The models are downscaled at grid resolution of 1x1 km and bias corrected using Climate Research Unit (CRU) Data. The multi model ensemble shows a consistent increasing temperature across the country. The results show an increase of 1.5 °C to 4°C, being highest in western parts of Baluchistan and lowest at the coastal line and Sindh province. Whereas, northern parts where the Indus River originates illustrate the temperature difference of 2.5°C. Moreover, the results indicate that the eastern parts of Pakistan including Sindh and Punjab show less uncertainty while western parts including Baluchistan, K.P.K and F.A.T.A show greater uncertainty in projections. The increasing temperatures have serious implications for the glaciers, water resources, energy and food security. This study can help in the hydrological modeling, crop water modeling and to devise adaptation strategies for the country.

Keywords: climate change; future projections; global climatic models; annual mean temperature; uncertainty analyses.

Water Sanitation and Hygiene facilities and student's satisfaction appraisal in Higher Education Institutes

Authors: Ubed Ur Rehman, Dr. Jamil Ahmed, Dr. R.B Mahar, Dr. Aneela Yasmin

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

Pakistan is the world's 36th most water-stressed country. One out of every three schools has no availability of clean drinking water. Two out of every five schools do not have a toilet facility. Every year 39,000 children under the age of five die, due to diarrhea. Adequate Water Sanitation and Hygiene (WASH) facilities at educational institutes not only benefit health outcomes, but they enhance educational outcomes and reduce gender disparities as well. Inadequate water supply also results in dehydration and leads to poor educational outcomes

Our study aimed to assess the quality of available WASH facilities and student satisfaction regarding those facilities, in two public sector universities of Jamshoro i.e Mehran University of Engineering and Technology (MUET) and University of Sindh (UoS) Jamshoro.

A cross-sectional study was done to assess WASH facilities of 10 departments/buildings and students satisfaction appraisal regarding those facilities by interviewing 300 students. The stratified random sampling was used to select department from each university and to further enroll required students within each department. The survey was supplemented by drinking water sampling for analysis of bacteriological quality of water such as Total coliform and faecal coliform. WASH resources were appraised through structured observations. For student's satisfaction appraisal, five-point likert scale questionnaire has been developed and filled.

The results revealed microbial contamination in the majority of drinking water samples. 95% handwashing stations doesn't supplied with soap / detergent for handwashing. Approximately, 65-70% of the students were dissatisfied with the available hand washing facilities, for example the non-availability of water, soap / detergent in the handwashing stations. 70% of the students were satisfied with the available water quantity, 52% were satisfied with the water quality, 40-45% students were satisfied with toilets availability, functionality and ventilation. Overall, student's satisfaction was 52%.

Characterization and Quantification of Produced Water from Bobi Oil Field Sanghar

Authors: Imran Khan¹, Abdul Jabbar Laghari², Rasool Bux Mahar³

¹Institute of Environmental Engineering & Management MUET Jamshoro, Sindh, Pakistan

²Dr. M. A. Kazi Institute of Chemistry University of Sindh, Jamshoro, Sindh, Pakistan

³U.S.-Pakistan Center for Advanced Studies in Water MUET Jamshoro, Sindh, Pakistan

Abstract

Produced water is co-produced with petroleum production. It is very toxic and containing dissolved solids which can be harmful to the environment. This study comprises of collection of samples, quantity and laboratory base analysis of produced water. Sampling points include well site, main facility site and final disposal pond of Bobi Oil Field Sanghar. Produced water quantity is measured as 1600 barrel per day according to daily monitoring reports, which increases with time as new explored wells will connect with the main facility. Samples are characterized, and their results were interpreted with the National Environment Quality Standard recommended by Sindh Environment Protection Agency. Parameters obtained from characterization are phosphate, nitrate, sulfate, total dissolved solids, electric conductivity, chlorides, pH, hardness & metal which are Lead, Iron, Manganese, Nickel, Chromium, Zinc, Calcium, Magnesium, Sodium and Oil & Grease. Results showed that quantity of sulfate, nitrate, and phosphate are within acceptable limits, and on the other hand, TDS exceeded required limits which are 1650 mg/L to 162000 mg/L. The electric conductivity ranged from 4 to 335 mS/cm, and pH ranges from 5.5 to 6.4. Chlorides observed high 1050 mg/L to 109800 mg/L. Ranges of hardness found 88 mg/L to 2592 mg/L. Amount of Na found 250 mg/L to 1319 mg/L. Value of K found 4 to 378 mg/L. Mg observed 20.5 mg/L to 260.1 mg/L and Ca observed 56 mg/L to 2379.75 mg/L. Cu observed higher than acceptable values except for pit site which is 1.5 mg/L to 3.3 mg/L. While Ni, Pb, Fe, Cr, and Mn observed in acceptable limits. The concentration of Oil & Grease observed higher which is 339 mg/L to 950 mg/L. Conclusion was made that if produced water will not be handled and disposed off in a proper way it will have a harmful impact on the environment.

Keywords: Produced water, quality characterization, quantification, and environmental impacts.

Water treatment through Neem seeds for drinking purpose

Abstract

Recently the trend towards adopting different natural products to purify water is at its peak because of its being safe for health, readily degradable, cost effective and locally available. In this research, Neem seeds is treated and converted into bio-coagulant which can be used as an environmental friendly alternative to the inorganic coagulants. The coagulation properties of the Neem seeds were studied for the treatment of potable water for the removal of turbidity. In this study optimum pH, coagulant dose and revolutions per minutes were decided for batch experimentation. To check the efficiency of *Azadirachta Indica* for turbidity removal, the synthetic turbid water of 250 NTU was prepared by kaolin chemical in the laboratory. The turbidity was removed by adopting different doses of Neem seeds in powdered form having a size of about 0.45mm operated at varying revolutions per minutes (rpm). It was observed that the Neem seeds are more efficient in removing the turbidity up to 35 NTU at 80rpm. It was concluded that Neem seeds can effectively substitute the chemical coagulants for the treatment of drinking water. It is recommended that research on Neem seeds is required to enhance its uses and other parameters can be examined to rise its applicability.

Keywords: Neem seeds; turbidity; efficiency; drinking water.

Health effects of Brick Plant Emissions on Tando Hyder, Pakistan

Authors: Waheed Ali Khokhar¹, Hussain Bakhsh Khore², Ayaz Ali Samejo³, Uzma Imran⁴, Kaleemullah Shaikh⁵, Hira Lal Soni⁶

^{1,2,3,4}Department of Environmental Engineering, USPCAS-W, MUET, Jamshoro 76090, Pakistan

⁵Department of Mechanical Engineering, BUIITEMS, Quetta 87650, Pakistan

⁶Department of Chemical Engineering, QUEST, Nawabshah 67450, Pakistan

Abstract

In developing world, the brick plants (BPs) are polluting the eco-system due to their poor management. About 20% of the clay bricks are produced in South Asia, and Pakistan is the third largest brick producing country. For burning, the BPs use coal, local biomass, plastic, tires and other materials as fuels without any provisions for pollution controls. Tando Hyder located in the east of Hyderabad is one of the Pakistani cities, which have nearly 60 BPs. For this study, we have selected one BP. The emissions of selected BP at the outlet of the chimney were analyzed by the Testo 350 Flue Gas Analyzer for SO₂, NO₂, NO, CO, and CO₂. Total Suspended Particulates (TSP), PM₁, PM_{2.5} and PM₁₀, CO, SO₂ and NO₂ concentration were analyzed in ambient air at different five locations by the Haz-Dust Model EPAM-5000. Results show that concentration of PM_{2.5}, PM₁₀, total suspended particulates, SO₂ and NO₂ were above the National Environmental Quality standards (NEQS) by Pakistan EPA and National Ambient Air Quality Standards (NAAQS) by US- EPA. These exceeds in ambient air concentrations causes different type of respiratory and skin diseases for that we have conducted 30 surveys from people living in the vicinity of brick plants. Survey results shows that most people who are working at BP have respiratory diseases (i.e. asthma, breathing problem and TB etc.) and some people have different type of skin diseases. They expend one fourth of their monthly income for the treatment of these diseases. Results of this study will help Pakistan EPA for making guideline regarding brick plants.

Keywords: Brick Plant; Ambient Air; Flue Gas; Particulate Matters; Pakistan

A comparative study of solar, diesel and electric operated tube wells on an irrigated agriculture command area of Gul Minor in District Naushahro Feroze

Authors: Muhammad Azeem, Abdul Latif Qureshi, Shafi Muhammad Kori

U.S-Pakistan Center for Advanced Studies in Water (USPCASW), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Abstract

This research study was conducted in taluka Kandiaro district Naushahro Feroze. A baseline survey was conducted in various locations of the Gul minor in taluka Kandiaro to determine the various types of tube well network installed, which irrigate the agricultural land. Mostly, diesel power and electric operated tube wells irrigated the agricultural land in the command area of Gul minor. In study area, about 80 tube wells are operated by the diesel fuel, 20 by electrical power operated tube wells and 15 are solar power tube wells. Water is more required for the agricultural and anthropological usage, and there is no power grid network in the emergent rural areas. Therefore, the electric power operated tube wells are not reliable in the command area of Gul minor, due to break fall, and shortfall of electricity and there is no subsidies. The diesel fuel price have increased a lot due to its transportation to rural areas. The maintenance cost of diesel power operated tube well is also maximized. The most of the farmers of command area of Gul minor have replaced their diesel power and electric power operated tube wells by the solar power tube well system. The six tube wells, each pair of diesel, electric and solar, were selected in the command area of Gul minor. The discharge of tube wells, power consumption, cropping intensity, irrigation intensity, net present value and benefit cost ratio of solar tube well is higher than electric and diesel operated tube well. The life cycle cost of solar power tube wells had lower down than electric and diesel operated tube wells. Probably, solar power tube wells are environment friendly, insignificant repair and maintenance cost than diesel power operated and electric power operated tube wells. Solar power tube well is cost-effective assets than diesel power operated and electric power operated tube wells.

Simulating Chickpea (*Cicer Arietinum*) potential yield for different irrigation applications using CropSyst model

Authors: Faris Ahmed Bhatti, Asmat Ullah, Nabeel Ali Khan, Arjumand Zaidi

US-Pakistan Center for Advanced Studies in Water (USPCAS-W) Mehran University of Engineering & Technology, Jamshoro 76090, Pakistan

Abstract

Crop simulation models are being used worldwide to predict crop response to various field management practices and climatic conditions. In this study, Cropping System Simulation model (CropSyst) was used to simulate Chickpea potential yield under sprinkler irrigation system. The model was calibrated using secondary data obtained from field experiments carried out during 2016 - 2017 at Drainage and Reclamation Center (DRIP), Tandojam. Model inputs were crop parameters, soil characteristic, weather, and management data. The cultivar parameterization details were obtained from the literature. Field conditions, comprising permanent wilting point, field capacity, were specified. CropSyst overestimated the biomass, but yield was precisely calculated by the model. The yield variation under 10% to 80% soil moisture depletion levels was calculated, and their variation was recorded. The sensitivity of crop yield against varying water application regimes and under rain-fed condition (with no additional irrigation) was evaluated. The analysis of these results can lead to better decision-making for water productivity, yield, and their economic tradeoffs. The results implied that further detailed simulations could be carried out considering additional management scenarios such as; fertilizer use, soil salinity, and nitrogen uptake to record the crop response, which will help agriculturalists and water managers in optimizing water use.

Keywords: Agriculture; Crop Modelling; Chickpea; Decision Support System; Irrigation; Simulation model

Application of Simplified Surface Energy Balance Index (S-SEBI) for Estimating Actual Crop Water Requirement Using Remote Sensing

Authors: Nabeel Ali Khan¹, Rao Muhammad Zahid Khalil², Asmat Ullah¹, Arjumand Zaidi¹, Faris Ahmed Bhatti¹

¹U.S.-Pakistan Center for Advanced Studies in Water, Jamshoro 76090, Pakistan.

²National Center for Remote Sensing & Geo-Informatics, Institute of Space Technology, Karachi 75270, Pakistan.

Abstract

Accurate estimation of an actual crop water requirement (ET_a) is important to assess the stress conditions of a crop and manage irrigation accordingly. The objective of this study was to estimate ET_a for a maize field during its growing season in the sub-region of the Lower Arkansas River Valley (LARV) named Fairmont Drainage District in South-eastern Colorado, USA. In this study, the surface energy balance was used to estimate ET_a. The Simplified Surface Energy Balance Index (S-SEBI) algorithm was used to determine the instantaneous and 24-hour ET_a using eleven temporal Landsat 7 and 8 images matching with the growing season of the maize crop. The potential crop evapotranspiration (ET_c) was calculated using the American Society of Civil Engineers' Penman-Monteith (ASCE-PM) equation by the Reference Evapotranspiration (REF-ET) calculator. The results showed a statistically significant relationship ($R^2 = 0.84$) between S-SEBI derived, and ASCE-PM derived instantaneous crop evapotranspiration. The Pearson correlation between ET_a and ET_c was found to be 0.919 and 0.887 for the instantaneous and 24-hour ET, respectively. The performance and the efficiency of the S-SEBI model for the estimation of crop ET were found to be satisfactory for maize crop grown in the Fairmont drainage district, Otero County, Colorado, USA.

Keywords: ASCE Penman-Monteith; Crop water stress; Evapotranspiration; Lower Arkansas River Valley; Maize; REF-ET calculator

Vegetation Change Detection to Quantify Impact of Small Dams Using Geospatial Techniques: A Case Study of Potohar Region

Authors: Vengus Panhwar, Dr. Arjumand Zaidi, Dr. Asmat ullah

U.S.-Pakistan Center for Advanced Studies in Water, Jamshoro 76090, Pakistan.

Abstract

Remote sensing in combination with geographic information system (GIS) helps in better understanding to detect changes of landscape dynamics. A case study of rainfed areas of Potohar region of Punjab, Pakistan was conducted to illustrate the temporal variation in the vegetation cover. Normalized difference vegetation index (NDVI) has been employed using ENVI classic image processing software. Landsat multi-temporal set of images from Landsat 4-5 TM and Landsat 8 for the years 2008-2016 were used to investigate the vegetation patterns and changes in the overall region. Buffers of 500 m and 1000 m were created around the dams using ArcGIS software to identify the changes in vegetation cover after the construction of these dams. Moreover, precipitation data and Google Earth images were also used in this study to further validate the impact of dams on agriculture. The images processed in ENVI, indicates changes in the mean value of NDVI from 0.105 to 0.157, before and after the construction of the dams, respectively, which shows a significant increase in the vegetation cover. Therefore, it is concluded that small and mini-dams found to be one of the effective intervention in improving the quality of livelihood and sustained agriculture in the Potohar region, Punjab. Thus, for an efficient and sustainable rainwater management, small and mini-dams can be considered as a feasible option in other rainfed areas of the country as well.

Assessment of 21st Century Hydro-climatic Impact on Flood Plains of The Indus Delta Using Geo-spatial Techniques

Authors: Salman Mohsin¹, Vipin Kumar²

¹US Centre for Advance Studies in Water Pakistan, MUET, Jamshoro, Pakistan

²Department of Civil and Environmental Engineering, University of Utah, USA

Abstract

Indus is the biggest river of Pakistan and major source of surface water for the entire country. Mangrove forests in Indus delta located at the end of the river's path are vital life-supporting ecosystem for the coastal belt of Sindh and acts as a barrier for the protection of coastal areas against the disastrous natural phenomenon. The Indus Delta is facing serious problems, the mangroves forest along the Sindh coastal area are under extreme stress and have decreased drastically due to the impact of climate change and other anthropogenic activities. This study revealed temporal variations of climatic variables (precipitation and temperature) and flow of the Indus River downstream of the Kotri Barrage. Unsupervised classification is used for analysis of 17 images from 2000 to 2016 using ArcGIS and ENVI. Hydrological data (discharge) of the Indus river and Meteorological data (precipitation and temperature) of Badin gauging station were analyzed for 17 years from 2000 to 2016. After analysis of images it can be concluded that the mangrove cover has decreased drastically since the start of 21st century. The results reveal that mangrove cover in the flood plains of the Indus Delta was 125553.21 ha in the year 2000 which has decreased up to 66703.96 ha in 2016. The hydro-climatic variables i.e. discharge, precipitation and temperature show an inclining trend from 2000 to 2016. Regression analysis was used to develop a causal relationship between area of mangroves and the hydro-climatic variables. Analysis reveals that only 66% change of mangrove cover was explained by the hydro-climatic variables. Thus, this study could be used as a framework while planning for the sustainability of the Indus delta.

Keywords: Indus Delta, flow, precipitation, ArcGIS, ENVI

Developing and Testing of Activated Carbon Based Desiccant Material for Adsorption Desalination Applications

Authors: Afaq Ahmad¹, Uzma Imran¹, Zubair Ahmed¹, Muhammad Sultan²

¹US-Pakistan Center for Advanced Studies in Water, MUET, Jamshoro 76020, Pakistan

²Department of Agriculture Engineering, Bahauddin Zakariya University, Multan 60800, Pakistan

Abstract

Adsorption assisted desalination has grabbed attention of researcher around the globe due to the multiple advantages over conventional desalination methods. It can utilize low grade waste heat i.e. solar thermal energy, bears minimal carbon footprints, can be used for treating water with total dissolved solids above 50k. In addition to desalination, the process can be used for cooling purposes. Continuous progress in material science has made it viable technology amongst energy intensive fossil fuel-based options. Activated carbon is being used since decades for adsorption due to its superior thermal and adsorption properties. Silica gel currently being used has good tendency of adsorption towards water vapors but has poor thermal properties. Hygroscopic salts have proven enhancer for desiccant properties of materials. The current research focuses on developing a composite material with goodness of activated carbon's thermal properties and vapor adsorption properties of silica gel. Total of 11 samples has been prepared and tested with varying treatment time and concentrations of hygroscopic salt. Material characterization is performed using Brunauer–Emmett–Teller (BET) and Thermogravimetric analysis of the prepared samples. Among all the tested samples, four samples were able to give out as much as 40% of the adsorbed moisture within the temperature range of 30-135 OC. Gravimetric measurement of weight gain and loss suggests that the composites based on activated carbon has the potential to be used in adsorption desalination applications. In addition to adsorption desalination the material can be used for adsorptive heating, thermal energy storage, dehumidification and moisture sequestration systems.

Keywords: Activated Carbon; Adsorption desalination; Silica Gel.

Optimization of Pilot-Scale Trickling Filter for Wastewater Treatment at MUET, Jamshoro

Authors: Faaiz Rafique Memon¹, Rasool Bux Mahar¹, Ashfaque Ahmed Pathan²

¹US-Pakistan Center for Advanced Studies in Water, MUET, Jamshoro 76020, Pakistan

²Civil Engineering Department, Mehran UET Jamshoro

Abstract

The purpose of this study was to optimize the performance of a pilot-scale trickling filter at MUET, Jamshoro, for the biological treatment of wastewater. Wastewater generated from Textile Engineering Department was used as the influent source. Gravel was used as support medium for microbial growth for the removal of organic matter from wastewater. The plant was operated at various influent loading rates and at different depths of media. It was found that the treatment efficiency of trickling filter increased when the depth of gravel media was increased from 1.5' to 2' and 2.5', while increasing the influent loading rate from 0.5 to 1 and 2 L/min had the opposite effect. The best treatment efficiency for the removal of pollutants (BOD₅, COD and TSS) was obtained when the plant was operated at the media depth of 2.5' and the influent loading rate of 0.5L/min. At these operational parameters, the BOD₅ removal obtained was more than 89%. Other parameters such as turbidity, TDS and TSS and COD were reduced to well within the limits prescribed by the NEQS. It was demonstrated that the pilot-scale trickling filter was successful in biological treatment of wastewater and its efficiency was significantly increased by increasing the depth of media and decreasing the influent loading rate. Therefore, we recommend scaling up of the trickling filter plant to treat all of the wastewater generated within MUET, Jamshoro, as it will be a very cost effective solution for wastewater management for the campus.

Hydromorphologic analysis of a meandering river using raster analytics of remotely sensed data: A case study of the Indus River

Authors: Arslan Mahmood¹, Altaf Ali Siya^{1,2}, Muhammad Wajid Ijaz^{1,3}

¹U.S.-Pakistan Centre for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, 76062, Sindh, Pakistan;

E-Mails: engr.arslanmahmood@gmail.com (A. Mahmood);

aasiyal.uspcasw@faculty.muett.edu.pk (A.A.Siyal);

wajidijaz331@gmail.com (M.W.Ijaz)

²Department of Land and Water Management, Sindh Agriculture University, Tandojam, 70060, Sindh, Pakistan

³Environmental Protection Agency, Lahore, 54000, Punjab, Pakistan

Abstract

Climate change induced hydrological extremes exert pressure over the river channels. Human-made constrictions across the flow render a considerable effect over main channel and floodplains in terms of excessive sediment deposition. This can impact the flood carrying capacity of the river. The Indus River reach, immediate to the downstream of the Kotri Barrage was selected to analyze the spatio-temporal variability of the channel geometry. Flow data in conjunction with the topographic configuration of the study area were used to interpret the inundation extents, by using interoperable standards. Raster analytics were performed over remotely sensed imageries acquired by the Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+) sensors of Landsat from 1990 to 2015. Normalized Difference Water Index (NDWI) was used to extract the planimetric characteristics of the reach. Results suggest that an empirical relationship exists between the top surface area and water depth of the main channel, in the concerned river reach. The coefficient of determination (R^2) between the top surface area and discharge was 0.75 which shows a significant empirical relation between the two variables. The empirical model constructed from the analysis of a larger dataset revealed that a 55% reduction in flood carrying capacity of the reach has occurred because of sediment deposition after the 2010 flood event. The excessive deposition along the right bank immediately below the barrage has increased the morphological vulnerability of the reach. In case of any haphazard event like a super flood, the water can overtop or potentially breach the levee, and

* Corresponding author: Arslan Mahmood (engr.arslanmahmood@gmail.com)

subsequently, adjacent settlements of Hyderabad city are susceptible to flood vulnerability. Thus, it is concluded that multispectral imageries can be used to monitor the hydro-geomorphologic evolution of an alluvial channel and geospatial information extracted from such data could be used for a flood warning system.

Keywords: Alluvial channel, Hydromorphology, Kotri Barrage, Normalized Difference Water Index, 2010 flood

Seasonal Variation in Water Quality of River Indus at Kotri Barrage Hyderabad, Sindh, Pakistan

Authors: Muhammad Essa Dakhan¹, Rasool Bux Mahar², Imdad Ali Kandhar³

¹Institute of Environmental Engineering & Management , Mehran University of Engineering and Technology Jamshoro, Sindh, Pakistan

²Mehran University of Engineering and Technology Jamshoro, Sindh, Pakistan

³Institute of Environmental Engineering & Management, Mehran University of Engineering and Technology Jamshoro, Sindh, Pakistan

Abstract

The present study deals with the analysis of water samples collected from the River Indus for various Water quality parameters and ,heavy metals at Kotri Barrage Hyderabad, Sindh, Pakistan. This study was conducted for six months from September 2014 to March 2015. The values recorded for water quality parameters ranging between: pH 7.1 to 8, Water Conductivity 0.4 to 0.8 mS/cm, Total Suspended Solids (TSS) 12 to 1268 mg/L, Total Dissolved Solids (TDS) 210 to 460 mg/L, Total Suspended Solids (TSS) by weight method 40 to 1210 mg/L, Alkalinity 50 to 130 mg/L, Turbidity 18 to 970 NTU, Chloride 10 to 104 mg/L, Sulphate 13 to 149 mg/L, Particulate Organic Matter (POM) 30 to 250 mg/l, Particulate Inorganic Matter (PIOM) 10 to 960 mg/l and Dissolved Organic Carbon (DOC) 1.96 to 4.1 g/m³. DOC in the Indus River was monitored first time only in this study. During each month, the ranging value recorded for Metals were: Iron (Fe) 0 to 5.82 ug/L, Manganese (Mn) 0 to 10.68 ug/L. The main aim of this study was to know the quantitative values of physicochemical water quality parameters of the river in different seasons (low & high flow season), mainly organic carbon (Particulate and dissolved both).

Keywords: Include; Dissolved Organic Carbon; Particulate Organic Matter; Particulate Inorganic Matter; River Indus.

* Corresponding author: Arslan Mahmood (enr.arslanmahmood@gmail.com)

Suitability and Assessment of Groundwater for Irrigation Purpose: A case Study of Hyderabad Sub-urban area

Authors: Summaiya Shaikh¹, Abdul Latif Qureshi², Hafiz Abdul Salam Memon³

¹M.S Student, Hydraulics, Irrigation and Drainage, USPCAS-W, MUET, Jamshoro, Pakistan

²Professor, Hydraulics, Irrigation and Drainage, USPCAS-W, MUET, Jamshoro, Pakistan

³Assistant Director, Drainage and Reclamation Institute of Pakistan, Tandojam, Pakistan

Abstract

The groundwater quality of Hyderabad sub-urban area has been assessed to check its suitability for irrigation purpose. Due to scarcity of canal/surface water, there is need to use the groundwater as a supplement to surface water to meet our requirements of food and fiber. Thirty five representative groundwater samples were collected from the Hyderabad sub-urban area. The water samples collected were analyzed for the physical and chemical parameters, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Alkalinity, Sodium percentage and Arsenic (As) in the Soil-Water laboratory of USPCAS-W using the standard methods. The results show that the groundwater quality in the study area does not fall in good category and it is not always feasible for agriculture purpose with respect to EC, TDS and sodium percentage. In respect of pH, all sample are within the limits. In terms of EC and TDS, only 12 samples out of 35 are within the limits. The highly saline water is not suitable for irrigation purpose. EC, TDS and sodium percentage directly affects the growth of plant and crop production and they cause the soil structure damage. The Arsenic value is ranging from 0 to 0.1 mg/l, thirty five, out of 29 samples are within the limits of WHO standards. It is suggested that those areas, where arsenic is beyond the limit, ground water should not be used. It is recommended that for all 23 areas, either groundwater should be not be used or used for irrigation purpose through the conjunctive use of surface and groundwater. It was observed that quality of ground water is declined day by day. Therefore in order to enhance the water quality artificial recharge is recommended to be adopted to recharge the aquifer.

Keywords: Groundwater Quality; Sodium percentage; Electrical Conductivity, Arsenic, Hyderabad, Pakistan.

Characterization of the Aquifer using Pumping test for Groundwater Modelling of Sakrand Distributary Command Area

Authors: Zulfiqar Ali Jumani¹, Dr. Abdul Latif Qureshi¹, Waqas Ahmed¹

¹US-Pakistan Center for Advanced Studies in Water, MUET, Jamshoro 76020, Pakistan

Abstract

The hydraulic characteristics of aquifer like co-efficient of Storage (S), transmissivity (T) and specific yield (Sy) are of prime importance in ground water hydrodynamics. The aquifer parameters are helpful in prediction of future tube well discharges and drawdowns for developing ground water management strategies. This study aims to determine the hydraulic characteristics of aquifer by using AQTESOLV in Sakrand distributary command area. The two pumping wells were selected, one in head and other one in tail of the command area of Sakrand distributary. Pumping tests were performed to characterize the aquifer. The parameters like Storativity (S) and Transmissivity (T) in AQTESOLV are determined by using Theis (1935) and Cooper Jacob (1946) methods. Whereas specific yield (Sy) is determined by using Neuman solution (1974) and Tartakovsky- Neuman solution (2007). The results revealed that S and T values at the head location by Theis (1935) method were 0.002506 and 1908.4 m²/day, and by Cooper Jacob (1946) method were 0.001723 and 2093.1m²/day respectively. The specific yield (Sy) at head location was 0.001 by using Neuman (1976) and Tartakovsky- Neuman (2007). The results of S and T of pumping test performed at tail end by using Theis (1935) method were 0.0002605 and 1908.4m²/day respectively, and by Cooper Jacob (1946) method were 0.0001843 and 2080.2m²/day respectively. The specific yield at tail end was 0.0021 by using Neuman (1976) and 0.0031 by Tartakovsky-Neuman (2007). The recovery data suggest that tube wells at tail end must be shut down for longer period in order to achieve recovery of water table. These all results are used in the development of ground water model for water balance assessment for the study area.

Environmental Benefits of Exploiting the Solar Energy Resources for Power Generation in Pakistan

Authors: Zohaib M. Saamftio¹, Nayyar Hussain Mirjat¹, Pervez Hameed¹

¹Department of Electrical Engineering, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Abstract

In Pakistan, the power shortage is a formidable problem and is badly affecting economy due to lack of energy resources. The adverse environmental effects due to massive dependence on fossil fuels are already being felt in the country and it is going to enhance the possible drastic change in the weather. Pakistan needs sustained struggles that should efficiently take into consideration the influence of environmental changes. This study analysed the adverse environmental effects and assessed the solar energy resources of Pakistan. There is the sufficient solar energy potential in the country which can contribute to electricity demand for centralized as well as for decentralized areas. This research determines the environmental benefits of exploiting the solar energy potential as compared to others i.e. biomass, hydro and wind energy resources for electricity generation. For this analytical hierarchy process has been used, a questionnaire sent to energy and environmental experts for selecting the most appropriate energy resource on the basis of environmental criteria i.e. minimum emissions (CO_x, NO_x, SO_x), minimum noise pollution, maintaining visual impacts, minimum stress on ecosystem, minimum impact on public health, and less land requirement. Analytical hierarchy process ranked the renewable energy resources based on environmental criteria for power generation. Results of AHP model developed in this research ranked solar as the most suitable electricity generation resource based on environmental criteria followed by hydro, wind and biomass energy resources respectively. The main intention of this research is to facilitate the decision makers with such a scheme which lead them to a sustainable solution for electricity generation in the country.

Keywords: Electricity Demand, Solar energy resources, Environmental criteria, Analytical hierarchy process, Pakistan.

Gold nanoparticles based fabrication of Electrochemical Biosensor for Detection of *Escherichia coli*

Authors: Sallahuddin Panhwar¹, Syeda Sara Hassan¹

¹U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering & Technology (MUET), Jamshoro 76062, Sindh, Pakistan

Abstract

The aim of this study was to develop a simple, fast, specific and ecofriendly electrochemical sensor for detection of (*E.coli* 25922) from water using citrate derived gold nanoparticles. The water security and microbiological defense applications are globally concerns because of accuracy in the results and time saving technology as compared to traditional detection method for detection of bacteria from water. The synthesized gold nanoparticles (AuNPs) size, shape, functionality and charge were characterized as applying UV-Visible spectrophotometer (UV-Vis), transmission electron microscopy (TEM), energy dispersive spectroscopy (EDS), and Fourier transform infrared (FT-IR) characterization techniques. Most of the particles were observed in the range of 25 to 35 nm in diameter, with the spherical shape. The AuNPs modified biosensor is highly stable and reproducible at room temperature. The signal to noise ratio (SNR) for 0, 2, 20 and 50 cfu/mL are respectively. However, in resulting the lowest bacterial concentration was weekly at 2 CFU/mL and the strongly on 50 CFU/mL. The electrochemical signals were increased with the increasing concentration of *E. coli*. These results supported that the AuNPs are an effective material to modify the electrode for detection of *E.coli*. The electrochemical behavior of *E. coli* was investigated at a citrate derived-AuNPs modified glassy carbon electrode (GCE) by using disperse pulse voltammetry in Britton Robinson Buffer solution in pH at 7.4. It showed excellent electro-catalytic activity at the peak potential value of 0.84 V, 0.90 V, 0.91 V, and 0.95 V with different concentration of *E.coli* 2552 (0, 2, 20 and 50 cfu/mL) respectively. The considerable improvement in the peak currents as compared to that observed at the bare GCE. The advantages are related to the unique properties of modified nanosensor (MGCE) such as large catalytic behavior surface area, and hence increased electron transfer abilities compared to bare (BGC) electrode.

Keywords: Gold nanoparticles, Biosensor, *E.coli* 25922, pathogens, water security.

Treatment of High Strength Synthetic Waste Water Using Anaerobic-Aerobic Membrane Bioreactor

Authors: Shan Saleem¹, Zubair Ahmed²

¹Envirometal Engineering USPCAS-W(MUET), Jamshoro, Pakistan

²Environmental Engineering USPCAS-W(MUET), Jamshoro, Pakistan

Abstract

In this study an Anaerobic-Aerobic Membrane Bioreactor (AnAMBR) has been designed to treat high strength synthetic waste water. The AnAMBR was consists of 6L anaerobic reactor and 5L aerobic reactor. The reactor was inoculated with sludge taken from anaerobic digester near Hyderabad. The treatment capacity of the reactor was 18 l/day. The hydraulic retention time (HRT) and sludge retention time (SRT) of the reactor was maintained at 0.16 l/day and 30 days, respectively. The mixed liquor suspended solids (MLSS) and mixed liquor volatile suspended solids (MLVSS) concentration were maintained at 4000 ± 200 and 3500 ± 200 , individually. The pH of the reactor was kept in between 7.5 to 8.5. The efficiency of the reactor was monitored in terms of COD removal. The reactor was operated at two different organic loading rates 1.63 kg/m³/day and 3.9 kg/m³/day. However, 99% COD removal was observed at the organic loading rate of 1.63 kg/m³/day.

Keywords: AnAMBR; Spent Wash; Anaerobic-Aerobic Reactor; COD removal.

Treatment of Edible Oil Industrial Wastewater by using Anaerobic Fluidized Bed Reactor

Authors: Jessica Lawrence¹, Zubair Ahmed², R.B.Mahar³

^{1,2,3} Department of Environmental Engineering, US-PCAS-W, MUET, Jamshoro 76062, Pakistan

Abstract

The anaerobic treatment has been widely used to treat organic pollutants in wastewater. The effluent from various industries is often rich in organic contaminants. The effluent discharged by industries consists high organic content thus leads to high COD of wastewater. The processes used in oil industries generate organic pollutants. The escalating population seek hike in oil demand which eventually means pollution will keep increasing In this regard, anaerobic process with different modification setup has been used. Initially, the anaerobic technology was used for the treatment of industrial wastewater. In this regard, several high rate anaerobic designs have been introduced in the past four decades but due to limitations found in these technologies for example: anaerobic filter has restraints of clogging. Therefore, anaerobic fluidized bed reactor is a highly preferred design for the industrial wastewater treatment. The study is focused on the design and fabrication of Anaerobic Fluidized bed reactor and to analyze COD reduction in wastewater along with optimization of the parameters of the reactor. Such as: organic loading rate and flow rate. The basic principle, of anaerobic fluidized bed reactor (AFBR) is to pass the water through a compact bed of media such as plastic chips at suitable velocity, in order to fluidize the particles. Consequently, the microorganisms become attached to the media and decompose the organic pollutants. Anaerobic fluidized bed reactor removed COD up to 80%. Thus, the usage of media such as plastic chips in AFBR seems to be promising in the treatment of wastewater.

Keywords: wastewater, anaerobic fluidized bed reactor, methane, organic pollutants, sludge, designing

Afflux on Rivers Due to Bridges: A Case Study of River Sutlej

Authors: Muhammad Umer Munir¹, Assi. Prof. Ammara Mubeen², Muhammad Ghazanfar Abdullah³

¹NUST Institute of Civil Engineering (NICE), NUST, Islamabad, Pakistan

²NUST Institute of Civil Engineering (NICE), NUST, Islamabad, Pakistan

³NUST Institute of Civil Engineering (NICE), NUST, Islamabad, Pakistan

Abstract

Due to encroachment of banks and siltation, the capacity of the rivers of Pakistan has been reduced as well as due to the presence of bridges in rivers, water levels on the upstream side of the bridges have also been increased along with the triggering effect for scouring, thus increasing the severity and extent of the floods. The scope of this research is to analyze the effect of afflux due to bridges on river on: natural condition, channelized condition (with bela removal) to check how channelization and bridges under different scenarios will affect the extent of floods.

The methodology adopted for this research is one dimensional hydraulic modeling on a flood of 100 year return period by using the software HECRAS. The study area chosen as the case study is River Sutlej near Bahawalpur. According to the simulations conducted; with the addition of the successive bridges, water level increases with percentage i.e. with 1 bridge 0.154%, with 2 bridges 0.33%, with 3 bridges 0.48% depending upon the discharge and bed characteristics and by channelization with Bela removed increases the capacity of the river. Moreover, the Froude's number and head losses change suddenly near the bridges

According to the conducted simulations, bridge decks in the region of River Sutlej have safe heights to avoid even 100-year flood event. However according to the results that 18 out of 21 cross sections of our case study area are overtopping under 100-year return period indicating that nearby areas to the selected river reach are vulnerable to flooding under 100-year flood event and will result in human and infrastructure loss, while further addition of bridges will add more severity to the disaster. In addition, channelization and removing bela will increase the capacity to cater for floods.

Keywords: Afflux; Bridges; Hydraulic modelling; Scouring; Flooding; River Sutlej.

²First author: Muhammad Umer Munir, Tel: +92-336-5016832, email: umermunirscee@gmail.com

³Corresponding author: Muhammad Ghazanfar Abdullah, Tel: +92-305-5551236, email: ghazanfar.abdullah7@gmail.com

Disinfection of biofilms formed in drinking water distribution systems using Chlorine and Hydrogen Peroxide

Authors: Muhammad Raffae^{1*}, Rasool Bux Mahar¹, Huma Tariq¹, Junaid Kori²

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Pakistan

²HEJ Research Institute of Chemistry, University of Karachi.

Abstract

Microbial presence in drinking water distribution systems (DWDS) has been found to be inevitable. Even clean treated water from treatment facilities contains some number of microbes that can get through the treatment processes. The major problem associated with the disinfection of biofilms is the penetration of a disinfectant into the depth of the biofilm. Even high dosages of disinfectants are found to be ineffective against the biofilm growth. The changes in DWDS microbial community on the application of different disinfectants with different dosages is also poorly understood. This research studies the impacts of different disinfectants (chlorine and hydrogen peroxide) and their optimum dosages on microbial diversity and community structure in DWDS; and the effective removal of the biofilm. The role of different compositions of pipe materials is also studied in this research. Two annular reactors, 1 liter each, were used in this study. Continuous flow was provided to both the reactors at the rate of 5 ml/min. Three doses of each disinfectant were applied to the reactors. The reactors were acclimatized for one week, during which no disinfectant was used, and were followed by one week of disinfection at one dose. The efficacy of the disinfection process was measured by Illumina Sequencing, LIVE/DEAD BacLight Bacterial Viability Kit, and growth of viable cells in a growth medium. The results of this research would help in determining the most suitable disinfectant, at the most effective dose, for a specific pipe material, to remove biofilms formed in DWDS in local conditions.

Keywords: biofilm disinfection; Illumina Sequencing; annular reactor; drinking water distribution system; LIVE/DEAD BacLight

Keywords: Afflux; Bridges; Hydraulic modelling; Scouring; Flooding; River Sutlej.

Characterization of biofilm formed in the drinking water distribution system at MUET, Jamshoro

Authors: Huma Tariq^{1*}, Rasool Bux Mahar¹, Muhammad Raffae¹, Junaid Kori²

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Pakistan

²HEJ Research Institute of Chemistry, University of Karachi.

Abstract

Transporting water from a treatment facility to an end user through a water distribution system allows the entry and subsequent regrowth of undesirable microbes. These microbes get themselves attached to pipe surfaces and generate extracellular polymeric substance that enables the microbial cells to stick together and form a complex matrix of biofilm. This biofilm provides shelter to a variety of microbes ranging from bacteria and viruses to protozoa. Being able to thrive in challenging environment and resist disinfectants, biofilms are likely to host opportunistic pathogenic organisms. They are also responsible for the adverse changes in color, taste and odor of water, along with corrosion, scale formation and obstruction in pipe flows. Hence, to understand the nature of microbial communities harbored by biofilm, characterization of biofilms formed within the drinking water distribution system, in the Mehran University of Engineering and Technology (MUET), Jamshoro, was done in this study. An annular reactor, with the slides of different plastic materials, was used for the biofilm formation. Tap water from the water supply of the MUET was fed to the annular reactor. Physical, chemical and biological parameters of the source water were tested. After a few days, the biofilm was scraped off the slides and the DNA were extracted. Illumina sequencing was performed on the extracted DNA. Shigella and Salmonella were found in most abundance, relatively.

Keywords: Biofilm, Illumina Sequencing, drinking water distribution system, MUET

Microbial characterization of biofilm and sediments formed on the bed of the Jordan River, Utah

Authors: Muhammad Raffae^{1*}, Huma Tariq¹, Rasool Bux Mahar¹

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Abstract

In recent times, the role of aquatic microbial population in biochemical degradation plus nutrient cycling has been emphasized in many research studies. Bacterial communities within sediments are an integral part of microbial food-chain and flows at the sediment-water interface of fresh water bodies. Any physical, chemical or biological alteration in the nutrients and pollution profiles will have direct influence on aquatic microbial population, which further affect the nutrient cycling. Hence, their analysis is being used as an indicator of environmental conditions, locally. Among various other microbial communities, bacteria are the most abundantly present microbial community within these ecosystems. These bacteria have been associated with the degradation of various pollutants that enter into the water bodies. To evaluate the river water quality and comprehend the mechanisms of nutrition cycle, it is important to understand the composition of bacterial community along with the factors that shape this composition. In this study, we conducted a small-scale analysis of the bacterial community present within the biofilm and sediments of the Jordan River near Mill creek. Samples were taken both from upstream the wastewater treatment discharge point and downstream that point. Analysis was conducted using high-throughput Illumina Sequencing. Proteobacteria were found to be the most abundant bacterial phylum in both the biofilm and sediment samples.

Keywords: Illumina Sequencing; nutrient cycling; Jordan River

A rising threat of water borne Pathogens to human health in rural area of Hyderabad Sindh

Authors: Shaista Mubarak*, Ayesha Tajammul, Jamil Ahmed Soomro

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Abstract

Pure drinking water is one of the essential needs of human life and may serve as a route of exposure to potentially lethal pathogens affecting mortality and morbidity rate of a community and responsible for waterborne diseases. Acute microbial diarrheal diseases are a major public health problem in developing countries. People affected by diarrheal diseases are those with the lowest financial resources and poorest hygienic facilities. The most common diseases which are transmitted through water are diarrhea, typhoid, cholera, bacillary dysentery. This study was designed to determine the prevalence of water borne pathogens in drinking water source of Hyderabad rural. Total 38 water were samples collected those from household, Schools and hospitals. The examination of water samples was done by culture based method, samples were analyzed for the detection of five reference pathogens (*Enterococcus faecalis*, *E. coli*, *Salmonella*, *Shigella flexneri* and *Vibrio cholerae*), the detection was done by filtering 100ml of water for each pathogen. This study revealed that *Vibrio cholerae* (23% in household, 48 % in schools and 12% in hospitals) was dominant in collected water samples followed by *Enterococcus faecalis* (33%) *Thermotolerant E.coli* (30%) in hospitals and the *salmonella* (10%) and *shigella* (9%) were in least concentration. The collected water samples were contaminated with microorganisms, according to guidelines of drinking water the water is not safe to drink, the people consuming water in Hyderabad are more expose to cholera (*vibrio cholerae*) and *enterococcus faecalis* hence posing very high risk to the health of the population.

Keywords: Microbial risk assessment, waterborne pathogens, cholera disease, risk of infection, morbidity, infectious dose.

Comparative Benefit-Cost Analysis of Concrete Canal Lining and the Linear Anionic Polyacrylamide Technology

Authors: Ahmad Abdur Rehman¹, Muhammad Munir Babar²

^{1,2}Department of Hydraulics, Irrigation, and Drainage, U.S-Pakistan Center for Advanced Studies in Water Mehran University of Engineering and Technology Jamshoro 76062, Sindh, Pakistan

Abstract

The bulk of the total freshwater supplies of Pakistan is consumed by the irrigation practices. While meeting the irrigation demands, a significant amount of this precious commodity is lost as seepage, therefore, it becomes necessary to save the wastage of water by lining the canals using cost-effective technologies. Various technologies to reduce seepage from earthen irrigation canals provide diverse benefits that are pertinent to specific field conditions. This study aims to compare the potential benefits and the associated costs of a widely adopted and common canal lining technology -Concrete Lining- with a relatively new and less known technology -Linear Anionic Polyacrylamide (LA-PAM)- to reduce seepage from earthen irrigation canals. For Concrete Lining, the data on benefits and costs have been obtained from the National Engineering Services of Pakistan and professional literature, respectively. Whereas, for LA-PAM, costs are estimated for LA-PAM applications on a distributary canal -The Tara Distributary- in New Saeedabad, Matiari. Besides, the benefits associated with LA-PAM are addressed by analyzing the field estimation and referring to some previously conducted comprehensive studies in a few foreign countries to assess the viability of using LA-PAM in the field. The addressed benefits range in the economy, ease of use/application, durability, effectiveness in conserving fresh water, while the allied costs comprise of labor costs, material costs, maintenance costs and construction/application costs etc. The results of the study reveal that the cost of LA-PAM per RD of the selected canal is significantly less than Concrete Lining, moreover, its effectiveness in reducing seepage from earthen canals was found close to that of Concrete Lining. However, Concrete Lining lasts for several years whereas the effectiveness of LA-PAM reduces with time. In the end, some recommendations are put forward to overcome some social and technical barriers while applying LAPAM on the selected canals.

Keywords: Seepage; Earthen Canals; Canal Lining; Linear Anionic Polyacrylamide; Concrete Lining

Comparative Benefit-Cost Analysis of Concrete Canal Lining and the Linear Anionic Polyacrylamide Technology

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Abstract

The bulk of the total freshwater supplies of Pakistan is consumed by the irrigation practices. While meeting the irrigation demands, a significant amount of this precious commodity is lost as seepage, therefore, it becomes necessary to save the wastage of water by lining the canals using cost-effective technologies. Various technologies to reduce seepage from earthen irrigation canals provide diverse benefits that are pertinent to specific field conditions. This study aims to compare the potential benefits and the associated costs of a widely adopted and common canal lining technology -Concrete Lining- with a relatively new and less known technology -Linear Anionic Polyacrylamide (LA-PAM)- to reduce seepage from earthen irrigation canals. For Concrete Lining, the data on benefits and costs have been obtained from the National Engineering Services of Pakistan and professional literature, respectively. Whereas, for LA-PAM, costs are estimated for LA-PAM applications on a distributary canal -The Tara Distributary- in New Saeedabad, Matiari. Besides, the benefits associated with LA-PAM are addressed by analyzing the field estimation and referring to some previously conducted comprehensive studies in a few foreign countries to assess the viability of using LA-PAM in the field. The addressed benefits range in the economy, ease of use/application, durability, effectiveness in conserving fresh water, while the allied costs comprise of labor costs, material costs, maintenance costs and construction/application costs etc. The results of the study reveal that the cost of LA-PAM per RD of the selected canal is significantly less than Concrete Lining, moreover, its effectiveness in reducing seepage from earthen canals was found close to that of Concrete Lining. However, Concrete Lining lasts for several years whereas the effectiveness of LA-PAM reduces with time. In the end, some recommendations are put forward to overcome some social and technical barriers while applying LAPAM on the selected canals.

Keywords: Seepage; Earthen Canals; Canal Lining; Linear Anionic Polyacrylamide; Concrete Lining

Floating Village: A Hotspot for Waterborne Diseases

Authors: Dilawar Hussain¹, Ayesha Tajammul¹

¹Department of WaSH, USPCAS-W, MUET, Jamshoro, Pakistan

Abstract

Pakistan has blessed with floating villages on water reservoirs; however, tragically, the life on the surface of the water does not have the essential elements concerning access to the safe drinking water and sanitation system. Besides, these free-floating communities are more prone to acquire the waterborne diseases as they dump their daily waste into the water body. These habits build the contamination load in already polluted water and make various health risk for inhabitants. Pollutants that have been discharged in water reservoir by the floaters may also be the leading factors that are causing deterioration in the Water. There are the variety of unfavorable factors that are imposing influences on the health of floating inhabitants including waterborne diseases and non-appearance of a specific close-by and national WASH legal framework; a situation which is troubled by the non-attendance of an organizational structure for the Floating Village. Our study represented to identify these hot spot areas where the waterborne diseases might suspect in the context of WaSH assessment in floating village. Tools for the assessment index system would be built to evaluate the health status of floating village, pointing areas concerning contaminations to track pathogen for future research by using GIS techniques. As resultant, variable would be set including health index, water quality assessment and concentration of agents responsible for waterborne disease to conduct research for future.

Keywords: Floating village, waterborne diseases, WaSH assessment.

Adsorption-based-filtration: an approach to remove inorganic pollutants from water

Authors: Muhammad Muqeeb¹, Rasool Bux Mahar¹, Zeeshan Khatri²

¹U.S.-Pakistan Centers for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro-76060, Pakistan

²Department of Textile Engineering, Mehran University of Engineering and Technology, Jamshoro-76060, Pakistan

Abstract

Activated carbon (AC) is considered as robust and cost-effective adsorbent which is used commercially as an adsorption-based-filtration media. But, critically it offers adsorption of only dissolved organic pollutants and undissolved traces. Additionally, its preparation process upsurges environmental footprints in the form of greenhouse gases. Herein, we proposed an “adsorption-based-filtration” consists of cationic and anionic cellulose nanofiber membranes. These membranes having affinity towards dissolved inorganic pollutants (salts and metal ions) present in water. The synthesized nanofibers membranes were characterized by SEM, FTIR, TGA and Zeta potential analyzer. The adsorption capacities of cationic and anionic cellulose nanofiber (CNF) membranes were determined at batch mode separately. The Langmuir adsorption capacities of c-CNF for SO₄²⁻ and Cl⁻ were found to be 24.5 and 9.6 mg/g respectively. Further, adsorption capacities of α-CNF for Ca²⁺ and Mg²⁺ were found to be 57.66 and 65.55 mg/g respectively. Finally, the resultant membranes were wrapped over the polypropylene cartridge separated by polyethylene terephthalate (PET) nanofiber membrane and fitted to the fabricated prototype to determine the flux rate at continuous mode.

Antibiotic Resistant Bacteria (The Superbugs): Emerging Challenge to Combat

Authors: Noor-Un-Nisa Ghanghro¹, Ayesha Tajammul¹

¹WaSH, USPCAS-W, Jamshoro, Pakistan

Abstract

Bacteria are evolving resistance to antibiotics at an alarming rate all over the world. More bacteria are resistant to existing antibiotics than ever. As a result, these superbugs are popping up in hospitals and the outside world. The perversely use of antibiotics these days has led to the evolution of new resistant strains of bacteria that are somewhat more lethal compared to the parent strain. Bacteria become resistant to antimicrobial drugs through different mechanisms which includes antibiotic inactivation, target modification, efflux mechanism of resistance and Plasmidic Efflux. The chemical composition of the drug molecule is the most important determinant of the entry mode. Currently, the clinically available treatments are not effective against the antibiotic resistance developed by some bacterial species. However, plant-based antimicrobials have immense potential to combat these superbugs without any known side effects. Several plants has been reported for their antibacterial activities such as the volatile oils of black pepper [*Piper nigrum* L. (Piperaceae)], clove [*Syzygium aromaticum* (L.) Merr. & Perry (Myrtaceae)], geranium [*Pelargonium graveolens* L'Herit (Geraniaceae)], Nutmeg [*Myristica fragrans* Houtt. (Myristicaceae)], oregano [*Origanum vulgare* ssp. *hirtum* (Link) Letsw. (Lamiaceae)] and thyme [*Thymus vulgaris* L. (Lamiaceae)] against different genera of bacteria. In current study, our aim was to point out the certain natural products which were active against antibiotic resistant bacteria for our preliminary research. To achieve complete applications of antibiotics, there is a need for more information on the role of bacteria in the rise of antibiotic resistance. In particular, creative approaches to the discovery of novel antibiotics and their expedited and plant-based controlled are obligatory.

Keywords: Superbugs; antibiotic resistance; natural products; antimicrobial activity

Intelligent Solutions for Consumption Feedback – Can they mitigate the Scarcity of Energy and Water in Pakistan?

Authors: Arzam Muzaffar Kotriwala¹

¹KTH Royal Institute of Technology, Stockholm 16440, Sweden

Abstract

A continuous growth in energy and water demands makes sustainability a key challenge of our time. Scarcity of these essential resources in Pakistan greatly hinders growth, prosperity, and peace. The dominant narrative is that the mismatch between demand and supply can only be met if the government takes the necessary medium- and long-term steps to resolve internal problems and install more capacity. Whilst such changes are absolutely required, there is a dire need for short-term solutions as well.

Previous research has shown that conservation plays an essential role in lowering resource demands. However, taking personal responsibility by individuals to proactively conserve resources is not discussed much. This paper introduces intelligent solutions for feedback of energy and water consumption that are enabled by recent advances in the Internet of Things and Machine Learning. These solutions provide transparency of resource usage by breaking down overall consumption of a building into smaller individual consumers, thereby making consumption easier to understand, track and control. An overview of this research area as well as the solutions available in the market today are presented.

Though such solutions are available for both, energy and water, the former are more mature as of now than the latter. For this reason, a questionnaire survey was conducted to primarily understand the awareness and attitude of individuals towards energy conservation. Almost all 367 respondents agreed that transparency of energy consumption would help them save energy. Interestingly, most participants identified themselves as having positive attitudes towards energy conservation but the questions posed to test their awareness in this regard highlighted a lack of understanding of everyday energy consumption. It can be concluded that intelligent solutions for consumption feedback will likely not diminish their scarcity completely and immediately but indeed have great potential to mitigate this crisis.

Keywords: Energy Conservation; Water Conservation; Machine Learning; Internet of Things.

A review on types and applications of solar energy technologies and its effect on environment in Pakistan

Authors: Kamran Mahboob^{1,2}, Abdul Qaddus¹, Muhammad Muneeb Aslam¹, Awais Khan²

¹Department of Mechanical Engineering, Chenab College of Engineering and Technology, Gujranwala 52250, Pakistan

²Department of Mechanical Engineering, University of Engineering and Technology, Lahore 54000, Pakistan

Abstract

Greater dependencies on fossil fuels for power generation has damaged the global environment severely in past few decades. Effect of these climate changes are seen everywhere and more severely in South Asian region. Severe energy crisis in country like Pakistan has pushed it more and more towards thermal power generation through fossil fuels. That has contributed greatly to disturb the echo system and to increase local temperatures. Effect of these changes are evident from glaciers of Himalayas and indirectly these disturb all the river system across South Asia. In this article an approach to harness the solar energy for power generation is discussed in detail. Different methods currently available for converting solar energy to electrical power are discussed. These covers mirror reflection and concentration technologies like solar tower thermal power plant, solar parabolic trough, Enclosed trough, solar parabolic dish for steam and sterling engine applications, Flat plate collector, Fresnel technologies, Linear Fresnel reflector, solar updraft tower, photovoltaic, roof heating systems etc. Application of these system as well as advantages and disadvantages of different methods are enlisted and their effect on climate is discussed in detail. Also different regions across Pakistan are highlighted that are suited for each type of technology. This includes sunshine, heat and radiation map, DNI etc. In the later part of this article effect of solar energy on environment are discussed. These include positive effect on climate, echo system, temperature, river and canal system, ocean. It is concluded that direct solar power is useful all across Pakistan and Concentrated solar technology is best suited for the southern region technically and both of these have positive effects towards environment

Keywords: Environment, Solar thermal energy, climate change, power plant, Radiation Map of Pakistan

Automatic Positioner Control System for Motorized Parabolic Solar Dish

Authors: Asif Ahmed Rahioon^{1*}, Dr. Pervez Hameed Shaikh¹, Dr. Zubair A.Memon¹, syed Abid Ali shah², Syed Zaigham Abbas^{3†}

¹Department Of Electrical power Engineering, Mehran university of Eng: & Technology, jamshoro 76062, Pakistan

²School of Engineering and Applied Sciences, Aston University, Aston Triangle, Birmingham, United Kingdom

³Department Of Electronics Engineering, Mehran university of Eng: & Technology, jamshoro 76062, Pakistan

Abstract

The undepletable energy resources are implemented to make the environment pollution less as well for completing energy demands. Among these energy harnessing resources solar energy research gets too much attention in various applications because these applications are environmental friendly and easy maintained. Solar energy is largely available and converted through means required efficiency. This paper discuss the development of dual axis parabolic solar dish tracker application for automatized position power system. This prototype tackles solar light in solar sterling design system or concentrated photovoltaic design by implementation of digitalize control circuit to enhance CSP and CPV applications. A normally 121.92cm parabolic dish is designed with H-bridge controller technique & Slew drive actuator mode to capture solar irradiances. The irradiances rate that falls on Photo sensors are observed in microcontroller and then converted in voltage mean. The surface of parabolic dish is polished with 12 aluminum bars to concentrate the solar irradiance in single reflective axis. Economic justification for Pakistan's industries would be possible if these automated based renewable prototypes are promoted in market in compare of single PV panel to meet the energy gap. This prototype controls the all weather conditions, utilizing real time flexible timing control strategy and photoelectric tracking scheme with Microcontroller Tray that assemble the Power Motor and Dc motor and provide a cost effective product for industrial power generation applications. This locally adaptive material based prototype encouraged the result about 33% efficient with compared to photovoltaic panel.

Keywords: Pakistan Energy future, solar concentrator, thermal energy utilization.

Assessing the Impacts of Gorano Dam on Vegetation Cover of the Area

Authors: Tahir Ali Shaikh^{1*†}, Altaf Ali Siyal¹, Kamran Ansari¹

¹U.S.-Pakistan Center for Advanced Studies in Water, Mehran UET, Jamshoro 76090, Pakistan

Abstract

Engro Powergen Limited in a long-term partnership with Government of Sindh has established Sindh Engro Coal Mining Company (SECMC) to explore Thar coal reservoirs and generate thermal power to meet the shortfall of the energy in Pakistan. In this context, for mining and extracting coal from the mining site of Block-II of Thar Coal Field allocated to SECMC, a large quantity of groundwater with an average salt concentration of 5,228.8 ppm is being extracted from the project site for dewatering the coal seam. That saline groundwater is being disposed into the nearby natural depression area called 'Gorano.' Local community fear that creating a saline evaporation pond will affect the natural vegetation and local shallow fresh aquifers. Thus it will result in an environmental disaster. Looking at the gravity of problem, the present study was conducted to quantify the spatial variation in the vegetation of Gorano dam and within the 1.5 kilometers buffer zone, both before (February 2017) and after disposal (February 2018) of the saline water in it. Remotely sensed images of the Sentinel-2 satellite were downloaded and classified using supervised classification method in ArcGIS 10.3 and ground truthing points for the training of the data. The analysis of satellite images revealed that vegetation within the dam and the buffer of 1.5 kilometers decreased from 1,003.6 acres (12.6% of total buffered area) to 702 acres (8.8%). It might be due to the submergence of 242 acres (3%) with saline water in 2018 which negatively impacted the vegetation within the dam as well as in the buffer area. Based on the present study, it is suggested to conduct a detailed survey to assess the environmental impact of the dam.

Keywords: Remote sensing; environment; Sentinel-2; GIS; Thar coal.

Assessment of Persistent Organic Pollutants (POPs) in Manchar Lake and its Surroundings.

Authors: Hafeez K*¹, R.B. Mahar¹, Uzma¹, Sheeraz A. Memon², Qandeel k¹, Sultan S¹..

¹.US-Pakistan Center for Advanced Studies in Water, MUET, Jamshoro, Pakistan.

²Institute of Environmental Engineering and Management, MUET, Jamshoro.

E-mail: *khoharohafeez@gmail.com

Abstract

: Persistent Organic Pollutants (POPs) are the major issue these days because of its persistent nature in the environment and have a very long half-life. They are found in the environment in the soil, sediments, waterways and biota bearing a persistent nature and affecting the health of living organisms by accumulating in it. Not only in the world is suffering from serious effects of the POPs but Pakistan also in the list. It was observed that in Pakistan less research has been done regarding this issue so, an assessment of Persistent Organic Pollutants (POPs) has been done on Manchar Lake and its surroundings. The aim of this study is to identify and quantify the selected 18 POPs in water and sediments. The water and sediment samples were collected from 4 and 7 sites respectively. The analysis has been done through GC-MS. The seven POPs namely HCB, Heptachlor, aldrin, Cis-Chlordane, dieldrin, endrin, and mirex have not found in both water and sediments. Trans-chlordane in water and p,p-DDE in sediments did not found. The other POPs were detected which were exceeding the allowable limits set by WHO, US-EPA, and BIS. The trend of these POPs' has been observed as p,p-DDT > o,p-DDD > alpha-BHC > gamma-BHC > p,p-DDE > o,p-DDE > delta-BHC > p,p-DDD > beta-BHC > o,p-DDT in water and p,p-DDT > alpha-BHC > o,p-DDT > p,p-DDD > o,p-DDD > beta-BHC > gamma-BHC > delta-BHC > o,p-DDE > trans-chlordane in sediments. This research concludes that most of the POPs are found above the threshold limit of WHO, US-EPA and BIS and it is recommended that the regular monitoring should be done on Manchar Lake by the authorities to save this natural lake of Pakistan

ADSORPTION OF INDIGO CARMINE DYE ON CHEMICALLY MODIFIED ADSORBENT PREPARED FROM MUNICIPAL SOLID WASTE

Authors: UmamaSoomro¹, Zubair Ahmed²

^{1,2}Department of Environmental Engineering, US-PCAS-W, MUET, Jamshoro76062, Pakistan

Abstract

Textile industries are the backbone of Pakistan's economy but the wastewater which is discharged through these industries contain toxic and organic compounds. These chemicals not only contaminate water but also pose serious threats to human health and aquatic life. Indigo carmine is one of the main industrial dyes which is used to dye cotton, yarn and mostly to produce denim cloth for jeans. This study focuses on removal of anionic dye indigo carmine from aqueous solution by using chemically modified municipal solid waste adsorbents. Corn stover, paper and yard waste were selected as adsorbent materials and were quaternized by using 3-chloro-2-hydroxypropyl trimethylammonium chloride. Batch technique was used to assess the efficiency of prepared adsorbent for the removal of anionic dye. Several parameters were taken in to consideration such as effect of adsorbent dose, pH, temperature and change in initial dye concentration. Different adsorption isotherms Freundlich and Langmuir were also studied. The results depicted the increase in adsorption rate with the increase in adsorbent dose and decrease in adsorption rate with the increase in initial dye concentration. Experiments were conducted at different pH ranges from 2-10. Adsorption was found to be increased with increase in pH and temperature due to interaction of positive and negative molecules of adsorbent material and dye. The maximum adsorption was found to be at pH 10, adsorbent dose of 400mg at room temperature. The data was found to follow Langmuir isotherm, with a good correlation ($R^2=0.9992$).

Keywords: Indigo carmine; adsorption; quaternization; color removal; isotherms; waste material.